TITLE	**:**	**E-TENDER FOR CIVIL, INTERIOR, ELECTRICAL, VENTILATION AND FIRE FIGHTING WORKS AT SRI GURU GOBIND SINGH COLLEGE OF COMMERCE.**
OWNER	**:**	**PRINCIPAL, SRI GURU GOBIND SINGH COLLEGE OF COMMERCE**
ADDRESS	**:**	**UNIVERSITY OF DELHI, OPPOSITE TV TOWER, PITAMPURA, DELHI-110034 (INDIA).**
WEBSITE	**:**	https://www.sggscc.ac.in/
TYPE OF TENDER	**:**	**OPEN- E TENDER (TWO COVER SYSTEM)**
ESTIMATED COST OF WORK	**:**	**RS. 100 LAKHS**
TENDER FEE	**:**	**RUPEES ONE THOUSAND ONLY**
DATE OF START	**:**	**03-11-2021**
LAST DATE OF SUBMISSION OF TECHNICAL BID DOCUMENT	**:**	**17-11-2021**
EARNEST MONEY DEPOSIT	**:**	**RS. 2,00,000**
TENDER PREPARED BY	:	RANJIT SINGH & ASSOCIATES, 1206 SURYA KIRAN BUILDING, 19 K.G. MARG, NEW DELHI 110001. PH. 011-23312688. rsa1206@msn.com

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TENDER SCHEDULE		
Validity Of Offer	:	90 Days
Cost Of Tender Document	:	Rs. 1,000
Estimated Cost of The Work	:	Rs. 100 lakhs
Earnest Money Deposit.	:	RS. 2,00,000 Payables by D.D. In Favour Of Principal, Sri Guru Gobind Singh College of Commerce. EMD of unsuccessful bidders will be returned.
Start Of Tender Download.	:	Wednesday, 03 November 2021
Last Date of Tender Download.	:	16-11-2021
Last Date of Submission of Tender.	:	17-11-2021 At 3:00 Pm
Date Of Opening of Technical Bid.	:	18-11-2021 At 3:00 Pm
Defects Liability Period.	:	24 Months
Contract Time Period.	:	6 Months
Penalty For Delay.	:	Rs. 5,000/- Per Day Up to Maximum Of 10% Of the Cost of The Works.
Minimum Running Account Bill Value.	:	15 Lakhs
Retention Percentage.	:	5%
Performance Guarantee.	:	Before Issue of Letter To Start The Work, Contractor Shall Furnish A Performance Guarantee In The Form Of A Bank Guarantee To The Tune Of Five Percent (5%) Of The Cost Of The Accepted Tender Amount. Bank Guarantee Will Be Kept Valid Up To 12 Months After Completion of The Works.
Contact Details for Clarification Related to Tender.	:	Email: Rsa1206@Msn.Com Phone. 011-43560879

ELIGIBILITY CRITERIA

S. NO.		DESCRIPTION
1)	:	**BIDDER SHOULD HAVE COMPLETED THREE SIMILAR WORKS EACH COSTING NOT LESS THAN RUPEES 40 Lakhs**
		OR
		BIDDER SHOULD HAVE COMPLETED TWO SIMILAR WORKS EACH COSTING NOT LESS THAN RUPEES 60 Lakhs
		OR
		BIDDER SHOULD HAVE COMPLETED ONE SIMILAR WORKS EACH COSTING NOT LESS THAN RUPEES 80 Lakhs
2)	:	**BIDDER SHOULD HAVE AVERAGE ANNUAL TURNOVER (GROSS) OF 50 LAKHS**
3)	:	**BIDDER SHOULD HAVE A SOLVENCY OF RUPEES 40 LAKHS**
4)	:	**BIDDER SHOULD SUBMIT AN EMD OF RUPEES RS. 2,00,000.**
5)	:	**BIDDER SHOULD BE THE MANUFACTURER OR AUTHORIZED DEALER. LETTER OF AUTHORIZATION FROM ORIGINAL EQUIPMENT MANUFACTURER (OEM) SPECIFIC TO THE TENDER SHOULD BE ENCLOSED.**

CHECKLIST OF DOCUMENTS TO BE PLACED IN THE TECHNICAL BID

S.NO.		DESCRIPTION	CHECK
1)	:	COMPANY REGISTRATION DETAILS	☐
2)	:	COMPANY PROFILE	☐
3)	:	GST REGISTRATION CERTIFICATE COPY	☐
4)	:	PAN CARD COPY	☐
5)	:	TURNOVER CERTIFICATE (ANNEXURE -1)	☐
6)	:	SOLVENCY CERTIFICATE	☐
7)	:	VALID COMPLETION CERTIFICATES	☐
8)	:	LETTER OF AUTHORISATION FROM OEM	☐
9)	:	TENDER FEE OF RS. 1000 IN THE FORM OF A DEMAND DRAFT IN THE NAME OF Principal, Sri Guru Gobind Singh College of Commerce. *ORIGINAL DEMAND DRAFT TO BE SUBMITTED WITH THE TECHNICAL BID TO THE OFFICE OF THE PRINCIPAL AND SCANNED COPY TO BE UPLOADED ALONG WITH THE TENDER*.	☐
10)	:	EMD FEE OF RS. RS. 2,00,000 IN THE FORM OF A DEMAND DRAFT IN THE NAME OF Principal, Sri Guru Gobind Singh College of Commerce. *ORIGINAL DEMAND DRAFT TO BE SUBMITTED WITH THE TECHNICAL BID TO THE OFFICE OF THE PRINCIPAL AND SCANNED COPY TO BE UPLOADED ALONG WITH THE TENDER*.	☐

SUBMISSION OF TECHNICAL BID

1) **THE TECHNICAL BID DOCUMENTS HAVE TO BE SCANNED AND UPLOADED ON THE CPP PORTAL.**

HARDCOPY OF THE TECHNICAL BID DOCUMENTS SHOULD BE SUBMITTED TO THE OFFICE OF PRINCIPAL, SRI GURU GOBIND SINGH COLLEGE OF COMMERCE ON OR BEFORE 3:00 PM ON 16-11-2021. *(IN ADDITION TO UPLOADING ON THE CPP PORTAL)*

To

All The Eligible Bidders,

Dear Sir/ Madam,

You are invited to submit your most competitive **ONLINE** Quotation through the Central Public Procurement (CPP) Public Procurement (CPP) portal web site https://eprocure.gov.in/eprocure/app in TWO COVER SYSTEM (TECHNICAL & FINANCIAL) on or before the prescribed due date and time for E-Tender for Civil, Interior, Electrical, Ventilation and Fire Fighting Works at Sri Guru Gobind Singh College of Commerce..

Manual Bids shall not be accepted, except for the supportive documents / instruments if any asked in this tender. However, bidders are requested to submit hardcopy technical bid on or before the tender due date mentioned in the tender document.

The complete details of the tender items are available in the tender document, which can be downloaded from https://www.sggscc.ac.in/ and the Central Public Procurement (CPP) Public Procurement (CPP) portal web site https://eprocure.gov.in/eprocure/app.

The bids are to be submitted ON-LINE through https://eprocure.gov.in/eprocure/app up to the due date and time of submission of tender. Any queries related to the tender document should be addressed to the tender inviting authority Principal, Sri Guru Gobind Singh College of Commerce.

Any queries relating to the process of online bid submission or queries relating to CPP Portal by bidders should be addressed to 24x7 CPP Portal Helpdesk by using the Toll-Free numbers given in the CPP website.

Sd/-

Principal, Sri Guru Gobind Singh College of Commerce

TENDER ACCEPTANCE (OFFER) LETTER

TO,

Principal, Sri Guru Gobind Singh College of Commerce
University of Delhi, Opposite TV Tower, Pitampura, Delhi-110034 (India).

Subject: Acceptance in respect of terms and conditions of tender document for E-Tender for Civil, Interior, Electrical, Ventilation and Fire Fighting Works at Sri Guru Gobind Singh College of Commerce.

Dear Sir,

1. I / We have downloaded the tender document(s) for the above-mentioned tender from the website https://www.sggscc.ac.in/ / https://eprocure.gov.in/eprocure/app .

2. I / We hereby certify that I / We have read every page of the tender document including all terms/conditions/drawings/annexures/forms/appendixes/paras etc. which are part of the contract agreement and I / We agree to accept all the terms and conditions contained therein.

3. The corrigendum(s) issued from time to time by your organisation has also been taken into consideration, while submitting this acceptance letter.

4. I / We hereby unconditionally accept all the terms and conditions of above-mentioned tender document and corrigendum(s) as applicable.

5. In case any provisions of this letter are found violated, then Principal, Sri Guru Gobind Singh College of Commerce shall without prejudice to any other right or remedy be at liberty to reject my/our bid including the forfeiture of EMD.

6. 1 / We hereby certify that all statements made and information supplied in the enclosed appendix, annexure, forms/paras etc. furnished herewith are true and correct.

7. I / We have furnished all information and details necessary for demonstrating our qualification and have no further critical information to supply.

8. I / We understand and accept that Principal, Sri Guru Gobind Singh College of Commerce is not bound to accept the lowest bid or any of the bids submitted by the bidders or to give any reasons for their decision.

9. I/We understand and accept that all taxes including GST shall be payable by the bidder/contractor and Principal, Sri Guru Gobind Singh College of Commerce will not entertain any claim whatsoever in respect of taxes.

10. I/We understand and accept that Principal, Sri Guru Gobind Singh College of Commerce reserves the right of accepting the whole or any part of the tender and the bidder/contractor shall be bound to perform the same at quoted rates.

11. I / We understand and accept that in case any information provided by me/us is found to be false/ incorrect, then Principal, Sri Guru Gobind Singh College of Commerce shall be at liberty to reject our bid and without prejudice to any other right or remedy, be at liberty to forfeit the EMD absolutely and I / We shall not have any claim against Principal, Sri Guru Gobind Singh College of Commerce .

12. I/We understand and accept that, if after the tender is accepted, I / We fail to commence the execution of the works within the stipulated time, then Principal, Sri Guru Gobind Singh College of Commerce shall without prejudice to any other right or remedy, be at liberty to forfeit the EMD absolutely and I / We shall not have any claim against Principal, Sri Guru Gobind Singh College of Commerce .

Yours Faithfully,

Signature of Bidder:

Name:

Designation:

Stamp of the Bidder:

BIDDER'S DETAILS

S.NO.	DESCRIPTION	DETAIL
1	Name of Company	
2	Address of Company	
3	PAN no.	
4	GSTN no.	
5	Telephone Number	
6	Email Address	
7	Name of Company Owner / Director / Partner	
8	Address of Company Owner / Director / Partner	
9	Telephone Number of Company Owner / Director/ Partner	

I/We hereby declare that the information furnished above is true and correct. In case the above information is found incorrect at any stage, the Principal, Sri Guru Gobind Singh College of Commerce may take appropriate action as warranted.

Name:	
Designation:	
Stamp & Signatures:	
Place:	
Date:	

SPECIAL CONDITIONS OF CONTRACT

1. CONTRACTORS are advised to inspect and examine the site and the surroundings and satisfy themselves before submitting their Tender as to the nature of the ground and sub-soil (so far as practicable), the form and the nature of the site, the means of access to the site, the accommodation they may require and in general shall themselves obtain necessary information as to the risks, contingencies and other circumstances which may influence or affect their Tender. CONTRACTORS shall be deemed to have full knowledge of the site, whether they inspect it or not and no extra charge consequent to any misunderstanding or otherwise shall be allowed.

2. Submissions of the Tender by the CONTRACTOR implies that he has read all contract documents and has made himself aware of the scope and specifications of the work to be done and local conditions and other factors bearing on the execution of the works.

3. On acceptance of the Tender, earnest money will be treated as a part of the security. In addition, contractor shall furnish performance guarantee in the form of an F.D.R or bank guarantee of 5% of the accepted Tender cost in favour of Principal, Sri Guru Gobind Singh College of Commerce before issue of letter to start the work.

4. The CONTRACTOR, whose Tender is accepted, shall permit Principal, Sri Guru Gobind Singh College of Commerce at the time of making any payments to him for works done under the contract to deduct towards security deposit such sum as will along with the amount of earnest money already deposited amount to the following % of the cost of the work: -

    a) 5% of the bill amount.
    b) 50% of the security money will be released along with the final bill and the balance after expiry of the successful performance of the Defects Liability Period of two year without any interest.
    c) TDS on Income Tax/GST/Labour Cess etc. as applicable.

5. Principal, Sri Guru Gobind Singh College of Commerce will return the earnest money where applicable, to every unsuccessful contractor on return of all the Tender documents without any interest.

6. TDS on Income tax/GST/Labour cess etc. as applicable shall be deducted from the payments made to the bidder/contractor and TDS certificates shall be issued by the owner.

7. The work shall be carried out in accordance with the phasing plan approved by the Principal, Sri Guru Gobind Singh College of Commerce to avoid any disturbance. The

site is expected to be handed over immediately. The contractor will prepare and submit a Phasing Plan with Bar Chart with targeted dates of completion for all the activities and get it approved from the Principal, Sri Guru Gobind Singh College of Commerce within 7 days of award of contract.

8. The rates shall be inclusive of 2 years ON SITE comprehensive defect liability maintenance including all tools, plants, parts, labour, supervision and technical support.

9. The work shall be carried out as per specifications in the Tender schedule/latest C.P.W.D. Specifications, along with the correction slips; issued up to date of acceptance of Tender in case of doubt the decision of the Architect shall be final and binding on the Contractor.

10. The Contractor shall carryout the work in stages as to cause minimum disturbance to the Owner. Contractor shall be responsible for any damage to the equipment or structures, injury to the personnel during the progress of the work and he shall be liable to pay compensation as may be decided by the Principal, Sri Guru Gobind Singh College of Commerce or his authorized representative in respect of such damages /injuries.

11. The serviceable materials out of the dismantled materials if any will be the property of the Principal, Sri Guru Gobind Singh College of Commerce and all such materials shall be properly stacked by the Contractor as directed by the Engineer-in-charge. Decision of Principal, Sri Guru Gobind Singh College of Commerce or his authorized representative on the service-ability of the dismantled materials shall be final and binding on the Contractor.

12. All labour Employed by the Contractor shall be covered by the workman's compensation act. Any death, injury or mishap to the workmen of the Contractor will entirely be the Contractor's responsibility and the College, shall not be liable to pay any damages for the same.

13. Contractor shall take adequate safety precautions to avoid any accident etc. at site. Shall erect proper barricades, sign boards, lights, etc. shall provide safety belts, safety shoes, head gears (helmet I.S.I standard) and shall be fully responsible for any criminal & civil liabilities. All safety arrangements are to be made by contractor at his own cost.

14. No labor or material rate escalation claims will be entertained from the contractor as this work has to be completed within 6 months from the date of commencement of work at site.

15. Rates quoted shall be applicable equally to all floors and shall include all lifts and leads. No extras on this account shall be payable.

16. The contractor shall provide training for operation and maintenance of Equipment's to the Owners representatives free of cost, where required.

17. Rates quoted by the contractor shall be inclusive of all items of work mentioned in the BOQ and Any work, supplies or services which might have not been specifically mentioned in the BOQ but are necessary for entire completion of the work shall be executed / provided/ rendered by the CONTRACTOR without any Extra cost and within the time schedule specified. Rates quoted shall be deemed to include such elements of labour and materials necessary to complete the items of work in all respects.

18. Contractor shall submit only computerized Bills supported with computerized measurement sheets in A4 size hard copy prints and soft copy in Microsoft Excel Format. Manual Handwritten bills or measurement sheets will not be accepted.

19. Labour Camp will be arranged by the contractor outside the Site of work at his own cost.

20. Principal, Sri Guru Gobind Singh College of Commerce College reserves the right to decrease the items of work, change the specifications of works or remove the entire section of work as may be deemed necessary to finish the works within the available budget.

GENERAL CONDITIONS OF CONTRACT

Definitions: the contract document consists of the agreement, the special and general conditions of the contract, specifications and bills of quantities including all modifications and the contract drawings prepared by the Architect from time to time

1. The site: shall mean the site of contract work.
2. Bidder / Contractor: Shall mean the person or business that agrees to conduct the contract work under the terms of the contract.
3. Sub-Contractor: includes those who have a direct contract with the Contractor.
4. Notice: written notice shall be deemed to have been served if delivered in person to a member of the Contractors firm.
5. Owner: Principal, Sri Guru Gobind Singh College of Commerce
6. Work: the term "work" includes both labour and material of the Contractor/Sub-Contractor.
7. Time limits: time limits stated in the contract are essence of the contract.
8. Law: law of the place of work shall govern the construction under this contract.
9. Virtual completion: date of virtual completion is the date when the construction is sufficiently completed in accordance with the contract documents, including modifications, if any.
10. Contract documents: shall consist of the following:
    a) The agreement.
    b) The General and Special conditions of contract.
    c) The Bill of Quantities.
    d) The drawings & specifications.
    e) The approved makes.

TYPE OF CONTRACT

It is an item rate contract. The Contractor shall be paid for the actual quantity and quality of work done, as measured at site on the rates quoted by him, on the basis of a payment certificate issued by the Architect/ Engineer- In charge.

SCHEDULE OF QUANTITIES

Schedules of quantities given in the contract bill are provisional and are meant to indicate the intent of the work and to provide a uniform basis for the contract. The Owner reserves the right to increase or decrease any of the quantities or to totally omit any of them. Contractor shall be bound to carry out the same without claiming any extras.

CONTRACT DRAWINGS

1. In general, drawings shall indicate dimension, position & type of construction.
2. Specifications shall indicate the qualities, methods, and bill of quantities shall indicate the quantum and rates. Any work indicated in drawings and not mentioned in the specifications or vice versa shall be furnished as fully set forth in both.
3. Contractor shall not deviate from the drawings and Architect's interpretation of the drawings shall be final and without appeal.
4. Errors/inconsistencies discovered in the drawings shall be instantly brought to the notice of the Architect for interpretation and correction, if any.
5. All drawings are the property of the Architect and shall not be used on any other project.

ARCHITECTS INSTRUCTIONS

If within seven days of receipt of written instructions from the Architect, requiring compliance with an instruction the Contractor does not comply hence-with, then the Owner may get the work executed through another agency at the risk and cost of the Contractor.

SCOPE OF WORK OF CONTRACTOR

The scope of work to be carried out by the CONTRACTOR shall also include the following:

1. Setting out of the works in respect of position, level dimensions, alignments, etc. including establishment of bench marks, survey reference points, etc.
2. Clearance of the site.
3. Site levelling /terracing within the limits as shown in the drawings or as directed by the Engineer In charge.
4. Disposal of debris, excavated materials, etc. as per the instructions of the Engineer In-Charge
5. All scaffolding, shorting, cantering, shuttering works, etc.
6. Running and maintenance of all plants and equipment, tools and tackles, etc.
7. Any other work required in connection with the execution of the contract work.

The cost of all the above-mentioned works shall be deemed to be included in the rates for various items of work although such inclusion may not be specifically spelt out.

SAMPLES AND SHOP DRAWINGS

The Contractor shall submit samples of materials and shops drawings required by the Architect with promptness within a week.

PROGRESS CHART

In order to achieve the completion time as stated above, the CONTRACTOR shall submit to the OWNER within 2 (two) days from the effective date of Agreement a detailed Bar chart/PERT Network. The list of activities for which the Bar chart/ PERT network has been

worked out and their commencement, duration and completion shall be subject to the approval of the OWNER

ACCESS FOR ARCHITECT/ ENGINEER IN CHARGE TO THE WORKS

The Architect and his representative shall have access, at all reasonable times, to the work and workshops of the Contractor.

ARCHITECTS STATUS AND DECISIONS

The Architect shall be Owner's representative during the construction period. He shall periodically visit the site to familiarize himself generally with the progress and the quality of work and to determine, in general if the work is proceeding in accordance with the contract documents. The Architect shall not be required to make exhaustive or continuous on-site inspections to check the quality and quantity of the work, and shall not be responsible for the Contractors failure to carry out the construction work in accordance with the contract documents. During his site inspections the Architect shall inform the Owner about progress of work, defects and deficiencies if any.

The Architect may in his absolute discretion from time to time, issue further drawings, details, written instructions, written decisions and written explanations in regard to: -

1. Variation or modification of the design
2. Quality or quantity of work, addition/alteration/omissions and substitutions of any work
3. Any discrepancy and divergence between drawings and specifications.
4. Removal and re-erection of any works executed by the Contractor
5. Dismissal of any persons employed on the site, who in the opinion of the Architect is not fit for the job.
6. Opening up for inspection any work-covered up
7. Amending and making good any defects under defects liability period
8. Removal from site, any materials brought by the Contractor, which in the opinion of the Architect is not up to the desired standard.
9. Delay and extension of time
10. Postponement of any work

ENGINEER IN CHARGE

Engineer In-Charge shall mean a competent engineer appointed and paid by the Owner and acting in congruence with the Architect.

CONTRACTORS FIELD ORGANIZATION AND EQUIPMENT

1. The Contractor shall employ qualified and competent licensed Electricians on the site.
2. Contractor shall provide and install all necessary hoists, ladders, scaffoldings, tools, tackles, plants and machinery necessary for execution of the works
3. Contractor shall provide and maintain simple water tight office accommodation at site

4. Contractor shall make his own security arrangements at site and keep a 24-hour Watchman
5. Contractor shall provide sanitary convenience for site staff and labour to keep the site clean
6. A telephone line at site to be maintained and paid by the Contractor
7. Guardrails shall be provided by the Contractor for safety of labour and general public at the site of works.

TAXES

Quoted rates shall be inclusive of all taxes taxes including GST, Labour Cess etc. All taxes as applicable in respect of this contract shall be payable by the Contractor and Principal, Sri Guru Gobind Singh College of Commerce will not entertain any claim whatsoever in respect of the same.

STATUTORY OBLIGATIONS

The Contractor shall comply with and give all notices required by any Govt. authority and instrument, rule or order made under an act of parliament or state assembly or any regulation or bye-law of the local body, relating to the work and indemnify the Owner against any such liability arising out of noncompliance of the law.

By way of illustration of various Acts/statutory compliances as stated above, the following Acts as amended from time to time shall be complied with by the CONTRACTOR:

1. Employee's Provident Fund Act 1952
2. Contract Labour Act (Regulations and Abolition 1970)
3. Minimum Wages Act 1948
4. Payment of Wages Act 1936
5. Workmen Compensation Act 1923
6. Factories Act 1948
7. Apprenticeship Act 1961

SUB CONTRACTOR

Before awarding any sub contract, the Contractor shall notify Architect/Engineer In-Charge in writing the names of the Sub-Contractors proposed. Contractor shall not employ the Sub-Contractor to whom Architect or Engineer In Charge may have a reasonable objection.

MEASUREMENT OF WORK

Unless otherwise specified, measurement of work shall be carried from the works actually executed. The measurements for the purpose of preparing Bills will be taken jointly by the Contractor’s representative and the Engineer In charge. In measurement of work as stated above, the CONTRACTOR shall certify that the work has been carried out strictly as per the drawings, specifications and item of work in terms of the agreement. Such certificate shall require Engineer In-Charge’s endorsement for the purpose of payment.

In the event of any dispute with regard to the measurement of the work executed, the decision of the OWNER shall be final and binding on the CONTRACTOR.

In the case of site measurements, should the CONTRACTOR not attend or neglect or fail to send his representative for taking joint measurements, the measurements taken by the Engineer in Charge shall be deemed to be the correct measurement of work and shall be binding on the CONTRACTOR.

REJECTION

If the Contract work or any portion thereof, at any time, is found to be defective or fails to fulfil the requirements of the agreement, the Engineer In Charge shall give the CONTRACTOR notice in writing setting-forth particulars of such defects or failure and the CONTRACTOR shall forthwith make good the defects or replace or alter the same to make it comply with the requirements of the agreement.

Any materials, equipment, etc. brought to the site and found to be not in accordance with the agreement, shall be rejected by the Engineer In-Charge and the CONTRACTOR shall remove the materials from the site within the period specified by the Engineer In-Charge.

The CONTRACTOR shall not be entitled to any extension of time or extra cost for rejection as per above.

CERTIFICATES OF PAYMENTS

Architect/Engineer In-Charge shall issue an interim certificate of payment stating the amount due to the Contractor from the Owner and the Contractor shall be entitled to payment thereof within a period of two week after issue of the certificate. From the total amount, certified deduction shall be made towards payments already made, security deposit, TDS etc. As applicable to Delhi or any other tax applicable at the time of making payment.

All running payments shall be regarded as payment by way of advance against final payment only and not as payment for the work completed till the date of final payment. The running payment made shall not preclude the liability of the CONTRACTOR to finally complete the work strictly in accordance with the specifications and drawings, if required by re-constructing faulty work

CLAIM FOR EXTRA

In the case of extra item(s) (items that are completely new, and are in addition to the items contained in the contract), the contractor will submit rates, supported by rate analysis, for the work and the engineer-in-charge shall within one month of the receipt of the rates supported by rate analysis, after giving consideration to the analysis of the rates submitted by the contractor, determine the rates on the basis of the market rates and the contractor shall be paid in accordance with the rates so determined.

DEDUCTION FOR UNCORRECTED WORK

If the Architect/ Engineer In-charge deems it in-expedient to correct work damaged or not done in accordance with the contract, an equitable deduction from the contract price shall be made thereof.

FLUCTUATIONS

The Contractor shall not claim any extras for fluctuation of price and the contract price shall not be subjected to any rise or fall in prices.

POSSESSION BEFORE VIRTUAL COMPLETION

If the Owner, with the consent of the Contractor takes possession of part of the works for handing over to the finishing Contractor, such part of the building shall not be deemed to be virtually completed. Virtual completion of such part would occur only on completion of every part of the contract work.

TIME EXTENSION

Upon it becoming reasonably apparent that the progress of the work is delayed, the Contractor shall forthwith give written notice of the cause of delay to the Architect/ Engineer In charge, to enable the Architect and Owner to take a proper decision in the matter.

INSPECTION AND TEST

1. The CONTRACTOR shall ensure inspection and test of all materials and work at his cost through his ENGINEER IN CHARGE and other technical staff either at site or through any approved laboratory.
2. The CONTRACTOR shall ensure proper supervision and inspection during the progress of work at site.
3. All materials and work, whether at the site or in the Contractor’s /Sub-Contractor's premises shall be subject to inspection and test by the ENGINEER IN CHARGE. The CONTRACTOR/ his Sub-Contractor shall provide all facilities free of cost to the ENGINEER IN CHARGE including all labour, materials, tools, tackles, instruments, appliances, etc. to enable the ENGINEER IN CHARGE to carry out inspection and/or test.
4. All test certificates shall be subject to certification by the ENGINEER IN CHARGE.
5. The CONTRACTOR shall submit to the ENGINEER IN CHARGE three copies of all inspection/ test certificates.
6. The CONTRACTOR shall not be entitled to any claim for extra time or cost due to any delay in carrying out inspection and testing or re-inspection and re-testing if so, decided by the ENGINEER IN CHARGE.
7. The CONTRACTOR shall take adequate steps to rectify the defects or to replace such materials and work which have failed during inspection /testing.

RESPONSIBILITY OF COMPLETION

Any work, supplies or services which might have not been specifically mentioned in the specifications, schedule of items or drawings but are necessary for entire completion of the contract work shall be executed / provided/ rendered by the CONTRACTOR without any Extra cost and within the time schedule specified. Rates quoted shall be deemed to include such elements of labour and materials necessary to complete the items of work in all respects.

DAMAGES FOR NON-COMPLETION

If the Contractor fails to complete the works by the date specified or within any extended time granted to him, the Contractor shall allow the Owner to deduct a sum calculated at the agreed liquidated damages, from the money due to him for the period the work remained incomplete, subject to a maximum amount of 10% of the Contract Value.

LIQUIDATED DAMAGES FOR DELAY

If the CONTRACTOR fails to complete the work/item (s) of work in all respects and hand over the same to the OWNER within the time stipulated the CONTRACTOR, without prejudice to any other right or remedy of the OWNER on account of such breach, be liable to pay the OWNER liquidated damages at the rate of Rs. 5,000/- (Five Thousand) per day of delay. The total amount of liquidated damages shall be limited to 10% (Ten percent) of the total contract price.

The above provisions shall not apply in cases of delay for which the CONTRACTOR is entitled to extension of completion time

VIRTUAL COMPLETION CERTIFICATE AND DEFECTS LIABILITY PERIOD

When in opinion of the Architect/Engineer In charge the works are practically completed, he shall forthwith issue a certificate to that effect, that date will be taken as the date of virtual completion.

The Architect/Engineer In charge shall prepare a schedule of defects, not later than 14 days after the expiry of the defect's liability period. The Contractor shall within a reasonable period of time after receipt of schedule of defects shall rectify the same, failing which the Architect/Engineer In charge will make suitable deductions from the contract sum.

MAINTENANCE GUARANTEE / DEFECTS LIABILITY PERIOD

Maintenance Guarantee period will be 24 months from the actual date of completion and handling over to the OWNER.

1. The CONTRACTOR guarantees that within the maintenance guarantee period, the contract work shall not show any signs of defects, cracks, settlements, disfigurations, shrinkage, leakage, dampness or any other defects.
2. The CONTRACTOR shall maintain and satisfactorily execute, at his own cost, all such works of repair, amendment, re-construction, rectification, replacement and any

other work to make good the faulty work as stated in Article (a) during the maintenance guarantee period.

3. The CONTRACTOR shall, if required by the ENGINEER IN CHARGE, search for the causes of any defects, imperfection or fault under the direction of the ENGINEER IN CHARGE. The cost of such search shall be borne by the CONTRACTOR.
4. At intervals specified by the ENGINEER IN CHARGE the CONTRACTOR, along with the ENGINEER IN CHARGE, shall inspect the contract work to satisfy himself that no defects have cropped up in the contract work. Should there be any signs of defects, the CONTRACTOR shall take immediate steps to rectify the same, failing which; the ENGINEER IN CHARGE may get the defects rectified at the risk and cost of the CONTRACTOR.
5. At the end of the maintenance guarantee period, the CONTRACTOR, along with the ENGINEER IN CHARGE, shall carry out final inspection of the contract work to prove that no defects had appeared in the contract work or that all defects which appeared in the contract work have been rectified to the entire satisfaction of the ENGINEER IN CHARGE. If during the final inspection it is found that the defects still remain in the contract work, the period ·of maintenance guarantee shall be extended at the discretion of the ENGINEER IN CHARGE and the CONTRACTOR shall be liable to make good the defects and be responsible for the maintenance of the work till the defects have been fully rectified.
6. Upon successful completion of the maintenance guarantee period the OWNER shall issue final acceptance certificate to the CONTRACTOR

PAYMENT WITH HELD

The Architect may withhold or on account of subsequently discovered evidence nullify the whole or part of any certificate to such an extent as may be necessary in his reasonable opinion to protect the Owner from loss, for defective work, non- payment to Subcontractors, or other claims connected to this work.

INJURY TO PERSONS

The Contractor shall indemnify the Owner against any liability, loss, claim or proceedings whatsoever arising under any statutory or common law in respect of personal injury to or the death of any person, whomsoever arising out of or in the course of or caused by carrying out the work.

INSURANCE

Without prejudice to his ability to indemnify the Owner, the Contractor and his Subcontractors shall maintain such insurance as are necessary to cover the liability of the Contractor and the sub-Contractors.

INSURANCE AGAINST FIRE

The Contractor shall in the joint name of the Owner and the Contractor, insure the works against loss or damage due to fire, earthquakes and riots.

COORDINATION OF WORK

Contractor shall extend complete coordination to other agencies i.e. electrical, firefighting and interiors working on the same site.

LABOUR

Contractor shall not employ child labour under 14 years of age and if female workers are employed, he should make provision for safeguarding the small children to keep them clear of the site. All labour shall wear safety helmets and shoes to protect them from injury.

SAFETY

In respect of all labour directly or indirectly employed in the work for the performance of the contractor's part of this contract, the contractor shall at his own expense arrange for the safety provisions as per C.P.W.D. Safety Code framed from time to time and shall at his own expense provide for all facilities in connection therewith. In case the contractor fails to make arrangement and provide necessary facilities as aforesaid, he shall be liable to pay a penalty of Rs.200/- for each default and in addition, the Engineer-in- Charge shall be at liberty to make arrangement and provide facilities as aforesaid and recover the costs incurred in that behalf from the contractor.

GUARANTEE

Besides guarantees required elsewhere, the Contractor shall guarantee the works in general for one year after completion of defects liability period.

PERFORMANCE GUARANTEE

In addition to the Security Deposit the Contractor shall furnish a performance guarantee in the form of a Bank Guarantee to the tune of Five percent (5%) of the cost of the tender amount, which will be kept valid up to 24 months after completion of the work.

WARRANTY

The Contractor shall give warranty that works to be done supplied shall be new and free from all defects and faults in material, workmanship, and manufacture and shall be of the highest grade and consistent with the established and generally accepted standards for materials of the type ordered and shall perform in full conformity with the specifications and drawings. The Contractor shall be responsible for any defects that may develop under the conditions provided by the contractor and under proper use, arising from faulty materials, design or workmanship such as corrosion of the equipment, inadequate contact protection, deficiencies in design and or otherwise and shall remedy such defects at his own cost when called upon to do so by the Institute who shall state in writing in what respect goods are faulty. This shall survive inspection or payment for, and acceptance of goods, after the goods have been taken over.

If it becomes necessary for the contractor to replace or renew any defective Portion / portions of the equipment under this clause, the provisions of the clause shall apply to the portion / portions of equipment's replaced or renewed or until the end of the warranty period of 24 months, whichever may be later. If any defect is not remedied within a reasonable time, the College may proceed to get the work done at the Contractor's risk and expenses, but without prejudice to any other rights which the College may have against the Contractor in respect of such defects. Replacement under warranty clause shall be made by the Contractor free of all charges at site including freight, insurance and other incidental charges

REPLACEMENT OF DEFECTIVE EQUIPMENT

If any equipment or any part thereof, is found defective or fails to meet the requirements of the contract before it is accepted College shall give the Contractor a notice setting forth details of such defects or failures and the Contractor shall forthwith arrange to set right the defective equipment or replace the same by the good one to make it comply with the requirements of the contract. This in any case shall be completed within a period not exceeding one month from the date of the initial report pointing out the defects. The replacement or rectification shall be made at site by the Contractor free of cost. Should the Contractor fail to do the needful within this stipulated time frame, the College reserves the right to reject the equipment in full or in part and get it replaced at the cost of the Contractor. The cost of any such replacement made by the College shall be deducted from the amount payable to the Contractor against this purchase order.

If any equipment or part thereof is lost or rendered defective during transit, pending settlement of the insurance claim, fresh order shall be placed on the Contractor for such loss or defective equipment and the Contractor shall arrange to supply the same within three months of such order at the same prices and on the same general terms and conditions as mentioned in this purchase order.

ADD ON ORDER

Principal, Sri Guru Gobind Singh College of Commerce reserves the right to place Add on order for additional quantity up to 100% of the original quantity at the same rate and terms & conditions of the purchase order within six months from the date of issue of purchase order.

ARBITRATION

In case of dispute, the difference of opinion on any matter pertaining to the works, the decision of the Principal, Sri Guru Gobind Singh College of Commerce be final and binding on the contractors. If either party is not satisfied with the decision of the Principal, Sri Guru Gobind Singh College of Commerce, within 28 days a notice to this effect will be sent to the Principal, Sri Guru Gobind Singh College of Commerce in writing. The matter can then be referred to a sole arbitrator or a panel of two arbitrators appointed under the arbitration act 1996.

LIQUIDATION

If the CONTRACTOR commences to be wound up, not being a member's voluntary winding up for the purpose of amalgamation or reconstruction, or carries on his business under a receiver for the benefits of his creditor the OWNER shalt be at liberty to:

i) Give such receiver the liquidator or other person the option of carrying out the performance under the Agreement, subject to the receiver, liquidator or other person providing a guarantee up to an amount to be agreed upon by the OWNER and such receiver liquidator or other person for the due and faithful performance of the Contractor's obligations under this Agreement, or

ii) If the receiver, liquidator or other person fails within 30 (thirty) days to exercise the option to carry out performance of the Agreement then the OWNER may terminate the Agreement and give notice in writing to the CONTRACTOR or to the receiver, liquidator or to any person in whom the Agreement may have become vested.

TERMINATION OF CONTRACT

If the CONTRACTOR violates the Agreement or shall neglect to execute the work with due diligence or expedition or shall refuse or neglect to comply with any reasonable directions, instructions or orders given to him in writing by the Architect/Engineer In-Charge in connection with the work or shall contrivance or breach any provisions of the Agreement, the OWNER may give notice in writing to the CONTRACTOR to make good the failure, neglect or contravention complained of or cure that breach within a period of 30 (thirty) days of receiving such notice and in default of the compliance with the said notice, the OWNER without prejudice to his rights as below may rescind or terminate the Agreement stating therein the effective date of termination, holding the CONTRACTOR liable for the damages that the OWNER may sustain in this behalf.

Without prejudice to any of the rights or remedies under this contract, if the contractor dies, the Owner shall have the option of terminating the contract without compensation to the CONTRACTOR.

OFFICIALS NOT TO BENEFIT

The Contractor warrants that it has not and shall not offer any direct or indirect benefit arising from or related to the performance of the Contract or the award thereof to any representative, official, employee, or other person in the office of Principal, Sri Guru Gobind Singh College of Commerce , University of Delhi, Opposite TV Tower, Pitampura, Delhi-110034 (India).. The Contractor acknowledges and agrees that any breach of this provision is a breach of an essential term of the Contract.

PENALTY FOR USE OF UNDUE INFLUENCE

The contractor undertakes that he has not given, offered or promised to give, directly or indirectly, any gift, consideration, reward, commission, fees, brokerage or inducement to any person in service of the Buyer or otherwise in procuring the Contracts or for bearing to do or

for having done or forborne to do any act in relation to the obtaining or execution of the present Contract.

Any breach of the aforesaid undertaking by the Contractor (Seller) or any one employed by him or acting on his behalf (whether with or without the knowledge of the Seller) or the commission of any offers by the, Seller or anyone employed by him or acting on his behalf, as defined in Chapter IX of the Indian Penal Code, 1860 or the Prevention of Corruption Act, 1986 or any other Act enacted for the prevention of corruption shall entitle the Buyer to cancel the Contract and all or any other Contracts with the Seller.

FORM OF PERFORMANCE SECURITY BANK GUARANTEE BOND

In consideration of the Principal, Sri Guru Gobind Singh College of Commerce (hereinafter called "The Owner") having agreed under the terms and conditions of agreement no.

Dated:

Made between the Owner and

(hereinafter called "the Said Contractor(s)) for the work of **E-Tender for Civil, Interior, Electrical, Ventilation and Fire Fighting Works at Sri Guru Gobind Singh College of Commerce.** herein after called "the said agreement".

We (please mention name of the bank below)

Undertake to pay to The Owner an amount not exceeding Rupees

(In words)

On demand by The Owner.

2. We (please mention name of the bank below)

Do hereby undertake to pay the amounts due and payable under this Guarantee without any demure, merely on a demand from The Owner 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 Rupees

(In words)

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3. We, the Said Bank further undertake to pay to The Owner any money so demanded notwithstanding any dispute or disputes raised by the Said Contractor(s) 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 Said Contractors(s) shall have no claim against us for making such payment.

4. We (please mention name of the bank below)

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 Owner under or by virtue of the said agreement have been fully paid and its claims satisfied or discharged or till Engineer-in-Charge on behalf of The Owner certified 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 (please mention name of the bank below)

Further agree with The Owner that The Owner shall have the fullest liberty without our 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 anytime of from time to time any of the powers exercisable by The Owner against the said contractor(s) and to for-bear or enforce any of the terms and conditions relating to the sad agreement and we shall not be relived from our liability by reason of any such variation, or extension being granted to the Said Contractor(s) or for any forbearance, act of commission on part of The Owner or any indulgence by The Owner 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. This guarantee will not be discharged due to the change in the constitution of The Bank or the Said Contractor(s)

7. We (please mention name of the bank below)

Lastly undertake not to revoke this guarantee except with the previous consent of The Owner in writing.

8. This Guarantee shall be valid upto_____. Unless extend on demand by The Owner. Notwithstanding anything mentioned above, our liability against this guarantee is restricted to Rupees

(In words)

And unless a claim in writing is lodged with us within six months of the sate of expiry of the extended date of expiry of this guarantee all our liablities under this guarantee shall stand discharged.

Dated: the_____day of_____for_____(Bank).

TURNOVER CERTIFICATE (ANNEXURE 1)

ON THE LETTER PAD OF CHARTERED ACCOUNTANT

This is to certify that the total turnover of

M/s _____

Having PAN _____

is as under:

FINANCIAL YEAR	AMOUNT (FIGURES)	AMOUNT (WORDS)
2018-2019		
2019-2020		
2020-2021		

Average = Total/3 = _____

It is further certified that the above-mentioned amounts have been derived from the books of accounts presented before us for the above-mentioned periods.

Stamp and Signature of Chartered Accountant.

LIST OF APPROVED MAKES FOR CIVIL WORKS

Approved Make of Materials		
(Applicable wherever the make is not listed in the item)		
S.No.	**Materials**	**Manufacturer**
1)	Commercial Ply and Commercial Board	Duro, Greenply, Virgo , Merino
2)	Teak Ply	Duro, Greenply, Virgo, Merino
3)	Laminate	Greenlam,Virgo, Merino, Sundek
4)	Mirror	Modigaurd, Saint Gobain
5)	Glass	Modigaurd, Saint Gobain
6)	Flush Door Shutters	Duro, Green, Virgo, Merino
7)	Paints	Nerolac, I.C.I, Asian, Berger
8)	Mortice Latches And Locks	Godrej, Dorset, Hardwyn, Ebco, Hettich,Hafele.
9)	Coarse Sand	As Per Is:383 (Latest Edition)
		Approved Quarry Or Equivalent
10)	Fine Sand	Do.
11)	Stone Aggregate	Do.
12)	Aluminium Section	Jindal/ Hindalco.
13)	Wall and Floor Tiles	Orient, Kajaria, Nitco, Johnson, Somany, Asian.
14)	Mdf Board	Century Prowud, Greenpanel, VIR.
15)	Hinges-Ms Oxidised / SS	Godrej, Dorset, Hardwyn, Ebco, Hettich,Hafele.
16)	Tower Bolt	Godrej, Dorset, Hardwyn, Ebco, Hettich,Hafele.
17)	Door Stopper	Godrej, Dorset, Hardwyn, Ebco, Hettich,Hafele.
18)	L-Drop	Godrej, Dorset, Hardwyn, Ebco, Hettich,Hafele.
19)	Handles and locks	Godrej, Dorset, Hardwyn, Ebco, Hettich,Hafele.
20)	Pvc Strips/ Hand Rail /Railing	Fixo Pan , Sun, Kelco, S-Rail,
21)	Cement: OPC 43 / 53	Ultratech, L&T, Ambuja, JK Laxmi, ACC.
22)	Steel	Tata, Sail, RNIL, Rathi Thermax 500.
23)	Gypsum Board and frame	USG Boral, India Gypsum, Armstrong, Saint Gobain Gyproc

LIST OF APPROVED MAKES FOR ELECTRICAL WORKS

LIST OF APPROVED MAKES FOR ELECTRICAL WORKS			
S.No.	**Details of Materials / Equipment**		**Manufacturer's Name**
1	LT Panel, Main Distribution Panel, Sub-Main Distribution Panel and Motor Control Centre		Tricolite industries Ltd.
			Adlec Control System
			SPC Electro Tech Pvt. Ltd.
			Ambit Switchgear
			Milestone
2	Sandwiched Construction Bus ducts		Control & Switchgear
			Henikwon (L&T)
			GE
			Schneider Electric
3	Final Distribution Board		Legrand
			Hager
			ABB
			Siemens
			Schneider Electric (MG)
4	Air Circuit Breaker (3/4 Pole)		Schneider Electric (MVS)
			Larsen & Toubro (C-Power)
			ABB (E-Max)
			Siemens
5	Moulded Case Circuit Breaker (MCCB)		Larsen & Toubro
			ABB
			Schneider Electric (CVS)
			Siemens
6	Motor Protection Circuit Breaker(MPCB)		Hager
			ABB
			Schneider Electric
			Siemens
7	Miniature Circuit Breakers (MCB)		Hager
			ABB
			Schneider Electric
			Siemens
8	Residual Current Circuit Breaker (RCCB)		Hager
			ABB
			Schneider Electric
			Siemens
9	Power/Aux. Contactor / Capacitor Duty Contactor		Schneider Electric (MG)
			Hager (L&T)
			ABB
			Siemens
10	Change Over Switch		Larsen & Toubro
			C & S

LIST OF APPROVED MAKES FOR ELECTRICAL WORKS			
S.No.	**Details of Materials / Equipment**		**Manufacturer's Name**
			HPL – Socomec
11	Control Transformer/Potential Transformers		Automatic Electric
			Matrix
			Pragati
			Precise
12	Current Transformer (Epoxy Cast Resin)		Automatic Electric
			Matrix
			Pragati
			Precise
13	Protection Relay		
	a. Numeric Type		ABB
			Areva
			Larsen&Toubro
			Siemens
	b. Electromagnetic Type		ABB
			Areva
			Larsen&Toubro
14	Indicating Lamps LED type and Push Button		Vaishno Electricals
			Larsen & Toubro (ESBEE)
			Schneider Electric Siemens
15	Overload relays with built in Single Phase preventer		ABB
			Larsen & Toubro
			Schneider Electric
			Siemens
16	a. Electronic Digital Meters (A/V/PF/Hz/KW/KWH) with LED Display		Conzerv
			Schneider Electric
			Secure
	b. ISI Marked Dual Energy Meter with centralized metering & billing system		Secure
			Radius
17	Static Power Meter & Logger (SPML)		Conzerv
	With RS 485 port		Schneider Electric
			Secure
18	Power Capacitor		Matrix
			Ducati
			EPCOS
			Meher
19	Autoamtic Power Factor Correction Relay		Areva
	(Numeric Type)		BELUK (Germany)
			Siemens

LIST OF APPROVED MAKES FOR ELECTRICAL WORKS			
S.No.	**Details of Materials / Equipment**		**Manufacturer's Name**
20	PVC insulated XLPE aluminium/copper conductor		Cable corporation of India
	armoured MV Cables upto 1100 V grade		Skytone
			Ravin Cable
			Polycab
			KEI
			Dimond
21	LT Jointing Kit / Termination		Birla-3M
			Raychem
			REPL
			Safe Kit
22	Cable Glands Double Compression with earthing links		Baliga Lighting
			Comet
			Cosmos
23	Bimettalic Cable Lug		Comet
			Dowell's (Biller India)
			Hax Brass (Copper Alloy India)
24	PVC insulated copper conductor stranded flexible wires		Finolex
			R RKabel
			Skytone
			KEI
			Polycab
			BatraHenlay
25	Mettalic / GI Conduit (ISI approved)		AKG
			BEC
			NIC
26	Lead Coated Flexible GI Conduit		PLICA India Pvt. Ltd.
			Flexicon
27	PVC Conduit &Accessories (ISI approved)		AKG
			BEC
			Precision
			Polypack
			Ravindra
28	Industrial Socket		
	a. Splash Proof		Clipsal
			Gewiss
			Legrand
			Neptune Balls
			Schneider Electric
	b. Metal Clad		BCH
			MDS
29	Switch & Socket		Clipsal (Opal Series)
			Crabtree

LIST OF APPROVED MAKES FOR ELECTRICAL WORKS			
S.No.	**Details of Materials / Equipment**		**Manufacturer's Name**
			M K India (Wraparound)
			Idoasian-simon
			Legrand (Mosaic)
			Wipro (NorthWest)
			Havells –crownos
			ABB – Lumina
			Anchor Roma
			Siemens
			L&T
30	Ceiling Fan		Crompton Greaves
			Havells
			Orient
			Usha
31	Lighting Fxiture		
	a. Incandescent / Halogen / PL / Metal Halide) / Fluorescent		Philips
			Wipro
			GE
	b. External Lighting Fixture		Bajaj Electricals Ltd.
			Keslec
			LIGMAN
			Philips
			Wipro
	b. Aviation Obstruction Light(LED Type)		Actos
			Bajaj
			Binay
32	Electronic Ballast for Fluorescent		Osram
	(To be selected as per fixtures' manufacturer)		Opal
			Philips
			Thorn
			Wipro (APF)
33	Selector Switch, Toggle switch		Kaycee
			Salzer (Larsen & Toubro)
34	Cable Trays (Factory Fabricated) / Raceways		Profab Engineer
			Ricco Steel
			Needo
			MaheshwariElectrtricals
35	Sealed Maintenance Free Batteries		Amar Raja
			Exide
			Global (Rocket)
			Hitachi
			Shinkobe
36	Battery Charger		Caldyne
			ChhabiElectricals

LIST OF APPROVED MAKES FOR ELECTRICAL WORKS		
S.No.	**Details of Materials / Equipment**	**Manufacturer's Name**
		Joshi Electricals
		Max Power
		Volstat
37	Invertor	Autopro (Professional Lighting)
		Luminous
		Megatech
		Microtek
38	Lightning Protection System	Erico
	(Early Streamer Emission Type)	LPI
39	Timer	ABB
		Larsen & Toubro
		Legrand
		Schneider Electric
		Siemens
40	50 W Halogen Light Transformer	Gemini Global
	(Encapsulated Transformer)	Opal
		Philips
		Reiz
41	Tap off / splitters complete with gasketed G.I. boxes	Catvision
		CE
		DX
		Powerage
		Vision Hire
B.	**<u>TELELEPHONE / DATA</u>**	
1	Tag Block	Krone
		TVSE
2	Telephone armoured / unarmoured cable / wire	Delton
		Finolex
		Skytone
		Fusion Polymer
		Polycab
3	Coaxial Cable	Beldon
		Comm-Scope (US Imported)
		Fusion Polymer

LIST OF APPROVED MAKES FOR PLUMBING WORKS

LIST OF APPROVED MAKES FOR SANITARY WORKS			
S.No.	**Details of Materials / Equipment**		**Manufacturer's Name**
1	Vitreous China Sanitaryware		Cera
			Neycer
			Parryware
2	W.C Seat Covers		Admiral
			Tara
3	Low level Flushing cisterns		Commander
			Duralite
	WC Connectors		Multiwik
			Viega
2	Bath Tub and Shower Tray		Aquaplus
			Parryware
3	Stainless Steel Sink		Cobra
			Jayna
			Nirali
6	Cistern		Commandor
			Champion
			Parryware
7	CP Brass Fittings		Crabtree
			Ess-Ess
			Gem
			Jaguar
			Kingston
			Parko
			Parryware
			Marc
			Plumber
8	Flow Control Devices		Jaquar
			RST
9	Storage Type Geyser / Heat Pump		Racold
			AO Smith
			Venus
10	Floor Drain Fixture, Rain Water Outlets		ACO
			GMGR
			Neer
11	Urinal Trap		Chilly
			Neer
12	ULTRA LOW FLOW FIXTURES-		M.N. Padia
	(Flush valves, Faucets, Bib taps)		Schell
	Low Flow C.P Fittings		
13	Macerating systems		Grundfos
			Sanitop

LIST OF APPROVED MAKES FOR SANITARY WORKS			
S.No.	**Details of Materials / Equipment**		**Manufacturer's Name**
14	Shower Channel / PP – car parking channel		ACO
			Kessel
			Viega
15	C.P. Grating for Floor Trap		Chilly
			GMGR
			Neer
			Viega
16	GI / M.S Pipes (IS : 1239 and IS : 3589)		AST Pipes
			Hitech
			Swastik
			Zenith
17	GI pipes fittings		Crescent Engg Corp. Jalandhar
			KS Engg
			RM Engg works, ahmedabad
			Zoloto
18	GI/MS Pipe Protection Wrapping & Coating		IWL - Pypkote
			Neotape
			Rustech – Coatek
			STP Ltd.
19	Pipe clamp & supports		Diamond
			Easyflex
			Intellotech
20	Pipe Hangers		Hitech
			OM fasteners
21	D. I. Pipes		Jindal
			NECO
22	UPVC Pipe		Finolex
			Jain
			Kisan
			Prince
			Crescent Engg Corp. Jalandhar
			KS Engg
			RM Engg works, ahmedabad
			Zoloto
23	CPVC pipes & fittings		Ajay
			Ashirwad
			Astral
			Prince
24	Teflon Tape		
25	Toilet Accessories		Akoi
			Parko
26	P.P.R Pipes		Prince
			Reliance
			Supreme

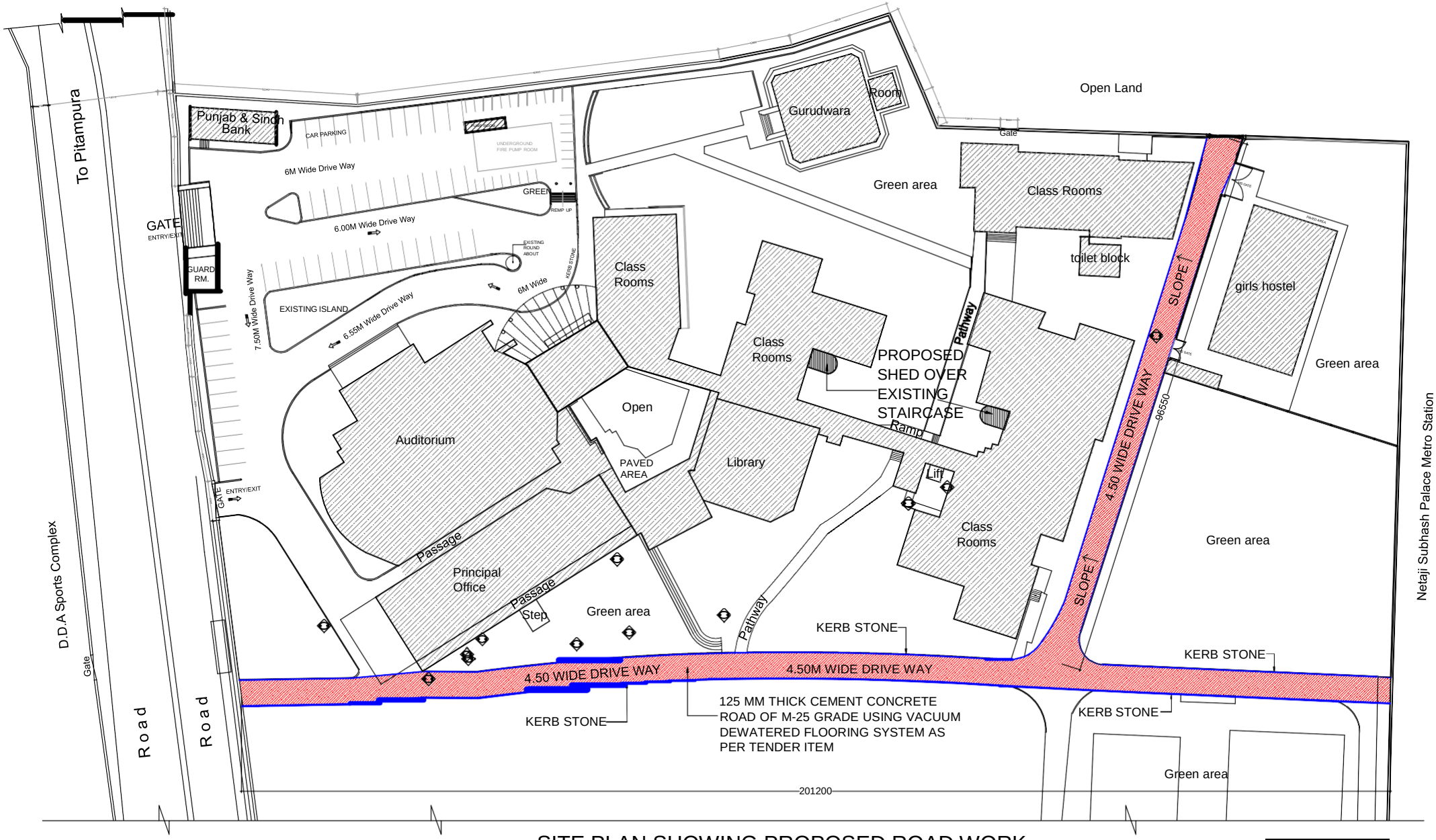
LIST OF APPROVED MAKES FOR SANITARY WORKS			
S.No.	**Details of Materials / Equipment**		**Manufacturer's Name**
27	P.E.X pipes		Itap
			Giacomini
			Henco
			Viega
28	FRP/GRP Manhole covers		Everlast
			Thermoset
29	HDPE Pipe & fitting		Duraline
			Kimplas
			Reliance
30	RCC Pipe		Dhere
			K K
			INDIAN HUME PIPE
			Pranali
31	Stoneware Pipes		Anand
			Burn & Co.
			Perfect potteries
			Rajura
32	GM / Forged Brass Ball Valves		Jayhiwa
			Leader
			RB
			Sant
33	Sluice Valves		Advance
			Kirloskar
			Marck-Cair
			SANT
			Zoloto
34	Butterfly Valve		Audco
			Jayhiwa
			Keystone
			Marck-Cair
35	Check Valve – WaferType		Kirloskar
			Jayhiwa
			Marck-Cair
			Normex
36	Check Valve – Dual Plate		Marck-Cair
			Normex
			Sant
37	Cast Iron Non Return valve		Leader
			Zoloto
38	Check Valve Forged Screwed		Leader
			RB
			Zoloto
39	Pressure Reducing Valve		Marck-Suzhik
			RB

LIST OF APPROVED MAKES FOR SANITARY WORKS			
S.No.	**Details of Materials / Equipment**		**Manufacturer's Name**
			OR
			Zoloto
40	Solenoid Valve		Avcon
			Aira
			Danfoss
41	Thermostatic mixing valve		Danfoss
			Overtrop
42	Air Release Valve		Marck
			OR
			RB
			Studor
			Zoloto
43	Ball Float Valve		Prayag
			Zoloto
44	NRV – Ball type – Sewage application		Danfoss
			Silverspark
			Normex
45	Backflow preventor		Normex
46	Foot valve		Kirloskar
			Normex
47	HDPE Tanks		Sintex
			Ashish
48	Air Vent Inlet Valve		Studor
49	Food Crusher for Sink		Enviro
			Venus
			Zach- Rajguru
50	FRP/GRP- SMC water tank		Devi Polymers pvt. Ltd.
			Smartage
			Binani
51	FRP/GRP storage tanks		Sintex
52	Y Strainer CI		Leader
			Marck-Cair
			Zoloto
53	Hydropneumatic System		Aquasub Engineering
			CRI Pumps
			Dharani pumps
			Grundfos
			Kirloskar
			Nocchi
			Nanfang
			Willo – Mather & Platt
54	Storm Water Drainage & Sewage Sump Pumps (Submersible)		Aquasub Engineering
			CRI Pumps
			Darling

LIST OF APPROVED MAKES FOR SANITARY WORKS			
S.No.	**Details of Materials / Equipment**		**Manufacturer's Name**
			Dharani
			Grundfos
			Kirloskar
			KSB
			Kishor
			Nocchi
			Mody
			Willo – Mather & Plantt
55	Transfer Pumps		Aquasub Engineering
			CRI Pumps
			Dharani
			Grundfos
			Kirloskar
			KSB
			Nanfang
			Nocchi
			Willo - Mather & Platt
56	Self-Priming Pumps		Aquasub Engineering
			CRI Pumps
			Johnson
			Kirloskar
57	Borewell Pump		Aquasub Engineering
			CRI Pumps
			Grundfos
			Kirloskar
58	Anti Vibration Mounting & Flexible Connections		Cori
			Dunlop
			Flexionics
			Easyflex
			Resistoflex
			VIMPA
59	Pressure Gauge		Fiebig
			H Guru
60	Water Meter (Mechanical Type)		Dasmesh
			Kranti
			Kent
61	Level Controller & Indicator (Water)		Pumptrol
			RM Engg. Works, Ahmedabad
62	Paints		Asian Paints
			Berger
			ICI
			Shalimar Paints
63	MH / Water Tank Plastic Steps		KGM
			Patel

LIST OF APPROVED MAKES FOR SANITARY WORKS			
S.No.	**Details of Materials / Equipment**		**Manufacturer's Name**
			Pranali Industries
64	Insulation for Hot Water Pipes		Armacell – Armaflex
			K-Flex
			Thermaflex
65	Electric Hot Water Generator / Heat Pump		A.O. Smith
			Spherehot
			Venus
			Riello
66	Solar Heating		A.O Smith
			Ecotherm
			Megason (Greece)
			Overtrap
			Solinteks
			Tata BP Solar
			Vijay Solar
67	Grease Trap/Separator		ACO
			Wade
68	Welding Rods		Ador
			Cosmos
			Prima (S)
			Super Bond (S)
69	Fastener		Fisher
			Hilti
			Mungo
			Powers
70	Fire Sealant		Birla 3 M
			Hilti
			Powers
			Promat
			STI (USA)/ Fire master
71	Manhole (prefabricated)		OK Play
			Supreme
72	Temperature Sensor / Gauge		Forbes Marshall
			Danfoss
			Wika
73	Vacuum Sewer System		Roediger Vacuum
74	Syphonic Roof Drainage System		Geberit
			George Fisher
			Neuva Terrain
			Saint Gobian

CONTRACT DRAWINGS



SITE PLAN SHOWING PROPOSED ROAD WORK

PROPOSED WORK	
	ROAD WORK
	KERB STONE

PROPOSED CEMENT CONCRETE ROAD AT SRI GURU GOVIND SINGH COLLEGE OF COMMERCE , PITAMPURA, NEW DELHI

Date : 01/11/2021
Scale : NTS
Drawn By : SANJAY
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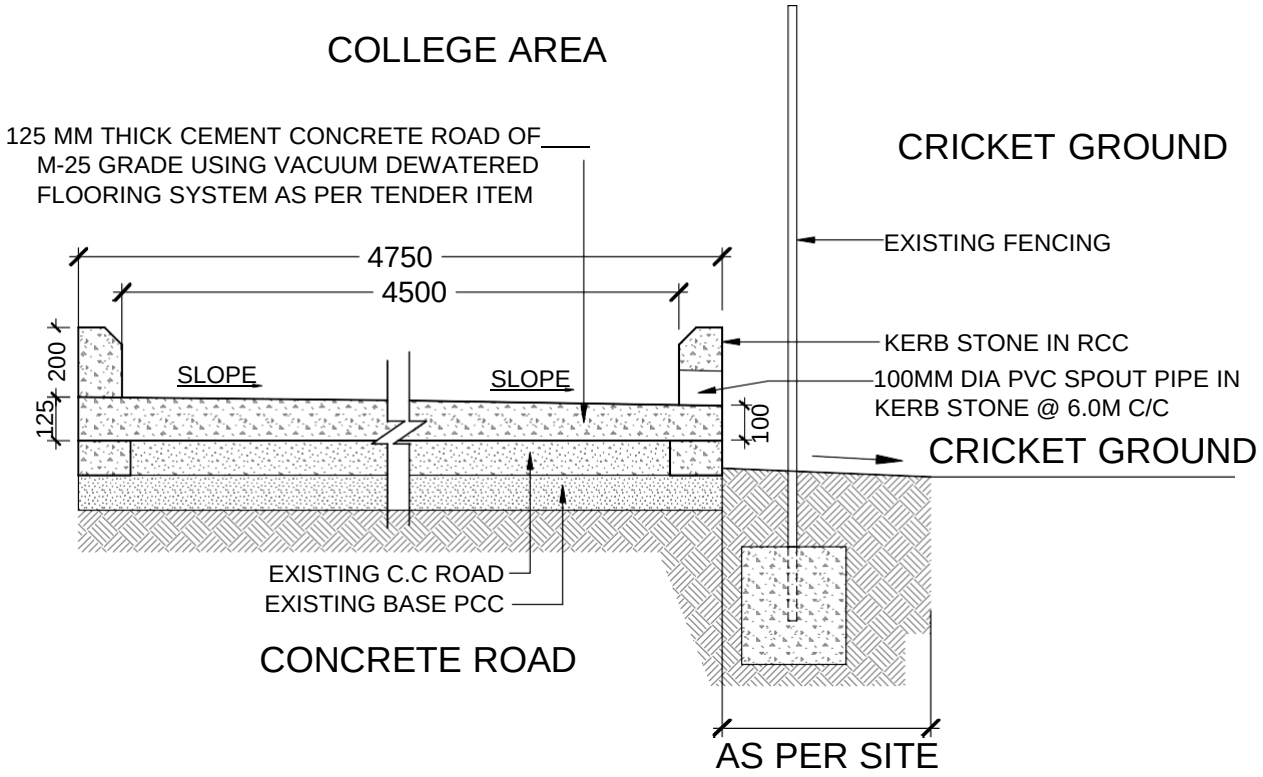
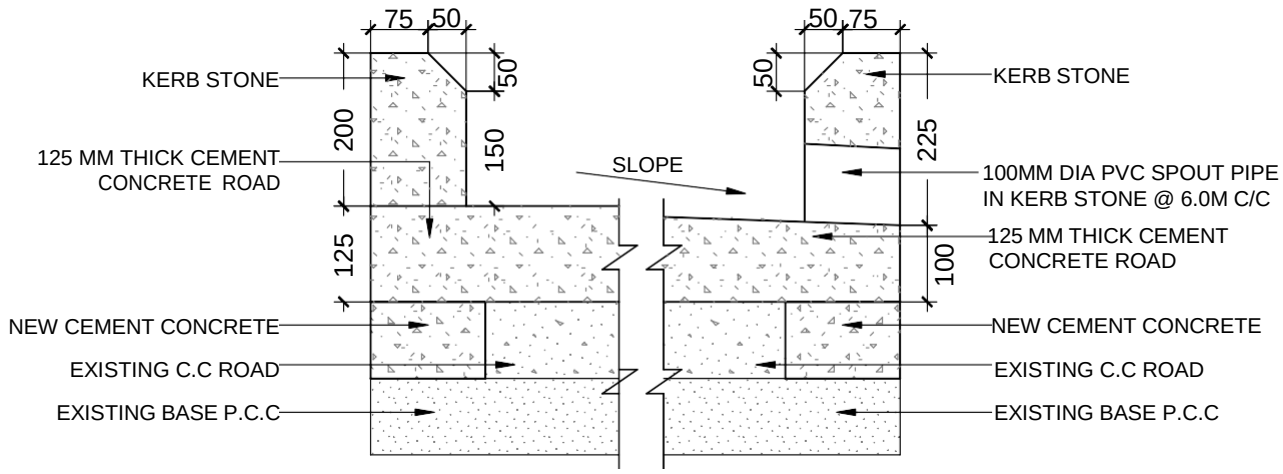
Sheet No. 1

Sheet Title
SITE PLAN

RANJIT SINGH & ASSOCIATES
1206 Surya Kiran Building,19 K.G.Marg, New Delhi 110001
Ph.23312688 Fax: 41510129 Email: rsa1206@msn.com
Architects, Engineers & Interior Designers
Govt. approved Valuers and House Tax Consultants





PROPOSED CEMENT CONCRETE ROAD AT SRI GURU GOVIND SINGH COLLEGE OF COMMERCE , PITAMPURA, NEW DELHI

Date : 01/11/2021
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Sheet No. 2

Sheet Title
C.C ROAD DETAIL

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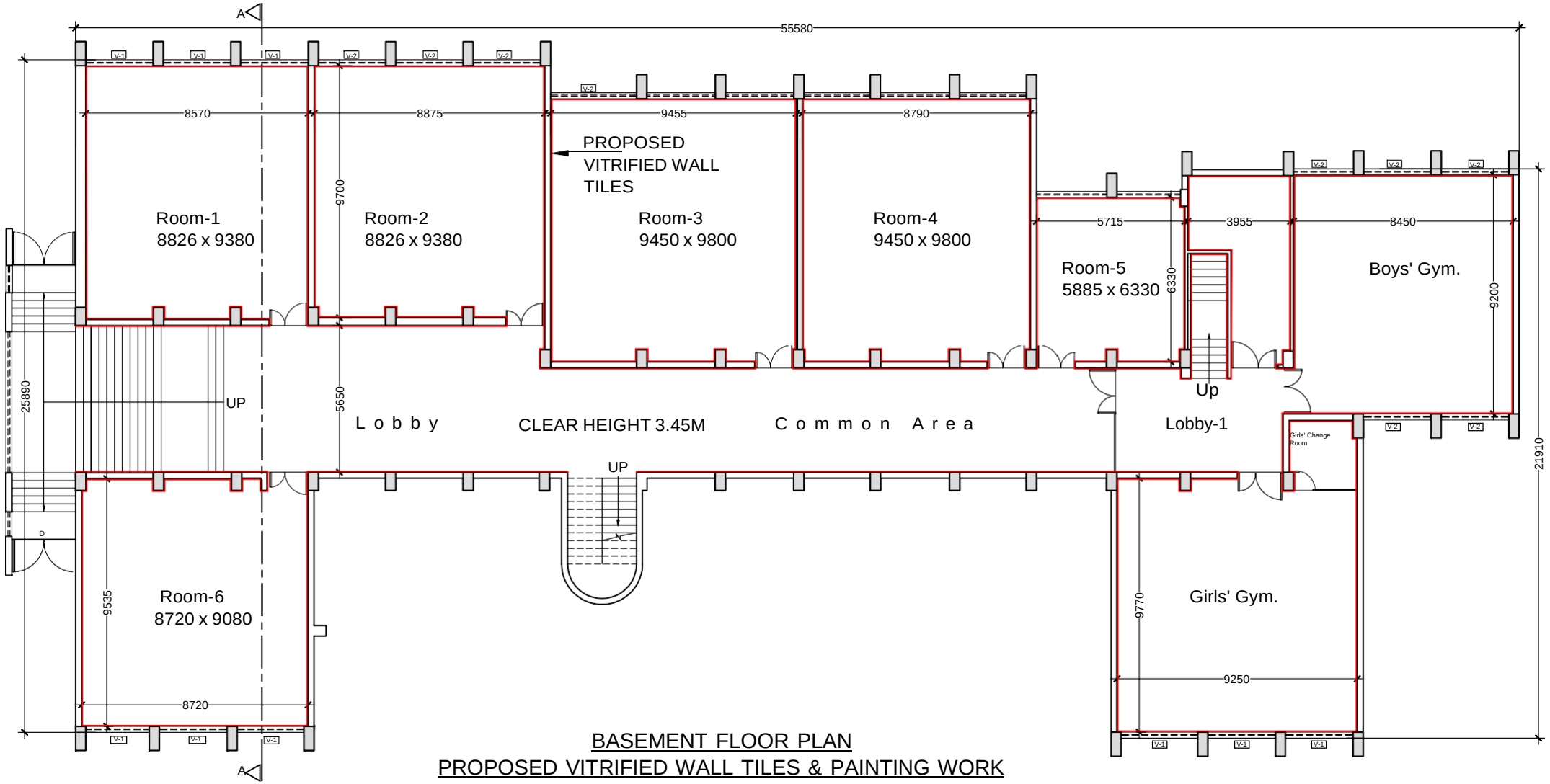

BASEMENT FLOOR PLAN
PROPOSED VITRIFIED WALL TILES & PAINTING WORK

REPAIR & RENOVATION WORK IN EXISTING BASEMENT ROOMS AT SRI GURU GOVIND SINGH COLLEGE OF COMMERCE , PITAMPURA, NEW DELHI

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Sheet No. 3

Sheet Title
BASEMENT FLOOR PLAN

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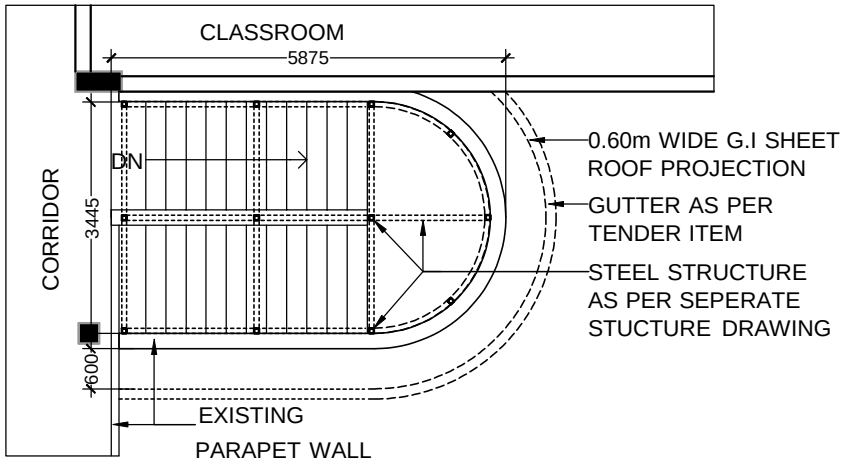
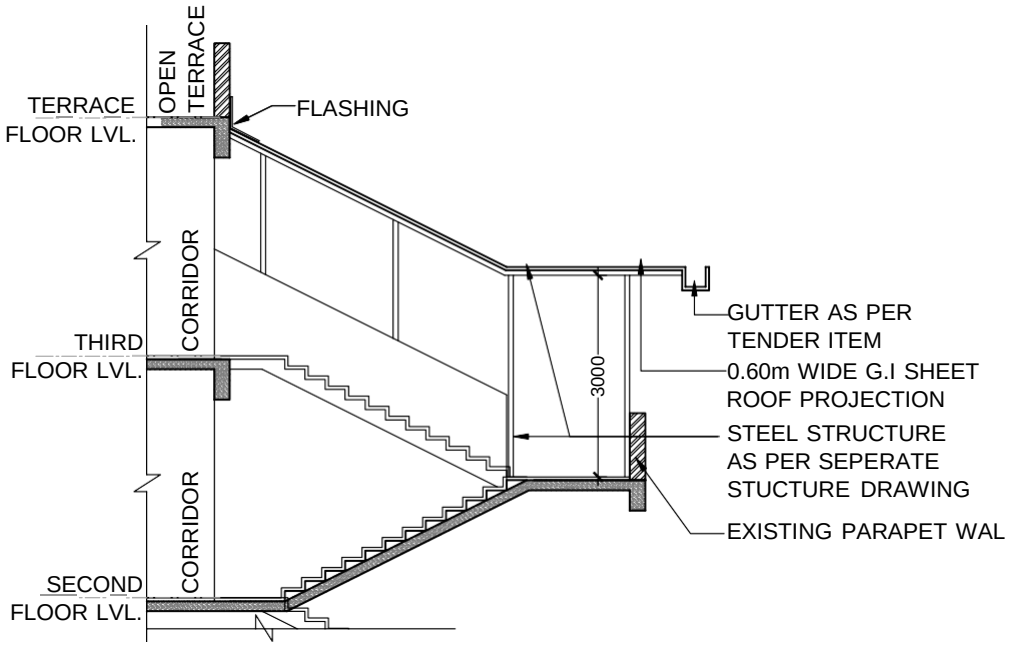
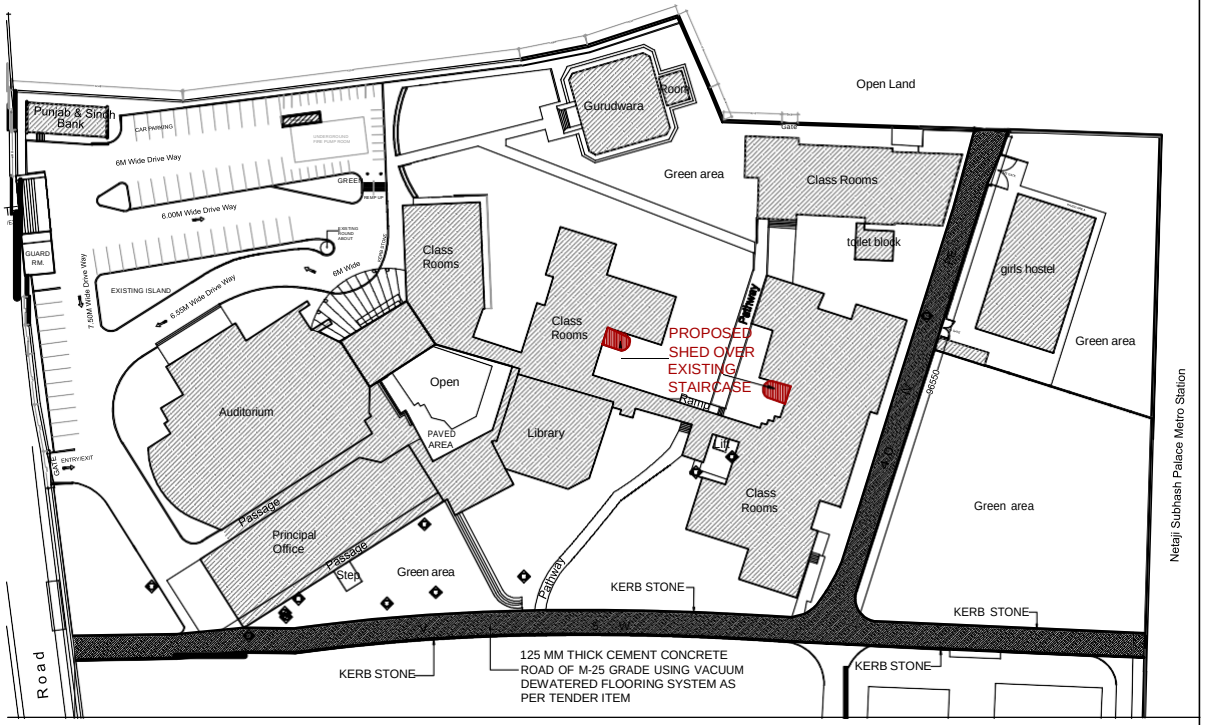


3rd FLOOR STAIRCASE PLAN



SECTION



LOCATION PLAN

PROPOSED G.I SHED OVER 2 NOS. EXISTING OPEN STAIRCASE AT SRI GURU GOVIND SINGH COLLEGE OF COMMERCE , PITAMPURA, NEW DELHI

Date :	01/11/2021
Scale :	NTS
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Sheet No. 4

Sheet Title
STAIRCASE SHED

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Govt. approved Valuers and House Tax Consultants

SRI GURU GOBIND SINGH COLLEGE OF COMMERCE PITAMPURA, NEW DELHI.

TECHNICAL SPECIFICATION &
MAKE LIST – ELECTRICAL WORKS

DATE: 19TH Aug' 2021

ARCHITECTS:	MEP CONSULTANTS:	EPE:
RANJIT SINGH & ASSOCIATES 1206 Surya Kiran Building,19 K.G.Marg, New Delhi 110001 Ph.23312688 Fax: 43560879 Email: rsa1206@msn.com Architects, Engineers & Interior Designers Govt. approved Valuers and House Tax Consultants	**UDAYAN CHAUDHARI & ASSOCIATES PVT. LTD.** BABA HEIGHTS, 111, OKHLA INDUSTRIAL ESTATE, PHASE III, NEW DELHI-110 020 □ 011-45141825 udayanchaudhari@gmail.com	

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- TECHNICAL SPECIFICATIONS ELECTRICAL WORKS
- TECHNICAL SPECFICATION
- LIST OF APPROVED MAKES
- BOQ

SPECIAL CONDITIONS OF CONTRACT

1.0 GENERAL

The Special Conditions of Contract are an extension of and are to be read in conjunction with the General Conditions of Contract

2.0 SCOPE OF WORK

Following is the scope of work included in this Tender:

a) Inetrnal Electrification works including installation of MDB,DB's,UPS,UPS PANEL,Lighting fixtures, cables and Cable Trays etc (As per enclosed BOQ & Specs.)

b) Conduiting and Wiring for Lighting and Power Sockets complete with accessories and fitting as required

c) Installtion of MLTP,MDB/DB's Panel and sub panels etc complete with accessories and fitting as required.

d) Installation of lighting fixtures and Switch sockets (Normal/Modular)

e) Installation of cable tray & raceway complete with accessories and fitting as required.

f) Installation, testing and commissioning of the entire installations to the satisfaction of Consultant and Local Authorities.

g) Applying, Liaison & obtaining NOC for the installations from Local Authorities (If any) including all expenses required for the purpose.

h) The start-up and commissioning will be by a OEM representative who is fully supported by OEM factory staff remotely.

Warranty period: the latest of [12] months from commissioning and handing over.

3.0 INSTALLATION SCHEMATIC

The installation shall confirm to as per latest NBC 2016, IS and IEC nad Main Single Line Diagram. Tender drawings attached along with Tender Papers.

Since the Agency, executing the job is responsible for obtaining the NOC from the Local Service Authorities, deviation, if any, with respect to the scheme and drawings attached may be brought out clearly in the Tender Paper while quoting for the job.

4.0 INSPECTION AND TESTING OF MATERIALS

The Contractor shall, if so required, produce manufacturers' test certificates for any particular batch of materials supplied by him. The tests carried out shall be as per relevant Indian Standards and shall be carried out at Government approved test facility specified by the Project Manager. **NO PAYMENT SHALL BE MADE WITHOUT TEST CERTIFICATE OF THE ITEM.** For checking setting out and testing materials at the Site the Contractor shall provide the following minimum testing equipment:

a) Clip-on Ammeter andvoltmeter
b) 1000 V Meggar and 5 KV Meggar
c) Steel tapes of various lengths
d) Spirit Level
e) Hydraulic Crimping Tool
f) Earth Testing Meggar
g) Pipe bending Tool, thread cutting die, bench vice etc.
h) Cable jointing kit

The Contractor shall provide at least four permanent benchmark at site which shall be preserved till the completion of works. These are essential for laying of cables at correct levels.

All such equipment shall be calibrated at specified frequency for accuracy at a Testing Facility approved by the Project Manager and calibration certificates will be submitted to the Project

5.0 DRAWINGS

i. Contract / Tender Drawings duly signed by the Architect / Consultants are diagrammatic but shall be followed as closely as actual construction permits. Any deviations made shall be in conformity with the direction of the Project Manager and with the prior approval of the Project Manager

ii. Architectural drawings shall take precedence over Electrical drawings, which in turn shall take precedence over services drawings in regard to all dimensions.

iii. The Contractor shall verify all dimensions at the Site and bring to the notice of the Project Manager discrepancies if any; the Project Manger's decision in this respect shall be final.

5.1 SHOP DRAWINGS

The Contractor shall submit, during the currency of the project, to the Project Manager four (4) copies of all shop drawings for Architect/Consultant approval. Shop drawings shall be submitted generally for the following :-

- Showing any changes in layout in the Electrical drawings.
- Equipment layout, piping and wiring diagram.
- Manufacturer or Contractor's fabrication drawings for any materials or equipment supplied by him.

All the shop drawings shall be prepared on computer through AutoCAD software. Within 7 days after the issue of award of the contract and initial set of working drawings, the contractor shall furnish to the Project Manager, for the approval of the Architect / Consultant, four sets of detailed shop drawings of all equipment and materials as required by the Architect / Project Manager.

Each item of equipment / material proposed shall be a standard catalogue product of an established manufacturer strictly from the List of Approved Makes and Manufacturers listed in the attached tender documents.

Shop drawings shall be submitted for approval sufficiently in advance of planned delivery and installation of any materials to allow Architect / Consultant ample time for scrutiny. No claims for extension of time shall be entertained because of any delay in the work due to his failure to produce shop drawings at the right time, in accordance with the approved programmed.

Manufacturers drawings, catalogues, pamphlets, equipment characteristics data, performance charts and other documents submitted for approval shall be in four sets. Each item in each set shall be properly labeled, indicating the specific services for which material or equipment is to be used, giving reference to the governing section and clause number and clearly identifying in ink the items and the operating characteristics. Data of general nature shall not be accepted.
Approval of shop drawings shall not be considered as a guarantee of measurements or of building dimensions. Where drawings are approved, said approval does not mean that the drawings supersede the contract requirements, nor does it in any way relieve the contractor of the responsibility or requirement to furnish material and perform work as required by the contractor.

Where the contractor proposes to use an item of equipment, other than that specified or detailed on the drawings, which requires any deviation in piping, wiring or any other part of the mechanical, electrical or architectural layouts; he shall inform the Project Manager well in advance and no delays resulting from such re-design shall be admissible. He shall also submit all related information as may be required for such redesign to the Architect / Project Manager.

Where the work of the contractor has to be installed in close proximity to, or will interfere with work of other trades, he shall assist in working out space conditions to make a satisfactory adjustment. If so directed by the Project Manager, the contractor shall prepare composite working drawings and sections at a suitable scale not less than 1:50, clearly showing how his work is to be installed in relation to the work of other trades. If the contractor installs his work before coordinating with other trades, or so as to cause any interference with work of other trades, he shall make all the necessary changes without extra cost to the Owner / Project Manager.

Within four weeks of approval of all the relevant shop drawings, the contractor shall submit four copies of a comprehensive variation in quantity statement, and itemized price list of recommended (by manufacturers) imported and local spare parts and tools covering all equipment and materials in this contract. The Project Manager shall make recommendation to Owner for acceptance of anticipated variation in contract amounts and also advise the Owner to initiate action for procurement of spare parts and tools at the completion of project.

5.2 COMPLETION DRAWINGS & STANDARD MEASUREMENT BOOK (SMB)

On completion of the work, the contractor shall submit three (3) complete sets of the site produced drawings and marked up prints of 'AS BUILT' drawings verified and approved by the Architect to the Project Manager. These drawings shall include and show all the changes / deviations made from the working drawings during the course of construction and also the other details as called for by the project manger. During the execution of the Works a set of drawings shall be retained in the Contractor's site offices for the exclusive purpose of recording changes made to the Work as the construction proceeds. The drawings shall be prepared on computer through AutoCAD Software and provided to the Project Manager on CD.

Along with the completion drawings the Contractor shall also prepare and submit to the Project Manager the Standard Measurement Book (SMB) in the form of a bound book and a soft copy of the same. SMB shall incorporate the standard measurements of the item as per the completion / as built drawings in modules finalized in consultation with the Project Manager.

6.0 CONTRACT DRAWINGS

Drawings forming part of the Contract are listed below. Further supplementary drawings furnished by the Project Manager from time to time shall also be deemed to form part of the Contract.

7.0 TESTING OF INSTALLATIONS

The Contractor shall perform all such tests as may be necessary and required by the Project Manager to ensure quality of the executed works and by local authorities to meet Municipal and other bye-laws, regulations in force. The Contractor shall provide all labour, equipment, and materials etc., required for the performance of the tests.

8.0 SITE INFORMATION

All information, levels and dimensions given in the tender drawings relating to Site conditions are given in good faith; the Contractor shall, however, make his own independent inquiries and verify the same. Any claims for extras on account of any deviations or incorrectness of above referred information, levels etc., shall be considered as in admissible. The Contractor shall obtain all information relating to local regulations, by-laws and all regulations applicable to the work or applicable profession. Any claims in this regard shall be inadmissible.

9.0 SITE INSTRUCTION FILE

The Contractor shall maintain a Site order book / instruction file at the Site office. All instructions received from the Project Manager relating to the Work shall be retained in the file.

10.0. PHOTOGRAPHS

Besides submitting progress charts, reports, etc., the Contractor shall submit progress Photographs as directed by Project Manager, in triplicate along with negatives.

11.0. PROFESSIONAL INTEGRITY AND TEAM SPIRIT:

It is the intent of the Owner and the Project Manager that this Project will be executed in a spirit of teamwork and full professional integrity. The Contractor shall fully co-operate with all agencies concerned to fulfill this objective. Special conditions of contract

12.0 QUALITY ASSURANCE AND CONTROL PROGRAMME:

The Contractor shall establish an effective quality control system at the Site and implement the same through an independent team consisting of the Contractor's Representative and qualified and experienced engineers and technical personnel to enforce quality control on all items of the Work and the Project at all stages.

13.0 CONTRACT DRAWINGS

Drawings forming part of the Contract are listed in page 189. Further supplementary Drawings

furnished by the Project Manager from time to time shall also be deemed to form part of the Contract.

14.0 ENTRY TO THE SITE

The Project Manager, at his discretion has the right to issue passes to control the admission of the Contractor, his agents, employees and work people to the Site of the Work or any part there of. Passes shall be returned at any time on demand by the Project Manager.

15.0 FIRE PRECAUTIONS

The Contractor shall take all precautions and preventive measures against fire hazards at the Site and shall assume full responsibility for the same.

16.0 DRILLING, CUTTING OF WATER PROOFING MEMBRANEETC

All cutting and drilling of walls or other elements of the building for the proper entry / installation of inserts, boxes, equipment etc., shall be carried out using electrically operated tools only. Manual drilling, cutting, chiseling, etc shall not be permitted. No structural member shall be cut or chased without the written permission of the Project Manager. Cutting and drilling of structural members shall be carried out using vibration free diamond wire sawing and diamond drilling only with prior permission from the Project Manger. The costs for procurement and using such equipment are deemed to be included in the Contract and no extra costs will be paid.
No walls terraces shall be cut for making and opening after waterproofing has been done without written approval of Project Manager/ Architects. Cutting of water proofing membrane shall be done very carefully so as other portion of water proofing is not damaged. On completion of work at such place the water proofing membrane shall be made good and ensured that the opening/ cutting is made fully waterproof as per specifications and details of waterproofing approved by Architects.

17.0 ASSOCIATED CIVIL WORKS / STORES

All civil works required for the storage of materials or the installation of equipments and any other requirement for the contractor's functioning shall be the responsibility of the contractor at his own risk & cost.

18.0 CONTRACTOR'S RATES

19.1 Rates quoted in this tender shall be inclusive of cost of materials, labour, supervision, erection, tools, plant, scaffolding, service connections, transport to site, all taxes, Octroi and levies, breakage, wastage and all such expenses as may be necessary and required to completely do all the items of work and put them in a working condition.

19.2 Rates quoted are for all heights and depths and in all positions, leads & lifts etc. as may be required for this work.

19.3 All rates quoted are inclusive or cutting holes and chases in walls and floors and making good the same with cement mortar/concrete/ water proofing of appropriate mix and

strength as directed by Project Manager. Contractor shall provide holes, sleeves, recesses in the concrete and masonry work as the work proceeds.

19.4 The Contractor shall furnish the Architects with vouchers & test certificates to prove that the materials are as specified and to indicate that the rates at which the materials are purchased in order to work out the rate analysis of non-tendered items, which he may be called upon to carry out.

20.0 SITE CLEARANCE ANDCLEANUP

20.1 The contractor shall, from time to time, clear away all debris and excess materials accumulated at the site.

20.2 After the fixtures, equipment and appliances have been installed and commissioned, contractor shall clean-up the same and remove all plaster, paints, stains, stickers and other foreign matter or discoloration leaving the same in a ready to use condition.

20.3 On completion of all works, contractor shall demolish all stores, remove all surplus materials and leave the site in a broom clean condition, failing which the same shall be done at Contractor's risk and cost.

TECHNICAL SPECIFICATIONS:

I. INSTALLATION OF 415 V. MDB & DISTRIBUTION BOARD.

1. DESCRIPTION OF WORK

This section covers the detailed requirements for installation, testing and commissioning of MDB, DISTRIBUTION BOARD suitable for 415 Volts, 3 phase, 50 HZ 4 wire system, in line with schematic diagram, schedule of quantities and as specified.

2. INSTALLATION

The installation work shall cover assembly of various sections of the panels, lining up, grouting the units etc. After connecting up the bus bars etc. all joints shall be protected with necessary insulated shroudings. A common earth bar as per IS specifications shall be run at the back of panel connecting all the sections for connection to frame earth system. All protections and other small wirings for indication etc. shall be completed before calibration and commissioning checks are commenced. All relays, meters etc. shall be mounted and connected with appropriate wiring.

3. TESTING & COMMISSIONING

3.1 TEST AT MANUFACTURERS WORK

All routine tests specified in IS : 8623: shall be carried out

3.2 Testing And Commissioning at Site

Commissioning checks and tests shall include all wiring checks and checking up of connections. Primary/Secondary injection tests for the relay adjustment/setting shall be done before commissioning in addition to routine meager test. Checks and tests shall include the following :

i) Operation checks and lubrication of all moving parts.
ii) Interlock function checks.
iii) Continuity checks of wiring, fuses etc. as required.

iv) Insulation test : when measured with 500 V megger the insulation resistance shall not be less than 100 mega ohms.

v) Trip test and protection gear test.

3.3 Test witness

Tests shall be performed in the presence of the Project Manager. The contractor shall give at least fifteen days advance notice of the date when the tests are proposed to be carried out.

II. CABLE WORK

1. DESCRIPTION OF WORK

Supply, laying, testing and commissioning of cables and cable trays as per specifications schedule of quantities and drawings.

2. APPLICABLE CODES, STANDARDS & PUBLICATIONS

2.1	IS : 1554 (Part-I)	:	1.1 KV Grade PVC insulated cables.
2.2	IS : 10242 (Part-3, Section-12)	:	Installation of cables for low voltage system.
2.3	IS : 7098 (Part-1&2)/IS:5831/ IEC:60502/BS:6746/BS:5467	:	Cross linked polyethylene insulated PVC sheathed cables.

Part-I : For working voltages upto & including 1100 Volts.

Part-II :For working voltage from 3.3 KV upto & including 11 KV.

2.4	IS : 10810	:	Method of test for cables
2.5	IS : 1255	:	Code of practice for installation & maintenance. of power cables upto & including 11 KV rating
2.6	IS : 8130/IEC : 60228	:	Conductors for cables
2.7	IS : 10418	:	Drums for electric cables.
2.8	IS : 2062, IS : 800, IS : 816	:	Structural wedding steel

3. SUBMITTALS

3.1 Cable schedule as per site conditions & good for construction drawings.

3.2 Layout of various cables on cable tray / trench along with sections showing no. of cables, distance between cables etc, size of cable trays etc.

3.3 Cable tray layout, as per site condition, duly coordinated with other services.

4. Test Reports

Routine test certificates for each drum of cable brought to site.

5. SPECIFICATIONS

5.1 GENERAL

Cable shall be supplied inspected, laid, tested and commissioned in accordance with drawings, specifications, relevant Indian Standards Specifications and cable manufacturer's instructions. Thecable shall be delivered at site in original drums with manufacturer's name clearly written on the drum.

5.2 MATERIAL

5.2.1 The MV power cable of 660/1100 V. grade shall be XLPE insulated Aluminium conductor armoured cable.

5.2.2 The MV control cables shall be XLPE insulated copper conductor armoured stranded cable

5.2.3 The HT power cable of 11 KV grade shall be XLPE insulated Aluminium conductor armoured cable.

5.3 CABLE LAYING

5.3.1 Standards

The work shall be carried out in the best workman like manner in conformity with this specification, the relevant specification, codes of practice of Indian Standards Institution, approved drawings and instructions of project-in-charge or his authorized representative issued from time to time in case of any conflict between the standards, the instructions of Engineer-in-charge shall be binding.

5.3.2 General:

The cables shall be visually inspected and the insulation resistance shall be checked before commencing the installation.

The routing of cable trays shall be coordinated with other agencies. The cable tray sizes and routing shall be as per the approved shop drawings. Shop drawings shall be prepared and submit for approval as per site instruction and requirement to avoid ambiguity.

Cable trays shall be supported by suitable structural steel (ISA, ISMC, MS square) as per GFC drawings/ approved shop drawings.

Cable tags of suitable size and material as per sample approval shall be provided with cross reference details shall beprovided.

The LT Cables laid on the cable tray shall clamp to the tray with suitable size of nylon cable ties. The other cables especially those for external lighting shall be laid in excavated and backfilled trenches. The excavation shall be to a depth of 800mm. A sand bedding of 175mm shall be provided around the cables. The cables shall be covered with protective bricks on the sides and top.

Standard cable grips and reels, cable drum unwinding stand or jack shall be utilized for cable pulling. The maximum pulling tension shall not exceed the limits stipulated by the manufacturer.

Sharp bends & kinks shall be avoided in the installation. The bending radius shall not be less than 12 times the diameter of the cable.

Adequate extra lengths shall be provided near all the terminations.

Apart from the specification detailed for cable tags, Identification tags made of Aluminium Strips bearing cable number at either ends, at intervals of 30Mtrs shall be provided. Along straight runs and at every bends for cables laid in excavated trenches

Cable route markers shall be installed at every bend and at 30 Mts. intervals for cables laid in excavated trenches.

End terminations using Single Compression / Double compression / Flameproof Cable glands & heavy duty copper lugs as specified elsewhere shall be carried out.

Megger test and continuity test shall be conducted on the cable after carrying out the end terminations.

Hot dip galvanized / Pregalvanised / MS Powder coated MS Ladder type / perforated trays as specified shall be used for all power cabling & perforated type for PLC signal / communication & LV cabling.

Cable tray sections shall be joined by fishplates.
The trays shall be supported at regular intervals of not more than 1.5m to 2m using engineered supports / High-tech threaded rods as approved.

The supporting system shall be of approved design supplied by the tray manufacturer considering the full loading of the cable trays.

The earth continuity of the cable trays shall be ensured at each joint. Earth flat shall be run all along each of the trays and connected to earth grid.

Annular space around cable trays while crossing walls/ floors shall be filled up by fire resistant sealing material by contractor in accordance with the instructions. No extra claim shall be entertained, for the same

5.4 CABLE TRAYS, FITTINGS & ACCESSORIES

5.4.1 Applicable Standards:-

-IS-1255-1963(Revised to date) = C.O.P. for laying.

-IS-226-	-do-	Structural steel
-IS-2074-	-do-	Zinc-oxide-primer
-IS-2633-	-do-	Testing of zinc coating

-IS-2629-	-do-	Hot dip galvanizing iron

5.4.2 Galvanized Cable tray

Cable trays should have undergone rigorous rust proofing process before galvanizing, which should comprise of alkaline, degreasing and descaling in diluted sulfuric acid and a recognized phosphate process. All nuts, bolts, washers & hardware etc. shall be hot-dip galvanized. Galvanizing shall be uniform, smooth and free from any spots. The zinc deposit shall not be less than 610 Grams. Per Sq. meter of surface area and also the thickness of zinc along the surface shall not be less than 75 microns.

However, the amount of zinc deposit on the threaded portions of the bolts, nuts etc., shall not be less than 300 Grams (Per Sq. m. of surface area). The zinc deposit on the washers shall not be less than 340 Grams (per Sq. m. of surface area).

5.4.3 MS Powder coated

MS powder coated cable trays should have undergone rigorous rust proofing process, which should comprise of alkaline, degreasing and descaling in diluted sulfuric acid and a recognized phosphate process. The sheet work shall then be given two coats of oxide primer before final approved shade of powder coating. Cable trays shall be powder coated of colour as approved by Engineer-in-Charge and shall conform to IS - 2074 amended to date. Thickness of powder coating shall not be less than 70 microns.

Minimum size of main channel for ladder type trays and rung should be as under:-

Size of Tray		
Size of Main Channel	**Size of Rung**	
450 mm to 750 mm	25 x 75 x 25 x 2.0 mm	20 X 50 X 20 X 2 @ 250 C/C

TABLE FOR ANGLES FOR CABLE TRAY SUPPORT AND HANGERS

Size of Cable Tray	Size of Angle	Spacing	Hangers
750 to 600 mm	40 x 40 x 5 mm	@ 1800 mm	10mm dia rod

In case of MS supports Contractor shall carry out 2 coat of primer and two coat of synthetic enamel paint (Spray paint or powder coating as specified& approved) of approved shade on all steel structures. Sizes of angles for cable tray supports and hangers shall be as per table given above or as specified in BOQ:

5.4.4 Cable Tray Mounting:

Unless otherwise specifically noted on the relevant layout drawing, all cable tray mounting works to be carried out as per following and to be approved by Engineer in charge (refer typical cable tray fixing details)

Hangers shall be of minimum10 mm Dia Steel Round Bar or as specified in BOQ.

Maximum loading on a horizontal support arm to be 120 Kg per meter of cable tray run.

Width of the horizontal arms of the tray supporting structures to be same as the tray widths specified in tray layout drawings, plus length required, for welding/bolting to the vertical supports.

Spacing between horizontal support arms of vertical tray runs must be specified & as required.

6. STORAGE AND HANDLING OF CABLES

a. All cables shall be inspected upon receipt at site and checked for any damage during transit. Cable drums shall be stored on a well drained, hard surface, preferably of concrete, so that the drums do not sink in the ground causing rot and damage to the cable drums.

b. During storage periodical rolling of drums once in 3 months through 90^{O} shall be done. Rolling shall be done in the direction of the arrow marked on the drum.

c. It should be ensured that both ends of the cable are properly sealed to prevent ingress/absorption of moisture by the insulation.

d. Protection from rain and sun shall be ensured. Sufficient ventilation between cable drums, should be ensured during storage.

e. The drums shall always be rested on the flanges and not on the flat sides.

f. Damaged battens of drums etc. should be replaced, if necessary.

g. When cable drums have to be moved over short distances, they should be rolled in the direction of the arrow, marked on the drum.

h. For 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.

i. When unloading cable drums from vehicles, a crane shall preferably be used. Otherwise the drum shall be rolled down carefully on a suitable ramp or rails, where necessary.

j. While transferring cable from one drum to another, the barrel of the new drum shall have a diameter not less than that of the original drum.

k. The cables shall not be bent sharp to a small radius. The minimum safe bending radius for all types of

XLPE cables shall be taken as 12 times the overall diameter of the cable. Wherever practicable, larger radius should be adopted. At joints and terminations, the bending radius of individual cores of a multi core cable shall not be less than 15 times its overall diameter.

l. Cable with kinks and straightened kinks or with similar apparent defects like defective armouring etc. shall be rejected.

m. Cables from the stores shall be supplied by the contractor as per the site requirement in pieces cut in the stores.

7. INSTALLATION

7.1 GENERAL

The cable installation including necessary termination shall be carried out in accordance with the specifications given herein. For details not covered in these specifications, I.S. 1255 shall be followed. No straight through joint shall be permitted in the system. The cables shall be supplied as per cable schedule submitted by the contractor & approved by Project Manager.

Cables shall be so laid that the maximum bending radius is 12 times the overall diameter of the cable for LT cables and 15 times the overall diameter for HT cables. Cables shall be laid in masonry trenches, directly on walls/cable trays, directly buried in ground or in pipes/ducts as elaborated below. Cables of different voltages and also power and control cables shall be laid in different trenches with adequate separation. Wherever available space is restricted such that this requirement cannot be met, LT cables shall be laid above HT cables. Where more than one cable is laid side by side, cable marker tags of approved type inscribed with cable identification details shall be permanently attached to cables at entry points to the building, at specified intervals for cables laid direct in grounds and in locations like manholes, pull pits etc.

7.2 In Masonry Trenches

Wherever so specified, cables shall be laid in indoor/outdoor masonry/RCC trenches to be provided by Project Manager. Cables shall be laid on galvanized angle iron supports fabricated from minimum 38mm x 38mm x 6mm galvanized angle iron supports grouted in trench walls at intervals not exceeding 600 mm. If required, cables shall be arranged in tier formation inside the trench. Suitable clamps, hooks and saddles shall be used for securing the cables in position and dressing properly so that the clear spacing between the cables shall not be less then the diameter of the cable. Trenches shall be provided with chequered plate/RCC covers. After laying and dressing of cables, trenches shall be filled with fine sand as directed.

7.3 On Trays/Walls

7.3.1 Wherever so specified, cables shall be laid along walls/ceiling or on cable trays. Cable shall be secured in position and dressed properly by means of suitable clamps, hooks, saddles etc. such that the minimum clear spacing between cables is diameter of the cable. Clamping of cables shall be at minimum intervals as below.

Type of cable	Size	Clamping by	Fixing interv
LT	Upto and including 25 sq mm	Saddles 1 mm thick	45 cm
LT & HT	35 sq mm to 120 sq mm	Clamps 3 mm thick 25 mm wid	60 cm
LT & HT	150 sq mm and above	Clamps 3 mm thick 40 mm wid	60 cm

Note : The fixing intervals specified apply to straight runs. In the case of bends, additional clamping shall be provided at 30 cm from the center of the bend on both sides.

7.4 ROUTE

i. Before the cable laying work is undertaken, the route of the cable shall be decided by the Project Manager.

ii. While shortest practicable route shall be preferred, cable runs shall generally follow fixed developments such as roads, footh-paths etc. with proper offsets so that future maintenance, identification etc. are rendered easy. Cross country run to shorten the route length is not desirable as it would lead to route identification and maintenance problems, besides posing difficulties during later development of open areas etc.

iii. While selecting cable routes, corrosive soils, ground surrounding sewage and effluent etc. shall be avoided. Where this is not feasible, special precautions as approved by the Project Manager shall be taken.

iv. As far as possible, the alignment of the cable route shall be decided taking into consideration the present and future requirements of other agencies and utility services affected by it, the existence of any cable in the vicinity as may be indicated by cable markers or cable schedules or drawing maintained for that area, possibilities of widening of roads/lanes, storm water drains etc. Cable routes shall be planned away from the drains and should be within the property.

v. Whenever cables are laid along well demarcated or established roads, the MV cables shall be laid further from the kerb line than HV cables.

vi. Cables of different voltages and also power and control cables shall be kept in different trenches with adequate separation. Where available space is restricted, MV cables shall be laid above HV cables. Where cables cross one another the cable of higher voltage shall be laid at a lower level than the cable of lower voltage.

7.5 WAY LEAVE

7.5.1 It may be necessary to obtain way leave for the cable route from the appropriate authorities some of whom are listed below :

a) Drainage, Public Health and Water Works.

b) Telephones and Telegraphs.

c) Gas works.

d) Other Undertakings.

e) Owners of properties.

Where necessary, joint inspection with representatives of other authorities may be arranged so that mutual interests are safeguarded. In case of private property, Section 12/51 of the Indian Electricity Act shall be complied with.

7.5.2 PROXIMITY TO COMMUNICATION CABLES

(I) Power and communication cables shall as far as possible cross at right angles. Where power cables are laid in proximity to communication cables the horizontal and vertical clearances shall not normally be less than 60 cms.

7.6 LAYING DIRECT IN GROUND

7.6.1 GENERAL

This method shall be adopted where the cable route is through open country along roads/lanes etc. and where no frequent excavation are encountered and where excavation is easily possible without affecting other services.

7.6.2 TRENCHING

(i) **WIDTH OF TRENCH :-** The width of trench shall be determined on the following basis:

a) The minimum width of trench for laying single cable shall be 35 cm.

b) Where more than one cable is to be laid in the same trench in horizontal formation, the width of trench shall be increased such that the inter-axial spacing between the cables, except where otherwise specified shall be at least 20 cm.

c) There shall be a clearance of at least 15 cm between axis of the end cables and the sides of the trench.

(ii) **DEPTH OF TRENCH:-** The depth of trench shall be determined on the following basis :

a) Where cables are laid in single tier formation, the total depth of trench shall not be less than 75 cm. for cables upto 1.1 KV and 1.20 m for cables above 1.1 KV.

b) When more than one tier of cables is unavoidable and vertical formation of laying is adopted, depth of trench in a (i) above shall be increased by 30 cm. for each additional tier to be formed.

(iii) EXCAVATION OF TRENCHES

a) The trenches shall be excavated in reasonably straight lines. Wherever there is a change in direction, suitable curvature shall be provided complying with the requirements of Clause 6 / k.

b) Where gradients and changes in depth are unavoidable, these shall be gradual.

c) Excavation shall be done by any suitable means-manual or mechanical. The excavated soil shall be stacked firmly by the side of the trench such that it may not fall back into the trench.

d) Adequate precautions shall be taken not to damage any existing cables, pipes or other such installations in the proposed route during excavation. Wherever bricks, tiles or protective covers or bare cables are encountered, further excavation shall not be carried without the approval of the Project Manager.

e) Existing property exposed during trenching shall be temporarily supported or propped adequately as directed by the Project Manager. The trenching in such cases shall be done in short lengths, necessary pipes laid for passing cables therein and the trench refilled in accordance with clause 7.6.2 (v)

f) If there is any danger of a trench collapsing and endangering adjacent structures, the sides should be well shored up with timbering and/or sheeting as the excavation proceeds. Where necessary, these may even be left in places when back filling the trench.

g) Excavation through lawns shall be done in consultation with the staff of the department/Owner concerned.

h) The bottom of the trench shall be level and free from stone, brick bats etc. The trench shall then be provided with a layer of clean, dry sand cushion of not less than 8 cm. in depth.

(iv) **LAYING OF CABLE IN TRENCH**

a) At the time of issue of cable for laying, the cores shall be tested for continuity and insulation resistance.

b) The cable drum shall be properly mounted on jacks or on a cable wheel, at a suitable location, making sure that the spindle, jack etc. are strong enough to carry the weight of the drum without failure and that the spindle is horizontal in the bearings so as to prevent the drum creeping to one side while rotating.

c) The cable shall be pulled over rollers in the trench steadily and uniformly without jerks and strains. The entire cable length shall as far as possible be pulled of in one stretch. However, where this is not possible the remainder of the cable may be removed by 'Flaking' i.e. by making one long loop in the reverse direction.

a) i) After the cable has been uncoiled and laid into the trench over the rollers, the cable shall be lifted slightly over the rollers beginning from one end by helpers standing about 10 m apart and drawn straight. The cable should then be taken off the rollers by additional helpers lifting the cable and then laid in a reasonably straight line.

ii) For short runs and sizes upto 50 Sq. mm of cables upto 1.1 KV grade, any other suitable method of direct handling and laying can be adopted with the prior approval of the Project Manager.

e) When the cable has been properly straightened, the cores shall be tested for continuity and insulation resistance. In case of PVC cables, suitable moisture seal tape shall be used for this purpose.

f) i) Cable laid in trenches in a single tier formation shall have a covering of clean, dry sand of not less than 17 cms above the base cushion of sand before the protective cover is laid.

ii) In the case of vertical multi-tier formation after the first cable has been laid, a sand cushion of 30 cms. shall be provided over the initial bed before the second tier is laid. If additional tiers are formed, each of the subsequent tiers also shall have a sand cushion of 30 cms. as stated above. The top most cable shall have a final sand covering not less than 17 cms. before the protective cover is laid.

g) At the time of original installation, approximately 3 m of surplus cable shall be left on each end of the cable and on each side of underground joints (Straight through/Tee/Termination) and at entries and places as may be decided by the Project Manager. The surplus cable shall be left in the form of a loop. Where there are long runs of cable length loose cable may be left at suitable intervals as specified by the Project Manager.

h) A final protection to cables shall be laid in accordance with para i to provide warning to future excavators of the presence of the cable and also to protect the cable against accidental mechanical damage by pick-axe blows etc.

i) Unless otherwise specified, the cables shall be protected by second class bricks of not less than 20 cm x 10 cm x 10 cm (nominal size) as per CPWD Building Specification or protection covers placed on top of the sand, (bricks to be laid breadth wise) for the full length of the cable to the satisfaction of the Project Manager. Where more than one cable is to be laid in the same trench, this protective covering shall cover all the cables and project at least 5 cm. over the sides of the end cables.

(v) **Back Filling**

a) The trenches shall be back-filled with excavated earth free from stones or other sharp edged debris and shall be rammed and watered, if necessary, in successive layers not exceeding 30 cm. Unless otherwise specified, a crown of earth not less than 50 mm. in the centre and tapering towards the sides of the trench shall be left to allow for subsidence. The crown of earth however should not exceed 10 cms. so as not to be a hazard to vehicular traffic. The temporary re-instatements of roadways should be inspected at regular intervals, particularly during the wet weather, and any settlement should be made good . Further trenches cut through roadways or other paved areas shall be restored to the same density and material as the surrounding area and repaved in accordance with the relevant Specifications to the satisfaction of the Project Manager.

b) Where road berms or lawns have been cut or kerb stones displaced, the same shall be repaired and made good except turfing/asphalting to the satisfaction of the Project Manager and all surplus earth or rock removed to places as specified.

(vi) **Route Markers**

a) Route markers shall be provided along straight runs of the cables at locations approved by the Project

Manager and generally at intervals not exceeding 100 m. Markers shall also be provided to identify change in the direction of the cable route and also for location of every underground joint.

b) Route markers shall be made out of 100 mm x 100 mm x 5 mm GI/Aluminium plate, welded or bolted on to 35 mm x 35 mm x 6 mm angle iron 60 cm. long. Such plate markers shall be mounted parallel to and 0.5 m or so away from the edge of the trench.

Alternatively cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate of 20 mm nominal size) marker 60 cm x 60 cm 10 cm in size shall be laid flat and centred over the cable. The concrete markers unless otherwise instructed by the Project Manager shall project over the surrounding surface so as to make the cable route easily identifiable.

c) The work 'cable' and other details such as voltage grading, size etc. as furnished by the Project Manager shall be inscribed on the marker.

Vii) Cable Identification Tags

Wherever more than one cable is laid/run side by side, marker tags as approved by the Project Manager, inscribed with cable identification details shall be permanently attached to all the cables in manholes/pull pits/ joint pits/ entry points in buildings/open ducts/ trenches etc. These shall also be attached to cables laid directly in ground at specified intervals, before the trenches are back-filled.

7.7 Laying in Pipes/Closed ducts :

7.7.1 In location such as road crossing, entry to building, on poles, in paved areas etc. cables shall be laid in pipes or closed ducts.

7.7.2 GI or Hume Pipes (spun reinforced concrete pipes) shall be used for such purposes. In the case of new construction, pipes as required shall be laid alongwith the Civil works and jointed according to the instructions of the Project Manager as the case may be. The size of pipe shall be as indicated in the electrical drawings. GI pipe shall be laid directly in ground without any special bed. Hume pipe (Spun reinforced concrete pipe) shall be laid over 10 cm. thick cement concrete 1:5:10 (1 cement : 5 coarse sand : 10 graded stone aggregate of 40mm nominal size) bed, after which it shall be completely embeded in concrete. No sand cushioning or tiles need be used in such situations. Unless otherwise specified, the top surface of pipes shall be at a minimum depth of 1mtr. from the ground level when laid under roads, pavement etc.

7.7.3 Where steel pipes are employed for protection of single core cables feeding AC load, the pipe should be large enough to contain both cables in the case of single phase system and all cables in the case of polyphase system.

7.7.4 The pipes on road crossing shall preferably be on the skew to reduce the angle of bends as the cable enters and leaves the crossings. This is particularly important for high voltage cables.

7.7.5 Manholes of adequate size as decided by the Project Manager shall be provided to facilitate feeding/drawing in of cables and to provide working space for persons. They shall be covered by suitable manhole covers with frame of proper design. The construction of manholes and providing the cover is not in the scope of this Contract and shall be got executed and paid for by the Project Manager through an other agency.

7.7.6 Pipes shall be continuos and clear of debris or concrete before cable is drawn. Sharp edges at ends shall be smoothened to prevent injury to cable insulation or sheathing.

7.7.7 Pipes for cable entries to the building shall slope downwards from the building and suitably sealed to prevent entry of water inside the building. Further the mouth of the pipes at the building end shall be suitably sealed to avoid entry of water. This seal in addition to being waterproof shall also be fireproof.

7.7.8 All chases and passages necessary for laying of service cable connections to buildings shall be cut as required and made good to the original finish and to the satisfaction of the Project Manager.

7.7.9 Cable grips/draw wires and winches etc. may be employed for drawing cables through pipes/closed ducts etc.

8. TERMINATION/JOINTING OF CABLES

Soldered jointing/termination shall be totally avoided. Solderless terminations by using Dowel crimping tools and suitable lugs shall be adopted for all cable terminations. Any terminations may without use of proper crimping tool is shall be liable to be rejected. In the case of aluminium conductors, it is to be ensured that the conductor oxidation is cleaned by means of emery paper and then a thin coat of tin is applied before pinching into any equipment. Heat shrinkable Raychem type terminations shall be provided for High Voltage cables and brass double compression glands shall be provided for LT cable terminations. Straight through jointing of LT or High Voltage cable shall normally be totally avoided. If absolutely unavoidable, such jointing shall be carried out as per procedure to be got specifically approved from Project Manager and without cost.

9. MEASUREMENT OF CABLE RUNS

The cable runs shall be measured upto the outer end of the boxes without any allowances for over lap in joints. The rate shall include all the above mentioned material, labour etc for laying as required.

10. CABLE LOOPS

At the time of the installation approximately 3 meters of surplus cable shall be left

- at each end of the cable
- on each side of underground straight through/tee/termination joints.
- at entries to buildings
- and such other places as may be decided by the Project Manager .

This cable shall be left in the form of a loop.

Wherever long runs of cable length are installed cable loops shall be left at suitable intervals as specified

by the Project Manager.

11. BONDING OF CABLES.

Where a cable enters any piece of apparatus it shall be connected to the casting by means of an approved type of armoured clamp or gland. The clamps must grip the armouring firmly to the gland or casting, so that in the event of ground movement no undue stress is placed on to the cable conductors.

12. TESTING & COMMISSIONING

12.1 Tests At Manufacturer's Work

The cables shall be subjected to shop test in accordance with relevant standards to prove the design and general qualities to the cables as below (as per IS 10810) :

- Routine test on each drum of cables.
- Acceptance tests on drums chosen at random for acceptance of the lot.
- Type test on each type of cables, inclusive of measurement of armour DC resistance of power cables. The type tests shall include the following conforming to VDE 0278/IS Specifications. The type test certificates shall be submitted.
- Rated withstand AC voltage test
- Partial discharge test
- Rated withstand surge voltage test
- Continuous AC voltage test with cyclic current loads (Number of heating cycles -3,)
- Partial Discharge Test
- Continues AC voltage Test with cyclic current (Number of Heating cycles-60)
- Thermal Short Circuit Test.
- Continuous AC Voltage Test with cyclic current load. (Number of heating Cycles-63)
- Rated withstand Surge Voltage Test.
- DC Voltage Test.
- Test under the Influence of Moisture.
- Dynamic short circuit Test.

The PVC cables shall also be tested as per IS 1554 and the XLPE cables as per IS 7098.

12.2 Site Testing

12.2.1 Testing before laying

All cables, before laying shall be tested with a 500V megger for cables of 1.1 kV grade, or with a 2500 / 5000V megger for cables of higher voltage. The cable core shall be tested for continuity, absence of cross phasing, insulation resistance from conductors to earth / armour and between conductors.

12.2.2 Testing before backfilling

All cables shall be subjected to the above mentioned tests, before covering the cables by protective covers and back filling and also before taking up any jointing operation.

12.2.3 Testing after laying

After laying and jointing, the cable shall be subjected to a 15 minutes pressure test. The test pressure shall be as given below. DC pressure testing may normally preferred to AC pressure testing

Working volts in kV Cables	AC 15 minutes test		DC 15 minutes test	
	Between condu in KV	Conductors toear KV	Between condu in KV	Conductors earth in KV
Upto 1.1	2.0	2.0	3.0	3.0
3.3	6.0	3.5	9.0	5.0
6.6	12.0	7.0	18.0	10.5
11	20.0	11.5	30.0	17.5
22	40.0	23.0	60.0	35.0
33	-	-	-	60.0

Or as per latest IS/IEC codes.

12.3 Test Witness

Tests shall be performed in presence of representative of Project Manager. The Contractor shall give at least fifteen (15) days advance notice of the date when the tests are to be carried out.

12.4 Completion plan and completion certificate

a) After completion of the work the Contractor shall draw completion plans to a suitable scale and shall submit to the Project Manager. The completion plans shall, inter-alia, give the following details:-

i Layout of cablework
ii Length, size, type and grade of cables.
iii Method of laying i.e. direct in ground, in pipes etc.
iv Location of each joint with jointing method followed.
v Route marker and joint maker with respect to permanent land marks available at site.
vi Wherever the previously laid cable is cut and additional joints are introduced etc., the cable records shall suitably be amended.

13. FIRE SURVIVAL ARMOURED CABLE

As per IEC standard recommend the following special guidelines, in conjunction with the standard installation instructions.

- The LSZH cable must be stored in proper packed condition, in the shade. Direct exposure to sun must be avoided.
- As LSZH sheaths have lower tear strength property when compared to PVC and PE sheaths, special care must be taken during installation to avoid any damage. Even a small cut on the LSZH sheath could result in the sheath splitting.
- Use pay-in rollers and corner rollers of non- metallic material (Nylon or Teflon) at least every 4 meters when laying the cable.
- Where possible installation must be under cover or indoors. Where outdoor installation is unavoidable, direct exposure to sunlight must be avoided by using suitable cable trays with suitable covers.
- The cables must not come into contact with hot surfaces.
- The installation bending radius must not be less than that stated on the cable data sheet. (Care must be taken, particularly if cable is installed by the flaking method, that this minimum bending radius is not compromised).
- Any clamping device must not be applied directly on to the outer sheath. There must be some form of cushion (for instance a rubber pad of approximately 3 mm thickness) between the cable's outer sheath and the clamps.
- The distance of unsupported length of cable for horizontal and vertical run must not exceed as defined parameters.

VI. EARTHING

1. DESCRIPTION OF WORK

The non-current carrying metal parts of electrical installation shall be earthed properly. All metalic structure, enclosures, junction boxes, outlet boxes, cabinets, machine frame, portable equipments, metal conduits, trunking, cable armour, switchgear and all other parts made of metal in close proximity with electrical circuits shall be bonded together and connected by means of specified earthing conductors to an efficient earthing system. Every item of equipment served by the electrical system shall be bonded to earthing system.

2. CODES AND STANDARDS AND APPLICABLE PUBLICATION

a) Indian Electricity Rules, 1956
b) IS : 3043 : Earthing

3. SUBMITTALS

3.1 Drawing Data

- Earthing pits layout along with earthing tape routing etc.
- Block Diagram for earthing showing all earthing pits and their coneections.

3.2 Tests & Test Reports

a) Test results of all Earthing pit test carried out at site with multiple electrode testing procedure.

4. SPECIFICATIONS

4.1 EARTHING CONDUCTORS

G.I. earthing system shall be provided except for neutral earthing of transformers and DG sets for which Cu earthing system shall be provided. All the bus ducts / cable trays shall be provided with suitable size of 2 nos. G.I. strips in the full length. All electrical equipment shall be earthed with 2 nos. G.I. strips / wires.

4.2 The resistance to each earthing system shall not exceed 1.0 ohm.

4.3 EARTHING STATION

4.3.1 PLATE ELECTRODE EARTHING

Earthing electrode shall consist of a **G.I.** plate of dimensions 600 mm x 600 mm x 6.3 mm thick or Copper plate of 600 mm X 600 mm X 3 mm as called for in the Bill of Quantity. The plate electrode shall be buried as far as practicable below permanent moisture level but in any case not less than 3 meters below ground level. Wherever possible, earth electrode shall be located as near the water tap, water drain or a down take pipe as possible. Earth electrode shall be kept clear of the building foundations and in no case shall it be nearer than 2 meters from the outer surface of the wall.

4.3.2 CONNECTION OF EARTHING CONDUCTORS

Main earthing conductor shall be taken from the earth connections at the main distribution panel to the main L.T. panel with which the connection is to be made. For distribution boards, earthing conductors shall run from main distribution boards. Circuit earthing conductor shall run from the exposed metal of equipment and shall be connected to any point on the main earthing conductor, or its distribution boards or to an earth leakage circuit breaker. Metal conduits, cable sheathing and armouring shall be earthed at the ends adjacent to switch boards at which they originate, or otherwise at the commencement of the run by an earthing conductor in effective electrical contact with cable sheathing. Where equipment is connected by flexible cord, all exposed metal parts of equipment shall be earthed with 2 no. G.I. strips / wires and non current carrying metallic parts with, 1 no. G.I. strips / wires.

Neutral conductor, sprinkler pipes, or pipes conveying gas, water or inflammable liquid, structural steel work, metallic enclosures cables and conductors, metallic conduits and lightning protection system conductors shall not be used as a means of earthing an installation or even as a link in earthing system. The Electrical resistance of metallic enclosures for cables and conductors measured between earth connections at the main switch boards and any other point on the completed installation shall be low

enough to permit the passage of current necessary to operate circuit breakers and shall not exceed 1 OHM.

4.3.3 EARTH CONNECTIONS

All metal clad switches and other equipment carrying single phase circuit, shall be connected to earth by a single connection. All metal clad switches carrying 3 phase shall be connected with earth by two separate and distinct connections. The earthing conductor inside the building wherever exposed shall be properly protected from mechanical injury by running the same in GI pipe of adequate size. The earthing conductor shall be painted to protect it against corrosion. Earthing conductor outside the building shall be laid 600 mm below finished ground level. The over lapping in **G.I.** strips in joints shall be welded. Lugs of adequate capacity and size shall be used for all termination of conductor wires. Lugs shall be bolted to the equipment body to be earthed after the metal is cleaned of paint and other oily substance and properly tinned.

4.3.4 PROTECTION FROM CORROSION

Connection between copper and galavanised equipment shall be made on vertical face and protected with paint and grease. Galvanised fixing clamps shall not be used for fixing earth conductors. Only copper fixing clamp shall be used for fixing earth conductors. When there is evidence that the soil is aggresive to copper, buried earthing conductors shall be protected by suitable serving and sheathing.

4.3.5 ARTIFICIAL TREATMENT OF SOIL

If the earth resistance is too high and the multiple electrode earthing does not give adequate low resistance to earth, as specified in Clause no. 4.3.2 then the soil resistivity immediately surrounding the earth electrodes shall be reduced by adding sodium chloride, Calcium chloride, sodium carbonate, copper sulphate, salt and soft coke or charcoal in suitable proportions.

4.3.6 RESISTANCE TO EARTH

No earth electrode shall have a greater ohmic resistance than 3 ohms as measured by an approved earth testing apparatus. In rocky soil the resistance may be upto 5 ohms. The electrical resistance measured between earth connection at the main switchboard and any other point on the completed installation shall be low enough to permit the passage of current necessary to operate circuit breakers, and shall not exceed 1 ohm.

5. INSTALLATION

5.1 The earth plate shall be set vertically and surrounded with 150 mm thick layer of charcoal dust and salt mixture. A 20 mm dia GI pipe shall run from the top edge of the plate to the ground level. The top of the pipe shall be provided with a funnel and a mesh for watering the earth through the pipe. The funnel over the GI pipe shall be housed in a masonry chamber approximately 300 mm x 300 mm x 300 mm deep. The masonry chamber shall be provided with a cast iron cover resting over a CI frame. Test facility shall be provided with test links for the earthing station.

6. TESTING & COMMISSIONING

6.1 Testing Of Earth Continuity Path

The earth continuity conductor including metal conduits and metallic envelopes of cable in all cases shall

be tested for electric continuity and the electrical resistance of the same alongwith the earthing lead but excluding any added resistance of earth leakage circuit breaker measured from the connection with the earth electrode to any point in the earth continuity conductor in the completed installation shall not exceed one ohm.

6.2 Earth Resistivity Test

Earth resistivity test shall be carried out in accordance with IS Code of Practice for earthing IS 3043.

VII. CONDUITING AND WIRING

1. GENERAL

The system of wiring shall consist of single-core/multi-core PVC insulated Copper conductor wires in Metallic/PVC conduits concealed/exposed or Raceways as called for.

2 STANDARDS AND CODES

Updated and current Indian Standard Specifications and Codes of Practice as stipulated below shall apply to the equipments and the work covered in this section. In addition the relevant clauses of the Indian Electricity Act 1910, Indian Electricity Rules 1956, National Building Code 2005, National Electric Code 1985, Code of Practice for Fire Safety of Building (general) : General Principal and Fire Grading – IS 1641 and IEE wiring regulation 16th edition as amended upto date shall also apply. Wherever appropriate Indian Standards are not available, relevant British and/or IEC Standards shall be applicable.

660/1100 V grade FR PVC insulated wires.	IS 694 : 1990
PVC Conduits	IS 2509, 3419, 6946
Accessories for rigid steel conduits	IS 3837 : 1990
Flexible steel conduits for electrical wiring	IS 3480 : 1990
Switch socket outlets	IS 4615 : 1990
3 pin plugs and socket outlets upto 250 volts	IS 1293 : 1988
Glossary of items for electrical cables and conductors	IS 1885 : 1971
Conductors for insulated electric cable	IS 8130 : 1984
General and safety requirements for fluorescent lamps luminaries	IS 1913 : 1978
Switches for domestic and similar purposes	IS 3854 : 1997
Boxes for the enclosure of electrical accessories	IS 5133 : Parts I &II 1969
Danger notice plates	IS 2551 : 1982
Code of practice for personal hazard fire safety of buildings	IS 1644: 1998
Code of practice for electrical installation fire safety of buildings	IS 1646 : 1997
Code of practice for electrical wiring installations	IS 732 : 1989
Code of practice of fire safety buildings (General- Electrical installations)	IS 1646 : 1982

Guide for safety procedure and practices in electrical works IS 5216 : 1982

3. CHECKING OF DRAWINGS

Before commencing the conduiting work, the Contractor shall carefully examine the drawings indicating the layout of conduits, check the number and size of conduits with respect to number of wires , location of junction boxes, sizes and location of switch boxes and other relevant details. Any changes suggested by the Contractor shall be got approved from the Consultants before the actual laying of conduits. Any discrepancy found in the drawings shall be brought to the notice of the Architects/ Consultants promptly before execution of the work.

4. MATERIAL

4.1 Load Balancing

The Contractor shall plan the load balancing of circuits in 3 phase installation and get the same approved by Project Manager before commencement of the work.

4.2 Colour Code of Conductors

Colour code for normal supply – Red, Yellow, Blue for three Phases, Black for Neutral and Green for Earth – shall be maintained for the electrical wiring installation

Colour code for UPS supply – Red/white, Yellow/white, Blue/white for three Phases, white for Neutral and Green for Earth

4.3 Insulation Resistance Test

The insulation resistance shall be measured between earth and the whole system conductors, or any section thereof with all protection in place and all switches closed and except in concentric wiring all lamps in position of both poles of the installation otherwise electrically connected together, a direct current pressure of not less than twice the working pressure provided that it does not exceed 1100 volts for LT circuits. Where the supply is derived from AC three phase system, the neutral pole of which is connected to earth, either direct or through added resistance, pressure shall be deemed to be that which is maintained between the phase conductor and the neutral. The insulation resistance measured as above shall not be less than 50 megohms divided by the number of points provided on the circuit the whole installation shall not have an insulation resistance lower than one megohm.

The insulation resistance shall also be measured between all conductors connected to one phase

conductor of the supply and shall be carried out after removing all metallic connections between he two poles of the installation and in those circumstances the insulation shall not be less than that specified above.

The insulation resistance between the frame work of housing of power appliances and all live parts of each appliance shall not be less than that specified in the relevant Standard specification or where there is no such specification, shall not be less than half a megohm or when PVC insulated cables are used for wiring 12.5 megohms divided by the number of outlets. Where a whole installation is being tested a lower value than that given by the above formula subject to a minimum of 1 Megohms is acceptable.

4.4 Testing Of Earth Continuity Path

The earth continuity conductor including metal conduits and metallic envelopes of cable in all cases shall be tested for electric continuity and the electrical resistance of the same alongwith the earthing lead but excluding any added resistance of earth leakage circuit breaker measured from the connection with the earth electrode to any point in the earth continuity conductor in the completed installation shall not exceed one ohm.

4.5 Testing Of Polarity Of Non-Linked Single Pole Switches

In a two wire installation a test shall be made to verify that all non-linked single pole switches have been connected to the same conductor throughout, and such conductor shall be labeled or marked for connection to an outer or phase conductor or to the non-earthed conductor of the supply. In the three of four wire installation, a test shall be made to verify that every non-linked single pole switch is fitted to one of the outer or phase conductor of the supply. The entire electrical installation shall be subject to the final acceptance of the Project Manager as well as the local authorities.

4.6 Earth Resistivity Test

Earth resistivity test shall be carried out in accordance with IS Code of Practice for earthing IS 3043.

4.7 Performance

Should the above tests not comply with the limits and requirements as above the contractor shall rectify the faults until the required results are obtained. The contractor shall be responsible for providing the necessary instruments and subsidiary earths for carrying out the tests. The above tests are to be carried out by the contractor without any extra charge.

4.8 Tests And Test Reports

The Contractor shall furnish test reports and preliminary drawings for the equipment to the Project Manager for approval before commencing supply of the equipment. The Contractor should intimate with the tender the equipment intended to be supplied with its technical particulars. Any test certificates etc., required by the local Inspectors or any other Authorities would be supplied by the Contractor without any extra charge. All test reports shall be approved by the Project Manager prior to energizing of installation.

VIII. MCB DISTRIBUTION BOARDS (SUB DISTRIBUTION BOARDS)

1. DESCRIPTION OF WORK

This section covers specification of Distribution Boards (DBs) suitable for operation on 415 V 3 Phase 4 wire 50 Hz supply feeding final lighting and power sub circuits.

2. APPLICABLE CODES, STANDARDS AND APPLICABLE PUBLICATIONS

Updated and current Indian Standard Specifications and Codes of Practice will apply to the equipment and the work covered by the scope of this contract. In addition the relevant clauses of the Indian Electricity Act, Indian Electricity Rules, National Building Code 2016, National Electric Code, Code of Practice for Fire Safety of Building (general): General Principal and Fire Grading – IS 1641 as amended upto date shall also apply. Wherever appropriate Indian Standards are not available, relevant British and/or IEC Standards shall be applicable.

Miniature Air Circuit Breakers for AC circuits	IS 8828 : 1996 and IEC 947
Residual current operated Circuit Breakers	IS 12640 : 1988
Low voltage switchgear and controlgear Part II	IS 13947 : 1993
Degrees of Protection provided by enclosures for low voltage switchgear	IS 2147 : 1962
Code of Practice for installation and maintenance of switchgear not exceeding 1000 volts	IS 10118 : 1982
General requirements for switchgear and controlgear for voltages not exceeding 1000 volts	IS 4237 : 1982

3. SUBMITTALS

3.1 Drawings and Data

The following minimum information shall be furnished with the Shop Drawings :-

(a) Overall dimensions showing front view, plan, elevation and cross section.
(b) Complete bill of material module wise.
(c). Complete one line diagram.

3.2 INSTRUCTION MANUALS

Contractor shall furnish 6 copies of instruction manual which shall contain detailed instruction for installation, testing, commissioning, operation and maintenance requirements.

4. SPECIFICATION

4.1 General

a) Distribution Boards shall be suitable for operation on 3 phase/single phase 415/230 Volts, 50 Hz neutral grounded at Transformer.

a) The Distribution Boards shall comply with the relevant Indian Standards and Indian Electricity Rules and Regulations.

4.2 MINIATURE CIRCUIT BREAKERS

The MCB's shall be of the completely moulded design suitable for operation at 240/415 Volts 50 Hz system. The MCB's shall have a rupturing capacity of 10 KA Ics. The MCB's shall have inverse time delayed thermal overload and instantaneous magnetic short circuit protection. The MCB time current characteristic shall coordinate with PVC cable characteristic. Watt loss per pole of MCB shall confirm to value specified in IS 8828 – 1996. Type test certificates from independent authorities shall be submitted with the tender.

4.3 RESIDUAL CURRENT CIRCUIT BREAKERS (RCCB)

RCCBs shall comply to IS 12640 –1988 and shall be of the current operated type. The RCCB shall be designed to trip within 20 mili sec at a current sensitivity of 30mA/ 100 mA/ 300mA as specified. The RCCB shall be of 2 pole construction for single phase and 4 pole construction for 3 phase. All RCCB shall be complete with test buttons. RCCB shall have a minimum life expectancy of 20,000 operations.

4.4 DISTRIBUTION BOARDS

- DBs shall be wall mounting, recessed/surfaced type, totally enclosed, dust and vermin proof and shall comprise of miniature circuit breakers, earth leakage circuit breakers, busbars, neutral link etc as required, of ratings detailed in the schedule of quantities.

- DBs shall be double door type access to the wiring shall not be possible with opening of the outer hinged cover. A cover shall be provided inside the DB to protect all live parts. Only the operating handle/knobs shall project outside the cover plate. The door shall be earthed with insulated copper braded flexible wires.

- Components forming a part of the DBs shall comply to the relevant Standards and Codes of the Bureau of Indian Standards.

- DBs shall be fabricated from minimum 18 gauge CRCA sheet steel and shall have a hinged lockable spring loaded cover. All cutouts and covers shall be provided with synthetic rubber gaskets. The entire construction shall give a IP 54/55 degree of protection unless otherwise stated.

- The bus-bar shall be of electrical grade copper having a maximum current density of 1.6 ampere per square mm and PVC insulated throughout the length. The minimum spacing between phases shall be 25 mm and between phase and earth 19 mm
- Separate neutral link for each phase shall be provided.

- All the internal connections shall be with either solid copper PVC insulated or copper conductor FRLS PVC insulated wires of adequate rating.

- All the internal connections shall be concealed by providing a hinged protective panel to avoid accidental contact with live points.

- All outgoing equipment shall be connected direct to the bus bar on the live side. The equipment shall be mounted on a frame work for easy removal and maintenance.

- The sheet steel work shall undergo a rigorous rust proofing process, two coats of filler oxide primer and final powder coated paint finish.

- All the circuits shall have an independent neutral insulated wire, one per circuit, and shall be numbered and marked as required by the Project Manager.

- A sample of the completed board is to be got approved by the Project Manager before commencement of supply and erection.

- Before commissioning, the distribution boards shall be megger tested for insulation and earth continuity.

The following colour coding shall be used for identification of the busbars and wiring as per IS 5578:1984.

Red phase - Red
Yellow phase - Yellow
Blue phase - Blue
Neutral – Black
Earthing - Green
Control wiring - Grey

The incoming and outgoing terminals shall be suitable for the termination of cables as required.

All terminals, bus bars shall be insulated and shrouded to avoid accidental contact.

All metal parts shall be adequately earthed. An earth bus of tinned copper shall be provided of adequate section and length to accommodate all circuits

4.5 SHEET STEEL TREATMENT AND PAINTING

- Sheet steel used in the fabrication of DBs shall undergo a rigorous cleaning and surface treatment seven tank process comprising of alkaline degreasing, descaling in dilute sulphuric acid and a recognised phosphating process after which a coat of primer paint compactively with the final paint shall be applied over the treated surface. Final paint coat of oven baked powder coating, of minimum 50 micron thickness, of sheet approved by Project Manager shall then be provided.

- All sheet steel shall after metal treatment be given powder coated finish painted with two coats of shade 692 to IS 5 on the outside and white on the inside. Each coat of paint shall be properly stoved and the paint thickness shall not be less than 50 microns.

4.6 NAME PLATES AND LABELS

- Suitable engraved white on black name plates and identification labels of metal for all Switchboards and Circuits shall be provided. These shall indicate the feeder number and feeder designation.

5. TYPE TEST

Type test certificates as per IS 8623 shall be submitted.

The Fire alarm system consists of the following elements:

Addressable Photo-Electric cum Thermal Detectors for areas like all Clinical room, admin area, multipurpose hall, table-tennis hall, Training hall, Centre of Excellence, Wet chaining area, Shooting range, Combat Sports hall, Goal Ball hall, Boccia, Lounge, Swimming Pool Area enclosed areas, Equipment Rental, Store, Fitness court and above false ceiling Electric Rooms, Telecom Room, BMS Control Room, Fire Control Room, Pump Rooms, Transformer Rooms, HT Panel Rooms and Lift head Rooms and all areas of Indoor Sports complex along with Heightedareas.

Addressable Thermal Detectors to detect unusual rate of rise of temperature for Kitchen and Pantries.

Addressable Manual Call Points are proposed to be installed at each Fire Exit Staircase on each floor.

Addressable Monitor Module shall be provided in suitable location for the purpose of providing location address for flow switch and valves with tamper switches.

Addressable Output Modules shall be provided in suitable location for the purpose of shutting off Fire Dampers on detection of smoke within its zone and for increasing the speed of exhaust / ventilation fans.

Addressable Very Early Warning Detection system (VESDA) along with all necessary required equipments such as CPVC pipes, Sampling capillary tubes, power supply, End caps etc.

PREAMBLE OF BILL OF QUANTITIES

1. The conditions of contract and the drawings shall be read in conjunction with the specifications and matters referred to, shown or described in one are not necessarily repeated in the other. These specifications are comprehensive but may exceed the requirements of this project. Any ambiguity between the General Specifications, the Bill of quantities and contract drawings, shall be referred to the Respective Contact Person mentioned in the NIT for clarification not later than 5 days before the date fixed for delivery of Tenders. Any ambiguity found after signing of the contract may be referred to the Project Manager and Project Manager shall give a ruling, which shall prevail. No claim for additional cost due to above, however, will be entertained.
2. Notwithstanding the sub-division of the specification into various headings, every part of it is to be deemed supplementary to every other part and is to be read with it, so far as it may be practicable so to do, or when the context so admits.
3. In this contract, reference is made to the Indian Standards or latest CPWD specification as approved by Project Manager and these references shall be deemed to include the latest editions or issue of standards, specifications or Bye-Laws including all revisions up to the date of invitation of Tenders. The contractor shall ensure that all materials and workmanship as far as they apply to this contract shall comply in every specifications or any other equivalent or specification approved by the Project Manager.
4. The Contractor shall keep at site copies of all relevant standards and codes of practice referred in these specifications throughout the period of contract. These shall be the latest editions and shall include all revisions/addendums thereof.

5. All items or materials shall be delivered to the site in the manufacturers original unopened containers with the manufacturers brand and name clearly marked on.
6. All items or materials shall be assembled, mixed, fixed, applied or otherwise incorporated in the works in accordance with the printed instructions of the manufacturer of the item or materials.
7. The quoted rate for each item of work shall include for the following irrespective whether it has been mentioned or not in the description of the item without any extra cost
8. If, the basic rate of some materials is given in schedule of quantities for respective items. The difference in basic rate after approval of samples shall be adjusted accordingly. The base rate of any material mentioned in the schedule of quantities is exclusive of Sales tax / VAT / GST (whichever is applicable) and cartage thereon unless specified otherwise in the item.

9. Unless otherwise provided in the description of various items of the work, the rates tendered by the contractor shall be for complete items of work covering all materials, labour , carriage, royalties, fees, rents, Taxes, wastage, scaffolding, ladders, temporary support, tools, plant, equipments, transport, electricity/ water, temporary constructions, overhead charges and profits as well as well as general liabilities, obligations and risk arising out of the conditions of contract and carrying the work in parts or under/ across/ along pipes, cables drains etc. complete and shall apply to all heights, depths, leads and lifts. No extra charges whatsoever consequent on any misunderstanding or otherwise shall be allowed.
10. All items to be installed/provided in position.
11. The quoted price for items shall include all accessories, consumables, spares etc, as required to make the item complete in all respects, compatible with other related/associated items and fully functional.
12. Loading, transporting, unloading, handling/ double handling, hoisting to all levels, setting, fitting and fixing in position, protecting, disposal of debris and other labour necessary in and for the full and entire execution and to fully complete the job in accordance with the contract documents, good practice and recognized principles shall be responsibility of the contractor.
13. The contractor shall remove all surplus materials/ debris/ waste materials etc. and clean the areas periodically while working and after completion.
14. Any sub-standard materials used during execution will be rejected and the Contractor shall replace the same to the entire satisfaction or the Architects at his own cost.
15. The contractor is required to fabricate one or more samples / mock ups of each items as instructed for approval. Any minor changes in the samples or to the specifications as mentioned in the tender shall not be deducted or paid extra. The bulk production of any item can only be taken in hand after the final approval of sample of each item. The sample of each item must be got approved within two weeks of the date of order/ commencement or as per agreed construction schedule. It shall be the responsibility of the contractor entirely to get the sample approved by the Architect / Consultant at the earliest and no extension of time shall be granted for getting the late approval of the samples.
16. Any damage caused to the existing and/ or work in hand during executing the work including that being done by other contractor's while executing the works, shall be made good by the contractor at his own cost.
17. Contractor, whenever asked, shall submit basic unit rates including their original invoices for all constituent materials of a particular item. These rates shall be for analysis of substituted items in case of additions or deductions or to establish their meeting with the desired specifications etc.

18. The Quantities of items given in the schedule of quantities are provisional. The Contractor shall be paid for the actual quantity of work measured at the site at the rates agreed. The Owner reserves the right to increase or decrease any of the quantities or to omit totally any item of work through their Consultants. Any claim by the Contractor on these accounts will not be entertained.
19. All the items of work given in the schedule of quantities shall be executed strictly in accordance with the relevant drawings and specifications.
20. Any error in description of quantity or omission of items from this Schedule shall not vitiate this Contract but shall be the corrected and deemed to be a variation required by the Owner.
21. The specification for items not covered in this specification schedule of quantity, specified standards and rules shall be followed as per IS Specifications / Architects / Consultant instructions.

ELECTRICAL- LIST OF APPROVED MAKES

S.No.	Details Of Equipment And Materials	Manufacturer's Name
1.	MS Conduit (ISI marked) and accessories	BEC / AKG / VIMCO / POLYCAB
2.	PVC / XLPE insulated aluminium / Copper conductor armoured/ Unarmoured MV Cables upto 1100V	Havells / Finolex / KEI / Polycab / RR Kabel / Glostar
3.	FRLS PVC insulated copper conducto stranded flexible wires i/c control Cables	Havells / Finolex / KEI / RR kabel / Polycab / Gloster
4.	Cat-6A/Fibre optic Cable accessories for LAN & Telephone	Commscope/ Systimex/ P anduit / Legrand
5.	Cable Glands, Lugs, Thimble	Comet / Jainsons / Braco / Dowell / Multi
6.	Protection Device (MCB/RCCB/DB) MCB should 10KA "C" Curve	Siemens (Betagard) / Schneider (Acti9) / Legrand (DX 3)/ L&T (AU)

7.	MCCBs	Siemens 3VA/Legrand DPX/Schneider –NSX/L&T D- SINE
8.	Power contactor	Siemens (Sicop), / L&T (MNX) / Schneider (Tesys) / Legrand (CTX 3)
9.	Main LT panel (Design Verified Panels) as per IS/IEC 61439	Siemens(Sivacon S8)/ Schneider(Blokset)/ L&T(T ERA)/ ABB(R2K)/Legrand(XL3)
10.	Indoor LED Lighting Fixture	Philips / Trilux/Lighting Technologies/Wipro
11.	Outdoor LED Light fixture	Philips / Trilux/Lighting Technologies/Wipro
12.	LED chip	Cree / Nichia / Osram / Lumileds/Citizen/Bridgelux
13.	Decorative & Signage LED	Decon / Bajaj / Prolite
14.	External Lighting Fixture	Philips / Trilux / Shreder/Lighting Technologies/Wipro
15.	Ceiling Fan – 5 star & BLDC/Exhaust fan	Bajaj / Havells / Usha/ Crompton/Atomberg
16.	Paint	Nerolac / Asian / Berger
17.	G.I. Pipe	Tata / Jindal (Hisar) / Surya Prakash
18.	Digital Meters	L&T/ Secure/ Conzerv/ Neptune
19.	Terminal Blocks/ Cage Clamp/ Connectors	Wago& controls/ Weidmuller/ phoenix contacts
20.	Stainless Steel wire mesh Cable Trays (Factory Fabricated) / Overhead & Floor Raceways alongwith its hanging Arrangements	Legrand/ MK/OBO Betterman

	& related accessories.	
21.	DWC-HDPE underground cable duct / Pipe	Supreme / Duraline / REX
22.	Insulating Mats	DL Miller & Co. Ltd. / Premier Polyfilm Ltd. / RMG Polyvinyl India Ltd/ Jyoti
23.	Sealing Compound	Hilti / 3M / m-seal
24.	DALI Server, Controller, Keypads & other components	Lutron / ABB / Legrand - Vantage/Philips
25.	Modular type Switches & Sockets Telephone outlets & accessories	LEGRAND- ARTEOR / SCHNEIDER- UNICA / MK – ELEMENTS
26.	External Lighting Pole/High Mast	Bajaj / Volmount/ Transrail
27.	DLP Trunking alongwith its installation arrangements & related accessories.	MK / LEGRAND/Panduit/OBO
28.	Ceiling Roses	Any ISI marked
29.	Contactors/ Relay/ Digital Timer	Schneider/L&T/Legrand /SIEMENS/ABB
30.	Chemical earthing	OBO / Universal / Earthplus
31.	Fire Safety Signage's	Prolite / Cooper / Plutron / Autoglow
32.	All other Items not covered above	As per Approval of Engineer In Charge.

FIRE ALARM AND DIGITAL PA SYSTEM - LIST OF APPROVED MAKES

S.No.	Details Of Equipment And Materials	Manufacturer's Name
1.	Addressable Optical Smoke Detectors	Notifier/Bosch UL/ Simplex
2.	Addressable Thermal Detectors	Notifier/Bosch UL/ Simplex
3.	Addressable Multi Criteria Photo Electric Smoke cum Heat Detectors / Addressable Very Early Warning detector (VESDA)	Notifier/Bosch UL/ Simplex
4.	Addressable Manual call Box.	Notifier/Bosch UL/ Simplex
5.	Duct Detectors	Notifier/Bosch UL/ Simplex
6.	Intelligent Addressable Main Fire Alarm Control Panel with ba ttery charger and Repeater Panels	Notifier/Bosch UL/ Simplex
7.	Addressable Input Module	Notifier/Bosch UL/ Simplex
8.	Addressable Output Module	Notifier/Bosch UL/ Simplex
9.	Addressable Photo electric Smoke Detectors with Sound Base	Notifier/Bosch UL/ Simplex
10.	Addressable Fault Isolator	Notifier/Bosch UL/ Simplex
11.	Sounders / Sounder with Strobe / Strobe/Directional Sounders	Honeywell / System sensor//Bosch UL/ Simplex Technologies/Wipro

12.	Fire survival cable as per BS 7486	LAPP Kabel / RR Kabel / Belden / Gloster
13.	Fire Extinguishers	Minimax / Cease Safeguard/Omex/Safex
14.	All other items not covered above	As per Approval of Engineer In Charge.
S.No.	**Details Of Equipment And Materials**	**Manufacturer's Name**
15.	Equipment Rack	Rittal/ Valrack/ HCL / Netrack/APC/APW
16.	Speaker cable	Krammer/ Klotz / Beldon
17.	Shielded data cable 6A Cat	Commscope/ Legrand/ Panduit/ Systimax
18.	Ceiling speaker	Honeywell/ Electrovoice / BeyerDynamic / D&BAudio Technik
19.	Horn Speaker	Honeywell/ Electrovoice / BeyerDynamic / D&BAudio Technik
20.	Digital Amplifier	Honeywell / Electro voice-Bosch / BeyerDynamic / D&B Audio Technik / Martin Audio
21.	Digital PA system 08 zone controller	Honeywell X618 / Bosch Prascedio / BeyerDynamic / D&B Audio Technik / Martin Audio
22.	3core 1.5 sq mm power cable	Finolex/ Polycab/ Belden / Lapp Cable/R RKable
23.	All other items not covered above	As per Approval of Engineer In Charge.

LIST OF APPROVED MAKES

S.No.	Details Of Equipment And Materials	Manufacturer's Name
1.	33 or 11 KV VCB Panel	Siemens(8BK80) / ABB(UniGear) / Schneider Electric(PIX)/Legrand
2.	Oil Type Transformer	ABB / Schneider Electric / Siemens/Voltamp / Kirloskar /Crompton
3.	33 or 11 KV H.T. Cable	Universal (Satna)/ Cable Corporation of India /Finolex / Gloster
4.	33 or 11 KV H.T. Cable Jointing Kits	Raychem / 3M / Xicon
5.	Air Circuit Breakers	Siemens (3WL) / L&T (U Power) / Schneider Electric (Masterpact) /)/Legrand(DMX3)
6.	Moulded Case Circuit Breakers	Siemens (3VA) /L&T(DSine) / Schnei der Electric(Compact NSX)/Legrand(DPX3)
7.	MCBs/RCCB/SPD/ELCB	Legrand(DX3) / Siemens(Betagard) / Schneider(Acti9) / L&T(AU)
8.	Selector Switches	Switron / BCH / L & T/ABB / Siemens/ Schneider
9.	Contactors	Siemens(Sicop))/L&T(MNX)/Schneider(Tesys)/Legrand (CTX 3)
10.	Multifunction Meter	Conzerv/ABB/Siemens/ Schneider Electric/ Krykard/Enercon/ Neptune/Legrand
11.	Digital Panel Meters	Conzerv / Siemens/ Schneider Electric/ Krykard /Enercon/Neptune Technologies/Wipro
12.	Indicating Lamps (LED type)	Siemens / Schneider / L &T/ABB

13.	Push Buttons	Siemens / Teknic / GE / C & S/ Schneider /L&T
14.	M.V. Power Capacitors / Harmonic Block Reactor	Malde(Momaya) / Schneider /Universal / Neptune/ L&T
15.	Connectors/ Terminal Blocks	Elmex / Connectwell / Essen/ Schneider /L&T
16.	Main LT panel (Design Verified Panels) as per IS/IEC 61439	Siemens(SivaconS8) / Schneider(Blokset) /L&T(T ERA)/ ABB(R2K)/Legrand(XL3)
17.	Capacitor Panel/Feeder pillar/Non design verified panels	Advance Panel and Switchgears pvt ltd/ Tricolite Electrical Industries (pvt) ltd / AdlecMundka/ASPL /BSPL,Bhopal / Pristine/Universal Transformers
18.	Lead Acid Battery	Exide (Powersafe) /Global Yuasa / Amar raja
19.	Insulation Mats	ISI marked
20.	Numerical Relays	Schneider Electric/ABB/Seimens
21.	APFC Relay	L&T / Enercon / Neptune Ducati/Bel uk/ Schneider/Legrand
22.	TVSS	Emerson / Indelec / Tarcel/ Schneider / Legrand
23.	Compact Busbar Trunking	Schneider / Seimens / Legrand
24.	Chemical earthing	OBO / Universal / Earthplus
25.	All other Items not covered above	As per Approval of Engineer In Charge.

PROJECT- SHRI GURU GOVIND SINGH COLLEGE OF COMMERCE, PITAMPURA
FIRE FIGHTING TECHNICAL SPECIFICATION

I) TECHNICAL SPECIFICATIONS:

1.0 SCOPE OF WORK:

1.1 Work under this section shall consist of furnishing all labour, materials, equipment and appliances necessary and required to completely install electrically operated and diesel driven fire pumps, wet riser, fire hydrant system/fire extinguishing as required by the drawings and specified hereinafter or given in the Bill of Quantities.

1.2 Without restricting to the generality of the foregoing, the work shall include but not limited to the following:-

2.0 PIPES AND FITTINGS

Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required.

Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages, etc.

Pipes shall be secured properly to walls and ceilings by suitable clamps at intervals specified. Only approved type of anchor fasteners shall be used for RCC ceilings and walls. Proper care shall be taken that drilling not to be done in the RCC ceiling of PT slab wherever marking done by civil agency.

Pipe Dia (mm)	Hanger Rod Dia (mm)	Spacing between Supports (m)	Length of Anchor Fasteners
Up to 25	10	2	80 mm
32 to 50	10	2.5	80 mm
65 to 80	10	2.5	100 mm
80 to 100	13	2.5	120 mm
125 to 150	13	3	120 mm
200 to 300	16	3.5	150 mm

All pipes within the building in exposed locations and shafts including connections buried under floor shall be M.S. ERW tubes conforming to IS-1239 up to 150 mm dia / IS-3589 for 200 mm dia and above (Minimum 6 mm thick) with welded joints for 50 mm dia and above and for 40 mm and below shall be socket welded. Factory Manufactured fittings shall be used for all sizes. Alternatively pipes with 40 mm and below shall be fitted with threaded joints.

Fittings shall be approved type Seamless fittings with tapered groove for welded joints. Fabricated fittings will not be accepted. For Fittings of 40 mm & Below Forged Steel Fittings shall be used.

JOINTING-

This covers the welding of systems. Deviations from applicable codes, approved procedures and approved shop drawings shall not be permitted. Materials or components with welds made off site shall not be accepted if the welding does not conform to the requirements of this specification. Develop and qualify procedures for welding metals included in the work. Certification testing shall be performed by an approved independent testing laboratory. Contractor shall bear costs of such testing.

Certified welders, for 6G position previously certified by test, may be accepted for the work without re-certification provided that all of the following conditions are fulfilled:

- Submit copies of welder certification test records.
- Testing was performed by an independent testing laboratory.
- The welding procedures and welders are certified and base materials, filler materials, electrodes, equipment, and processes conform to the applicable requirements of this specification.
- Certification has been within a one (1) year period from the start of the project.

Filler metals, electrodes, fluxes and other welding materials shall be delivered to the site in manufacturers' original packages and stored in a dry space until used. Packages shall be properly labeled and designed to give maximum protection from moisture and to assure safe handling.

Submit certificates of electrodes for review. Each welder assigned to work covered by this specification shall be certified by performance tests using equipment, positions, procedures, base metals, and electrodes or bare filler wires.

Before assigning welders to the work, provide the architect with their names, together with certification that each individual is certified as specified by engineer in-charge. No welding work shall start prior to submissions. The certification shall state the type of welding and positions for which each is certified, the code and procedure under which each is certified, date certified, and the firm and individual certifying the certified tests.

Each welder shall be assigned an identifying number, letter, or symbol that shall be used to identify his welds. A list of the welders' names and symbol for each shall be submitted. To identify welds, either written records indicating the location of welds made by each welder shall be submitted, or each welder shall apply his mark adjacent to his weld using an approved rubber stamp or felt-tipped marker with permanent, weatherproof ink or other approved methods that do not deform the metal. For seam welds, identification marks shall be placed adjacent to the welds at 3 foot intervals. Identification by die stamps or electric etchers shall be confined to the weld reinforcing crown, preferably in the finished crater.

Welding equipment, electrodes, welding wire, and fluxes shall be capable of producing satisfactory welds when used by a certified welder using qualified welding procedures.

EXECUTION

Perform welding in accordance with qualified procedures using certified welders. Welding shall not be done when the quality of the completed weld could be impaired by the prevailing working or weather conditions.

Field bevels and shop bevels shall be by mechanical means i. e. using grinders / cutting machines, not by flame cutting.

The following sizes of electrodes to be used for welding. Root – 2.5 mm dia.

Filler – 3.15 mm dia. Final – 3.15 mm / 4 mm.

Minimum 2.5 mm gas should be maintained with 'V' groove for butt welded joints.

Replace and re inspect defective welds. Repairing defective welds by adding weld material over the defect or by peeling shall not be permitted. Welders responsible for defective welds must be re-certified.

Store electrodes in a dry heated area; keep free of moisture and dampness during fabrication operations. Discard electrodes that have lost part of their coating.

Joints between M.S.pipes of 40 mm and below shall be made by providing socket welded/threaded fittings. Wherever flanges are welded to the M.S pipes the same shall be fastened with standard nut bolts and 3 mm thick neoprene gaskets. All the pipe joints after welding shall be applied with zinc spray to maintain the galvanizing of the pipes.

PIPE PROTECTION-

All Hydrant and Sprinkler exposed pipes shall be painted with one coat of Zinc chromate primer and two coats of synthetic enamel paint of approved shade after completion of hydraulic testing of piping network and approval of EIC. Paint used for this work shall be lead free quality. The cost of painting shall be inclusive in the respective items. All M.S. pipes shall first be cleaned thoroughly before application of primer coat. After application of primer coat, paint shall be applied. Each coat shall be given minimum 24 hours drying time. Wherever required, all pipe headers shall be worded indicating the direction of the pipe and its purpose etc.

Painting shall be expertly applied, the paint shall not over run on surfaces not requiring painting such as walls, surfaces etc. Nuts and bolts shall be painted black, while valves shall be painted blue.

Pipes buried in soil shall be treated by applying one coat of pypkote primer and covered with 4 mm pypkote anticorrosive tape after successful completion of hydraulic testing of piping network**.**

Surface Preparation - The pipe surface shall be cleaned by a wire brush.

Application of Primer - primer is to be applied on pipes immediately after cleaning. This is to prevent any further accumulation of rust on the pipe. This is a cold applied primer and is applied by brush.

Application of 4 mm Tape - After the primer is applied on the pipe, it is allowed to dry for about 30 min. till it becomes touch dry. Before adhering the tape to the pipe, gently heat the primer coated pipe by a run of LPG torch. Remove the bottom polyethylene from the tape & then heat bottom surface of the tape by LPG torch or any heat source & start wrapping the tape to the pipe by heating the primer coated pipe & by removing the bottom polyethylene from the tape before wrapping better adhesion between the tape & pipe is obtained. Overlaps are maintained with a minimum of 12.5 mm. Tape coating of weld joints - The tape is applied over the weld joints after the necessary welding & testing methods of the joints is

completed. The procedure for application of tape shall be the same as bare pipe procedure. Overlaps on each side of the weld joints shall be 50 mm.

Pipe protection test

Holiday test is to be conducted and as per approved procedure established by EIC. The testing to be done with required voltage recommended by manufacturer

3.1 VALVES

BUTTERFLY VALVES OF PN: 16

Butterfly valves of PN 16 rating shall be of cast iron with nylon coated disc black nitrile seat and shaft material SS. Up to 150 mm dia shall be lever operated 200 mm dia and above shall be gear operated.

type, PN 10 with C.I hand wheel etc.

DRAIN VALVES

Gun metal Gate / Ball valve of 15 / 25 / 32 / 40 / 50 dia as per IS; 778 with fittings as required for instruments / draining any water in the system / Risers in low points.

SPRINKLER ALARM VALVES

Each installation shall be provided with a set of installation control valves comprising:-

a. An Alarm Valve.

b. A Water Motor Alarm & Gong.

c. Installation valves shall be installed on the sprinkler circuits.

d. Installation valve shall comprise of a cast iron body with gunmetal trim, and double seated clapper check valves, pressure gauges, test valve and orifice assembly and drain valve with pressure gauges, turbine water gong including all accessories necessary and required and as supplied by original equipment manufacturer and required for full and satisfactory performance of the system. A cast iron isolation valve with lock and chain at the inlet of the installation valve shall be provided.

The Installation valve shall be UL / FM approved.

INSPECTION AND TEST VALVE ASSEMBLY

Inspection and testing of the automatic starting of the sprinkler system shall be done by providing an assembly consisting of gunmetal valves, gunmetal sight glass, bye-pass valve as per approved drawing.

Y type strainer:

Y type strainer shall consist of cast iron body and cover with a removable perforated SS strainer.

Working pressure: 10 kg/CM².
Test pressure: 15 kg/CM²

End connection: Flange type

3.2 PRESSURE GAUGES

Pressure gauge shall be constructed of die cast aluminium and shall be stove enameled. They shall be weather proof with an IP-55 enclosure. They shall be stainless steel bourden type pressure gauges with a scale range from 0 to 21 Kg/cm^2 and shall be constructed as per IS-3624. Pressure gauges shall be 100 mm dia size.

3.3 FLOW SWITCHES

Flow switch shall have a paddle made of flexible and sturdy material of the width to fit within the pipe bore. The terminal box shall be mounted over the paddle/ pipe through a connecting socket. The Switch shall be potential free in either N O or N C position as required. The switch shall be able to trip and make / break contact on the operation of a single sprinkler head. The terminal box shall have connections for wiring to the Annunciation Panel. The flow switch shall have connections for wiring the seat shall be of S.S to the Annunciation Panel. The flow switch shall have IP: 55 protection. The flow switch shall be of UL / FM approved. The detectors of the Flow switch shall have a sensitivity in the range of 4 to 10 GPM flow for activation.

3.4 S.S FLEXIBLE PIPES

S.S Flexible pipes of SS 304 with maximum working pressure of 175psi & testing pressure of 875psi with 0.4mm thickness shall be installed for sprinkler drops. The flexible pipe shall be of UL / FM approved.

3.5 ORIFICE PLATES-

The contractor shall provide orifice plates fabricated from 6 mm thick stainless steel plate to reduce pressure on individual hydrants to restrict the operating pressure to 5.5 Kg./Cm² and allow a discharge of 900 LPM. **The design of the orifice plates shall be given by the contractor as per the location and pressure conditions of each hydrant / hose reel for approval before installation.**

3.6 FLOOR FIRE HYDRANTS-

Hydrants inside the building shall be located on every landing of the floor furnished with required accessories such as hosepipes with instantaneous gunmetal couplings and short pattern branch pipes located in hose cabinets. The hose cabinets shall be of wall/column mounting type, constructed out of 16 gauge M.S. sheets. Contractors shall submit drawing & schedule of items and shall get it approved by EIC prior to delivery.

The internal hydrants (Landing Valves) shall be of double headed type taken out from 150 mm dia riser through suitable tapping. The outlets shall be of gunmetal and confirm to IS-5290. The Hose reels shall be firmly held against the wall by suitable heavy brackets and supports. The hose reel shall be swinging type (180 degrees) and the entire Drum reel etc. shall be as per IS: 3876. The hose tubing shall be of best quality (shut off) and the shut off nozzle shall be 5 mm dia. The equipment shall be out of one of the approved makes only.

3.7 HOSE REEL

Hose reel shall be circular made of Heavy Duty MS swinging type for 180 deg with mounting base plate confirming to IS 884. Hose reel shall consist with 20 mm dia high-pressure rubber braided hose of 36.5 mts length with gunmetal/SS nozzles. Hose reel water shall be tapped off from the wet riser with Ball valve. The hose reel shall be installed in fire hose duct inside the building.

3.8 LANDING HYDRANT VALVE

The landing valve (internal) shall be gunmetal Single headed type conforming to IS: 5290 complete with hand wheel, quick coupling, spring and blank cap. 2 Nos. of RRL type hose pipe of 63mm dia and 15 mts. length as per IS: 636 with 63mm dia instantaneous type Gun metal heavy duty couplings & Gun metal Branch pipe and nozzle to be provided. Fire hoses and branch pipes shall be mounted inside the fire shaft with suitable supports.

3.9 FIRE HOSE

Fire hoses shall be Reinforced Rubber Lined (RRL) type as per IS: 636 & 63 mm dia and 15 mts long. Hoses shall be bounded by M.S wire to heavy-duty instantaneous gunmetal couplings as per IS 903.

3.10 BRANCH PIPE WITH NOZZLE

Branch pipe shall be gunmetal, 63 mm dia with Nozzle of 19 mm dia made as per IS: 903 and suitable fitted with hoses.

3.11 HOSE CABINET

Hose cabinet shall be fabricated by M.S. sheet of 16 swg and size shall be 750mm x 600mm x 250mm. Hose cabinet shall have glass fronted double door fitted with 4mm thick clear glass & powder coated finish of red outside & white inside. Cabinet shall be suitable for stand mounting and shall have built in breakable glass type feature to keep key with locking arrangement and bear the words “Fire Hose Cabinet" in prominent position.

3.12 SHUTTER FOR FIRE SHAFT

Fire shaft shall have shutter fabricated by M.S. sheet of 16 swg with glass-fronted door (glass shall be 4mm thick) and size of the shutter shall be 900mm x 1200mm minimum. The door shall be in two leaves with necessary stiffeners. Shutter shall be powder coated finish of red out side and white inside and on the glass label of “FIRE” shall be stick, the letter size shall be min. 75 mm height. Also there shall be built in breakable glass type feature to keep key.

3.13 SPRINKLER HEADS (STANDARD RESPONSE)

Sprinkler heads shall be provided at approximate spacing so as to cover 12 M^2 per sprinkler head. The spacing shall however be in conformity with the drawings and properly coordinated with electrical fixtures, ventilation ducts and grilles and other services along the ceiling.

Pendent / Upright sprinkler:

Sprinkler shall be UL (Underwriter's Laboratory) approved, thermo-sensitive quartzoid liquid glass-bulb burst actuated type and be standard products from an established firm of repute and standing and approved by an appropriate authority for fire fighting duty. Alternatively sprinkler heads may be side wall type with fusible links for operation. All sprinklers shall be of **Standard Response Type** only.

All Sprinklers shall be brass castings polished / chrome OR white (polyester) unless stated otherwise and rated for 7.0 Kg/CM² WG and factory tested for 15.0 Kg/CM². Sprinklers type and Temperature classification shall be as per the following table. All sprinklers shall be provided with an adjustable OR fixed type Rosettes of approved finish.

Room Type	Temperature Rating	Sprinkler Type (Standard Response)	K factor	Thread size
Corridors	68°C	Pendent	5.6 (80)	15 mm
Pantry	79°C	Pendent	5.6 (80)	15 mm
All other Areas	68°C	Pendent / Up right	5.6 (80)	15 mm

Wherever the specified sprinkler is not adequate, the tenderer may offer appropriate size required. Tenderers are free to suggest alternatively other suitable sprinklers with its justification.

Contractor shall install cabinet fabricated from 16 Gauge M.S. sheets with lockable glass shutters. Shelves for keeping spare sprinklers and standard sprinkler wrench at locations approved by the Engineer-in-Charge and given in the schedule of quantities. The contractor shall also give required tools for removing and fixing of different types of sprinkler free of cost as directed by Engineer-in-Charge.

3.14 AIR VESSEL

The air vessel shall be provided to compensate slight loss of pressure in the system and to provide an air cushion for counter acting pressure, surges, whenever the pumping sets come into operation. Air vessel shall confirm to IS-3844. Air vessel shall be fabricated with minimum of 10 mm thick M.S. plate with dished ends having minimum 12 mm Thk. and suitable supporting legs. It shall be provided with one 25 mm dia connection from pump delivery, one 25 mm drain with valve, one water level gauge and 25 mm sockets for pressure switches. The air vessel shall be tested to 1.5 times of working pressure. The size of the Air Vessel shall be 450 mm dia x 2000 mm height.

4.0 IS CODES FOR DESIGN, MANUFACTURE, ERECTION, TESTING AND TRAIL OPERATION OF PIPING VALVES ETC.:

4.1 The following codes and standards and their subsequent modifications shall apply for the design, manufacture, shop testing, erection, fabrication at site, resting and trial operation of piping, valves and specialties requirements:

4.1.1 IS: 554: Dimensions for pipe threads where pressure tight joints are required on the threads.

4.1.2 IS: 638: Sheet rubber jointing and rubber insertion jointing.

4.1.3 IS: 778: Copper alloy gate, globe and check valve for water work purposes.

4.1.4 IS: 14846: Sluice valves for water –works purposes (50 mm to 1200 mm).

4.1.5 IS: 901: Couplings, double male and double female, instantaneous pattern for firefighting.

4.1.6 IS: 1239: Mild steel tubes, tubulars and other wrought (Part I & II) steel fittings.

4.1.7 IS: 884 : Swinging type wall mounted hose reel with drum.

4.1.8 IS: 388: Hose tubing.

4.1.9 IS: 4038: Foot valves for water-works purposes.

4.1.10 IS: 5290: landing Valves.

4.1.11 IS: 10221: Anti corrosion treatment for underground MS pipes.

4.1.12 IS: 5312: Swing check type reflux (non-return) valves.

5.0 FIRE EXTINGUISHERS:

5.1 Scope of Work:

Without restricting to the generality of the foregoing the work shall inter-alia consist of the following:

a) Installation of fully charged and tested fire extinguishing hand appliances CO_2 and dry chemical powder type as required by these specifications and drawings.

5.2 Portable Fire Appliances Requirement, Type and Location as per Fire Authority:

5.2.2 Portable Fire appliances as mentioned below:-

[a] CO_2 Gas Fire extinguisher IS 2878 – 4.5 Kg capacity

[b] ABC Dry powder type fire extinguisher IS: 13849 – 5 Kg capacity

5.3 General Requirements:

Fire extinguishers shall conform to the following codes and standards as revised and amended up to date and shall be with BIS approved stamp.

a) CO_2 type : IS: 2878

b) ABC Type Stored Pressure : IS: 13849

5.3.1 Hand appliances shall be installed in readily accessible locations with the appliance brackets fixed to wall by suitable anchor fasteners or by means of floor mounted supports.

5.3.2 Each appliance shall be provided with an inspection card indicating the date of inspection, testing, change of charge and other relevant data.

5.3.3 All appliances shall be fixed in a true workman like manner truly vertical and at correct locations. Identical type of extinguishers shall be of same make and shall have similar method of operation.

5.4 ABC Type Fire Extinguishers:

a)	Code	:	IS: 13849
b)	Capacity	:	5.0 Kg
c)	Body	:	Material–MS sheet, MIG Weld Minimum Thickness-2mm
d)	Valve	:	Brass Forging – IS: 6912 Threads conf : IS : 2643 Handle – MS, Epoxy coated upper & lower level for squeezing.
e)	Pressure Gauge	:	Brass Shell, Nickel plated, water proof
f)	O' Ring Washer	:	Rubber IS: 5382
g)	Spindle	:	Brass – IS: 319
h)	Spring	:	Carbon Steel-IS: 4454
I)	Siphon Tube	:	Outer dia (nominal) – 16 mm Inner dia (nominal) – 12 mm Length – (nominal) – 350 mm
j)	Discharge Hose	:	Braided Rubber Length (nominal) – 500 mm Internal Dia (nominal) – 10 mm Bursting Pressure – 50 Kg/cm^2
k)	Charge	:	Mono ammonium phosphate Base dry Chemical powder (IS 14609) Weight – 5 Kg $\pm$ 2% Propellant gas – Nitrogen Working Pressure – 15 Kg/cm^2
l)	Performance	:	Discharge – Duration – 15-20 Seconds Jet throw – minimum 4 mtrs Minimum %age discharge – 85%

5.5 Carbon-Die-Oxide Fire Extinguisher:

a)	Code	:	IS: 2878
b)	Capacity	:	4.5 Kg
c)	Body	:	Material–Manganese, seamless Tube conforming IS: 7285 Overall length (nominal) – 620 mm Outer Dia (Nominal) – 140 mm Wall Thickness (Nominal) – 4.5 mm Base Thickness – 12-16 mm Mass Empty (Nominal) – 11.3 Kg Full Weight – 18.4 Kg
d)	Testing Pressure	:	250 Kg/cm^2
e)	Working Pressure	:	150 Kg.cm^2 at 15^{o}C
f)	Neck Ring	:	Threads – As per IS: 3224 Type – Wheel Type
g)	Valve	:	As per IS: 3224: 2002 Working pressure – 158 Kg/cm^2
h)	Hose	:	Internal dia – 10 mm Length – 1 mtr Working Pressure – 140 Kg/cm^2

			Bursting Pressure – 275 Kg/cm^2
i)	Discharge Tube	:	MS, Swivel joint type with rubber Cover Rotation – 360^o
j)	Discharge Horn	:	Property – Non Conductive Material – Fiber Glass/Polythene Length – 250 mm Internal dia at discharge – 62 mm
k)	Charge	:	Carbon Dioxide confirms IS: 15222 Filling Ratio – 0.667 Outer dia – 19 mm Inner dia – 9 mm Thickness – 3 mm
m)	Painting	:	Fire Red
n)	Maintenance	:	As per IS: 2190
o)	Siphon Tube	:	Brass – IS: 407
p)	Performance	:	Discharge Duration – 10 – 18 Seconds Minimum %age of discharge-95.

5.6 Measurement and rates:

Fire extinguishers shall be measured by numbers and shall include full charge of extinguishing agent, installation and all items necessary and required and given in the specifications.

7) FIRE FIGHTING EQUIPMENT:

TAC	Tariff advisory committee fire protection manual Part I
TAC	Rules of Tariff Advisory Committee for Automatic Sprinkler system
NFPA : 12, 1993	Standards on Carbon Dioxide Extinguishing System
IS : 636	Non- percolating flexible fire fighting delivery hose
IS : 884	Specification for First Aid Hose Reel for fire fighting
IS : 901	Specification for first aid hose reel for fire fighting
IS : 902	Specification for couplings, double male and double female, instantaneous pattern for fire fighting
IS : 903	Suction hose coupling for fir fighting purposes
IS : 904	Specification for fire hose delivery couplings, branch pipe, nozzles and nozzle spanner
IS : 905	Specification for 2-way and 3-way suction collecting heads for fire fighting purposes
IS : 907	Specification for delivery breechings, dividing and collecting instantaneous pattern for fire fighting purposes
IS : 908	Specification for suction strainers, cylindrical type for fire fighting purposes.
IS : 909	Specification for underground fire hydrant, sluice valve type
IS : 910	Specification for combined key for hydrant, hydrant cover and lower valve.
IS : 933	Specification for portable chemical foam fire extinguisher
IS : 1648	Code of practice for fire safety of building (general): Fir fighting equipment and its maintenance.
IS : 2171	Specification for portable fire extinguishers dry powder (cartridge type)
IS : 2190	Selection installation and maintenance of first-aid fire extinguishers- Code of practice
IS : 2871	Specification for branch pipe, universal for firefighting purposes.
IS : 2878	Specification for fire extinguishers, carbon dioxide type (portable and trolley mounted)

IS : 3844	Code of practice for installation and maintenance of internal fire hydrants and hose reel on premises
IS : 5290	Specification for landing valves
IS : 5714	Specification for hydrant, stand pipe for fire fighting
IS : 8090	Specification for coupling, branch pipe, nozzle, used in hose reel tubing for fire fighting
IS : 8423	Specification for controlled percolation type hose for fire fighting
IS : 10658	Specification for higher capacity dry powder fire extinguisher (trolley mounted)
IS : 11460	Code of practice for fire safety of libraries and archived buildings
IS : 13039	External hydrant system – provision and maintenance – Code of practice.
IS : 5514 (Parts 1 to 7)	Reciprocating internal combustion engines: performance.

APPENDIX - I

List of approved makes for Equipment and materials.

S.NO	DESCRIPTION		MAKES
1	MS / GI Pipes	:	Jindal (Hissar) / TATA
2	G.I fitting	:	Unik/DRP.M
3	Forged Steel Fittings	:	True Forge / VS Forge
4	CI Gate Valve	:	Zoloto / NVR/DRP
5	Butterfly Valve	:	Zoloto / NVR
6	Dual Plate type NRV (C.I.)	:	Zoloto / NVR
7	Non Return Valve (GM)	:	Zoloto / NVR
8	Gun metal Gate valves	:	Zoloto / NVR
9	Ball Valve	:	Zoloto / NVR
10	CI Air release valve	:	Zoloto / NVR
11	Single / Double Headed Hydrant valves	:	Newage / Padmini / Lifeguard
12			
13	Hose reel drum	:	Newage / Padmini / Lifeguard
14	shut off nozzle	:	Newage / Padmini / Lifeguard
15	Branch Pipe	:	Newage / Padmini / Lifeguard
16	Fire Man Axe	:	Newage / Padmini / Lifeguard
17	Male & Female Coupling	:	Newage / Padmini / Lifeguard
18	RRL Hose	:	Newage / Padmini / Lifeguard
19	20 mm dia thermoplastic for hose reel	:	Mitra/ Eversafe

PROJECT- SHRI GURU GOVIND SINGH COLLEGE OF COMMERCE, PITAMPURA
FIRE FIGHTING TECHNICAL SPECIFICATION

S.NO	DESCRIPTION		MAKES
20	Pressure switch	:	Danfoss/Switzer/Waaree
21	Pressure Gauges	:	Fiebig / H Guru./Waree
22			
23	Fire Extinguishers (ISI Branded only)	:	Ceasefire / Fyrex
24	Anti-corrosive pipe treatment (As per IS:10221 – 1982)	:	Pypkote (IWL)/Coatek
25	Mechanical Seal	:	Sealol/ Hindustan
26	Paint Primer	:	Asian / Jenson Nicholson / Berger
27	Enamel Painting of pipes etc.	:	Asian / Jonson Nicholson /Berger
28	Welding Electrodes	:	Advani / ESAB/ L&T
29	Installation control valve	:	Viking /Tyco / Victaulic
30	Deluge Valve	:	Viking /Tyco / Victaulic
31	Pendant / Upright / Powder coated Pendant Sprinkler Heads / Spray Nozzels	:	Viking / RAP / Victaulic
32	Sprinkler Flexible Connector	:	Viking / Tyco / Victaulic
33	Structural Support	:	EASY FLEX (Kanwal) / Chilley
34	Powder coated sprinkler rosette	:	Viking / Tyco / Victaulic
35	Concealed Sprinkler	:	Viking / Tyco / Victaulic
36	Flow Switch	:	System Sensor
37	Exit Sign with Battery backup	:	Legrand/System Tek

SPECIFICATIONS

1.0 EQUIPMENT

1.1 INDUSTRIAL FANS

1.1.1 CENTRIFUGAL FANS:

Centrifugal fans shall be of high efficiency forward/backward curved approved make DIDW/SISW of specified Class and arrangement complete with access door, squirrel-cage induction motor, V belt drive, belt guard and vibration isolators. Type, direction of discharge / rotation, and motor position shall be as per the Approved for Construction shop drawings. The fan shall be complete with the following:

Housing:

Housing shall be constructed out of heavy gauge galvanized sheet steel welded/bolted construction. Housing for mounting of blower should be strong enough to hold the bearings preferably with twin rib spider arrangement. It shall be rigidly reinforced and supported by structural angles. Split casing shall be provided on larger sizes of fans, however neoprene packing should be provided throughout split joints to make it air tight.

18 gauge galvanized wire mesh inlet guards of 5cm sieves shall be provided on both inlets. Housing shall be provided with standard cleanout and door with quick locking tension handles and neoprene gasket. Rotation arrow shall be clearly marked on the housing.

Fan Wheel:

Fan Wheel shall be backward-curved non-overloading type OR forward curved type. Fan wheel and housing shall be statically and dynamically balanced, conforming to standard G 2.5. Fan outlet velocity shall not exceed 2000 FPM (610 MPM) and maximum fan speed shall be 1000 RPM.

Shaft:

Shaft shall be constructed of high-quality steel, turned, ground and polished.

Bearings:

Bearings shall be of ball bearing, taper lock type for self-alignment, mounted directly on the fan housing. Bearings shall be designed especially for quiet operation and shall be of the self-aligning, oil grease pack pillow block type.

Motors:

Fan motor shall be **high efficiency IE-02/IE-03,** suitable for operation on 415 ± 10% volts, 50 cycles, 3 phase AC power supply. The motor shall be TEFC, squirrel cage induction type having two speed and IP-55 protection, provided with class'B' insulation, centrifugal fans, whenever used for smoke venting duty, motor shall be with class 'H' insulation. Motor name plate horse

power shall exceed brake horse power by a minimum of 20%.

Motor shall be designed specially for quiet operation and motor speed shall not exceed 1450 rpm. The fan and motor combination selected for the particular required performance shall be energy efficient ensuring lowest noise level. The motor shall be of approved make.

Drive

Drive to fan shall be provided through belt with adjustable motor sheave and standard belt guard. Belt shall be of the oil resistant type.

Vibration Isolation:

MS base shall be provided for both fan as well as motor, built as an integral part, and shall be mounted on a concrete foundation through vibration isolators of approved make or cushy foot mountings. The concrete foundation shall be at least 15 cm above the finished floor level or as shown in approved for construction shop drawings.

1.1.2 INLINE FANS

Inline fan shall incorporate approved make SISW direct driven Centrifugal Fan with TEFC motor with IP-44 protection. The fan assembly shall be encased in a sheet metal housing of 22 gauge GSS and with necessary inspection cover with proper gasket assembly. The fan material shall be galvanized sheet steel. Flanges shall be provided on both sides of the Inline fan to facilitate easy connection. Flexible anti-vibration joints shall be provided to arrest vibration being communicated to other equipment connected to the Inline fan. Motor shall be single phase/three phase as per required duty conditions.

All single phase fans shall be provided with speed regulator while all three phase fans shall be provided with opposed blade damper in GSS construction at fan outlet for air balancing.

All inline fans shall be internally lined with 15mm thick open cell nitrile rubber insulation to achieve noise level of 40 db.

1.1.3 PROPELLER FANS

Propeller type, Ring/Diaphragm mounted fans shall be equipped with a TEFC Single phase motor with the impeller mounted directly on the shaft. The blades shall be die formed steel. The fan shall be fitted with gravity type louvers. The speed of fan shall not exceed 900 RPM. The fan speed can go up to 1400 RPM only in case of fans having diameter of 305 mm.

Installation

a. The Contractor shall supply all foundation bolts, base frame wherever required, vibration eliminators etc. and shall ensure that all the above accessories are placed securely in proper position while the foundation is cast.

b. Vibration eliminators shall be provided with an efficiency of not less than 80% wherever necessary.

c. Fan inlet and outlet connections shall be affected using new generation with flexible canvas wherever necessary.

Testing

All the fans shall be tested for performance and the following test results shall be furnished:

a. Air flow rate in CFM.
b. Static pressure at the fan supply end.

Painting

On completion of the erection and testing, the outside of the fans shall be painted with two coats of Synthetic Enamel paint of approved color over and under coat of primer.

1.1.4 **AXIAL FLOW FANS:**

Fans shall be Vane/ tube axial type of approved make, complete with motor mount, direct driven and vibration isolation type suspension arrangement as per approved for construction shop drawings. The fan shall be complete with the following:

a. Casing:

Casing shall be constructed out of heavy gauge galvanized sheet steel. Fan casing, motor mount shall be of welded steel construction. Motor mounting plate shall be minimum 20 mm thick and machined to receive motor flange. Casing shall be provided with wide hinged door which opens easily for removal of wheel, shaft and bearings. A small inspection door with handle and neoprene gasket shall also be provided. Casing shall have flanged connection on both ends for ducted applications.
Support brackets for ceiling suspension shall be welded to the casing for connection to hanger bolts. Casing shall be bonderized, primed and finish coated with enamel paint.

Vertically mounted fans shall also be installed in the same manner, however, fans shall be equipped with thrust bearings.

b. Rotor:

Rotor hub blades shall be die cast aluminum alloy construction. Blades shall be die formed aerofoil shaped for maximum efficiency and shall vary in twist and width from hub to tip to effect equal air distribution along the blade length. Tip clearance between impeller and fan casing should be 1% of diameter. Fan blades mounting on the hub shall be statically and dynamically balanced. Extended grease leads for external lubrication shall be provided. The fan pitch control may be manually readjusted at site upon installation, for obtaining actual air flow values, as specified and quoted.

c. Motor:

Motor shall be high efficiency **IE-02/ IE-03** (where called for in the Schedule of Quantities)

of approved make, squirrel cage, totally enclosed, fan cooled standard round frame, constant speed, continuous duty, single winding, suitable for 415 ± 10% volts, 50 Hz, 3 phase power supply, provided with **Class F/H insulation** (where called for in the Schedule of Quantities). Motor name plate horse power shall exceed brake horse power by a minimum of 15%. Motor shall be specially designed for quiet operation. The speed of the fans shall not exceed 1000 RPM for fans with impeller diameter 300mm, and 1440 RPM for fans with impeller diameter 300mm or more. For lowest sound level, fan shall be selected for maximum efficiency or minimum horsepower. Motor conduit box shall be mounted on exterior of fan casing, and lead wires from the motor to the conduit box shall be protected from the air stream by enclosing in a flexible metal conduit. The motor should withstand fire up to 2 hours at 250 degC where called for in the Schedule of Quantities.

All normally operating fans (i.e. excluding emergency only) shall have 6 pole motors only.

d. Vibration Isolation:

The assembly of fan and motor shall be suspended from the ceiling by vibration isolation suspension of rubber in shear type of approved make.

e. Accessories:

The following accessories shall be provided with all fans.

i. Outlet cone for static pressure regain.
ii. Inlet cone.

Fan silencers may be provided where specifically called for in Schedule of Quantities.

Fans shall be factory assembled and shipped with all accessories factory mounted and fan shall be AMCA certified for sound & air performance.

All rotors shall be statically and dynamically balanced as per AMCA 204-05 standard to a minimum of BV-3 level.

The minimum acceptable total efficiency of the fans shall be 70% and the sound pressure should not exceed 80 db(A) at a distance of 3 meters. When measured in a hemispherical surface under reverberant room conditions. Fan performance shall be based on tests conducted in accordance to AMCA 210 for air performance and AMCA 300 for Inlet sound power levels. These fans shall be licensed to bear the AMCA seal for air and sound performance.

All the High Temperature Fans should either be EN-12101-3 or UL tested for High Temperature (UL Power & Smoke Ventilation listed) for a minimum of 250 Deg C for a minimum of 2 Hrs and should be UL or CE labeled.

1.2 **AIR WASHERS**

Scope

The scope of this section comprises of supply, installation, testing and commissioning of packaged type Double Skin Air Washers of specific capacity set forth in the “Schedule of Quantities”.

The housing/casing of the air washer shall be of double skin construction. The housing shall be so constructed that it can be delivered at site in total/semi knock down conditions depending upon size of the air washer, location& access available.

The framework shall be extruded aluminum hollow sections filled with preformed insulation section. Frames shall be assembled using mechanical joints to make a sturdy and strong framework for various sections.

Double skin panels (each not exceeding 750mm wide) shall be made out of 24 gauge pre-painted galvanized steel sheet on outside and 24 gauge plain galvanized sheets inside with 25 mm thick injected PU foam insulation in between. These panels shall be bolted from inside on to the frame work with soft rubber gasket in between to make the joints air tight.

Frame work for each section shall be bolted together with soft rubber gasket in between to make the joints air tight. Suitable doors with pressure die cast aluminum hinges and latches shall be provided for access to various panels for maintenance. The entire housing shall be mounted on galvanized steel channel frame work.

Marine light with switch, view window and proximity switch to be provided in the casing of each air washer. Factory Fabricated Plenums shall be provided as shown in design drawings.

The air washer sump shall be made out of SS-304A grade, 1.25mm thick stainless steel sheet with bolted construction having suitable stiffeners and FRP lining on the joints. The bottom tray shall be made out of 16 gauges GI with 1mm FRP lining from inside. The casing shall be of bolted construction designed for outdoor installation. The entire fan section shall be coated with epoxy based paint internally. The centrifugal fans shall be coated with epoxy paint to avoid moisture abuse.

The packaged air washer shall be complete but not restricted to the following:

a) 50mm thick aluminum wire mesh filters at the air intake.

b) 200mm thick cellulose based paper fills preferably of imported origin. It shall provide extended and sufficient wetted surface to provide a water absorbing efficiency of 90% with air velocity not exceeding 500 FPM (2.54 MPS).

c) FRP water header with equidistant slits for uniform water distribution over the paper fills.

d) Drain, overflow, make-up and quick-fill connections with 20mm float valve of commercial grade brass.
e) Suction screen constructed out of brass and shall be of sufficient area to maintain velocity not exceeding 25Cms/sec.

f) All interior and exterior GI piping with valves and fittings to connect the water circulating pumps including ‘Y’ strainer etc.

g) Cabinet type supply air fan section shall be completely factory assembled and tested of approved manufacture.
h) Casing shall be of heavy gauge galvanized steel sheet, ribbed and re- enforced with

access panels as may be required.

The fan shall be forward curved floor standing double inlet double width type preferably of imported origin. The wheel and housing shall be fabricated from heavy gauge galvanized steel. The fan impeller shall be mounted on a solid shaft supported to housing with angle iron frame and pillow block heavy duty ball bearings. The fan shall be selected for speed not exceeding 1000 RPM. Variable pitch pulley shall be provided to affect reduction in speed in winter if required. The impeller and fan shaft shall be statically and dynamically balanced. The fan outlet velocity shall not be more than 2000 FPM (10.1 MPS). Fan housing with motor shall be mounted on a common steel base mounted inside the air handling housing on anti-vibration spring mounts or rubber mounts. The fan outlet shall be connected to casing with the help of anti-vibration flexible joints made out of imported fire retardant fabric with extruded aluminum frame/flange on either both side. The centrifugal fans shall be epoxy coated in the factory prior to delivery.

Fans shall be driven by an electric motor as specified in the schedule of quantities. Motor ratings are only tentative and where a fan requires a higher capacity motor, the contractor shall clearly point out the requirement and make his offer accordingly. Motor ratings shall be at least 10% over limit load plus transmission losses.

Fan motors shall be of **IE-02/ IE-03** category and suitable for operation on 415±10% volts, 50 Hz, 3 phase, AC power supply and shall be TEFC squirrel cage induction type totally enclosed fan cooled with IP-55 protection. Motors shall be especially designed for quiet operation and motor speed shall not exceed 1440 RPM. Drive to fan shall be provided through belt-drive arrangement. Belts shall be of the oil-resistant type.

a) Vibration isolators for pumps and centrifugal fans.

b) Pumps

- The water distribution pumps shall be of heavy duty, vertical type mounted inside the tank. It shall be complete with adjustable bleed of arrangement to prevent concentration of undesirable salts.

- The pump shall be provided with single phase, self-tripping starter of North West or equivalent make.

c) Limitation

The air velocity limits are as follows:

- Velocity across wet media shall not be exceeding 500 FPM (2.54 MPS).
- Velocity at fan outlet shall not be exceeding 2000 FPM (10.1 MPS).

1.3 FAN FILTER UNITS

The scope of this section comprises of supply, installation, testing and commissioning of packaged type Fan Filter Units (FFU) of specific capacity set forth in the “Schedule of Quantities”.

The housing/casing of the FFU shall be of double skin construction. The housing shall be so constructed that it can be delivered at site in total/semi knock down conditions depending upon size of the FFU, location& access available.

The framework shall be extruded aluminum hollow sections filled with preformed insulation section. Frames shall be assembled using mechanical joints to make a sturdy and strong framework for various sections.

Double skin panels (each not exceeding 750mm wide) shall be made out of 24 gauge pre-painted galvanized steel sheet on outside and 24 gauge plain galvanized sheets inside with 25 mm thick injected PU foam insulation in between. These panels shall be bolted from inside on to the frame work with soft rubber gasket in between to make the joints air tight.

Frame work for each section shall be bolted together with soft rubber gasket in between to make the joints air tight. Suitable doors with pressure die cast aluminum hinges and latches shall be provided for access to various panels for maintenance. The entire housing shall be mounted on galvanized steel channel frame work. Marine light with switch, view window and proximity switch to be provided in the casing of each FFU. Factory Fabricated Plenums shall be provided as shown in design drawings.

The fan shall be forward/backward curved, floor standing, double inlet double width type. The wheel and housing shall be fabricated from heavy gauge galvanized steel. The fan impeller shall be mounted on a solid shaft supported to housing with angle iron frame/spider and self-lubricated sealed eccentric type ball bearings.

The impeller and fan shaft shall be statically and dynamically balanced. The fan outlet velocity shall not be more than 2000 FPM (10.1 MPS). Fan housing with motor shall be mounted on a common steel base inside the air handling housing on anti-vibration spring mounts or rubber mounts. The fan outlet shall be connected to casing with the help of fire retardant canvass.

Fans shall be driven by an electric motor as specified in the schedule of quantities. Motor ratings are only tentative and where a fan requires a higher capacity motor, the contractor shall clearly point out the requirement and make his offer accordingly. Motor ratings shall be at least 20% over limit load plus transmission losses.

Fan motors shall be suitable for operation on 415±10% volts, 50 Hz, 3 phase, AC power supply and shall be **IE-02/ IE-03**, TEFC squirrel cage induction type totally enclosed, fan cooled with IP-55 protection. Motors shall be especially designed for quiet operation and motor speed shall not exceed 1440 RPM. Drive to fan shall be provided through belt-drive arrangement. Belts shall be of the oil-resistant type.

Fan Filter units should be provided with necessary viscous metallic filters as mentioned under subhead filters.

1.4 EXTRACT FAN SECTIONS

The scope of this section comprises of supply, installation, testing and commissioning of packaged type Extract Fan Sections (EFS) of specific capacity set forth in the "Schedule of Quantities".

The housing/casing of the EFS shall be of double skin construction. The housing shall be so constructed that it can be delivered at site in total/semi knock down conditions depending upon size of the EFS, location & access available.

The framework shall be extruded aluminum hollow sections filled with preformed insulation section. Frames shall be assembled using mechanical joints to make a sturdy and strong framework for various sections.

Double skin panels (each not exceeding 750mm wide) shall be made out of 24 gauge pre-painted galvanized steel sheet on outside and 24 gauge plain galvanized sheets inside with 25 mm thick injected PU foam insulation in between. These panels shall be bolted from inside on to the frame work with soft rubber gasket in between to make the joints air tight.

Frame work for each section shall be bolted together with soft rubber gasket in between to make the joints air tight. Suitable doors with pressure die cast aluminum hinges and latches shall be provided for access to various panels for maintenance. The entire housing shall be mounted on galvanized steel channel frame work. Marine light with switch, view window and proximity switch to be provided in the casing of each EFS. Factory Fabricated Plenums shall be provided as shown in design drawings.

The fan shall be forward/backward curved, floor standing, double inlet double width type. The wheel and housing shall be fabricated from heavy gauge galvanized steel. The fan impeller shall be mounted on a solid shaft supported to housing with angle iron frame/spider and self-lubricated sealed eccentric type ball bearings. The impeller and fan shaft shall be statically and dynamically balanced. The fan outlet velocity shall not be more than 2000 FPM (10.1 MPS). Fan housing with motor shall be mounted on a common steel base inside the air handling housing on anti-vibration spring mounts or rubber mounts. The fan outlet shall be connected to casing with the help of fire retardant canvass.

Fans shall be driven by an electric motor as specified in the schedule of quantities. Motor ratings are only tentative and where a fan requires a higher capacity motor, the contractor shall clearly point out the requirement and make his offer accordingly. Motor ratings shall be atleast 20% over limit load plus transmission losses.

Fan motors shall be suitable for operation on 415±10% volts, 50 Hz, 3 phase, AC power supply and shall be **IE-02/ IE-03**, TEFC squirrel cage induction type totally enclosed, fan cooled with IP-55 protection. Motors shall be especially designed for quiet operation and motor speed shall not exceed 1440 RPM. Drive to fan shall be provided through belt-drive arrangement. Belts shall be of the oil-resistant type. Provisions of separate GI sheet enclosure to locate the motor in hot air stream free area to be made (applicable for kitchen extract fan sections only).

1.5 **FILTERS**

1.5.1 Viscous Metallic Filters

Viscous metal filter shall be all metal, washable type. The filter media shall be composed of layers of crimped GI wire mesh. The velocity over face of filter shall not exceed 90 MPM. and pressure drop shall not exceed 5mm for 50mm thick filter. The filter shall be of GI and suitable for mounting as required at site.

1.5.2. Synthetic Fiber Filters (EU-3)

Synthetic fiber filter shall be constructed out of 50mm deep non-woven synthetic fiber replaceable media secured with anodized ductile aluminium mesh on one side & 40 sieve HDPE mesh on the other side. All the layers to be dully stitched together & to be housed in 18G Aluminium anodized frame. The filter element shall have 11 folds/Rft. The filter shall have an efficiency of 90% down to 10 microns when tested as per BS: 2831 standard. It shall be suitable for operation under 100% Relative Humidity & 120 degree C temperature conditions. The velocity over the face of filter shall not exceed 105 MPM and the pressure drop across the filter shall not exceed 3 mm WG for 50mm thick filter. The filter frame shall be suitable for mounting in air handling unit as required at site.

2.0 AIR DISTRIBUTION

2.1 SCOPE

The scope of this section comprises of supply, fabrication, installation and testing of all sheet metal ducts and supply, installation, testing and balancing of grilles, registers and diffusers, in accordance with these specifications and the general arrangements shown on various drawings.

MATERIAL

i) All ducts shall be fabricated either from Galvanised Sheet Steel (GSS) conforming to IS: 277 or aluminium sheets conforming to IS:737. The steel sheets shall be hot dip galvanized with MAT finish with coating of minimum 120 grams per square meter (GSM) of Zinc, GI sheets shall be lead free, eco friendly and RoHS compliant.

ii) The thickness of sheets for fabrication of rectangular ductwork shall be as under. The thickness required corresponding to the longest side of the rectangular section shall be applicable for all the four sides of the ductwork.

Longest side (mm)	Minimum sheet thickness	
	For GSS	For Aluminium
750 mm and below	0.63	0.80
751 mm to 1500 mm	0.80	1.00
1501 mm to 2250 mm	1.00	1.50
2251 mm & above	1.25	1.80

(iii) Thickness of sheet for Round Ducts

Diameter of duct, mm	Thickness of Sheet, mm	
	GI sheets	Aluminium Sheets
150 to 500	0.63	0.80
501 to 750	0.80	0.80
751 to 1000	0.80	1.00
1001 to 1250	1.00	1.50
1251 and above	1.25	1.80

iv) All sheet metal connections, partitions and plenums required for flow of air through the filters, fans etc. shall be at least 1.25 mm thick galvanised steel sheets, incase of G.I. sheet ducting or 1.8 mm thick aluminium sheet, in case of aluminium sheet

ducting and shall be stiffened with 25 mm x 25 mm x 3 mm angle iron braces.

v) Circular ducts, where provided shall be of thickness as specified in IS: 655 as amended upto date.

vi) Aluminium ducting shall normally be used for clean room applications, hospitals works and wherever high cleanliness standards are functional requirements.

Associated Items

Supply/ return air outlets, F.A. grilles and accessories shall be constructed from extruded aluminium sections.

Flanges for matching duct sections, stiffening angles (braces) and supporting angles shall be of rolled steel sections, and shall be of the following sizes.

Application	Duct Width	Angle size
Flanges	Upto 1000 mm	35 mm x 35 mm x 3 mm
-do-	1001 mm to 2250 mm	40 mm x 40 mm x 3 mm
-do-	More than 2250 mm	50 mm x 50 mm x 3 mm
Bracings	Upto 1000 mm	25 mm x 25 mm x 3 mm
-do-	More than 1000 mm	40 mm x 40 mm x 3 mm
Support angles	Upto 1000 mm	40 mm x 40 mm x 3 mm
-do-	1001 mm to 2250 mm	40 mm x 40 mm x 3 mm
-do-	More than 2250 mm	Size and type of RS section shall be decided in

Hanger rods shall be of mild steel and of at least 10 mm dia for ducts upto 2250 mm size, and 12 mm dia for larger sizes.

All nuts, bolts and washers shall be zinc plated steel. All rivets shall be galvanised or shall be made of magnesium - aluminium alloy. Self tapping screws shall not be used.

2.2 **CONSTRUCTION**

2.2.1 Ducts

2.2.1.1 Ducts shall be fabricated at site or factory fabricated and shall be generally as per IS: 655 "Specifications for metal air ducts", unless otherwise deviated in these General Specifications.

2.2.1.2 The interior surfaces of the ducting shall be smooth.

2.2.1.3 All the ducts upto 600 mm longest side shall be cross broken between flanges by a single continuous breaking. Ducts of size 600 mm and above shall be cross broken by single continuous breaking between flanges and bracings. Alternatively, beading at 300 mm centres for ducts upto 600 mm longest side, and 300 mm centres for ducts above 600 mm

size shall be provided for stiffening.

2.2.1.4 As far as possible, long radius elbows and gradual changes in shape shall be used to maintain uniform velocity accompanied by decreased turbulence, lower resistance and minimum noise. The ratio of the size of the duct to the radius of the elbow shall be normally not less than 1:1.5.

2.2.1.5 Flanged joints shall be used at intervals not exceeding 2500 mm. Flanges shall be welded at corners first and then riveted to the duct.

2.2.1.6 Stiffening angles shall be fixed to the sides of the ducts by riveting at 1.25 meters from joints for ducts of size 600 mm to 1500 mm, and 0.6 mm from joints for ducts of size larger than 1500 mm. Bracings for ducts larger than 1500 mm can alternatively be by diagonal angles.

2.2.1.7 Plenums for filters shall be complete with suitable access door of size 450 mm x 450 mm.

2.2.1.8 All factory fabricated duct shall be supplied in L sections, the length of any piece shall not be more than 1800 mm for duct with longest side of cross section as 600 mm and above and 3000 mm for rest.

2.2.2 Air Outlet and Inlets (Supply and Return)

2.2.2.1 All air outlets and intakes shall be made of extruded aluminium sections & shall present a neat appearance and shall be rigid with mechanical joints.

2.2.2.2 Square and rectangular wall outlets shall have a flanged frame with the outside edges returned or curved 5 to 7 mm and fitted with a suitable flexible gasket between the concealed face of the flanges and the finished wall face. The core of supply air register shall have adjustable front louvers parallel to the longer side to give upto 22.5 degrees vertical deflection and adjustable back louvers parallel to the shorter side to achieve a horizontal spread air pattern to at least 45 degrees. Return air grilles shall have only front louvers. The outer framework of the grilles shall be made of not less than 1.6 mm thick aluminium sheet. The louvers shall be of aerofoil design of extruded aluminium section with minimum thickness of 0.8mm at front and shall be made of 0.8mm thick aluminium sheet. Louvers may be spaced 18 mm apart.

2.2.2.3 Square and rectangular ceiling outlets/intakes shall have a flange flush with the ceiling into which it is fitted or shall be of anti smudge type. The outlets shall comprise an outer shell with duct collar and removable diffusing assembly. These shall be suitable for discharge in one or more directions as required. The outer shell shall not be less than 1.6 mm thick extruded section aluminium sheet. The diffuser assembly shall not be less than 0.80 mm thick extruded aluminium section.

2.2.2.4 Circular ceiling outlets/intakes shall have either flush or anti smudge outer cone as specified in the tender specifications. Flush outer cones shall have the lower edge of the cone not more than 5 mm below the underside of the finished ceiling into which it is fitted. Anti smudge cones shall have the outer cone profile designed to reduce dirt deposit on the ceiling adjacent to the air outlet. The metal sheet used for construction of these shall be minimum 1.6 mm thick extruded aluminium sheet.

2.2.2.5 **Towards fire protection, all kitchen extract ductwork shall be fabricated out of 18 gauge GSS and coated with approved fire retardant surface treatment (on internal and external duct surface)**

preferably sprayed at factory prior to dispatch in order to capture the flanges, corners and internal joints. These ducts should be finished off with 50mm thick mineral wool on the external surface the duct, enveloped in 0.1mm thick Aluminum foil, and joints sealed off with Aluminum tape.

2.2.3 Duct Installation

All ducts shall be installed generally as per the drawings and in strict accordance with approved for construction shop drawings prepared by the contractor.

a. The contractor shall provide and neatly erect all sheet metal work as may be required to carry out the intent of these specifications and drawings. This work shall meet with the approval of the Architect/ Consultants in all its parts and details.

b. All necessary allowances and provisions shall be made by the contractor for beams, pipes or other obstructions in the buildings, whether or not the same are shown on the drawings. Where it becomes necessary to avoid beams or other structural work, plumbing or other pipes, and or conduits, the ducts shall be transformed, divided or curved to one side, the required area being maintained as approved or directed by the Architect/ Consultants.

c. If a duct cannot be run as shown on the drawing, the contractor shall install the duct between the required points by any path available, subject to the approval of the Architect/ Consultants.

d. All duct work shall be independently supported from building elements or as required by the Architect/Consultants. All horizontal ducts shall be rigidly and securely supported, in an approved manner, within hangers formed of wire rope suspension arrangement with hot dipped galvanized (HDG) perforated channel under the ducts. The distance between two successive supports shall not be greater than 2 meter center to center. All vertical duct work shall be supported by structural members at each floor.

e. Ducting on top of the ceiling shall be supported from the slab above, or from beams with the help of adequate strength dash fasteners, after obtaining approval of the Architect/ Consultant. In no case shall a duct be supported from the ceiling hangers or be permitted to rest on a hung ceiling.

f. All metal work in dead or closed down spaces shall be erected in time to occasion no delay to other contractors in the building.

g. All ducts shall be totally free from vibration under all conditions of operations. Whenever duct work is connected to fans, that may cause vibrations in the duct, ducts shall be provided with two flexible connections located close to the unit in mutually perpendicular directions. Flexible connection shall be constructed of fire resistant flexible double canvas sleeves at least 100mm deep, secured properly and bolted at both ends. Sleeve shall be made smooth and the connecting duct work rigidly held by independent supports on both ends. The flexible connection shall be suitable for pressures at the point of installation.

h. The two mating flanges of the ducts being joined with each other shall be made air tight by providing 2mm thick foam rubber insertion fixed on both mating flanges by means of good quality adhesive. Rubber strip shall also be provided between bottom surface of duct and angle iron at each duct support to avoid metal to metal contact.

2.3 FACTORY FABRICATED SPIGOTS

Spigots shall be readymade, circular in shape, fabricated out of 22 gauge galvanized steel sheet through spinning process. The spigot shall be provided with a circular opening with a cylindrical neck with grooves to facilitate fail safe flexible duct connection. Spigot shall have circular flange all around which shall be screwed to the main rigid ductwork.

Readymade gaskets shall be provided between circular flange and surface of rigid ductwork with pre-conceived round opening, and sealant applied to prevent leakage of air.

2.4 VOLUME CONTROL DAMPERS

a. All dampers shall be multi-blade type of robust construction of galvanized steel and tightly fitted. The design, method of handling, and control shall be suitable for the location and service required.

b. Dampers shall be provided with suitable links, levers and quadrants as required for their proper operation control or setting devices shall be made robust, easily operable and accessible through suitable access doors in the ducts. Every damper shall have an indicating device clearly showing the damper position at all times.

c. Dampers shall be placed in ducts and at each supply air collar, whether or not indicated on the drawings, for the proper volume control and balancing of the system.

2.5 FIRE CUM SMOKE DAMPERS

2.5.1 BARE DAMPERS

a. All supply and return air ducts/return air spaces at AHU room crossings and at all floor crossings shall be provided with approved make motorized fire and smoke dampers of at least 90 minutes fire rating as certified by CBRI Roorkee, India as per clause 10 of UL:555-1995. These dampers shall be multi-leaf type -Ruskin.

b. Fire damper blades and outer frame shall be formed out of 1.6mm (16G) galvanized steel sheet of length as mentioned in the approved for construction shop drawings titled as AHU Room Blow Up. The damper blade shall be pivoted on both ends using chrome plated spindles in self lubricated bronze bushes. Stop seals shall be provided on top and bottom of the damper housing made of 16 gauge galvanized sheet steel. For preventing smoke leakage, metallic compression side seals shall be provided. Dual side linkage shall be provided for better structural stability. The construction of the fire damper shall allow maximum free area to reduce pressure drop and noise in the air passage. In normal position damper blade shall be held in open position with the help of a 220 V operated electric actuators thereby providing maximum air passage without creating any noise or chatter.

c. For wall mounted fire dampers retaining **MS angles duly painted with black enamel paint shall be supplied and installed by HVAC Contractor** as per established installation procedure. Whereas the fire damper is also to be used for Smoke management (Smoke and fire damper) the same shall be as per UL-555 S-Class-II.

d. Every motorized fire damper/ Smoke and fire damper shall be tested for in the factory and will be certified by the manufacturer in form of the test certificate.

e. Fire damper shall also be supplied with spring locked fusible link rated for 72^0 C (UL stamped) to close fire damper in event of rise in duct temperature.

f. For fire dampers/ smoke fire dampers of size higher than one approved by certifying agency the damper shall be supplied in multiple units of size not exceeding the tested damper by CBRI. All the multiple units shall be housed in a common factory fitted sleeve.

g. The fire dampers shall be mounted in fire rated wall with a duct sleeve 400mm/500mm long depending upon the wall thickness. The sleeve shall be factory fitted on fire damper. The joints at sleeve end shall be slip on type. Minimum thickness of galvanized sheet shall be 18 gauge.

h. The damper shall be installed in accordance with the installation method recommended by the manufacturer.

2.5.2 **ACTUATORS**

The actuator shall be maintenance free direct coupled spring return type suitable to work on 24 V electric supply. The torque rating of the actuator shall exceed at least by 15% over torque required to open/ close the damper. The selection of actuator size shall be the responsibility of the manufacture of the fire damper. Spring return time shall be 20 seconds or less at ambient temperature. Other features of the damper actuator shall be as under:

a. Actuator shall have tamper proof housing with IP-54 protection rating.

b. Actuator shall have mechanical integrity of at least one hour at 900^0 C.

c. Actuator shall have minimum 60000 safe position at rated torque. It shall be capable to withstand temperature of 75^0 C for 24 Hrs.

d. Actuator shall have electronic over load or digital sensing circuit to prevent damage to actuator.

e. Should be capable of changing direction of rotation by changing mounting orientation.

f. Actuator shall have manual over ride facility.

Damper actuator shall be such that it should close the damper in the event of power failure automatically & open in the same manner in case of power being restored.

2.5.3 **CONTROL PANEL**

The Control panel shall be supplied by damper manufacturer fitted on damper compatible with damper actuators. The control panel shall have at least following features:

a. Power on lamps with 230 V/ 24 V Transformer.

b. Damper close and open indication.
c. Reset push button.
d. Push button for manual running of actuator for periodic inspection.
e. Auxiliary contacts 24V & 230V.
f. Contact points to receive signal from smoke detector/fire alarm panel.
g. Additional terminal shall be provided to have signal (audio or visual) in central control room.

The control panel shall receive 230 V A/C supply & interconnecting wiring between control panel and actuator shall be carried out using fire proof cables.

The Contractor shall ensure that all electrical connections are suitably terminated. The HVAC Contractor shall also check continuity of electrical circuit as recommended by the manufacture. Fire damper inspection door will be provided in AC duct to facilitate access to the system.

2.6 SUPPLY AIR REGISTERS

Supply air registers shall be of approved make and of mild steel construction with individually adjustable bars. Supply air registers shall be double deflection type, with removable key-operated volume control dampers. The outer frame should be made out of 20 gauge and louvers of 24 gauge MS sheet.

a. All registers shall be selected in consultation with the Consultants. Different spaces shall require horizontal or vertical face bars and different width of margin frames.
b. All registers shall have a soft, continuous rubber gasket between the periphery of the register and the surface on which it has to be mounted. The effective area of the registers shall not be less than 80 percent.
c. Registers shall be adjustable pattern as such grille bar shall be pivot able to provide pattern with 0 to 100 degree horizontal arc and up to 30 degree deflection up or down. Bars shall hold deflection settings under all conditions of velocity and pressure.
d. Bars longer than 450 mm shall be reinforced by a setback vertical member.
e. Registers shall be given a rust inhibiting prime coat and factory applied enamel finish of approved color.

2.7 SUPPLY AIR DIFFUSERS

Diffusers shall be of approved make and of mild steel construction, square in shape with flush fixed pattern or adjustable flow pattern. Diffusers for different spaces shall be selected in consultation with the Consultant.

All supply air diffusers shall be equipped with removable key-operated volume control dampers. Anti-smudge ring may be required in specific applications. The outer shell and diffusing assembly shall be made out of 18 gauge and 24 gauge MS sheet respectively.

2.8 EXTRUDED ALUMINIUM GRILLES & DIFFUSERS

2.8.1 RECTANGULAR/ SQUARE CEILING DIFFUSERS

Rectangular /square ceiling diffusers shall be fabricated out of extruded aluminum sections

powder coated in color approved by Architects/ Consultants. The four directional air flow diffuser shall consist of outer ring fixed to duct collar with concealed screws. Foam gasket shall be provided between outer ring and suspended ceiling. The central core shall be clip fixed to the outer ring. Opposed blade volume control damper in extruded aluminum construction shall be fixed to the neck of diffuser. The damper shall be adjusted after removing the central core. The diffuser shall be equipped with anti-smudge ring.

In case of grid type false ceiling, the entire diffuser assembly with plenum shall be independently hung from the ceiling through adjustable GI wires and the same shall be connected to the main duct through a flexible round duct.

2.8.2 PLAQUE DIFFUSER

The Plaque diffusers shall be constructed out of Extruded Aluminum powder coated sections is designed to integrate with suspended ceiling arrangement preferably grid type.

The diffuser shall consist of a rear pan and a removable heavy gauge front flat panel attached to the rear pan through spring loaded locking posts. The flat panel may be removed whenever need arises to facilitate adjustment of the damper for air balancing.

The front panel shall be aerodynamic in appearance, rigid and preferably in single piece construction and free from any welding or forming blemishes.

The horizontal air discharge pattern shall be 360^{0} type. Blank off baffles shall be provided to obtain one, two or three way blow pattern if specifically asked for in the "Schedule of Quantities".

Diffusers shall be provided with following accessories:

I. Opposed blade damper
II. Spiggot to facilitate round duct connection at neck.

The performance criteria shall be in conformity with relevant ANSI/ASHRAE standards.

2.8.3 SWIRL DIFFUSER

The diffuser face shall consist of fixed radically arranged air control blades. The supply air pattern shall permit specifically arranged internal air guidance elements or guide vanes. Such elements are not required for return/extract versions. Due to the rotary swirling motion of the air discharge, induction of room air occurs very quickly, resulting in decay of supply air velocity and temperature differential.

In order to stabilize horizontal discharge, all sizes must be mounted flushed with the suspended ceiling. The minimum height between floor & the diffuser face should be 2.6 M or less. The face plate shall be square. The supply air versions shall be supplied with top/side entry spigot with lip seals and Volume Control Damper.

The diffuser face shall be fabricated out of 1.2 mm thick galvanized steel sheet, pretreated and powder coated white. The spigot shall also be of 1.2 mm thick galvanized steel sheet & lip seal of soft rubber.
The performance criteria shall be in conformity with relevant ANSI/ASHRAE standards.

2.8.4 MULTISLOT LINEAR DIFFUSER

Linear ceiling diffuser shall be multi-slot type. The diffuser shall be fabricated out of extruded aluminium sections. Each slot shall be 19mm wide. Each slot shall be equipped with air flow direction control louver mechanically fixed. Integral sliding type hit & miss type volume control damper in extruded aluminium construction shall be provided for each slot for fine control of air flow in supply air portion only. The damper shall be fabricated out of anodized extruded aluminium sections.

Other sections of ceiling diffuser shall be powder coated in color & shade approved by the Consultants/Architects.

The linear diffuser shall be fixed in to a plenum chamber with concealed screws. Side end pieces or corner pieces shall be provided if required.

2.8.5 MULTI LOUVERED GRILLES

For supply air double louvered grilles in extruded aluminium construction shall be provided with individually adjusted louvers along with volume control damper in extruded aluminium construction. The louvers shall be pivoted in Nylon bushes for smooth operation for return air grilles similar to supply air as described above will be provided but without volume control dampers. These grilles shall be painted as per approved powder coated shade.

2.8.6 LINEAR GRILLES

Linear Grilles shall be fabricated out of extruded aluminium sections. Flanges shall be of 1.3mm thick extruded aluminium. Louvers shall be of extruded aluminium sections 3.7mm thick at the front and 2.2 mm at the rear with 15 degree deflection strong enough to withstand site abuse during installation. The sample of grille shall have to be got approved by the consultants before delivery. The linear grilles shall be provided with removable/fixed internal core.

All sections of linear grille shall be powder coated in color/shade approved by the Architects/Consultants.

The linear grilles shall be fixed into a plenum chamber having GI spacers with concealed screws. End pieces or corner pieces shall be provided as required.

2.9 FRESH AIR ARRANGEMENTS

Extruded aluminium construction duly anodized (20 microns and above) fresh air louvers with bird screen and extruded construction dampers shall be provided in the clear openings in the masonry walls of the air handling rooms having at least one external wall. Louvers, damper, pre-filters, ducts and fresh air fan, if required with speed regulator shall be provided as shown on drawings and in schedule of quantities.

Fresh air dampers shall be of the interlocking, opposed-blade louver type. Blades shall be made of extruded aluminium construction and shall be rattle-free. Dampers shall be similar

to those specified in "Air Distribution". Fresh air fans and fresh air intake shall be as per the schedule of quantities.

2.10 AIR TRANSFER DOOR GRILLE

Air transfer grilles in extruded aluminium construction shall be provided at the door of pantry and toilets wherever required. The air transfer grille shall be complete with matching rear flange. The grilles shall be anodized or powder coated in color and shade as approved by the Architects/Consultants.

2.11 RAIN WATER PROTECTION LOUVERS

Louvers shall be manufactured out of extruded aluminium sections powder coated, outer flange 18mm wide & 45mm deep, louvers also of extruded sections of 1.2mm thickness.

A suitable rat mesh shall be provided using expanded metal mesh preferably aluminium of 1mm thickness having 12mm diamond shaped openings. Fixing screws shall be cadmium coated. The size of such louvers shall be physically measured after openings are internally plastered, often termed as rough opening.
Louvers shall be installed at external building fabric for fresh replenishment or exhaust air.

2.12 PRE-INSULATED FLEXIBLE DUCTS

2.12.1 General:

The scope of this section comprises supply, installation, testing and commissioning of flexible ducting conforming to these specification and in accordance with requirements of drawings and schedule of quantities.

2.12.2 Type:

a. Un-Insulated Flexible ducts

Wherever required, uninsulated flexible ducts shall be made of double lamination, 0.05 mm thick aluminum foil followed by a layer of fire retardant metalized polyester film permanently bonded to a coated spring steel wire helix. Ducts shall be of “tear and puncture resistant” in construction.

a. Insulated Flexible Ducts

Wherever insulated flexible ducts are incorporated in design, inner core of such an assembly should be made of fiber glass reinforced double layer of metalized polyester film laminate permanently bonded to a coated spring steel wire helix. Blanket of fiber glass insulation exhibiting resistance of R-3.6 (RSI - 0.64 m^2K/W) having density not less than 16 Kg/CuM and thickness of 25 mm shall be wrapped over the inner core & covered with “tear and puncture” resistant outer jacket cum vapour barrier made out of preferably 0.05 mm thick aluminum foil.

The pre-insulated flexible duct shall comply with UL 181, BS 476 part VI & Part VII besides

Class '1' followed by Class'O'.

2.12.3 **Installation**:

Care must be taken to install all the flexible ducts in fully extruded position and bends made with adequate radius as per manufacturer's recommended practices.

a. Hangers and Supports

The flexible duct must be installed fully extended to produce optimum results. The maximum allowable sag, between any two adjacent suspension points, should not exceed 50 mm per meter.

The distance between any two adjacent suspension points may vary from 150 cm to 300 cm, depending upon the type of flexible duct in use.

Flexible ducts mounted above suspended ceiling should always be independently supported. Ducts mounted in these locations are susceptible to damage whenever ceiling panels need to be periodically interchanged, unless separately supported.

b. Bending Radius

All bends should be made as large as possible and should have a radius of not less than the diameter of the duct in use. This reduces un-favorable pressure losses and is particularly important for metal based products which are more susceptible to stress rupturing. Double bends should be avoided, however if un-avoidable, ensure that each radius is not less than R = 2 x D.

c. Flexible Duct to Conventional Duct Connection

Extra care should be taken when making connection to fixed conventional ducts, etc., and ensure that they do not become too stressed. An additional support is recommended to obviate this potential problem. **Readymade circular galvanized sheet steel spigots of approved makes shall be used to make such connections.**

Metal based flexible ducts are particularly prone to fracturing due to stress caused as a result of sharp connection.

Connections to ceiling illumination "Low Pressure Plenums" should be served in the most direct manner similar to that described for conventional ducts.

Too many bends, when connecting to "Low Pressure Plenums" and / or any other type of air supplying component, may result in excessive pressure loss and the generation of noise.

d. Longer Length Installation

In the event where extreme length of flexible ducts is to be installed, round duct connectors made of galvanized sheets of at least 30 cm long should be used to connect the duct at every distance of 10 meters. Use metal or galvanized hangers as

recommended to support the point where connections are made. Light railing is a good alternative hanging support when using long length of flexible ducts.

e. Direct Contact with other services

It should be emphasized that the flexible ducts must not be in direct physical contact with un-insulated heating or hot process pipes. If in the event where such situation cannot be avoided, additional 1" thick insulation should be wrapped around pipes that are in contact with the pre –insulated flexible ducts.

2.13 **Sound Attenuators**

Scope

The scope of this section comprises of supply, installation and testing of rectangular silencers of approved make as shown on the drawings.

Material

a. The outer casing shall be out of min.22 G galvanized steel in accordance with ASHRE (ISI) recommendations for high pressure rectangular duct work. Seams shall be lock formed and mastic filled.
b. Interior elements of silencers shall be out of min. 22 galvanized perforated steel.
c. Acoustic fill shall be inorganic mineral fibre of density sufficient to obtain specified acoustic performance and shall be packed under 10% compression to eliminate voids due to vibration and setting. Material shall be inert, vermin and moisture proof.
d. All materials of construction and acoustic fill shall be incombustible as per IS 3144.
e. Air-tight construction shall be provided by use of duct sealing compound at site by the air conditioning contractor.

Acoustic Performance

Silencer acoustic ratings shall include insertion loss and self-noise power levels and shall meet or exceed minimum performance.

Aerodynamic Performance

Static pressure drop through silencers shall not exceed those listed in the silencer schedule at the indicated airflows.

Transitions

Where transitions are required to adapt silencer dimensions to connecting duct work, they would be supplied by the installing contractor.

Minimum Sound Attenuator Performance Requirement

Sound Attenuator Type		Minimum required Octave Band Centre				Acoustic Frequency Rating (Hz)				Face Velocity (MPS)	Pressure Drop (N/SqM)
		63	125	250	500	1K	2K	4K	8K		
900 mm Long	IL dB	4	7	12	19	25	23	17	11	6	50
	SN	47	36	39	37	34	35	33	25		
dB re 1pW for 0.5 SqM face area											
1500 mm Long	IL dB	6	10	18	30	42	34	23	14	6	50
	SN	47	36	39	37	34	35	33	25		
dB re 1pW for 0.5 SqM face area											

2.14 TESTING AND BALANCING

After completion of the installation of the complete air distribution system, all ducts shall be tested for air leaks.

Before painting the interiors, air distribution system shall be allowed to run continuously for 48 hours for driving away any dust or foreign material lodged within ducts during installation.

The entire air distribution system shall be balanced using approved anemometer. Air quantities at the fan discharge and at various outlets shall be identical to, or less than 5 percent in excess of, those specified and quoted. Leakage in each air distribution system shall be within 3 percent so that supply air volume at each fan shall be identical to , or no greater than 3 percent in excess of, the total air quantity measured at all supply outlets served by the fan. Branch duct adjustments shall be made by volume or splitter dampers. Dampers shall be permanently marked after air balancing is complete so that these can be restored to their correct position if disturbed at any time. Complete air balance report shall be submitted to the Consultants for scrutiny and approval, and six copies of the approved report shall be provided with completion documents.

3.0 INSULATION

3.1 ROOM ACOUSTIC LINING

Thermal/acoustic lining of walls & ceiling of rooms shall be done using fibre glass board having density not less than 80kg/cu.m, laminated with aluminium foil on one side and three layers of black glass cloth on the other side. The board shall be cut to size and secured onto the walls or ceiling through fasteners as per manufacturer's recommendations.

3.2 DUCT ACOUSTIC LINING

3.2.1 Scope

The scope of this section comprises of supply and application of acoustic insulation conforming to following Specifications.

3.2.2 Material

Insulation material for Duct Acoustic Lining shall be resin bounded fiberglass wool with one side factory laminated either Black Glass Oven Cloth or Black Glass Tissue. The Thermal conductivity of the fiberglass for air-conditioning application shall not exceed 0.034 W/m K at 25 deg C mean temperature and average Noise Reduction Coefficient (NRC=1, frequency range from100 Hz to 8000Hz). The density of insulation material shall be either 48 Kg/m^3 and thickness of insulation material shall not less 25mm.

The installation guideline for glasswool in Duct Acoustic Lining:

1> The inside duct surface should be cleaned with suitable solvents and rendered free from all physical and chemical impurities.

2> Fix 22-gauge G.I. channels & angle frame work 25mm wide x depth equal to thickness of insulation at 600mm centre, screwed to the sheet metal by means of brass metal screws.

3> Cut the panels of fiberglass wool insulation material & fix in framed work using two coats of cold applied bitumen STARBOND 30-36 / FOSTER 30-36 / MAGIK 30-36. Paramount Polytreat Chemicals Pvt. Ltd approved product.

4> The inner most surface of insulation material shall be covered with factory laminated either Black Glass Oven Cloth or Black Glass Tissue.

5> Finally cover the insulation with 0.5 mm thick perforated aluminum sheet having 20% perforation with joints overlapped and screwed to the frame by means of brass metal screws, to produce an even surface.

Application should be internal and similar to duct insulation.

4.0 ELECTRICAL INSTALLATION

4.1 Scope

The scope of this section comprises of fabrication supply, erection, testing and commissioning of electrical control panels, wiring and earthing for all components of the Ventilation system.

4.2 General

Work shall be carried out in accordance with the Specifications, local rules, Indian Electricity Act 1910 as amended up to date and rules issued thereunder, regulations of the Local Fire Insurance Association and Indian Standard code of practice No. IS : 732-1963 (revised) including Indian Electricity Rules 1956.

4.3 Wiring System

All power wiring shall be carried out with 650/1100 volts grade PVC insulated, aluminum/copper conductor cables as per "Schedule of Quantities", sized for starting current and continuous running current carrying capacity and by applying proper derating factor.

4.4 Selection of components in panels

Contractor shall use only one make of component for ease in maintenance and interchangeability. The rating of other components i.e., contactor, fuse, circuit breaker, and overload relay, single phasing preventer etc. shall be as recommended in these specifications.

4.5 Selection of Cables/Wires

The size of cables and wires for individual connection to outgoing MCCB/ SFU/Isolator shall be suitably rated. Above 100 Amps. Solid links shall be used.

All power wiring shall be carried out with 650/1100 volt grade PVC insulated aluminium/copper conductor cables/wires sized for starting current and continuous rating of motors after applying derating factor as per the "Schedule of Quantities".

4.6 Cable Compartments

Cable compartment should be adequately spaced considering aluminium cables, however not less than 250 mm width.

The outgoing/incoming terminations should be shrouded by means of polycarbonate sheets.

Cable compartment of minimum size of 400x400 mm or as shown in drawings shall be provided in the boards for termination of all incoming and outgoing cables entering from bottom or top. Adequate supports shall be provided in cable compartment to support cables. All incoming & outgoing switch terminal shall be brought out to the spring loaded terminal blocks in cable compartments and identified accordingly.

All the outgoing connections shall be brought on spring loaded (Elmex Type CSLT-1) terminals in the cable-alley. Minimum size of terminals for control and power wiring shall be 2.5 & 10 Sqm respectively. No cable however shall be terminated in to the switch/isolator/ MCCB/contactor/over load relay, under any circumstances.

4.7 Meters and Indications

All meters shall be housed in a separate compartment or as shown in design drawings and accessible from front only. Lockable doors shall be provided for the metering compartment. All switches, contactors, push buttons, push button stations, indicating lamps shall be distinctly marked with a small description of the service fed.

4.8 Painting

Painting sheet metal work should be chemically pre-treated (7-tank process) prior to powder coating of approved paint shade.

Entire sheet metal works shall undergo seven tank process including passivating, sprayed with a high corrosive resistant primer and baked in oven. The finishing treatment shall be of two coats of synthetic enamel paint of approved color& shade.

Degreasing : Concentration of chemical: 5% - 7% & 40 deg C
Derusting : Concentration of chemical: 25%
Phosphatising : Concentration of chemical: 3.5% & 40-50 deg C
Passivation : Concentration of chemical: 0.05% - 0/1% & 60-70 deg C

Two coats of zinc chromate primer should be applied after the above processing before baking in oven.

Wherever necessary filler putty is applied to make the surface smooth. Properly rubbed surface is to be given a coat of surface and baked in oven.

4.9 Testing

Motor control center shall be tested at manufacturer's works. The test certificates shall be got approved before dispatch of MCC to site.

4.10 Instrument Compartment

All instruments shall be flush mounted 144 mm square & suitably scaled. Instrument chamber should have sufficient space. Indicating lamps should have minimum 50mm space between them. They shall be accessible for testing and maintenance without any danger of accident and contact with live parts of circuit's breaker and bus bar.

4.11 Control Cables and Terminals

All control wiring shall be with minimum area of 1.5 Sqm copper conductors. These shall be ferruled coded and identified at both ends as per IS specifications. A horizontal wire way shall be provided along the length of panel for taking the control wiring from one section to

another control wiring when terminated, shall be terminated on the terminal block and identified for the duties to be performed. Each terminal shall be separately identified. Minimum 10% spare terminals shall be provided on every terminal block.

4.12 **Other Components**

4.12.1 Moulded Case Circuit Breaker (MCCB)

The MCCB (moulded case circuit breaker) shall conform to the latest IEC 947-2 & IEC 947-3–1989. The Service Short Circuit Breaking Capacity (Ics at 415VAC) should be as specified at the required level.

The MCCB shall be Current Limiting type and comprise of Quick Make – Break switching mechanism, preferably Double Break Contact system, arc extinguishing device and the Tripping unit, contained in a compact, high strength, heat resistant, flame retardant, insulating moulded case with high withstand capability against thermal and mechanical stresses. All MCCBs shall be capable of defined Variable overload adjustment. All MCCBs rated 200Amps and above shall have adjustable Magnetic short circuit pick up.

The trip command shall over ride all other commands. The MCCB shall employ maintenance free double break contact system to minimize the let thru' energies and capable of achieving discrimination up to the full short circuit capacity of the downstream MCCB. The manufacturer shall provide both the discrimination tables and let thru energy curves. The MCCB shall not be restricted to Line/ Load connections. The handle position shall give positive indication of 'ON', 'OFF'' or 'Tripped' thus qualifying to Disconnection as per the IEC947-3 indicating the true position of all the contacts. In case of 4 pole MCCB the neutral shall be defined and capable of offering protection.

4.12.2 Miniature Circuit Breaker (MCB)

Miniature Circuit Breaker shall comply with IEC898 – 1996. The Miniature circuit breakers (MCB) shall be quick make and break type for 230 / 415 VAC 50 Hz application with thermal magnetic releases for over current and short circuit protection. The Breaking capacity shall not be less than 10 KA at 415VAC. MCBs shall be DIN mounted. The MCB shall be Current Limiting type (Energy Class–3). MCBs shall be classified (B, C, D as per the IEC 898 standards) as per their Tripping characteristic curves defined by the manufacturer. The MCB shall have the minimum power loss (Watts) per pole defined as per the IS/IEC and the manufacturer shall publish the values.

The housing shall be heat resistant and having high impact strength. The terminals shall be protected against finger contact to IP20 Degree of protection. All DP, TP and TPN miniature circuit breakers shall have a common trip bar independent to the external operating handle.

4.12.3 Switch Fuse Units

a) High rupturing capacity fuse (HRC Fuse) shall carry ISI mark on it and shall be rated for duty as indicated on the drawing/schedule of Quantities. The rating of HRC fuse shall be as per the rating of motor/equipment. The rating of fuse shall be selected so as to provide discrimination.

b) The switch fuse units shall be three pole double break action with switched neutral. All switch fuse units shall be provided with the hinged doors duly interlocked with operating mechanism so as to prevent opening of the door when the switch is 'ON' position and also to prevent energizing the switch when the door is not properly secured. All contacts shall be silver plated and alive parts shall be shrouded. High rupturing capacity (HRC) fuse links shall be provided with switch fuse units and shall have rupturing capacity of not less than 31 MVA at 415 volts. All switch fuse units shall be provided with visible indicators to show that they are in 'ON or OFF' position. All switch units shall be of AC-23 category.

4.12.4 Motor Starter

The Motor Starter shall be a combination starter consisting of motor protection circuit breaker and suitable contactor for remote starting.

a. Motor protection circuit breaker

The motor protection circuit breaker must comply to the latest IEC 947-4 and the corresponding IS 13947-4. The motor protection circuit breaker should be suitable for AC3 duty at 415V. The motor protection circuit breaker should offer built in coordinated overload and short circuit protection. The motor protection circuit breaker should have built in single phase / phase loss preventer. The motor protection circuit breaker should offer separate ON/OFF indication and Fault signal contacts which should be wired onto the panel for indication. The motor protection circuit breaker should offer Type 2 coordination along with the contactor.

b. Contactors

The contactor should be suitable for AC3 duty at 415V and should comply to the latest IEC 947-4 and the corresponding IS 13947-4. The contactor should have minimum 10 x IE rated making / breaking capacity as per the latest standard. The same should be suitable for Type 2 coordination along with motor protection circuit breaker. The contactor should have Class H insulation for the coil to prevent heating and to facilitate frequent start / stop function without heating.

c. Earth Leakage CB/ Residual Current CB

The ELCB/RCCB shall comply with IEC 1008. The ELCB/RCCB shall current operated independent of the line voltage. ELCB / RCCB shall work on the principle of core balance transformer. The ELCB / RCCB shall be rated for current sensitivity of a Min of 30mA and a Max of 300mA at 240 / 415VAC.The terminals shall be protected against finger contact to IP20 degree of protection. The ELCB / RCCB shall have a minimum of 20,000 electrical operations.

d. Testing Provision for the Earth Leakage Circuit Breaker

A test device shall be incorporated to check the integrity of the earth leakage detection system and the tripping mechanism. When the unit is connected to service, pressing the test knob shall trip the ELCB and the operating handle shall move to the "OFF" position.

4.12.5 **Air Circuit Breaker (ACB):**

The ACB shall conform to IEC 947-2-1989 & IS 13947 (Part –2). The Service Short Circuit Breaking Capacity shall be as specified and equal to the Short circuit Withstand Values. The ACB shall be provided for controlling the incoming supply feeder or as required and specified in schedule. Shall be available in 3 or 4 poles with modular construction, fixed or draw out, manually or electrically operated versions as specified. ACB shall be capable of providing short circuit, overload and earth fault protection (in absolute values) if required, through microprocessor based control unit sensing the true RMS values to ensure accurate measurement meeting the EMI/ EMC requirement as per the standard.

The breaker should have 3 distinct positions – SERVICE / TEST / ISOLATED within the cubicle. It should be possible to withdraw the breaker for testing with the door closed. Safety interlock must be provided to prevent the ACB from falling out in a fully withdrawn position. The ACB shall be provided with a door interlock. The contacts should be copper and silver plated only with a feature of contact wear inspection indicating the life of the contacts. The ACB shall have double insulation (Class-II) with moving and fixed contacts totally enclosed for enhanced safety and inaccessibility to live parts.

All electrical closing of breaker should be with Electrical motor wound stored energy spring closing mechanism with Mechanical indicator to provide. ON/ OFF status of ACB.

For all ACBs the Operating handle should be provided for charging the spring in continuous action. The spring shall be released with ON / OFF push button command in one operation at the correct speed independent of operator speed. A direct mechanical coupling should indicate the ACB in ON or OFF position thus qualifying to Disconnection as per the IS/IEC indicating the true position of all the contacts. One set of NO / NC potential free contacts to be provided for operation on Building Management System. All accessories like shunt, under voltage motorized mechanism etc shall be front mounted, requiring no adjustments and can be fitted at site.

The manufacturer shall provide details of opening time and deration with temperature to ensure discrimination and proper selection for feeders protection. All ACBs of 4000 A and above shall be a single ACB and Tandom operated will not be acceptable.

4.12.6 SAFETY FEATURES:

1. The safety shutter shall prevent inadvertent contact with isolating contacts when breaker is withdrawn from the Cradle.
2. It should not be possible to interchange two circuit breakers of two different thermal ratings.
3. There should be a provision of positive earth connection between fixed and moving portion of the ACB either thru connector plug or sliding solid earth mechanism.
4. Earthing bolts must be provided on the cradle or body of fixed ACB. Arc Chute covers should be provided wherever necessary.
5. The incoming panel accommodating ACB shall be provided with indicating lamps for ON-OFF positions, voltmeter and ammeter of size not less than 96mm x 96mm, selector switches, fuses for potential circuit and current transformers.
6. It should be possible to bolt the draw out frame not only in connected position but also

in TEST and DISCONNECTED position to prevent dislocation due to vibration and shocks.

4.12.7 PROTECTIONS

1. The Electromagnetic and thermal release or Microprocessor based unit should be provided on circuit breaker for short circuit, over current and earth fault protection with adjustable settings.

2. Specific LED indications should be provided for over current and earth fault operation.

3. Relays should be CT operated through shunt trip for short circuit and earth fault protection.

4. Under voltage relays should be provided.

5. Minimum 6 NO and 6 NC auxiliary contacts shall be provided on each breaker. The contacts shall be rated 5 Amps.

6. Rated insulation voltage is 1000 volts AC.

4.12.8 Push Button Stations

Push button stations shall be provided for manual Start & Stop of equipment. Push button shall have ON & OFF indicating lamp in red and green color. Push button shall be fabricated in 16 gauge sheet steel.

These stations shall be factory fabricated. ON & OFF operations shall be carried out from front without opening the door. One set of NO & NC contact shall be provided in push button station as spare.

4.12.9Toggle Switch

The toggle switch shall be of minimum 5 Amps rating.

4.12.10 Thermal Overload

The relay shall be factory calibrated, sealed and suitable for an ambient temperature at site or 50 deg C whichever is higher.

It should provide reliable and accurate protection against overload, single phasing and locked rotor conditions. Relays are to be provided with:

a) Trip alarm contact
b) Trip lever for testing
c) Auto reset facility

Rated insulation voltage shall be 660 volts AC.

4.13 Instruments

a. General :

The specifications hereinafter laid down shall cover all the meters and instruments.

b. Instrument Transformers

(i). Current Transformers

Current transformers shall be in conformity with IS : 2705 (Part I,II,III & IV) in all respects . All current transformers used for medium voltage applications shall be rated for 1 KV. However, the rated secondary current shall be 5 A unless otherwise specified. The acceptable minimum class of various applications shall be as given below:
Measuring: Class 0.5 to 1
Protection : Class 10 p

Current transformers shall be capable of withstanding without damage, magnetic and thermal stresses due to short circuit fault of 35 MVA on medium voltage system. Terminals of the current transformers shall be marked permanently for easy identifications of poles. Current transformers shall be provided with earthing terminals, for earthing chasis frame work and fixed part of the metal casing (If any). Each CT shall be provided with rating plate indicating the following:

a) Name and make
b) Serial Number
c) Transformation Ratio
d) Rated Burden
e) Rated Voltage
f) Accuracy Class

Current transformers shall be mounted such that they are easily accessible for inspection, maintenance and replacement. The wiring for CT's shall be copper conductor, PVC insulated wires with proper termination lugs and wiring shall be bunched with cable straps and fixed to the panel structure in a neat & clean manner.

c. Potential Transformers

Potential transformers shall be provided if specifically called for potential transformers shall comply with the requirements of IS : (Part I,II,III) in all respects.

d. Measuring Instruments

i. General

Direct reading electrical instruments shall be in conformity with IEC-51, BS:89 or IS :1248. The accuracy of direct reading shall be 1.0 for voltmeters and 1.5 for ammeters. Other type of instruments shall have accuracy of 1.5. The

meters shall be suitable for continuous operation between -10 deg C and +50 deg C. All meters shall be of flush mounting type with square pattern. The meter shall be enclosed in a dust tight housing. The meters shall be provided with white dials and black scale markings. The pointer shall be black in colour and shall have zero position adjustment device which could be operated from outside.

ii. Ammeters

Ammeters shall be of moving-iron type. The moving part assembly shall be with jewel bearings. The jewel bearing shall be mounted on a spring to prevent damage to pivot due to vibrations and shocks. The ammeters shall be manufactured and calibrated as per the latest edition of IS: 1248 or BS:89. Ammeters shall be instrument transformer operated, and shall be suitable for 5 A secondary.

Upto 30 Amps the ammeter shall be direct operated without current transformer on one phase only. Beyond 30 Amps the ammeter shall be CT operated with selector switch.

iii. Voltmeters

Voltmeters shall be of moving-iron type. The range for 400 volts, 3 phase voltmeters shall be 0 to 500 volts. The voltmeter shall be provided with protection fuse of suitable capacity.

4.14 **Earthing**

a. General

All non-current carrying metal parts of the electrical installation shall be earthed as per IS-3043. All metal conduits, trunking, cable sheathes, switchgear, distribution boards and all other metal parts forming part of the work shall be bonded together and connected by two separate and distinct conductors to control panel. Earthing shall meet the requirements of IER 1956.

b. Earthing Conductor

All earthing conductors shall be of high conductivity copper as specified and shall be protected against mechanical damage and corrosion. The size of the earth conductor shall not be less than half of the largest size of the current carrying conductor.

The connection of the earth continuity conductor of earth and earth electrodes shall be strong and sound and shall be rigidly fixed to the walls, cable trenches, cable trays or conduits and cables by using suitable clamps made of nonferrous metals. Incoming power supply along with earthing upto MCC/AHU control panel shall be provided by another agency. The panel shall be earthed to building main earthing. The motor shall be double earthed to the panel.

The earthing shall be done with wires/flat as under:

S. No.	Equipment	Size of Earth Wire/Strip	
		GI	Copper
01.	Motors upto 5 HP	2 Nos. 8 SWG	2 Nos. 14 SWG
02.	Motors upto 15 HP	2 Nos. 8 SWG	2 Nos. 12 SWG
03.	Motors upto 30 HP	2 Nos. 4 SWG	2 Nos. 8 SWG
04.	Motors upto 50 HP	2 Nos 25x6mm Flat	2 Nos. 4 SWG
05.	Motors above 50 HP	2 Nos 32x6mm Flat	2 Nos. 25x3mm Flat

AHU electrical panel shall generally be wall mounted type. Above stated specifications shall also stand good where applicable. The AHU motor shall be double earthed with two independent earth conductors as per the Indian Electricity Rules & Regulations-1956.

4.15 **Medium Voltage Cable**

a. Type

Medium voltage cables shall be aluminium/copper conductor, PVC insulated, PVC sheathed and steel wire armored or steel tape armored construction.

b. Rating

The cable shall be rated a voltage of 660/1100 volts.

c. Construction

The conductors shall be made of electrical purity aluminium 3/4 or H temper/copper. The conductor shall be insulated with high quality PVC base compound. A common covering (bedding) shall be applied over the laid-up cores by extruded sheath of unvulcanized compound.

Armouring shall be applied over the inner sheath of bedding. Over the armouring a tough outer sheath of PVC sheathing shall be extruded. The armouring shall be of single layer, galvanized steel round wire or flat strip. Wire armour should be used for cable dia over inner sheath upto 13mm and strip armour to be used for higher dia.The outer sheath shall bear the manufacturer's name and trade mark at every meter length.

d. Core Identification

Cores shall be provided with the following colour scheme of PVC insulation:

Core 1 : Red/Black/Yellow/Blue
Core 2 : Red & Black
Core 3 : Red, Yellow & Blue
Core 4 : Red, Yellow, Blue & Black

e. Current Rating

The current ratings shall be based on the following conditions:

i. Maximum conductor temperature : 70 deg C
ii. Ambient Air temperature : 43 deg C
iii. Ground temperature : 30 deg C
iv. Depth of laying : 75 CM

f. Short Circuit Rating

Short circuit ratings for the cables shall be as specified in IS: 1554-Part I.

g. Selection of Cables

The cables shall be suitable for effectively earthed A/C system 415 volts, 3 Phase 50 Hz.

Cables have been selected considering the conditions of the maximum connected load, switch rating ambient temperature, grouping of cables and the allowable voltage drop. However, the contactor shall recheck the sizes before the cables are ordered and brought to site. Discrepancy if any, shall be brought to the notice of Consultant.

h. Laying of Cables

For laying of cables along building steel structure and technological structures the cables shall be taken by clamping with MS saddles screwed to the MS flat welded to the structure. MS saddles and flats are to be galvanized after fabrication so that there is no rusting during maintenance period.

For laying cables along concrete walls, ceiling etc. The cables shall be taken by clamping with MS saddles screws to the MS flat welded on to the inserts. Where inserts are not available the saddles shall be directly fixed in the wall using rowl steel plugs of sufficient capacity and MS flat spacers of minimum 2mm thick.
The MS saddles shall be spaced at an interval, not more than 500mm both for horizontal and vertical runs. However, at the bends, it shall be spaced within 300mm and where terminating to the equipment/junction box the cable shall be clamped immediately before such terminations. In the area prevailing with corrosive atmosphere, PVC saddles instead of MS saddles shall be provided.

Underground cables shall be laid not less than 750mm below ground. The width of the trench shall be 300mm minimum for single cable. For additional cables additional width of 150mm for each cable is to be added. The sand should be spread in trench as under.

The cushion of sand to be provided below and above the cable joint boxes etc must not be less than 80mm i.e, total depth of sand shall be 160mm minimum. The sand should be spread in trench as under.

i. After laying the cable in trench 80mm of sand should be put over the cable. The cable should then be lifted and placed over the sand bed and the balance 80mm of sand put over it.

ii. Where cable is laid in rocky situation extra thick cushioning of sand as may be decided by site in charges shall have to be done without any extra cost.

Filling of trenches shall be done after the sand cushioning and laying of tiles/ bricks are carried out to the satisfaction of the engineer.

4.16 Cable Trays

i. Trays shall have suitable strength and rigidity to provide adequate support for all cables.
ii. Shall not have sharp edges, burres or projections injurious to cable insulation.
iii. Shall be adequately protected against corrosion.
iv. Shall include fittings factory fabricated or other suitable means for change of direction and elevation in run.

4.16.1 Installation of Trays

Trays shall be installed as complete system supported properly and rigidly from the building structure.

Each run of cable tray shall be completed before the installation of cables.
Cable trays shall be accessible.

Non combustible solid barriers shall be used for segregating the cables of different systems on the same cable tray. Cable trays shall be grounded by 2 Nos earth strips. Trays shall not be used as equipment grounding conductor.

4.17 Testing

a. Cables shall be tested as per the requirements of IS 1554. The tests shall be incorporate routine test and acceptance tests. Type test certificate shall be furnished whenever demanded.

b. Tests shall be carried out at site and submitted to project authorities.

4.18 Cable Identification Tag

Suitable cable identification tag shall be placed along the route of cable at every 10 meters and bends. The tags shall be of size 150mm x 100mm x 2mm aluminium sheet. It shall be punched with similar details as given below.

Cable from	MCC or AHP-1
Cable to	CDWP-1 or CT-1
Size of cable	2 Nos 3Cx 6 Sqmm.

4.19 **Drawings**

Shop drawing for MCC/control panels and wiring of equipment showing the route of cables shall be got approved by the Consultants before starting the fabrication of panel and starting the work.

APPENDIX –I

APPROVED MAKES OF EQUIPMENT & MATERIALS

List of approved makes of different equipment/materials to be used in this project.

S. NO.	DETAILS OF EQUIPMENT AND MATERIALS	MANUFACTURER'S NAME
EQUIPMENT		
1.	Extract Fan Sections & Fan Filter Units	Zeco/ System Air/ VTS/ Waves
2.	Centrifugal Fans	Nicotra/ Kruger/ Lau/ Blowtech
3.	Axial Flow Fans	Greenheck/ Kruger/ System Air/ Air Flow
4.	Inline Fans	System Air/ Kruger/ Caryaire
5.	Propeller Fans	Alstom/ Khaitan
6.	V-Belts	Fenner India/ Dunlop
7.	Air Washers	Zeco/ System Air/ VTS/ Waves
8.	Monobloc Pumps for Air Washers	Grundfoss/ Armstrong/ KBL
9.	Cellulose based Paper Fills	Munters/ Eco-Cool
10.	Motors	
10.1	High Efficiency Normal	Siemens/ Bharat Bijlee/ ABB/ Havells
10.2	Fire Rated (Upto 250 deg C)	Rotomotive/ Siemens/ Havells
11.	Air Curtains	VTS/ System Air/ Euronics
12.	Jet Vent Fans	Wolter/ System Air/ Howden/ Kruger
13.	CO Sensors	Honeywell/ Greystone/ MSR

S. NO.	DETAILS OF EQUIPMENT AND MATERIALS	MANUFACTURER'S NAME
	AIR DISTRIBUTION	
1.	GS Sheet	Rolastar/ Zeco/ Ductofab/ Waves/ Pioneer
2.	Factory Fabricated Ducts	Rolamate/ Zeco/ Ductofab/ Waves
3.	Flanges & Accessories for the above ducts	Gripple/ Dobygrip
4.	Wire Rope Suspension Arrangement	Dobyverrolec/ Ductmate/ Verromez
5.	Pre-Insulated Glass Wool Duct-Board	Saint Gobain/ UP Twiga/ Kimmco
6.	Fine Filters/ Hepa Filters/ Activated Carbon Filters	Thermadyne/ Spectrum/ Anfilco/ SAGI Cofim
7.	Pre-Filters	Thermadyne/ Spectrum/ Anfilco/ SAGI Cofim
8.	Metallic Air Filters	Zeco/ System Air/ VTS/ Waves
9.	Antivibration Canvass Sleeve	Zeco/ System Air/ VTS/ Caryaire/ Servex
10.	Extruded Aluminium Grilles & Diffusers	Dynacraft/ Titus/ System Air/ Servex/ Caryaire
11.	Jet Nozzles	Dynacraft/ Titus/ System Air/ Servex/ Caryaire
12.	Air Transfer Grilles/ Louvers	Dynacraft/ Titus/ System Air/ Servex/ Caryaire
13.	Fire & Smoke Dampers:	
13.1	Bare Dampers	Greenheck/ Ruskin/ System Air/ Caryaire
13.2	Actuators	Belimo/ Siemens/ Honeywell
14.	Sound Attenuators	Ruskin/ Intertec/ Dynacraft/ Servex/ Caryaire
15.	Intake Louvers	Dynacraft/ Ruskin/ System Air/ Servex/ Caryaire
16.	Duct Dampers	Dynacraft/ Ruskin/ System Air/ Servex/ Caryaire
17.	Motorized Volume Control Dampers:	
17.1	Bare Dampers	Greenheck/ Dynacraft/ Ruskin/ System Air/ Caryaire
17.2	Actuators	Belimo/ Siemens/ Honeywell

S. NO.	DETAILS OF EQUIPMENT AND MATERIALS	MANUFACTURER'S NAME
	AIR DISTRIBUTION	
18.	Dash fastners/ suspension accessories with anti-seismic feature	HILTI/ Fischer/ Canon
19.	Pre-insulated Flexible Ducts	UP Twiga/ Sphere
20.	Un-insulated Flexible ducts	Atco/ Sphere
21.	Spigots	Dynacraft/ Mapro/ Sevex/ Caryaire
22.	Fire Retardant Canvass connections for ductwork (for building expansion joints)	Resistoflex/ Easyflex/ Sevex/ Caryaire/ System Air/ Zeco/ Waves
23.	Fire Sealant	3M/ Hilti
24.	Round/ Elliptical ducts	GP Spira/ Waves/ Pioneer
25.	Fire Retardant Coating on Ductwork	Flamebar/ Paramount-Polytreat/ Cischem
26.	Anti-Corossion Coating on STP Ductwork	Paramount-Polytreat/ Cischem

S. NO.	DETAILS OF EQUIPMENT AND MATERIALS	MANUFACTURER'S NAME
INSULATION		
1.	Fibre Glass	UP Twiga/ Owens Corning/ Kimmco
2.	R P Tissue	UP Twiga/ Owens Corning/ Kimmco
3.	Closed/ Open Cell Elastomeric Insulation material:	
3.1	Nitrile Rubber	Armaflex/ Aerocell/ K-Flex/ Eurobatex
3.2	EPDM	Aeroflex/ HT Armaflex/ K Flex HT
4.	Adhesive for closed/ open cell insulation material	Pidilite/ Paramount-Polytreat/ Cischem
5.	Expanded Polystyrene	Beardsell/ Styrene Packing
6.	Adhesive for Expanded Polystyrene	Unishield/ Polyshield
7.	Aluminium Tape	3M/ Magic/ Johnson
8.	Aluminium Foil	INDALCO/ BALCO
9.	PUF Pipe Supports	Malanpur Entech/ Bestopuf/ Rinac
10.	Polyester Membrane	Shelko/ Bituplus
11.	External surface treatment of insulated surface of ductwork & piping to achieve mechanical strength and UV protection.	Paramount-Polytreat/ Polybond/ Cischem

S. NO.	DETAILS OF EQUIPMENT AND MATERIALS	MANUFACTURER'S NAME
	ELECTRICALS	
1.	MCC & Starter Panels: Category A Category B	 Tricolite/ Advance/ Adlec India Tech/ Neptune Systems
2.	Air Circuit Breaker	Schneider/ Siemens/ ABB/ L&T
3.	MCCB	Schneider/ Siemens/ ABB/ L&T
4.	MCB	Legrand/ L&T/ Schneider/ ABB
5.	Cables	Polycab/ / KEI/ Rallison/ Bonton/ Havells
6.	Cable Glands	Commet
7.	Cable Lugs	Dowels
8.	Cable Trays	Profab/ India Tech/ MEM
9.	ELCB	Schneider/ L&T/ Legrand/ ABB
10.	Changeover Switch	L&T/ HH Elcon/ Socomec/ HPL
11.	Contactors	Schneider/ Siemens/ ABB/ L&T
12.	Overload Relay	Schneider/ Siemens/ ABB/ L&T
13.	Indicating Lamp/Push Button (LED type)	L&T (ESSBEE)/ Vaishno (2XVLDIL-B1)/ Siemens/ ABB/ Schneider
14.	SFU/FSU	Siemens/ L&T
15.	HRC Fuses & fuse fittings	Siemens/ L&T
16.	Current Transformers	Procom/ Automatic Electric/ Kappa
17.	Rotary switches	Salzer/ L&T/ Kaycee
18.	Toggle Switches	L&T/ Kaycee
19.	Selector Switches	Salzer/ L&T/ Kaycee
20.	Time delay relay	Schneider/ L&T

S. NO.	DETAILS OF EQUIPMENT AND MATERIALS	MANUFACTURER'S NAME
	ELECTRICALS	
21.	Ammeter/Voltmeter (Digital)	Schneider/ L&T/ Secure
22.	Ammeter/Voltmeter (Analog)	AE/ Rishabh
23.	Time Clock	L&T/ Schneider
24.	KWH Meter (Digital Type)	Schneider/ Secure/ L&T
25.	Under Voltage Relays	Procom/ C&S/ L&T
26.	Over Voltage Relays	Procom/ C&S/ L&T
27.	MS Conduits (ISI Marked)	BEC/ AKG
28.	PVC Conduits – FRLS	BEC/ AKG/ Polypack
29.	XLPE Wires – FRLS (Halogen free)	KEI/ Polycab/ Havells / Bonton
30.	Circuit Integrity Cables	FrTek/ AFW/ Belden
31.	Factory Fabricated Distribution Board	Legrand/ Schneider/ L&T

NOTE:

- **Make of any other equipment/ material not mentioned above will require approval from the Consultants prior to execution**.
- **Multiple makes for one equipment/ material while approval being sought, shall not be acceptable.**