THE PHARMACEUTICAL CORPORATION (IM) KERALA LTD KUTTANELLUR.P.O, THRISSUR-680 014
(A Government of Kerala Undertaking)

Upgradation of Fire Protection System at Oushadhi, Kuttanellur,Thrissur

TENDER DOCUMENT

TENDER No: OUSHADHI/KITCO/MH/05/2020

KITCO
the consultants

KITCO LTD.

P.B.No. 4407, Femith's Building, Puthiya Road, NH Bypass, Cochin-682 028

THE PHARMACEUTICAL CORPORATION (IM) KERALA LTD
KUTTANELLUR.P.O, THRISSUR-680 014
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ISSUE LETTER

TENDER No: OUSHADHI/KITCO/MH/05/2020

Date . 24.08.2020

Online tenders are invited by KITCO on behalf of The Pharmaceutical Corporation (I.M) Kerala Ltd., (Oushadhi), Kuttanellur.P.O, Thrissur -680 014 from competent Contractors for executing the following work.

1.	Name of Work	Upgradation of Fire Protection System at Oushadhi, Kuttanellur, Thrissur
2.	Estimate Amount	Rs.3.60 Cr
3.	Earnest Money Deposit (EMD)	Rs.1,00,000/-
4.	Tender Submission Fee	Rs.8,850/- (Inclusive of GST 18%)
5.	Period of completion	18 months
6.	Tender documents	Can be downloaded from the website **www.etenders.kerala.gov.in**
7.	Last date and time of Receipt of Tender/ Bids	15.09.2020 at 05.00pm
8.	Date and Time of Opening of Tender	19.09.2020 at 10.30 am
9.	Form of Contract	Item Rate
10.	Pre-bid Meeting	04.09.2020 at 11.00am

GENERAL TERMS AND CONDITIONS OF E-PROCUREMENT

This tender is an e-Tender and is being published online for the above work. This tender is invited in 2 cover system from the registered and eligible firms 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**: As per NIT

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 upload:

i) Technical bid document digitally signed and upload.

ii) Document proof of Eligibility Criteria mentioned in clause 1.02 of Notice Inviting Tender

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

iv) 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 copies of the above documents shall be submitted to the office of Oushadhi, Kuttanellur, Thrissur

(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.8,850/- including 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

State Bank of India Multi Option Payment System (SBI MOPS Gateway): Bidders are required to avail Internet Banking Facility in any of below banks for making tender remittances in eProcurement System.

A)	**Internet Banking Options (Retail)**		
1	Allahabad Bank	32	Kotak Mahindra Bank
2	Axis Bank	33	Lakshmi Vilas Bank
3	Andhra Bank	34	Mehsana Urban Co-op Bank
4	Bandan Bank	35	NKGSB Co-operative Bank
5	Bank of Bahrain and Kuwait	36	Oriental Bank of Commerce
6	Bank of Baroda	37	Punjab and Maharashtra Cooperative Bank
7	Bank of India	38	Punjab National Bank
8	Bank of Maharashtra	39	Punjab and Sind Bank
9	Bassein Catholic Co-operative Bank	40	RBL Bank
10	BNP Paribas	41	Saraswat Cooperative Bank
11	Canara Bank	42	ShamraoVithal Cooperative Bank
12	Catholic Syrian Bank	43	South Indian Bank
13	Central Bank of India	44	Standard Chartered Bank
14	City Union Bank	45	State Bank of India
15	Corporation Bank	46	Syndicate Bank
16	Cosmos Bank	47	Tamilnad Mercantile Bank
17	DCB Bank	48	Tamilnadu Cooperative Bank
18	Dena Bank	49	The Kalyan Janata Sahakari Bank
19	Deutsche Bank	50	TJSB Bank (Erstwhile Thane Janata Sahakari Bank)
20	Dhanalaxmi Bank	51	UCO Bank
21	Federal Bank	52	Union Bank of India
22	HDFC Bank	53	United Bank of India
23	ICICI Bank	54	Vijaya Bank
24	IDBI Bank	55	YES Bank
25	Indian Bank		
26	Indian Overseas Bank		
27	IndusInd Bank		
28	Jammu & Kashmir Bank		
29	Janata Sahakari Bank		
30	Karnataka Bank		
31	Karur Vysya Bank		
B)	**Internet Banking Options (Corporate)**		
1	Bank of Baroda	21	Laxmi Vilas Bank
2	Bank of India	22	Oriental Bank of Commerce
3	Bank of Maharashtra	23	Punjab & Maharashtra Coop Bank
4	BNP Paribas	24	Punjab & Sind Bank
5	Canara Bank	25	Punjab National Bank
6	Catholic Syrian Bank	26	RBL Bank
7	City Union Bank	27	ShamraoVitthal Co-operative Bank
8	Corporation Bank	28	South Indian Bank
9	Cosmos Bank	29	State Bank of India
10	Deutsche Bank	30	Syndicate Bank

11	Development Credit Bank	31	UCO Bank
12	Dhanalaxmi Bank	32	Union Bank of India
13	Federal Bank	33	UPPCL
14	HDFC Bank	34	Vijaya Bank
15	ICICI Bank	35	Axis Bank
16	Indian Overseas Bank		
17	JantaSahakari Bank		
18	Jammu & Kashmir Bank		
19	Karur Vysya Bank		
20	Kotak Bank		

During the online bid submission process, bidder shall select ***SBI MOPS*** option and submit the page, to view the ***Terms and Conditions*** page. On further submitting the same, the e-Procurement system will re-direct the bidder to MOPS Gateway, where two options namely ***SBI*** and ***Other Banks**** will be shown. Here, Bidder may proceed as per below:

a) *SBI Account Holders* shall click ***SBI*** option to with its Net Banking Facility., where bidder can enter their internet banking credentials and transfer the Tender Fee and EMD amount.

b) *Other Bank Account Holders* may click ***Other Banks*** option to view the bank selection page. Here, bidders can select from any of the 54 Banks to proceed with its Net Banking Facility, for remitting tender payments.

**Transaction Charges for Other Banks vide SBI Letter No. LHO/TVM/AC/2016-17/47 – 1% of transaction value subject to a minimum of Rs. 50/- and maximum of Rs. 150/-*

Any transaction charges levied while using any of the above modes of online payment has 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 KITCO Ltd. during working hours.

Sd/-
Managing Director

1.0 NOTICE INVITING TENDER

1.01 Online tenders are invited by The Pharmaceutical Corporation (I.M) Kerala Ltd., (Oushadhi), Kuttanellur.P.O, Thrissur -680 014 from competent contractors for Upgradation of Fire Protection System at Oushadhi, Kuttanellur, Thrissur.

1.02 Eligibility Criteria

i) Bidder should have executed at least one similar nature of work of value not less than 80% of the PAC in single contract during the last seven financial years as Prime Contractor (Satisfactory completion certificate from the client for the work done shall be submitted in the designated cover)

or

Bidder should have executed at least two similar nature of works each of value not less than 60% of the PAC during the last seven financial year as Prime Contractor (Satisfactory completion certificate from the client for the work done shall be submitted in the designated cover)

or

Bidder should have executed at least three similar works each of value not less than 40% of the PAC during the last seven financial year as Prime Contractor (Satisfactory completion certificate from the client for the work done shall be submitted in the designated cover)

ii) Average Annual turnover of the tenderer shall be more than 100% of the PAC during last three preceding years (Audited balance sheet, profit and loss account of the last 3 financial years shall be submitted in the designated cover.)

iii) The bidder should have valid GST registration, PAN, ESI and PF Registration.

iv) The bidder should have appropriate class registration in PWD/CPWD/Govt. undertakings. And should also have valid 'B' grade electrical contractors license issued by KSELB. Or should associate a person /firm with the above license/ registration for doing civil and electrical works.

Similar work for the purpose of eligibility shall be firefighting works associated civil and electrical works

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

1.03 The general information on the project may be found under Section 3.00 of this tender. The information is only indicative. The tenderers are required to visit the site and familiarize themselves with the site conditions, nature of substrata, availability of construction materials, etc., before quoting. The drawings, General and Special Conditions of Contract, Specification and Schedule of quantities and the specifications may be carefully studied before they offer the prices. No claims for extra compensation over and above the quoted rates will be entertained by OUSHADHI on the ground that the tenderer have misjudged site conditions, nature of substrata, tender conditions or any item of tender. Tender documents and tender schedule may be downloaded free of cost from the website **www.etenders.kerala.gov.in**. A bid submission fee of Rs.8,850/- shall be remitted through online payment mechanism for e-procurement system of Govt. of Kerala through NEFT/Online banking through SBI. This payment is not refundable.

The bid should be submitted online in two cover system at website `http://etenders.kerala.gov.in' in the relevant covers only, by the due date and time, as specified in the 'Critical Dates' view of the 'Work Item details' of the tender. The Server Date & Time as appearing on the website `http://etenders.kerala.gov.in' shall only be considered for the critical date and time of tenders. Offers sent through post, fax, telex, e-mail, courier will not be considered.

The bidders are requested to go through the instruction to the bidders in the website `http://etenders.kerala.gov.in'. The bidders who submit their bids for this tender after digitally signing using their Digital Signature Certificate (DSC), accept that they have clearly understood and agreed the terms and conditions in the website including the terms and conditions of this tender.

BOQ other than downloaded against the Tender will not be considered

Accepting Authority shall not be responsible for any delays reasons whatsoever in receiving as well as submitting offers, including connectivity issues.

For more assistance e tendering system you can contact Kerala State IT Mission e-Procurement Help desk, Basement floor of Pension Treasury Building Uppalam Road, Statue, Thiruvananthapuram. Phone 0471-2577088, 2577188. (On all working days from 10:30 am to 5:30pm)

All bid/tender documents are to be submitted online only and in the designated Cover/ envelope(s) on the above website. All the required documents shall be submitted in their respective designated online covers with digital signature. The prequalification document in the prescribed format shall be downloaded, filled in with relevant details and uploaded to the website in digitally signed pdf format.

1.04 The bidders are requested to submit all the required documents for pre qualification and the price bid in the appropriate covers provided.

1.05 The offer shall be valid for 2 months 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 two months 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.

1.06 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.

1.07 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.

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.

Before commencing the work and within a week after the letter of acceptance of the tender has been intimated to him, the tenderer shall make a security deposit as given in clause 1.11 of this notice and furnish the same for the proper fulfillment 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.

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 off. 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.

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

1.08 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.

1.09 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. The tender should be in a sealed cover.

1.10 EARNEST MONEY DEPOSIT (EMD)

.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 RTGS payment will not be accepted by the system and hence EMD should remitted only through Online banking through SBIMOPS. 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.

.02 Bidders shall remit the tender fees and EMD by using the online payment options of e-Procurement system only. Bidders are advised to visit the "Downloads" of e-Procurement website (www.etenders.kerala.gov.in) for detailed instructions on making online payment using internet banking facility.

.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.

1.11 PERFORMANCE SECURITY DEPOSIT

. 01 Within 15 days of issue of letter of acceptance, the Contractor should submit 5% of the Contact Value as Performance Guarantee. At least fifty percent of the Performance Guarantee will be in the form of Treasury Fixed Deposit and the rest in the form of Bank Guarantee.

.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.

.03 Security deposit can be released against bank guarantee on its accumulation to minimum amount of Rs. 5 lakh. The minimum amount of Bank Guarantee shall not be less than Rs. 5 lakhs at a time. This Bank Guarantee has to be valid up to the end of defect liability period and shall be in the Performa attached.

.04 On satisfactory completion of the work and on recording of completion certificate, the performance guarantee will be released based on the report from the Engineer-in-charge.

.05 On completion of Defects Liability Period, the Engineer-in-Charge shall recommend on demand from the Contractor to refund to him the security deposit 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.

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

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

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

1.14 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 ESI, PF and labour welfare funds constituted by the Union Government and Government of Kerala from time to time.

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

1.16 **PERIOD OF VALIDITY**

1.16.01 The tender shall remain valid for acceptance for a period of **2 months** from the date of submission 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 OUSHADHI has the liberty to forfeit the said Earnest Money Deposit.

1.17 **INSPECTION OF SITE**

Every tenderer is expected to inspect the site of the proposed work and acquaint himself with the site conditions of substrata, approaches, availability of raw materials, geological and weather conditions, etc., before quoting his rates. He must go through all the drawings, specifications and other tender documents. Any further clarifications in the drawings and documents can be had from OUSHADHI at the above mentioned address.

1.18 **QUANTUM OF WORK**

1.18.01 A schedule of approximate quantities for various items accompanies this tender. It shall be definitely understood that OUSHADHI 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 OUSHADHI without affecting the terms of the contract.

1.18.02 OUSHADHI reserves the right to increase or decrease the quantum of work at site without assigning any reason.

1.18.03 Variations 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 OUSHADHI at the same agreed rates.

1.19 ALL INCLUSIVE RATES

The rate quoted by the bidders shall include all taxes and duties, construction workers welfare fund contribution etc., except the 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.

In case of change in the GST rate between the date of invoice and date of supply OR last date of submission of tender, and the date of release of payment for works done, the prevailing GST rate will be reckoned as per the GST laws of the Central and State Govt. for payment.

Any variations in the tax rate of GST (increase or decrease) shall be adjusted at the time of bill processing i.e, deduction in the case of decrease in GST rate or addition in case of increase in GST rate shall be made at the time of settlement of bills.

1.19.1 GST APPLICABLE

The tenderer shall clearly indicate their GST registration number in the bid.

1.20 INTERPRETING SPECIFICATIONS

1.20.01 In interpreting the specifications, the following order of decreasing importance shall be followed:

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

1.20.02 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 OUSHADHI shall be final.

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

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

1.22.02 The authorised representative of OUSHADHI 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.

1.23 The work shall be carried out under the direction and supervision of OUSHADHI 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.

1.24 OUSHADHI'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.

1.25 **SUB-LETTING**

No part of the contract shall be sublet without the written permission of OUSHADHI nor shall transfers be made by the Power of Attorney authorizing others to carryout the work or receive payment on behalf of the tenderer.

1.26 **DEFECTS LIABILITY PERIOD/ GUARANTEE PERIOD**

Any defect developed within 'Defect Liability Period'/ Guarantee period of Twelve months will have to be rectified by the contractor at their own cost and in case the defects are not rectified by the contractor, OUSHADHI or their representative shall get the work done at the risk and cost of the contractor.

1.27 **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.

1.28 **OCCUPATION IN PART**

If OUSHADHI wants to occupy areas in part, the contractor shall complete the work of these areas in conjunction with OUSHADHI and hand over the same to OUSHADHI without affecting any of the clause of contract agreement.

1.29 The contractor should inspect the source of materials, their quality, quantity and availability. All materials must strictly comply with the relevant B.I.S./IBR.

1.30 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.

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

Suitable area in the site of work shall be allowed to the contractor free of cost for constructing temporary structures for storing his tools and plants, materials, site office and cement godown. However, the structure will be provided by him at his own expense and he will be solely responsible for guarding his property with requisite insurance against theft, fire, etc. The contractor however will have to

dismantle the sheds and vacate the land of all debris, etc. at his own expense after completion of work.

1.32 MEASUREMENT AND BILLING

Wherever mode of measurement is specified, the measurement will be taken at site as per the latest BIS code of practice for measurement.

1.32.02 The contractor or his representative shall accompany OUSHADHI or their representative in taking measurements and shall agree to the measurements taken on spot. All necessary tapes shall be of steel and shall be supplied by the contractor. The contractor shall then present his bill based upon the agreed and recorded measurements and as per the directions of OUSHADHI. If the contractor fails to accompany OUSHADHI's representatives for measurements, then he shall be bound by the measurements taken by OUSHADHI or their representative.

1.32.03 The contractor may raise bills monthly, which shall be for a minimum value of 15% of contract amount.

1.32.04 Payment towards all interim bills will be made by OUSHADHI within 30 days of presentation by the contractor.

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

1.33 EXTRA ITEMS

1.33.01 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 OUSHADHI to execute is deemed as an extra item of work. All such works that are necessary to be carried out under the direction of OUSHADHI shall be carried out by the contractor. No such variation will violate the Contract.

1.33.02 Extra items of work thus carried out by the contractor will be paid at the rates worked out by OUSHADHI in the following manner.

1.33.03 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.

1.33.04 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.

1.33.05 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 DSR 2016 applying the contractor's quoted percentage above or below.

1.33.06 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 public work department rates, the rates for such part or parts of items as are not covered in the schedule of rates shall be determined by OUSHADHI 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.

1.35.07 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 departmental schedule or rates, the contractor after execution of the work as mentioned in 1.35.01 above and 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 OUSHADHI shall within one month thereafter, determine, the rate on the basis of the market rate giving due consideration to the rate claimed by the Contractor.

1.36 The contractor shall make arrangement for water and electricity required for the work as per clause no.4.2.0 and 4.3.0 of Special Conditions of Contract.

1.37 **INSURANCE**

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

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

Managing Director,
The Pharmaceutical Corporation (I.M) Kerala Ltd., (OUSHADHI)
Kuttanellur.P.O, Thrissur – 680 014.

DECLARATION OF THE TENDERER

I/We hereby declare that I/we have read and understood the above instructions and the terms and conditions mentioned above are binding on me/us.

SIGNATURE OF THE TENDERER

SUMMARY OF NOTICE INVITING TENDER

1.	Defects liability period	:	Twelve months from the date of Completion
2.	Period of final measurements and valuation	:	Three months from the date of Completion
3.	Date of commencement of work	:	15th day from the date of receipt of letter of acceptance or handing over the site or the date on which Engineer-in-charge issues written orders to commence the work, which ever is later.
4.	Period of completion of work	:	18 months from the date of Commencement of work.
5.	Earnest money deposit	:	Rs.1,00,000/-
6.	Performance Guarantee	:	5% of contract value
7.	Security deposit	:	2.5% of gross amount from each running bill
8.	Firm period of tender	:	Two months from the date of opening of Tender
9.	Escalation	:	No Escalation
10.	Liquidated damages	:	1% per week of delay. Maximum 10% of total contract value.

Managing Director,
The Pharmaceutical Corporation
(I.M) Kerala Ltd.,
Kuttanellur.P.O,
Thrissur – 680 014.

SECTION 2.00 – GENERAL CONDITIONS OF CONTRACT

GENERAL CONDITIONS OF CONTRACT

2.1.0 Definition of Terms

In construing these General Conditions of Contract and the annexed Technical Specifications and Commercial Terms, the following words shall have the meanings herein assigned to them unless there is something in the subject or context inconsistent with such construction.

a. Client/Purchaser/Company

The 'Client/Purchaser/Company' shall mean The Pharmaceutical Corporation Kerala Ltd, Kuttanellur P.O, Thrissur-680014, Kerala or its authorized representatives.

b. Consultants

The 'Consultants' shall mean M/s.KITCO Ltd., P.B.No.4407, Puthiya Road, NH Bypass, Vennala, Kochi-28

c. Tender

The Tender shall mean the tender submitted by the Contractor for acceptance by the Purchaser.

d. Contractor/Supplier

The 'Contractor/Supplier' shall mean the person or company whose tender is accepted by the Purchaser and shall be deemed to include the Contractor's successors, heirs, executors, administrators, representatives and assignees approved by the Purchaser.

e. Sub Contractor

The 'Sub-contractor' shall mean the person or company named in the contract for any part of the work or any person to whom any part of the contract has been sub-let by the Contractor with the consent in writing of the Purchaser and shall include his heirs, executors, administrators, representatives and assignees approved by the Purchaser.

f. Inspector

The Inspector shall mean any person or persons nominated by the Purchaser to inspect works or stores under the contract.

g. The Goods/Items

The Goods/Items means all the equipments, machinery and/or other materials which the supplier is required to supply to the purchaser under the contract.

h. Contract

The Contract shall mean and include the Notice Inviting Tender, Conditions of Contract, Technical Specifications, Commercial terms, Technical data, Schedules, Drawings, Tender offer of the Contractor with covering letter if any, Letter of

Acceptance of the Purchaser, Schedule of Quantities, Prices, the Final General Conditions, any Special conditions applying to the particular contract, specifications and drawings, subsequent Amendments mutually agreed upon, and the Agreement to be entered into under these Conditions of Contract.

i. Contract Price

'The Contract Price' means the price payable to the Supplier under the Contract for the full and proper performance of its contractual obligations.

j. Services

'Services' means services ancillary to the supply such as transportation and insurance, and other incidental services, such as installation, commissioning, provision of technical assistance, training and other such obligations of the Supplier covered under the Contract.

k. Specifications

The Specifications shall mean the specification annexed to or issued with these General Conditions \ technical specifications and Drawings attached thereto, if any.

l. Site

The site shall mean the actual place or places to which the machines/equipments are to be delivered or where work is to be done by the Contractor, together with the area surrounding the said place or places as the Contractor shall with consent of the Purchaser actually use in connection with the works, and shall include where applicable the lands and buildings upon or in which the works are to be executed.

m. Tests on Completion

Tests on Completion shall mean such tests which are to be made by the Contractor before the Works are taken over by the Purchaser as are provided in the Contract and such other tests as may be agreed upon between the Purchaser and the Contractor.

n. Commercial Use

Commercial use shall mean use of the work or works which the Contractor contemplates or of which it is to be commercially capable.

o. Dimensions

Dimensions shall mean the extent of a line, area, volume. All dimensions shall be given in the metric system i.e. for length measurement in kilometres, metres, or millimetres, for surface measurement in square metres, for volume measurement in cubic metres, etc.

p. Weight

Weight of a body shall mean the measure of the force of gravity on the body. It shall be given in metric units i.e. in tons (1 ton = 1000kg.), kilograms, grams and milligrams.

q. Time

Time shall be reckoned in months, days and hours, and the month shall mean calendar month.

r. Letter of Intent/Letter of Acceptance

Letter of Intent/Acceptance shall mean the Purchaser's letter to the Contractor conveying his acceptance of the tender subject to such reservations as may have been stated therein.

s. Writing

Writing shall include any manuscript, type-written or printed statement, under or over signature or seal, as the case may be.

t. Person

Words importing person shall include firms, companies, corporations, and associations or body of individuals, whether incorporated or not. Words importing the singular only shall also include the plural and vice-versa where the context requires.

Terms and expressions not herein defined shall have the same meanings as are assigned to them in the Indian Sale of goods Act (No.III of 1930) failing that in the Indian Contract Act (Act IX of 1872) and failing that the General Clauses Act 1987.

2.2.0 Packing and Marking

2.2.1 The Supplier shall provide such packing of the Goods as is required to prevent their damage or deterioration during transit to their final destination as indicated in the Contract. The packing shall be sufficient to withstand, without limitation, rough handling during transit and exposure to severe climatic conditions during transit and open storage. Packing case size and weights shall take into consideration, where appropriate, the remoteness of the Goods' final destination and the absence of heavy handling facilities at all points in transit

2.2.2 The packing, marking and documents within and outside the packages shall comply strictly with such special requirements as shall be expressly provided for in the contract and in any subsequent instruction ordered by the Purchaser.

2.2.3 Each package shall be marked outside to indicate:

- Name of the Supplier
- Details of items in the packages
- Name of the Consignee
- Purchase Order Number
- Gross, net and tare weights of the item
- Destination address

2.3.0 Inspection of Site

The Contractor or his representative shall be deemed to have inspected and examined the site and surroundings before submitting his tender and shall obtain the necessary information as to risks, contingencies and other circumstances which may influence or affect his tender. Whether a tenderer visits the site or not, it will be assumed that a tenderer who submits his tender is fully aware of the site conditions and difficulties in erecting the work and no claims under this account will be entertained by the Purchaser at any future date.

2.4.0 Quantum of Work

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

2.4.2 The Client/Consultants reserves the right to increase or decrease the quantum of work at site without assigning any reason.

2.4.3 Variations 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 account. The contractor shall carry out all works as directed by the Consultants at the same agreed rates.

2.5.0 Contract

A formal agreement shall be entered into by the Contractor with the Purchaser for the proper fulfillment of the Contract within 15 days of receipt of the Letter of Acceptance in the prescribed format of the Company.

2.6.0 Application

These General Conditions shall apply to the extent that they are not superseded by provisions in other parts of the Contract.

2.7.0 Standards

The items and Services supplied under this Contract shall conform to the standards mentioned in the Technical Specifications and, when no applicable standard is mentioned, to the latest current edition or revision of the relevant Indian Standards and Codes.

2.8.0 Security Deposit

If the Contractor is called upon by the Purchaser to deposit 'Security' and the Contractor fails to provide the security within the period specified, such failure shall constitute a breach of the Contract and the Purchaser shall be entitled to make other arrangements for the repurchase of the stores contracted for at the risk and expense of the Contractor and/or to recover from the Contractor damages arising from such cancellation. No claim shall lie against the Purchaser either in respect of interest if any due on Security Deposits or depreciation in value.

2.9.0 Sub-Letting of Contract

The Contractor shall not sub-let any part of the contract.

2.10.0 Time Schedule and Drawings

The Contractor shall deliver to the Purchaser a detailed time schedule covering the various phases involved e.g. shop drawing, procurement, manufacture, assembly, inspection, test, delivery, etc. within 10 days of acceptance of the order by the Contractor.

The Contractor shall submit 4 copies of the foundation drawings/fabrication drawings for approval within 10 days from the award of Contract.

2.11.0 Mistakes in Drawing

The Contractor shall be responsible for any discrepancies, errors or omissions in the drawings and other particulars supplied by him, whether such particulars and drawings have been approved by the Purchaser or not. The Contractor shall pay for any extra cost due to any alteration of the works necessitated by reason of any discrepancy, error or omission in the drawings and particulars supplied by the Contractor.

2.12.0 Warranty/ Guaranty

The work and items shall be of the best quality and workmanship and shall comply with particulars of the contract and in all respect shall be to the entire satisfaction of the Inspector and the Purchaser/Consultants.

Whether or not the items have been installed under his supervision, the Contractor shall give the warranty/guaranty in respect of the work to be supplied by him for a period of 12 (twelve) months after the complete materials have been provisionally accepted, the Contractor shall be responsible for any defects that may be discovered therein notwithstanding that such defects could have been discovered at the time of inspection or any defects therein are found to have developed under proper use, arising from faulty materials or workmanship or fails to fulfil the performance guarantee or other requirement of the contract and the Contractor shall remedy all such defects as aforesaid at his own cost. The Purchaser shall state in writing in what respect the goods are faulty and further if in the opinion of the Purchaser the defects are of such a nature that it is necessary to replace or renew any defective stores, such replacement or renewal shall be made by Contractor forthwith without any extra costs to the Purchaser provided notice informing the Contractor of the defects is given by the Purchaser within the period of 12 (twelve) months from the date of provisional acceptance. The decision of the Purchaser notwithstanding any prior approval or acceptance of the Inspector as to whether or not the stores delivered are defective or any defect has developed within the said period of twelve months or as to whether the nature of defects require renewal or replacement shall be final, conclusive and binding on the Contractor. For the items replaced, the contractor shall give guarantee for another six (6) months.

Should the Contractor fail to rectify such defects to the full satisfaction of the Purchaser within a reasonable time, the Purchaser may reject and replace at the cost of the Contractor the whole or any part of the work as the case may be which is

defective or fails to fulfil the requirements of the contract. Such replacement at the cost of the Contractor shall be carried out by the Purchaser within a reasonable time with items of the same particulars or when the items conforming to the stipulated particulars are, in the opinion of the Purchaser, not readily procurable, such opinion being final, then with the nearest substitutes. In the event of such rejection, the Purchaser shall be entitled to use the work in a reasonable manner for a time reasonably sufficient to enable him to obtain replacement as herein before provided. The Purchaser may engage any other contractor for carrying out such replacements.

2.13.0 DELETED

2.14.0 Liquidated Damages for Late Delivery

If the Contractor fails to fulfill his contractual obligations within the time fixed, he shall be liable at the discretion of the Purchaser to an unconditional and agreed liquidated damages of 1% (one per cent) of contract value per week or part thereof reckoned on the contract value based on the final bill. The Contractor's liability for delay shall not in any case exceed 10% (ten per cent) of the total contract value. Upon the liquidated damages attaining the maximum value, the Purchaser shall have the right to source the item from elsewhere at the risk and cost of the contractor.

2.15.0 Inspection and Rejection

The stores shall be offered by the Contractor for inspection at such places as may be specified by the Inspector, at the Contractor’s own risk, expenses and costs and shall lie at such places of inspection at the risk of the Contractor and the stores will be subjected to inspection and test as may be considered necessary by the Inspector and his decision as regards rejection of goods shall be final and binding on the Contractor.

2.16.0 Deductions from Contract Price

All costs, damages or expenses which the Purchaser may have paid for which under the contract the Contractor is liable, may be deducted by the Purchaser from any money due or becoming due to the Contractor from the Purchaser under this contract or may be recovered by action of law or otherwise from the Contractor.

2.17.0 Time of Completion and Force Majeure

Should progress of work be delayed by strikes, lockouts, fire, accidents, acts of god, or any cause whatsoever beyond the reasonable control of the Contractor, a reasonable extension of time of completion shall be granted. Should one or both parties be prevented from fulfilling their contractual obligations by a state of force majeure lasting continuously for a period of at least one month, the two parties shall consult each other regarding the further implementation of the contract with the provision that if no mutually satisfactory arrangement is arrived at within a period of one month from the expiry of the one month referred to above, the contract shall be deemed to have expired at the end of the said one month referred to above. The above mentioned expiry of the contract will imply that both the parties have the obligation to reach agreement regarding the winding up and financial settlement of the contract.

2.18.0 Death, Bankruptcy, etc.

If the Contractor shall die or dissolve or go into bankruptcy, or being a corporation cause to be wound up except for reconstruction purposes or carry on its business under a receiver, the executors, successors or other representatives in law of the estate of the Contractor or any such receiver, liquidator, or any person in whom the contract may become vested, shall forthwith give notice thereof in writing to the Purchaser and shall remain liable for the successful performance of the contract, and nothing aforesaid shall be deemed to relieve the Contractor or his successors of his or their obligations under the contract under any circumstances. The Contract may however be terminated by the Purchaser at his discretion by notice in writing to the Contractor.

2.19.0 Failure and Termination

If the Contractor fails to deliver the stores or any installment thereof within the period fixed for such delivery or at any time repudiates the contract before the expiry of such period, the Purchaser may without prejudice to the right of the Purchaser to recover damages for breach of the Contract.

2.19.1 Purchase or authorize the purchase from elsewhere without notice to the Contractor, on the account and at the risk of the Contractor of the stores not so delivered or others of a similar description (where stores exactly complying with particulars are not in the opinion of the Purchaser, which shall be final, readily procurable) without canceling the contract in respect of the installments not yet due for delivery, or

2.19.2 Cancel the contract or a portion thereof and if so desired purchase or authorize the purchase of the stores not so delivered or other of a similar description (where stores exactly complying with particulars are not in the opinion of the Purchaser, which shall be final, readily procurable) at the risk and cost of the Contractor, if the Contractor had defaulted in the performance of the original contract, the Purchaser shall have the right to ignore his tender for risk purchase even though the lowest.

Where action is taken under sub-clause (i) or sub-clause (ii) above, the Contractor shall be liable for any loss which the Purchaser may sustain on that account provided the purchase or, if there is an agreement to purchase, such agreement is made, in case of failure to deliver the stores within the period fixed for such delivery within two months from the date of such failure and in case of repudiation of the contract before the expiry of the aforesaid period of delivery, within two months from the date of cancellation of the contract. The Contractor shall not be entitled to any gain on such purchase and the manner and method of such purchase shall be in the entire discretion of the Purchaser. It shall not be necessary for the Purchaser to serve a notice of such purchase on the Contractor.

2.20.0 Arbitration

2.20.1 All disputes or difference whatsoever arising between the parties out of or relating to the construction, meaning and operation or effect of this contract or the breach thereof shall be settled by the sole Arbitrator appointed by the Chief Executive Officer of the Purchaser and the award of such Arbitrator shall be final and conclusive and binding on all parties to the contract.

2.20.2 The Contractor shall not in any way delay or default or cause to delay or default the carrying out of the Works by reasons of the fact that any matter has been agreed to be referred to and/or referred to Arbitration.

2.20.3 The seat of Arbitration shall be Thrissur and only the appropriate court coming under the High Court of Kerala will have jurisdiction to entertain all matters of litigation to the exclusion of all other courts.

2.21.0 Amendments

No variation to the contract shall be valid unless made in writing and duly signed by both the parties. The Purchaser shall not, in the absence of written acceptance, be bound by any provision in the Contractor's quotation, offers, form of acknowledgement of the contract, invoices, packing lists and other documents which purport to impose any condition at variance with or supplemental to the Contract.

2.22.0 Law Governing the Contract

This Contract shall be governed by the laws of India for the time being in force. The marking of all stores supplied must comply with the requirements of Indian Acts relating to Merchandise marks and all the rules under such acts.

2.23.0 Exercising the Rights and Powers of the Purchaser

All the rights and discretions and powers of the Purchaser under the contract shall be exercisable by and all notices on behalf of the Purchaser shall be given by the Chief Executive Officer or any person or persons authorized to enter into contracts on behalf of the Purchaser and any reference to the opinion of the Purchaser in the terms and conditions contained in the contract shall mean and be construed as reference to the opinion of any of the persons mentioned in the clause.

2.24.0 Notices

2.24.1 Any notice to be given to the Contractor under the terms of the contract shall be served by sending the same by post, fax or telegram to or leaving the same at the Contractor's principal place of business (or in the event of the Contractor being a company to or at its registered office) or at the site.

2.24.2 Any notice to be given to the Purchaser under the terms of the contract shall be served by sending the same by post to or leaving the same at the Purchaser's last known address.

2.25.0 Secrecy

The Contractor shall not at any time during the pendency of the contract or thereafter disclose any information furnished to them by the Purchaser or any drawings, designs, reports and other documents and information prepared by the Contractor for this contract, without the prior written approval of the Purchaser/Consultants except in so far as such disclosure is necessary for the performance of the Contractor's work and service hereunder.

2.26.0 Ownership of Drawings and Specifications

All drawings, specifications, materials and designs furnished by the Purchaser/Consultants or his representatives shall be treated strictly as confidential property of the Purchaser. All such drawings, specifications, manuals and other materials shall be returned to the Purchaser upon the completion of the work under this contract. No copies, duplications or Photostats shall be retained by the Contractor without the consent of the Purchaser/Consultants.

2.27.0 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 court of competent jurisdiction located in Thrissur.

2.28.0 Performance Tests and Provisional Acceptance

2.28.1 On the completion of a satisfactory start-up operation, the Purchaser will proceed with the performance tests. The duration of the performance test shall be 3 days.

2.28.2 On the completion of a satisfactory start-up operation, the Purchaser will proceed with the performance tests. The duration of the performance test shall be one (1) month.

2.28.3 On successful completion of the performance test, the Purchaser will issue the Provisional acceptance certificate to the Contractor. If the system fails to qualify the performance test, the duration will be extended for one month from the date of failure of the system and if the Contractor is unable to prove the performance within this period, the Client shall have the right to procure similar equipment from another source at the risk and cost of the Contractor.

2.28.4 The final acceptance certificate will be issued on successful completion of the Warranty/Guarantee period.

2.29.0 Accident or Injury to Workmen

2.29.1 The Contractor shall be solely liable for any accident or injury that may happen to any of his personnel engaged in connection with the erection work according to the Contract. The Purchaser/ Consultant shall not be liable for, or in respect of, any damage or compensation payable at law in respect of, or in consequence of, any accident or injury to any personnel in the employment of the Contractor and the Contractor shall indemnify and keep indemnified the Purchaser/Consultant against all such claims, damages, compensations and proceedings.

2.29.2 The Contractor is the employer of all the worker’s engaged for this work and should therefore take all required registrations, insurance cover, etc. and pay premium correctly to labour welfare funds constituted by the Union Government and Government of Kerala from time to time.

2.30.0 Compliance with Statutory and Other Regulations

The Contractor shall, in all matters arising in the performance of the Contract, conform at his own expense with the provisions of all Central or State statutes,

ordinances or laws and the rules, regulations, or bye-laws of any local or other duly constituted authority and shall keep the Purchaser/Consultant indemnified against all penalties and liabilities of every kind for breach of any such statute, ordinance, law, rule regulations or bye-law.

The Contractor shall give all notices and pay all fees and taxes required to be given or paid under any Central or State statutes, ordinances or other laws or any regulations including GST Act or bye-laws of any local or other duly constituted authority in relation to the erection work.

2.31.0 Labour Rules

2.31.1 Provisions of Contract Labour Act

In respect of all labour, directly or indirectly, employed by the Contractor for the erection work, the Contractor shall comply with the provisions of the Contract Labour (Regulation and Abolition) Act, 1970, or any amendment thereof, and all legislations and rules of the State and/or Central Government or other local authority, framed from time to time governing the protection of health, sanitary arrangements, wages, welfare and safety for labour employed on the erection work. The rules and other statutory obligations with regard to fair wages, welfare and safety measures, maintenance of registers, etc. will be deemed to be part of the Contract.

2.31.2 Provisions of Minimum Wages and Payment of Wages Act

The Contractor shall comply with the provisions of the Minimum Wages Act, 1948, and the Payment of Wages Act, 1936, and any amendment thereof in respect of all employees employed by him for the purpose of carrying out the erection work. The Contractor shall supply to the Purchaser any labour required to work wholly or partly under the direct order and control of the Purchaser, whether in connection with any work being executed by the Contractor or otherwise for the purpose of the Purchaser and such labour shall for the purpose of this clause still be deemded to be persons employed by the Contractor.

If any money shall, as a result of any claim or application made under the said Acts, be directed to be paid by the Purchaser, such money shall be deemed to be money payable to the Purchaser by the Contractor, and, on failure by the Contractor to repay the Purchaser, any money paid by the Purchaser as aforesaid, within seven days after the same, shall have been demanded form the Contractor, the Purchaser shall be entitled to recover the same from any money due or accruing to the Contractor under this or any other contract with the Purchaser.

In the event of the retrenchment of workers by the Contractor or sub-contractors employed by the Contractor during or after the completion of the work, the retrenchment compensation and other benefits will be paid by the Contractor to the workers as per the Industrial Disputes Act.

2.32.0 Provisions of Workmen's Compensation Act

The Contractor shall at all times indemnify and keep indemnified the Purchaser against all claims for compensation under the provisions of the Workmen's

Compensation Act, 1923 (VIII of 1923), or any other law for the time being in force by, or in respect of, any workman employed by the Contractor in carrying out of the Contract and against all costs and expenses or penalties incurred by the Purchaser in connection therewith. In every case in which, by virtue of the provisions of Section 12, sub-section (1) of the Workmen's Compensation Act, 1923 the Purchaser is obliged to pay compensation to a workman employed by the Contractor in executing the contract, the Purchaser shall recover from the Contractor the amount of the compensation so said and, without prejudice to the rights of the Purchaser under Section 12, sub-section (2) of the said Act, the Purchaser shall be at liberty to recover such amount or any part thereof deducting it from the security deposit or from any sum due by the Purchaser to the Contractor, whether under this contract or otherwise. The Purchaser shall not be bound to contest any claim made against him under Section 12, sub-section (1) of the said Act, except on the written request of the Contractor and upon his giving to the Purchaser full security for all costs for which the Purchaser might become liable in consequence of contesting such claim.

2.33.0 Damage to Persons or Property

The Contractor shall indemnify and keep indemnified the purchaser against all losses and claims for injuries or damages to any property whatsoever which may arise out of, or in consequence of, the work at site carried out by the Contractor and against all claims, demands, proceedings, damages, costs, charges and expenses whatsoever in respect thereof or in relation thereto.

2.34.0 Work in or around an Operating Plant

When the work is being carried out in or around an operating plant, where the plant must run uninterrupted, the Contractor shall only work at specified places and times as mutually arranged between the Contractor and the Purchaser. The Contractor shall take sufficient care in moving his constructional / erection plant and equipment from one place to another in an operating plant so that they may not cause any damage to the property of the Purchaser, like roads, overhead and underground cables, pipes and/or any other service or equipment or building, and, in the event of the Contractor's failure to do so, the cost of such damages, including eventual loss of working hours as estimated by the Purchaser, shall be borne by the Contractor.

2.35 INSTRUCTIONS FOR FILLING THE TENDER FORM

1. In this tender item specifications are given in the following sections:

   A. **TECHNICAL SPECIFICATIONS**
   B. **SCHEDULE OF QUANTITIES**

   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 bidder by considering all tender information.

2. The tenderer has to work out his rate as an overall percentage above or below or at the rate given in the schedule by a single entry. The tenderer's over all percentage shall be worked out based on the unit rate specification and rates provided against each specification.

   The rate has to be entered by a single entry in front of the schedule both in words and in figures. The rates should be quoted in decimal coinage system.

3. The tenderers should certify that he has studied the works at site and acquainted himself with the position with regard to constructions, materials and labour required for the work.

4. Every tenderer should furnish along with his tender, documents to prove their annual turnover and latest acknowledged income-tax clearance certificate and information regarding the income-tax circle of Ward of the District in which he is assessed by income-tax, the reference No. of assessment and the assessment year.

5. Experience in similar works have to be established by means of completion certificates from Clients.

6. The tenderer has to pay the earnest money deposit as specified in the tender notice along with the tender. Tenders for which earnest money deposit has not been received shall be rejected. There shall be no exemption for any tenderer from submitting the earnest money deposit.

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

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

9. The tenderer should return the original tender document after putting the signature on all pages.

10. The tenderer shall be responsible for furnishing the necessary forms including Form No.8-C, 20, 20-A, 20-B, 20-D, 20-F, etc. applicable for deducting GST/ work contract tax under the GST Act

11. Should the tenderer 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 CONSULTANT/OUSHADHI 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 tenderer to execute the work according to the statement made for quantities or units shown in the tender, without any compensation.

12. The tenderer shall execute a preliminary agreement on non-judicial stamp paper of value not less than Rs.200/- and enclose the same with the tender documents. The Performa of the preliminary agreement can be found in Forms for different deeds.

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

Signature of the tenderer.

Place:
Date :

Tender No. OUSHADHI/KITCO/MH/05/2020

TENDER FORM

To

The Managing Director,
The Pharmaceutical Corporation (I.M.) Kerala Ltd., (OUSHADHI)
Kuttanellur P.O, Thrissur-680 014.

Dear Sirs,

Sub: Tender for Upgradation of Fire Protection System at Oushadhi, Kuttanellur, Thrissur

With reference to the tender invited by you for the above proposed work, I/We do hereby Tender for this 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) relating to Construction.

b) Visited the site of work, studied the site conditions, nature of substrata, availability of construction materials 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 undertake to 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 Liquidate 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 retention money and to remit security deposit which will be returned to me/us as per the relevant clauses in the agreement. The deduction will be as explained in clause 1.11 of Notice Inviting Tender.

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

We have also executed the preliminary agreement as is enclosed.

Further we undertake the 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 accepted we agree to enter into a contract as specified by you within one week of 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.

3.0 GENERAL INFORMATION OF THE PROJECT

3.00 GENERAL INFORMATION OF THE PROJECT

3.01	Owner	:	The Pharmaceutical Corporation (I.M) Kerala Ltd. (OUSHADHI), Kuttanellur.P.O, Thrissur-680014
3.02	Project	:	Upgradation of Fire Protection System at Oushadhi, Kuttanellur, Thrissur
3.03	Tender No	:	OUSHADHI/KITCO/MH/05/2020
3.04	Location	:	Kuttanellur, Thrissur
3.05	Nearest Railway Station	:	Thrissur/Ollur
3.06	Nearest Airport	:	Cochin International Airport Ltd.
3.07	Accessibility	:	Site is accessible by NH47.
3.08	Scope of work	:	Upgradation of Fire Protection System associated civil and electrical works at Oushadhi, Kuttanellur, Thrissur
3.09	Schedule Taken	:	DSR 2016 with cost index 131.06 and Market Rates

SECTION - 4.00 - SPECIAL CONDITIONS OF CONTRACT

4.0 SPECIAL CONDITIONS OF CONTRACT

General

The following special conditions shall be read in conjunction with General terms and conditions of Contract (GCC) and amendments/corrections thereto. Where any portion of the GCC are repugnant to or at variance with any provisions of the SCC, then, unless a different intention appears, the provision of the SCC shall be deemed to override the provisions of the GCC.

4.1.0 MATERIALS

ALL MATERIALS

1. All materials required for the work is to be procured by the contractors. All materials that are brought to site for use in the work shall conform to the relevant B.IS specification.

2. All materials to be used in the works shall have the specific approval of the site engineer as to its quality and grade. If any batch of materials are found unacceptable and rejected by the engineer the same shall be removed from the site without demure.

3. In the event where there are no standard specification for any materials, the Judgment of the site engineer will be final as to its quality for incorporating the same in the works.

4.2.0 WATER

Water required for the construction is to be provided by the contractor at his 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. If water supply required for the construction is drawn from Oushadhi on chargeable basis, Contractor shall provide necessary arrangements (plumbing works) to take water from the approved source given by Oushadhi. He shall also arrange water meter, pump, pipe and pipe fittings etc. at his own cost.

4.3.0 ELECTRICITY

Electric power for the construction shall be drawn by the Contractor from the nearest power point of Oushadhi on chargeable basis at the prevailing rate depending on the availability.

Necessary arrangements as per the norms of KSEB/ Electrical Inspectorate for drawing the power from the power point through calibrated energy meter shall be done by the Contractor at his cost.

4.4.0 OTHER CONDITIONS

1. After the completion of the first stage of work, the contractor has to allow the entrepreneurs to start moving with in the building and take over the units allotted to them and start their activities.

2. The expansion joints for the kerbs shall be provided at 5m interval or as required for the available length. The expansion joints has to be with straight edges and close together.

3. The initial levels of the area shall be taken and recorded before the earth work is started in the presence of the representative of the Consultants/owner.

4. Casting of pre-cast slabs and boundary blocks etc. shall be carried at the central casting yards which are to be erected by the Contractor to his convenience and curing shall be done by flooding water for minimum of 15 days. The drawing of the paving slabs illustrates typical dimensions of slab. The cover slab is proposed for the drains only for the width of the road at the entry to the plots. The kerbs formed along the cable trenches and dividers are to be of perfect shape and straight with the expansion joints etc. For casting of paving slab perfect machined steel shuttering as per actual dimensions and right angles should be used. The edges of the slabs shall be perfect square with no honey combing. The finish of the slabs for all sides has to be obtained simultaneous to concreting and no patching or plastering shall be allowed. The slabs of any buckling or defects shall be rejected. The surfaces stone wash finish of the precast slabs have to be done simultaneously with casting of the slab. We expect perfect finish for the surface with the stone surface exposed by the stones strongly and adhering to the base. The sealing notch in the side wall of duct have to be perfectly made so that the slan when placed shall have to be perfectly seating, and even level surface. No cement mortar levelling shall be allowed. Conveying of slabs have to be done carefully without any damage to sides/corners.

5. Setting out of the boundary of the plots shall be done correctly as in the drawing, boundary stones has to be laid on all four corners of the plot firmly. This has to be done along with the setting up of the roads.

6. Vertical walls of duct are to be concreted to get an even surface without honey combing. No patching or plastering shall be allowed. The excavation for trenches shall be allowed for the dimension of the trench plus 10 cm on both sides for shuttering placing only. Any shoring required has to be provided for the vertical face of the sandy soil without any extra claim.

7. The various works shall be done true to line level and grade. The periodical checking of these by the Consultants shall not absolve the contractor of his responsibility regarding their accuracy. In case of any deviation or discrepancy in line, level or grade at the meeting faces, the contractor shall make good the discrepancy at his own cost and without any compensation for the additional work if any involved. The Consultants has the unquestioned right, if need by, to rectify the discrepancies and recover the cost from the Contractor.

8. The work whether fully completed or incomplete all materials, machinery's, plants, tools etc. shall remain on the risk and in the sole charge of the contractor until the complete work has been delivered to the owner and till completion certificate has been issued by the Consultants.

9. The site order book has to be maintained by the contractor in the site office, Consultants and their representatives shall enter orders regarding the work in the book. All entries there in shall be signed by the contractor or his authorised representative within 2 days. It is the responsibility of contractor to follow the instructions given in the site order book.

10. All the items of the work are to be executed as per relevant I.S. specifications.

11. The Contractor has to agree and strictly abide to all the conditions stipulated in the tender and any offer with deviation or request for deviation are liable to be rejected.

4.5.0 SITE OFFICE

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

The following minimum furniture shall be provided.

a. Executive tables	-	1 No
b. Chairs	-	3 Nos
c. Steel Almirah	-	1 No

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

4.6.0 SUPERVISORY STAFF

The Contractor shall appoint required number of experienced and qualified technical and supervisory staff at the site (minimum one Degree holder in Civil Engineering) 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 an agent as per terms given above, Owner/Client reserves the right to deduct a reasonable amount from the Contractor's bill, subject to a maximum of Rs.25,000/- per month, for every month of absence.

4.7.0 PROGRESS REPORT

The Contractor shall submit to the Engineer-in-Charge by the first week of every month three Copies of the Progress Report in a duly approved format showing the progress made in the Construction Works, Mobilization of Resources, etc. during the previous month. The Contractor shall also submit Photographs of completed works along with Monthly

Progress Report and Two copies of Photographs (both soft copy &hard copy of approved size) of the completed project with the final bill.

4.8.0 DOCUMENTATION

The contractor shall prepare the detailed documentation of all the structures by means of Photography, Video by a professional photographer covering various views of the project up to the satisfaction of the client and As built drawings at the times of before, while and after the execution of the work.

4.9.0 Additional bank guarantee as performance guarantee has to be remitted by the Contractor who quote very low rates as below:

i. If the quoted amount of lowest bidder (L1) is X% below the estimated PAC, additional performance guarantee amount shall be (x-10)% of estimated PAC.

ii. 50% of Additional performance guarantee shall be in the form of Treasury Fixed Deposit and rest in the form of Guarantee issued from any Nationalised Bank/ Scheduled Bank.

iii. Additional performance guarantee shall be collected before executing the agreement in the same form as Performance Guarantee and may be released while passing the final contract bill.

iv. Performance guarantee for specialized items of work like antitermite treatment, glass work, water proofing works, 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.

4.10 VARIATION IN QUANTITY

In case of quantities exceeding the agreement schedule quantities and upto 25% limit that are necessitated for proper completion of work, the contract rates of corresponding item shall apply.

For excess, quantities, ie., quantities in excess of 25% over agreement schedule quantities, the admissible rates shall be limited to Technical Sanctioned estimate rate modified by overall tender excess/tender deficit, as the case may be, subject to a maximum of PWD local market rates prevailing at the time of ordering.

4.11 ADDITIONAL SPECIAL CONDITIONS

4.11.1 Works to be done by Contractor

Unless and otherwise mentioned in the tender document, the following works shall be done by the contractor (whichever applicable), and therefore their cost shall be deemed to be included in their tendered cost.

a) Foundation bolts, components etc wherever required or specified.

b) Supports and brackets for suspending/supporting cables as required.

c) Supports for cable trays for laying the cables, where required.

d) 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.

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

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

g) Fixing of danger notice boards wherever required.

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

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

j) Testing and commissioning of the completed installation.

4.11.2. General Requirements and Arrangement of Materials

All sundry fittings, assemblies, accessories, hardware items, foundation bolts, termination lugs for equipments 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.

4.11.3 Quality of materials

All the materials and equipment supplied by the contractor for this work shall be new and should conform 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.

4.11.4 Inspection of material and Equipment

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

4.11.5 Supply of Tools, Tackles and Materials

The Supplier shall, at his own expense, provide all the necessary equipment, tools and tackles, haulage power, consumables, etc. necessary for effective execution and completion of the works during site fabrication, erection and commissioning.

4.11.6 Protection of Plant

All works completed or in progress as well as machinery and equipment that are liable to be damaged by the Supplier's work shall be protected by the Supplier and protection shall remain and be maintained until its removal is directed by the Purchaser.

The Supplier shall effectively protect from the effects of weather and from damages or defacement and shall cover appropriately, wherever required, all the works carried out by him.

Adequate lighting, guarding and watching at and near all the storage, handling, fabrication, pre-assembly and erection sites for properly carrying out the work and for safety and security shall be provided by the Supplier at Supplier's cost. The Supplier should adequately light the work area during night time also.

The Supplier shall take full responsibility for the care of the works or any section or portions thereof until taking over of the plant by the Purchaser and in case any damage or loss shall happen to any portion of the works not taken over as aforesaid, from any cause whatsoever, the same shall be made good by and at the sole cost of the Supplier and to the satisfaction of the Purchaser. The Supplier shall also be liable for any loss of or damage to the works including works carried out by others, caused by the Supplier or his sub-supplier in the course of any operations carried out by them for the purpose of completing any outstanding work or complying with his obligations.

4.11.7 Training of Personnel

The Supervisory and operating personnel of the Purchaser shall be provided with adequate training by the Supplier during the installation, testing, start-up and commissioning of the system free of cost and the training shall be continued during the entire guarantee run period

4.11.8 Consumption of Materials

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

4.11.9 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.

4.11.10 Inspectorate Approval

All the equipment to be supplied and works to be executed shall conform to the provision of statutory and other regulations in force such as the Indian Boiler Regulations, Indian Factories Act, Indian Explosives Regulations, Kerala State Pollution Control Board, etc. Approval of drawings if required shall be arranged by the successful contractor at no extra cost to the Purchaser.

All testing are to be carried out as per the requirements of statutory authorities concerned.

On completion of work, the contractor has to submit necessary completion certificate, drawings, equipment details, load details, test results etc. to electrical contractor for getting approval from inspectorate.

All costs incurred in obtaining any approval/certificates are to be borne by the contractor.

4.11.11 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 Purchaser 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 Purchaser 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.

4.12 Detailed Working Drawings

The detailed fabrication drawings are to be prepared by the contractor as per the relevant BIS specifications and the State / Central Electrical Inspectorate standards / specifications / guidelines and should obtain necessary statutory approvals/sanctions (if necessary) prior to execution. Drawings provided by the Purchaser, if any, shall at all times be properly correlated before execution. In case of any discrepancy, the same should be brought to the notice of Engineer-in-charge immediately. However, the discrepancy in the item given in the Schedule of Requirements appended with the tender drawings relating to the relevant item, the former shall prevail unless and otherwise given in writing by the Engineer-in-charge.

4.13 Virtual Completion

The work shall not be considered as completed until the Engineer-in-charge has certified in writing that the work has been virtually completed and the Defects Liability period shall commence from the date of such certificate.

Should it become necessary to occupy any portion of the building or to use any part of any equipment, before the contract is completed, the same shall **not constitute an**

acceptance of any part of the work unless so stated in writing by the Engineer-in-charge.

4.14 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 built drawings" drawn to a suitable scale in tracing sheet (whichever is applicable) in **three copies** and one set soft copy (CD) of the same to the Engineer-in-charge before the submission of the final bill.

1. G.A drawings
2. Drawings with dimensions of equipment
3. Equipment Layout Drawings with elevations
4. Equipment Specifications
5. Equipment Fabrication Drawings
6. Empty Weight
7. Foundation Drawings with load details.
8. Erection, Operation & Maintenance manual

4.15 Handing over the site

The site shall be handed over in Phases, if warranted. Contractor shall plan the work as per the phasing decided by the Purchaser and no claim will be entertained for not handing over the entire area in one stretch. In case there are small patches, which could not be handed over due to legal and technical reasons, this will not be considered as obstructions and no claim will be entertained for delays for such reasons.

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.

4.16 Deviations from Purchaser's Specification

Deviations from the purchaser's specification, if any, proposed by the bidder will be considered, provided they meet with the purchaser'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.

4.17 Conformity to IE Act, IE Rules and Standards

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.

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

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

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

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

d. Fire Insurance Regulations/Tariff Advisory Committee.

e. Regulations laid down by the Factory Inspector of the State.

f. Any other regulations laid down by the local authorities.

g. Installation & operating manuals of original manufacturers of equipment.

4.18 Deleted

4.19 Data/Drawings/Documents

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

i) Fabrication drawings
ii) List of deviations clause by clause and reasons.
iii) Descriptive literature of the various equipment offered with catalogues, if any.
iv) Guaranteed technical particulars of the equipment and performance particulars
v) Approximate dimensions, foundation drawings with load details and preliminary G.A drawings.
vi) List of optional features with extra price.
vii) Make of various equipment and associated components/ accessories.
viii) 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 purchaser/Consultant's approval.

1. Data Sheets
2. G.A drawings
3. Drawings with dimensions of equipment
4. Equipment Layout Drawings with elevations
5. Equipment Fabrication Drawings
6. Equipment Specifications
7. Empty Weight

8. Foundation Drawings with load details.

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.

4.20 PAYMENT TERMS FOR ELECTRICAL AND MECHANICAL WORKS

a. 75% of rate of items, on pro-rata, would be released after the satisfactory supply of materials at site as assessed by the Engineer-in-Charge, which are required in accordance with the contract and are safeguarded against loss due to any cause whatsoever covered by an insurance to the satisfaction of the Engineer-in-charge.

b. 90% of rate of items including supply and installation, on pro-rata, less the payment already released against (a) above will be made against the completion of installation at site.

c. 100% of rate of items less the amount already paid against item (a) & (b) above will be made on testing, commissioning and handing over of the system.

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

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 turnover for the last three years	2016-17	
		2017-18	
		2018-19	
7	Permanent Account Number (PAN)		
8	GST Registration No.		
9	PF Reg. No		
10	ESI Reg. No.		

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

Signature & Seal of tenderer: Name of Tenderer:
Date: Address:

TECHNICAL SPECIFICATIONS

FIRE PROTECTION SYSTEM

1. SCOPE OF WORK

1.1 The scope of the work covers supply of materials, installation, testing, commissioning and **obtaining statutory approval from the local fire authority** for the Fire Hydrant & Sprinkler, Fire alarm & detection system in the entire industrial complex of the Oushadhi Kuttanellur campus.

1.2 The scope of work, in general shall include the following:

i) Revamping of the Existing fire system. (External hydrant system in the campus, Pump house, Internal hydrant & sprinkler and detection system in the Centre of excellence building).

ii) Proposed Fire Fighting Pumps & Accessories and related electrical works.

iii) Proposed External & Internal Fire Hydrant System for all the buildings.

iv) Fire sprinkler system.

v) Intelligent Addressable Automatic Fire Alarm & detection system.

vi) Localized Panel Suppression system for MV electrical main distribution panel.

vii) Public address & firemen talkback system and emergency signages.

viii) Fire extinguishers/ Hand Appliances.

1.3 Copies of drawings of buildings and schedule of quantities are enclosed in the tender document. All the equipment and installation shall conform to specifications contained in Indian Standards.

1.4

a) The installation of Fire Hydrant & sprinkler systems, automatic detection alarm systems shall conform to norms as per NBC 2016, relevant IS codes, CPWD specifications and rules and regulations of Local Fire Authority as per the statutory regulations applicable for obtaining the occupation/No objection certificate from the Local Development / Fire Authority.

b) **The scope of work also includes obtaining Initial and final approval/ NOC for the system in all the buildings from State Fire Department and liaison works with the department.** Documents including the drawings for obtaining Fire NOC/approval from the authority shall be prepared by the contractor. All incidental expenses in connection

with the same shall be borne by the contractor. However statutory fee paid by the Contractor shall be reimbursed on production of documentary evidence.

c) Obtaining initial NOC from Kerala State Fire and Rescue Department shall be a pre-condition for the payment against fire protection works items. If the reasons for non-availability of such NOC is solely attributable to the contractor, the Client/Consultant (Authority) reserves the right to withhold the amount of fire protection work items in the Running Account Bills (RABs).

d) Applicable norms laid down by the relevant sections of latest editions of National Building Code 2016 (NBC 2016) and all relevant codes of Bureau of Indian Standards (B.I.S.) and CPWD general specifications for electrical works Part – 5 (Wet riser and sprinkler system) shall be followed as applicable. The codes of the National Fire Protection Association of USA (N.F.P.A.) shall used as a general guide for good engineering practice, design and workmanship norms.

e) All materials used in the works (as applicable) shall have Bureau of Indian Standards valid certification stamped, marked or cast on the material in an acceptable and approved manner, as specified hereinafter.

f) It is the contractor's responsibility to ensure the competence of design to meet the above requirements.

g) Drawings issued with the tenders are schematic and indicate the concept. Contractor shall make his shop drawings on basis of Architectural and Interior design drawings issued by the Engineer-in- Charge. Work will be executed only as per approved shop drawings.

h) A schedule of approximate quantities for various items accompanies this tender. It shall be definitely understood that the Client / Consultants do not accept any responsibility for the correctness or completeness of this schedule in respect of items and quantities and this schedule is liable for alteration by deletions, deductions or additions at the discretion of the Consultants/Client without affecting the terms of the contract.

i) The quantities given in the schedule of quantities (SOQ) are only approximate and payment will be made as per actual measured quantities of work executed at site.

j) Contractors shall furnish detailed shop drawings, design calculations for submission and approval of the Local Fire Authority and for Insurance Companies as may be required by the CLIENT.

k) The quantities given in the tender SOQ are tentative and shall vary as per the site/ CLIENT requirements. Only required items & quantities are to be supplied/ installed. Contractor shall take detailed site measurements for items before placing purchase order / taking procurement action. Contractor shall monitor the requirements of various items and shall report to Engineer with regard to deviations in the existing items and requirement of additional / extra items, if any, for taking necessary action.

1.5 The bidder shall visit the site before submitting the tender and familiarize the work and nature of site condition.

1.6 Without restricting to the generality of the foregoing, the work shall include the following:

1) Revamping of the existing fire protection system consisting of External hydrant system in the campus, Mechanical and electrical works in the existing pump house, Internal hydrant & sprinkler and detection system in the Centre of excellence building.

2) Hydrant & Sprinkler System Covering the different buildings as detailed in the tender drawings and as per NBC 2016 and consisting of the following Pumps:
   a) Electric Motor Driven Pump-2850 lpm with minimum pressure of 3.5 Kg/cm2 at the remotest location- 1 No
   b) Diesel Engine Driven Pump-2850 lpm with minimum pressure of 3.5 Kg/cm2 at the remotest location- 2 Nos
   c) Electric Motor Driven Jockey Pump-180 lpm with minimum pressure of 3.5 Kg/cm2 at the remotest location - 2 Nos
   d) Terrace Pump – 900 lpm with minimum pressure of 3.5 Kg/cm2 at the terrace level- 1 No

3) Other piping system ancillaries such as Suction & Delivery Headers, Air Vessel, Pressure Gauges, Pressure Switches, expansion bellows, valves etc. as required.

4) Suitable electrical panel and instrumentation for automatic operation of pumps as detailed in technical specification.

5) Cabling from electrical panel to Main pump, Jockey pump and Battery charger of diesel engine. The scope also includes supply of cables, starters, isolators and earthing for all pumps as required.

6) External and Internal hydrant system for all the buildings as detailed in Specification, BOQ and drawings. Landing valves in decided locations accompanied by 1 number of swinging Hose reel, 2 numbers of RRL hose & Branch pipe in hose box.

7) All minor building work, such as cutting and making good the damages and filling up the hole in walls, floor with cement concrete, after laying the wet riser and sprinkler pipes.

8) Necessary supports and clamps for pipes for the firefighting, in the buildings, pump room. Vibration elimination arrangements (anti-vibration pads) and expansion bellows for main pump and standby diesel engine driven pump & jockey pumps. Necessary masonry work/steel work for supporting hose cabinets for external (yard) hydrants. Pipes shall be provided with angle supports on beams in addition to other supports as mentioned in technical specifications.

9) Hand appliances (extinguishers) as specified in bill of quantities.

10) Intelligent addressable Fire alarm & detection system consisting of addressable Manual call points, Sounder with strobes, Fire Alarm control panel, different kind of detectors, modules and control cabling. Fire alarm & detection system to be integrated with the public address-firemen talkback system.

11) CO2/Clean agent Suppression system for MV main distribution electrical panel. This system shall be integrated with the Fire alarm and detection system.

12) Public address & Firemen talkback system (2 way communication) integrated with the Fire alarm and detection system.

13) Signages as mentioned in the BOQ and installed at the right locations as mentioned in technical specification or as directed by the engineer-in-charge/consultant.

14) Preparation of detailed layout drawing and co-ordination drawing with other services and submission to the Engineer In-charge for approval prior to execution.

15) The contractor shall submit the Technical Data Sheets for all the relevant items in the BOQ. The TDS shall contain the catalog of the product, routine/type test certificate, BOQ as well as technical specification compliance from the OEM (wherever obtaining compliance from OEM is found to be difficult compliance may be provided by the contractor after acceptance from the Engineer-in-charge/ consultant).

16) Preparation of drawings and liaison works for obtaining statutory approvals from local fire authority, electrical inspectorate for the fire protection system.

17) The Contractor shall be required to coordinate his activities with all other services such as Air Conditioning, Electrical and Civil (Interiors) etc.

18) Providing & fixing Fire Barrier mortar with minimum 2 hours fire rating when tested in accordance with BS 476 part 20 and UL 1479 for horizontal openings in fire rated floors or slabs and vertical openings in walls for passing fire shafts. It shall include the closing of gaps around cable tray crossing from wall and shafts vertically or horizontally.

1.7 Statutory approval

Obtaining of the statutory approval of drawings (required drawings shall be prepared by the contractor) including initial and final approval for the entire system in all buildings (as applicable by the local laws) including fire alarm & detection system from fire and rescue department shall be under the scope of the contractor. The required fee shall be remitted by the contractor. Incidental expenses shall also be borne by the contractor. Statutory fee remitted shall be reimbursed at actual on submission of documentary evidence. The contractor shall also be responsible for arranging inspections by local fire officer from fire & rescue department.

1.8 Contractor's experience

- Only specialized agencies shall quote for this work of Fire protection system.
- The selected specialist agency must have sufficient experience in the execution of turn-key projects as specified.
- Contractor must submit with the tender a list of similar jobs carried out by him as required along with the name of works, name and address of clients, year of execution, capacity of plant and value of work.

1.9 Technical Information

Contractor shall submit along with the tender copies of detailed specifications, cuts, leaflets, and other technical literature of equipment and accessories offered by him.

Contractor's attention is specially invited to the special conditions and other clauses in the agreement which required the contractor to:-

a. Submit detailed shop drawings.

b. Use material of specific makes and brands.

c. Obtain all approvals from Fire Fighting authorities.

d. Execute the entire work on a turn-key basis so as to provide a totally operating plant.

1.10 Site Accessibility

1) The equipments are to be located in the space designated by the purchaser within the site.

2) The equipment must be carried from the goods receiving station to the site in an extremely careful manner to prevent damage to the equipment building or existing services.

3) Contractor must visit the site and familiarize himself with site problems to ensure that the equipment offered by him are of dimensions that they can be carried and placed in position without any difficulty.

2.0 FIRE HYDRANT & SPRINKLER SYSTEM

2.1 STANDARDS

2.1.1 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. Following standards to be adhered & followed:

IS:5- 2004	Colors for ready mixed paints and enamels (Fifth revision)
IS: 325	Three phase Induction Motors (Fifth revision)
IS: 444 - 1987	General purposes rubber water hose (Fourth revision)
IS: 636	RRL hose pipe-Non-percolating flexible firefighting delivery hose
IS: 694	PVC insulated cables (light duty) for working voltage upto 1100 volts.
IS: 780	Cast iron sluice valve
IS: 823	Welding procedure
IS: 884	First aid hose reel-Specification for first-aid hose reel for firefighting
IS: 900	Installation of motors
IS 901 - 1988	Specification for couplings, double male and double female, instantaneous pattern for firefighting (Third revision)
IS 902 - 1992	Specification for suction hose coupling for firefighting purposes
IS: 903 -1993	Specification for fire hose delivery couplings, branch pipe, nozzles and nozzle spanner (Fourth revision)
IS: 904 -1983	Specification for 2-Way And 3-Way Suction Collecting Heads For Fire Fighting Purposes
IS: 907 - 1984	Specification for Suction Strainer cylindrical type for fire fighting purposes (Second revision)
IS: 908 -1975	Specification for Fire Hydrant, Stand Post Type (Second revision)
IS: 909 - 1992	Specification for underground fire hydrant, sluice valve type (Third revision)
IS: 1239	Mild steel/GI, black ERW pipes up to 150 mm dia, with fittings. (Part 1)-2004 Specification for steel tubes, tubular and other wrought steel fittings Part 1: steel tubes (Sixth revision). (Part 2) -1992 MS tubes, tubular and other wrought steel fittings, Part 2 MS tubular and other wrought steel pipe fitting (Fourth revision).
IS: 1255	Code of practice for installation and maintenance of power cables.
IS: 1554	PVC insulated cables (heavy duty) for voltage up to 1100 volts. — do — for voltage 3.3 kV to 11 kV
IS: 1652	Batteries
IS: 2062	Steel for General Structural Purposes
IS 2190	Selection, installation and maintenance of first-aid fire extinguishers
IS: 2379 - 1990	Color code for identification of pipe lines (First revision).
IS: 3043	Code of practice for earthing.
IS: 3589	Mild steel/GI, black ERW pipes 200 mm dia and above, with fittings.
IS: 3844 - 1989	Code of practice for installation and maintenance of internal fire

	hydrants and hose reels on premises (First revision)
IS: 4038 - 1986	Specification for Foot Valves for water works purposes.
IS: 4928 - 1986	Specification for delivery valve for centrifugal fire pump outlets (First revision)
IS 4984	HDPE pipes
IS 4985	PVC pipes
IS: 5216	Guide for safety procedures and practices in electrical work.
IS: 5290-1983	Specification for Landing Valves (Third revision)
IS: 5312	Non return valve (Part I) - 1984 Specification for Swing check type reflex valves (Non return) for water works purposes: Part I single door pattern. (Part 2) -1986 Specification for Non-Return Valves for water works purposes: Part 2 multi door pattern
IS: 5578	Guide for marking of insulated conductors
IS: 5714 - 1981	Specification for Hydrant Stand-Pipe for Fire Fighting (First revision)
IS: 5959	Specification for polyethylene insulated PVC sheathed heavy-duty electric cables, voltage not exceeding 1100 V — do — voltage 3.3 kV to 11 kV
IS: 7098	XLPE insulated cables
IS: 7673 - 2004	Fire Fighting Equipment - Glossary of Terms
IS: 8757 - 1999	Glossary of terms Associated with Fire Safety
IS: 9972 - 2002	Specification for Automatic Sprinkler Heads for Fire Protection Service (First revision)
IS: 10221	Code of practice-coating & wrapping of underground mild steel pipelines
IS:11101 - 1984	Specification for Extended Branch Pipe for Fire Brigade Use
IS:12349 - 1988	Fire protection-safety signs
IS:12407 - 1988	Graphic symbols for fire protection plans
IS:12469 - 1988	Specification for Pumps for Fire Fighting System
IS 13095	Butterfly valve
IS: 13947	SDFUs
IS:14845-2000	Air Relief Valves for Water Works Purposes
IS:14846 - 2000	Sluice Valve for water works purposes (50 to 1200 mm size)
IS:14933 - 2001	High Pressure Fire Fighting Hose - Specification
IS:15051 - 2001	High Pressure Fire Hose Delivery Couplings - Specification
IS:15105 - 2002	Code of Practice for Design and Installation of Fixed Automatic Sprinkler Fire Extinguishing Systems
IS:15301 - 2003	Code of Practice for Installation and Maintenance of Fire Fighting Pumps
IS:15683-2018	Portable Fire Extinguishers-Performance and Construction--Specification
CPWD General Specifications For Electrical Works-Part 5	**Wet Riser & Sprinkler System**

2.1.2 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 (such as **CPWD specifications)** and practices as approved by the Purchaser shall be adopted. Any minor changes or modifications directed by the Purchaser shall also be incorporated by the contractor during execution of the work without any additional cost to Purchaser.

2.2 SYSTEM COMPONENTS

2.2.1 The Wet riser-sprinkler system in the compound shall comprise of a main (diesel) pump set for hydrant network, one main (diesel) pump set for sprinkler network, one standby electric pump set common to both network, two jockey pump set (one each for sprinkler network and hydrant network) for pressurization with all required accessories including valves, expansion bellows, special fittings, instrumentation, control panels and any other components required to complete the system in all respects.

2.2.2 The Wet riser-Sprinkler system shall be automatic in action and shall be laid covering the entire area externally and all the floors internally with independent piping system.

2.2.3 The system shall be kept pressurized at all times. The proposed Jockey Pump shall take care of the leakages in the system.

2.2.4 The pressure in the pipe work shall be kept constant at a suitable pressure. In the event of fire when any of the hydrant valve in the network is opened or sprinkler system is operated, the resultant fall in header pressure shall start the main fire pumps through pressure switches automatically. There shall be a Fire pump as standby for both hydrant & sprinkler system. In case of failure of main pumps to start on demand, the standby Pump shall automatically take over.

2.2.5 However, shutting down of the pumps set shall be manual except for the Jockey Pump which shall start and stop automatically through pressure switches. In addition to auto start arrangements, the main pump shall also have an over-riding manual starting facility by push button arrangement.

2.2.6 The piping for the hydrant system in the yard shall be laid in soil one metre deep or in rectangular trench. The pipe laid in soil shall be protected as specified below. The scope of work includes necessary excavation of trench and back filling the same. The scope of work also includes necessary watering, ramming, and removing the surplus earth from the site and construction of brick masonary/concrete pedestal at 3.5 Mtrs intervals. Pipes shall be cleaned before wrapping and coating.

2.2.7 The yard hydrants shall be placed at a regular spacing of 45m centre to centre and as per the approved drawing. The following accessories are proposed in each yard hydrant.

i) One no. gunmetal single headed hydrant valve.

ii) Two nos. RRL Hoses of size 63mm dia x 15m long.
iii) One no. gunmetal Branch pipe.

2.2.8 RRL hose and gunmetal branch pipe will be accommodated in a hose box mounted on brick/concrete pedestals.

2.2.9 The Internal Hydrant System (Wet Risers) shall be provided at points as indicated on the drawing on each floor. **Hydrant system shall be as per NBC 2016, conforming to IS 3844 and IS 13039 (latest) and in accordance with CPWD specifications.**

2.2.10 The hydrant point shall be directly tapped from the Riser pipes, and shall be furnished with required accessories such as

i) One no. gunmetal single headed hydrant valve.
ii) Two nos. RRL Hoses of size 63mm dia x 15m long.
iii) One no. first aid hose reel full swinging type 20mm dia x 30m long.
iv) One no. gunmetal Branch pipe.

2.2.11 The hydrant risers shall be terminated with air release valve at the highest points to release the trapped air in the pipe work.

2.2.12 Orifice plates of suitable design shall be provided for hydrants where pressure exceeds 7 Kg per Sq. cm.

2.2.13 The riser from the pump room shall be provided with instantaneous control valve with alarm gong.

2.2.14 The entire system shall be divided in various zones with the help of flow switches which shall be connected to central annunciation panel so that in case of fire exact location of affected area can be identified.

2.2.15 All suction and delivery lines of the pumps shall be provided with double flanged reinforced neoprene flexible pipe connectors. Connectors should be suitable for a working pressure of each pump. Length of the connector shall be as per manufacturer's details.

2.2.16 Suitable drainage arrangement with bye pass valves shall be provided in all risers to facilitate maintenance of pipe work.

2.2.17 To compensate for slight losses of pressure in the system and to provide an air cushion for counteracting pressure surges/water hammer in the underground pipe work Air Vessels shall be furnished in the pump room near fire pumps. The air vessel shall be normally partly full of water and the remaining being filled with air which shall be under compression when the system is in normal operation.

2.2.18 The entire Wet Risers, external Hydrant Ring Main System shall be fed from the water supply tank (underground) (Static Water Tank) and a terrace (over head) tank. The Bidder shall note that the Pump House is located adjacent to the Static Fire Water Tank.

2.3 ELECTRIC FIRE PUMP FOR HYDRANT & SPRINKLER

2.3.1 Scope

This section covers the details of requirements of the motor, starter and pump for the electrically operated fire pumps (if any).

2.3.2 General

The electric fire pump shall be suitable for automatic operation complete with necessary electric motor and automatic starting gear, suitable for operation on 415 volts, 3 phase, 50 Hz. A/C system. Both the motor and the pump shall be assembled on a common baseplate.

2.3.3. Drive

The pump shall be only direct driven by means of a flexible coupling. Coupling guard shall also be provided.

2.3.4 Fire Pumps

a) The fire pump shall be horizontal split casing centrifugal type. It shall have a capacity to deliver 2850 LPM as specified in the Bill of quantities, developing adequate head so as to ensure a minimum pressure of 3.5 Kg per sq.cm at the highest and the farthest outlet.

b) The pump shall be capable of giving a discharge of not less than 150 percent of the rated discharge, at a head of not less than 65 percent of the rated head. The shut off head shall be within 120 percent of rate head.

c) The pump casing shall be of cast iron to grade FG 200 to IS:210 and parts like impeller, shaft sleeve, wearing ring etc., shall be of non-corrosive metal like bronze/stainless steel. The shaft shall be of stainless steel.

d) Bearing of the pump shall be effectively sealed to prevent loss of lubricant or entry of dust or water.

e) The pump shall be provided with a plate indicating the suction lift delivery head, discharge speed and number of stages. The pump casing shall be designed to withstand 1.5 times the working pressure.

2.3.5 Motor

The motor shall be squirrel cage A/C induction type suitable for operation on 415 volts 3 phase 50 Hz system. The motor shall be totally enclosed fan cooled type conforming to protection clause IP 55 vide I.S. 4691. The class of insulation shall be F. The motor

shall be rated for continuous duty as per relevant IS and shall have a horsepower rating necessary to drive the pump at 150 percent of its rated discharge.

2.3.6 **Motor Starter**

a) The motor starter shall be automatic Star Delta type (VFD /Soft starter also acceptable) conforming to IS:1822-1967. The starter shall not incorporate under voltage or overload trip or single-phase preventer. The starter assembly shall be suitably integrated in the power control panel for the wet riser system.

b) Each pump shall be provided with vibration isolating pads and cement concrete foundations of appropriate size and other accessories as detailed in the BOQ line item.

2.4 DIESEL FIRE PUMP

1. **Scope**

This section covers the details or requirements of the fire pump operated by a diesel engine.

2. **General**

The diesel pump set shall be suitable for automatic operation complete with necessary automatic starting gear, for starting on wet battery system and shall be complete with all accessories. Both engine and pump shall be assembled on a common baseplate.

3. **Drive**

The pump shall be only direct driven by means of a flexible coupling. Coupling guard shall also be provided. The speed shall be 1500 or 1800 RPM.

4. **Fire Pump**

a) The fire pump shall be horizontal split casing centrifugal type. It shall have the capacity to deliver 2850 LPM while developing adequate head so as to ensure a minimum pressure of 3.5 kg. Per sq.cm. at the highest and the farthest outlet. The pump shall be capable of giving a discharge of not less than 150% of the rated discharge at a head of not less than 65% of the rated head. The shut off head shall be within 120% of the rated head. The shaft shall be of stainless steel. The pump shall be provided with mechanical seal. The pump casing shall be designed to withstand 1.5 times the working pressure.

b) Bearings of pump shall be effectively sealed to prevent loss of lubricant or entry of dust or water.

5. **Diesel Engine**

a) Engine Rating:-

1. 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.

2. 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 base plate. 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

1. 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.

2. The engine fuel tank shall be welded steel construction (3mm thick) and of capacity sufficient to make the engine to run on full load for at least 8 hours (min 300 liters). 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.

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

1. 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. 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.

2. The capacity of the battery shall be suitable for meeting the needs of the starting system but not less than 180 AH.

3. The battery capacity shall be adequate for 10 consecutive starts without recharging with cold engine under full compression.

4. 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/heavy class GI pipe.

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

1. 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

2. The instrument panel shall be suitably mounted on 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 G.I/MS.

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

1. 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.

2. The battery charging equipment (transformer rectifier unit) shall be provided to charge the batteries required for diesel engine starting and it shall be inter connected to the MCC/panel board. The battery charging equipment shall be part of the diesel engine control panel. The battery shall 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. A 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' and 'boost-charge' shall also be provided on panel. Voltmeter with protective HRC fuses and Ammeter shall be mounted on the charging panel. The battery cells and charging equipment will be housed in separate units. The battery shall be in accordance with IS 1652 'Specifications for Stationary cells and batteries lead acid type'. Batteries shall be of lead acid stationary type, indoor, comprising enough number of cells for the required output of 12 V. The battery shall be complete with inter-cell connectors, acid level indicating floats, filter vent plugs, etc. The battery ampere-hour rating shall suit the required duty but not less than 180 AH. The discharge rate shall take into account the maximum load imposed during starting of engine, together with steady load.

3. The following accessories and tools required for battery and shall be supplied by the Contractor:

i) Hydrometer, syringe type, suitable for testing specific gravity of the electrolyte.
ii) Thermometer, with specific gravity correction scale.

iii) Acid level indicator.
iv) Center zero 3-0-3 voltmeters.
v) Any other accessories considered necessary/desirable

2.5 POWER AND CONTROL PANEL AND OTHER CONTROL COMPONENTS

1. **Scope**

This section covers the detailed requirements of the power and the control panel for the wet riser system, and also for the various control components in the system. Complete details specified as in the electrical specifications section of this document to be followed for electrical components in Fire protection system also.

2. **Power and Control Panel**

A. Constructional Requirements

a. General Features

The power and control panel shall be totally enclosed, free standing floor mounted cubicle type, fabricated out of sheet steel not less than 2mm thick. Wherever necessary, additional stiffening shall be provided by angle iron framework. General construction shall be of compartmentalization and sectionalisation such as main income**r**s, main fire pump, diesel fire pump, pressurization pump, and control, so that there is no mix up of power and control wiring and connections in the same sections as far as possible. The panel shall also have the space for cable allays. The space for cable alleys shall be at least 300mm wide to the entire depth of panel. The panel shall be front operated type with all connections accessible from the front. Front doors shall be hinged type. Back doors shall be hinged type or removable type for inspection. The door hinges shall be of concealed type. The doors for busbar chamber shall be of removable type with the help of bolts. The doors shall be provided with quick fixing doors knobs with indication. The general arrangement of the panel shall be got approved before fabrication the cubicle construction shall be to IP 42 as per IS:2147. The battery charger and all its components should be housed inside the main pump panel.

b. All cable entries shall be through gland plates which are removable and sectionalized. Where heavy cables are brought in and terminated, suitable clamps shall be incorporated to relieve the stress on the glands due to the weight of the cable. Cable entries may be from top.

c. The busbars shall be air insulated, and of aluminium of high conductivity electrolytic quality (grade E 91 E to IS: 5082) and of adequate cross section. Current density shall not exceed 0.8 amps. Per sq.mm. All connections to individual circuits from the busbars shall preferably be with solid connections. The busbars and the connections shall be suitable covered with PVC sleeves or in an approved manner. Busbars shall be suitably supported using non-hygroscopic insulated supports. High tensile bolts and spring washers shall be provided at busbar joints.

d. Cu strip 25mm x 6mm shall be run at the rear of the board. 2 nos. earth terminals shall be provided at the ends of the GI strip for connection to earth system.

e. Terminal blocks shall be of heavy duty type and generally not less than 15 amps 250V grade upto 110V, and 600V grade for the rest of the functions. They shall be easily accessible for maintenance. All control wiring inside the panel shall be with HFFR type copper conductor of 2.5 sq.mm. size and 600V grade conforming to IS:694-1977. Suitable colour-coding may be adopted. Wiring harness shall be neatly formed and run preferably function wise, and as far as possible segregated voltage wise. Identification ferrules shall be used at both ends of the wires.

f. All LED indication lamps and instruments (digital) shall be flush mounted type in front of the panel. The voltmeter and ammeter shall be of size 100mm nominal (dial size) conforming to clause 1.5 of IS 1248 for accuracy.

g. Current transformers shall be provided with ammeters.

h. Indicating lamps to indicate the availability of electric supply shall be provided at the incoming section. Necessary indicating lamps for alarm indications and battery charging shall be provided in the respective sections.

i. All indicating lamps and meter shall be protected with 4A, C curve type MCB.

j. All internal components shall be provided with suitable identification labels. Suitably engraved labels shall be fixed at the panel for all switches, instrument push buttons, indicating lamps etc.

k. The entire panel shall be given a primer coat of red lead after degreasing and phosphating treatment and 2 coat of final paint of approved shade before assembly of various items.

l. The power and control panel shall comprises individual section for the various equipment's of the system and controls, in a combined cubicle type design. All switches, MCCBS, MCBS and fuse/fuse switch units shall be conforming to relevant IS.

m. Control Wiring from Pressure Switches of different settings in Hydrant and Jockey Pumps, for sequence of operation shall be included to complete the system.

n. Colour code with ferrule marking shall also be made.

o. The cabling shall be XLPE insulated PVC sheathed and aluminium conductor cable of 1100 volts grade conforming to IS as required from Fire Pump Board to motor and cable of suitable size as per BOQ.

p. Electric Fire pump section shall incorporate the following facilities.

(a) Suitable capacity SDFU/MCCB isolator as detailed in the BOQ.

(b) Control system components and equipment such as relays, contractors, timers etc. for automatic operation.
(c) Starter Unit, Current Transformer and digital ammeter.
(d) Terminal block, push buttons, control and selector switches etc. are as required.
(e) Pump lock out devices due to faults or abnormalities as specified in operating sequence.
(f) Visual/audio alarms, indications and communications facility. A remote alarm shall be provided in the operator room. Necessary control & power cabling for the same shall be included in the scope.
(g) Necessary inter-connection and control wiring etc.

q. Engine section shall incorporate the following facilities.

(a) Control system components and equipment such as relays, contractors, timers etc. for automatic operation.
(b) Instruments, indicator lamps, fuses terminal blocks, push buttons, control and selector switches etc. as are required.
(c) Engine shut down and block out devices due to faults or abnormalities as specified.
(d) Visual/audio alarms and indications as specified.
(e) Inter-connection and control wiring, 1.5Sq mm copper armoured cable wiring from DG to fire panel etc.

r. Auxiliary pump section for jockey pump shall incorporate the following facilities.

(a) Control system components and equipment such as relays, contractors, timers etc. for automatic operation.
(b) TP&N SDFU/ MCCB isolator as detailed in the BOQ.
(c) Control system components such as relays, timers, contractors, etc. as are necessary for functional requirements.
(d) Starter unit, current transformer and ammeter.
(e) Indication lamps, fuses, terminal blocks, push buttons selector, switch etc. as required.
(f) Inter-connections and control wirings etc.

s. Control section shall incorporate the following facilities.

(a) Control components integrating the various sections, so as to satisfy the functional requirements.
(b) Battery charger unit with boost/float charge facility with voltmeter, capable of independently charging 2 sets of batteries at a time.
(c) Visual/audio alarms, not covered in individual sections.
(d) Lamps healthy test facility.
(e) Instruments, indicating lamps, push buttons, fuse terminal blocks etc. as are required.
(f) Test facility to simulate operation of hydrants.

t. Pressure switches shall be provided for switching on and off the pressurization pump at preset pressures and also for switching on the fire Pump at preset pressure. Being the main component for initiating the signal for the operation of the pumps, the pressure settings shall be totally reliable, sturdy in construction and of long life. The pressure

settings shall be adjustable. 1.5 sq mm Copper Armoured cable shall be used for taking control wiring from pressure switches to fire pump panel.

u. In order to ensure that the control systems remains co-operational at all times the control system shall be designed for 24 VDC operation fed from the battery.

2.6 ELECTRICAL WORK AND EARTHING

1. **Scope**

a) This section covers the detailed requirements of electrical works including earthing, for the materials installation.

b) Electric power supply shall be terminated in the incoming switch gear of the power and control panel by the Electrical Contractor. All further connections to the various components of the system shall be the responsibility of the contractor, for a complete and working system, satisfying all the functional requirements.

c) The scope shall particularly include the following:

i) Power and Control Panel(s) as given in relevant section.
ii) All inter-connections with multi-core armoured copper cables of size suitable between various control units and control panel(s).
iii) All power cable connections with multi-core armoured aluminum cables of size as specified in BOQ, between panels, motors etc.
iv) Necessary earthing shall be provided as per State Electrical Inspectorate guidelines.

All the electrical works in the firefighting system shall be carried out conforming to CPWD General Specifications for electrical works part-I (Internal) amended up to date and part-II (External) amended upto date.

2.7 AUXILIARY PUMPING EQUIPMENT

2.7.1 Jockey Pump

1. **Scope**

This section covers the details of requirements of the auxiliary equipment necessary for the operation of the fire pumps and the wet-riser system.

2. **Drive**

The pump shall be directly driven from the electric motor. Flexible coupling and coupling guard shall be provided.

3. **Capacity**

a) The discharge and head of the jockey pump shall be as mentioned in Bill of Quantities.

b) Jockey pump shall be vertical inline pump. The pump casing shall be of cast iron and parts like impeller, sleeve, wearing ring etc. shall be of non-corrosive metal like bronze or stainless steel. The shaft shall be of stainless steel.

c) Bearings of the pump shall be effectively sealed to prevent loss of lubricant or entry of the dust or water. The pump casing shall be designed to withstand 1.5 times the working pressure.

4. **Motor**

The motor shall be squirrel cage A/C induction type suitable for operation on 415 volts 3 phase 50 Hz system. The motor shall be totally enclosed fan cooled type conforming to protection clause IP 55 vide I.S. 4691. The class of insulation shall be F. The motor shall conform IS 325-1978 and rated for continuous duty.

5. **Motor Starter**

The motor starter shall be automatic star delta type with overload trip, but without under voltage/no volt trip. Starter shall conform to IS 1822-1967.

2.7.2 Terrace/Booster Pump

a) Pump shall be direct-coupled and not belt-driven. Parts of pumps like impeller, shaft sleeve, wearing sleeves, etc. shall be of non-corrosive metal such as SS or bronze.

b) The discharge and head of the terrace pump shall be as mentioned in Bill of Quantities.

c) The pump shall be provided with a pressure gauge on the delivery side between the pump and the non-return valve, and all the items as mentioned in Bill of Quantities. Also a name plate showing the delivery head, capacity and the rpm should be fixed over pump. Pump shall be securely mounted on a robust bedplate of horizontal type, and shall be free from vibration at all varying loads. The pump shall be connected to the Fire riser/downcomer line of the building.

d) The starting of terrace pump should' be automatic with pressure switch incorporated in down-comer side so that with opening of any hydrant valve or hose reel, it will start automatically with fall in line pressure. In addition, there should be a manual push button starter in the starter control panel to be located on ground floor of building. Stopping of pump should be by a push button located in the same starter control. Both the push buttons should be prominently indicated, and should be in different color for easy identification.

e) Cost of power & control cabling for the operation as detailed above shall be included and is in the fire contractor's scope only.

2.8 SPRINKLER & HYDRANT SYSTEM- PIPING & OTHER COMPONENTS

1) GI Pipes

Only GI pipes, heavy duty type shall be used in sprinkler & hydrant system. The GI pipes used shall be of standard IS 1239, heavy-duty type (Class C), electric resistance welded and shall be free from scale, cracks, surface flaws and other defects. For pipes 200 mm dia. and above, IS 3589 Class '2' shall be applicable.

2) Exposed/Above ground (AG) pipes

a) Exposed/Above ground (AG) pipelines and fittings shall be coated with one coat of suitable primer and two or more coats of synthetic enamel paint as per IS approved colour 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.

b) All pipes shall be adequately supported from ceiling or walls by structural clamps fabricated from M.S. structural e.g. rods, channels, angles and flats. In addition to that, angle supports shall be provided from beams for the pipes. All clamps shall be painted with one coat of primer and two coats of black enamel paint. The contractor shall provide inserts at the time of slab casting or provide suitable anchor fasteners.

c) The pipe supports or hangers shall be designed to withstand combined weight of pipe, pipes fittings, fluid in pipe and insulation. Pipe supports shall be of steel fully galvanized and coated with rust preventing paint and finished with two coats black enamel paint. The maximum spacing for pipes supports shall be as below:

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

d) Pipes supports shall be spaced at maximum interval of 1.5 mtrs. on either side of heavy fitting and valves. Wherever piping passes through walls, pipes sleeves of diameter larger than that of piping at least by 50 mm shall be provided and annular spaces shall be filled with felt and finished with retaining rings. Pipe sleeves shall be of steel or cast iron pipe.

e) The installation work shall be carried out in accordance with the detailed drawings prepared by the contractor and approved by the Engineer-In-Charge.

f) In Pipe above Ground level expansion loops or joints shall be provided to take care of expansion / contraction of pipes. Tee of connections shall be through equal and reducing tees, otherwise ferrules welded to the main pipe shall be used. Drilling and Tapping of the walls of the main pipe shall not be resort to.

g) Open end of piping shall be blocked as soon as the pipe is installed to avoid the entrance of foreign matter.

h) Pipe supports in Pump house shall be floor mounted and of Mild steel / G.I. Spacing of pipe support shall not be more than that specified above.

i) Extra support shall be provided at the bends and heavy fittings like valves to avoid undue stress on the pipes.

j) Anti-vibration pads, springs and Liners of resilient and non-deteriorating material shall be provided at each support so as to prevent transmission of vibration through the supports.

k) Vertical riser shall be parallel to walls in column lines and shall be straight and in Plumb. Riser passing from floor to floor shall be supported at each floor using standard supports as detailed in the typical details drawings and approved by the engineer-in-charge.

l) The space in the floor cutouts around the pipe works shall be closed using cement concrete 1:2:4 or steel sheet from the fire safety considerations, taking care to see that a small annular space is left around the pipes to prevent transmission of vibration to the strcuture.

3) <u>Underground (UG) pipes</u>

a) Underground pipes shall be laid such that the top of the pipe is not less than 1 m below the ground level. Pipes shall be supported by PCC blocks (1:2:4) of size 250 mm x 250 mm x 200 mm at intervals of 3.5 m in trenches. The bends and joints shall also be supported at both sides. Mains shall not be laid under buildings. Air release valves shall be provided in the hydrant lines at suitable intervals. Yard hydrants shall preferable be located at a minimum distance of 2 m. but not more than 15 m from the building face. The yard hydrants shall be accessible and should normally be provided near boundary wall/along road. While locating yard hydrants it should be ensured that same do not become hindrance in vehicular movement or entrance to the building.

b) Corrosion protection tape shall be wrapped on pipes to be buried in ground. This corrosion protection tape shall comprise of coal tar/asphalt component supported on fabric of organic or inorganic fibre and minimum 4 mm. thick and conform to requirement of IS:10221-Code of practice for coating and wrapping of underground steel pipe line. Before application of corrosion protection tape all foreign matter on pipe shall be removed with the help of wire brush and suitable primer shall be applied over the pipe thereafter. The primer shall be allowed to dry until the solvent evaporates and the surface becomes tacky. Both primer and tape shall be furnished by the same manufacturer. Corrosion protection tape shall then be wound around the pipe in spiral fashion and bounded completely to the pipe. There shall be no air pocket or bubble beneath the tape. The overlaps shall

be 15 mm. and 250 mm. shall be left uncoated on either end of pipe to permit installation and welding. This area shall be coated insitu after the pipe line is installed. The tapes shall be wrapped in accordance with the manufacturer's recommendations. If application is done in cold weather, the surface of the pipe shall be pre- heated until it is warm to touch and traces of moisture are removed and then primer shall be applied and allowed to dry.

c) For laying of external pipes, excavation up to a depth of 1.25 m or more is to be carried out. This may cause hindrance in execution of other building works. External pipes shall therefore be laid in a phased manner in coordination with other agencies. The pipes shall be tested and earth filled back before excavation for next phase is taken up. Equipment for testing etc should be available in advance before start of underground pipe laying work.

d) To facilitate detection of leak and isolation of defective portion of pipe, valves shall be provided in underground pipe at suitable locations. As far as possible such valves shall be provided over ground. If the valves shall are to be provided below ground, suitable masonry chamber with cover plate shall be provided. Locations where vehicles can pass shall be avoided for provision of valves below ground.

e) Suitable identification shall be provided to indicate the run of underground wherever the route of underground pipe cannot be ascertained from the location of yard hydrant / isolating valves.

4) Fittings

Pipe fittings like bends/elbows, tees, reducers etc. shall be of GI conforming to IS-1239(Part-II). All fittings shall be able to withstand at least a pressure of 150 % of the maximum working pressure.Joints for pipes and fittings upto 50mm diameter shall be threaded joints using Teflon Tape or equivalent bonding tape on the threads. Joints for pipe and fittings above 50mm diameter shall be welded joints. Fittings shall be used wherever tapping from the main/ distribution/ branch/ range pipe is taken. Holes shall not be cut in pipe for taking branches and connections All the fittings shall be of reputed make preferably IS approved.

5) 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.

6) Welding procedure

The welding procedure shall only be carried out by fully trained and experienced welders and shall conform to IS-823 and PURCHASER 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.

7) Hydrant valves

a) The external/internal fire hydrant valves 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, orifice plate, other fittings, etc. The hydrant couplings shall be flanged gunmetal with instantaneous female spring lock of 63 mm dia. and valves shall be of screw down type.

b) Orifice plates of suitable design shall be provided for hydrants where pressure exceeds 7 Kg per Sq. cm. The contractor shall submit the pressure calculation based on the pump head and pressure drop due to frictional losses and the selection of orifice plate shall be done based on this calculation.

c) The number of fire hydrants in a terminal 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. All hydrant outlets shall be situated 1 m above ground level.

8) Hose reel

The hose reel shall consist of 30 m long 20 mm dia. Thermoplastic (Textile reinforced) Type-2 water hose as per IS: 12585 mounted on heavy duty circular MS drum complete with gun-metal shut-off valve, nozzle, etc. The hose reel bracket shall be of GI fabricated or cast iron swing type suitable for 90 deg. smooth and free rotation in vertical plane conforming to IS-884.

9) Hose boxes

The fire hose boxes shall be of size 900/750x250x600 mm, made out of 16 SWG MS sheet of minimum 2mm thickness front side glass of 6 mm thick, lockable hinged door and painted with one coat of primer and two coats of synthetic enamel paint of approved colour. All external hydrants hose box shall be openable with one key and all internal hydrant also with one key. The lock shall be uniform type for external type boxes and internal type boxes.

10) Couplings

All couplings shall be of the instantaneous spring-lock. All couplings in the branch pipes and nozzles shall be of gunmetal and shall comply with IS-903. The hose shall be attached to the coupling.

11) Fire brigade outlets/ Inlets

The fire brigade collective breaching shall be with 150 mm flange outlet connection with gunmetal 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.

Fire Service connection- In case underground storage tank is not approachable by fire tenders, a 4 way 63 mm diameter instantaneous male inlet connection is provided at street level and connected to UG tank with 150 mm diameter underground pipe.

12) Delivery Hose

Delivery Hose for firefighting shall be of 63mm dia, 15mtr. long RRL hose pipe with 63mm dia Male and Female Gun metal couplings duly binded with MS wire, rivets etc. conforming to IS 636 (type-A)

13) Non Return Valve (NRV)

Dual plate Cast Iron/ Cast Steel Non return valve of conforming to API 594 complete with rubber gaskets, MS bolts, nuts, workers etc. and water end construction. Pressure class shall be of PN 16/PN 20 for water purpose.

14) 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.

15) Pressure switches

It shall be of industrial type, single pole, double throw electric pressure switching designed for starting or stopping equipment within 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. The pressure switch shall have a rating of 4-20 kg/cm2 with 0.8 to 3 kg. Differential pressure setting. Maximum working pressure shall be 28 kg/cm2 with auto reset.

16) Strainer.

Strainer: Y-strainer shall have CI body, 3 mm perforated SS screen, flanged end connection. Shall be as per relevant IS standard (& ISI Marked if applicable).

17) Butterfly Valves

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 Bronze/Gunmetal/EPDM/Nitrile rubber seat liner duly ISI marked completed with nuts, bolts, washers, gaskets conforming to IS 13095. The PN rating shall be of 16/20.The valve shall be hand lever operated.

18) Ball Valve

The ball valve shall be made forged brass and suitable for test pressure of pipe line. The valve shall be internally threaded to receive pipe connections. The ball shall be made from brass and machined to perfect round shape and subsequently chrome plated. The seat of the valve body-bonnet gasket and gland packing shall be of Teflon. The handle shall be provided with PVC jacket. The handle shall also indicate the direction of 'open' and 'closed' situations. The gap between the ball and the Teflon packing shall be sealed to prevent water seeping. The handle shall also be provided with a lug to keep the movement of the ball valve within 90°. The lever shall be operated smoothly and without application of any unnecessary force.

19) HDPE Tank

HDPE Storage tank (Priming Tank)
The tank shall be manufactured from virgin HDPE. The tank shall be provided with adequate stiffeners. The tank shall be capable of withstanding all weather conditions. The tank shall be of seamless one piece construction. The tank shall be complete with inlet, outlet & drain nozzles.

20) Air Release Valve

The air release valve shall be designed to automatically remove air pockets at the high points. The valve shall be a normally open valve and will slowly release air through the top orifice. As fluid enters the valve, the float will rise, closing the orifice. As air accumulates in the piping system and enters the valve the float drops allowing the venting orifice to open. The working pressure shall be 15 kg/cm2. Shall conform to relevant IS standard.

21) Orifice Plate

Orifice plate shall be made of minimum 6 mm thick stainless steel with orifice of required size in between flange and landing valve to reduce pressure to working pressure of 7 kg/cm2. The item shall be complete with fixing arrangements etc.

SELECTION OF ORIFICE PLATE

Pressure Loss Kg/cm²	Diameter of Orifice Pipe Size	
	80 mm	100 mm
3.5	41.9	
3.0	43.0	
2.5	44.80	
2.0	46.40	
1.5	48.90	56.20

Pressure Loss Kg/cm²	Diameter of Orifice Pipe Size	
	80 mm	100 mm
1.0	52.30	57.60
0.9	53.20	59.00
0.8	54.10	60.40
0.7	55.30	62.00
0.6	56.60	63.90
0.5	58.20	66.50
0.4	59.80	69.70
0.3	62.00	74.20
0.2	65.00	81.10
0.1	—	82.20

22) <u>Sprinklers system</u>

a) The standard sprinkler system shall be designed for a discharge density of 5.00 lpm/Sq.m (ordinary hazard building) and Assumed Maximum Area of Operation (AMAO) is 360 Sq.m. ***Sprinkler system shall be as per NBC 2016, conforming to IS 15105 and in accordance with CPWD specifications.***

b) The minimum sprinkler discharge pressure for standard sprinkler shall be 1 bar (or as per manufacturers standard). 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.

c) Types of sprinklers to be used shall be as given in specifications, BOQ and approved by the Engineer-in-charge. It shall be of Quartzoid Bulb suitable for installation indoor as well as outdoor.

d) Sprinkler heads shall be provided at appropriate spacing to cover max 12 sqmtr. per sprinkler head or as per specific requirements to meet the approval of the authority having jurisdiction. The spacing shall also be in conformity with the drawings and properly coordinated with Electrical Fixtures, Ventilation Ducts and Grills and other services along the ceiling.

e) Only UL listed sprinklers to be used. Standard pendant type (K- 5.6) sprinklers are considered for the rooms and passages (to protect areas below false ceiling) in the building and standard upright sprinklers (K-5.6) are proposed in areas where false ceiling voids

exceeding 800 mm depth. In double height areas, quick response extended coverage sprinkler of K-11.2 is proposed.

f) **Arrangement of sprinklers**

I. Sprinklers shall be installed with the deflector parallel to the floor (for upright). Sprinklers shall be not spaced at less than 2 m. The distance between the boundary and sprinklers when measured along the range pipe shall not be more than 0.5 times the spacing between the sprinklers and range pipes. As far as possible, sprinklers shall be located away from the columns. Sprinklers shall not be connected directly to distribution and main pipes. **Sprinkler spacing and coverage shall conform to NBC 2016 norms, IS 15105 or as per NFPA 13 guidelines.**

II. Sprinklers need not be provided in the following areas of the building:

1). Stairs, spaces below stair headings.
2). Toilets.
3). Rooms containing electric power distribution apparatus.
4). Control rooms.

III. Number of standard 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.

IV. Number of standard 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.

V. **For Extended coverage sprinklers and sidewall sprinklers, IS 15105 and NFPA 13 shall be followed for spacing, coverage and other details.**

VI. For fixing sprinkler heads, 15 mm dia GI Socket is to be welded to range pipes at the locations as per drawings. Dead plug shall be fixed in the socket.

VII. If sprinkler head is to be provided away from range pipe, GI pipe nipple of suitable size be used to extend the sprinkler head and socket is welded at desired locations.

VIII. Joints for Sprinkler pipes: Fittings up to 50mm diameter shall be threaded joints using Teflon Tape or equivalent bonding tape on the threads. Joints for pipe and fittings above 50mm diameter shall be welded joints.

IX. After completion of work in sections, pressure rating of entire pipe work shall be carried out for 24 hours.

X. After completion of entire work, pressure rating of entire pipe work shall be carried out for 24 Hours. The drop of pressure up to 0.5 kg/cm2 shall be accepted.

XI. The lines shall be flushed before completion of building work so that any foreign matter which might have entered the system is taken out. The pressurization pump (Jockey pump) be operated and valve open at different locations.

XII. During occupation of the building, sprinkler heads shall be provided in place of dead plugs. Teflon tape shall be used on threaded portion. The sprinkler heads shall be properly tightened in the socket.

XIII. When all sprinklers heads are installed, pressure is built up in the system by pressurization pump slowly and in case no leak is found, desired pressure is developed and maintained. In case any leak is detected, the same shall be attended before pressurizing the system further.

23) <u>Alarm valve</u>

UL listed Alarm valves shall be fitted on the main supply pipe immediately above the main control valve leading to the sprinkler installations. The alarm valve & water motor gong valve is to be provided on all the Sprinkler main delivery pipes or Installation Control Valves (ICV) as per approval of authority having jurisdiction. It shall be vertically mounted and the direction of water travel shall be indicated on the surface. Head loss in the alarm valve to be restricted to 9 m. The alarm valve shall have the following accessories:

Main Stop Valve	-	1 No. shall be fitted immediately downstream of the alarm valve and shall be at fire brigade access level.
Test Valve	-	1 No. shall be provided to test the hydraulic alarm or any electric alarm pressure switch if provided by drawing water from the downstream side of a wet alarm valve. It shall be installed close to the alarm valve.
Drain valve immediately	-	1 No. shall be fitted to allow drainage from downstream of the alarm valve.
Water motor alarm	–	1 No. shall be fitted as close as possible to the alarm valve. It shall be installed with its gong on the outside of an exterior wall. A strainer readily accessible for cleaning shall be fitted between the motor nozzle and alarm valve connection. The water outlet shall be positioned so that any flow of water can be seen. The pipe work to the water motor shall be galvanized. Any device to reduce

		the frequency of false or intermittent alarms fitted to the installation shall be suitable for sprinkler service.
Pressure gauge	-	1No. Shall be fitted immediately downstream of the alarm valve. Pressure gauges fitted shall comply with relevant IS standards. The scale sub-division shall not exceed 0.2 bar for a maximum scale value upto and including 10 bar.

24) <u>Flow Switch</u>

The flow switch shall be with SPDT contacts, with fixing accessories suitable for nominal pipe dia meters ranging from 1" to 6". The body of the flow switch shall be water proof with IP55 class protection. There shall be inbuilt settings to adjust the flow rate and alarm retard time. While installing a minimum clearance of 5 pipe dia meters should be ensured from the nearest elbow, valve or other pipe restrictions. The flow switch should have minimum withstand pressure of 15Kg/cm2 and operating pressure ranging from 1 kg/cm2 to 17 Kg/cm2.

Electrically operated alarm shall be provided for indication of operation of sprinkler in an area. Water flow switches shall be installed in main distribution pipes which shall be wired to sprinkler annunciation panel. In the event of operation of a sprinkler, the flow switch will operate and give signal to the annunciation panel to indicate operation of sprinkler in the area. This will initiate an electrically operated alarm. The system shall be independent of fire alarm system.

2.9 INSPECTION AND TESTING (HYDRANT & SPRINKLER SYSTEM)

1. <u>Inspection – General</u>

a) 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 PURCHASER. The Contractor shall ensure that each stage of fabrication is carried out in compliance with the procedures specified in the IS / NBC/CPWD standards as applicable and/or specified in this document.

b) The contractor shall conduct sample tests of all the materials supplied at reputed laboratories/agencies as directed by PURCHASER at his own cost and test reports are to be submitted. Inspecting officials of PURCHASER 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, consumables including power & water or procedures for conducting the inspections by the authorities as required by them shall be arranged by the contractor free of cost.

c) All testing shall be carried out in the presence of PURCHASER / statutory authorities and test registers shall be maintained by the contractor. The contractor shall provide all material including water and electricity, tools, equipment, instruments, services and

personnel required to perform the tests and remove debris/water resulting from cleaning and after testing free of cost

d) The original test certificates of all tests conducted are to be forwarded to PURCHASER. 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

Testing of the entire system shall be in accordance with NBC 2016 standards and CPWD Specifications. Before energizing 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

i) The pumps shall be tested according to the standard recommendations of the manufacturer and as per the relevant IS codes. The following parameters are to be recorded and plotted and submitted to the PURCHASER.

a. Discharge Q
b. Pressure P or Head H
c. Motor voltage and current.
d. Efficiency

ii) The power consumption is to be computed and crosschecked with manufacturer's 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 PURCHASER for verification.

iii) Flow Test: - The design flow of pumps shall be checked. The pump shall be operated after opening a number of landing valves at different locations. Design pressure is to be maintained in the pump house. Water discharge is to be measured by drop in level in UG tank for a certain period or using flow meters. All pumps shall be tested one by one. The flow rate shall be not less than as specified while maintaining the design pressure in pump house.

b. Piping

i) 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 (but not less than 10 kg./sq.cm.) and see that the pressure drop is within 0.5 Kg per Sq. cm over a period of 24 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. All leaks and defects in joints revealed during the testing

shall be rectified to the satisfaction of the Engineer-in-Charge. Piping repaired subsequent to the above pressure test shall be re-tested in the same manner. System may be tested in sections and such sections shall be securely capped. Pressure gauges may be capped off during pressure testing of the installation.

ii) At least 10% of the total weld joints on pipes shall be tested by radiography.

c. Electrical system

I. The following tests are recommended:-

i) Earth resistance
ii) Cable Insulation

II. Trial run and testing of diesel engine.

III. Resistance of metal conduits/sheaths (Earth continuity test)

IV. Insulation of the cables shall be not less than one mega ohm when tested with a 500 volts meggar for any particular section of the wiring.

V. 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 Mega Ohms.

d. Hydrant system

The entire hydrant system shall be tested in the presence of PURCHASER/ Consultant to ascertain the functioning of each system, equipment, etc. as desired by PURCHASER/consultant. The contractor shall hand over the system only if it is proved that the system performs as per the specifications. Testing shall conform to IS 3844, IS 13039, CPWD and NBC 2016 standards.

e. Sprinklers

It shall be factory tested for operation characteristics and chemical tests. Necessary test results shall be submitted before supply. The contractor shall establish the discharge of the sprinkler during the testing at site. System testing shall conform to IS 15105, CPWD and NBC 2016 standards.

f. Sprinkler alarm valve

i) The pump shall start automatically and maintain pressure at the appropriate flow rate. The drain valve fitted above the alarm valve shall be opened and the time taken for the alarm gong to operate be noted. There shall not be a significant variation in the timing. The pressure at the "C" gauge of the alarm valve shall be noted at the full load condition of the pump and the value should match with that of the specification. The proper functions of the alarm gong associated with the alarm valve and its level of audibility shall be checked. An audibility level of 85 db above the background noise level is required. Necessary testing equipment shall be arranged by the contractor free of cost.

ii) While conducting the tests, the water flowing through the test valve shall be equivalent to the flow through one sprinkler. It should auto start the pumps and activate the alarm motor and gong. When the test valve is closed, the water flowing through the test valve should stop.

g. Operation of pumps

i) All the pumps shall be operated by both auto /manual modes, and shall have automatic starting and stopping arrangements to maintain the system pressure. Pump operation shall be as per the CPWD norms and as specified here.

ii) The control system shall be designed to provide the following sequence of operation.

iii) The Pressurisation Pump shall maintain pressure in the system and shall operate only on account of slow pressure loss. In case of sudden pressure loss the Pressurisation Pump shall not operate. Jockey pump shall not be in operation while the main pump is in operation. Under normal conditions, the auto/manual switch shall be in the auto mode. When the pressure drop by about 1 kg/sq.cm below the normal system pressure, the jockey pump shall start automatically through pressure switches arrangements and when pressure develops to the normal system pressure, the pump shall stop automatically. Both limits shall be adjustable. The jockey and main pumps shall not be in operation simultaneously.

iv) Main Fire Pump shall operate on account of even further pressure loss. So long as Main Fire Pump is working, other Fire Pumps will not operate. The pump shall start when the water pressure falls to a pre-set value in the system (drop of about 3 kg./cm2 from normal system pressure).

v) In the event of failure of main fire pump, the standby fire pump shall start operation automatically. The main pump shall then be locked out. The standby pump shall start when the water pressure falls to a pre-set value in the system (drop of about 5 kg./cm2 from normal system pressure).

vi) The pressure settings, which shall be adjustable, would be as under assuming the working pressure for Hydrant and Sprinkler system as 'p' and 'q' in kg/sq.cm respectively. (Operation explained in the table below:)

Pump Status	Hydrant System	Sprinkler System
Operating Pressure	p	q
Jockey Pump Starts (Automatic)	p-1	q-1
Jockey Pump Stop (Automatic)	p	q
Main Pump Starts (Automatic)	p-3	q-3
Standby Pumps Starts (Automatic)	p-5	q-5
Main & Standby	Manual	Manual

Pump Stops (Manual)		

vii) If within a preset period the standby pump fails to start or fails to develop adequate pressure, the control system shall shut down the standby pump and lock it out and given an audiovisual indication to that effect at the control panel. Suitable interlocking of pumps shall be provided to prevent simultaneous operation of pumps.

viii) The control panel shall have status selection for each of the pumps for "automatic" as well as "manual" operation.

ix) Pumps when under "manual" status shall be operated manually through relevant push buttons.

x) The fire pumps once started shall not be stopped automatically except for the jockey pump.

xi) The fire pumps shall be locked out for operation both for "manual" and "automatic" operations, once the low water controls operates and furnish an audio and visual alarm on the panel the audio alarm can be silenced by accepting the alarm. The visual alarm shall be individual for each equipment. It shall be flashing type and on acceptance remain steady. A reset button shall be provided for each pump for returning the pump for fire duty.

xii) Over load or under voltage/no volt trip devices for main fire pump shall not be provided in the starter. LED type indication lamps to indicate the availability of power shall be provided.

xiii) Once tripped the main fire pump shall remain locked out for operation irrespective of the position of its operational status selection switch. Look out indication shall be available on the panel.

xiv) Return to normal operational availability shall be feasible only by manual re-set of locked out units by operation of appropriate push buttons.

xv) When fire pumps are brought into operation an audible tone from turbine type alarm operated by water flow in the mains shall be provided to indicate the healthiness of the system. The healthy running alarm shall not be silenced till the fire pump is shut down, but the tone may be mellowed by the operation, if required.

xvi) Alarm for failure and lock out of any pump shall distinct from "healthy" alarm. Failure alarms shall be loud and can be silenced on acceptance.

xvii) Repeat indication of various audio and visual indications on a slave remote panel in fire control room in building shall be available. The slave Remote panel shall have indication lamps to show the status of:

1) Power healthy in fire pump room.
2) Jockey pump 'ON'

3) Main pump 'ON'

xviii) The slave Remote panel shall also have a hooter, which shall sound in case, any pump is 'ON'. The slave Remote panel shall have a provision to reset the hooter with the help of a push button.

xix) The contractor shall carry out necessary arrangements for supply and installation of items required like timer switches, sensors, cables, etc. and control wiring between pressure switches and panels to operate the pumps as described above. The cost for the same shall be included in the total contract value.

3. APPROVAL FROM STATUTORY AUTHORITIES

a) **It is responsibility and included in the scope of the contractor to get initial and final approvals / NOC for systems like electrical, fire protection system, etc. from the concerned departments /local bodies. The contractor shall also do all the liaison works with the departments for getting the approvals/ NOC.** All the incidental expenses in connection with the above shall be borne by the contractor with no extra cost to the PURCHASER. For all approvals / NOC, statutory fees shall be paid by the contractor initially; however, it shall be reimbursed on submission of documentary evidences.

b) After completion of the work and testing to the entire satisfaction of Engineer-in Charge, the installation shall be offered for inspection by Chief Fire Officer or his representative. Testing as desired by the Fire Officer shall be carried out. The contractor will extend all help including manpower during testing. The observation of Chief Fire Officer which are a part of agreement shall by attended by the contractor. Nothing extra is to be paid for testing as above.

c) All testing/calibration, etc. are to be carried out as per the requirements of statutory authorities at no extra cost to PURCHASER. The tests/calibration certificates shall be submitted, if required.

d) On completion of work, the contractor has to obtain necessary safety / energization certificate (if required by the norms) from EI / local bodies by submitting necessary completion certificates, drawings, equipment details, load details, test results, etc. before energization.

4. MODE OF MEASUREMENTS.

a) Pipe

1. All pipes shall be measured in linear meter (to the nearest CM) along the axis of the pipes and rates shall be inclusive of all fittings e.g. Tees, bends, reducers, elbows etc. Deduction shall be made for valves in the line.

2. Rate of pipe shall include exposing reinforcement in wall and ceiling and floors if possible and making good the same or installing anchor fasteners and inclusive of all items as specified in specifications and schedule of quantities.

3. Rates quoted shall be inclusive of providing and fixing vibration pads and wooden pieces, wherever specified or required by PURCHASER.

4. Flexible connections, wherever required or specified shall be measured as part of straight length of same diameter, with no additional allowance being made for providing the same.

5. The length of the pipe for the purpose of payment will be taken through the centre line of the pipe and all fittings (e.g. Tees, bends, reducers, elbows, hangers, structural supports etc.) as through the fittings are also presumed to be pipe lengths. Nothing extra whatsoever will be paid for over and above for the fittings for valves and flanges. Rate quoted shall be inclusive of all supports, hangers etc. and no additional measurement would be taken.

b) Valves

1. All valves shall be measured according to the nominal size in MM and shall be measured by number. Such valves shall not be counted as part of pipe length hence deduction in pipe length will be made, wherever valves occur.

2. Valves shall include (Except for screwed ends) 2 Nos. of flanges Rate shall include the necessary number of bolts, nuts and washers, 3 MM thick insertion gasket of required temp. Grade and all items specified in the specifications.

3. The rates quoted shall be inclusive of making connections to the equipment, tanks, pumps etc. and the connection made with an installed pipe line shall be included in the rates as per the B.O.Q.

3. FIRE EXTINGUISHERS

The portable fire extinguishers shall be provided as per IS 2190 and NBC 2016 with references made to NFPA 10 wherever applicable. However, additional fire extinguishers shall be provided as per requirement of the local Fire Service authorities.

a) All Fire Extinguishers shall be as per the latest applicable IS codes. The extinguishers shall be manufactured and perform in conformance to relevant IS codes, mainly IS: 15683:2018.

b) All the extinguishers should be with B.I.S. markings and should be located at an easily accessible position without obstructing the normal passage and maintained periodically.

CO2 TYPE FIRE EXTINGUISHER

CO2 type fire extinguisher of 4.5 kgs assembled out of seamless steel cylinder (conforming to IS:7285 latest) having CCE approval and ISI mark complete with wheel type valve (conforming to IS: 3224 latest), high pressure wire braided discharge hose (minimum 1 meter length) with horn and carrying handle. The cylinder should be fully charged with CO2 Gas. All other components, design, performance, corrosive treatment should be as per IS: 15683 and IS: 16018 latest.

6 KG CAPACITY DCP EXTINGUISHER

The design, construction and testing of 6 kg DCP store pressure type extinguisher shall confirm to IS 15683 latest edition. The fire extinguisher shall be suitable for class A, B and C fires. The body of extinguisher shall be made up of seamless deep drawn MS shell. The cylinder hydraulically tested at 35 kg/cm2 and burst pressure shall be 55 kg/cm2. The bottom of the cylinder shall be welded to the seamless cylinder body confirming to IS 15683 requirements. The valve shall have the tapping for pressure gauge with NRV. The handle shall be of M.S., cold form, powder coated upper-lower lever for squeezing. The squeeze grip shall have the safety locking arrangement to avoid accidental operation. The safety pin shall be provided with seal. the valve shall also have the provision to mount the extinguisher on the wall bracket. Suitable wall bracket shall be provided along with extinguishers.

Discharge hose: PVC nylon braided rubber or EPDM rubber, burst pressure 50 kg/cm2. Provision shall be made for housing the discharge hose on extinguisher body.

Extinguishing media: extinguisher shall be filled with 50% BIS listed mono ammonium phosphate powder. Painting: shall be powder coated with fire red conforms to IS 2932, shade 536 of IS 5. Operating instruction shall be displayed on extinguisher body. Working and store pressure shall mention on the stickers. It shall have BIS certified permanently engraved ISI mark on body.

Performance test: Extinguisher shall meet all performance tests as per IS 15683(latest edition).

Test certificates shall be produced for client's approval.

Certificates: Vendor shall submit the following test reports and documents at the time of delivery.

• ISI certificate as per IS 15683(latest edition).

• Manufacturer test certificates.

• Extinguisher details and operating manual.

• Any other relevant reports/guarantee certificates etc.

CLEAN AGENT FIRE EXTINGUISHER 2 KG

Clean agent Fire Extinguisher 2 Kg capacity manufactured to IS:15683, with BIS mark , Brass forged squeeze lever discharge valve with NRV(CEEN 3APPROVED), fitted with pressure indicating guage (CEEN3APPROVED), direct nozzle, wall mounting bracket & screw, duly charged. Also to meet the requirements given in the latest NFPA 2001 on clean agent fire extinguishing systems in line with environmental considerations of Kyoto and Montreal Protocol & latest MOEF regulations (Ministry of Environment & Forest).

4. FIRE DETECTION & ALARM SYSTEM

1. GENERAL

a. Fire alarm & detection system shall be designed so as to detect all type of fires at the earliest possible time and give warning at the fire alarm control panel and repeater also at the locations where fire has occurred, so that timely action can be taken to protect life and property.

b. This section covers the requirement of intelligent addressable fire alarm system for the proposed buildings as per the layout drawing enclosed, specification laid down below and as per description of item given under the schedule of quantities.

c. The work described in this specification consists of all labour, materials, equipment and services necessary and required to complete, test and commission the fire detection and alarm system. Any material not specifically mentioned in this specification but required for proper performance and operation shall be provided and installed for a complete and operational system, by the contractor at no extra cost.

d. The contractor shall furnish, and install complete and ready for intended use and operation, an intelligent, addressable fire detection and alarm system including Fire alarm panel(s), initiating devices (manual pull stations, addressable photo & thermal detectors, beam detectors etc.) indicating devices (sounders, bells, visual warning signals, etc.) and supervisory devices, enunciators, wiring apparatus and accessories.

e. The installation and locations of equipment and devices in the building shall be governed by the code/publication with due regard to actual site conditions, manufacturers' recommendations, ambient factors affecting the equipment and other operations in the vicinity. If any deviation from the specifications is necessary, approval shall be obtained from the Engineer-in-Charge before work is started thereon.

f. All materials, devices, and equipment shall be compatible with the circuits or systems in which they are utilized.

g. In addition to SITC of Fire alarm system, the following work shall be deemed to be included within the scope of work to be executed by the bidder as this is being a turnkey job :

i) It includes obtaining approvals from Chief Fire Officer and all other statutory authorities for complete scope of work as per relevant rules & regulations etc.
ii) The Fire Detection and Alarm System of the building shall be integrated with respective to the zoning of PA system so that, in case of fire, the PA system shall automatically come in announcement mode of that zone and play pre-recorded evacuation messages from PA system.
iii) Suitable racks shall be provided for housing amplifiers, pre-amplifiers, CD player control equipments etc.

iv) Minor Civil repair works, making surface good after work i/c minor items/ petty work etc required for successful commissioning of entire system.

h. The Fire Alarm System shall be intelligent addressable type for all the buildings. The Fire alarm control panel, manual call points, detectors, modules and other devices used in the system shall conform to International Standards including UL &FM.

i. The system shall incorporate a Firemen talkback system & Public address system with selector switch and Hooter/Speaker. Firemen talkback for two way communication to be provided at every staircase/ exit points in the building. Necessary console & amplifier with micro phone (digital voice command station) to be provided at the fire control room (command center) in the ground floor.

j. The fire detection and alarm system shall integrate with the PA & Firemen talkback system in the building and the gas based panel suppression system provided for the main electric distribution panel.

k. Before commencing work, the contractor must submit data showing that the manufacturer / vendor has successfully installed fire alarm systems of the same scope, type and design as specified. The contractor must provide the services of a factory trained and certified representative or technician, experienced in the installation and operation, maintenance and service of the type of system provided. The technician shall supervise installation, software documentation, adjustment, preliminary testing, final testing and certification of the system. The technician shall provide the required instruction to the owner's personnel in the system operation, maintenance and programming.

2. STANDARDS

a. 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.

b. The following standards shall apply to this Section:

IS 2175:1988	Specification for heat sensitive fire detectors for use in automatic fire alarm system (Second revision)
CPWD General Specifications For Electrical Works- Part 6	**Fire Detection & Alarm System**
IS 2189:1999	Code of Practice for Selection, Installation and Maintenance of Automatic Fire Detection and Alarm System (Third revision)
IS 11360-1985	Specification for smoke detectors for use in automatic electrical fire alarm system

IS: 823:	Welding procedure
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.
NFPA 72E:	Standards on automatic fire detection.
UL 864	Control Units for Fire Protective Signaling Systems 9th Edition Listed
UL 464	Audible Signaling Appliances
UL 1971	Visual Notification Appliances
UL 38	Manually Actuated Signaling Boxes
UL 268	Smoke Detectors for Fire Protective Signaling Systems
UL 521	Heat Detectors for Fire Protective Signaling Systems
UL 346	Waterflow Indicators for Fire Protective Signaling Systems

c. In case where the offer deviates from the specified standards, the tenderer shall indicate clearly in the offer the alternative standards proposed and details thereof.

d. 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 Client (Purchaser) /Consultant such as CPWD specifications shall be adopted. Any changes or modifications directed by Client /Consultant shall also be incorporated by the contractor during execution of the work.

3. PRODUCTS

3.1 All equipment and components shall be new, and the manufacturer's current model. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a protective signaling system, meeting the National Fire Alarm Code.

3.2 All equipment and components shall be installed in strict compliance with manufacturers' recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation.

3.3 All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

3.4 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.

3.5 The fire detection and alarm system shall be installed as per NBC 2016 & IS 2189 with specific reference to NFPA 72E.

a. Fire alarm Control Panel

The FACP shall be intelligent microprocessor based with its own micro controller, memory, communication module and fire device loop interface cards and should also be networkable in peer-to-peer basis with other Addressable Fire Alarm Panels. The Panel shall have fully featured operator interface control and annunciation panel with LCD display. The panel must have network card inside for networking communication with other display devices like repeater panel, other panels etc. It should have the required number of outgoing loops to connect addressable type detectors and devices. One loop must be capable of including a minimum of 240 devices. The panel shall have built in maintenance free battery, charger and automatic change over from mains to battery. Battery shall be capable of supporting the system for at least 48 hours of continuous normal operation. The Panel shall also have Logic hardware and software built into it for time delay operation of hooter. **The panel must be UL listed and FM approved.**

The panel shall be capable of performing the following functions:-

i) Programming software for the system

ii) Automatic system test activation

iii) Shall be capable of incorporating detector sensitivity adjustments.

iv) Alarm verification

v) Shall have provision to connect to access doors

vi) Shall have provision to connect to PCs and external printers

vii) Each detector / device that is connected on the loop shall be identified by a unique address that shall be assigned to each device. This address shall indicate the individual device address as well as the address of the loop to which it is connected.

viii) Check the status of the system at definite preset intervals and give warning in case of system faults like open circuit, short circuit, dirty detector, removal of detector or any other faults.

ix) In case of fire the panel shall give audio as well as alphanumeric display.

x) For switching off the AHU or other equipments in case of fire, potential free contacts shall be available.

xi) Shall be capable of getting connected to a PC for interfacing with any Building Management System and Public Address system. It shall support IP/ bacnet/ modbus protocol

xii) Shall have event log history of fault and alarm. (200 events minimum).

xiii) Shall have port to connect a PC to do necessary programming, retrieval or information etc.

xiv) Shall be capable of automatic compensation for loss of sensitivity of detectors due to change in ambient condition, aging etc.

xv) Shall be capable of operating alarms/sirens/hooters and indications at remote location.

xvi) Facility to integrate with a single or multichannel voice firefighter's talkback & PA system operational in all respect.

b. Detector

Detectors used shall be of analogue addressable type capable of giving exact location of fire. Detector shall be intelligent (analog) and addressable, and shall connect with two wires to the fire alarm control panel Signaling Line Circuits. In locations where heat is likely to rise rapidly such as kitchen, heat detectors shall be used. Detectors shall be of adequate sensitivity but it should not give false alarm. Loss of sensitivity due to aging or dust should be automatically compensated by software in the control panel. Visual indication shall be provided by LED on the detector housing to indicate healthy operation, fault and alarm. There shall be provision for remote indication by LED for the above states whenever detector is mounted inside closed rooms or above false ceiling. Detector shall conform to UL/ FM standards. The detectors and the bases over which the detectors would be mounted shall be of same make and shall be compatible for interchange of detectors.

c. Manual Pull Station

Addressable manual pull station must be compatible to be installed either flush or surface mounted as required. Manual stations shall contain the intelligence for reporting address, identity, alarm and trouble to the fire alarm control panel. The manual station communications shall allow the station to provide alarm input to the system and alarm output from the system within less than four (4) seconds. The manual pull station shall be with clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front of the stations in raised letter. They shall be designed so that after actual emergency operation, they cannot be restored to normal use except by the use of a key.

d. Wiring

i) Wiring shall be in accordance with local, state and national codes (e.g., NEC Article 760) and as recommended by the manufacturer of the fire alarm system. Number and size of conductors shall be as recommended by the fire alarm system manufacturer. The wiring shall be carried out by the contractor using FRLS PVC insulated armoured copper cable and the same should be laid in GI conduit wherever the cable is exposed to the atmosphere. The contractor shall indicate the layout of detectors, MCPs, and configuration of wiring including color coding to be done. The design of the loop shall be such that not more than 90 % of the loop capacity of the panel is utilized with addressable devices connected in one loop.

ii) The contractor shall submit detailed layout drawing to the Engineer In-charge for approval prior to execution.

e. Relay Module

These shall be of addressable type available for HVAC control and other building functions. The relay shall be rated for a minimum of 2.0 Amps resistive or 1.0 Amps inductive. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100% of all auxiliary relay or NACs may be energized at the same time on the same pair of wires. Monitor module shall be addressable type and shall derive power from the loop for its operation.

f. Isolator Module

Isolator modules shall be of addressable type and are to be provided to automatically isolate wire-to-wire short circuits on an SLC Class A or Class B branch. The isolator module shall limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on the SLC loop segment or branch. At least one isolator module shall be provided for every 20 devices. If a wire-to-wire short occurs, the isolator module shall automatically open-circuit (disconnect) the SLC. When the short circuit condition is corrected, the isolator module shall automatically reconnect the isolated section. The isolator module operations shall be totally automatic. It shall not be necessary to replace or reset an isolator module after its normal operation. The isolator module shall provide a single LED that shall flash to indicate that the isolator is operational and shall illuminate steadily to indicate that a short circuit condition has been detected and isolated.

g. Input module

Input module shall be of addressable type and are to be provided to monitor contacts for such items as water-flow switches connected to the fire alarm system. These interface devices shall be able to monitor a single or dual contacts. An address will be provided for each device and all physical devices shall require only one address on a signaling line circuit regardless of the number of circuits on an individual module.

h. Sounder with strobe

The sounder/strobe appliance as indicated on the drawings shall be a synchronized temporal horn with a synchronized strobe light with multiple candela taps to meet the intended application. The strobe light taps shall be adjustable for 15/75, 30/75, 75, and 110 candela. The appliance shall be red for wall mounted and white for ceiling mounted. Addressable control modules shall be provided to supervise and control the operation of one conventional NACs of compatible, 24 VDC powered, polarized audio/visual notification appliances. Audio/visual power shall be provided by a separate supervised power circuit from the main fire alarm control panel or from a supervised UL listed remote power supply.

i. Addressable type Rate of Rise type Heat Detector

1. Heat/thermal detectors shall be rated at 135 degrees fixed Fahrenheit temperature and 15 degrees Fahrenheit per minute rate of rise. The choice of alarm reporting as a fixed temperature detector or a combination of fixed and rate of rise shall be made in system software and be changeable at any time without the necessity of hardware replacement. The Heat Detector shall be Analogue Addressable detector with its own digital code and be able to give a single digitized output to the Fire Alarm Panel regarding its condition. The Detector shall employ the thermistor principle for heat sensing. It shall be able to communicate with the Fire Alarm Panel by the electrical pulses emitted from the Panel.

2. The construction of base shall be of poly carbonate or any approved proprietary flame retardant material. LEDs shall be provided to indicate locally alarm condition. The enclosure shall meet IP 22 protection grade.

3. It shall be able to operate in conditions with temperature ranging from 0o Centigrade to 50o Centigrade. Further, Relative Humidity (noncondensing type) upto 95 % shall not hamper its performance. The Voltage rating shall be from 17 V DC to 28 V DC, though the voltage may be changed depending upon the working voltages of a proprietary Fire Alarm Panel.

4. The Detector shall be UL & FM approved. It shall be possible to test the Detector's working both from the Panel as well as locally by means as designed by the Bidder.

j. Addressable type Multi sense Detector

1. The smoke detector shall be analog addressable type, plug-in, two-wire, multi-sensor detector with both photoelectric and thermal inputs and must be compatible with Fire Alarm Control Panel and consisting of a dust resistant, field-cleanable photoelectric chamber, a solid state non-mechanical thermal sensor, and microprocessor based electronics with a low-profile plastic housing. The multi sense detector shall have an intelligent digital photoelectric detector with a programmable heat 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.

2. The detector shall be mounted in a duct detector housing listed for that purpose. The duct detector shall support the use of a remote test switch, relay or LED remote indicator. Detectors shall be intelligent (analog) and addressable, and shall connect with two wires to the fire alarm control panel Signaling Line Circuits.

3. Detector bases shall be low profile twist lock type with screw clamp terminals and self-wiping contacts. Bases shall be installed on an industry standard, 4" square or octagonal electrical outlet box. The fire alarm control panel shall permit detector sensitivity adjustment through field programming of the system. The panel on a time-of-day basis shall automatically adjust sensitivity.

4. The coverage per smoke detector shall be upto a minimum of 30 M2. This coverage area will reduce depending upon structural configurations or partitions etc.

5. Using software in the FACP, detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance. The detectors shall be listed by UL as meeting the calibrated sensitivity test requirements of NFPA Standard 72.

6. Detectors will operate in an analog fashion, where the detector simply measures its designed environment variable and transmits an analog value to the FACP based on real-time measured values. The FACP software, not the detector, shall make the alarm/normal decision, thereby allowing the sensitivity of each detector to be set in the FACP program and allowing the system operator to view the current analog value of each detector.

7. Neither its performance shall be affected by air current up to 10m/s. The detector shall be suitably protected against dust accumulation / ingress and it shall be free from maintenance and functional test at intervals.

8. All detectors shall be identical in construction design and characteristic to facilitate easy replacement. The detector housing shall be damage resistant made of polycarbonate or proprietary self-extinguishing material.

9. It shall be able to operate in conditions with temperature ranging from 0o Centigrade to 50o Centigrade. Further, Relative Humidity (noncondensing type) up to 95 % shall not hamper its performance. The Voltage rating shall be from 17 V DC to 28 V DC, though the voltage may be changed depending upon the working voltages of a proprietary Fire Alarm Panel.

10. The Detector shall be UL & FM approved. It shall be possible to test the Detector's working both from the Panel as well as locally by means as designed by the Bidder.

k. Addressable type Beam Detector

Single ended reflector type addressable beam smoke detector shall be used for protecting open areas with high and sloping ceilings, and wide-open areas, where spot-type smoke detectors are difficult to install and maintain. The system must comprise of a single unit incorporating an infra-red transmitter and receiver. The signal generated in the transmitter element and reflected by the prism back to the receiver element is analyzed for the presence of smoke. The internal microprocessor determines an alarm condition when a predetermined level is reached. The detector shall operate between a range of 16.5 ft. to 330 ft. (5m to 100m).The temperature range of the beam shall include the range of -4°F to 131°F (-20°C to +55°C).The beam detector shall feature automatic gain control which will compensate for gradual signal deterioration from dirt accumulation on the lenses. The unit shall include a wall mounting bracket. Testing shall be carried out by using a calibrated obscuration test filter.

l. Repeater Panel

1. The Panel shall be controlled by a Micro-Processor that shall control all fire / fault / short signals. The microprocessor shall continually monitor each zone in the Panel for each signal, as well as the condition of the battery.

2. The Panel shall be provided with an LCD Display Unit that shall provide alpha numeric information on the fire / fault signal with zone number.

3. For accessing the LCD display a keypad operation shall be provided. The keypad shall have Help Menu and other functions controlled from either Function Keys or by a combination of keypad numbers. By using the Keypad one can scroll through the event list for at least a month.

4. The Processor shall be rugged with nonvolatile memory. Due to voltage fluctuations and change from normal to standby current there shall be no variation in the software or programmed logic sequence. The Repeater Panel shall be provided with a Buzzer / Sounder to indicate Alarm, which shall generate automatically in case of an alarm in the area to which the Repeater Panel is connected / programmed.

m. 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.

n. Cable Connectors

Cable connectors, lugs/sockets, shall be of copper/aluminum 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.)

o. GAS BASED PANEL FLOODING SYSTEM:

a) The scope covers supply, installation, testing and commissioning, performance guaranteeing of automatic gaseous fire extinguishing CO2/Clean agent based flooding system complete suitable for electrical panels with fire detection tube, cylinder, valves, and integration with fire alarm control panel for annunciation as per specifications, drawings, codes, standards and good engineering practice etc. complete. The contractor shall be responsible to complete the entire work in all respects and any other work necessary to complete the job whether specifically mentioned or not in the scope of work. This installation shall be made in strict accordance with the specifications and applicable National Fire Protection Association Standards. System shall be integrated with the Fire alarm & detection system in the building.

b) Applicable Standards Include:

NFPA 12	Standard on Carbon Dioxide Extinguishing Systems.
NFPA 2001	Standard on Clean Agent Fire Extinguishing Systems
NFPA 70	National Electrical Code.
NFPA 72	National Fire Alarm Code-Standard For Protective Signaling Systems.

c) The work shall cover briefly as under:

1. Direct fire extinguishing clean gas based flooding system.
2. Providing fire detection tube inside the panels for direct systems.
3. CO2/Clean agent for flooding of the Panels as per specification having zero ODP and having a distinct odor for flooding system and suitable for human beings. Details of gas used shall be submitted with offer.
4. Wiring /Connection to local/remote fire alarm systems.
5. Any other item required for successful commissioning of the system.

d) Main MV electric distribution panel and Lift panel shall be protected through localized fire trace-tube type suppression system for efficient and prompt Fire Suppression. The system consists of Polymer base tubing, CO2/Clean agent cylinder and custom engineered valves.

e) The cylinder shall be kept near the protected area and tubing through cylinder shall be done inside the protected Panels. In case of Fire, when the flame touches the tubing and it reaches a temperature of 90-110 Deg C the tubing bursts at its hot test point (which is nearest to the most vulnerable part of the fire), thus forming a nozzle. The pneumatic mechanism then triggers the valve of the extinguisher and sprays the agent out directly in to the fire, thus dousing the fire quicker and locally.

f) Heat Sensing tube shall have the following characteristics:

1. acts as a multi-sensor and multi extinguishing jet
2. made of a high-tech polymer
3. long time resistance, flexibility and temperature sensitivity
4. when bursting at the hottest spot, it ruptures as a nozzle shape opening

g) The actual net volume of the risk shall be calculated by the Contractor based on the GA Drawing of the electrical panel to be protected. CONTRACTOR shall design the system to meet the minimum requirements of total flooding fire extinguishing Carbondioxide/Clean agent system as per NFPA-12/NFPA 2001.

h) No deviation from specification will be acceptable.

i) System supplied and design calculation shall be approved by UL/FM/Vds/LPC and TAC accredited agency. All equipments shall be approved by UL/FM/Vds/LPC and cylinders along with cylinder valve assemblies shall be seamless and PESO/CCE approved. It shall be noted that system to be provided shall meet the requirements of NFPA-12/NFPA 2001 (latest edition). Hence anything specified as “Mandatory” in NFPA-12/NFPA 2001, although not specifically mentioned in this specification, shall form part of this specification.

j) Approval of Installation

i) The complete system shall be tested to meet the approval of Owner. Only listed or approved equipment and devices shall be used in the systems i.e. all equipments shall be approved by UL/FM/Vds/LPC and cylinders along with cylinder valve assemblies shall be seamless and PESO/CCE approved.

ii) All critical equipments such as cylinders, cylinder valves, directional valves, pressure reducers, nozzles, actuation controls, pressure gauges etc. shall have approvals from UL/FM/Vds/LPC. In order to determine that the system has been properly installed and will function as specified, the following tests shall be performed:

a. A thorough visual inspection of the installed system and hazard area. The piping, operational equipment and discharge nozzles shall be inspected for proper size and location. The locations of alarms and manual

emergency releases shall be confirmed. The hazard area shall be inspected closely for un-closable openings and sources of agent loss.

b. A check of labeling of devices for proper designations and instructions. Name plate data on the storage cylinders shall adhere to specifications

c. The cylinder along with cylinder valve assembly shall be PESO/CCE, Nagpur approved.

4. DRAWINGS & MANUAL

4.1 The successful bidder shall prepare the following drawing and submit to the Engineer-in-charge for approval within 30 days of award of work.

i) Schematic diagram of the detectors, manual call points, hooters / sirens and interlocks with AHUs.

ii) Floor wise Wiring diagram of the system indicating the location of detectors and other devices.

4.2 Work shall be started on receipt of approval of drawings, if any changes are required at the time of execution it shall be brought to the notice of Engineer-in-charge and got approved. On completion of work three no's of prints and one no. of CD duly incorporating all the changes / modifications if any shall be submitted to the Engineer-in-charge.

4.3 Operating Manuals: The following manuals shall be supplied by the contractor on completion of the installation clearly specifying the:

a. Operating instructions, with a write up on the salient features of system offered.
b. Maintenance activities and its schedule.
c. Trouble shooting procedure.

5. INSPECTION AND TESTING (FIRE DETECTION & ALARM SYSTEM)

5.1 INSPECTION

a. 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/Consultant. The Contractor shall ensure that each stage of fabrication is carried out in compliance with the procedures specified in the IS or International standards as applicable and/or specified in this document.

b. 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/Consultant, 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.

c. All testing shall be carried out in the presence of Client/Consultant/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.

d. The original test certificates of all tests conducted are to be forwarded to Client/Consultant. 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.

5.2 TESTING

a. **Installation & testing of Fire alarm & detection system shall be as per IS 2189, NBC 2016, CPWD norms or NFPA 72.**

b. b. The entire fire detection and alarm system shall be tested for continuity and performance as per IS-2189 code and NFPA 72. 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. All detectors found to have the sensibility outside the approved range shall not be used.

c. 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 recognized testing institutions or Govt. test bodies in India or abroad.

d. Following tests shall be conducted in the presence of the Client/Consultant and the test certificate shall be furnished with the record of tests.

1. Continuity test

Test for insulation resistance of the wiring work and the control and indicating panels.

2. 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.

3. Wiring for FAS/AFAS
A. Circuit Design:
i) The loop element (Smoke Detectors Heat Detectors, Manual Call Points, Monitor Modules, Control Modules, Loop Sounders) wiring in AFAS shall be closed circuit loop type (Class A type), so that if the communication fails from one side, it is restored automatically from the

other side. The wiring shall be independent of the detector zoning. The Zones shall be software based.
ii) The design of the system wiring shall match the control and indicating equipment in the system.

B. Wiring Materials:
i) The wiring shall be PVC insulated 2 core 1.5 Sq mm FRLS shielded copper Conductor stranded cables in red/black color and generally confirming to IS-694-2010 and meet the signal cabling requirements.
ii) The strand of cables shall not be cut to accommodate & connect to the terminals.
iii) The terminals shall have sufficient cross sectional area to take all the strands.

C. Installation requirements:

i. The electrical work connected with a FAS shall be carried out in conformity with CPWD general specification for electrical works Part-I (Internal) 2013, and part-II (external) 1994, both amended up to date.
ii. In no case the FAS equipment or connections be mounted in or on boxes, cover plates or blanks carrying the accessories or connections of any other service.
iii. FAS wiring shall be exclusive to the FAS and be physically separated from wiring for any other service in the building.
iv. Wiring for different circuit voltages in a FAS shall be in separate conduits.
v. To minimize possible disruption due to fire or other causes, fire alarm circuits should be separated as much as possible from each other. Where practicable, the different fire alarm circuit shall be run through different routes.
vi. The metal body of all control and indicating panels shall be loop earthed using 2.5 sqmm copper wire and bonded to the earthling system in the building.

4. INSPECTION, TESTING AND COMMISSIONING FIRE ALARM & PA SYSTEM

This section covers the requirements for testing and commissioning of Automatic Fire Alarm System/ Intelligent addressable fire alarm system.

A. Testing before supply

i. Control and indicating panels, sounders, PA system equipment and battery unit with charger etc. shall be tested at the manufacturer's works to indicate satisfaction to the contract specifications, and test certificates be furnished with the supply at site of work by the contractor.
ii. In case of imported fire alarm components such as main fire alarm panel, Repeater panel, detectors, Manual Call points, Monitor and Control modules, Response Indicators, etc; individual certificate with individual number confirming to the relevant international standard shall be provided by the contractor at the time of supply at site of work.

B. Initial Installation Inspection:

i. After installation, a visual inspection of all the devices should be made to make sure that they are property placed. Each device should be inspected to ensure that it is properly mounted and connected. Each manual call points should be tested to initiate an alarm at its installed location

with testing key and also tested at FACP.

ii. Restorable heat detectors and restorable elements of combination detectors should be tested by a heat source, such as a hair dryer, or shielded heat lamp until it responds, making sure that the sensing element is not damaged. After each heat test, the detector should be reset precaution should be taken to avoid damage of the non- restoratable fixed temperature element of a combination rate of rise /fixed temperature detector. Non-resettable fixed temperature heat detectors which are not to be heat-tested should be tested mechanically or electrically for fire alarm function. Heat detectors with replaceable fusing alloy element should be tested first by removing the element to see whether contact operate properly and then reinserting them in proper position.

iii. In periodic testing, heat detectors should be visually examined for damaged for other conditions
(such as heavy coats of paints etc. likely to interfere with the correct operation) Each smoke detector should be tested to initiate an alarm at its installed location with smoke or other approved aerosol which demonstrates that the smoke can enter the chamber and initiate an alarm.
In order to ensure that each smoke detector is within its senility range, its sensitivity range, it should be tested using either.
1) A calibrated test method, or
2) A manufacturer's supplier's approved calibrated sensitivity test instrument, or
3) Approved control equipment for the purpose, or
4) Other approved calibrated sensitivity test method.
iv) Detectors found to have a sensitivity outside the approved range should be replace.

C. Testing after installation:

i) Following tests shall be conducted the completed intelligent addressable FAS installation, in the presence of the Engineer-in-Charge and the test certificate shall be furnished for the following test.

a. Continuity test.
b. Test for insulation resistance of the wiring and the control and indication panels.
c. Test for system operation. In the case of AFAS, this test for fire conditions shall be conducted using a test fire at normal floor level. The number of locations for such a test shall be 1% of the total number of detectors in an installation subject to a minimum of two and maximum of five. 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.

5. Inspection by local bodies
It shall be the responsibility of the contractor to get the installation inspected and passed by the local authorities concerned, as may be required by the local bye-laws, including liasioning works and an 'No Objection Certificate' (N.O.C) shall be obtained from the authority.

5. FIREMEN TALKBACK SYSTEM (FTS) and PA SYSTEM:

Two way communication can be accomplished using firemen talkback system. The system shall be suitable for Class-B wiring. It shall have provision to accept the range of 230V ± 10% single phase, 50 Hz Leaner power supply. It consists of master Control panel with multiple zone location alarm indications, Phone jack/press to talk back and Handset/console. The Control Panel shall indicate the location of the call and provide an audio visual indication to alert the operator's attention. Once connected a clear full duplex audio Conversation can take place. The call is ended by, replacing the master handset

1. The Digital Voice Command Center/ Master Talkback Panel located near the FACP, shall contain all equipment required for all audio control, emergency telephone/talkback system control, signaling and supervisory functions. This shall include speaker zone indication and control, telephone circuit indication and control, digital voice units, microphone and main telephone handset.
2. Function: The Voice Command Center equipment shall perform the following functions:
   a) Operate as a supervised multi-channel emergency voice communication system.
   b) Operate as a two-way emergency communication control center.
   c) Audibly and visually annunciate the active or trouble condition of every speaker circuit and emergency telephone circuit.
   d) Audibly and visually annunciate any trouble condition for digital tone and voice units required for normal operation of the system.
   e) Provide all-call Emergency Paging activities through activation of a single control switch.
   f) As required, provide vectored paging control to specific audio zones via dedicated control switches.
   g) Provide a factory recorded "library" of voice messages and tones in standard WAV.
   h) Provide a software utility capable of off-line programming for the VCC operation and the audio message files. This utility shall support the creation of new programs as well as editing and saving existing program files.
   i) The Digital Voice Command shall be modular in construction, and shall be capable of being field programmable without requiring the return of any components to the manufacturer and without requiring use of any external computers or other programming equipment.
   j) The Digital Voice Command and associated equipment shall be protected against unusually high voltage surges or line transients.
   k) Audio Amplifiers
      1. The Audio Amplifiers will provide Audio Power for distribution to speaker circuits.
      2. Multiple audio amplifiers may be mounted in a single enclosure, either to supply incremental audio power, or to function as an automatically switched backup amplifier(s).

3. The audio amplifier shall include an integral power supply, and shall provide built-in LED indicators
4. The audio amplifier shall provide the following built-in controls:
   - Amplifier Address Selection Switches
   - Signal Silence of communication loss annunciation Reset
   - Level adjustment for background music
   - Enable/Disable for Earth Fault detection on DAPA
   - Switch for 2-wire/4-wire FFT riser
5. Adjustment of the correct audio level for the amplifier shall not require any special tools or test equipment.
6. Includes audio input and amplified output supervision, back up input, and automatic switch over function, (if primary amplifier should fail).

l) Portable Emergency Telephone Handset Jack

1. Portable emergency telephone handset jacks shall be flush mounted on stainless steel plates as indicated on plans. Handset jacks shall be approved for emergency telephone system application.
2. Insertion of a remote handset plug into a jack shall send a signal to the fire command center which shall audibly and visually indicate the on-line condition, and shall sound a ring indication in the handset.
3. The two-way emergency telephone system shall support a minimum of seven (7) handsets on line without degradation of the signal.

1. <u>PA system-GENERAL</u>

a. It will constitute a part of the master control panel and shall consist of

   i) Control console with microphone etc.
   ii) Amplifier in Amplifier Rack etc
   iii) External speaker and connecting cable etc.

b. The speech will be fed from microphone, through the preamplifiers and amplifiers to combination speakers on various floors.

c. The amplifier shall have solid state circuitry, properly tropicalised and capable of AC/DC operation and capable to drive the external speakers used for installation. It shall have provision of 3 channels namely (i) Alert, (ii) Evacuate and (iii) Speech.

d. There should be zone switches for selection where communication is to be made. Under normal condition, Auto/manual switch shall be in auto mode, in the event of fire in a particular floor, the speaker-cum-hooter connected to that floor will start producing an 'Alert Tone'. If it is necessary to warn other floors or all places there shall be zone switches as well as common switches through, which it can be done. If it is required to evacuate people from any of the areas Evacuate Switch is to be pressed to create Evacuate Tone. For accounting purposes, a speech switch is to be operated so that quality voice can be generated which will be optically indicated through LED. There shall be provision for adjustment of tone and volume in each case from the panel.

e. P.A system enclosure shall be fabricated sheet metal constitution and consisting the following switches and controls:

i) One goose neck type moving coil/cardoid/hyper cardoid or equivalent microphone and one hand set to speak from any floors through manual call point telephone socket whenever necessary.
ii) Arrangement for speaking to each floor separately or all floors together.
iii) Provision for playing pre-recorded/taped instructions or otherwise as necessary through the speakers.
iv) Pre-amplifier, monitor loudspeaker and other accessories.
v) Testing arrangements and provisions.

f. Amplifier rack have the following:

i) Amplifier mounting rails.
ii) Lockable steel doors with proper ventilations slot for heat dissipations.
iii) Proper cable entry arrangements and terminal blocks.

g. Design Requirement :

Speakers shall be connected in parallel and correctly phased. System should be designed for high impedance and impedance matching between microphones and pre-amplifier, amplifier and speakers on floor shall be done. Impedance of long length of cables also shall be considered. The system shall be properly earthed to avoid unwanted distortion in the system. System installation diagram giving details of cables routing, speaker installation, junction boxes etc and circuit diagrams for P.A system amplifier etc shall be given by the contractor.

2. <u>POWER SUPPLY</u>

a. The console shall be provided with a complete charger unit, rectifier & distribution system. The charger shall be provided with auto change over system from normal to emergency supply in case of failure of normal power supply. The emergency power shall be derived from a battery, which shall be included in the offer. The unit shall rechargeable maintenance free dry have provision of protection against overload.

b. Only 230 V, 1 Ph, 50 Hz AC power supply shall be made available to the PA console from the nearest available power source. The cabling from the permanent supply source to the PA console and the cabling from Console to the respective floors and to the individual sensing items external speaker-cum-hooter are to be included in the offer.

c. The Master Control Panels(PA console) or any other panels requiring power supply for its operation shall be provided with “Power Supply Healthy “ON” “Indication” “Fuse Blown”, “Charge ON”, “Supply in EM Power” etc indications.

d. The battery/ battery bank shall be such that all the equipment will work at its “Final voltage”.

e. The battery charging equipment shall incorporate automatic control features, which should match the output with the limits, specified by the battery manufacturer taking into consideration the quiescent load of the system.

f. Low battery voltage condition shall be monitored and indicated on MCP by visible and audible alarm.

g. Each battery of the secondary calls when charged by its normal charging arrangements for a period of 24 hours from the fully discharged condition shall then have sufficient power to supply quiescent load together with fault signal resulting from disconnection for a period of 24 hours. Thereafter it shall have enough supply to cope with additional load resulting in an alarm originating in all zones for 30 minutes. If utilized to sound emergency evacuation alarm it shall supply additional power for at least 10 minutes.

h. There shall be provision of protection against earth leakage current. All panels/equipments shall be effectively earthed whenever required to satisfy statutory & system requirements.

3. GENERAL REQUIREMENTS

a. All equipments and panels shall be rugged in design. It shall be reliable in design and should have long service life.

b. Equipment shall be designed to operate continuously on a maximum ambient temperature of 45oC and the temperature rise shall be within the allowable limit. It shall also be so designed that it should work in local vibration and impacts, if arises at any time in the locality during use.

c. The internal circuits shall be so designed that due to failure of any part/component or malfunction it should not give any false fire alarm signals at any time. It should instead may give rise to fault alarm signals only.

d. There shall be no easily accessible normal controls, e.g. switches off – main/standby power supply etc. to the unauthorized person.

e. All manual controls, indicators, switches etc. shall be clearly labeled to indicate their proper function/services. All manual controls shall be robust in construction positive in action and so located that no accidental operation can take place.

f. All equipments and components shall be designed, manufactured and selected to work satisfactorily against deterioration due to temperature, humidity, corrosion etc. resulting from the atmospheric condition existing in the vicinity. The equipments and components shall be of first class good quality materials for its reliability. The cubicle type Master Control Panels shall be dust and vermin proof and to prevent ingress of moisture. Protective painting shall be provided after installation of the panels and equipments wherever required.

g. The selection of the power supply unit and the cables shall be such that no appreciable voltage drop takes place. There shall be provision of protection against over load.

h. All the electrical/electronic components covered under this specification, shall conform to the following:

   i) Components shall conform to the ISI specification or to BS specification where no IS specification exist.
   ii) Alarm indication lamps may have signals or double filaments to suit the requirement and it should be having longer life. The intensity of the indications shall be clearly visible from a distance at 10 meters in normal condition. LED may be used wherever it suits to have low power consumption.
   iii) Double lamps should be used to avoid confusion/inattention in case of one lamp blows off.
   iv) All frictional contact surfaces should be plated/flashed with double metals or equipments.

i. List of recommended spares for its normal and trouble free operation for at least 5 years shall be furnished separately as an optional item.

4. Circuit design

Latest design and technology shall be offered as accepted by the WEBEL or similar institution. All components shall be interchangeable in design. The equipment offered shall have "Self diagnosis feature" of each circuit. The design of the circuits shall be such that any failure or malfunction in it shall activate automatic fault warning.

5. Conduit wiring system

a. Conduit wiring shall be adopted in wall/floors/ceilings or similar other coverages. Wherever required chases are to be cut on wall/floor to suit the requirement of the fire protection system and made good in an approved manner. No extra cost will be paid on this account.

b. All conduits shall be of 19 mm or 25 mm dia made of PVC, ISI marked.

c. Necessary bends in the system including diversions shall be done by bending the pipes or by inserting suitable inspection type bends/elbows or similar fittings.

d. Generally 1100V grade 1.5 mm PVC insulated and sheathed copper cable shall be used conforming to IS 694 (Part II) with adequate number of cores required for wiring. However, the voltage drop in the system should be duly taken into consideration and higher size of cables may be selected wherever such necessity arises. Total number of cables shall be so taken in a conduit as to facilitate easy drawing of the cables.

e. For loop earthing G.I wires shall be used.

f. Panels and bigger items should be having cable glanding facility using double compression dust and moisture proof electro plated brass cable glands of approved make.

6. Cable Work

a. All heavy duty cables to be used for the purpose of connecting the fire protection system shall be PVC insulated and PVC sheathed copper conductor cables of armoured type conforming to IS 1554 (Part-I) 1964 of 650/1100V grade wherever used for indoor purpose. Cables concerned only with fire protection system are generally to be taken along the fire protection duct provided in the building. All cables after bringing to site must be got approved by the Engineer-in-Charge before use. All relevant test certificates shall be submitted in support of the sound manufacturing of the cables for approval to the Engineer-in-Charge / Consultant. The requirement of the exact length of cables shall be determined by the successful tenderer after measurements at site.

b. Cables shall be laid in walls/ceilings/structures wherever concealed wiring is to be done but mainly the wiring run along the duct provided for the fire protection system shall be surface wiring. The cables shall be suitably supported @ 0.45 M for vertical run and @ 0.30 M for horizontal run in general, by means of M.S brackets and clamps or aluminium cleats fixed on M.S brackets. Bolts of suitable sizes are to be grouted on wall for fixing of the brackets. Cables to be laid underground shall be of armoured type conforming to IS 1554 (Part-I) 1964.

c. All the cables and wires should be tagged for proper identification. Wires should be identified by ferrules and cables by colour bands at every 3 M distance.

6. SIGNAGES

Scope includes supply and installation of photo luminescent glow signages (as mentioned in BOQ) of standard size as per conventional design/ colour code on 3 mm thick aluminum composite panel and conforming to IS 9457, IS 12349, IS 12407 and NBC 2016. The signages shall be either fixed on the wall with the help of screws & double tape or hanged from the false ceiling with the help of chain & screws etc. complete as required.

SUPPLY

1.1 The scope of supply will include the following items:

a) Includes the supply of signage boards as per the BOQ

b) Mounting arrangement for all the Signboards

1.2 PHOTO LUMINESCENT SIGNAGE

1. All non-illuminated emergency exit directional / destination signage shall be made out of the photo luminescent sheeting which gets luminous in dark places even when the essential power supply has been cut off.

2. The sizes and colors of these signs shall be in accordance with the standards as applicable (IMO symbols) and installed as per the requirements of the Engineer In Charge.

3. The photo luminescent sheeting shall be of cast film type with self-adhesive property. Photo luminescent sheet shall have minimum luminance property of 1 to 2 hours.

4. The Photo luminescent sheeting shall be made of materials which are non toxic, non-radioactive and shall contain no Lead and Phosphorous and present no health or environment hazards. The photo luminescent signage shall be completely independent of electrical power or any source. These are to be fabricated and installed as per the directions of the Engineer-in-Charge.

1.3 LOCATION

1. Details of location/ layout of signboards and text, logos pertaining to each signboards will be given to the contractor.

2. All work shall be installed square, plumb, straight, true to line or radius accurately fitted and located. Wall mounted multi information signs may be fixed along the direction of the flow on walls. All signs shall be vertically mounted and read horizontally.

3. The mounting level or clearance of each sign shall be according to ceiling heights but specific for each floor level as directed by Engineer-in-Charge.

4. Signboards shall be so placed that these do not obstruct sighting another signage and shall be placed according to the need as assessed by the Engineer in- Charge

1.4 GENERAL

The signage shall have no sharp edges that are likely to cause injury during handling and maintenance. All screws used in assembly of fitting shall be engaged in nuts or tapped holes. Screw heads on the outside of fitting shall be counter sunk to ensure a smooth finish. Only ISI marked, wherever applicable, materials shall be used for the work. Letter, pictogram and arrows shall be precision made and free from imperfection. They shall be accurately cut aligned, clear and sharp. The contractor shall protect the Signage boards with protective application while installation.

1.5 IMPORTANT NOTES

1) The photo luminescent film shall be pasted on Aluminium composite panel of thickness 3mm size.

2) All signs shall be vertically mounted and read horizontally.

3) Signage shall be either fixed directly on Walls/ Columns using screws/double tape or hung from ceiling using proper suspender arrangement preferably of SS304 chain arrangement as approved by Engineer in charge.

4) All screws, nuts and bolts fasteners that are exposed should be cold forged and powder coated.

5) The suspender arrangement shall be made suitable to enable the signage to be fixed/fitted on existing RCC roof / wall / truss work. The type of fixing shall be approved by EIC/Consultant prior to installation.

6) Color Coding used shall be as per International standards and directions of Engineer-in-Charge. Wherever required NBC/ICAO/IMO standards should be followed.

7) The design of the sign boards should be of International standards with high quality finish.

8) All signboards should be maintenance friendly.

9) The detail model of all the sign boards with text, logo and location layout should be submitted and approved by Engineer-in-charge before installation.

10) All Clamps, suspenders, hooks and other accessories required for proper clamping of the sign boards on walls, columns, floor and ceiling shall be in the scope of contractor. No additional payment shall be made for this.

7.0 SYSTEM COMMISSIONING

7.1 After the completion of testing and obtaining statutory approval, the system (Includes fire hydrant & sprinkler system, Fire detection & alarm system, PA-Firemen talkback system, panel gas suppression system, portable extinguishers, existing fire protection &detection system and signages) shall be commissioned in the presence and to the satisfaction of the Purchaser/Consultant and in accordance with the approved standards and norms specified in this document.

7.2 During commissioning the contractor shall establish the head, discharge, efficiency, drive connected load etc of the pumps. The discharge from the hydrant valves, sprinklers etc shall also be demonstrated. The commissioning will be for a continuous period of 7 days. The system shall be put in automatic mode and checked. The automatic operation shall be verified by releasing system pressure by opening of valves. Sprinkler system shall be tested by opening the drain valve. Automatic operation of jockey pump and main electric & stand-by diesel pumps shall be verified. The system operation shall not be affected during the continuous operation period of 7 days.

7.3 If defects noted in the system during the seven days period the same shall be rectified by the contractor in a time bound manner without any additional cost to PURCHASER. Leakage in the piping network, if any, noted during the commissioning shall also be attended by the contractor and rectified without any additional cost to PURCHASER. The system shall be operated in manual mode also to confirm manual operation of the system.

7.4 The commissioning of the system shall be carried out in close coordination with PURCHASER.

7.5 All equipments, tools, tackles, materials, personnel etc required for the system commissioning shall be arranged by the Contractor at no extra cost to PURCHASER.

7.6 Completion drawings: Three sets of all the building's following laminated drawings shall be submitted by the contractor while handing over the installations to the Client/Purchaser. Out of this one of the sets shall be laminated on a hard base for display in the fire control room. In addition one soft copy shall also be furnished.

i. Installation drawings shall include complete details of all the components/ items such as hydrants, valves, pipe routing, detectors, call boxes, extinguishers, signages etc.
ii. Line diagram and layout of all electrical control panels and work station.
iii. Control wiring drawings with all control components and sequence of operation to explain the operation of control circuits

8. LIST OF APPROVED MAKE

FIRE HYDRANT & SPRINKLER SYSTEM, FIRE EXTINGUISHERS & SIGNAGES

1.	Motor	Siemens/ABB/Cromption Greaves/Kirloskar	Category 2
2.	Pump	Mather & Platt/KSB/Beacon/Patterson/ Kirloskar	Category 2
3.	Diesel engine	Cummins/Caterpillar/Greevescotton/Kirloskar	Category 2
4.	GI Pipe	Tata/Jindal/SAIL/Surya	Category 2
5.	Sluice valve	L&T/Leader/Zoloto/Kirloskar/Sant	Category 2
6.	Butterfly, check valve& ball valve	Intervalve/L&T/ Advance/ Leader/KSB/Sant	Category 2
7.	Strainer	Sant/Leader/Emerald or equivalent	Category 2
8.	Pressure gauge	Fiebig/H.Guru/Forbes marshal/ Waree	Category 2
9.	Pressure switch	Indfoss/Switzer/Schneider/Danfoss	Category 2
10.	Air release valve	Rapidcool/Anergy/Econosto/Emerald or equivalent	Category 2
11.	Hydrant valve, Fire brigade point	Minimax / Safex / Newage/ Shah bhogilal	Category 2
12.	Branch pipe	Newage/ Arihant/Shah Bhogilal/Steelage(Minimax)	Category 2
13.	RRL Hose, Hose coupling	Newage/ Arihant/Shah Bhogilal/Steelage(Minimax)	Category 2
14.	Hose Reel	Newage/Shah Bhogilal/Minimax/Safex or ISI marked	Category 2
15.	Hose cabinet	Newage/ Zenith/Shah Bhogilal/Arihant	Category 3
16.	Paint	Asian/ICI/Nerolac/Berger	Category 2
17.	Anti-corrosive wrapping /Polymeric mix	IWL/Rustech	Category 2
18.	Alarm valve	Tyco/Viking/HD Fire	Category 2
19.	Sprinkler	Tyco/ Viking/HD fire(UL listed)	Category 2
20.	Flexible hose for sprinkler	Tyco/ Newage/HD Fire/Viking	Category 2
21.	Flow switch	Tyco/Honeywell/Danfoss/Siemens/Indfoss	Category 2
22.	Fire Extinguisher	Minimax/safex/safeguard/cease fire/Supremex/Kanex	Category 2
23.	Signages	Autolite/Prolite or equivalent.	Category 3

FIRE ALARM & DETECTION, PA, PANEL SUPPRESSION SYSTEM

1.	Fire alarm control panel / Modules/ MCP/ Sounder cum strobe/ Repeater panel and all types of detectors	Siemens/ Simplex/ Notifier/ Edwards(all UL and FM approved)	Category 2
2.	FRLS Armoured Cable	Finolex/ Havells/ Gloster/ RRKabel/ Belden/KEI/ KEC/Polycab	Category 2
3.	Public address - talkback system	Notifier/ Simplex/ Siemens/ASES/Agni/Bosch or equivalent	Category 2
4.	Amplifier	Agni/Ahuja/Bosch or Equivalent	Category 2
5.	MS/PVC conduits	ISI marked	Category 3
6.	Panel Suppression System	Supremex/Firetrace/Firetrex/Ansul/ Minimax/Tyco/Siemens	Category 2

CATEGORY REQUIREMENT OF TEST CERTIFICATE / INSPECTION

CATEGORY -1:
a) Type test certificate for similar item done if not, one of the items offered to be type tested.
b) OEMs routine test certificate.
c) Acceptance test to be conducted in the presence of Engineer/Employer at OEMs factory.

CATEGORY-2:
a) Type test certificate for similar item done if not, one of the items offered to be type tested.
b) OEMs routine test certificate.
c) Visual and functional check by Engineer/Employer at site.

CATEGORY -3:
a) OEM / Dealer/ Contractor routine test certificate.
b) Visual and functional check by Engineer/Employer at site.

CATEGORY -4:
a) Visual and functional check by Engineer/Employer at site.

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.

1.0 EARTH WORK

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 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 established 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 earth fill 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.

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.

2 & 3 . CONCRETE AND RCC 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 cement conforming to IS: 8112-1989 & IS:1489 part I respectively for 43 Grade OPC 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
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	20
M 35	35.0	5.0	20
M 30	30.0	5.0	20
M 25	25.0	4.0	20
M 20	20.0	4.0	20
M 15	15.0	3.5	20

It shall be very clearly understood that whenever the class of concrete such as M 20 is specified it shall be the Contractor's responsibility to ensure that minimum crushing strength stipulated for the respective class of concrete is obtained at works. The maximum total quantity of aggregate by weight per 50 kg of cement shall not exceed 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 workability suitable for the conditions of the job. After the amount of water required is determined, the consistency of the mix shall be maintained throughout the progress of the corresponding parts of the work and approved tests e.g. slump tests, compacting factor tests, in accordance with IS 1199 shall be conducted from time to time to ensure the maintenance of such consistency.

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: Lightly reinforced sections in slabs, beams, walls, columns: Floors; Hand placed pavements; Canal lining; Strip footings	Low	25-75
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 trench 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 shovelling. Any tendency to segregation shall be corrected by shovelling stones into mortar rather than mortar on to stones. Such a condition shall be corrected by redesign of mix or other means, as directed by Engineer.

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

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 under layer is still plastic to ensure good bond and homogeneity between the two layers and prevent the formation of cold joints.

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

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

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

The formation of stone pockets or mortar 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 planned to remove irregularities or unevenness in the face. Formwork with linings shall be permitted.

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

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

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

4.0 MASONRY WORK

CONCRETE BLOCK

Concrete block, hollow (open or closed cavity) or solid shall be referred to by its nominal dimensions. The
IS 2185 (Part 1) :2005 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 shall be as follows:
Length : 400, 500 or 600 mm
Height : 200 or 100 mm
Width : 50,75, 100, 150,200, 250 or 300 mm.

In addition, block shall be manufactured in half lengths of 200, 250 or 300 mm to correspond to the full lengths. Full length and half length U-blocks may also be manufactured for the purposes of band and lintels. The nominal dimensions of the units are so designed that taking account of the thickness or mortar joints, they will produce wall lengths and heights which will conform to the principles of modular co-ordination.

Blocks of sizes other than those specified may also be used by mutual agreement between the purchaser and the supplier. In the case of special concrete masonry units such as jallie wall blocks and ornamental blocks, the specified sizes may not necessarily apply.
The variation in the length of the units shall not be more than* 5 mm and variation in height and width of units, not more than + 3 mm.

MATERIALS

Cement

Cement complying with any of the following Indian Standards may be used:
43 grade ordinary Portland cement, conforming to 1S 8112 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

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 blocks shall be protected until they are sufficiently hardened before starting curing.

Curing

The blocks hardened in accordance with 7.3.2 shall then be cured as per 13.5 of IS 456 or by mist curing .So as to deliver the specified strength of block.

The blocks hardened in accordance with 7.3.2 of IS 456 may alternatively be cured by steam.

Drying

After curing the blocks in accordance with 7.4.1, they shall be dried for a period of 4 weeks before

being used on the work. In case of curing as per 7.4.2, once low pressure steam curing has been done, the blocks shall -be dried at ambient temperature for a period of seven days. The blocks shall then be stacked with voids horizontal to facilitate through passage of air. It shall be ensured that the blocks have been thoroughly dried and allowed to complete their initial drying shrinkage before supply to the work-site.

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 when measured as given above shall in accordance with 4 subject to the tolerances mentioned therein.

Blocks Density

The block density when determined as per code shall conform to the requirement.

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 code.

Water Absorption

The water absorption, being the average of three units, when determined in the manner prescribed in

code 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 code 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 code, shall not exceed 0.09 percent.

TESTS

Tests shall be conducted on samples of units selected according to the sampling procedure to ensure conformity with the physical requirements.

SAMPLING

The blocks required for carrying out the tests laid down in this standard shall be taken by one of the methods given code. In either case, 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 defects

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.

CRITERIA FOR CONFORMITY

The lot shall be considered as conforming to the requirements of the specification if the conditions mentioned in code are satisfied.

The number of blocks with dimensions outside the tolerance limit and/or with visual defects, among 1S 2185 (Part 1) :2005 those inspected shall be not more than two,

For block density, the mean value determined shall be greater than or equal to the minimum limit specified in code. For compressive strength, the average value and minimum individual value determined shall be greater than or equal to the value specified in code.

For drying shrinkage and moisture movement, all the test specimens shall satisfy the requirements of the test. If one or more specimens fail to satisfy the requirements, the remaining 3 blocks shall be subjected to these tests. All these blocks shall satisfy the requirements.

For water absorption, the mean value determined shall be equal or less than maximum limit specified in code.

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.

5.0 JOINERY WORKS

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

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.

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 sections including snap beading fixed in place shall be measured in running meter along the outer periphery of composite section correct to a millimeter. The weight calculated on the basis of actual average (average of five samples) weight of composite section in kilogram correct to the second place of decimal shall be taken for payment. (Weight shall be taken after anodizing). The weight of cleat shall be added for payment. Neither any deduction nor anything extra shall be paid for skew cuts.

Rate: The rate shall include the cost of all the materials, labours involved in all the operations as described in nomenclature of item and particular specification.

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 sections including snap beadings fixed in place shall be measured in running meter along the outer periphery of composite section correct to a millimeter. The weight calculated on the basis of actual average (average of five samples) weight of composite section in kilogram correct to the second place of decimal shall be taken for payment (weight shall be taken after anodizing). The weight of cleat shall be added for payment. Neither any deduction nor anything extra shall be paid for skew cuts.

Rate

The rate shall include the cost of all the materials, 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.

ROLLING SHUTTERS

Supplying and fixing rolling shutters of approved make, made of required size GI laths, interlocked together through their entire length and jointed together at the end by end locks, mounted on specially designed pipe shaft with brackets, GI side guides and arrangements for inside and outside locking with push and pull operation complete, including the cost of providing and fixing necessary 27.5cm long wire springs manufactured from high tensile steel wire of adequate strength conforming to IS:4454 part 1 and GI top cover of required thickness for rolling shutters including two coats of approved make and colour synthetic enamel paint over two coats of approved make anticorrosive yellow zinc chromate primer, including cost and conveyance of all materials, labour charges, lead, lift etc. complete as directed by Engineer in Charge at all levels

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 metres correct to two places of decimal.

Rate

The rate shall include the cost of materials including painting 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.

Steel Work In Built Up Sections (Riveted and Bolted)

The steel work in built up section (Riveted and bolted) such as trusses, framed work etc. is specified in this clause.

Laying Out

A figure of the steel structure to be fabricated shall be drawn on a level platform to full scale. This may be done in full or in parts, as shown on drawings or as directed by the Engineer-in-Charge. Steel tape shall be used for measurements.

Fabrication

Fabrication shall generally be done as specified in IS 800. In major works or where so specified, shop drawings giving complete information for the fabrication of the component parts of the structure including the location, type, size, length and details or rivets, bolts or welds, shall be prepared in advance of the actual fabrication and approved by the Engineer-in-charge. The drawings shall indicate the shop and field rivets, bolts and welds. The steel members shall be distinctly marked or stenciled with paint with the identification marks as given in the shop drawings.

Great accuracy shall be observed in the fabrication of various members, so that these can be assembled without being unduly packed, strained or forced into position and when built up, shall be true and free from twist, kinks, buckles or open joints. Wooden or metal sheet templates shall be made to correspond to each member, and position of rivet holes shall be marked accurately on them and holes drilled. The templates shall then be laid on the steel members, and holes for riveting and bolting marked on them. The ends of the steel members shall also be marked for cutting as per required dimensions. The base of steel columns and the positions of anchor bolts shall be carefully set out at the required location.

The steel section shall be straight or to be straightened or flattened by pressure unless required to be of curvilinear form and shall free from twists. These shall be cut square either by shearing or sawing to correct length and measured by steel tape. No tow pieces shall be welded or joined to make up for the required length of member.

Making Holes: Holes through more than one thickness of materials for members, such as compound stanchion and girder flanges shall, where possible, be drilled after the members are assembled and tightly clamped or bolted together. Punching may be permitted before assembly, provided the holes are punched 3mm less in diameter than the required size and reamed after assembly to the full diameter. The thickness of material punched shall be not greater than 16 mm.

Rivet Holes

The diameter for rivets and black bolts holes shall be taken as the nominal diameter of a rivet/ black bolts plus 1.5 mm for rivets/ bolts of nominal diameter less than or equal to 25mm" and 2.0 mm for rivets of nominal diameter exceeding 25 mm, unless specified otherwise. Holes for turned and fitted bolts shall be drilled or reamed large by 0.2 to 8 mm depending upon the dia. of bolts. Holes shall have their axis perpendicular to the surface bored through. The drilling or reaming shall be free from

burrs, and the holes shall be clean and accurate. Holes for rivets and bolts shall not be formed by gas cutting process.

Holes for counter sunk bolts shall be made in such a manner that their heads sit flush with the surface after fixing.

Assembly : Before making holes in individual members, for fabrication and steel work intended to be riveted or bolted together shall be assembled and clamped properly and tightly so as to ensure close abutting, or lapping of the surfaces of the different members. All stiffeners shall be fixed (or placed) tightly both at top and bottom without being drawn or caulked. The abutting joints shall be cut or dressed true and straight, and fitted close together.

Web plates of girders, which have no cover flange plates, shall have their ends flush with the tops of angles unless otherwise required. The web plate when spliced, shall have clearance of not more than 5mm. The erection clearance of cleated ends of members connecting steel to steel shall preferably be not greater than 1.5 mm. The erection clearance at the ends of beams without web cleats shall not be more than 3 mm at each end but where for practical reasons, greater clearance is necessary, seating designed suitably shall be provided.

Column splices and butt joints of struts and compression members *requiring c*ontact for tress transmission shall be accurately, machined and close butted over the whole section. In column caps and bases, the ends of shafts together with the attached gussets, angles, channels etc. after riveting together shall be accurately machined so that the parts connected, butt against each other over the entire surfaces of contact. Connecting angles or channels shall be fabricated and placed in position with great accuracy so that they are not unduly reduced in thickness by machining. The ends of all bearing stiffeners shall be machined or grounded to fit tightly both at top and bottom.

Riveting : Rivets shall be used, where slip under load has to be avoided. Preliminaries before Rivetings:- Members to be riveted shall have all parts firmly placed and held together before and during riveting, and special care shall be taken in this respect for all single riveted connections. For multiple riveted connections, a service bolt shall be provided in every third or fourth hole.

Process of Riveting

The riveting shall be carried out by using machines of the steady pressure type. However, where such facilities are not available hand riveting may be permitted by the Engineer-in-charge. The rivets shall be heated red hot, care being taken to control the temperature of heating so as not to burn the steel. Rivets of diameter less than10mm may be driven cold. Rivets shall be finished neat with heads full and of equal size. The heads shall be central on shanks and shall grip the assembled members firmly. All loose, burnt, or badly formed rivets with eccentric or deficient heads shall be cut out and replaced. In cutting out rivets, care shall be taken so as not to injure the assembled members. Caulking and recapping shall not be permitted.

For testing rivets, a hammer weighing approx. 0.25 kg shall be used and both heads of the rivet (Specially the machine head) shall be tapped. When so tested, the rivets shall not give a hollow sound and a jar where so specified, other tests shall be carried out to ensure the soundness of rivets. All rivets heads shall be painted with approved steel primer paint within a week of their fixing.

Bolting : The nominal length of the bolt shall be the distance from the underside of the head to the further end of the shank. The nominal diameter of the bolt shall be the diameter at the shank above the screwed threads. Bolts, nuts and washers shall be thoroughly cleaned and dipped in double boiled linseed oil, before use. All bolts heads and nuts shall be hexagonal unless specified otherwise. The screwed threads shall conform to IS 1363 and the threaded surface shall not be tapered. The bolts shall be of such length as to project at least two clear threads beyond the nuts when fixed in position, and these shall fit in the holes without any shake. The nuts shall fit in the threaded ends of bolts properly. Where necessary, washers shall be tapered or otherwise suitably shaped to give the heads and nuts of bolts a satisfactory bearing. The threaded portion of each bolt shall project through the nut at least two thread. In all cases where the full bearing area of the bolt is to be developed, the bolt shall be provided with a washer of sufficient thickness under the nuts to avoid any threaded portion of the bolt being within the thickness of the parts bolted together.

Where there is a risk of the nuts being removed or becoming loose due to vibrations or reversal of stresses, these shall be secured from slackening by the use of lock nut, spring washers as directed by the Engineer-in-charge.

Erection

Steel members shall be hoisted and erected in position carefully, without any damage to itself, other structures and equipment and injury to workmen. The method of hoisting and erection proposed to be adopted by the contractor shall be got approved from the Engineer-in-charge in advance. The contractor however shall be fully responsible for the work being carried out in a safe and proper manner without unduly stressing the various members and proper equipment such as derricks, lifting tackles, winches, ropes etc. shall be used.

The work of erection may be done in suitable units as may be directed by the Engineer-in-Charge. Fabricated members shall be lifted at such points so as to avoid deformation or excessive stress in members. The structure or part of it placed in position shall be secured against over-turning or collapse by suitable means. During execution, the steel members shall be securely bolted or otherwise fastened when necessary temporarily braced to provide for all loads including those due to erection equipments and its operation to be carried safely by structure during erection. The steel members shall be placed in proper position as per approved drawing, final riveting or permanent bolting shall be done only after proper alignment has been checked and confirmed.

Trusses shall be lifted only at nodes. The trusses above 10 m in span shall not be lifted by slinging at two mid points of rafters, which shall be temporary braced by a wooden member of a suitable section. After the trusses are placed in position, purlins and wind bracings shall be fixed as soon as possible. The end of the truss which faces the prevailing winds shall be fixed with holding down bolts, and the other end kept free to move. In case of trusses of spans upto 10m the free end of the truss shall be laid on lead sheet or steel plate as per design, and the holes for holding down bolts shall be made in the form of oblong slots so as to permit the free movements of the truss end. For larger spans the truss shall be provided with proper bearing as per design.

Columns and stanchions shall be erected truly vertical with the necessary cross bracing etc. and the base shall be properly fixed with the foundation concrete by means of anchor bolts etc. as per drawing.

Anchor bolts to be placed in the concrete foundation should be held in position with a wooden template. At the time of concreting anchor bolt locations shall be provided with suitable timber mould or pipe sleeve to allow for adjustment which shall be removed after initial setting of concrete. The spaces left around anchor bolts shall be linked to a stopping channel in the concrete leading to the side of the pedestal and on the underside of the base plate to allow the spaces being grouted up after the base plate is fixed in the position along with the column footing. Grouting shall be of cement mortar 1:3(1 cement: 3 coarse sand) or as specified.

Bedding of Column, Stanchions etc.:- Bedding shall not be carried out until the steel work has been finally levelled, plumbed and connected together. The stanchion shall be supported on steel wedges and adjusted to make the column plumb. For multistoried buildings, the bedding shall not be done until sufficient number of bottom lengths of stanchions have been properly lined, levelled and plumbed and sufficient floor beams are fixed in position. The base plates shall be wedged clear of the bases by M.S. wedges and adjusted where necessary to plumb the columns. The gaps under the base plate may be made upto 25 mm which shall be pressure grouted with cement grouts. With small columns, if permitted by the Engineer-in-charge, the column base shall be floated on a thick cement grout on the concrete pedestal. The anchor bolt holes in the base plate may be made about 10 to 15 mm larger than the bolts. In such cases suitable washers shall be provided.

Painting

Before the members of the steel structure are placed in position or taken out of the workshop these shall be painted as specified

Measurements

The work as fixed in position shall be measured in running metres correct to a millimeter and their weight calculated on the basis of standard tables correct to the nearest kilogram. The standard weight of steel sections shall conform to IS 808 with tolerance in sizes as per IS 1852. Steel sections shall be acceptable within tolerance limits. Payment for steel sections shall be made as per actual weight within tolerances. Sections having weight on higher side than permissible tolerance, may be acceptable but payment shall be made on the basis of standard weight only. Steel sections having weight variations lower than permissible variation shall not be acceptable.

Unless otherwise specified. Weight of cleats, brackets, packing pieces, bolts nuts, washers, distance pieces, separators diaphragm gussets (taking overall square dimensions) fish plates etc. shall be added to the weight of respective items. No deductions shall be made for skew cuts. In riveted work, allowance is to be made for weight of rivet heads. Unless otherwise specified and addition of 2.5% of the weight of structure shall be made for shop and site rivet heads in riveted steel structures. No deduction shall be made for rivet/ or bolt holes (excluding holes for anchor or holding down bolts). Deduction in case of rivet or bolt hole shall, however, be made if its area exceeds 0.02 m2. The weight of steel sheet and strips shall be taken from relevant Indian Standards based on 7.85 kg/m2 for every millimeter sheet thickness. For rolled sections, steel rods and steel strips, weight given in relevant Indian Standards shall be used.

Rate

The rate shall include the cost of all materials and labour involved in all the operation described above.

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.

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.

STAINLESS STEEL WORK

The Stainless steel railing pipes, hardware's & accessories of specified grade to be supplied and installed at site as per the above mentioned specifications as per BOQ , drawings and approved by the Engineer-in-Charge.

Material Properties:

The material properties of stainless steel pipes and accessories should be conforming to SS 304 grade.

Stainless Steel Works

The stainless steel pipes shall be procured from approved manufacture and of approved grade. The quality of stainless steel sheet and pipe shall be approved by Client/Consultant before proceeding with execution any item of work.

Hand Rail

The pipe used for handrail shall be of 16 gauge thick. The welded links are to be ground and organ buffed to get the original finish of the surface of the material welded. The joints or junctions where two pieces are joined/welded to be precisely cut and then welded.

Surface Finish

Surface finish of all the stainless steel materials will be satin finish free from all marks and blemishes.

Execution

The execution shall be carried out at site respectively as per the BOQ and drawings.

Accessories

Fixing will be done by stainless steel bolts and joining shall be with SS connectors of approved type, size and make as per direction of Engineer-in-charge and welding to be done by using organ welding rods and the surface being duly finished and cleaned by K_2 passivation, which is nitric acid plus fluoric acid solution treatment by which the chances of corrosion will be eliminated and any burn out makes on the metal will also be eliminated.

Final Cleaning:-

Protective coating and warning markings shall remain undisturbed until final acceptance. Immediately prior to final inspection, temporary protective covering or coating shall be removed and surfaces shall be washed with a suitable thinner and left in a finished condition having approved uniform appearance and free from all marks and blemishes.

Fabrication & Tolerances

Unless otherwise shown on the drawing, the fabricating tolerances shall generally be as follows:

Straightness: Compression members shall not deviate from straightness by more than 1/1000 of the axial length between points, which are to be laterally supported.

Completed members shall be free from twist bends and open joints. Sharp links or bends shall be cause for rejection of material.

Length: of 1mm is permissible in the overall length of members with parts of the structure, shall have a variation for the detailed length not greater than 2mm for members 10 meters or less in length and not greater than 3mm for members over 10 meters in length.

Inspection:-

The Agency should arrange for factory inspection of all stainless steel material and glass to ascertain the quality of material i.e. stainless steel fixtures / accessories and glass as per manufacturer's standard / BIS / ASTM standard, including lamination of glass as per specification to the satisfaction of Engineer in charge.

Measurement

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 & Rates shall be inclusive of all stainless steel pipes and fittings required vertically or horizontally per running meter of composite section of railing including all stainless steel components complete as per the BOQ as required. Glass railing shall be measured in running meter.

Rate

The rate shall include the cost of all materials like, 12mm toughed glass,Stainless Steel pipes, Stainless steel fitting & accessories, other fixing material ,T & P, scaffolding and labour involved in all the operations described above including fixing/installation, lead & lift etc. as applicable.

7.0 FLOORING WORKS

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

General

The tiles shall be of approved make and shall generally conform to IS 15622. They shall be flat, and true to shape and free from blisters crazing, chips, welts, crawling or other imperfections detracting from their appearance. The tiles shall be square of nominal size and of thickness as per drawing's requirement and as directed and approved by the Engineer-in-Charge. The tiles shall be sound, true to shape, flat and free from flaws and other manufacturing defects affecting their utility.

The top surface shall be free from welts, chips, craze, specks, crawling or other imperfections detracting from the appearance when viewed from a distance of one metre.

The top surface of tiles shall be either polished or matt as specified.

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.

8. FINISHING WORKS

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.

Application

The plaster shall be applied in two coats i.e. 12 mm under coat and then 6 mm finishing coat and shall have an average total thickness of not less than 18 mm.

***12 mm Under Coat* :** This shall be applied as specified except that when the plaster has been brought to a true surface a wooden straight edge and the surface shall be left rough and furrowed 2 mm deep with a scratching tool diagonally both ways, to form key for the finishing coat. The surface shall be kept wet till the finishing coat is applied.

6 mm Finishing Coat : The finishing coat shall be applied after the under coat has sufficiently set but not dried and in any case within 48 hours and finished in the manner specified

Specifications for Curing, Finishing, Precautions, Measurements and Rate shall be as described

6mm Cement Plaster on Cement Concrete and Reinforced Cement

Concrete Work

Mortar

The mix and type of fine aggregate specified in the description of the item shall be used for the respective coats. Generally the mix of the finishing coat shall not be richer than the under coat unless otherwise described in item. Generally coarse sand shall be used for the under coat and fine sand for the finishing coat, unless otherwise specified for external work and under coat work, the fine aggregate shall conform to grading zone IV. For finishing coat work the fine aggregate conforming to grading zone V shall be used.

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.

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 centring 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. correct 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 theother 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 later 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 exterior primer

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.

WALL PAINTING WITH PLASTIC EMULSION PAINT

The plastic emulsion Paint is not suitable for application on external, wood and iron surface

and surfaces which are liable to heavy condensation. These Paints are to be used on internal surfaces except wooden and steel. Plastic Emulsion Paint as per IS 5411 of approved brand and manufacture and of the required shade shall be used.

Painting on New Surface

The surface shall be thoroughly cleaned and dusted off. All rust, dirt, scales, smoke splashes, mortar droppings and grease shall be thoroughly removed before painting is started. The prepared surface shall have received the approval of the Engineer-in-Charge after inspection, before painting is commenced.

Application : The number of coats shall be as stipulated in the item. The Paint will be applied in the usual manner with brush, spray or roller. The Paint dries by evaporation of the water content and as soon as the water has evaporated the film gets hard and the next coat can be applied. The time of drying varies from one hour on absorbent surfaces to 2 to 3 hours on non-absorbent surfaces.The thinning of emulsion is to be done with water and not with turpentine. Thinning with water will be particularly required for the under coat which is applied on the absorbent surface. The quantity of water to be added shall be as per manufacturer's instructions.

The surface on finishing shall present a flat velvety smooth finish. If necessary more coats will beapplied till the surface presents a uniform appearance.

Precautions

(a) Old brushes if they are to be used with emulsion Paints, should be completely dried of turpentine or oil Paints by washing in warm soap water.Brushes should be quickly washed in water immediately after use and kept immersed in water during break periods to prevent the Paint from hardening on the brush.
(b) In the preparation of wall for plastic emulsion painting, no oil base putties shall be used in filling cracks, holes etc.
(c) Splashes on floors etc. shall be cleaned out without delay as they will be difficult to remove after hardening.
(d) Washing of surfaces treated with emulsion Paints shall not be done within 3 to 4 weeks of application.

PAINTING WITH SYNTHETIC ENAMEL PAINT

Synthetic Enamel Paint (conforming to IS 2933) of approved brand and manufacture and of the required colour shall be used for the top coat and an undercoat of ordinary Paint of shade to match the top coat as recommended by the same manufacturer as far the top coat shall be used.

Painting on New Surface

Wooden Surface : The wood work to be painted shall be dry and free from moisture.The surface shall be thoroughly cleaned. All unevenness shall be rubbed down smooth with sand paper and shall be well dusted. Knots, if any shall be covered with preparation of red lead

made by grinding red lead in water and mixing with strong glue sized and used hot. Appropriate filler material conforming to IS 345 with same shade as Paint shall be used where specified. The surface treated for knotting shall be dry before Paint is applied. After obtaining approval of Engineer-in-Charge for wood work, the priming coat shall be applied before the wood work is fixed in position. After the priming coat is applied, the holes and indentation on the surface shall be stopped with glazier's putty or wood putty.

Stopping shall not be done before the priming coat is applied as the wood will absorb the oil in stopping and the latter is therefore liable to crack.

Iron & Steel Surface : All rust and scales shall be removed by scrapping or by brushing with steel wire brushes. Hard skin of oxide formed on the surface of wrought iron during rolling which becomes loose by rusting, shall be removed. All dust and dirt shall be thoroughly wiped away from the surface. If the surface is wet, it shall be dried before priming coat is undertaken.

Plastered Surface : The surface shall ordinarily not be painted until it has dried completely. Trial patches of primer shall be laid at intervals and where drying is satisfactory, painting shall then be taken in hand. Before primer is applied, holes and undulations, shall be filled up with plaster of paris and rubbed smooth.

Application : The number of coats including the undercoat shall be as stipulated in the item.
(a) Under Coat : One coat of the specified ordinary Paint of shade suited to the shade of the top coat, shall be applied and allowed to dry overnight. It shall be rubbed next day with the finest grade of wet abrasive paper to ensure a smooth and even surface, free from brush marks and all loose particles dusted off.
(b) Top Coat : Top coats of synthetic enamel Paint of desired shade shall be applied after the undercoat is thoroughly dry. Additional finishing coats shall be applied if found necessary to ensure properly uniform glossy surface.

Painting on Old Surface

Preparation of Surface : Where the existing Paint is firm and sound it shall be cleaned of grease, smoke etc. and rubbed with sand paper to remove all loose particles dusted off. All patches and cracks shall then be treated with stopping and filler prepared with the specified Paint. The surface shall again be rubbed and made smooth and uniform.
Painting : The number of coats as stipulated in the item shall be applied with synthetic enamel Paint. Each coat shall be allowed to dry and rubbed down smooth with very fine wet abrasive paper, to get an even glossy surface. If however, the surface is not satisfactory additional coats as required shall be applied to get correct finish.

9.0 MISCELLANEOUS BUILDING WORKS

MANHOLE COVERS & FRAMES

Manhole Covers

The covers and frames shall conform to IS 1726 for cast Iron and IS 12592 for pre-cast concrete covers and shall be of the following grades and types. Grades Grade Type/shape of cover Designation Light Duty LD - 2.5 Rectangular, Square, Circular Medium Duty MD - 10 Rectangular, Circular and Square (for pre-cast concrete manhole covers) Heavy Duty HD - 20 Circular-Square, Rectangular, (Scrapper Manhole) Extra Heavy Duty EHD - 35 Circular, Square, Rectangular, (Scrapper Manhole)

Cast Iron Manhole Covers and Frames

(i) Manhole covers and frame shall be manufactured from appropriate grade of grey cast iron not inferior than FG150 grade of IS 210.
(ii) They shall be cleanly cast and shall be free from air and sand holes, cold shuts and warping. (iii) Covers shall have on its operative top a raised chequered design to provide for an adequate no-slip grip. The rise of chequers shall be not less than 4mm.
(iv) Key holes, keys and lifting devices shall be provided in the manhole covered to facilitate their placement in the frames and their operative maintenance.
(v) Manhole covers and frames shall be coated with materials having base with a black bituminous composition. The coating shall be smooth and tenacious. It shall not flow when exposed to temperature of 63°C and shall not be so brittle as to chip off at temperature of 0°C.
(vi) Size and shape and performance requirement of manhole covers and frames shall conform to IS 1726.
(vii) Each manhole covers and frame shall have cast on them the following information:
(a) Manufacturer's name or trade-mark
(b) Grade designation
(c) Date of manufacturer
(d) The words SWD or 'Sewer' to denote 'storm water drain' or 'sewer' respectively
(e) Identification marks as required by Engineer-in-Charge.
(viii) The cover shall be gas tight and water tight.
(ix) The sizes of covers specified shall be taken as the clear internal dimensions of the frame.
(x) The approximate weight of the various type of manhole covers and frames shall be as per IS 1726.
(xi) The cover shall be capable of easy opening and closing and it shall be fitted in the frame in workmanship like manner.

Measurements:
The manhole covers shall be enumerated under relevant items.

Rates:
The rate shall include the cost of materials and labour involved in all the operation described above.

FIBRE REINFORCED ELASTOMERIC LIQUID WATER PROOFING MEMBRANE WITH RESILIENT ACRYLIC POLYMERS

Material

Fibre reinforced elastomeric liquid water proofing membrane is a ready-to-use waterproofing, white product,
with high solar reflectance and Sun Reflectivity Index (SRI) of 105, for external applications. This is made from resilient acrylic polymers and synthetic resins in water dispersion, and when dry forms a continuous, flexible waterproofing membrane. This is resistant to all atmospheric conditions and UV rays, and guarantees longlasting protection for the substrate.

Technical Specification/ Parameters:

1. Fibre reinforced elastomeric liquid water proofing membrane with fibers in water emulsion with high
reflectance and emissivity with a solar reflectance index SRI of 105 should comply with the requirements of EN 1504-9 ("Products and systems for protecting and repairing concrete structures: definitions, requirements, quality control and conformity assessment. General principles for the use of products and systems") EN 1504-2 coating (C) principles PI, MC and IR ("Concrete surface protection systems").

2. This should posses a paste like consistency having highly reflective white colour.
3. This should have density of 1.35 with dry solid content of 61.4%.
4. This should have minimum tensile strength of 1.0N/mm² as per ISO 37 or ASTM D-412.
5. This should confirm to results after testing as per EN1062-11 for exposure to artificial weather conditions.
6. The Sun Reflectivity Index when tested as per ASTM E1980 should be 105 minimum.
7. Elongation at break (% age) of 150 % minimum as per ASTM D-412.
8. Adhesion strength is more than 1.0 N/mm2 as per ASTM D-4541.

Applications

It is to be applied using a long-haired roller, brush or spray on any horizontal, sloping or vertical surfaces to form a string, flexible, tack-free dry surface, suitable for occasional light foot traffic. This can with stand normal expansion and contraction stresses caused by temperature variations due to its flexibility. This also helps lower the working temperature of roofs and guarantees good energy performance properties of all the layers of the roof.

Preparation of Surface

All the substrates, whether they are new or old, must be sound, clean, dry and free of all traces of oil, grease, old paint, rust, mould and nay other material which could compromise the bond. Application temperature may be from 70C to 400C.

Concrete and in general mineral substrates must be sound and dry with no rising damp. Any loose parts must be removed with wire brushes. All wax, water-repellent treatments, etc. must be removed from the surface of ceramic substrates with a suitable detergent and/ or by sanding. Any hollows and gaps in the surface must be repaired properly with appropriate material as described and instructed by the manufacturer of this product. The tools to be used must be properly cleaned.

Application Procedure

All the area of operation shall be thoroughly cleaned as described in para 22.15.3 above. Mix the content in such a manner that they are perfectly blended into a homogenous state of liquid which can be applied by long haired roller or airless spray. The fibre reinforced elastomeric liquid water proofing membrane with resilient acrylic polymers shall be applied on top of concrete roof in three coats @ 10.76 litre/10 sqm or more as recommended by manufacturer specification. One coat i.e. first coat of self priming elastomeric water proofing liquid. The material shall be diluted with water in the ratio of 3:1 (3 parts of elastomeric water proofing liquid and 1 part of water). Wait until the first coat is completely dry and becomes slightly darker in colour. After the first coat has dried completely apply second coat with undiluted elastomeric water proofing liquid in a cross direction to the previous coat. After the drying of second coat completely apply the final coat of undiluted elastomeric water proofing liquid in a direction perpendicular to previous coat. The overall dry film thickness should not be less than 500 microns or more as specified in manufacturer specification. Protect the membrane from rain unless it is completely dry. The overall consumption of the material should be as per nomenclature of the item and should also adhere to the specifications detailed in the approved schedule of the manufacturer.

Measurement
The length and breadth/ height shall be measured in running metre correct to two places of decimal and the area of applications should be measured in sqm correct to two places of decimal.

Rate

The rate shall be include the cost of all the labour and material involved in all the operations described above.

POLYMER MODIFIED FLEXIBLE CEMENTATIOUS NEGATIVE SIDE WATERPROOFING COATING WITH ELASTIC WATERPROOFING POLYMERS

Material

Flexible cementatious negative side waterproofing coating with elastic waterproofing polymers is a onecomponent, concentrated liquid admixture used to enhance the performance of cementations repair mortars, plasters, stuccos, concrete mixes and toppings for restoration of horizontal, vertical and overhead concrete; concrete masonry units (CMU); and masonry surfaces.

Technical Specification/ Parameters:

1. Flexible cementations negative side waterproofing coating with elastic waterproofing polymer should have PH value of 7 and consist of liquid state.
2. This should have the density of 1.02 gm per ml.
3. This should posses the property of application in undiluted as well as diluted form.
4. This should be non-reemulsifiable.

Applications

It is to be applied using a long-haired roller, brush or spray on any horizontal, sloping or vertical surfaces to form a string, flexible, tack-free dry surface. This is easy to use and control in construction works for water proofing of the surface and optimizes bond to concrete substrates. It also improves resistance to abrasion and freeze/ thaw cycles.

Preparation of Surface

All substrates must be structurally sound, stable and solid, with all loose material removed. Thoroughly clean the surface of any substance that could interfere with the bond of the installation material, including dirt, paint, tar, asphalt, wax, oil, grease, latex compounds, from release agents, laitance, foreign substances pre existing paint film & loose particles till plaster is visible and any other residues. Concrete surfaces must be mechanically profiled and prepared by shotblasting, sandblasting, diamond-grinding, water-jetting, scarifying or other engineer-approved methods to obtain an acceptable profile. Concrete substrate and ambient room temperatures must be maintained between 45°F and 95°F (7°C and 35°C) before application. Temperatures must be maintained within this range for at least of 72 hours after the application coating. Application temperature varies from 7°C to 40°C.

Application Procedure

Apply the coating on to this sound and dry surface using a long-haired roller, brush or spray. The dilution of the compound the water should be done in a clean mixing pail. The polymer modified flexible cementatious negative side water proofing coating with elastic water proofing polymers shall be applied on interior wall plaster surface in three coats @ 14.35 kg/10 sqm or more as recommended by manufacturer specification. The ratio of mixing with water is to be done in accordance with the nomenclature of the item along with corresponding coats and manufacturer specifications. One coat i.e. first coat of self priming cementatious water proofing polymers shall be applied on to the properly prepared and dried surface (diluted with water in the ratio of 1:1). Another coat shall be applied when the coat below is still wet. Two coats of cementatious water proofing polymers (diluted with water in the ration of 3:1) over the first coat applied. All the coats shall be applied in perpendicular direction to each other. The final surface is to be protective from excessive heat or draft conditions during the first 24 to 72 hours. Final surface should be cured for at least 5 to 7 days. Use of damp burlap, polyethylene sheeting or water-based curing compound is also recommended to be used for curing.

Measurement

The length and breadth/ height shall be measured in running metre correct to two places of decimal and the area of applications shall be measured in sqm correct to two places of decimal.

Rate

The rate shall be include the cost of all the labour and material involved in all the operations described above.

LIST OF APPROVED MAKE

1.	Cement	Malabar, Ultra Tech, Zuari, Ramco, ACC, India Cements, Dalmia, Ambuja, J.P. Rewa, Vikram, Shri Cement, Birla Jute and Cement Corporation of India, Chettinadu, JSW Cement 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.	Cement Concrete floor tiles	Eurocon Tiles, Excello or equivalent as approved
6.	Tile Adhesive /Epoxy Grout	Ardex Endura (India) Pvt. Ltd, MYK Laticrete, Kerakoll India Pvt. Ltd, Eurobuild Construction Chemicals & Coating, Bostik, MAPEI BASF, Pidilite, Sunanda Speciality Coatings Pvt. Ltd, Kunal Conchem Private Ltd. or equivalent as approved
7.	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, Bostik, Sunanda Speciality Coatings Pvt. Ltd, Kunal Conchem Private Ltd.. or equivalent as approved
8.	Industrial Flooring	Euro Build, BASF, Fosroc, Sika, Pidilite or Equivalent as approved

9.	Metallic Hardener	BASF, Fosroc, Sika, Kironite, Eurobuild Construction Chemicals & Coating or equivalent as approved
10.	Integrated water proofing	India water proofing, Sika, Pidilite, BASF, Fosroc, Euro Build, Bostik, MAPEI, The Structural Waterproofing co. Pvt.Ltd. / CHRYSO or equivalent
11.	Water proofing compound	Roffe, Fosroc, Sika, Pidilite, Structural Waterproofing Co.Pvt. Ltd, BASF, Eurobuild Construction Chemicals & Coating, Bostik, MAPEI, CICO Technologies Ltd., Sunanda Speciality Coatings Pvt. Ltd, Kunal Conchem Private Ltd., The Structural Waterproofing co. Pvt.Ltd. / CHRYSO, MYK Schomburg or equivalent as approved
12.	Paint & Primer, Distemper	ICI (Akzonobel), Berger, Asian, Jotun or equivalent as approved
13.	Water Proof Cement paint	Super Snowcem, Supercem or equivalent as approved
14.	Sealers	ICI (Akzonobel), Berger, Asian, Euro Build or equivalent as approved
15.	Primer	Altek, Berger, Asian, ICI , Jotun or equivalent as approved
16.	Synthetic Enamel Paints & Primer	ICI (Akzonobel), Asian Paints, Berger, Jotun or equivalent as approved
17.	Epoxy Paint	ICI (Akzonobel),Asian Paints, Berger, Jotun or equivalent as approved
18.	Protective Paints	AkzoNobel, Jotun India Private Limited, Berger Paints India Limited, Asian Paints Ltd, Grand

		Polycoats Co. (P) Ltd, Euro Build, Hempel Paints, CIPY Polyurethanes Pvt Ltd, MYK Schomburg 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 Kaba Security Systems Pvt. Ltd., Magnum, Ozone Overseas Pvt. Ltd, Dorma or equivalent as approved
22.	Patch Fittings	Dorma, Savex, Niki, Ozone, D-line 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.	Plain float glass /lacquered glass & Mirror	Saint Gobain, Asahi, Pilkington ,Modiguard or equivalent as approved
26.	Silicon Sealant	Dow corning, GE Silicon, Euro Build, CIPY Polyurethanes Pvt Ltd, MYK Schomburg or equivalent as approved
27.	Chemical /Mechanical Anchor Fasteners	HILTI, Fisher, MKT (Germany), Black and Decker India Ltd., MAPEI, SS Fasteners Pvt. Ltd or equivalent as approved.
28.	Plasticisers, Non shrink grout	Fosroc, BASF, Krishna conchem, Fairmate, Eurobuild Construction Chemicals & Coating, MYK Schomburg or equivalent as approved

29.	Admixtures	FOSROC, Polygon, STP, BASF, CERACHEM, Don Chemicals, Sika, Eurobuild Construction Chemicals & Coating, MAPEI, Bostik, MYK Schomburg, Sunanda Speciality Coatings Pvt. Ltd, Kunal Conchem Private Ltd., The Structural Waterproofing co. Pvt.Ltd. / CHRYSO or equivalent as approved
30.	Weather proof coating	Fosroc, BASF, Sika, Euro build, Pidilite or equivalent as approved
31.	Anti-Corrosive coating for Structural steel, Aluminium, FRP, Wooden, Plastic, Glass surfaces & Concrete.	Grand Polycoats or equivalent as approved

TECHNICAL SPECIFICATIONS –ELECTRICAL WORKS

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 LT Panel Boards, Power & control cables, Internal lighting and earthing network etc. Requirement shall be as specified in schedule of requirements/approved drawing of the Purchaser or as per the battery limits fixed by the Client/consultant. The bidder shall furnish complete details of the equipment with all necessary drawings.

The tender specifications consists of 9 sub heads as shown below:

1. LT Panel boards
2. Cables and Cabling.
3. Earthing & Safety Equipment
4. Wiring and Accessories
5. MCB Distribution Board and Accessories
6. Measurement
7. Approved makes of Equipment and Materials
8. Category Requirement of Test Certificate / Inspection
9. Abbreviations

1.0 LT Panel boards

GENERAL

This Section covers the detailed requirements of medium voltage switch gear Panel for 415V, 3 phase 50Hz, 4 wire system. All switchgears shall be fully rated at an ambient temperature of 40 ^{0} C. All the switch boards are to be factory assembled, fabricated by a firm having CPRI test certificate for short circuit rating, temperature rise and IP classification for similar panels.
Switch Board Construction

The switch boards are to be manufactured / assembled as per the latest BIS/IEC specifications, IP42 classification for indoor duty, including special requirements of Kerala state Electrical Inspectorate and the detailed specifications mentioned. The panel shall be floor mounted, free standing type, suitable for indoor installation in dust, vermin proof construction and extensible type. The design shall include all provisions for safety

of operation and maintenance personnel. The general construction shall conform to IS: 8623/1993 for factory assembled switch board.

Housing Details

The Switch Board shall be fabricated out of 14 SWG (2mm) CRCA sheet for frame and 1.5mm for door and internal partitions (except load bearing members). It shall be provided with hinged doors on the front with necessary handles and earthed using flexible copper conductor. The doors shall be provided with neoprene gaskets. Suitable channel base frame should be provided for the panel board.

Detachable gland plates of 3mm thick shall be provided at the bottom and top of the cable chamber, suitable for the termination of cables with compression type glands to the sizes as specified. Adequate space should be provided in the cable chamber for safe bending and termination of runs of cables and size as required.

The enclosure shall be provided with lifting hooks, supporting legs and double earth terminals with double washers.

The switch board shall be in cubicle design (each feeder components are housed in individual cubicle) and fully compartmentalized having total segregation between each cubicle. Suitable cable and busbar alleys shall be provided. All components of the switch board shall be approachable from front. The Busbar chamber cover should be bolted type. The maximum operating handle/push button height of any feeder shall not be more than 1800 mm with reference to panel bottom. Supporting arrangement for dressing of power and control cables in cable alleys also shall be provided. The front openable/lockable door shall act as a cover for the switch boards. When door is open no live parts are accessible from the front door open case. The busbar should be extendable at both ends. No busbar should be protruded in the cable alley. General construction shall employ the principle of compartmentalization and segregation for each circuit. Unless otherwise approved, incomer and bus section panels or sections shall be separate and independent and shall not be mixed with sections required for feeders. Each section of the rear accessible type panel shall have hinged access doors at the rear. Overall height of the panel shall not exceed 2.4 meters. Multi-tier mounting of feeder is permissible. The general arrangement for multi tier construction shall be such that the horizontal tiers formed present a pleasing and aesthetic look. The general arrangement and design of panels shall be got approved by client/consultant before fabrication. Cable entries for various feeders shall be either from top or bottom. Through cable alleys located in between two circuit sections, either in the rear or in the front of the panel. All cable terminations shall be through gland plates. There shall be separate gland plate for each cable entry so that there will not be dislocation of already wired circuits when new feeders are added. Cable entry plates shall therefore be sectionalized. The construction shall include necessary cable supports for clamping the cable in the cable alley or rear cable chamber.

Cubicle panels with more than 1000 Amps Busbar shall be made of suitable structural modular sections.

Necessary Eye bolt shall be designed and provided in the panel to take the dead load and dynamic loads during the unloading of the panels.

Powder coating

All metal sheets shall undergo 7tank metal treatment for CPRI approved panel thorough degreesing, water rinse, derusting, water rinse, phosphating, water rinse 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 undersurface shall be made free from all imperfections before undertaking powder coating.

The colour of the Panel shall be colour of paint light gray to shade RAL 7035, however the contractor shall obtain details of approved colour from the Engineer-in-charge before powder coating .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.

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 of incomer switch rating and interconnecting busbar to feeders should be rated to switch rating. Maximum current density permissible for Aluminium bus bars shall be 0.8 Amps/Sq.mm without considering derating factors. An earthing busbar size shall be suitable for withstanding the fault current and minimum 150 sq.mm section copper shall be provided outside panel at bottom throughout the length of the panel.

The bus bar system may comprise of a system of main horizontal bus bars and ancillary vertical bus bars run in bus bar alleys on either side of which the circuit could be arranged with front access cable entries. In the case of rear access, horizontal bus system shall run suitably either at the top or bottom. All connections to individual circuits from the bus bar shall preferably be solid connections.

The busbars shall be provided with heat shrinkable PVC insulating sleeve. Supports for busbars shall be made of suitable size cast resin ribbed insulators or SMC/DMC solid block type base 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 as per IS/IEC standards. The entire panel shall have a common earth bar of size as specified with two terminals for earth connections.

Power Connection

For power interconnections within the panel board rigid Aluminum conductor, with PVC insulation, of adequate cross section i.e., current carrying capacity not less than the outgoing switches 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.

In case of panel boards having busduct as incomer, the panel board should be designed to accommodate proper connection/termination of the bus duct. Adequate cable termination facility shall be made in the panel boards to terminate required runs and size of cables.

To prevent accidental contacts, all interconnecting cables/ busbars and all terminals also shall be shrouded. Provision for clamping the cables inside the cable alley should be provided.

Standard colour code of red, yellow and blue for phases and black for Neutral to be followed for all busbars/conductors.

Auxiliary wiring and Terminals

Wiring for all controls, protection, metering, signaling, etc. inside the switchboard shall be done with 650 volts grey colour minimum1.5sqmm HFFR (Halogen free fire retardant) copper conductor cables. Control wiring to components fixed on doors shall be flexible type. CT wiring shall be done with minimum 2.5 sq mm wires with colour code.

Wiring shall be suitably protected within switch board. Runs of wires shall be neatly bunched, suitably supported and clamped. All control wiring meant for external connections are to be brought out of terminal board.

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 ACBs, MCCBs, SDFUs, fuses, meters, relays and instruments, PLC etc. of size, capacity as specified in schedule of quantities and specification. The switch gears should be positioned inside the panel board as per manufacturers standards.

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 60947-1 for general rules and IS 13947-2/IEC 60947-2 for circuit breakers in all respects. MCCB shall be suitable for isolation as per standard, single phase 240V or three phase 415 V, 50Hz, AC and shall have a rated insulation voltage of 690 V AC. The MCCBs shall have thermal memory and shall have no Line-Load restriction. All the breakers shall have tropicalisation as a standard feature.

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/IEC 60947-2, 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 Service Breaking Capacity (Ics) equal to Ultimate Breaking capacity (Icu).

Protection

All breakers (except MCCB Isolator) shall have thermal magnetic based trip unit as specified in BOQ with adjustable overload protection 80% to 100% based of the nominal current(In). The short circuit protection should be adjustable from 6 to 10 times the rated current(Ir) with tripping time fixed.

MCCB should have the flexibility of connecting the load either on the top or on the bottom side without deration.

Accessories

MCCBs shall be provided with the following accessories and all these devices shall be fittable at site. The accessories shall be separated from Power circuit. Preferably the Shunt trip release and under voltage release shall be snap-in type and fitted with terminal blocks.

Shunt trip
Auxiliary switch
Extended rotary Handle.
2 NO + 2NC auxilliary contacts
Spreader
All the MCCBs terminals should be fitted with spreaders for accommodating aluminum cable termination.

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 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.

Measuring instruments

These shall be of square pattern having dimensions of 96x96 mm flush mounting type. Instruments like Multifunction Meter, ammeter, Voltmeter, frequency meter etc. and instrumental transformers/ transducers etc. are also included in the scope of supply. The accuracy class of all AC meters shall be as per schedule of quantity.

Voltmeter shall be suitable for direct line connection. Voltmeters shall be connected through MCBs only.

All voltmeters shall be provided with selector switches as per schedule of quantity.

Ammeters shall be CT operated wherever specified.

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 "5P" 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".

CTs used for REF protection in transformers and MSB shall have same ratio, compatible excitation and saturation characteristics required for reliable operation etc. preferably of same manufacturer.

Connection

Connections to the busbars shall be made by drilling holes. However, no holes shall be left in the busbars except at the both ends of the main busbar for panel extension. 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 sleeved 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 only rigid connections with heat shrinkable PVC sleeve shall be used. 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 minimum 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 (blue colour base & white letters engraved) screwed to panel. The size of each letters shall be 15mm x 10mm for Panel Board Identification name and remaining details shall be approprate size and it shall be clearly visible from 1.5 meter away from the panel. PVC identification ferrule numbers shall be used for all internal wiring. The name plate shall contain the following information.

- Panel Board Identification name & number
- Feeder name.
- Switch/ fuse rating.
- Cable size.

- Feeder Cable from …../ to…….
- CT Ratio

Supports

Busbars shall be rigidly fixed to the supports, 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 IEC/IS standards.
Indicating Lamps

On all the incomers of M.V panels, ON/OFF/TRIP indicating LED lamps shall be provided, whereever specified and shall be suitable for operation on AC supply. Phase indicating LED lamps shall be associated with necessary control MCB.

Type	:	Panel mounting wide band LED type within built surge suppressor to protect LED against switching surges and built-in low voltage glow protection of 25V.
Standards applicable	:	IEC 947-5-1
Diameter	:	22mm
Operating voltage	:	240V AC
Illumination Level	:	Minimum 100 lux on the front face of the lens.
Colour of lamps	:	as per standards

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.

INSTALLATION , TESTING AND COMMISSIONING

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.

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 insulation tester:

a)	Control circuits upto 220 V	:	by 500 V Insulation tester
b)	Power circuits, busbars, connections Upto 11kV	:	by 1000V Insulation tester
c)	Power circuits, busbars, connections above 33kV	:	by 5000V motor operated insulation tester

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 manufacturer'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.

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.

ii) Test operation of circuit breaker for micro process release using simulation kit (supplied along with panel).

iii) Test proper operation of lockout device in the closing circuit, wherever provided by simulating conditions, which would cause a lockout to occur.

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).

a) Between each phase of bus : Mega ohm

b) Between each phase and earth : Mega ohm

c) DC and AC control & auxiliary circuits : Mega ohm

d) 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 panels, 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.

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, rigid connections with heat shrinkable PVC sleeve 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.

2.0 CABLES & CABLING

Cables Scope

The scope under this section covers the following:

a) Power cables
b) Control cables

Armouring and Serving

All multicore cables liable for mechanical damage shall be armoured.

The armouring for cables above 16 sqmm. shall be galvanized steel strips and 16sqmm & below shall be with galvanized steel round wire.

Storage and handling

Storage:

(i) The cable drums shall be stored on a well-drained, hard surface, so that the drums do not sink in the ground causing rot and damage to the cable drums paved surface is preferred, particularly for long term storage.
(ii) The drums shall always be stored on their flanges, and not on their flat sides.
(iii) Both ends of the cables should be properly sealed to prevent ingress/absorption of moisture by the insulation during storage.
(iv) Protection from rain and sun is preferable for long-term storage for all types of cables. There should be enough ventilation between cable drums.
(v) Damaged battens of drums etc. should be replaced, as may be necessary.

Handling:

(i) When the cable drums have to be moved over short distances, they should be rolled in the direction of the arrow marked on the drum.
(ii) For manual transportation over long distances, the drum should be mounted on cable drum wheels, strong enough to carry the weight of the drum, and pulled by means of ropes. Alternatively, they may be mounted on a trailer or on a suitable mechanical transport.

(iii) For loading into and unloading from vehicles, a crane or a suitable lifting tackle should be used. Small sized cable drums can also be rolled down carefully on a suitable ramp or rails, for unloading, provided no damage is likely to be caused to the cable or to the drum.

Standards

The following standards, amended up to date, 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 XLPE insulated and PVC 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.
9. IS : 5819	:	Recommended short circuit ratings for high voltage PVC cables.

Power cables (LV) 1.1kV grade XLPE insulated cable

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 cable, strictly as per relevant IS specification. Unarmoured cable to be used only if specifically mentioned in schedule of requirements. Bi-metalic plate washers should be provided where ever cables, lugs, and switch terminals are of different materials. Cables and cable lugs should be of same material where ever possible and Core identification shall be by colour coding. The size of these cables shall be as specified in schedule of requirements or as per erection drawings.

Control Cables

Control cables for use on 415 V system shall be 1100 volts grade, copper conductor, PVC/XLPE insulated, PVC sheathed, round wire armoured and overall PVC sheathed, strictly as per IS : 1554 (Part I) – 1976 and IS 7098 part 1. Unarmoured cables to be used only if specifically mentioned in schedule of quantities. Control cable carrying current should be black colour and voltage circuit shall be of grey colour and shall be segregated and Core identification shall be by numerals.

The size of these cables shall be as specified in schedule of requirements or as per erection drawing. No cable of size less than 1.5 sq.mm. shall be used.

Cable Glands

Cable glands shall be of heavy duty compression type of brass, chrome plated. These shall have a screwed nipple with conduit electrical thread and checknut. These shall be suitable for armoured/unarmoured cables, which is being used.

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

All the cables shall be tagged at both ends with 2 mm thick aluminium strap.
Self-sticking type PVC identification numbers, ferrule shall be used for each wires.

Cable Route Markers

The specification of the cable route markers shall be as per SOQ.

Cables Tags:

Cable tags shall be made out of 2mm thick aluminum sheets/PVC, each tag 1-1/2 inch in dia with one hole of 2.5mm dia, 6mm below the periphery. Cable designations are to be punched with letter/number punches and the tags are to be tied inside the panels beyond the glanding as well as below the glands at cable entries. Trays tags are to be tied at all bends

G.I. Pipes for Cables

For laying of cables under floor, ground etc. G.I. class 'B' pipes shall be used. MS. conduits is not acceptable for this purpose. All accessories of pipes shall be threaded types. Size of pipe shall depend upon the overall outer diameter of cable to be drawn through pipe. No G.I pipe less than 40 mm dia. shall be used for this purpose. To determine the size of pipe, assume that 40% area of pipe shall be free after drawing of cable.

INSTALLATION, TESTING AND COMMISSIONING

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 IR Tester.

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 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 or 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.

n) All the openings made for the cable entry/exit shall be properly sealed using fire retardant mortar.

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/ Transformers 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.

Sufficient number of earth pits shall be provided, if found necessary and inter-connected so as to have the resistance of the earthing installations not more than 0.5 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.

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. 1956. MV installation should conform to I.S. 732/1989.

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)

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.

a) 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.

b) Width of trench: The width of the trench shall first be determined on the basis indicated herein. The minimum width of the trench for laying a single cable shall be 35 cm. Where more than one cable is to be laid in the same trench in horizontal formation, the width of the trench shall be increased such that the inter-axial spacing between the cables, except where otherwise specified, shall be at least 20 cm. There shall be a clearance of at least 15 cm between axis of the end cables and the sides of the trench.

c) Sand bedding using quarry sand of 75 mm thick shall be made below and above the cables. A layer of protecting covering with solid concrete block of 300 X 200 X 50 mm shall be laid breadth wise, above quarry sand bedding to cover cable completely. Warning tape indicating the symbol for danger and specified voltage shall be laid in-between cover block and trench top. More than one cable can be laid in the same trench .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.

e) For all underground cables, route markers should be used.
f) Separate cable route markers should be used for LT, HT and telephone cables.
g) Route markers should be grounded in ground with GI plate size as per SOQ.
h) Cable markers should be installed at an interval not exceeding 30 M along the straight routes of cables at a distance of 0.5 M away from center 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.
i) 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.
j) Road Crossing: The top surface of RCC hume pipes shall be at a minimum depth of 1m from the pavement level when laid under roads, pavements etc. with man holes at both ends of the pipes. The number of pipes to be laid should include sufficient number of spare pipes for future use.

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 on cable tray:

This method may be adopted in places like indoor substations, switch rooms, etc., or where long horizontal runs of cables are required within the building and where it is not convenient to carry the cable in open ducts. The cable trays may be either of perforated sheet type or of ladder type. The width of cable tray shall be chosen, so as to accommodate all the cables in one/two tier plus 30 to 50% additional width for future expansion. This additional width shall be minimum 100 mm. The overall width of one cable tray shall be limited to 900 mm. The cable tray shall be bonded to the earth terminal of the switchboards. Factory fabricated bends, reducers, tee/cross junctions, etc., shall be provided as per good engineering practice. The radius of bends, junctions etc., shall not be less than the minimum permissible radius of bending of the largest size of cable to be carried by the cable tray.

The cable tray shall be measured on unit length basis, along the center line of the cable tray, including bends, reducers, tees, cross joints.

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 without sagging. Structural bracket grounded in the buildup trenches to support the cable such supports shall be at intervals of not less than 750 mm centers. 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.

Laid on troughs/ trays duly clamped

The SS saddles and clamps used for fixing the cables on surface shall be 1 mm thick with fixing interval of 45 cm for cable of overall diameter up to 26 mm and 3mm thick 25mm wide with fixing interval of 60 cm for cable of overall diameter up to 45 mm. For cable of overall diameters above 45 mm the clamps shall be minimum of 3 mm thick 40 mm wide and fixing interval 60 cm. Additional clamping shall be provided at 30 cm from the center of bend on both sides. Saddles shall be secured with screws to suitable approved plugs. Clamps shall be secured with nuts on to the bolts, grouted in the supporting structure in an approved manner. In the case of single core cables, the clamps shall be of non-magnetic material. Suitable non-corrosive packing shall be used for clamping unarmored cables to prevent damage to the cable sheath. Cables shall be fixed neatly without undue sag or kinks. All MS components used in fixing the cables shall be either galvanized or given a coat of red oxide primer and finished with 2 coats of approved paint.

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 XLPE cable up to 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.

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
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

CABLE TRAY SYSTEM

CABLE TRAY:-

The cable tray and all accessories shall be fabricated from sheet steel and has to be hot dip galvanized as per IS-2629 & Zinc coating shall be as per IS-4759 and properties against corrosion confirming to EN10346/ ISO1461-1999 for installations in indoor and outdoor applications respectively. The cable trays shall be supplied in standard lengths of 2500/ 3000 mm and the width of the tray shall be as follows.

All the cable tray accessories like Bend's, TEES's, Cross over's etc. should be designed in accordance with IEC 61537 and shall be factory fabricated. The accessories shall be from the same material as of the tray and modular type, it should be connected with the trays by using fasteners. Typical details of trays, fittings and accessories. etc are shown in the enclosed drawings.

For Cable trays designed, tested and confirming to IEC 61537, thickness of cable tray should be according to the manufacturer's catalogue.

CABLE LADDER:-

The cable Ladder and all accessories shall be fabricated from sheet steel and has to be galvanized against corrosion confirming to EN10346 / ISO 1461-1999 for installations in indoor and outdoor applications respectively. The cable ladders shall be supplied in standard lengths of 3000 mm and the width of the ladder shall be as follows.

Maximum rung spacing in the ladder shall be 300mm. The rung's should be made of C profiles suitable to fix cables by special metal clamps according to the drawing. The ladder shall be of riveted and foldable type for easy transportation and to avoid damage during transportation and storage. All the ladder accessories like Bend's , TEES's, Cross over's etc should be designed in accordance with IEC 61537 and shall be factory fabricated . The accessories shall be made from the same material as of the ladder and modular type, it should be connected with the ladder by using fasteners. The details of ladders, fittings and accessories. etc. are shown in the enclosed drawing.

For Cable Ladders designed, tested and confirming to IEC 61537, thickness of cable Ladder should be according to the Boq.

COVER FOR CABLE TRAYS / LADDERS:-

Cover for trays/ladders to protect the cable insulation from falling objects, water droplets, harmful effects of ultraviolet rays and accumulation of dust. Covers shall be 1.6mm thick with line item as per BOQ.

MOUNTING ACCESSORIES (SUPPORTS AND BRACKETS):-

The mounting accessories shall be fabricated from steel and has to be hot dip galvanized against corrosion confirming to ISO 1461-1999 for installations in both indoor and outdoor applications and should be of completely modular type.

All supports and Brackets should be factory made, hot dip galvanized after completing welding, cutting, drilling, other machining operations and tested according to IEC 61537 according to the arrangements in the enclosed drawing. The system shall be designed such that it allows easy assembly at site by using Bolts and Nuts. The main support and brackets shall be fixed at site using necessary brackets, clamps, fittings, bolts, nuts and other hard ware etc to form various arrangements required to support the cable trays. Welding of the components at the site shall not be allowed.

Testing and Certification:-

Cable tray / Ladder, bend, T Bend, cross, and all supports are to be tested for Safe Working Load (SWL), deflections, Impact resistance, Salt Spray & Electrical continuity test according to IEC 61537. The cable tray/ladder should not deflect more than 1/100th of the span length at SWL in Mid span and the transverse deflection of all mounting accessories at SWL shall not exceed 1/20th of the length. The cable tray / cable ladder should be tested up to 1.7 times SWL at minimum and maximum room temperature. The temperature classification of cable tray system should be - 5 to + 150°C.

4.0 EARTHING AND SAFETY EQUIPMENTS

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 Sub station.

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

5.0 WIRING AND ACCESSORIES

WIRING SYSTEMS

SCOPE

This chapter covers the detailed requirements of wiring work in conduit system,casing and caping,trunking system etc.

Conduiting

All non- metallic conduit pipe and accessories shall be of suitable material complying with IS:2509-1973 and IS:3419-1989, IS: 9537(Part5)2000.

General requirements:

a. 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.

d. Flexible conduits will only be permitted for interconnections between ceiling rose/junction box to light fixtures, conduit terminations in wall and interconnection between switchgear, DB's.

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 under no 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.

b) 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.

c) The minimum width and the thickness of girder 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 .

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.

d) 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
1/1.5	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)

Installation of Conduit

(i) Conduit Joints

The erection of conduits of each circuit shall be completed before the cables are drawn in. All joints shall be sealed/cemented with approved cement. Damaged conduit pipes/fittings shall not be used in the work.

Cut ends of conduit pipes shall have neither sharp edges nor any burrs left to avoid damage to the insulation of conductors while pulling them through such pipes. The Engineer-in-charge, with a view to ensuring that the above provision has been carried out, may require that the separate lengths of conduit etc. after they have been prepared shall be submitted for inspection before being fixed.

(ii) Bends in conduit

All bends in the system may be formed either by bending the pipes by an approved method of heating, or by inserting suitable accessories such as bends, elbows or similar fittings, or by fixing non-metallic inspection boxes, whichever is most suitable. Where necessary, solid type fittings shall be used.Radius of bends in conduit pipes shall not be less than 7.5 cm.

No length of conduit shall have more than the equivalent of four quarter bends from outlet to outlet. Care shall be taken while bending the pipes to ensure that the conduit pipe is not injured, and that the internal diameter is not effectively reduced.

(iii) Outlets

All switches, plugs, fan regulators etc. shall be fitted in flush pattern. The fan regulators can be mounted on the switch box covers, if so directed by the Engineer-in-Charge.

After installation, all accessible surfaces of metallic accessories shall be painted. Conduit pipes shall be fixed by heavy gauge non-metallic saddles with base,secured to suitable approved plugs with screws in an approved manner, at an interval of not more than 60 cm, but on either side of couplers or bends or similar fittings, saddles shall be fixed at a closer distance from the centre of such fittings.

Slotted PVC saddles may also be used where the PVC pipe can be pushed in through the slots.

(iv) Fixing of conduits

Where the conduit pipes are to be laid along the trusses, steel joists etc. the same shall be secured by means of saddles or girder clips as required by the Engineer-in-Charge. Where it is not possible to use these for fixing, suitable clamps with bolts and nuts shall be used.

If the conduit pipes are liable to mechanical damage, they shall be adequately protected.
The chase in the wall shall be neatly made and of ample dimensions to permit the conduit to be fixed in the manner desired.

In the case of buildings under construction, the conduits shall be buried in the wall before plastering, and shall be finished neatly after erection of conduit. In case of exposed brick / rubber masonry work, special care shall be taken to fix the conduit and accessories in position along with the building work.

The conduit pipe shall be fixed by means of staples, J-hooks, or by means of saddles, not more than 60 cm apart or by any other approved means of fixing. All threaded joints of conduit pipes shall be treated with some approved preservative compound to secure protection against rust.

The conduit pipes shall be laid in position and fixed to the steel reinforcement bars by steel binding wires before the concreting is done. The conduit pipes shall be fixed firmly to the steel reinforcement bars to avoid their dislocation during pouring of cement concrete and subsequent tamping of the same.

Fixing of standard bends or elbows shall be avoided as far as practicable, and all curves shall be maintained by bending the conduit pipe itself with a long radius, which will permit easy drawing in of conductors. Location of inspection / junction boxes in RCC work should be identified by suitable means to avoid unnecessary chipping of the RCC slab subsequently to locate these boxes.

Suitable inspection boxes to the minimum requirement shall be provided to permit inspection and to facilitate replacement of wires, if necessary. These shall be mounted flush with the wall or ceiling concrete. Suitable ventilating holes shall be provided in the inspection box covers.

Casing and caping

This covers the requirements of casing wiring system using metallic or PVC casing and capping confirming to IS 14927 Part-2.

Casing and capping wiring is suitable for surface wiring work in-doors necessitated, either due to aesthetics or technical requirements, such as case of extension of existing wiring, avoidance of recessed wiring in RCC columns ,work stations, etc. PVC insulated cables and/or other approved insulated cables conforming to IS: 694-1990 shall be used.

The casing and capping shall be of the same material. The casing shall have a square or rectangle body. The capping shall be slide-in type with double grooving in the case of PVC wire-ways, and plain. PVC casing and capping shall be of good quality PVC, free from defects like deformation, unevenness, blisters, cavities etc.

Dimensions

(i) The sizes of casing and capping for the various sizes of cables and the maximum number of 650/1100V grade PVC insulated Aluminium/ copper conductor cables that can be carried in one casing are given size wise in **Table III**.

(ii) The thickness of the casing and capping shall be 1.2 mm +/- 0.1 mm.

Outlet boxes

The outlet boxes such as switch boxes, regulator boxes and their front covers shall be as per requirements.

TABLE – III

MAXIMUM NUMBER OF PVC INSULATED 650/ 1100 VOLT GRADE ALUMINIUM / COPPER CONDUCTOR CABLE CONFORMING TO IS: 694 - 1990 IN CASING AND CAPPING

Nominal Cross sectional area of conductor in sq.mm.	10/15 mm x 10 mm	20 mm x 10 mm	25 mm x 10 mm	30 mm x 10 mm	40 mm x 20 mm	50 mm x 20 mm
1.5	3	5	6	8	12	18
2.5	2	4	5	6	9	15
4	2	3	4	5	8	12
6	-	2	3	4	6	9
10	-	1	2	3	5	8
16	-	-	1	2	4	6
25	-	-	-	1	3	5
35	-	-	-	-	2	4
50	-	-	-	-	1	3
70	-	-	-	-	1	2

Note :- Dimensions shown above are outer dimensions of casing.

Installation of Casing and capping and DLP trunking

Attachment to wall and ceiling

(i) The casing and caping and DLP trunking shall be fixed by means of suitable screws to approve or fiber fixing plugs, at intervals not exceeding 60 cm for all sizes for casing and capping. In case of DLP trunking, the screwing distance shall be such that the weight of the trunking & cable hold firmly on the wall or ceiling. On either side of the joints, the distance of the fixing arrangement shall not exceed 15 cm from, the joint. All trunking body shall be fixed directly on wall or ceiling

(ii) DLP trunking shall be with pill off cover for protection against dust. Pill off cover shall be removed only on completion of painting of walls.

Passing through floors or walls

When conductors pass through floors, the same shall be carried in an approved PVC conduit. The conduit shall be carried 20 cm above floor level and 2.5 cm below ceiling level and neatly terminated into the casing.

Joints in casing and capping

(i) The wire ways in straight runs should be in single piece as far as possible so as to avoid joints. Trunking shall be of 2m or 3m standard length for the ease of installation.

(ii) All joints shall be scar-fed or cut diagonally in longitudinal section, and shall be smoothed down by filing to make the joints a very close fit as far as possible and without burrs. They shall be screwed at joints with two or more screws as would be necessary.

(iii) Joints arising out of bends or diversion shall be done using standard accessories like Internal angle, External angle, Flat angle (elbows), Flat junction (T) and end caps. For the separation of data and power cables there shall be partition in both trunking and accessories. Internal and external angle shall have variable angle for the alignment at the wall corners. In no case the radius of curvature of the cables inside a bend shall be less than 6 times their overall diameter. Trunking should be of white colour or as instructed by engineer in charge, in case of PVC trunking.

(iv) Casing and capping attached to ceiling shall be carried completely across the ceiling/wall whenever required by the engineer in charge, instead of being stopped at an outlet location and in all such cases, dummy casing and capping must be provided.

Attachment of capping

(i) Wherever required by the Engineer in Charge, capping shall not be fixed until the work has been inspected with the wires in position and approved. The inspection will be done from time to time as the work progresses.

(ii) Cover shall be attached to body after all the insulated wires are laid inside.

(iii) No screws or nails shall be used for fixing PVC cover to the body.

(iv) Aluminium cover shall be fixed by using cadmium plated flat head /round head screws with an axial spacing not exceeding 30 cm.

Installation of Cables

(i) For ease of maintenance, cables carrying direct current or alternating current shall always be bunched so that the outgoing and return cables are drawn in the same trunking.

(ii) Casing and caping shall be of such a design that it holds the wires inside the trunking body (casing) at suitable intervals, so that at the time of opening of the trunking cover (capping), the wires may remain in position in the trunking body (casing) and do not fall out.

WIRING

Wires shall be Flame Retardant Low Smoke Halogen (FRLSH), PVC insulated bright annealed electrolytic grade (99.9% pure) copper stranded for uniformity of resistance, dimension and flexibility and 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

WIRING IN CONDUIT

The wiring in conduit shall comply the following:

Wire sizes

	Copper conductor
Light point / Sub main wiring	1/1.5 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.

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.

i) Socket outlets

(a) The 5A/6A socket outlet shall be 5 pin socket outlet with 5A/6A switch, where so specified in the tender documents.

(b)

(c) 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

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.

(b) A ceiling rose shall not be used on circuit the voltage of which normally exceeds 250V.

(c) Only one flexible cord shall be connected to a ceiling rose. Specially designed ceiling roses shall be used for multiple pendants.

(d) A ceiling rose shall not embody fuse terminal as an integral part of it.

(e) Where ever ceiling roses are not used the wires are to be terminated in good quality connectors of 6A capacity inside PVC junction boxes.

(f) All the junction boxes are to be covered with good quality round cover plate of approved colour.

v) Lamp holders

The standard constructional feature of manufacturers (ISI approved) of lamp holders is acceptable.

DISTRIBUTION AND WIRING

The main distribution board and branch distribution board shall be controlled or provided with miniature circuit breaker (MCB) of specified rating on the phase or live conductor or combined phase and neutral control gear for incoming and out-going as indicated in the SOQ.

Distribution of sub-main and circuits shall be as per final approved single line diagram. The balancing of circuits in three wire or poly phase installations shall be arranged to the satisfaction of the Engineer in charge. Unless and otherwise specified in the tender documents, wiring shall be done only by the "Looping system". Phase or live conductors shall be looped at the switch boxes and neutral conductors at the point outlets. Lights, fans and call bells shall be wired in the 'lighting' circuits. 15A/16A socket outlets and other power outlets shall be wired in the 'Power' circuits. 5A/6A socket outlets shall be wired in the 'lighting circuits'. The wiring throughout the installation shall be such that there is no break in the neutral wire except in the form of linked switchgear. Surface wiring shall run, as far as possible, along the walls and ceiling so as to be easily accessible for inspection.

In no case, the open wiring shall be run above the false ceiling without the approval of Engineer-in-charge. In all types of wiring, due consideration shall be given for neatness, good appearance and safety.

Where a wall pipe passes outside a building so as to be exposed to weather, the outer end shall be bell mouthed and turned downwards and properly bushed on the open end. All floor openings for carrying any wiring shall be suitably sealed after installation. No bare conductor in phase and/or neutral or twisted joints in phase, neutral, and /or protective conductors in wiring shall be permitted. There shall be no joints in the through-runs of cables. If the length of final circuit or sub main is more than the length of a standard coil, thus necessitating a through joint, such joints shall be made by means of approved mechanical connectors in suitable junction boxes. Termination of multi-stranded conductors shall be done using suitable crimping type thimbles.

Fixing switch boxes and accessories.

Switch boxes shall be mounted flush with the wall. All outlets such as switches, socket outlets etc. shall be flush mounting type, unless otherwise specified . To facilitate subsequent drawing of wires in the conduit, GI fish wire of 1.6mm/1.2mm (16/18 SWG) shall be provided along with the laying of the recessed conduit. Cables carrying Direct Current may, if desired, be bunched whatever their polarity, but cables carrying alternating current, if installed in metal conduit shall always be bunched so that the outgoing and return cables are drawn into the same conduit. Where the distribution is for single phase loads only, conductors for these phases shall be drawn in one conduit. In case of three phase loads, separate conduits shall be run from the distribution boards to the load points, or outlets as the case may be. The conduit pipe shall be fixed by means of staples, or by means of non-metallic saddles, placed at not more than 60 cm apart, or shall be fixed by any other approved means of fixing. At either side of the bends, saddles/staples shall be fixed at a distance of 15 cm from the centre of the bends.

Special Note

1. It may be noted that if the walls are already plastered the electrical contractor has to arrange necessary cutting of wall, re-plastering, making good all damages, finishing, etc and same has to be carried out without any extra cost.

2. Wherever spare conduits are laid GI fish wire of 1.6mm/1.2mm (16/18 SWG) shall be laid along with the conduit to facilitate easy pulling of wires in future without any extra cost.

3. All the wiring shall be measured on linear basis along the run of wiring depending on the actual number and size of wires.

4. Conduiting including required accessories like bends, junction boxes, saddlers, couplers etc shall be measured on a linear basis. Extra claim for conduiting accessories shall not be entertained.

5. For points coming in false ceiling, as far as possible, wiring shall be terminated in a junction box/connector very close to the points.

6. All the civil works such as chipping, plastering, making good all damages connected with the fixing of switch boxes are included in the scope.

7. Unless otherwise specified wiring shall be terminated to either ceiling rose, connector, lamp holder or switch.

6.0 MCB DISTRIBUTION BOARDS (MCB DBS) AND ACCESSORIES

M C B Distribution Boards (MCB DBs)

All SPN & TPN DBs shall be 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 42/43 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 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 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.

(f) Provision for accomodating four pole MCB and RCCB as incomer.

Miniature Circuit Breakers (MCBs)

All MCBs should conform to IS:8828, IEC:60898-1(2002) and rated for 10kA category of short circuit duty and tested for breaking capacity upto 10 kA. **C** curve type for inductive loads and **D** curve type for UPS loads. MCBs shall be suitable for use in frequency range 50 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 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. 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.

Residual Current Circuit Breaker (RCCB)

Residual Current Circuit Breakers shall be provided complete protection against Earth leakage faults. RCCB should conform to IS: 12640-2008, IEC 61008-1.

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 RCCB 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.

7.0 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 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/client 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/client 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/client, for decision by the Consultant/client, 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, installation testing & commissioning of LT panel , LT Cables, MCB Distribution boars, wiring , light fixtures, and earthing system etc

2. Cable laying, termination at both ends, testing & commissioning of cables from Switch Board, Distribution boards etc.

3. Cable laying in buried route/trenches/trays as per specification, termination at both ends, testing and commissioning of LT power and control/instrumentation cables, cables between Switch boards and sub switch boards and various equipment in the building.

4. The scope of this contract includes supply, installation and termination on both sides of all control/instrumentation cables, its supports, etc.

5. Earthing system includes supply, installation and testing of earth pits and relevant earth conductors as per specification.

6. Internal electrification of the instrumentation room and yard lighting is also included in the scope of this tender.

7. 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.

8. Civil work includes grouting of equipment, complete supply & erection of LT panel boards, fixing of cable trays, pipes with all necessary supports.

9. The rates quoted for installation should include the charges for painting the conduits & supports as directed by Purchaser/Consultant.

10. Liaison with all statutory authorities for getting sanction/approval/safety certificate/ power connection including submission of necessary forms to EB/Electrical inspectorate as required is included in the scope of this work. Necessary fee for the same shall be reimbursed on production of actual bills

8.0 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	Remarks
1.	LT Panel boards	CPRI certified panel manufacturer with components of approved makes.	Category 1
2.	MCCB	Schneider, L&T, ABB, Siemens, Legrand(Only for MCCB Distribution Boards), Mitsubhishi	Category 2
3.	SDF/ SDFU	L&T, Simens, Schneider, ABB	Category 2
4.	Capacitor and block reactor (LT)	L&T, Sprague, Schneider, Epcos, Shreem, ABB	Category 2
5.	Starters, Timer & Contactors	Siemens, L&T, Schneider, C&S, ABB, BCH	Category 3
6.	Push Buttons	Schneider, Siemens, L&T, BCH, C&S, Teknic	Category 4
7.	Indicating lamps (LED type)	Teknic, Schneider, Siemens, L&T, BCH, C&S	Category 3
8.	Indicating meters (Analogue)	AE, MECO, L&T, Rishab	Category 3
9.	Digital meters	L&T, ABB, Siemens, Schneider, Socomec, Secure, Elmeasure	Category 3
10.	Current Transformer	AE, Intrans, Kappa, L&T, Rishab, ResiTech Electricals, PGR Powertech, Pragati	Category 3
11.	Selector switches	Tecnic, Kaycee, L&T	Category 4
12.	Battery Charger	Waves, HBL, Amararaja, Dubas	Category 3
13.	SMF/VRLA Batteries	Exide, Amara Raja, HBL	Category 3
14.	1.1 kV grade XLPE insulated PVC sheathed Al./ Cu. Cable	KEI, Polycab, Havells, Gloster, Finolex, Torrent	Category 2
15.	660/1100 volt grade	Finolex, RR Kabel, Lapp Kabel,	Category 2

	stranded unsheathed wire with copper conductor	Polycab, V-guard	
16.	Cable glands, lugs, End termination kits	Lapp Kabel, Gripwel, HMI, Denson, Multipressings, Yamuna Gasses, Dowels	Category 3
17.	Thermoplastic Junction Box and enclosures	Clipsal, Hensel, OBO, Spelsberg	Category 3
18.	Fire Sealant	Promat, Hilti, 3M	Category 2
19.	Anchor Fastener	Hilti, Fischer	Category 3
20.	LT Termination	Raychem, 3M	Category 3
21.	GI Cable tray	Indiana / Steelite / Rico Steel / Profab Engg /OBO/ Legrand, fixotech	Category 3
22.	Modular type switches, sockets, bell push, fan regulator etc-Medium range	Honeywell (Blenze), Wipro-North West (Nowa) , Legrand (Myrius), Kolors (krest),Crabtree (Athena)	Category 3
23.	Metalclad plug/socket/Decontactor	Legrand, Schneider, L&T	Category 3
24.	Thermoplastic receptacles & Decontactor	Mennekes, Hensel Walther, Schneider, Scame	Category 3
25.	MCB, RCCB	Legrand, Siemens, Hager, Schnedier,L&T,ABB	Category 2
26.	MCB Distribution Boards	Legrand,Siemens, Hager, Schneider,L&T,ABB	Category 2
27.	Floor trunking/ DLP trunking	Honeywell, Legrand, OBO	Category 3
28.	PVC Conduit and accessories/ casing and capping	Precision , Clipsal, Lappkabel, Balco, Konseal, Polycab	Category 2
29.	Ceiling Rose	Anchor, GM	Category 4
30.	GI conduit/M S Conduit	Any ISI marked.	Category 3
31.	LED Light Fixtures (indoor)	Philips, Wipro, Crompton Greaves, Trilux, XAL, LT, Zumtobel, Osram, Duralamp Targetti.	Category 2
32.	LED module/LED Chip	NICHIA/ OSRAM/ CREE/ LUMILEDS/SAMSUNG/CITIZEN /LG innotex	Category 2
33.	LED Driver	Osram, Meanwell, Tridonics, BAG, LT, Helvar, Wipro	Category 3
34.	External Light	K-lite, Crompton, Philips, Wipro, Keselec, LT, Bajaj	Category 2

35.	Lightning Protection and accessories	OBO , Dehn, Furse, Erico	Category 2
36.	Surge Protective Devices	OBO, Dehn, Furse, Phoenix Contact, Erico	Category 2
37.	Synthetic Insulating Mats	CPRI certified for required voltage level as per IS 15652	Category 2
38.	Variable frequency drive	Schneider,ABB,Siemens, Fuji electrical	Category 2
39.	Chemical earthing	OBO, Dehn, Furse, Jeftechno,Erico	Category 3

9.0 CATEGORY REQUIREMENT OF TEST CERTIFICATE / INSPECTION

CATEGORY -1:

a) Type test certificate for similar item (UL/ CPRI/ NABL certificate for doing the particular test).
b) OEMs routine test certificate.
c) Acceptance test to be conducted in the presence of CLIENT/CONSULTANT representative at OEMs factory.

CATEGORY-2:

a) Type test certificate for similar item. (UL/ CPRI/ NABL certificate for doing the particular test).
b) OEMs routine test certificate.
c) Visual and functional check by CLIENT/CONSULTANT official at site.

CATEGORY -3:

a) OEM / Dealer/ Contractor routine test certificate.

b) Visual and functional check by CLIENT/CONSULTANT official at site.

CATEGORY -4:

a) Visual and functional check by CLIENT/CONSULTANT official at site.

10.0 ABBREVIATIONS

ACB	Air Circuit Breaker
AC	Alternating Current
AIS	Air Insulated Switchgear
AMF	Auto Mains Failure
APFC	Automatic Power Factor Control
AVR	Automatic Voltage Regulator
CB	Circuit Breaker
CFL	Compact Fluorescent Lamp
COS	Change Over Switch
CT	Current Transformer
CSS	Compact Substation
DB	Distribution Board
DC	Direct Current
DCDB	Direct Current Distribution Board
DOL	Direct On Line
ELCB	Earth Leakage Circuit Breaker
ELR	Earth Leakage Relay
GCP	Generator Control Panel
GI	Galvanised Iron
IR	Insulation Resistance
kV	kilo Volt
kVA	kilo Volt Ampere
kVAr	kilo Volt Ampere reactive
kW	kilo Watt
kWh	kilo Watt hour
LDB	Lighting Distribution Board
LED	Light Emitting Diode
HT	HighTension
LT	Low Tension
LV	Low Voltage
MCB	Miniature Circuit Breaker
MCC	Motor Control Centre
MCCB	Moulded Case Circuit Breaker
MSB	Main Switch Board
MVA	Mega Volt Ampere
MW	Mega Watt
PDB	Power Distribution Board
PF	Power Factor
PI	Polarization Index
PLC	Programmable Logic Control
PT	Potential Transformer
PVC	Poly Vinyl Chloride
RCCB	Residual Current Circuit Breaker
REF	Restricted Earth Fault
RTD	Resistance Temperature Device
SCADA	Supervisory Control and Data Acquisition

SDF	Switch Disconnector Fuse
SLD	Single Line Diagram
SSB	Sub Switch Board
THD	Total Harmonic Distortion
TOD	Time of Day
UG	Under Ground
UPS	Uninterrupted Power Supply
USS	Unitised Sub Station
VA	Volt Ampere
VT	Voltage Transformer
VSD	Variable Speed Drive
WTI	Winding Temperature Indicator
XLPE	Cross Linked Poly Ethylene

CONTRACT FORM

(ON NON-JUDICIAL STAMP PAPER OF REQUIRED AMOUNT MENTIONED IN THE TENDER DOCUMENT)

THIS AGREEMENT made in …… day of …… 20… between …… *(Name of Owner)* of …… *(Address of Owner)* (hereinafter called "the Owner") of the one part and …… *(Name of Contractor)* of …… (*Address of Contractor)* (hereinafter called "the Contractor") of the other part:

WHEREAS the Owner invited bids for the execution of work viz., …… *(Brief description of work)* and had accepted a bid by the Contractor for the work in the sum of …… *(Contract price in words and figures)* (hereinafter called "the Contract Price").

NOW THIS AGREEMENT WITNESSETH AS FOLLOWS:

1. In this Agreement words and expressions shall have the same meanings as are respectively assigned to them in the Conditions of Contract referred to.
2. The following documents shall be deemed to form and be read and construed as part of this agreement, viz.:
   a. the Tender Document No…….. and the Price schedule submitted by the Contractor.
   b. the Owner's Letter of Acceptance.
   c. Work order no…….
3. In consideration of the payments to be made by the Owner to the Contractor as hereinafter mentioned, the Contractor hereby covenants with the Owner to complete the work and to remedy defects therein in conformity in all respects with the provisions of the Contract.
4. The Owner hereby covenants to pay the Contractor in consideration of the execution of the works and the remedying of defects therein, the Contract Price or such other sum as may become payable under the provisions of the Contract at the times and in the manner prescribed by the Contract.

TOTAL CONTRACT PRICE:

TIME OF COMPLETION: ……

IN WITNESS whereof the parties hereto have caused this Agreement to be executed in accordance with their respective laws the day and year first above written.

Signed, Sealed and Delivered by the

said …… (for the Owner)

in the presence of: ……

Signed, Sealed and Delivered by the

said …… (for the Contractor)

in the presence of ……

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 ……. (Hereinafter called Owner) 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 an additional sum of Rs……..which together with the amount of earnest money deposited 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 The Pharmaceutical Corporation (I.M) Kerala Ltd 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 The Pharmaceutical Corporation (I.M) Kerala Ltd. results, the same will be recovered from him as arrears of revenue but should it be a saving to The Pharmaceutical Corporation (I.M) Kerala Ltd. 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 The Pharmaceutical Corporation (I.M) Kerala Ltd. 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. Construction of (Name of the 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, The Pharmaceutical Corporation (I.M) Kerala Ltd. may rearrange the works otherwise or get it done otherwise at the risk and cost of the contractor and the loss so sustained by The Pharmaceutical Corporation (I.M) Kerala Ltd. 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 The Pharmaceutical Corporation (I.M) Kerala Ltd. or any other officer or officers authorised by The Pharmaceutical Corporation (I.M) Kerala Ltd.

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 The Pharmaceutical Corporation (I.M) Kerala Ltd. 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 The Pharmaceutical Corporation (I.M) Kerala Ltd. may deem fit in this regard.

In witness where of Sri....., The Managing Director, The Pharmaceutical Corporation (I.M) Kerala Ltd. and Sri.....……..

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

Signed by Sri.....……. The Managing Director, The Pharmaceutical Corporation (I.M) Kerala Ltd.

In the presence of witness

1. .....
2. .....

Signed and delivered by Sri....., Contractor.

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

To
Managing Director,
……..(OUSHADHI)

In consideration of the…….....(hereinafter called The OUSHADHI) 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 OUSHADHI an amount not exceeding Rs…….(Rupees…… only) on demand by the OUSHADHI.

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 OUSHADHI 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 OUSHADHI any money so demanded notwithstanding any dispute or disputes raised by the contractors) 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 OUSHADHI 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 OUSHADHI that the OUSHADHI 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 OUSHADHI 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 OUSHADHI any indulgence by the OUSHADHI 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 OUSHADHI in writing.

8. The guarantee shall be valid up to ……..unless extended on demand by the OUSHADHI. Notwithstanding anything mentioned above, our liability against this guarantee 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 The Pharmaceutical Corporation (I.M) Kerala Ltd

For and on behalf of The Pharmaceutical Corporation (I.M) Kerala Ltd

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,
……..(OUSHADHI)

In consideration of the ……(OUSHADHI) 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 …….(OUSHADHI) 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 ……..(OUSHADHI) 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 ……(OUSHADHI) 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 …….(OUSHADHI) on demand and without demur to the extent aforesaid.

2. We, the _____ Bank, further agree that ……..(OUSHADHI) 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 ….(OUSHADHI) on account thereof and the decision of ……..(OUSHADHI) 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 …..(OUSHADHI) 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 ……(OUSHADHI) 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 OUSHADHI 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 ……(OUSHADHI) 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. ….....(OUSHADHI) 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 ….....(OUSHADHI) and the said Bank shall not be released from its liability under these presents by any exercise by ….(OUSHADHI) 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 ….(OUSHADHI) or any indulgence by ….(OUSHADHI) to the said Contractor or any other ….....(OUSHADHI) 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 ….....(OUSHADHI) 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 ….....(OUSHADHI) 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 ….(OUSHADHI) 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 ……(OUSHADHI)

For and on behalf of ……..(OUSHADHI)

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).

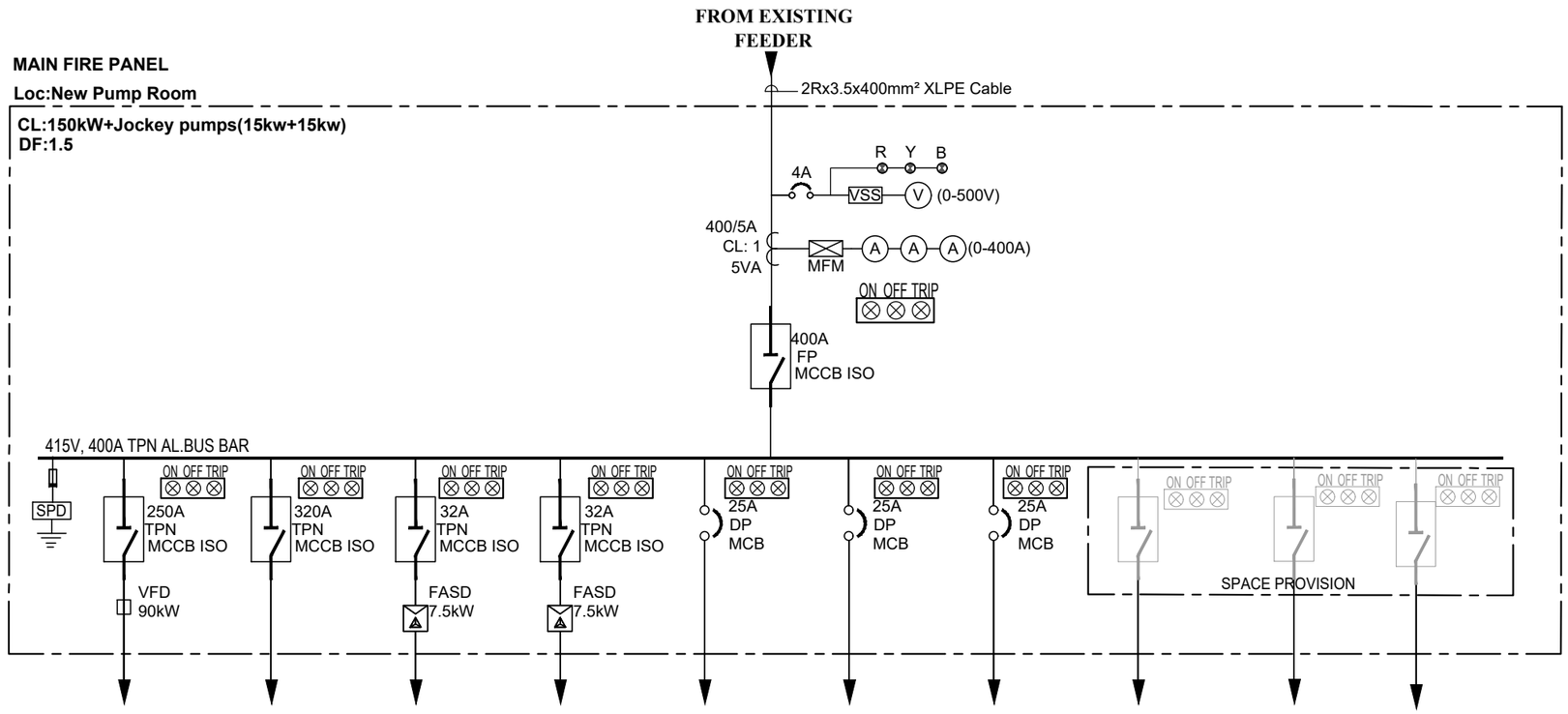
*** For Companies**

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).

LEGEND

	MINIATURE CIRCUIT BREAKER
	CURRENT TRANSFORMER
	INDICATION LAMP
A	AMMETER
V	VOLT METER
TOD	TIME OF DAY METER
VSS	VOLT METER SELECTOR SWITCH

	LEGEND
D.G	DIESEL GENERATOR
	MCCB ISOLATOR
	CHANGE OVER SWITCH



DESCRIPTION OF LOAD	MAIN FIRE PUMP	EXISTING FIRE PANEL	JOCKEY PUMP	JOCKEY PUMP	BATTERY CHARGER	BATTERY CHARGER	PUMP ROOM LDB
WORKING LOAD (KW)	90	45kw+15kw	7.5	7.5	--	--	--
SETTING (A)	250	320	32	32	25	25	25
POWER Cable (mm²) Al.	240	185	4 Cu	4 Cu	6 Cu.	6 Cu.	6 Cu.
NO. OF CORES	3	3.5	3	3	2	2	2
NO. OF RUNS	1	2	2	2	1	1	1
EARTHING	25X3 Cu	10 SWG Cu wire	10 SWG Cu wire	10 SWG Cu wire	10 SWG Cu wire	10 SWG Cu wire	10 SWG Cu wire

FOR TENDOR PURPOSE ONLY

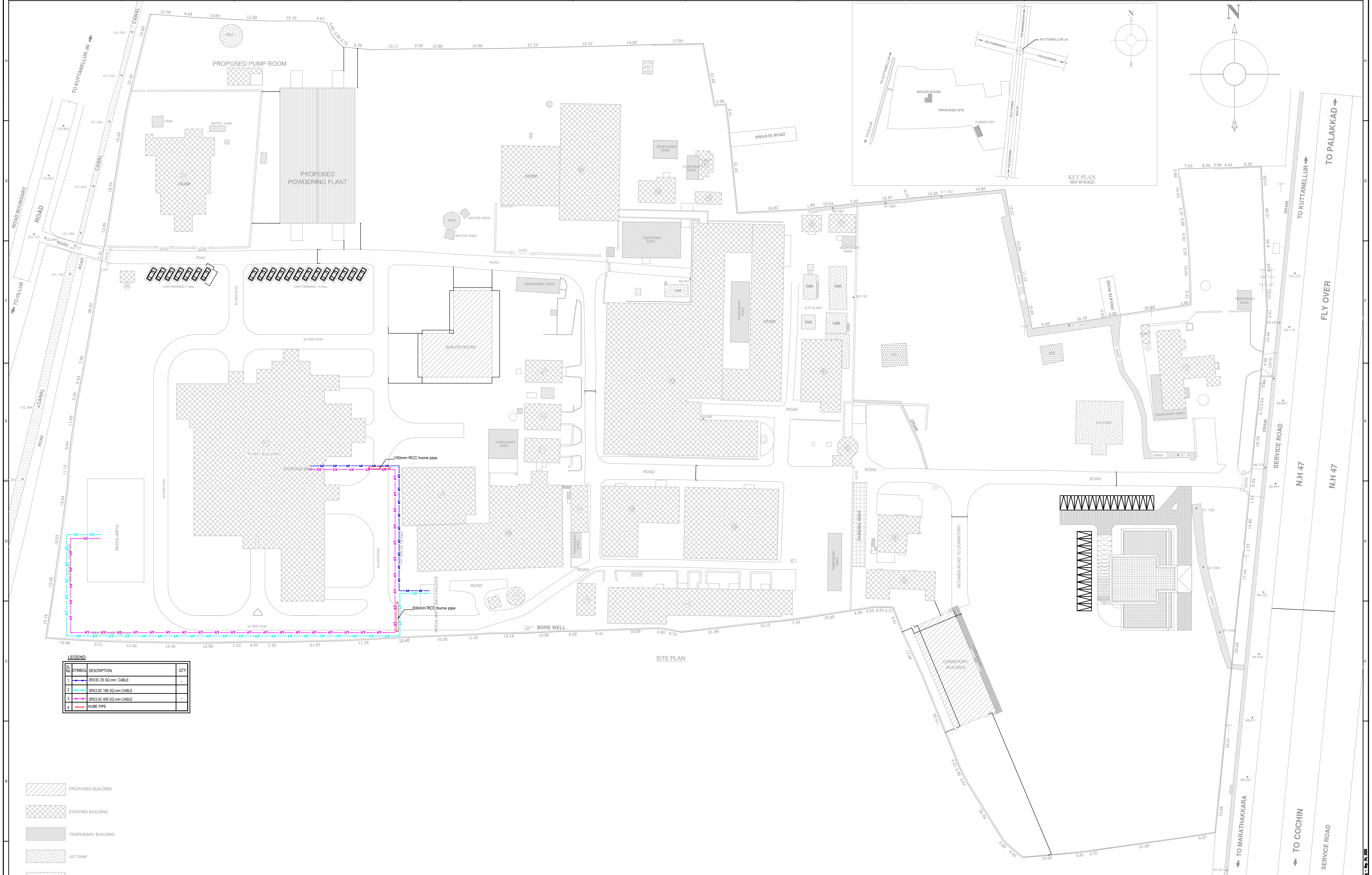
SL.No.	PARTICULARS	INITIAL	DATE
	REVISION		

DESIGNED	Xaviour	CLIENT:	OUSHADI
CHECKED	Rajna	PROJECT:	FIRE PROTECTION WORK FOR OUSHADI KUTTANELUR
DRAWN	Fremin		
CHECKED	Soumya	TITLE:	SCHEMATIC DIAGRAM OF FIRE PANEL
APPROVED	SMS		

UNIT:	SCALE:	DRG NO:	SHEET NO:	REV.	DATE:
mm.	1 : 100	DP 1009 DRG EL 01 001	1 OF 1		13.12.2019

KITCO the consultants
KITCO Ltd.
(Estd. in 1972 by IDBI & Govt. of Kerala)
PUTHIYA ROAD - NH BYPASS, KOCHI - 28

D:\WORK FROM HOME\OUSHADHI\MAIN SLD (2).dwg – May. 04, 2020



LEGEND

SL. No.	SYMBOL	DESCRIPTION	QTY
1		2RX3C 25 SQ mm CABLE	--
2		2RX3.5C 185 SQ mm CABLE	
3		2RX3.5C 400 SQ mm CABLE	--
4		HUME PIPE	

PROPOSED BUILDING

EXISTING BUILDING

TEMPORARY BUILDING

UG TANK

WELL

NO. OF CAR PARKING REQUIRED = Total Carpet Area / 200
(2799.32+934.49) = 3733.81 / 200 = 19 Nos.
NO. OF CAR PARKING PROVIDED = 20 Nos.

AREA REQUIRED FOR TWO WHEELER PARKING
25 % x (19x5.5x2.7) = 70.54 m²
PROVIDED = 72.00 m²

SL.No.	PARTICULARS	INITIAL	DATE
REVISION			

DESIGNED	
CHECKED	
DRAWN	Fremin
CHECKED	
APPROVED	
SCALE	1 : 400
UNIT	mm.
DATE	29.04.2020

KITCO Ltd.
the consultants
(Estd. in 1972 by IDBI & Govt. of Kerala)
PUTHIYA ROAD-NH BYPASS, KOCHI-28

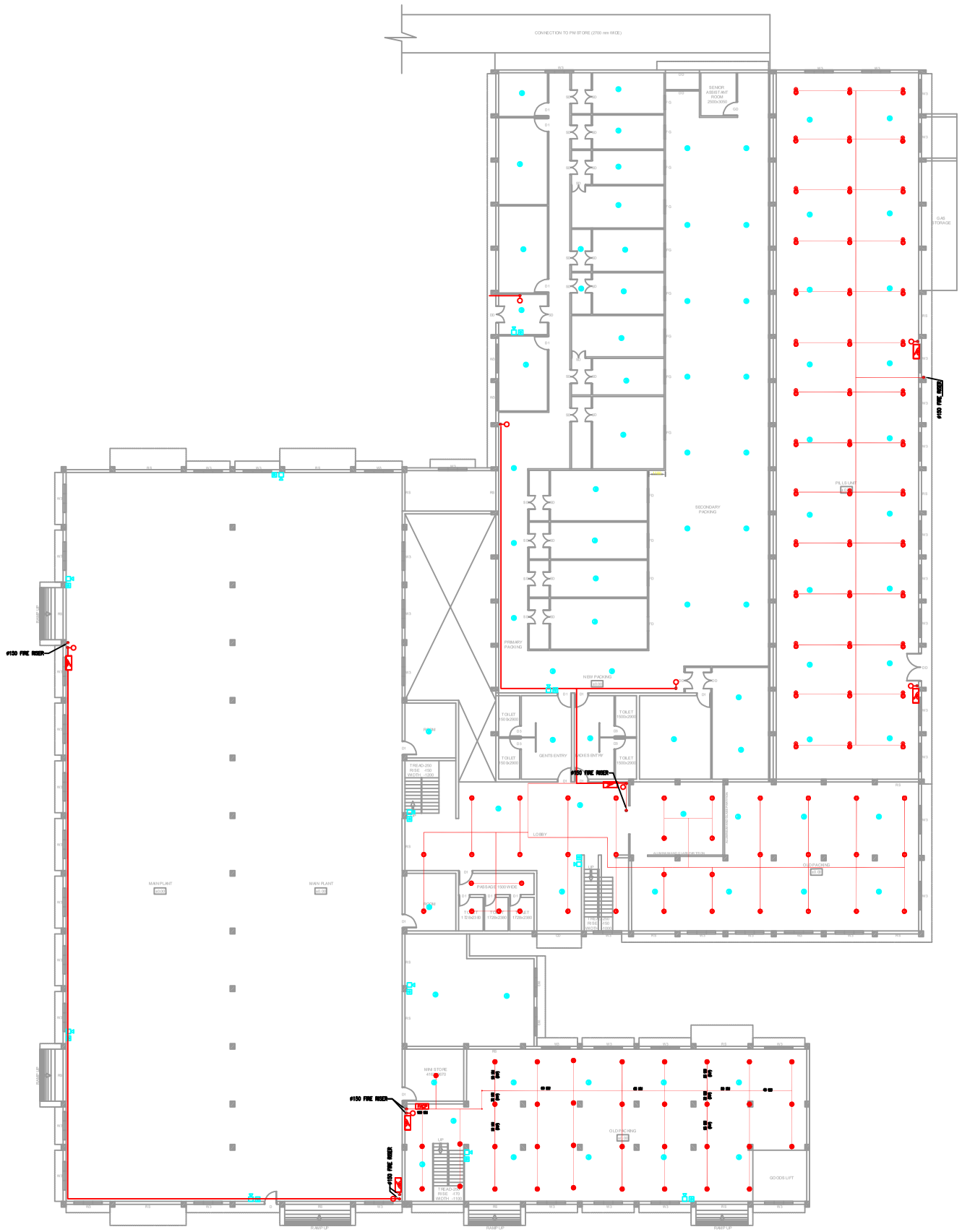
CLIENT: THE PHARMACEUTICAL CORPORATION (IM) KERALA LTD.

PROJECT: CENTRE OF EXCELLENCE FOR AYURVEDA MEDICINES

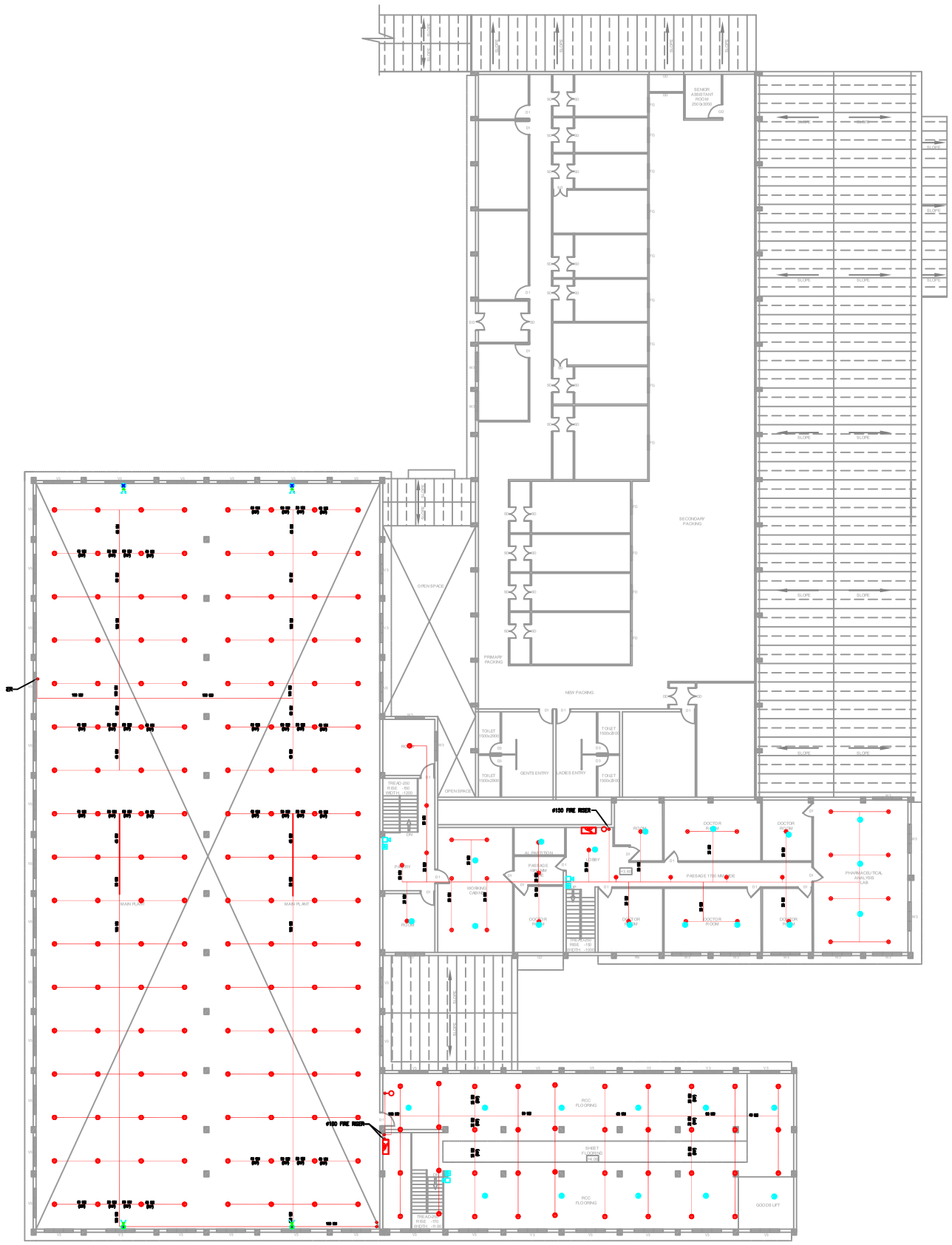
TITLE: EXTERNAL CABLE ROUTE LAYOUT

DRG NO: DP 525 DRG EL 01 001 A | REV. | SHEET NO: 1 OF 1

D:\WORK FROM HOME\OUSHADHI\TENTATIVE CABLE ROUTE LAYOUT.dwg -- May. 04, 2020



GROUND FLOOR PLAN



FIRST FLOOR PLAN

FOR TENDER PURPOSE ONLY

EXTENDED COVERAGE SPRINKLER PIPE SIZE

SPRINKLER QUANTITY	PIPE SIZE
1	ø40
2	ø50
3-4	ø65
5-7	ø80
8 AND ABOVE	ø100

STANDARD SPRINKLER PIPE SIZE

SPRINKLER QUANTITY	PIPE SIZE
1-2	ø25
3	ø32
4-6	ø40
7-9	ø50
10-18	ø65
19-24	ø80
24 AND ABOVE	ø100

LEGENDS:

SN	SYMBOL	DESCRIPTION
01		FIRE PIPE
02		EXTENDED COVERAGE SPRINKLER
03		UPRIGHT SPRINKLER
04		PENDENT SPRINKLER
05		FIRE HOSE CABINET
06		INTERNAL HYDRANT
07		MANUAL CALL POINT
08		HOOTER CUM STROBE
09		BEAM EMITTER
10		BEAM RECEIVER
11	FACP	FIRE ALARM CONTROL PANEL
12		MULTI DETECTOR

NOTE:

1. ALL DIMENSIONS ARE IN MM AND LEVELS ARE IN METRES.
2. ONLY WRITTEN DIMENSIONS SHOULD BE FOLLOWED.
3. FIRE EXTINGUISHER SHALL BE AS PER IS-2190
4. FIRE HYDRANT SYSTEM SHALL BE IN ACCORDANCE TO IS 13039, IS 3844
5. SPRINKLER SYSTEM SHALL BE IN ACCORDANCE TO IS 15105.

SL.No.	PARTICULARS	INITIAL	DATE
	REVISION		

DESIGNED	Srinath
CHECKED	AUS
DRAWN	Anshad
CHECKED	Srinath
APPROVED	SMS
SCALE	1 : 100
UNIT	mm.
DATE	04.05.2020

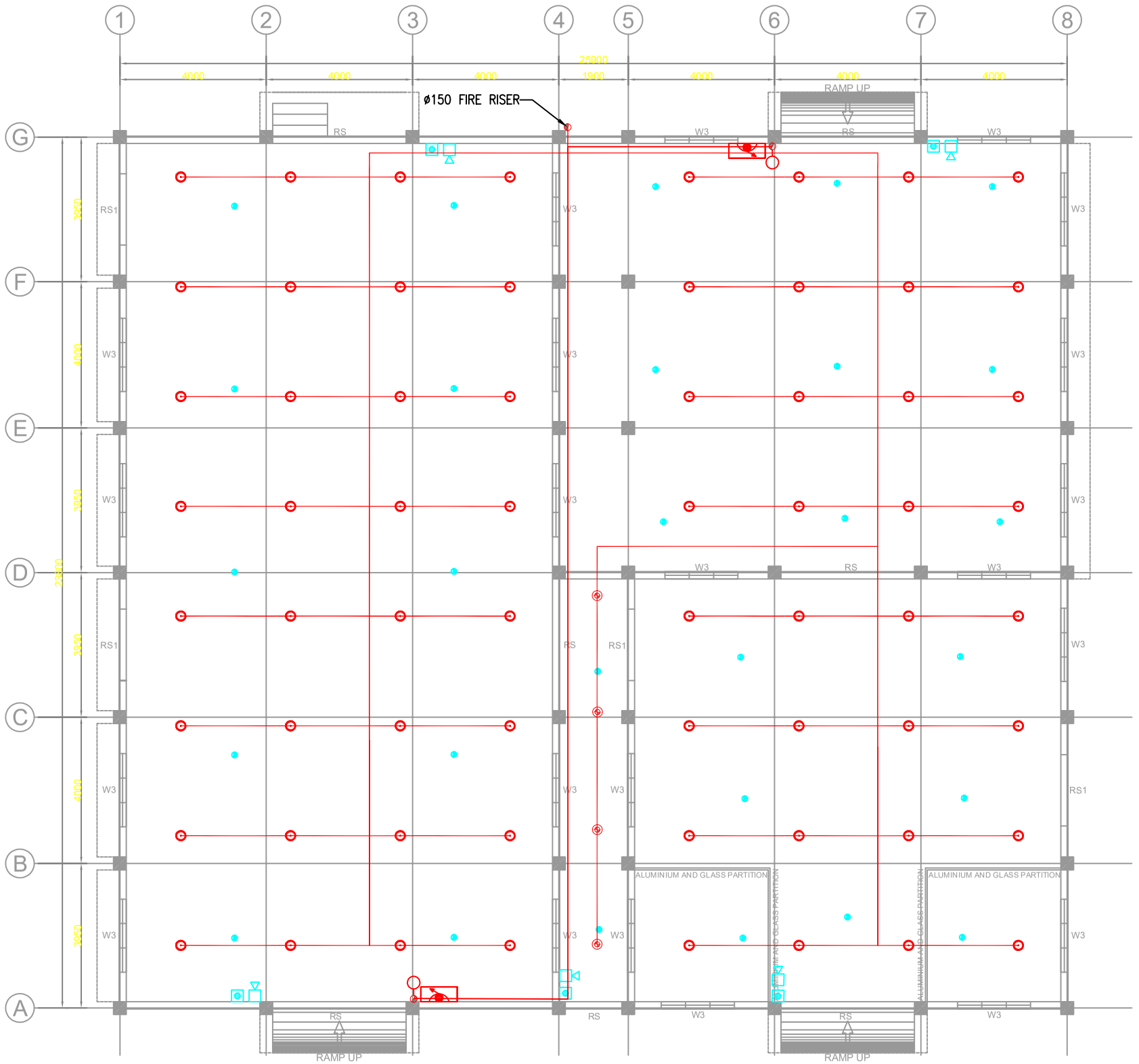
KITCO Ltd.
the consultants
(Estd. in 1972 by IDBI & Govt. of Kerala)
PUTHIYA ROAD - NH BYPASS, KOCHI - 28

CLIENT: THE PHARMACEUTICAL CORPORATION (IM) KERALA LTD.

PROJECT: FIRE PROTECTION WORKS FOR OUSHADHI KUTTANELLUR

TITLE: MAIN PLANT FIRE PROTECTION LAYOUT

DRG NO: DP 1009 DRG MH 01 005 | REV. | SHEET NO: 1 OF 1



GROUND FLOOR PLAN
AREA- 618.90 SQ.M

LEGENDS:

SN	SYMBOL	DESCRIPTION
01		FIRE PIPE
02		EXTENDED COVERAGE SPRINKLER
03		FIRE HOSE CABINET
04		INTERNAL HYDRANT
05		MANUAL CALL POINT
06		HOOTER CUM STROBE
07		MULTI DETECTOR

EXTENDED COVERAGE SPRINKLER PIPE SIZE

SPRINKLER QUANTITY	PIPE SIZE
1	ø40
2	ø50
3–4	ø65
5–7	ø80
8 AND ABOVE	ø100

NOTE:

1. ALL DIMENSIONS ARE IN MM AND LEVELS ARE IN METRES.
2. ONLY WRITTEN DIMENSIONS SHOULD BE FOLLOWED.
3. FIRE EXTINGUISHER SHALL BE AS PER IS-2190
4. FIRE HYDRANT SYSTEM SHALL BE IN ACCORDANCE TO IS 13039, IS 3844
5. SPRINKLER SYSTEM SHALL BE IN ACCORDANCE TO IS 15105.

FOR TENDER PURPOSE ONLY

SL.No.	PARTICULARS	INITIAL	DATE
	REVISION		

DESIGNED	Srinath
CHECKED	AUS
DRAWN	Anshad
CHECKED	Srianth
APPROVED	SMS

CLIENT: THE PHARMACEUTICAL CORPORATION (IM) KERALA LTD.

PROJECT: FIRE PROTECTION WORKS FOR OUSHADHI KUTTANELLUR

TITLE: -:KASHAYA CHOORNAM BLOCK:- FIRE PROTECTION LAYOUT

UNIT:	SCALE:	DRG NO:	SHEET NO:	REV.	DATE:
mm.	1 : 100	DP 1009 DRG MH 01 003	1 OF 1		04.05.2020

KITCO Ltd.
the consultants
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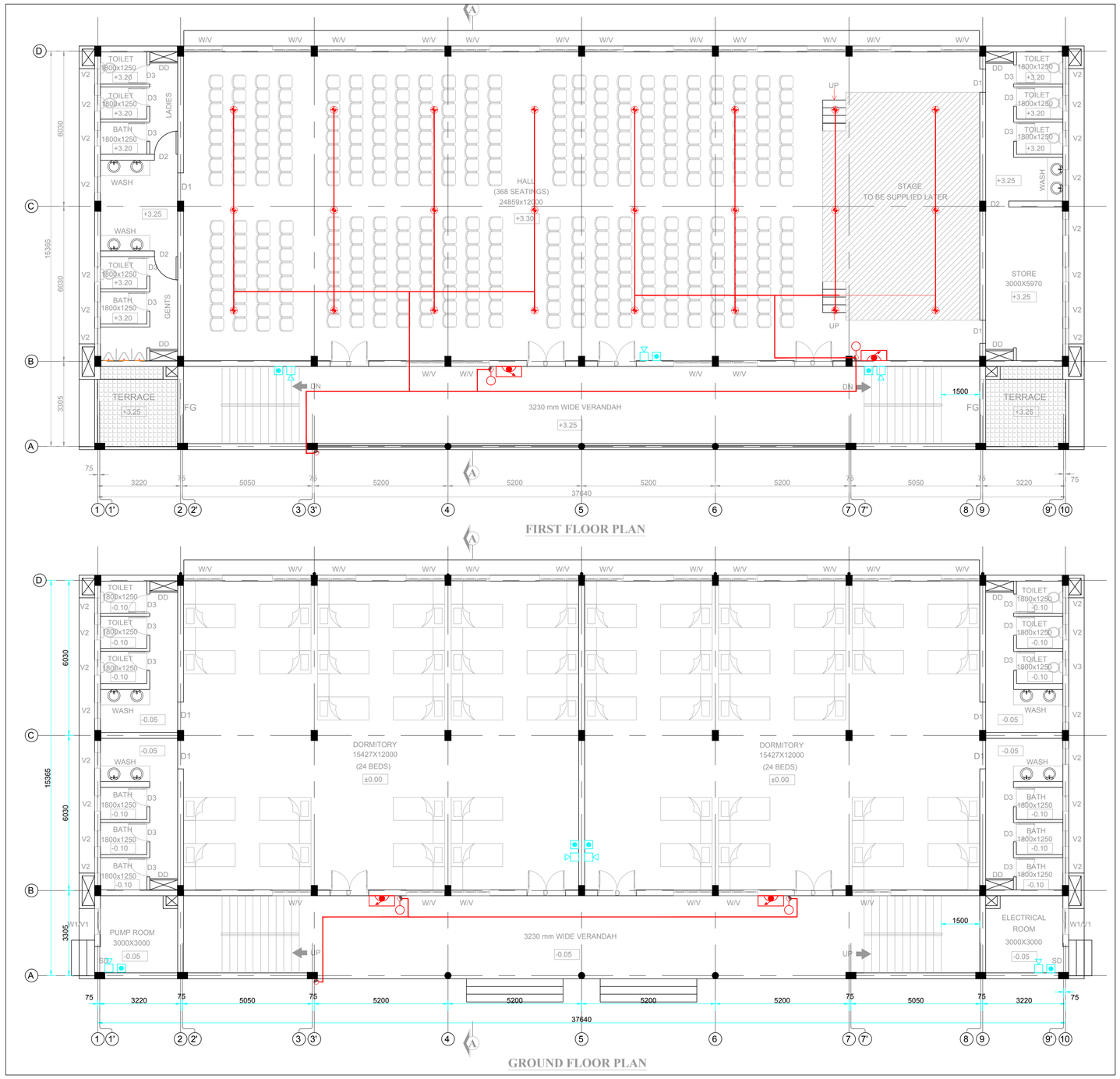
PUTHIYA ROAD - NH BYPASS, KOCHI - 28



LEGENDS:

SN	SYMBOL	DESCRIPTION
01		FIRE PIPE
02		UPRIGHT SPRINKLER
03		FIRE HOSE CABINET
04		INTERNAL HYDRANT
05		MANUAL CALL POINT
06		HOOTER CUM STROBE
07	FACP	FIRE ALARM CONTROL PANEL

NOTE:

1. ALL DIMENSIONS ARE IN MM AND LEVELS ARE IN METRES.
2. ONLY WRITTEN DIMENSIONS SHOULD BE FOLLOWED.
3. FIRE EXTINGUISHER SHALL BE AS PER IS-2190
4. FIRE HYDRANT SYSTEM SHALL BE IN ACCORDANCE TO IS 13039, IS 3844
5. SPRINKLER SYSTEM SHALL BE IN ACCORDANCE TO IS 15105.

FOR TENDER PURPOSE ONLY

SL.No.	PARTICULARS	INITIAL	DATE

REVISION

This drawing is the property of KITCO Ltd. and is to be used only for the purpose for which it was lent and must not be in any way detrimental to the interest of the company and is subject to return on demand

DESIGNED	Srianth
CHECKED	AVS
DRAWN	Anshad
CHECKED	Srinath
APPROVED	SMS
SCALE	1 : 100
UNIT	mm.
DATE	04.05.2020

KITCO the consultants

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CLIENT: THE PHARMACEUTICAL CORPORATION (IM) KERALA LTD.

PROJECT: FIRE PROTECTION WORKS FOR OUSHADHI KUTTANELLUR

TITLE: -: DORMITRY:- FIRE PROTECTION LAYOUT

DRG NO: DP 1009 DRG MH 01 009 | REV. | SHEET NO: 1 OF 1

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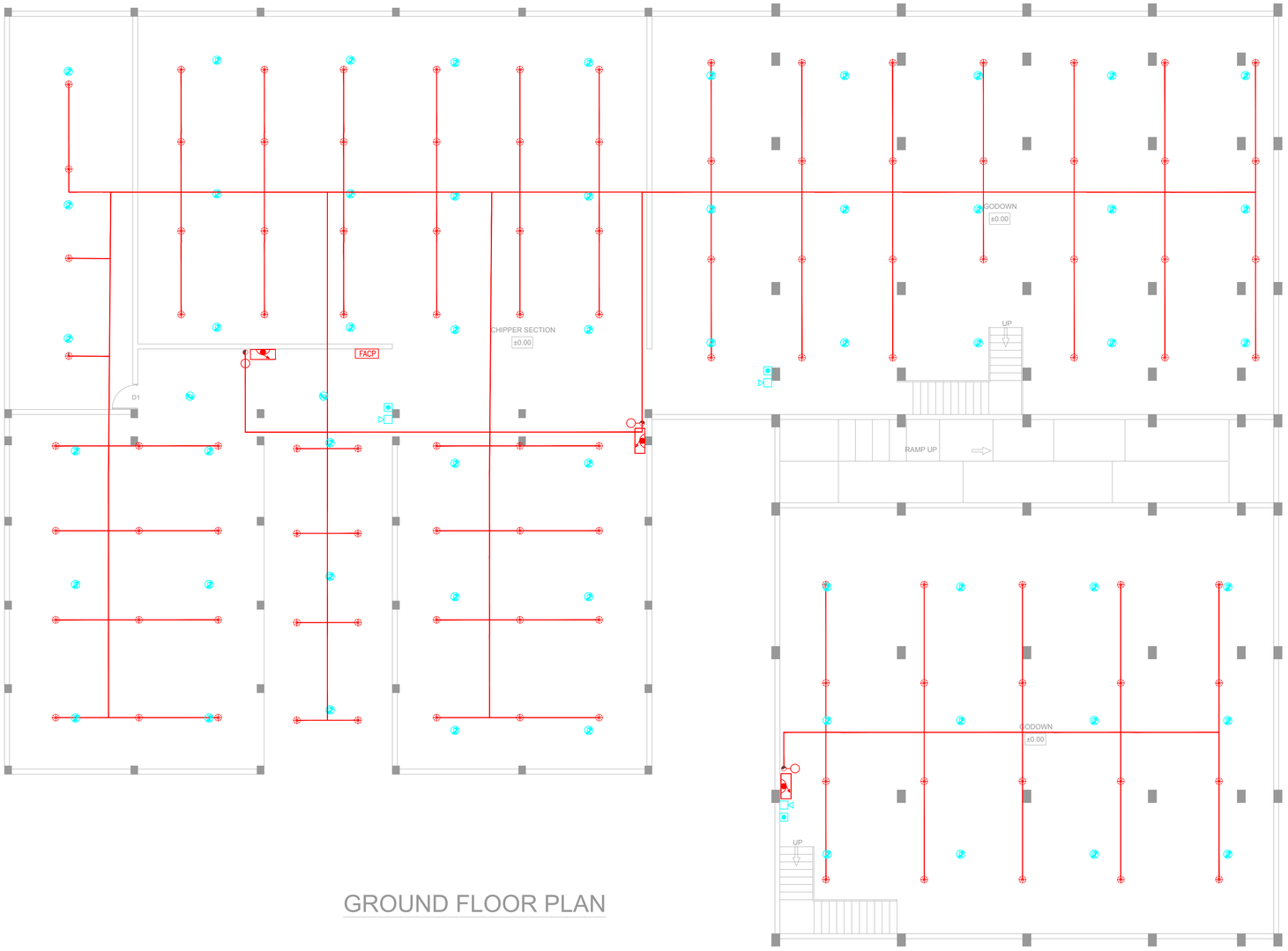

GROUND FLOOR PLAN

STANDARD SPRINKLER PIPE SIZE

SPRINKLER QUANTITY	PIPE SIZE
1–2	ø25
3	ø32
4–6	ø40
7–9	ø50
10–18	ø65
19–24	ø80
24 AND ABOVE	ø100

LEGENDS:

SN	SYMBOL	DESCRIPTION
01		FIRE PIPE
02		PENDENT SPRINKLER
03		FIRE HOSE CABINET
04		INTERNAL HYDRANT
05		MANUAL CALL POINT
06		HOOTER CUM STROBE
07		MULTI DETECTOR
08	FACP	FIRE ALARM CONTROL PANEL

EXTENDED COVERAGE SPRINKLER PIPE SIZE

SPRINKLER QUANTITY	PIPE SIZE
1	ø40
2	ø50
3–4	ø65
5–7	ø80
8 AND ABOVE	ø100

NOTE:

1. ALL DIMENSIONS ARE IN MM AND LEVELS ARE IN METRES.
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FOR TENDER PURPOSE ONLY

SL.No.	PARTICULARS	INITIAL	DATE
	REVISION		

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CHECKED	AVS
DRAWN	Anshad
CHECKED	Srinath
APPROVED	SMS
SCALE	1 : 100
UNIT	mm.
DATE	04.05.2020

KITCO Ltd.
the consultants
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PUTHIYA ROAD - NH BYPASS, KOCHI - 28

CLIENT: THE PHARMACEUTICAL CORPORATION (IM) KERALA LTD.

PROJECT: FIRE PROTECTION WORKS FOR OUSHADHI KUTTANELLUR

TITLE: -: CHIPPER UNIT:- FIRE PROTECTION LAYOUT

DRG NO: DP 1009 DRG MH 01 007 | REV. | SHEET NO: 1 OF 2

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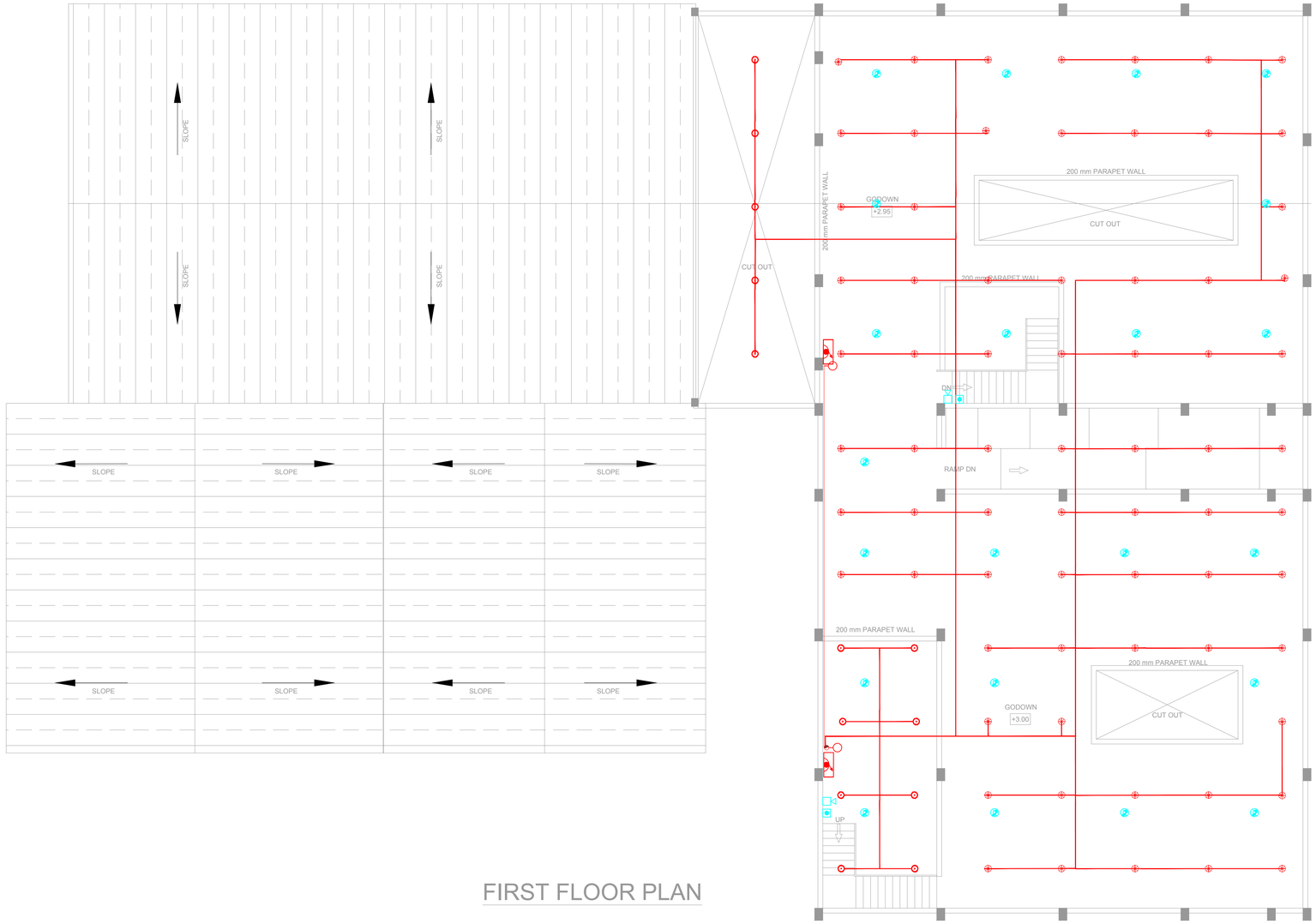

FIRST FLOOR PLAN

STANDARD SPRINKLER PIPE SIZE

SPRINKLER QUANTITY	PIPE SIZE
1–2	ø25
3	ø32
4–6	ø40
7–9	ø50
10–18	ø65
19–24	ø80
24 AND ABOVE	ø100

LEGENDS:

SN	SYMBOL	DESCRIPTION
01		FIRE PIPE
02		STANDARD COVERAGE SPRINKLER
03		EXTENDED COVERAGE SPRINKLER
04		FIRE HOSE CABINET
05		INTERNAL HYDRANT
06		MANUAL CALL POINT
07		HOOTER CUM STROBE
08		MULTI DETECTOR
09	FACP	FIRE ALARM CONTROL PANEL

EXTENDED COVERAGE SPRINKLER PIPE SIZE

SPRINKLER QUANTITY	PIPE SIZE
1	ø40
2	ø50
3–4	ø65
5–7	ø80
8 AND ABOVE	ø100

NOTE:

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FOR TENDER PURPOSE ONLY

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DRAWN	Anshad
CHECKED	Srinath
APPROVED	SMS
SCALE	1 : 100
UNIT	mm.
DATE	04.05.2020

KITCO Ltd.
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PUTHIYA ROAD - NH BYPASS, KOCHI - 28
the consultants

CLIENT: THE PHARMACEUTICAL CORPORATION (IM) KERALA LTD.

PROJECT: FIRE PROTECTION WORKS FOR OUSHADHI KUTTANELLUR

TITLE: -: CHIPPER UNIT:- FIRE PROTECTION LAYOUT FIRST FLOOR PLAN

DRG NO: DP 1009 DRG MH 01 007 | REV. | SHEET NO: 2 OF 2

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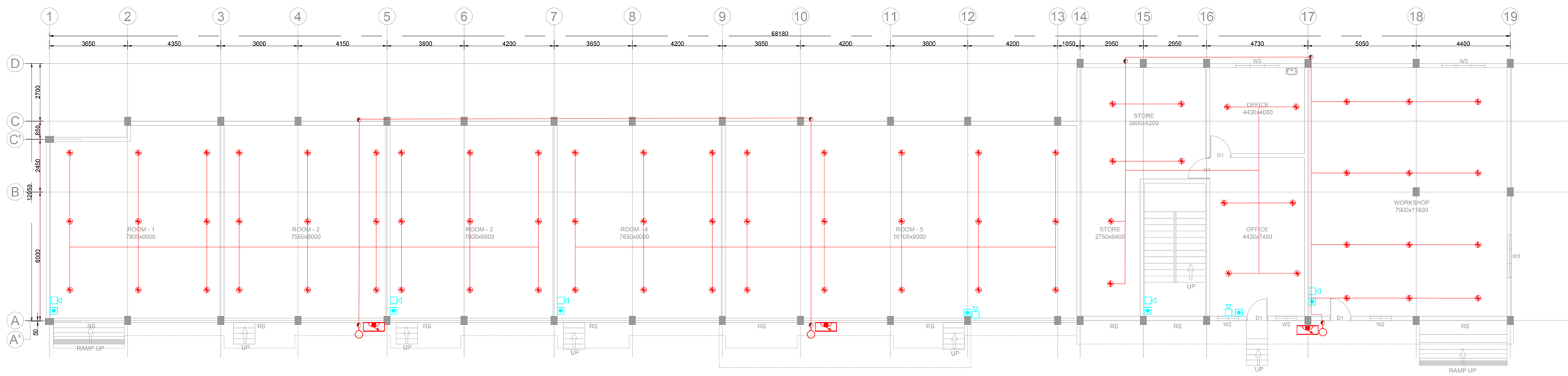

GROUND FLOOR PLAN
AREA- 692.71 SQ.M

LEGENDS:

SN	SYMBOL	DESCRIPTION
01		FIRE PIPE
02		STANDARD COVERAGE SPRINKLER
03		FIRE HOSE CABINET
04		HYDRANT VALVE
05		MANUAL CALL POINT
06		HOOTER CUM STROBE

STANDARD SPRINKLER PIPE SIZE

SPRINKLER QUANTITY	PIPE SIZE
1–2	ø25
3	ø32
4–6	ø40
7–9	ø50
10–18	ø65
19–24	ø80
24 AND ABOVE	ø100

NOTE:

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2. ONLY WRITTEN DIMENSIONS SHOULD BE FOLLOWED.
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FOR TENDER PURPOSE ONLY

SL.No.	PARTICULARS	INITIAL	DATE
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CHECKED	AVS
DRAWN	Anshad
CHECKED	Srinath
APPROVED	SMS
SCALE	1 : 100
UNIT	mm.
DATE	04.05.2020

KITCO the consultants

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(Estd. in 1972 by IDBI & Govt. of Kerala)
PUTHIYA ROAD - NH BYPASS, KOCHI - 28

CLIENT: THE PHARMACEUTICAL CORPORATION (IM) KERALA LTD.

PROJECT: FIRE PROTECTION WORKS FOR OUSHADHI KUTTANELLUR

TITLE: -: ENGINEERING STORE:- FIRE PROTECTION LAYOUT

DRG NO: DP 1009 DRG MH 01 001 | REV. | SHEET NO: 1 OF 1

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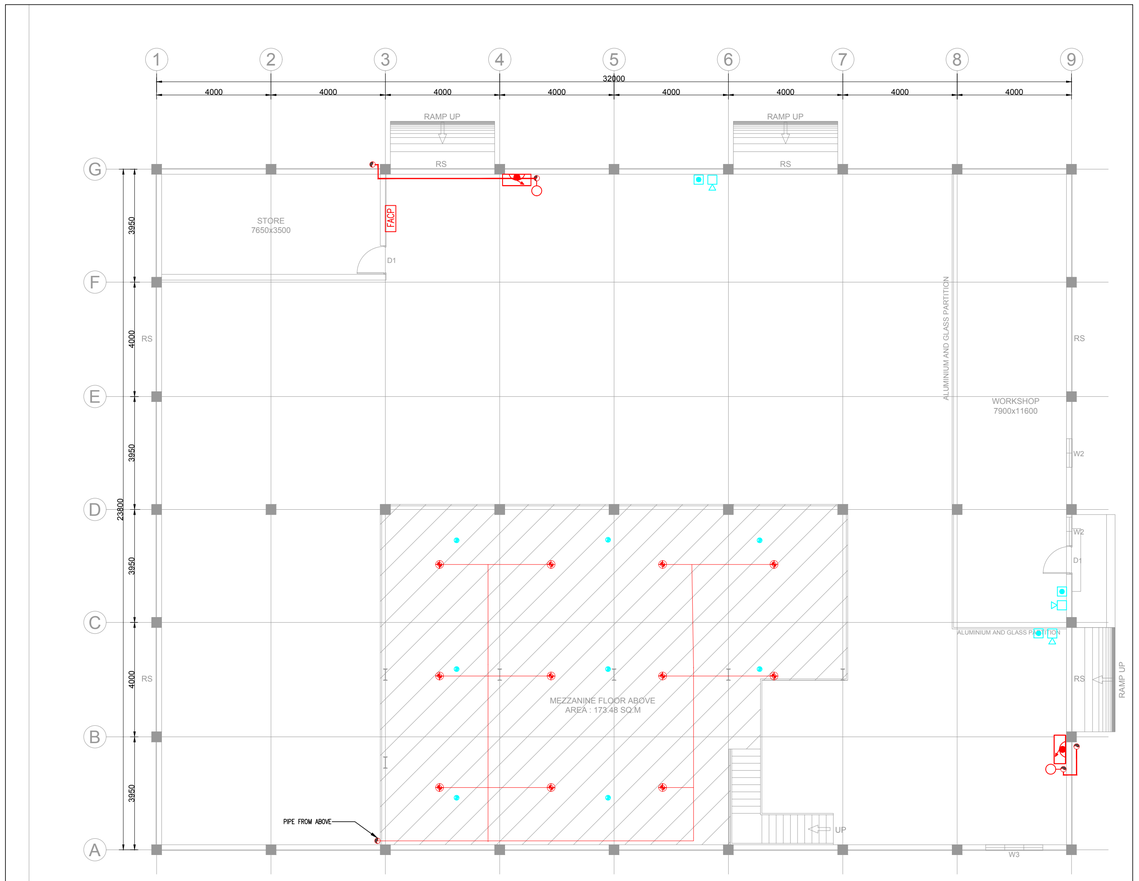
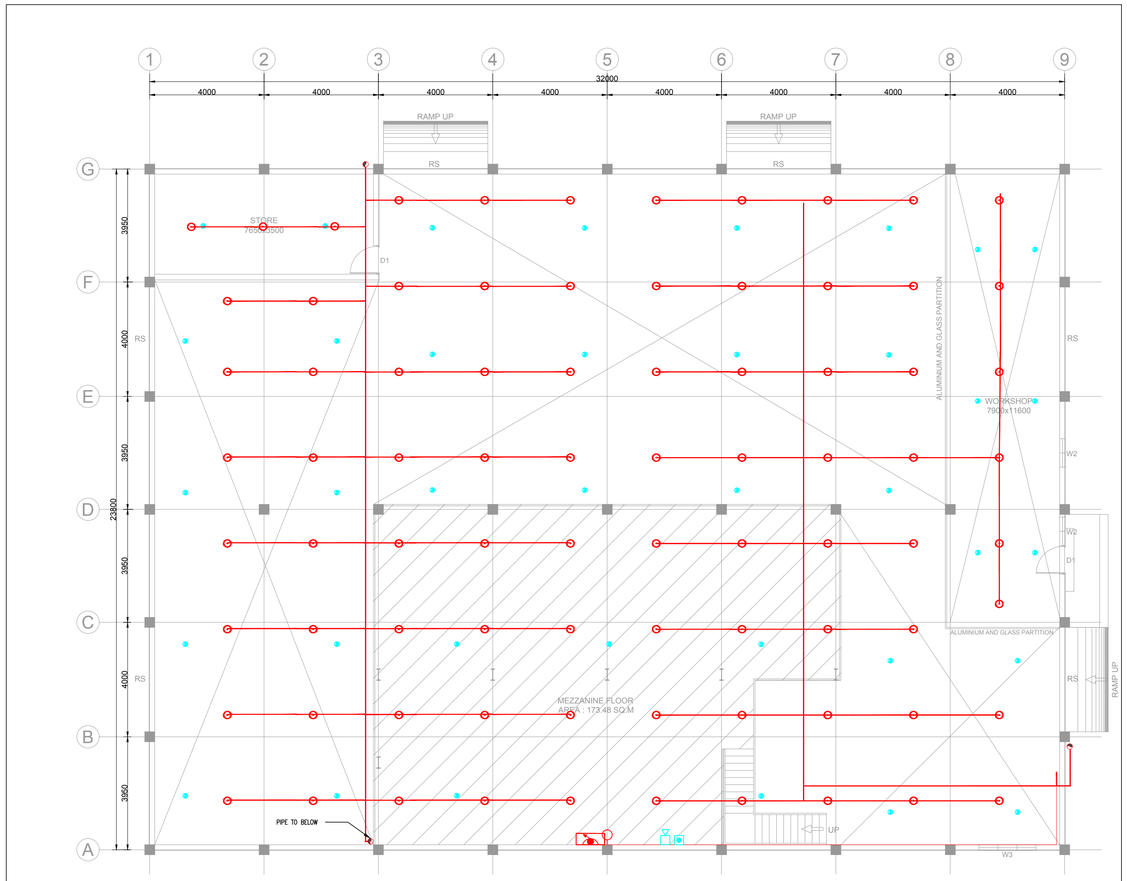


GROUND FLOOR PLAN
AREA- 764.39 SQ.M



GROUND FLOOR PLAN
AREA- 764.39 SQ.M

LEGENDS:

SN	SYMBOL	DESCRIPTION
01		FIRE PIPE
02		EXTENDED COVERAGE SPRINKLER
03		STANDARD COVERAGE SPRINKLER
04		FIRE HOSE CABINET
05		INTERNAL HYDRANT
06		MANUAL CALL POINT
07		HOOTER CUM STROBE
08		MULTI DETECTOR

EXTENDED COVERAGE SPRINKLER PIPE SIZE

SPRINKLER QUANTITY	PIPE SIZE
1	ø40
2	ø50
3–4	ø65
5–7	ø80
8 AND ABOVE	ø100

STANDARD SPRINKLER PIPE SIZE

SPRINKLER QUANTITY	PIPE SIZE
1–2	ø25
3	ø32
4–6	ø40
7–9	ø50
10–18	ø65
19–24	ø80
24 AND ABOVE	ø100

NOTE:

1. ALL DIMENSIONS ARE IN MM AND LEVELS ARE IN METRES.
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FOR TENDER PURPOSE ONLY

SL.No.	PARTICULARS	INITIAL	DATE

REVISION

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DESIGNED	Srianth
CHECKED	AVS
DRAWN	Anshad
CHECKED	Srinath
APPROVED	SMS
SCALE	1 : 100
UNIT	mm.
DATE	04.05.2020

KITCO the consultants

KITCO Ltd.
(Estd. in 1972 by IDBI & Govt. of Kerala)
PUTHIYA ROAD - NH BYPASS, KOCHI - 28

CLIENT: THE PHARMACEUTICAL CORPORATION (IM) KERALA LTD.

PROJECT: FIRE PROTECTION WORKS FOR OUSHADHI KUTTANELLUR

TITLE: -: RAW MATERIAL STORE:- FIRE PROTECTION LAYOUT

DRG NO: DP 1009 DRG MH 01 002 | REV. | SHEET NO: 1 OF 1

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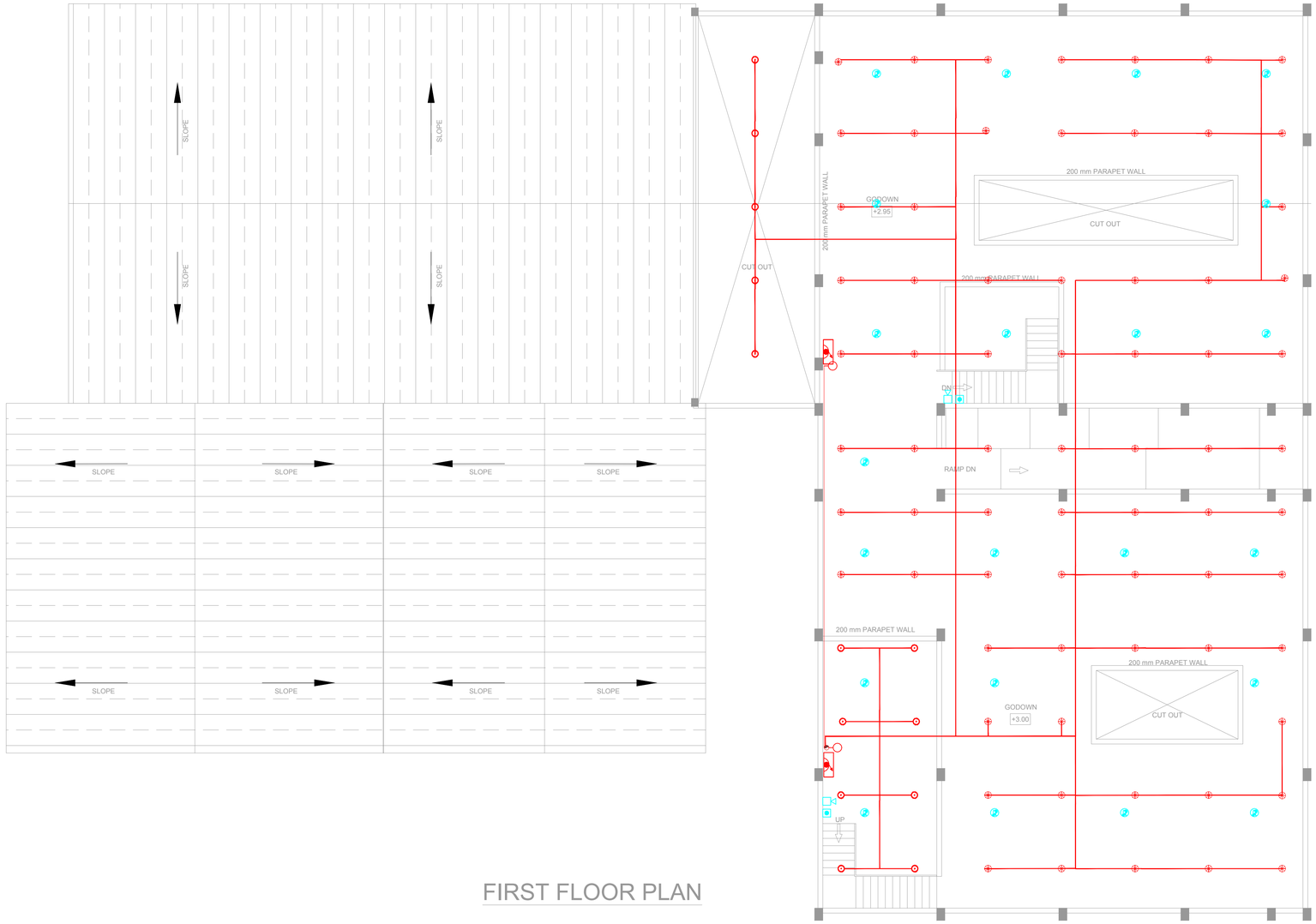

FIRST FLOOR PLAN

STANDARD SPRINKLER PIPE SIZE

SPRINKLER QUANTITY	PIPE SIZE
1–2	ø25
3	ø32
4–6	ø40
7–9	ø50
10–18	ø65
19–24	ø80
24 AND ABOVE	ø100

LEGENDS:

SN	SYMBOL	DESCRIPTION
01		FIRE PIPE
02		STANDARD COVERAGE SPRINKLER
03		EXTENDED COVERAGE SPRINKLER
04		FIRE HOSE CABINET
05		INTERNAL HYDRANT
06		MANUAL CALL POINT
07		HOOTER CUM STROBE
08		MULTI DETECTOR
09	FACP	FIRE ALARM CONTROL PANEL

EXTENDED COVERAGE SPRINKLER PIPE SIZE

SPRINKLER QUANTITY	PIPE SIZE
1	ø40
2	ø50
3–4	ø65
5–7	ø80
8 AND ABOVE	ø100

NOTE:

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FOR TENDER PURPOSE ONLY

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CHECKED	AVS
DRAWN	Anshad
CHECKED	Srinath
APPROVED	SMS
SCALE	1 : 100
UNIT	mm.
DATE	04.05.2020

KITCO Ltd.
(Estd. in 1972 by IDBI & Govt. of Kerala)
PUTHIYA ROAD - NH BYPASS, KOCHI - 28
the consultants

CLIENT: THE PHARMACEUTICAL CORPORATION (IM) KERALA LTD.

PROJECT: FIRE PROTECTION WORKS FOR OUSHADHI KUTTANELLUR

TITLE: -: CHIPPER UNIT:- FIRE PROTECTION LAYOUT FIRST FLOOR PLAN

DRG NO: DP 1009 DRG MH 01 007 | REV. | SHEET NO: 2 OF 2

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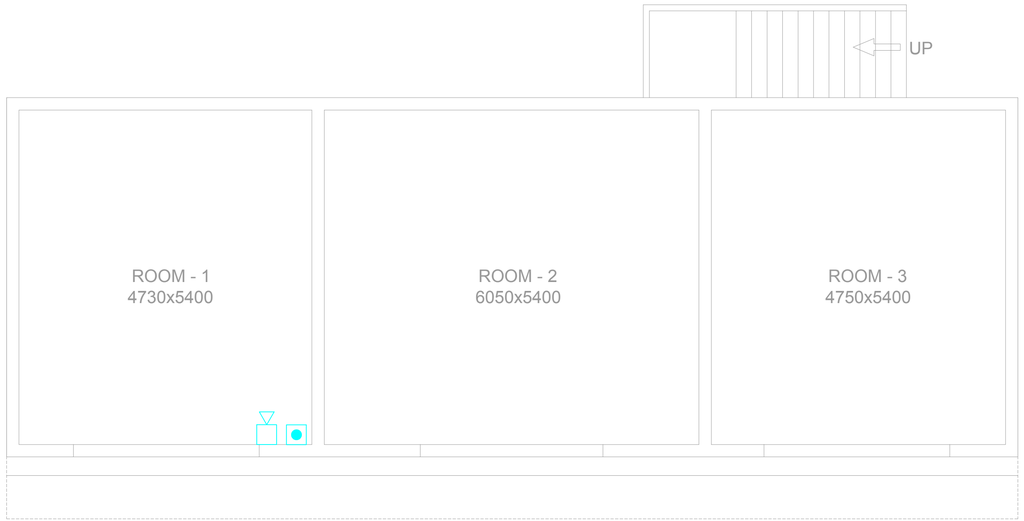

GROUND FLOOR PLAN
AREA- 618.90 SQ.M

LEGENDS:

SN	SYMBOL	DESCRIPTION
01		MANUAL CALL POINT
02		HOOTER CUM STROBE

NOTE:

1. ALL DIMENSIONS ARE IN MM AND LEVELS ARE IN METRES.
2. ONLY WRITTEN DIMENSIONS SHOULD BE FOLLOWED.

FOR TENDER PURPOSE ONLY

SL.No.	PARTICULARS	INITIAL	DATE
	REVISION		

DESIGNED	Srianth
CHECKED	AUS
DRAWN	Anshad
CHECKED	Srianth
APPROVED	SMS

CLIENT: THE PHARMACEUTICAL CORPORATION (IM) KERALA LTD.

PROJECT: FIRE PROTECTION WORKS FOR OUSHADHI KUTTANELLUR

TITLE: -:KASHAYA CHOORNAM PACKING BLOCK:- FIRE PROTECTION LAYOUT

UNIT:	SCALE:	DRG NO:	SHEET NO:	REV.	DATE:
mm.	1 : 100	DP 1009 DRG MH 01 004	1 OF 1		04.05.2020

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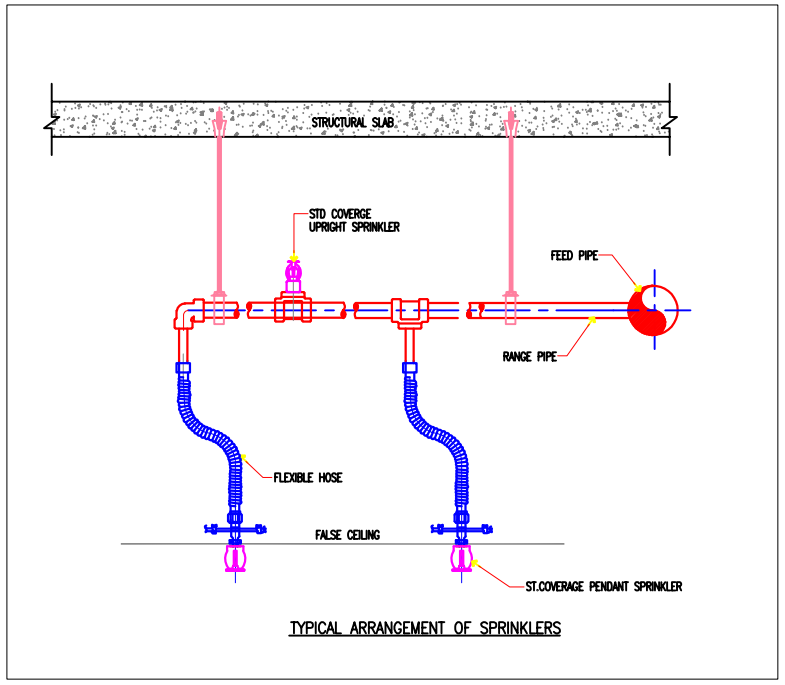
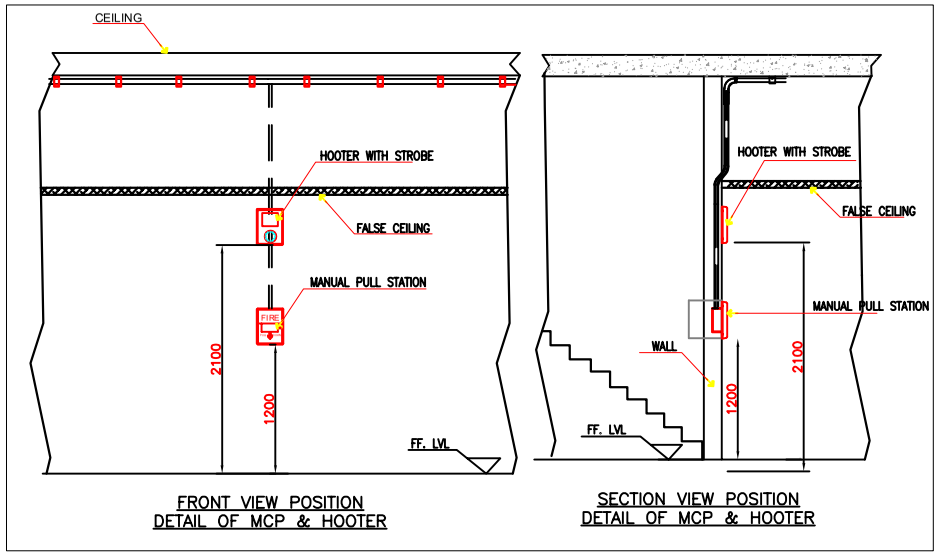
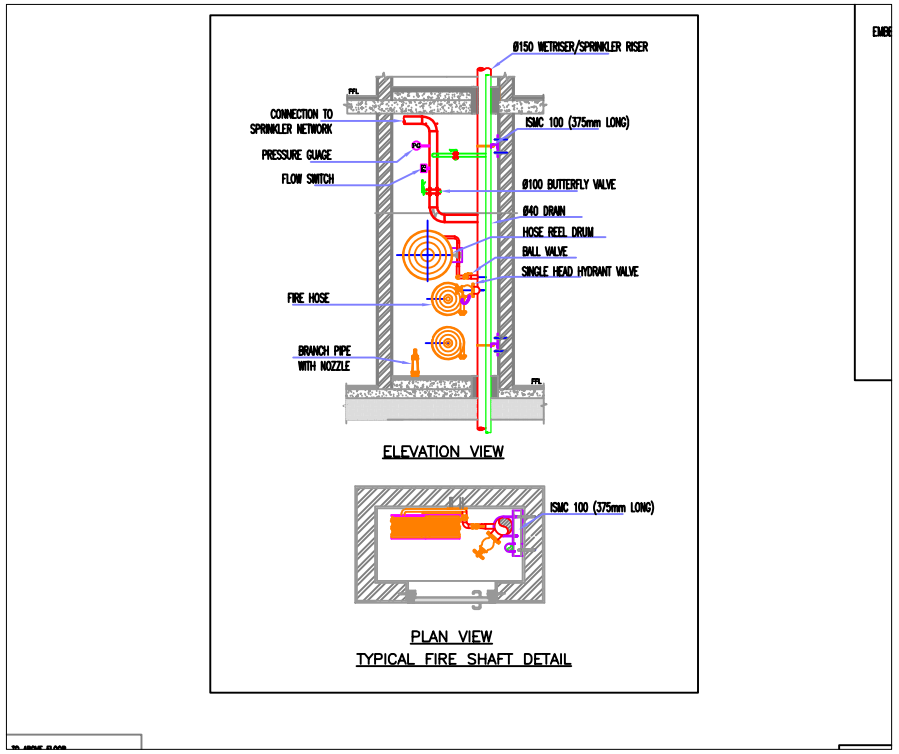


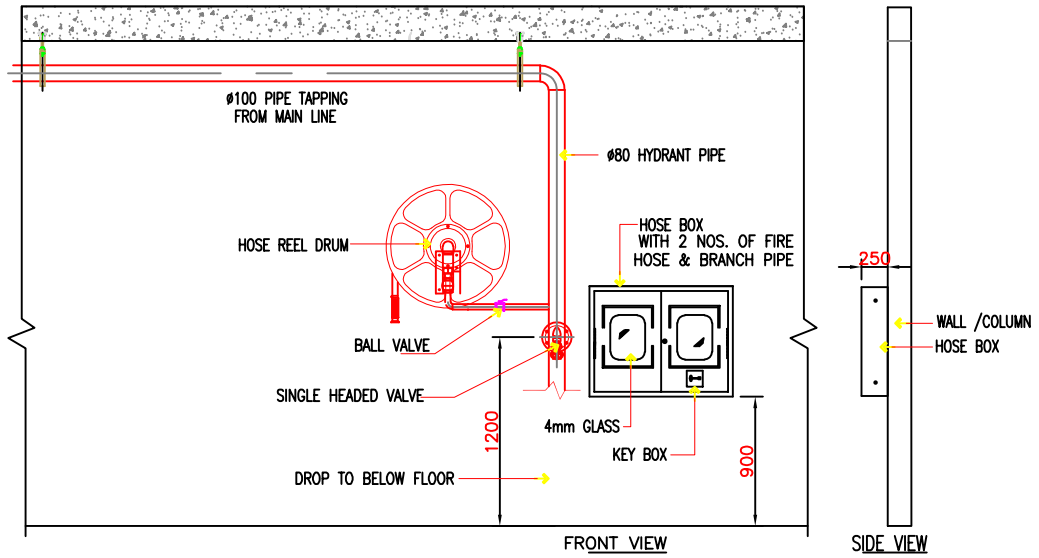
TYPICAL ARRANGEMENT OF SPRINKLERS



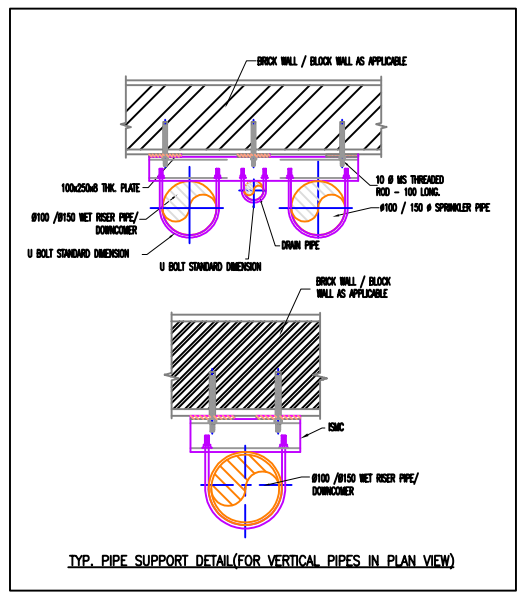
FRONT VIEW POSITION
DETAIL OF MCP & HOOTER

SECTION VIEW POSITION
DETAIL OF MCP & HOOTER

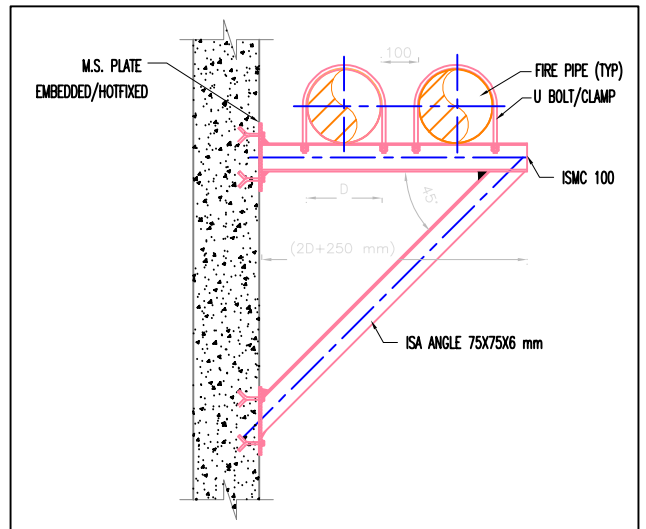




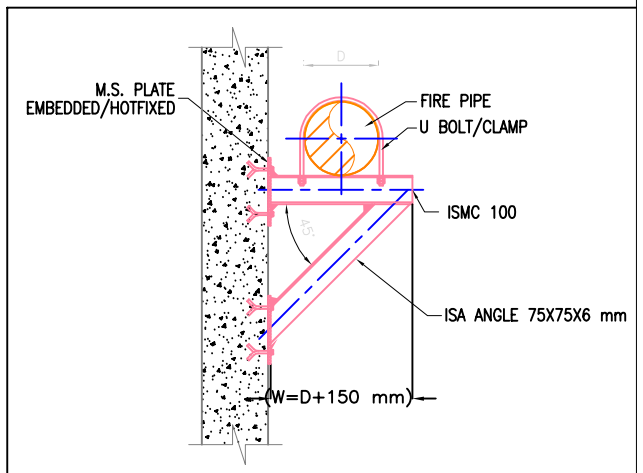
EXPOSED FIRE HOSE CABINET WITHOUT SHAFT



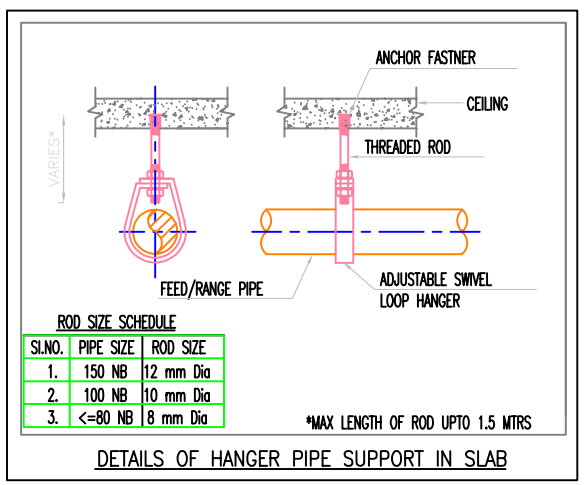
TYP. PIPE SUPPORT DETAIL(FOR VERTICAL PIPES IN PLAN VIEW)



TYP. PIPE SUPPORT DETAIL (WALL)



TYP. PIPE SUPPORT DETAIL (WALL)

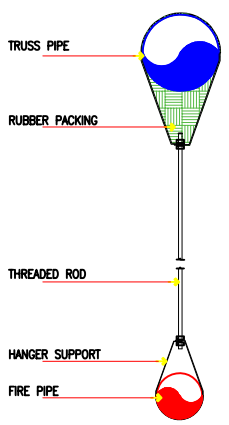


ROD SIZE SCHEDULE

SL.NO.	PIPE SIZE	ROD SIZE
1.	150 NB	12 mm Dia
2.	100 NB	10 mm Dia
3.	<=80 NB	8 mm Dia

*MAX LENGTH OF ROD UPTO 1.5 MTRS

DETAILS OF HANGER PIPE SUPPORT IN SLAB



TYPICAL PIPE SUPPORT IN TRUSS

FOR TENDER PURPOSE ONLY

SL.No.	PARTICULARS	INITIAL	DATE
	REVISION		

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CHECKED	AUS
DRAWN	Anshad
CHECKED	Srinath
APPROVED	SMS
SCALE	1 : 100
UNIT	mm.
DATE	04.05.2020

KITCO the consultants

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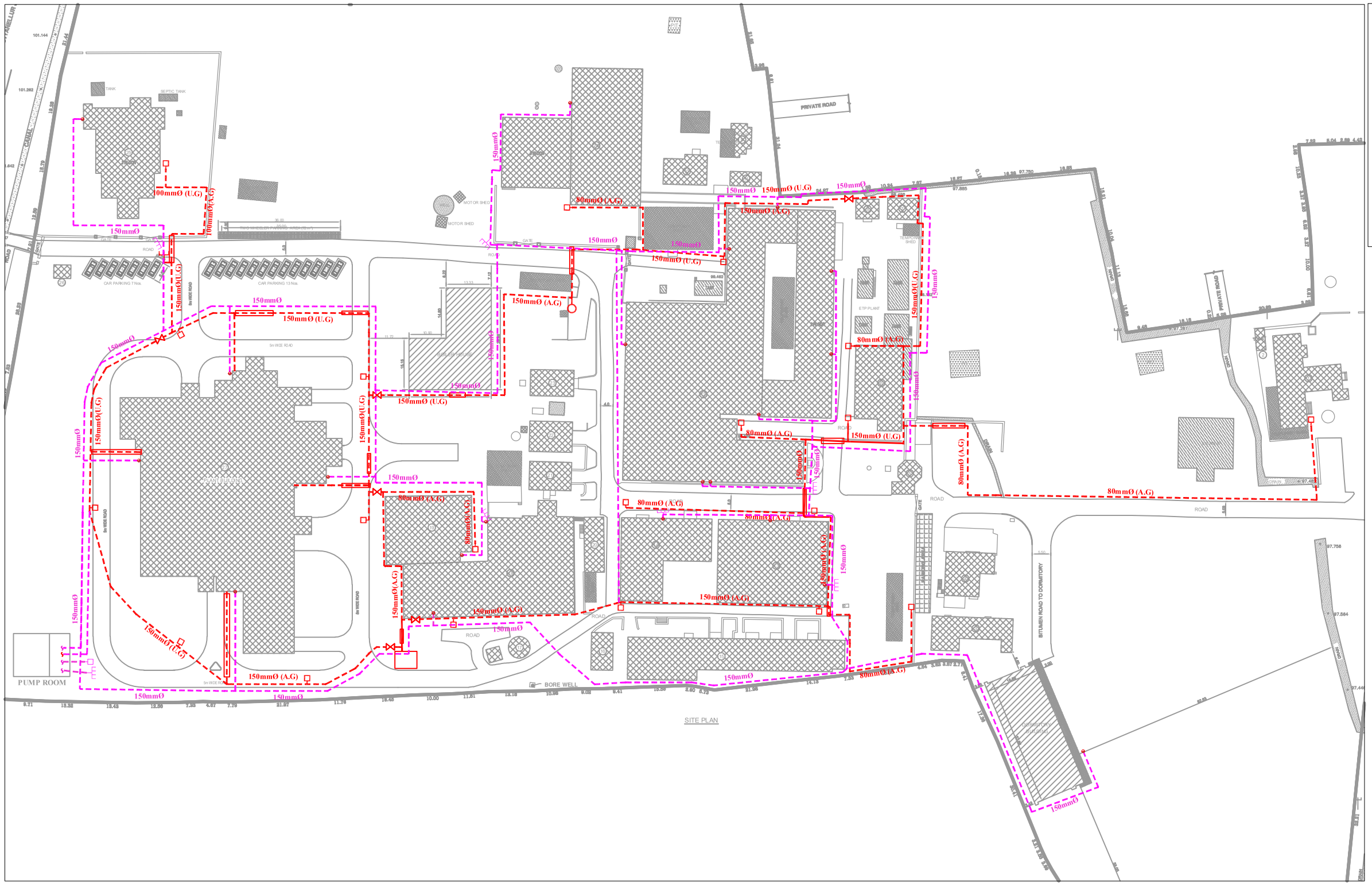
PUTHIYA ROAD - NH BYPASS, KOCHI - 28

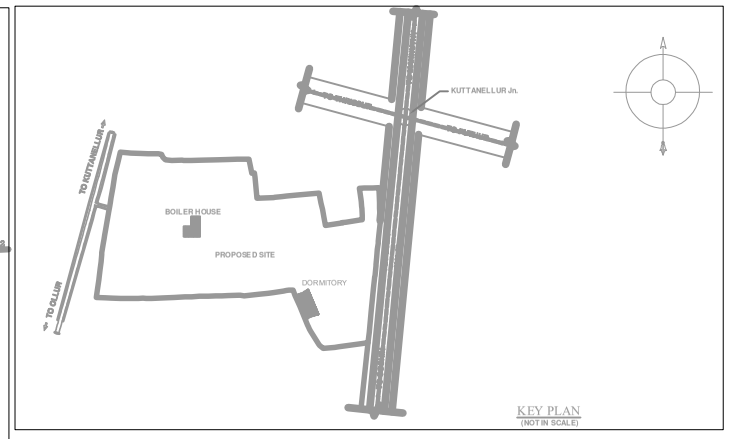
CLIENT: THE PHARMACEUTICAL CORPORATION (IM) KERALA LTD.

PROJECT: FIRE PROTECTION WORKS FOR OUSHADHI KUTTANELLUR

TITLE: FIRE PROTECTION AND DETECTION TYPICAL DETAILS

DRG NO: DP 1009 DRG MH 01 010 | REV. | SHEET NO: 1 OF 1



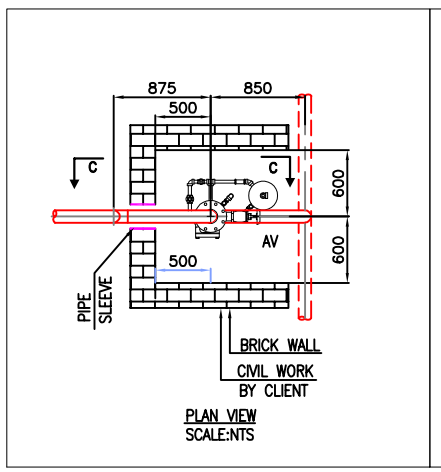


LEGENDS:

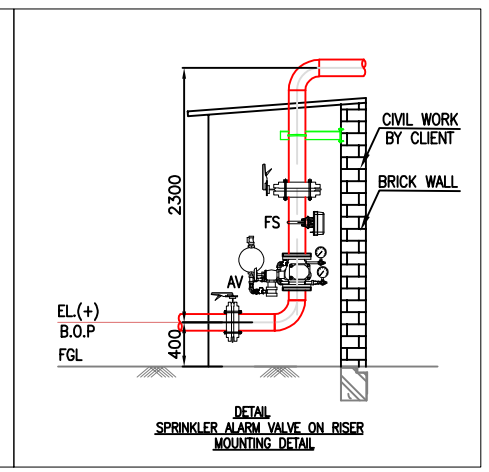
SN	DESCRIPTION
12	MAIN PLANT
13	RAW MATERIAL STORE
14	KASHAYA CHOORNAM BLOCK
18	CHIPPER SECTION
19	CHIPPER SECTION
20	CHOORNAM PACKING BLOCK
24	PM STORE
25	RESEARCH CENTER
27	CENTRE OF EXCELLENCE

LEGENDS:

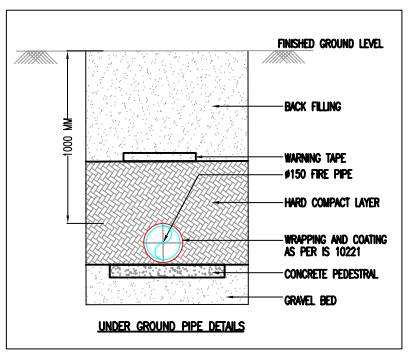
SN	SYMBOL	DESCRIPTION
01		PROPOSED FIRE PIPE
02		EXISTING FIRE PIPE
03		EXTERNAL HYDRANT & HOSE BOX
04		4-WAY BREECHING INLET
05		FIRE BRIGADE DRAW OUT CONNECTION



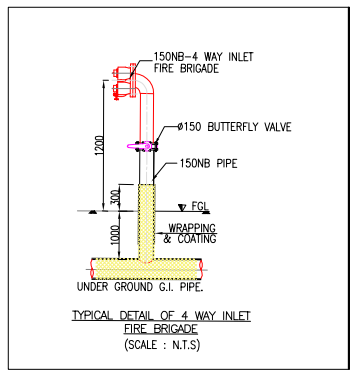
PLAN VIEW
SCALE:NTS



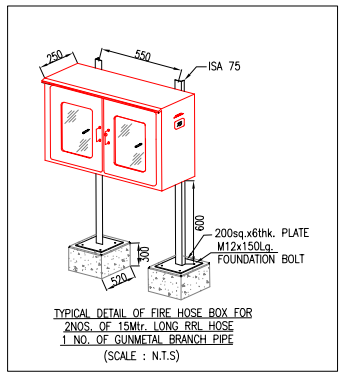
DETAIL
SPRINKLER ALARM VALVE ON RISER
MOUNTING DETAIL



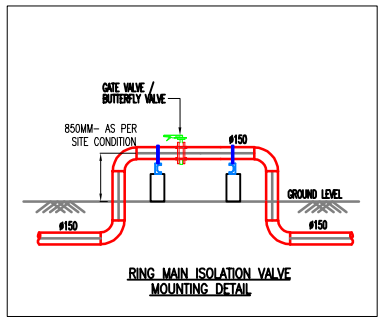
UNDER GROUND PIPE DETAILS



TYPICAL DETAIL OF 4 WAY INLET
FIRE BRIGADE
(SCALE : N.T.S)



TYPICAL DETAIL OF FIRE HOSE BOX FOR
2NOS. OF 15Mtr. LONG RRL HOSE
1 NO. OF GUNMETAL BRANCH PIPE
(SCALE : N.T.S)



RING MAIN ISOLATION VALVE
MOUNTING DETAIL

NOTES

1. ALL DIMENSIONS ARE IN MM AND LEVELS ARE IN METRES.
2. ONLY WRITTEN DIMENSIONS SHOULD BE FOLLOWED.
3. THE CONTRACTOR SHALL COORDINATE WITH OTHER SERVICES TO ENSURE THAT THE FIRE PROTECTION ACCESSORIES DOES NOT PROVIDE ANY OBSTRUCTION.
4. THE CONTRACTOR SHALL PREPARE DETAILED SHOP DRAWING BASED ON THE DRAWING RELEASED BY THE CONSULTANT AND GET IT APPROVED BY CONSULTANT BEFORE EXECUTING THE WORK.
5. STANDARD FITTINGS SHALL BE ADHERED.
6. FIRE HYDRANT SYSTEM SHALL BE IN ACCORDANCE TO IS 13039, IS 3844
7. UNDERGROUND PIPING SHALL BE PROVIDED WITH COATING AND WRAPPING OF 4MM THICK CONFORMING TO IS: 10221
8. UNDERGROUND PIPE SHALL BE LAID IN SUCH A WAY THAT THE TOP OF THE PIPE WILL BE MINIMUM 1M BELOW FROM THE FINISHED GROUND LEVEL.
9. HUME PIPE SHALL BE PROVIDED FOR PIPES AT ROAD CROSSING.

FOR TENDER PURPOSE ONLY

SL.No.	PARTICULARS	INITIAL	DATE
	REVISION		

DESIGNED	Srinath
CHECKED	AUS
DRAWN	Anshad
CHECKED	Srinath
APPROVED	SMS
SCALE	1 : 100
UNIT	mm.
DATE	04.05.2020

KITCO the consultants

KITCO Ltd.
(Estd. in 1972 by IDBI & Govt. of Kerala)
PUTHIYA ROAD - NH BYPASS, KOCHI - 28

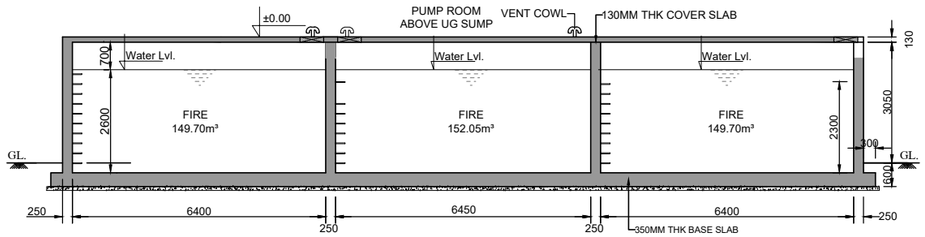
CLIENT: THE PHARMACEUTICAL CORPORATION (IM) KERALA LTD.

PROJECT: FIRE PROTECTION WORKS FOR OUSHADHI KUTTANELLUR

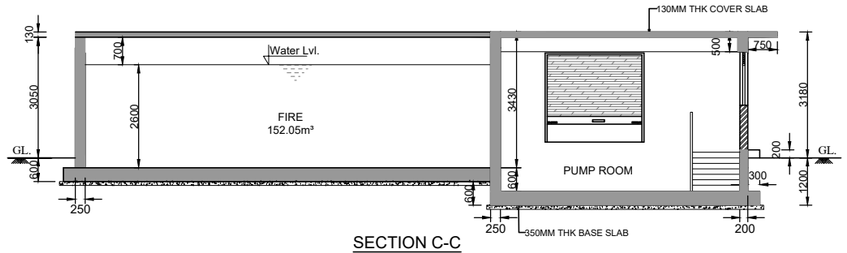
TITLE: EXTRENAL LAYOUT-FIRE PROTECTION SYSTEM

DRG NO: DP 1009 DRG MH 01 011 | REV. | SHEET NO: 1 OF 1

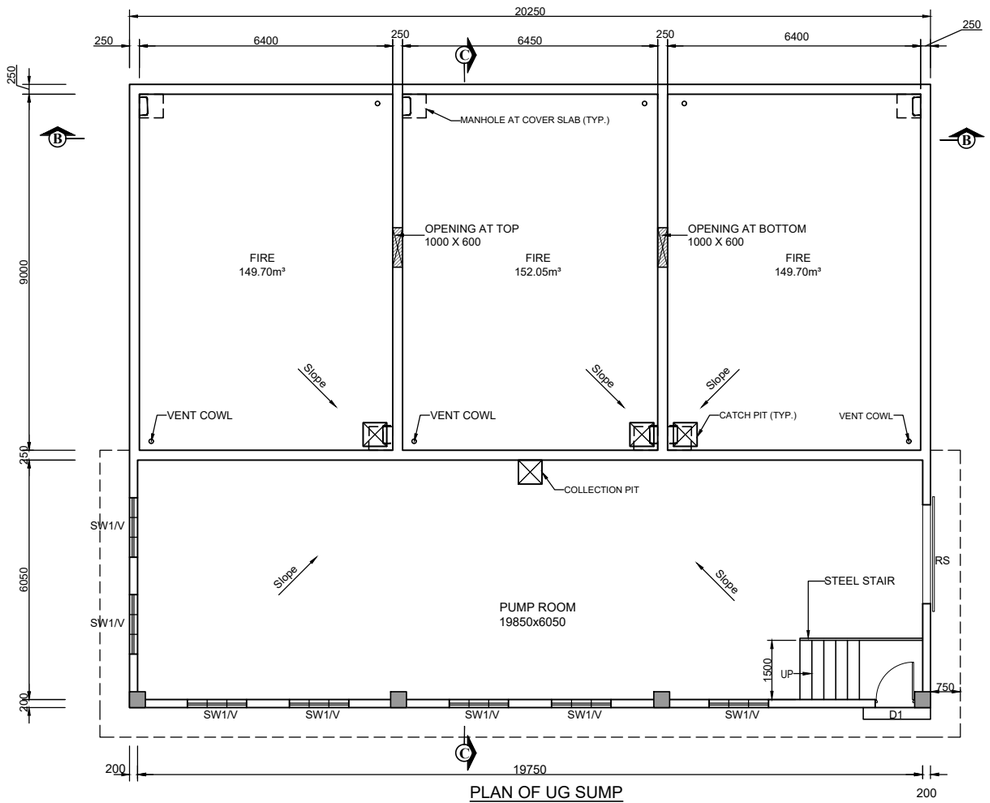
1 2 3 4 5 6 7 8



SECTION B-B



SECTION C-C



PLAN OF UG SUMP

JOINERY SCHEDULE			
TYPE	PARTICULARS	NO.S	SIZE
RS	ROLLING SHUTTER	01	2500 x 2400
SW1/V	AL. WINDOW (FIXED GLASS WITH TOP LOUVER	07	1500 x 1050 1500 x 300
D1	STEEL DOOR	01	1000 x 2100

NOTE:
1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS
2. ONLY WRITTEN DIMENSIONS SHOULD BE FOLLOWED

FOR TENDER PURPOSE ONLY

SL.No.	PARTICULARS	INITIAL	DATE
	REVISION		

This drawing is the property of KITCO Ltd. and is to be used only for the purpose for which it was lent and must not be in any way detrimental to the interest of the company and is subject to return on demand

DESIGNED	KS
CHECKED	SAG
DRAWN	Sruthy
CHECKED	KS
APPROVED	SMS
SCALE	1 : 100
UNIT	mm.
DATE	28.05.2020

KITCO the consultants

KITCO Ltd.
(Estd. in 1972 by IDBI & Govt. of Kerala)
PUTHIYA ROAD - NH BYPASS, KOCHI - 28

CLIENT: THE PHARMACEUTICAL CORPORATION (IM) KERALA LTD.

PROJECT: FIRE PROTECTION WORKS FOR OUSHADHI - KUTTANELLUR

TITLE: -:SUMP AND PUMP HOUSE:- PLAN, ELEVATION AND SECTION

DRG NO: DP 1009 DRG CL 01 001 | REV. | SHEET NO: 1 OF 1

S:\DWGS\1009 OUSHADI FIRE\CIVIL\PLAN ELEVATION AND SECTION UG SUMP AND PUMP HOUSE 19750X17000.dwg - Jun. 25, 2020