



INDRAPRASTHA INSTITUTE OF INFORMATION TECHNOLOGY (IIIT) AT NEW DELHI

TENDER DOCUMENTS FOR

Modification, addition and alteration works in existing HVAC System for Airconditioning and ventilation of Ground floor of Library block at Indraprastha Institute of Information Technology (IIIT) at New Delhi.

HVAC CONSULTANTS :

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TENDER NO: 04/2014

PROJECT

Modification, addition and alteration works in existing HVAC System for Airconditioning and ventilation of Ground floor of Library block at Indraprastha Institute of Information Technology (IIIT) at New Delhi.

Issued By:

Manager(Projects)

On behalf of

Registrar

Indraprastha Institute of Information Technology

IIITD Campus, Service Block, Okhla Phase III , New Delhi - 110020

Issued to:

M/s

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Indraprastha Institute of Information Technology, New Delhi (IIIT-Delhi)

DATED: 11.12.2014

TENDER NOTICE

1. Last Date & Time of issue of tender documents from 11/12/2014
2. Last Date & Time of receipt of tender 19/12/2014 upto 3.00 p.m.

Manager(P), IIIT-Delhi, Okhla, New Delhi-110020 on behalf of Registrar, IIIT-Delhi invites sealed item rate tenders from eligible contractors for similar works.

Name of work: **Modification, addition and alteration works in existing HVAC System for Airconditioning and ventilation of Ground floor of Library block at Indraprastha Institute of Information Technology (IIIT) at New Delhi**

Location : **Ground floor of Library Block**

Estimated cost of work put to tender : **Rs. 8.25lacs**

Time of completion : **One Month**

Earnest Money Deposit: **Rs. 16,500/- (Rupees Sixteen thousand five hundred only)** is to be submitted with tender document as earnest money.

- 1) Tenders are invited from experienced airconditioning contractors. Each tenderer shall submit with his tender a list of airconditioning installations of a like nature they have executed, giving details as to their size and application.
- 2) If the tender is made by an individual it shall be signed with his full name and his complete address shall be given. If it is made by a firm, it shall be signed with the copartner ship name and address of the firm who shall sign his own name and give the name and address of each member of the firm and attach a copy of the power of attorney with the tender. In case the tender is made by or on behalf of a company incorporated under the companies act (1 of 1956), it shall be signed by a person holding power of attorney duly authorized on their behalf and shall bear the seal of the company. Each tender is to be in a sealed cover super scribed, Tender for **Modification, addition and alteration works in existing HVAC System for Airconditioning and ventilation of Ground floor of Library block at Indraprastha Institute of Information Technology (IIIT) at New Delhi.**
- 3) The acceptance of a tender will rest with the employer and the Engineer Incharge which does not bind itself to accept the lowest tender and reserve to itself the authority to reject any or all the tenders received without assigning any reason. All tenders in which any of the prescribed conditions are not fulfilled or are incomplete in any respect are liable to be rejected.

- 4) Tenders shall remain open for acceptance for a period of (60) sixty days from the date of opening of tenders.
- 5) The successful tenderer must be co-operative with the other contractors appointed by the employer so that the work shall proceed smoothly with the least possible delay and to the satisfaction of the Engineer Incharge.
- 6) The tenderer whose tender has been accepted shall within four days of the intimation of the acceptance of tender hand over the Engineer in Charge a stamp paper of suitable value. Tenderer's failure to supply stamp paper within the time shall give right to the employer to revoke the acceptance of tender without any further to the tenderer.

Tender documents can be purchased by approved/eligible contractors from Manager(P), Office between 10.00 a.m. to 5.00 p.m. on all working days from 11/12/2014 on payment of **Rs.500/-** (non-refundable) as cost of tender in form of DD in favour of "IIIT Delhi Collections' or downloaded from IIITD website (www.iiitd.ac.in) and submitted with non refundable DD of Rs. 500/- in favour of "IIIT Delhi Collections' as cost of tender. Earnest Money Deposit: **Rs. 16,500/- (Rupees Sixteen thousand five hundred only)**

The above payment shall be made in the shape of deposit at pay order/demand draft of a scheduled bank issued in favour of **Indraprastha Institute of Information Technology ,Delhi** payable at New Delhi.

- 1) The tenders shall be placed in sealed envelopes with a name of work and due date written on the envelope and addressed to the Manager(P),IIITD. Complete tender documents shall be submitted by the approved contractors in **two envelopes**. **1st envelope** shall contain the earnest money in the shape of Demand Draft / Pay Order of a scheduled Bank requisite shape as per condition & eligibility criteria and cost of tender as stated above in case of the downloaded version.
- 2) The eligible contractors who have carried out similar works in IIIT-D/Govt Deptts/PSU/Reputed Pvt sector /MNCs are to submit the experience certificates for the works and registration certificates with Govt. Depts. if any. The said certificates along with the EMD be enclosed in Envelope-1.
- 3) Experience of having successfully completed similar works during last seven years ending on the last day of the month previous to the one in which the tenders are invited. The similar works are defined as works of interiors

Three similar works not less than 40% of est.cost	Rs 3.3 lacs each Or
Two similar works not less than 60% of est cost	Rs 4.9 lacs each Or
One similar work not less than 80% of est cost	Rs 6.6 lacs each

- 4) The applications not supported with requisite experience certificates, valid DVAT certificate, TIN no. and ITCC in Envelope-1 shall not be entertained.
- 5) The **2nd envelope** shall contain the financial bids including Priced Schedule of Quantities, Form of Tender, Conditions of Tender, Articles of Agreement, Brief Specifications, Condition of contract, Drawings all duly signed by the authorized signatory of the firms.

All these envelopes are to be put in a single envelope duly super-scribed the name of work, and addressed to Manager(P), (IIITD) and with their address. In case the tenderer does not fulfill the laid down eligibility criteria or fails to deposit the earnest money in prescribed form, financial bid shall not be opened.

Tenderers shall seal the tender affix their initials and put stamp on each and every page of tender document before submission. The tender of the contractor, who submits incomplete tender document or submits more than one tender for one work, shall not be considered at all.

Tenders will be received by the Manager(P) up to 3.00 P.M on 19/12/2014 and will be opened by him or his authorized representative in the office of Registrar/CE, IIITD on the same day at 3.30 P.M.

First the Technical Bids will be opened and screened .The bids shall be examined whether the EMD is in order and the bidder meets the minimum eligibility criteria specified above. . Those bidders whose EMD is in order, meets the minimum eligibility criteria, has submitted all the required documents and meet the technical requirements shall be considered for opening of financial bid.

Conditional tenders would not be accepted. Financial bids in respect of contractors who do not fulfill above criterion shall not be opened.

- 6) No Xerox / certified copies of tenders shall be accepted, if submitted these tenders shall be rejected.
- 7) Tenderers should visit the site before submission of tenders and no extra would be paid for non acquaintance of site conditions.
- 8) The working hours may have to be modulated as per Institute requirements and no extra would be payable on such account.
- 9) Water and electricity would be provided free of cost at one point and further extensions/arrangements shall be made by the contractor at his cost.
- 10) Care should be taken for ensuring that no existing building /services are damaged . Any such damages shall be got rectified by the Contractor or shall be got executed through any other agency at his cost.
- 11) The equipment supplied shall be BMS compatible and necessary ports for same should be made available in the system for the same.

Letter of Acceptance

Date

Subject :-

Sir,

I/we hereby tender for the execution of the work specified in the under written memorandum within the time specified at the rates specified therein accordance in all respects with the specifications, design, drawings and instructions supplied by your which I/we have read very carefully.

I/we hereby distinctly and expressly declare and acknowledge that before the submission of my/our tender, I/we have carefully followed the general instructions and read the detailed specifications and schedule of quantities and clearly understood all the conditions of contract. I/we have also seen the location where the said work is to be done and made such investigations of the work required in regard to the materials required to be furnished as to enable me/us to complete the work successfully.

I/we agree to complete the work in 1 month from the date of award of work.

I/we agree to keep the offer open for sixty days from the date of opening of tender.

Yours faithfully,

Signature.

Conditions of Contract

1. Definition :

In constructing this contract as defined in 1(e) below the following words shall have the meaning herein assigned to them except where the subject or contract otherwise requires :

- a) Employer/ Owner : Shall mean IIIT-Delhi Okhla ,Phase III New Delhi, India - 110020 include his/their representative/s assign/s successor/s
- b) Consultants : Shall mean M/S Abid Husain Consultants, LG1 & LG2, Jeevan Prakash Apts., 16 A, Okhla, New Delhi - 110025 include his/their representative/s assign/s successor/s
- c) Contractor : Shall mean and shall include his/their legal representative/s assign/s successor/s
- d) Site : Shall mean the site of the contract works.
- e) This contract : Shall mean invitation to tenders and general instruction to contractor's letter of acceptance of tender. Articles of agreement and conditions of contract, the appendix, system specifications and the schedule of quantities attached hereto and duly signed.
- f) Notice in writing or written notice : Shall mean a notice in writing, typed, or printed characters sent (unless delivered personally otherwise proved to have been received) by registered post to the last known private or business address or registered offices of addressee and shall be deemed to have been received when in the ordinary course of post it would have been delivered.

Words importing persons include firm and corporations. Works importing the singular only also include the plural and vice-versa where the contract requires.

2. Scope of Contract :

The contractor shall carry out and complete the said work in every respect in accordance with this contract and under the directions of and to the satisfaction of the Engineers Incharge. The Engineers Incharge may in his discretion and from time to time issue further drawings and/or written instructions, details, directions and explanations which are hereunder collectively referred to as “Engineers Incharge” instruction in regard to :-

- a) The variation or modification of the design, quality or quantity of works or omission or substitution of any work.
- b) Any discrepancy in the drawings or between the schedule of quantities and/or drawings and/or specifications.
- c) The removal and/or execution of any works executed by the contractor.
- d) The dismissal from the works of any person employed thereupon.
- f) The amending and making good of any defects under clause 21. The contractor shall forthwith comply with and duly execute any work comprised in such Engineers Incharge instructions provided always that verbal instructions, directions and explanations given to the contractor or his representative upon the works by the Engineers Incharge shall if involving a variation, be confirmed in writing by the contractor within 14 days. And if not dissented from in writing within a further 7 days by the Engineers Incharge, such shall be deemed to be the Engineers Incharge instructions within the scope of the contract.

3. **Contract to Provide Everything Necessary :**

- a) The contractor shall provide everything necessary for the proper execution of the work according to the intent and meaning of the drawings, schedule of quantities and specifications taken together whether the same or may not be particularly shown or described therein provided that the same can be reasonably inferred there from, and in case of any discrepancy in the drawings or between the drawings, schedule of quantities and specifications, the more stringent shall be followed.
- b) The contractor shall supply, fix and maintain at his own cost during the execution of any works, all the necessary centering, scaffolding, staging, planking, timbering, strutting, shoring etc., as occasion shall require or when ordered to do so and shall fully reinstate and make good all matters and things disturbed during the execution of the works, to the satisfaction of the consultant.

4. **Authorities Notices and Patents :**

The contractor shall conform to the provisions of any act of legislature relating to the works, and to the regulations and by-laws of any authority, and of any water, lighting and other companies and/or authorized with whose system the

plant is proposed to be connected, and shall before making any variations from the

drawings or specifications that may be necessitated by so conforming, give to the engineers Incharge written notice specifying the variation proposed to be made and the reasons for making it and apply for instructions thereon. In case the contractor shall not within ten days receive such instructions he shall proceed with the work, conforming to the provisions, regulations or by-laws in question. the contractor shall indemnify the employer against all claims in respect of patent rights and shall defend all act once arising from such claims, and shall himself pay all royalties license fees, damage, costs and charges of all and every sort that may be legally incurred in respect thereof.

5. **Contractor's Supervision on the Works :**

The contractor shall give all necessary personal superintendence during the execution of the works, and as long thereafter as the Engineers Incharge may consider necessary until expiration of the "Guarantee period" stated in the appendix hereto. The contractor shall also during whole time the works are in progress, appoint a competent representative who shall constantly supervise work at site.

6. **Access of Engineers Incharge to Work :**

The Engineers Incharge/Employer and their representative shall at all reasonable time have free access to the works. The contractor shall give every facility to the Engineers Incharge/Employer and their representative, necessary help for instructions and examinations and test of the materials and workmanship.

7. **Measurement of Works :**

The Engineers Incharge may from time to time intimate to the contractor that he requires the works to be measured and the contractor shall forthwith attend or send a qualified agent to assist the Engineers Incharge or the Engineers Incharge's representative in taking such measurements and calculations and to furnish all particulars or give all assistance required by either of them. Should the contractor not attend or neglect or omit to send such agent, then the measurements taken by the Engineers Incharge or approved by him shall be taken to be the correct measurements of the works. Such measurements shall be taken to be the correct measurements of the works, in accordance with the standard method of measurements, as in prevalent use, for the airconditioning work.

The contractor or his agent may at the time of measurement take such notes and measurements as he may require. The contractor shall submit running bills supported by detailed measurement sheets as and when necessary preferably once a month for all the works executed by him upto date. After the virtual completion of the works to the satisfaction of the Engineers Incharge, the contractor shall forward the final bill in the same manner as explained above. No claims shall be entertained in respect of works after submission of the final bill by the contractor.

8. **Certificate of Virtual Completion :**

The works shall not be considered as completed until the Engineers Incharge has certified in writing that the works have been 'Virtually Completed' and the guarantee period shall commence from the date of such certificate. Such certificate shall not be issued until all tests as given in clause 19 are carried out to the entire satisfaction of the Engineers Incharge or his representative.

9. **Insurance in Respect of Damage to Persons and Properties :**

The contractor shall be responsible until the virtual completion of all works for all injury to persons, animals or things and for all structural and decorative damage to property, plant and machinery which may arise from the operation or neglect of himself, or of sub contractor or any of his sub contractors employees, whether injury or damage arise from carelessness, accident or any other cause whatever in any way connected with the carrying out of this contract. The contractor shall indemnify the employer and hold him harmless in respect of all and any expenses arising from any such injury or damage under any act of government or otherwise and also in respect of any award of compensation or damage upon such claim.

The contractor shall indemnify the employer with a policy of insurance in the joint names of the employer and the contractor against such risks and deposit such policy or policies with the Engineers Incharge from time to time during the currency of this contract.

The contractor shall be responsible for anything which may be excluded from the insurance policies above referred to and also for all other damages to any property arising out of and incidental to the negligent or defective carrying out of this contract.

10. **General Insurance :**

The contractor shall at the time of signing the contract insure the works, plant and machinery and keep them insured until the virtual completion of the contract against loss or damage by fire, theft or loss in transit, in an office to be approved by the Engineers Incharge, in the joint names of the employer and the contractor (the name of the former being placed first in the policy) for the full amount of the contract.

11. **Date of Commencement and Completion :**

The contractor shall be allowed admittance to the site on the 'date of commencement's stated in the appendix and he shall thereupon and forthwith

begin the works and shall regularly proceed with and complete the same on or before the date of completion stated in appendix subject nevertheless to the provisions for extension of time hereinafter contained.

12. **Damage for Non Completion :**

If the contractor fails to complete the works by the date stated in the appendix or within any extended time under clause 14 hereof and the Engineers Incharge certifies in writing that in his opinion the same ought reasonably so to have been completed, the contractor shall pay or allow to the employer the sum named in the appendix as 'liquidated damages' for the period during which the said works shall so remain incomplete and the employer may deduct such damage from any moneys due to the contractor.

13. **Force Majeure :**

The right of the contractor to proceed with the work shall not be terminated because of any delay in the completion of the work due to unforeseeable causes beyond the control and without the fault or negligence of the contractor, including but not limited to acts of god, or of the public enemy, restraints of a sovereign state, firms, floods, unusually serve weather and act of the employer.

14. **Delay and Extension of Time :**

In the opinion of the Engineers Incharge the works be delayed :

- a) By force majeure.
- b) By reasons of civil commotion, location combination of workers on strike or lock-out affecting any of the building trades.
- c) In consequence of the contractor for not having received in due time necessary instructions from the Engineers Incharge for which he shall have specifically applied in writing.
- d) By reasons of Engineers In charge's instructions as per clause 2. the Engineers Incharge shall make a fair and reasonable extension of time for completion of the contract works.

In case of such strike or lock-out, the contractor shall, as soon as possible give a written notice thereof to the Engineers Incharge, but the contractor shall nevertheless constantly use his endeavors to prevent delay and shall do all that may reasonably be required to the satisfaction of the Engineers Incharge to proceed with the work.

15. **Clearance of Site :**

The contractor shall have to remove all malba and other unwanted material from site of work, before handing over airconditioning installation to the employer. The work shall not be treated as complete in all respects unless these requirements are fulfilled by him. In the event of the contractor failing to do so, the architects and the employer shall have right to get the site cleared.

16. **Prices :**

The prices to be quoted by the intending tenderer shall include the supply and installation, at the site, of all equipment, ancillary material and other items whatsoever required for carrying out the job to fulfill the intent and purpose as laid down in the specifications and/or the drawings. The tenderer's price shall be deemed to include all nuts, bolts, shims, clamps, supports, etc., as required for proper fixing and/or grouting of equipment, ancillary items, etc. whether specifically mentioned or not. The contractor shall also include, in his price, all taxes, duties or other levies, (viz., excise duty, customs duty, sales tax, WCT, Octroi etc.) which are legally leviable on airconditioning plant and installation. Failure to include all leviable taxes and duties will not entitle the contractor to any extra claims from the employer. The contractor's rates shall remain firm and fixed during the currency of the contract.

17. **Variation in Quantities :**

The quantities for ancillary work given in the drawings and/or specifications are for the guidance of the tenderer. The contractor shall, however, be paid on the basis of actual quantities of works carried out.

18. **Working Drawing, Maintenance Manuals etc :**

On the award of the work, the contractor shall immediately proceed with the preparation of detailed working drawings detailing the equipment that are to be installed and the ancillary work that are to be carried out. Three sets of all such working drawings shall be submitted to the Engineers Incharge for his approval to ensure that the works will be carried out in accordance with the specifications and drawings, including such changes as may have been mutually agreed upon. All the drawings shall be received by the Engineers Incharge, for his approval, within one week of the award of work. The approval of the drawings by the Engineers In charge, shall in no way relieve the contractor from his obligations to provide a complete and satisfactory plant and installation as per intent and purpose as laid down in the specifications. Any commissions and/or errors shall be made good or rectified whether or not the drawings are approved.

Prior to the completion of the work, the contractor shall furnish to the employer (4) four sets of a comprehensive manual, describing all components, furnish a list of spare parts and settings forth in details the instructions for the operation and maintenance of the plant.

The contractor shall also fix in the plant room, neatly typed and framed, instructions in details, for the starting and running of the plant.

Any special tools required for the operation or the maintenance of the plant shall be supplied free with the plant.

19. **Testing :**

All types of routine and type tests shall be carried out at the works of the contractor or the manufacturers of the components. The Engineers Incharge shall be free to witness any or all tests if he so desires.

On the completion of the installation the contractor shall arrange to carry out various initial tests as detailed below, in the presence of and to the complete

satisfaction of the Engineers Incharge or his representative. Any defects or shortcomings found during the tests shall be speedily rectified or made good by the contractors at his own expense. The initial tests shall include but not be limited to the following :

- i) To test and check the proper functioning of switch gears, safety and other controls to ensure their proper functioning.
- ii) To check and adjust the water flow in the water circuits.
- ii) To check the systems against leaks in different circuits.
- iv) On the satisfactory completion of all 'initial' tests the plant shall be considered to be 'virtually complete' for the purpose of taking over by the employer.
- v) To check the systems against leaks in different circuits, alignment of motor, v-belt adjustments, control setting all such other tests which are essential for smooth functioning of the plant.
- vi) In addition to the 'initial' test the contractor shall also give one continuous running tests of the plant of 8 hours duration for three day. The running test will be conducted on the completion of the initial test.
- vii) The contractor shall provide all necessary tools, instruments, gauges, flow meter, anemometer etc., as may be required for conducting the various tests. He shall also provide necessary lubricants, etc., and required personnel for the tests. however, water and power for the tests shall be provided by the employer.

20. **Power for Installation :**

The employer shall provide power at one point in the building for proper execution of the work. The contractor shall install his own sub-meter any pay for all electricity consumed by him.

21. **Subletting :**

No part of contract shall be sublet without written permission of the Client.

22. **Minor Civil Work :**

The contractor shall provide all necessary minor opening/closing for refrigerant piping and cabling etc.

23. **Frame :**

The Contractor shall provide all necessary wooden, GI frame for grills/diffusers and MS frame for outdoor units.

24. **Rejection of Defective Plant :**

- a) If on test any portion of the plant, equipment or components are found to be defective or not fulfilling the intent or the meaning of the specifications, the same shall be replaced or repaired to the entire satisfaction of the Engineers Incharge.
- b) In case the contractor fails to remove the defects, within a period considered reasonable by the Engineers Incharge, the employer reserves the right to take necessary remedial measures through other agencies and all expenses thus incurred would be recovered from the contractor.
- c) The employer reserves the right to operate all the equipment and complete system, whether or not the plant is taken over after the initial test and commissioning.

Any defects found during the initial or running tests shall be removed at a suitable time as decided upon by the Engineers Incharge .

25. **Maintenance of the Plant/Equipment Training of Personnel :**

- a) The contractor shall arrange to provide, at no extra cost necessary personnel and material to carry out all routine and special maintenance of the plant/Equipment as required, regularly for a period of (12) twelve months from the date of virtual completion.
- b) The contractor shall also train the employer's personnel, to operate the plant/equipment and carry out routine checks, during the period of installation and testing. If found necessary, the employer shall train such personnel at his work at no extra cost to the employer.

26. **Completeness of the Plant :**

The contractor shall provide all required materials, equipment, ancillary items, etc., to install a complete and satisfactory airconditioning plant capable of fulfilling the intent and purpose of the contract, whether or not each and

every item is mentioned in the specifications and/or drawings. Any shortcomings notices at any stage shall be made good at no extra cost.

27. **Guarantee :**

- a) The contractor shall guarantee that all the material, machinery and components supplied, fabricated, designed and installed by him shall be free from defects due to faulty design material and/or workmanship, that the plant shall perform satisfactorily and the efficiency of the system and all the components shall not be less than the values laid down in the specifications and the capacities, shall be at least equal to those specified.
- b) The period of the guarantee shall be (12) twelve months from the date of commissioning & handing over of complete system during which period of any or all components found to be defective shall be replaced or repaired free of charge

and any short comings found in the system as specified shall be removed at no extra cost. The contractor shall provide the necessary personnel and tools for fulfilling the above guarantee.
- c) If for any reason, the first running test cannot be carried out, then the plant shall carry a guarantee for

A period of (15) fifteen months from the date of "Virtual Completion".
- d) If the defects are not removed with in a reasonable time, the employer may arrange to do so at the contractor's risk and cost, without prejudice to any other rights.

28. **Certificate and Mode of Payment :**

The contractor shall be paid by the employer from time to time, by installments, on obtaining interim certificates to be issued by the Engineer Incharge, in the manner described below :-

- a) 10% of the contract value as advance against a bank guarantee.
- b) 50% prorata payment against the supply of equipment, components at site.
- c) 20% of the contract value against erection.
- d) Final 10% of the contract value against testing and commissioning.
- e) 10% retention amount for period of 12 months from the date of virtual completion. This amount can be released against Bank Guarantee of same amount.

Appendix

- | | | |
|----|-------------------------|---|
| 1. | Name of work | Airconditioning & Ventilation Work for Library Building at Indraprastha Institute of Information Technology (IIIT) at New Delhi. |
| 2. | Time of completion | 1 month |
| 3. | Commencement of work | Within 7 days from award of work. |
| 4. | Defect liability period | 12 months form date of virtual completion. |
| 5. | Liquidated damages | 2% per week maximum 5% of total contract value of the airconditioning work. |
| 6. | Terms of payment | 10% of the contract value as advance against a bank guarantee.
50% prorate payment against the supply of equipment, components at site.
20% of the contract value against erection.
Final 10% of the contract value against testing and commissioning.
10% retention amount for period of 12 months from the date of virtual completion. This amount can be released against Bank Guarantee of same amount. |

Specification

Section 1

System Design Data

1. General :

This report outlines the basis of design, estimated requirements, proposed system, other requirements and estimated cost.

2. Location :

- 2.1 The proposed work is to be carried out for the **Airconditioning & Ventilation Work for Library Building at Indraprastha Institute of Information Technology (IIIT) at New Delhi.**

3. Scope of Work

- 3.1 The work proposed under this tender includes providing and fixing Airconditioning and Ventilation system for the above areas.
- 3.2 Providing and fixing at site all main equipments associated with **Airconditioning & ventilation** system asked under these technical specifications.
- 3.3 To execute all incidental work at site including materials supply at site associated with ventilation system asked in the technical specifications. Nature of such works will be sheet metal duct/grill work, etc. incidental civil work, incidental electrical engineering work, cable, control panel etc. erection at site for all manufactured items at work and also items fabricated at site.
- 3.4 Routine testing, pressure testing of fabricated components, commissioning of complete system at site.
- 3.5 Performance testing at site complete **Airconditioning & ventilation** system as per various technical requirements as stipulated in performance testing clause.

4. Basis of Design :

- | | | | | |
|-----|---------------------|--------------|---|----------------------|
| 4.1 | Out side conditions | Summer | : | 43.3° CDB; 23.8° CWB |
| | | Monsoon | : | 35.0° CDB; 28.3° CWB |
| 4.2 | Inside conditions | Summer | : | 26.0° CDB +/- 1° C |
| | | &
Monsoon | : | RH 55% ±5% |

- 4.3 Lighting load : 1.5 watt per sqft.
 4.4 Occupancy : 100 person.
 4.5 Fresh air : As per ASHRAE 62.1.2007

5. **Estimated Requirement :**

Based on above design data, the estimated requirements are as follows.

S.No.	Description	Area	Summer	Monsoon
		SQFT	TR	TR
1	Sitting area	4451	17.08	17.7
2	Double Ht Area 1	383	1.13	1.32
3	Double Ht Area 2	383	1.13	1.32
	SUB-TOTAL:	5217	19.34	20.34

6. **System Design :**

- 6.1 It is proposed to install Floor Mounted Airhandling unit with VFD for airconditioning the above area .
 6.2 The new system shall be installed after dismantling of existing system including airwasher, false ceiling, ducting, grilles etc.
 6.3 The existing smoke extraction system will be used for proposed system also.
 6.4 We will be using the existing ducts placed in trenches.
 6.5 It is proposed to take out chilled water connections from the existing header going through the AHU room.

7. **Drawings :**

The drawings forming part of these specifications provide a feasible scheme for locating the equipment. The contractor may re-arrange the equipment for improving the layout and meeting the site conditions. All such changes shall however be subject to the architects approval. These drawings are not meant to be working drawing which shall be prepared by the contractor as required.

8. **Test data :**

The plant whole system shall be tested as per specifications given elsewhere and complete test data shall be furnished on prescribed data sheet.

9. **Deviation from Specifications :**

Deviation from specifications may be accepted, provided such deviations are found necessary and appropriate, in order to conform to the design .

10. **Technical Data :**

The contractor shall furnish complete “technical data” on the equipment offered by him as required under the heading "Technical Data".

11. **Performance Guarantee :**

11.1 The contractor shall guarantee that the capacity of various components as well as the whole system shall not be less than specified.

11.2 The contractor shall ensure, that the system shall be free of vibrations and disturbing sounds.

End of Section 1

Section 2

Air Handling Units - Double Skin (Floor Standing)

1. AIR HANDLING UNITS

1.1 SCOPE

The scope of this section, comprises the supply, erection, testing and commissioning of double skin construction air handling units, conforming to these Specifications and in accordance with requirements of drawings and of the Schedule of Quantities.

1.2 TYPE

The air handling units shall be double skin construction, draw-thru type comprising of various sections, filter section, coil section and fan section, mixing box, (wherever the return air and fresh air are ducted) as shown on drawings and included in schedule of quantities.

1.3 CAPACITY

The air handling capacities, maximum motor horse power and static pressure shall be as shown on Drawings and in Schedule of Quantities.

1.4 CASING

Double skinned panels shall be 40+/-2 mm thick. Double Skin Panels shall be made of 0.6mm Pre-coated GSS on outside and 0.6mm Galvanized sheet inside with CFC – FREE P.U. insulation of 42 (+/- 5%) kg/Cu M injected in between with an internal gasket between the skins to interrupt the thermal bridge of the panel. Outer sheet of panels shall be made of galvanized pre coated sheet of 0.6mm thickness to ensure mechanical strength air leakage thermal bridging and thermal transmittance. There should not be any metal to metal contact between inner and outer skins of AHU casing to ensure thermal bridging. AHU shall be with thermal break casing.

The entire framework shall be mounted on an aluminium alloy or galvanized steel or heavy duty engineering composite material channel base as per manufacturer 's recommendation. Panels shall be assembled together to form an enclosure that is capable of low air leakage potential. Handles shall be made of hard nylon and all access panels should be openable with Allen key arrangement. Units supplied with various sections shall be suitable for on site assembly with continuous foam gasket. All fixing and gaskets shall be concealed.

Units shall have hinged, quick opening access door in the fan section and also in filter section where filters are not accessible from outside. Access doors shall be double skin type.

Condensate drain pan shall be fabricated from 18 gauge stainless steel sheet with all corners welded.

1.5 **DAMPER**

Dampers shall be opposed blade type. Blades shall be made of double skinned aerofoil aluminum sections with integral gasket and assembled within a rigid extruded aluminum alloy frame. All linkages and supporting spindles shall be made of aluminium or nylon, turning in Teflon bushes. Manual dampers shall be provided with a Bakelite knob for locking the damper blades in position. Linkages shall be extended wherever specified for motorized operation. Damper frames shall be sectionalized to minimize blade warping. Air leakage through dampers when in the closed position shall not exceed 1.5% of the maximum design air volume flow rate at the maximum design air total pressure.

1.6 **MOTOR AND DRIVE**

Fan motors shall be energy efficient and shall be $415 \pm 10\%$ volts, 50 cycles, three phases, totally enclosed fan-cooled class F, with IP-55 protection. Motors shall be especially designed for quiet operation. Motor shall be suitable to operate with direct driven plug fans and frequency converter. VFD shall be IP 20 type.

1.7 **FAN**

Fans shall be backward curved plug fan with aerofoil design blades so as to give maximum efficiency for given duty condition. The entire fan with casing will be certified by a reputed, internationally acclaimed certifying body which will be a 3rd party like Eurovent or ARI or AMCA and the entire Fan + Motor assembly will be balanced at supplier's works before dispatch. Fans driven by variable frequency drive shall be backward inclined irrespective of static pressure value. Fans shall be selected for minimum efficiency of 70%. Fan array with multiple fans shall be used for capacities more than 15000 CMH. Plug fan in fan array shall have individual VFDs for every motor fan set. Fan motor assembly shall be statically and dynamically balanced as per relevant ISO/AMCA/EUROVENT standard. **Certified computerized selection for AHU shall be with fan selection.**

Motors shall be mounted inside the AHU casing on slide rails for alignment and be totally enclosed, fan cooled with class 'F' insulation.

Both fan and motor assemblies shall be mounted on powder coated MS/galvanized steel (depending on size) base frame.

Heavy duty anti-vibration mounts shall be provided for isolating the unit casing. Flame retardant, waterproof silicone rubber impregnated flexible connection shall be provided at the fan discharge.

1.8 COOLING COILS

Chilled water coils shall have 12.5 to 15 mm dia (O.D) tubes minimum 0.35 mm thick with sine wave aluminium fins firmly bonded to copper tubes assembled in zinc coated steel frame. Face and surface areas shall be such as to ensure rated capacity from each unit and such that the air velocity across the coil shall not exceed 150 meters per minute. The coil shall be pitched in the unit casing for proper drainage. The coil shall have suitable size header with chilled water supply & return connections protruding out of AHU casing by minimum 150 mm. Each coil shall be factory-tested at 21 kg per sq. m air pressure under water. Tube shall be mechanically expanded for minimum thermal contact resistance with fins. Fin spacing shall be 4 - 5 fins per cm. Water pressure drop in coil shall not exceed 10 PSIG.

All AHUs shall be provided with minimum 4 Row Cooling Coil.

Coil performance shall be certified by a third party like Eurovent/AHRI.

1.9 FILTERS

Each unit shall be provided with a factory assembled filter section containing washable synthetic type air filters having GI frame. Filter media and frame shall be rust proof and corrosion resistant. The filter shall have minimum 90% efficiency down to 10 microns. The media shall be supported with HDP mesh on one side and aluminium mesh on other side. Filter banks shall be easily accessible and designed for easy withdrawal and renewal of filter cells. Filter framework shall be fully sealed and constructed from galvanized steel.

1.10 ACCESSORIES

Each air handling unit shall be provided with manual air vent at high point in the cooling coil and drain plug in the bottom of the coil. In addition, the following accessories may be required at air handling units, their detailed specifications are given in individual sections, & quantities separately identified in schedule of Quantities.

- a. Insulated butterfly valves, balancing valves, 'Y' strainer, union & condensate drain piping with 'U' trap upto sump or floor drain in air handling unit room, as described in section "Piping".
- b. Thermometers in the thermometer wells & pressure gauge (with cocks) within gauge ports in chilled water supply and return lines as per the section "Instruments".

1.11 FRESH AIR INTAKES

Extruded aluminium construction duly anodized (20 microns and above) fresh air louvers with bird screen and dampers shall be provided in the clear openings in masonry walls of the air handling unit rooms having at least one external wall. Louvers, dampers, pre-filters, ducts and fresh air fan with speed regulator shall be provided as shown in 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 intakes shall be as per the requirements of Schedule of Quantities.

1.12 PAINTING

Shop coats of paint that have become marred during shipment or erection shall be cleaned off with mineral spirits, wire brushed and spot primed over the affected areas, then coated with paint to match the finish over the adjoining shop painted surface.

1.13 PERFORMANCE DATA

Air handling unit shall be selected for the lowest operating noise level of the equipment. Fan performance rating and power consumption data with operating points clearly indicated shall be submitted and verified at the time of testing and commissioning of the installation. Computerized selection for all FMUs shall be provided through 3rd party certified software.

1.14 TESTING

Cooling capacity of various air handling unit models will be computed from the measurements of air flow and dry and wet bulb temperatures of air entering and leaving the coil. Flow measurements shall be by an anemometer and temperature measurements by accurately calibrated mercury-in-glass thermometers. Computed results shall conform to the specified capacities and quoted ratings. Power consumption shall be computed from measurements of incoming voltage and input current.

End of Section 2

Section 3**VARIABLE FREQUENCY DRIVE (VFD)****1. VARIABLE FREQUENCY DRIVE (VFD)****1.1 Air quantity flow control**

1.1.1 The VFD shall be a dedicated HVAC engineered design supporting HVAC applications. The VFD and all its options shall be Factory built and Factory tested as a SINGLE unit and not at site.

1.1.2 The VFD shall be tested to UL 508C, CE marked and conform to the European Union Electro Magnetic Compatibility directive. The VFD shall be UL listed for a short circuit current rating of 100 kA and labeled with this rating.

1.1.3 The VFD shall allow the motor to produce full rated power at rated motor voltage, current, and speed without using the motor's service factor. The VFD shall be using Advanced PWM control methodology for high motor performance. The motor current shall closely approximate a sine wave.

1.1.4 The VFD shall have a dual 5% impedance DC link reactor (Harmonic filters) on the positive and negative rails of the DC bus to minimize power line harmonics and protect the VFD from power line transients. The chokes shall be non-saturating.

1.1.5 IEEE519, 1992 recommendations shall be used for the basis of calculation of total harmonic distortion (THD) at the point of common coupling (PCC).

1.1.6 All VFDs up to 90 KW shall contain integral EMC Filters to attenuate RFI conducted to the AC power line and must be complying with the emission and immunity requirements of IEC 61800-3: 2004, Category C1 with 50m motor cable (unrestricted distribution) that are recommended for Critical Applications with high volume of Electronic Data communications for Airports.

1.1.7 The VFD shall be able to provide variable torque Volts/Hz output to give full motor torque at any selected frequency from 20 Hz to base speed. Breakaway current of 160% shall be available.

1.2 The VFD shall have the following features –

1.2.1 A AUTOMATIC ENERGY OPTIMIZATION to automatically and continuously monitor the motor's speed and load to adjust the applied voltage to maximize energy savings

1.2.2 An Automatic Motor Adaptation algorithm shall measure motor stator resistance and reactance to optimize performance and efficiency. It shall not be necessary to run the motor or de-couple the motor from the load to perform the test.

- 1.2.3 The VFD shall be capable of running the system at programmed lower speed even in case of Phase loss. Protection against input transients, loss of AC line phase, output short circuit, output ground fault, over voltage, under voltage, VFD over temperature and motor over temperature.
- 1.2.4 The VFD shall be fully protected from switching a contactor / isolator at the output without causing tripping and it should not be necessary to provide the interlocks for Switches on Output side.
- 1.2.5 The Local Control Panel shall be alphanumeric, graphical, backlit display with provision for two levels of password protection. It is capable to show Five simultaneous parameters display. A red FAULT light, a yellow WARNING light and a green POWER-ON light shall be provided. These indications shall be visible both on the keypad and on the VFD when the keypad is removed.
- 1.2.6 Standard Control and Monitoring Inputs and Outputs: Four programmable digital inputs Two programmable digital outputs, Two programmable relay outputs, Form C 240 V AC, 2 A with delay timers, Two programmable analog inputs (0-10 V or 4-20 mA), One programmable analog output. The Analogue/ Digital / Relay I/O shall be expandable using the additional modules based on the application requirement.
- 1.2.7 A real-time clock shall be an integral part of the VFD. All VFD faults shall be time stamped to support troubleshooting.
- 1.2.8 The VFD shall be able to store load profile data to assist in analyzing the system demand and energy consumption over time. There shall be a KWH counter available to record the Energy consumption of the equipment.
- 1.2.9 The VFD shall include a standard EIA-485 (RS 485) communications port and capability to communicate with BMS over Metasys N2 / Modbus RTU protocols. VFD shall have standard USB port for direct connection of Personal Computer (PC) to the VFD.
- 1.2.10 The VFD (≤ 90 kW) shall have 45°C Ambient temperature rating and (> 90 kW) shall have 40°C Ambient temperature rating at full speed, full load operation with continuous drive rated output current without any derating. Relative Humidity Rating shall be 0 to 95%, non-condensing, Elevation rating Up to 3300 feet without derating.
- 1.2.11 VFDs ≤ 90 KW rating Enclosure protection: IP 55, integral, with inbuilt Mains Disconnect with no additional cabinets.
- 1.2.12 The VFD shall have provision for additional PID controllers which can be used to control Chilled Water Valve / Hot Water valve / Fresh Air Damper etc. in the system through the VFD and save I/O points required for BMS.

- 1.2.13 The VFDs shall have three-feedback PID controller to control the speed of the VFD shall be standard. This controller shall accept up to three feedback signals of same kind to support 3-Zone Feedback Control. The VFD shall be programmable to automatically select either maximum / minimum / average of the 3 feedbacks signal as the controlling signal.
- 1.2.14 In case of Multi Motor Operation (Multiple Motors operated thru One VFD), the Distribution box shall be provided separately to distribute power coming from VFD to the respective motors with Over current protection provided for individual motors.

End of Section 3

Section 4

Duct Work and Outlet

1. **General :**

- 1.1 The work under this part shall consist of furnishing labour materials, equipment and appliances as specified necessary and required to install all sheet metal and other allied work to make the air conditioning supply, ventilating, and exhaust system ready for operation as per drawings.
- 1.2 Except as otherwise specified all duct work and related items shall be in accordance with these specifications.
- 1.3 Duct work shall mean all ducts, casings, dampers, access doors, joints, stiffeners and hangers.

2. **Duct Materials :**

- 2.1 The ducts shall be fabricated from galvanized steel sheets class VIII conforming to ISS:277-1962 (revised) or aluminium sheets conforming to ISS:737-1955 (wherever aluminium ducts are specified).
- 2.2 All duct work, sheet metal thickness and fabrication unless otherwise directed, shall strictly meet requirements, as described in IS:655-1963 with amendment-I (1971 edition)

The thickness of the sheet shall be as follows :-

Size of Duct	Sheet thickness		Type of Joint	Bracing if any
	G.I.	Aluminium		
2.2.1 Upto 750mm	0.63 mm	0.80 mm	G.I. Flange	--
2.2.2 751 mm to 1000 mm	0.80 mm	1.00 mm	25x25x3 mm angle iron frame	25x25x3 mm angle iron

				with 8 mm dia nuts & bolts	frame at the rate of 1mt.
2.2.3	1001 mm to 1500 mm	0.80 mm	1.00 mm	40x40x5 mm angle iron frame with 8 mm dia nuts & bolts	40x40x3 mm angle iron frame at the rate of 1 mt.
2.2.4	1501 mm to 2250 mm	1.00 mm	1.50 mm	50x50x5 mm at angle iron with 10 mm dia nuts & bolts at 125 mm centre.	40x40x3 mm at the rate of 1.2 mt. to be crossed braced diagonally
2.2.5	2251 mm and Above	1.25 mm	1.80 mm	50x50x6 mm at angle iron the rate of frame with 1.6 10 mm nuts & bolts at 125 mm centre.	40x40x3 mm at the rate of 1.2 mt. to be crossed braced diagonally

2.3 The gauges, joints and bracings for sheet metal duct work shall further conform with the provisions as shown on the drawings.

2.4 Ducts larger than 450 mm shall be cross broken, duct sections upto 1200 mm length may be used with bracing angles omitted.

2.5 Changes in section of duct work shall be affected by tapering the ducts with as long a taper as possible. All branches shall be taken off at not more than 45 Deg. Angle from the axis of the main duct unless otherwise approved by the engineer-in-charge.

2.6 All ducts shall be supported from the ceiling/slab by means of M.S. Rods of 9 mm (3/8") Dia with M.S. Angle at the bottom. The rods shall be anchored to R.C. Slab using metallic expansion fasteners.

3. **Installations :**

3.1 During the construction, the contractor shall temporarily close duct openings with sheet metal covers to prevent debris entering ducts and to maintain opening straight and square, as per direction of Engineer-In-Charge.

3.2 Great care should be taken ensure that the duct work does not extend outside and beyond height limits as noted on the drawings.

- 3.3 All duct work shall be of high quality approved galvanized sheet steel guaranteed not to crack or peel on bending or fabrication of ducts. All joints shall be tight and shall be made in the direction of air flow.

The ducts shall be re-inforced where necessary, and must be secured in place so as to avoid vibration of the duct on its support.

- 3.4 All air turns of 45 degrees or more shall include curved metal blades or vanes arranged so as to permit the air to make the abrupt turns without an appreciable turbulence. Turning vanes shall be securely fastened to prevent noise or vibration.
- 3.5 The duct work shall be varied in shape and position to fit actual conditions at building site all changes shall be subject to the approval of the Engineer-In-Charge. The contractor shall verify all measurements at site and shall notify the engineer-in-charge of any difficulty in carrying out his work before fabrication.
- 3.6 Sponge rubber or approved equal gaskets shall be installed between duct flanges as well as between all connections of sheet metal ducts to walls, floor columns, heater casings and filter casings. Sheet metals connections shall be made to walls and floors by means of wooden member anchored to the building structure with anchor bolts and with the sheet screwed to them.
- 3.7 Flanges bracings and supports are to be black, mild steel and are to be galvanised on all surfaces before erection. Accessories such as damper blades and access panels are to be of materials of appropriate thickness and the finish similar to the adjacent ducting, as specified.
- 3.8 Joints, seams, sleeves, splitters, branches, takeoffs and supports are to be as per duct
- 3.9 Joints requiring bolting or rivetting may be fixed by Hexagon nuts and bolts, stove bolts or buck bolts, rivets or closed centre top rivets or spot welding. Self tapping screws must not be used. All jointing material must have a finish such as cadmium plating or Galvanized as appropriate.
- 3.10 Flexible joints are to be fitted to the suction and delivery of all fans. The material is to be normally double heavy canvass or as directed by Engineer-In-Charge. On all circular spigots the flexible materials are to be screwed or clipband with adjustable screws or toggle fitting. For rectangular ducts the material is to be flanged and bolted with a backing flat or bolted to mating flange with backing flat.
- 3.11 The flexible joints are to be not less than 75 mm and not more than 250 mm between faces.
- 3.12 The duct work should be carried out in a manner and at such time as not to hinder or delay the work of the other agencies especially the boxing or false ceiling contractors.

4. **Dampers :**

- 4.1 At the junction of each branch duct with main duct and split of main duct, volume dampers must be provided. Dampers shall be two gauges heavier than the gauge of the large duct and shall be rigid in construction.
- 4.2 The volume dampers shall be of an approved type, lever operated and complete with locking devices which will permit the dampers to be adjusted and locked in any positions.
- 4.3 The dampers shall be of splitter, butterfly or louver type. The damper blade shall not be less than 1.25 mm (18) gauge, reinforced with 25 mm angles 3 mm thick along any unsupported side longer than 250 mm. Angles shall not interfere with the operation of dampers, nor cause any turbulence.
- 4.4 Automatic and manual volume opposed blade dampers shall be complete with frames and bronze bearings as per drawings. Dampers and frames shall be constructed of 1.6 mm steel sheets and blades shall not be over 225 mm wide. The dampers for fresh air inlet shall additionally be provided with fly mesh screen, on the outside, of 0.8 mm thickness with fine mesh.
- 4.5 Wherever required for system balancing, a volume balancing opposed blade damper with quadrant and thumb screw lock shall be provided.
- 4.6 After completion of the duct work, dampers are to be adjusted and set to deliver air flow as specified on the drawings.
- 4.7 Automatic fire dampers shall be provided wherever shown on the drawings. The damper shall be multiblade curtain type. The blades should out of the air stream in open position and shall be constructed with minimum 1.8 mm thick aluminium sheets. The frame shall be of 1.6 mm thickness. Other materials shall include return spring, locking device, solenoid aculator, etc.

The fire dampers shall be capable of operating automatically with the actuation of smoke/heat detector. Units fans shall be interlocked with the damper.

5. **Access panel :**

- 5.1 A hinged and gasketed access panel measuring at least 450 mm x 450 mm shall be provided on duct work before each reheat coil and at each control device that may be located inside the duct work.

6. **Miscellaneous :**

- 6.1 All duct work joints are to be true right angle and with all sharp edges removed.
- 6.2 Sponge rubber gaskets also to be provided behind the flange of all grilles.

- 6.3 Each shute from the duct, leading to a grill, shall be provided with an air deflector to divert the air into the grille through the shoot.
- 6.4 Diverting vanes must be provided at the bends exceeding 600 mm and at branches connected into the main duct without a neck.
- 6.5 Proper hangers and supports should be provided to hold the duct rigidly, to keep them straight and to avoid vibrations. Additional supports are to be provided where required for rigidity or as directed by Engineer-In-Charge.
- 6.6 The ducts should be routed directly with a minimum of directional change.
- 6.7 The duct work shall be provided with additional supports/hangers, wherever required or as directed by the Engineer-In-Charge, at no extra cost.
- 6.8 All angle iron flanges to be welded electrically and holes to be drilled.
- 6.9 All the angle iron flanges to be connected to the gss ducts by rivets at 100 mm centres.
- 6.10 All the flanged joints, to have a sponge rubber packing stuck to the flanges with suitable adhesive.
- 6.11 The G.S.S. Ducts should be lapped 6 mm across the flanges.
- 6.12 The ducts should be supported by approved type supports at a distance not exceeding 2.4 metres.

7. **Standard Grilles :**

- 7.1 The supply and return air grilles shall be fabricated from extruded aluminium sections. The supply air grilles shall have single/double louvers. The front horizontal louvers shall be of extruded section, fixed/adjustable type. The rear vertical louvers where required shall of aluminium extruded sections and adjustable type. The return air grille shall have single horizontal extruded section fixed louvers. The grilles may or may not be with an outer frame.
- 7.2 The damper blades shall also be of extruded aluminium sections. The grill flange shall be fabricated out of aluminium extruded section. Grilles longer than 450 mm shall have intermediate supports for the horizontal louvers.

8. **Diffusers/Slot Diffusers :**

- 8.1 The ceiling type square diffusers shall be of aluminium extruded sections with flush or step down face, as specified with fixed pattern and neck.
- 8.2 All supply diffusers shall be provided with extruded aluminium dampers, with arrangement for adjustment from the bottom.

8.3 The slot diffusers shall be of Aluminium extruded sections with diffusion plate and sliding damper.

9. **Linear Diffusers/Grilles :**

9.1 The linear diffusers/grilles shall be fabricated from Aluminium extruded sections.

9.2 The diffusion blades shall be extruded, flush mounted type with single or double direction air flow.

9.3 The frame shall be of aluminium extruded section and shall hold the louvers tightly in fixed position.

9.4 The dampers as described under grilles shall be provided wherever specified.

10. **Painting :**

10.1 All grilles, and diffusers shall be powder coated, before installation, in approved colour.

10.2 All ducts immediately behind the grilles/diffusers etc. are to be given two coats of black paint in matt finish.

11. **Testing :**

11.1 After completion, all duct system shall be tested for air leakage.

11.2 The entire air distribution system shall be balanced to supply the air quantity as required in various areas and the final tabulation of Airquantity through each outlet shall be submitted to the engineer-in-charge for approval.

End of Section 4

Section 5

Controls

1. **SCOPE**

The scope of this section comprises the supply, erection, testing and commissioning of automatic controls and instruments conforming to these specifications and in accordance with the requirements of Drawings and Schedule of Quantities.

2. **TYPE**

All automatic controls shall be of approved as described in the various sections of these specifications.

3. **AUTOMATIC CONTROLS**

Automatic controls required for various types of equipment/machines have been described in the various sections of these specifications. The individual safety controls and various automatic controls shall be installed within the equipment/machines by the manufacturers before shipment. However, the following automatic controls, if not already installed on the equipment/machines, may need to be installed at site by the Contractor, as per the Schedule of Quantities.

4. **2 WAY MODULATING / PRESSURE INDEPENDENT BALANCING AND CONTROL VALVE**

HVAC APPLICATION- COOLING - AHU's,

A pressure independent balancing and control valve shall be a self balancing, pressure independent, 2-way control valve with 100% authority on the control valve. It can be fitted with an actuator to accept input signals from the control system.

Each Air Handling Unit Cassette Unit shall be provided with a 2-way Pressure Independent Balancing and Control Valve. The control valve should be a globe type. Regarding control – The response characteristic should be independent of pressure, A differential pressure controller should ensure 100% valve authority at all loads and all settings.

Regarding Balancing – Each Valve should have a precisely adjustable maximum flow limitation as per the designed flow rate of coils. The balancing should be done only in the valve and not in the actuator so that in case of actuator failure, the balancing is not lost and the system can still function as designed.

All Valves actuators should be microprocessor based with a self calibrating feature to adjust to any valve travel or setting with full control range..

The valve should have a linear characteristic and the actuator should have a function that can convert it to a logarithmic characteristic to ensure that the valve-actuator combination can be used for all applications.

Minimum required differential pressure should not exceed 20 kPa for fan coil units DN32 and not exceed 30 kPa for air handling units to minimize pump head requirements,

The valve should be equipped with an electronic modulating actuator which can accept either 4(0)-20 mA / 2(0)-10 V DC signals. Operating voltage for actuator shall be 24V AC. The actuator shall be able to close against maximum differential pressure of 6 Bar

VALVE SPECIFICATIONS

Discription	For 15 to 32 mm	For 40 to 150 mm
Diff Pressure (P1-P3)	16 To 400 kPa	30 To 400 kPa
Media Temperature	-10 ° to 120 °C	-10 ° to 120 °C
Body Material	Brass (CuZn40Pb2 - CW 617N)	Grey iron EN-GJL-250(GG25)
Test Ports	Needle measuring nipple	Needle measuring nipple
Leakage acc. to standard IEC 534	No visible leakage (at 100N)	max.0,01 - 0.05% of kv at 650N
Stem Seals	EPDM - CuZn40Pb2	EPDM -NBR
Maximum Close Off Pr	600 kPa	600 kPa
Pressure rating	PN16	PN16
Control Range	Standard IEC 534 Since CV Characteristic is linear control range is Infinity (1:256 as a result of the actuator-valve combination)	
Control Valve Character	Linear characteristic and, with the help of actuator, logarithmic	

ACTUATOR SPECIFICATIONS FOR ALL SIZES

Supply Voltage	: 24V AC
Power Consumption	: 10V AC
Frequency	: 50 HZ
Control Input	: 2-10V DC, 4-20mA, 3-point Selection.
Position Output	: 2-10V DC 4-20mA
Body Housing Insulation	: Non Corrosive - IP 42 or higher

GENERAL SPECIFICATIONS: Pressure Independent Balancing and Control Valve shall be provided/installed at each outlet of cooling coil unit, AHU & FCU.

A:- Valve Body and Characteristics:-

- The differential pressure controller should maintain a constant differential pressure across the control valve, irrespective of fluctuations in the system, with the help of a self adjusting diaphragm.
- The control valve shall accurately control the flow with help of a modulating actuator
- All valve sizes should have testing ports for verifying the flow by measuring the differential pressure.

B:- Valve Actuator and Housing:-

- The valve and actuator must have the ability to undertake both Logarithmic control characteristics and linear control characteristics. This ensures compatibility for both Water/Air and Water/Water Heat Exchanger.
- Control/Dip switch settings should be easy to access, to avoid Manual Contact directly with Integrated IC Circuit of the system.
- The actuator should not play a part in the balancing process. This will ensure that an operational issue in the actuator will not lead to a loss of balancing, causing problems elsewhere in the system.
- Only linear characteristics should not be acceptable as with this valve & actuator characteristic, the resultant energy characteristic will not remain linear and this shall lead to improper control leading to fluctuating room temperatures.
- In chilled water systems, the valve should be mounted with the actuator above the valve to prevent condensation water leaking into the actuator.

C:- Valve Flow Balancing :-

- Balancing & Control: The balancing should be accomplished by the spring loaded diaphragm and the control should be done by the actuator receiving signals from room thermostats or BMS.
- Flow Setting Balancing (Commissioning) for the valves should be simple and not require measuring devices.
- Setting the flow should not involve the actuator.
- Proper operation of the valve should not be dependent on additional operations like de-airing of the valve or flushing procedures

5. Thermostats :

Shall be cooling/heating electronic type with 3 point output for modulating 2 position reversible motor of two way valve of AHU/FCU/Cassette with sensing element located in the return air stream. The profile, mounting arrangements and exact location of the thermostats shall be as approved by the Engineer in charge. All thermostats shall be supplied with the standard mounting boxes, as recommended by the manufacturer.

Electronic type thermostats for cooling/heating application for actuating the two way modulating cum pressure independent balancing valve at each unit.

6. Instruments :

Instruments required for different types of machines have been described in the various sections of these specifications and shown on the drawings. Following instruments shall be provided as per the schedule of quantities.

Thermometers shall be of approved make, mercury-in-glass type with cast brass scale in a steel casing. Thermometers shall be filled with red reading mercury. Thermometers shall be of the separable socket type and shall have extended neck, where required, for insulated pipes. The scale shall be 23 cm long. Thermometers shall be installed at chilled water supply and return at air handling units, supply and return at chillers and condensers. Range of scales shall be 30- 120 F (0- 50) for air conditioning applications.

Pressure Gages shall be approved make, installed on suction and discharge sides of pumps, inlet and outlet at chillers, condensers and AHU 's etc. as shown on the drawings and included in Schedule of Quantities. Suction side gauges at pumps shall be compound gauges.

Air Flow Switches shall be of sturdy and corrosion resistant construction, suitable for monitoring air flow in ducts, and supplied with mounting plate and gasket for duct mounting. Paddle shall be of stainless steel of size 50mm x 150mm minimum. Air flow switches shall be chosen to suit the velocities to be monitored. Performance of air flow switches shall not be affected when mounted on ducts handling air below ambient dew point temperature

7. **Calibration and Testing :**

All automatic controls and instruments shall be factory calibrate and provided with necessary instructions for site calibration and testing. Various items of the same type shall be completely interchangeable and their accuracy shall be guaranteed by the manufacturer. All automatic controls and instruments shall be tested at site for accuracy and reliability before commissioning the installation.

End of Section 5

Section 6

Pipe Work

1. **General :**

All piping work shall conform to quality standards and shall be carried out as per specifications and details given hereunder :-

2. **Pipes :**

All pipes in sizes upto 200 mm shall M.S. E.R.W tube (black steel) heavy class as per I.S. 1239-79, Part-I with amendment-I of January '81. All pipes above 150 mm dia shall be minimum 6.4 mm thick.

3. **Fittings :**

3.1 The dimensions of the fittings shall conform to I.S. 1239/69 Part-II unless otherwise indicated, in the specifications.

3.2 All bends in sizes upto and including 150 mm dia, shall be ready, made of heavy duty, wrought steel of appropriate class.

3.3 All bends in sizes 200 mm and larger dia, shall be fabricated from pipes of the same dia and thickness, with a minimum of 4 sections, and having a minimum centre line radius of 1.5 diameter of pipes.

3.4 All fittings such as branches reducers etc. In all sizes shall be fabricated from pipes of the same Dia. And thickness, and its length should be at least twice the dia of the pipe.

3.5 The branches may be welded straight to the main line, without making a separate fitting, where specified on drawings or required by engineer-in-charge.

3.6 Blank ends are to be formed with flanged joints and 6 mm thick blank between flange pair for 150 mm and over, in case where, a future extension is to be made otherwise blank end discs of 6 mm thickness are to be welded on, with additional cross stiffeners from 50 mm x 50 mm M.S. Heavy angles, for sizes upto 350 mm. All ends larger than 400 mm dia shall have dished ends.

4. **Flanges :**

4.1 All flanges shall be of mild steel as per I.S. 6392/71 and shall be steel slip-on-type, welded to the pipes, flange thickness shall be to suit class-II pressures.

4.2 Flanges may be tack welded into position, but all final welding shall be done with joints dismantled. 3 mm thick gaskets shall be used with all flanged joints. The gaskets shall be fibre reinforced rubber as approved by the Engineer-In-Charge. Special adhesive compound shall be used between flanges of steam, air and gas lines.

4.3 Flanges shall be used as follows :-

- 4.3.1 Counter flanges for equipment having flanged connections.
- 4.3.2 Flanged pairs shall be used on all such equipment, which may require to be isolated or removed for service e.g. Pumps, refrigeration machines air handling units etc.
- 4.3.3 All threaded valves shall be provided with nipples and flanged pairs on both sides to permit flange connections, for removal of valves from main lines for repair/replacement.

5. **Valves :**

5.1 **Butterfly Valves**

- 5.1.1 The butterfly valve shall consist of cast iron body preferably in two piece construction.
- 5.1.2 The disc shall consist of disc pivot and driving stem shall be in one piece centrally located.
- 5.1.3 The valve seat shall be synthetic material suitable for water duty. It shall line the whole body.
- 5.1.4 The disc should move in slide bearings on both ends with 'o' ring to prevent leakage.
- 5.1.5 The handle should have arrangement for locking in any set position.
- 5.1.6 The valve should be suitable for 10 Kg/sq.cm working pressure.
- 5.2 All gate valves and check valves should be dual plate type upto & including 65 mm Dia shall be of gunmetal screwed type, conforming to class 2 of I.S. 778. And shall be with I.S.I. Marking and certification.
- 5.3 All gate valves and check valves of 80 mm dia and above shall be of cast iron flanged type conforming to class 2 of I.S.780/69 (For sizes upto 350 mm). And of I.S. 2906/69 (For sizes 350 mm and above). All such valves shall be with I.S.I. Marking and certification.
- 5.4 All guage cocks shall be of gunmetal plug type, complete with siphon (brass chrome plated).
- 5.5 All drain valves shall be of gunmetal with a hose union connection of one hand.
- 5.6 All valves on the supply of fan coil units shall be of gunmetal ball type with integral water strainers, having (BSP) fpt inlet and flare type MPT outlet connection.
- 5.7 All valves on the return line of fan coil units shall be as in 5.6 but without integral water strainer.

6. Balancing Valves :

- 6.1 The balancing valves upto 80 mm Dia shall be of gunmetal screwed type confirming to B.S. 5154 or equivalent specifications.
- 6.2 The valve shall be cast gunmetal ASTM B-62 and complete with non rising spindle. PTFE disc seal cast metal hand wheel.
- 6.3 The port opening shall permit precise regulation of flow rate, by accurately measuring the pressure drop across the port.
- 6.4 The valve shall be complete with two ports for connections to a mercury manometer, to measure the pressure drop, as well as a drain port.
- 6.5 The spindle shall have a shielded screw to set the flow at the desired level.
- 6.6 This valve shall be used wherever specified.

7. Strainers :

- 7.1 The strainers shall either be pot type or 'Y' type with cast iron or fabricated steel body, and shall have S baskets, tested upto pressure applicable for the valves as shown on the drawings.
- 7.2 The strainers shall have a perforated bronze sheet screen with 3 mm perforation and with a permanent magnet, to catch iron fillings.
- 7.3 Pot strainers shall be provided with flanged connections and 'Y' strainers shall be provided with flanged ends.
- 7.4 The strainers shall be designed to facilitate easy removal of filter screen for cleaning, without disconnection of pipe line.

8. Jointing :

- 8.1 All pipe lines shall be welded type.
- 8.2 Square cut plain ends will be welded for pipes upto and including 100 mm dia.
- 8.3 All pipes 125 mm dia or larger will be bevelled by 35 Deg before welding.

9. Miscellaneous :

- 9.1 Provide all pipe work as required to make the apparatus connected complete and ready for regular and safe operation. Unless otherwise noted, connect all apparatus and equipment in accordance with manufacturer's standard details, as approved by Engineer-In-Charge.

9.2 Unless otherwise specified, pitch the lines of piping as follows :-

All condensation drainage, including air handling unit and fan coil unit shall be pitched in the direction of flow to ensure adequate drainage, with an adequate trap seal to prevent leakage of air due to static pressure developed by airconditioning units. Pitch, 20 mm per metre wherever possible, but not less than 10 mm per metre.

Drains from other equipment shall be pitched similarly without trap seal.

9.3 Provide valves and capped connections for all low points in piping system, where necessary or required for draining systems. Provide isolating valves & Drain valves in all risers to permit repairs without interfering with the rest of the system.

9.4 During construction, temporarily close, open ends of pipes with sheet metal caps, where necessary, or required to prevent debris from entering the piping system.

9.5 Support piping independently of all equipment so that the equipment is not stressed by the piping weight or expansion.

9.6 To facilitate the maintenance, repair and replacement:

9.6.1 Provide shut-off valves where indicated and for individual equipment, units at inlet and outlet, to permit unit removal for repairs, without interfering with the remainder of the system. Additional shut-off valves shall be provided as required to enable all systems to be fully sectionalized. By-pass and stop valves shall be provided for all automatic control valves as specified.

9.6.2 Arrange piping for maximum accessibility for maintenance and repair, locate valves for easy access and operation. No valves shall be installed with handles pointing down, unless unavoidable.

9.6.3 Cut the pipes accurately according to measurements, established at building site & work into place without springing or forging.

9.6.4 Pipe supports shall be adjustable for height and primecoated with rust preventive paint & finish coated with grey paint, both as approved by engineer-in-charge. The spacing of pipe supports shall not be more than that specified below :-

Nominal pipe size mm	Spacing (metres)
15	1.25
20 & 25	2.00
32,30,50 & 65	2.50
80,100 & 125	2.50
150 & Above	3.00

- 9.6.5 Extra supports shall be provided at the bends and at heavy fittings like valves to avoid undue stresses on the pipes. Pipe hangers shall be fixed on walls and ceiling by means of metallic approved dash fasteners.
- 9.6.6 Insulated piping shall be in such a manner as not to put undue pressure on the insulation, such as providing teak wood block between pipe and support.
- 9.6.7 Where pipes are to be buried under ground, they should be coated with one coat of bituminous paint. The top of the pipes shall not be less than 75 cms. From the ground level. Where this is not practical permission of engineer-in-charge shall be obtained for burying the pipes at lesser depth. The pipes shall be surrounded on all sides by sand cushions of not less than 15 cms. After the pipes have been laid and top sand cushions provided, the trench shall be refilled with the excavated soil, excess soil shall be removed from the site of work by the contractor.

10. **Hangers & Supports :**

- 10.1 Hangers and supports shall be provided and installed for all piping and tubing wherever indicated, required or otherwise specified. Wherever necessary, additional hangers and supports shall be provided to prevent vibration or excessive deflection of piping and tubing.
- 10.2 All hangers and supports shall be made of steel or other durable and non-combustible materials, given two coat of primer red oxide and then painted with Aluminium colour paint. Wood wire or perforated strap iron shall not be used as permanent hangers or supports.
- 10.3 Hangers shall be supported from structural steel, concrete inserts & pipe racks, as specifically approved.
- 10.4 No hangers shall be secured to underside of light weight roof decking and light weight floor glass.
- 10.5 Mechanical equipment shall be suspended midway between steel joists and panel points.
- 10.6 Drilling or punching of holes in steel joist members will not be permitted.

11. **Sleeves :**

- 11.1 Where pipes pass through floors, walls, etc provide Galvanized steel pipe sleeves 50 mm larger than outside diameter of pipe. Where pipes are insulated, sleeves shall be large enough to ample clearance for insulation.
- 11.2 Where pipes pass through outside walls or foundations, the space between pipe and sleeve shall be caulked with lead wool and oakum.
- 11.3 The centre of pipes shall be in the centre of sleeves, and sleeves shall be flush with the finished surface.

12. **Expansion or Contraction :**

12.1 The contractor shall provide for expansion and contraction of all piping installed by the use of swing connections and expansion loops.

13. **Arrangement and Alignment of Piping :**

13.1 All piping shall be arranged and aligned in accordance with the drawings as specified. Where special conditions are encountered in the field, the arrangement and alignment of piping shall be as directed by the engineer-in-charge.

13.2 The piping shall be installed in a uniform manner, parallel to or perpendicular to walls or ceilings, and all changes in directions shall be made with fittings. The horizontal piping shall be run at right angles and shall not run diagonally across rooms or other piping. Wherever possible all piping shall be arranged to provide maximum head room.

13.3 All piping shall be installed as directly as possible between connecting points in so far as the work of other trades permits. Where interference occurs with another trade whose work is more difficult to route, this contractor shall reroute his pipes as required to avoid interference, at the discretion of the engineer-in-charge.

13.4 All piping shall be carefully installed to provide for proper alignment, slope and expansion.

13.5 The stresses in pipe lines shall be guided and pipes shall be supported in such a manner that pipe lines shall not creep, sag or buckle.

13.6 Anchors and supports shall be provided wherever necessary to prevent any misalignment of piping.

13.7 Small tubing gauges, controls or other equipment installed on any apparatus, shall not be coiled nor excessive in length, but shall be installed neatly, carefully bent at all changes in direction, secured in place and properly fastened to equipment at intervals to prevent sagging.

13.8 The piping shall be grouped wherever practical and shall be installed uniformly in straight parallel lines in either vertical or horizontal positions.

14. **Testing :**

14.1 In general, tests shall be applied to piping before connection of equipment and appliances. In no case shall the piping, equipment or appliances be subjected to pressures exceeding their test ratings.

14.2 The tests shall be completed and approved before any insulation is applied. Testing of segments of pipe work will be permitted, provided all open ends are first closed, by blankoffs or flanges.

- 14.3 After tests have been completed the system shall be drained and flushed 3 to 4 times and cleaned of all dust and foreign matter. All strainers, valves and fittings shall be cleaned of all dirt, fillings and debris.
- 14.4 All piping shall be tested to hydraulic test pressure of at least one and half times the maximum operating pressure but not less than 10 kg/sq.cm for a period of not less than 12 hours. All leaks and defects in the joints revealed during the testing shall be rectified to the satisfaction of the engineer-in-charge, without any extra cost.
- 14.5 All the piping systems shall be tested in the presence of the engineer-in-charge or their authorised representative. Advance notice of test dates shall be given and all equipments, labour, materials required for inspection, and repairs during the test shall be provided by the contractor. A test shall be repeated till the entire systems are found to be satisfactory to the above authority. The tests shall be carried out for a part of work if required by Engineer-In-Charge in order to avoid hinderance in the work of the insulation contractor.
- 14.6 All steam and condensate pipes shall be tested and proven tight under hydrostatic pressure of 20 kg/sq.cm, unless otherwise stated, for a minimum period of 4 hours without drop in pressure.
- 14.7 Miscellaneous piping, tests with air at 10.5 kg/sq.cm for a minimum of 24 hours without drop in pressure.
- 14.8 The contractor shall make sure that proper noseless circulation is achieved through all piping systems. If due to poor bond, proper circulation is not achieved, the contractor shall bear all expenses for carrying out the rectification work including finishing of floors, walls and ceiling damaged in the process of rectifications.
- 14.9 The contractor shall provide all labours and materials to make provision for removing water and throwing it at the proper place, during the testing or/and after the testing to avoid damages to employer or other contractors 'properties. Any damages caused by the contractor to the employer or other contractors' properties, shall be borne by the contractor.
16. **Painting :**
- 16.1 All pipes supports, hangers, etc., shall be given two coats of red oxide primer.
- 16.2 All pipes, which are not to be insulated, shall then be given one coat of finish paint, of a type and colour, as per ISI code.

End of Section 6
Insulation

Section 7

1. **General :**

The Insulation of water piping, ducting, etc., shall be carried out as per specifications given below :

2. **Materials :**

The materials to be used for insulation shall be as follows, unless some other material is specifically mentioned elsewhere.

2.1 **Duct Insulation and Drain Pipe :**

The insulation for drain piping, and duct shall be carried out from closed cell electromagnetic nitrile rubber having a 'K' value of 0.034 W/(M.K) at mean temperature of 10° C. and a density of not less than 40 kgs/cubm. Water vapour permeability 4000 U and above. Fire rating class I/O as per British standard BS 476 part VII/- - 1997 building regulation. Approval of sample to be obtained in writing prior to execution.

2.2 **Other Insulation :**

- 2.2.1 The material for acoustic treatment of ducts, rooms, roofs etc. shall be resin bonded fibre glass, as described earlier, conforming to I.S. 8183 of 1976. The density of fibre glass shall be 32 kg/cub.m and the material shall be in the form of rolls of uniform density. The 'k' value at 10° C. shall not be less than 0.028 kcal/mhr/° C. Wherever insulation is to be carried out inside the duct, fibre tissue is to be installed and contractor to ensure that no fibers of insulation material get mixed up with supply/return air.

3. **Drain Piping :**

- 3.1 Insulation of drain piping shall be carried out using 6 mm thick insulation tube of closed cell electromagnetic nitrile rubber having a 'K' value of 0.034 W/(M.K.) at mean temperature of 10° C and a density of not less than 40 kg/cubm.

3.2 **Installation**

- 3.2.1 The pipe shall be thoroughly cleaned with a wire brush and rendered free from all rust and grease.
- 3.2.2 Cut insulation tube longitudinally and put on pipe and sealed the joints with adhesive and Aluminium tape (as approved by manufacturer).

4. **Refrigerant Piping :**

4.1 The suction line of refrigerant piping shall be insulated with 13 mm thick insulation as specified for chilled water pipe lines.

5. **Ducting :**

5.1 The ducts shall be insulated with the insulation sheets as follows.

5.2 Duct insulation thickness shall be as follows :

Duct in conditioned space - 6 mm thick

Duct in unconditioned space - 9 mm thick

Duct with treated fresh air - 9 mm thick

6. **Acoustic Lining :**

6.1 The acoustic lining shall consist of 25/50 mm resin bonded glass wool of density 32 KG/CUB.M (min) then it shall be covered by 0.5 mm perforated aluminium sheets having 3 mm perforation at 6 mm centers.

6.2 **Insulation**

6.2.1 The duct surface shall first be cleaned from inside.

6.2.2 Then the insulation shall be fixed inside the duct.

6.2.3 The insulation shall be covered with RP tissue.

6.2.4 The insulation shall then be covered with 0.5 mm perforated aluminium sheets.

6.2.5 The sheet and the insulation shall be secured to the duct by means of cadmium plated bolts, nuts and washers. The ends should be completely sealed off, so that no insulation material is exposed.

End of Section 7

Section 8

Electric Wiring

1. **General :**

The electric wiring of motors for compressors, pumps, air handling units etc. As well as controls, heaters etc. and earthing of all equipment shall be carried out as per specifications given hereunder.

2. **Wiring for Motors, Heaters etc :**

2.1 The wiring for above equipment shall be carried out in conduits or using PVC armoured cables.

2.2 The PVC armoured power cable for use on 415 volts system shall be 3 or 3.5 core with aluminium conductors and be of 1100 volts grade, as per IS 1554 part I-1964. The cross section of the cable shall be to suit the load or rating of the equipment. The cable shall be aluminium conductor PVC insulated single wire/strip armoured with overall PVC sheathing.

2.2.1 The cables shall be laid as per IS-1255/1967, Indian Standard Code of Practice.

2.2.2 The cables shall be laid, as per drawings or along a short and convenient route between switch board and the equipment, either in trenches, on wall or on hangers, supported from the slab. Cable routing shall be checked on the site to avoid interference with structure, equipment etc. Where more than one cables are running close to each other, proper spacing should be provided between them.

2.2.3 The radius of bends of the cable should not be less than 12 times the radius of cable to prevent undue stress and damage at the bends, the cables should be supported with wooden cleats fixed on M.S. Supports, when running in trenches, wall or ceilingsuspended hangers. When laid under ground the cables should be covered with fine soft earth and protected with cement concrete covering. Suitable G.I. Pipe shall be used wherever the cable comes out of the connected surface and clamped properly.

2.2.4 Wooden bushes shall be provided at the ends of pipes through which cables are taken in walls and floors.

2.2.4 All cables shall be terminated using suitable size cable glands and packing.

2.3 The wiring in conduits shall be 1100 volts grade.

2.3.1 The conduits used shall be of high quality, all joints shall be made with sockets. The bends and elbows shall have inspection covers fixed with grease free screws. The joints shall be water tight. Approved metal saddles shall be used to secure the exposed conduits at a space of 1 meter or less. The connection of the conduit to switches etc., shall be secured by a check nut and ebonite bushes provided at the ends of conduits.

2.3.2 Flush inspection covers shall be provided in case of concealed, recessed conduits. The staples for the conduits shall not be spaced more than 0.60 meters apart. Before filling up the chase with concrete the conduits should be given a coat of rust proof paint.

2.3.3 The wires shall be drawn only after all the conduits have been properly fixed in position.

3. **Control Wiring :**

3.1 Control cables shall be 650 volts grade as per IS 1554 made from copper conductor of 1.5/2.5 sq. mm PVC insulated single multi core unarmoured with an overall PVC sheathing.

3.2 The cables and conduits wiring shall be carried out as per details given under 2.2 and 2.3 above.

4. **Earthing :**

4.1 All equipment connected with electric supply shall also be provided with double earthing continuity conductors. The size of copper earthing conductors shall be :-

Size of phase wire sq.mm Aluminium	size of copper conductor tape/wire (swg)
300	25 mm x 6 mm (strip)
185	20 mm x 3 mm (strip)
150	20 mm x 3 mm (strip)
120	12 mm x 3 mm (strip)
95	4 Swg
70	4 Swg
50	6 Swg
35	8 Swg
25-6	8 Swg
4	10 Swg

Note :- GSS earthing conductors of equivalent size may be used in lieu of copper earth mentioned above.

5. **Miscellaneous :**

5.1 The final connections to the equipment shall be through flexible connections in case of conduit wiring and also where the equipment is likely to be moved back and forth, such as on slide rails.

5.2 An isolator switch shall be provided at any motor which is separated from the main switch panel by a wall or partition or other barrier or is more than 15 metres away from the main panel.

- 5.3 Two separate and distinct earthing conduits shall be connected from the equipment upto the main switch board panel.
- 5.4 The branch lines from the main panel to each equipment shall be separated and should not criss cross other lines.
- 5.5 The entire installation shall be tested as per electricity rules and I.S.S 732-1973 with amendments 1,2 & 3 prior to the commissioning of the plant and a suitable test report furnished by a competent and authorised person. The test report will be obtain by contractor himself at his own expenses.
- 5.6 All exposed switch board panels, conduits, hangers etc. shall be given 2 coats of suitable paint of approved colour, when all work has been completed.

End of Section 8

Section 9**Tests at Site/Works****1. General :**

The contractor must perform all inspection and tests of the system as a whole and of components individually as required, under the supervision of the Architect/ Consultants, in accordance with the provisions of the applicable ASHRAE standards or approved equal and furnish necessary test certificates from manufacturers at the time of delivery of requirement at site.

2. Airhandling Units/UAHU**2.1 Blowers**

2.1.1 Dynamic/static balancing of impeller.

2.1.2 Performance test as per applicable codes.

2.2 Coils

2.2.1 Pneumatic test.

2.3 Filters

2.3.1 Test of filter elements as per B.S. 2831 B.S. 1701 as applicable. This is to ascertain filtration efficiency by weight at inlet and outlet.

2.4 Manufacturer's test certificates also to be produced for the assembled F.C.U. Final dimensional check will be done. Inspection will be done during assembly of components for quality of workmanship, painting etc.

2.5 Piping

Materials check for specifications and size.

2.6 Valves

Hyd./pneumatic test certificates.

2.7 Motors

Manufacturer's test certificate as per motor data sheet.

2.8 Instruments and Controls

Visual examination.

3. For Associates Works at Site :

- 3.1 All electrical items will be subjected to inspection at any stage during manufacturing activity. Routine electrical test as per relevant codes. Inspection of manufacturer's test certificates.
- 3.2 Inspection of raw materials to be used for fabrication and assembly and inspection of manufacturer's certificates.
- 3.3 Inspection of welding including welders qualification as desired by inspection engineers. Inspection of fabricated items.
- 3.4 Pressure testing of pipe fittings used for the refrigerant and water services.
- 3.5 Pressure testing, leak testing of complete piping network for chilled water. Condenser water and refrigerant/services.
- 3.6 Vacuuming and gas/oil charging for refrigeration system.
- 3.7 Checking of electrical circuits (power & controls) and checking functioning of controls of refrigerant systems and other circuits of air conditioning plant.
- 3.8 Checking of calibration of controls and instrumentation
- 3.9 Checking of assemblies for electrical control panel, instruments panels, local panels (dimensional and functional) annunciator panels etc.
- 3.10 Inspection of complete electrical installation at site.
- 3.11 Performance testing of complete A.C. Plant as per specifications.
4. The above inspection procedure is given for general guidance and information of vendors and inspection of purchaser/consultant is strictly not limited to these and inspection engineer of purchaser/consultant will have full right to have detailed inspection at any stage right from placement of order to completion of project as desired by inspection engineer, co-ordination of inspection agency of purchaser/consultant with his factory/ subvendor's factory/erection site will be the sole responsibility of successful vendor after placement of order for complete air conditioning plant covered under these technical specifications.

5. **Piping System :**

- 5.1 In general pressure tests shall be applied to piping only before connection of equipment and appliances. In no case shall piping, equipment or appliances be subjected to pressure exceeding their test ratings.
- 5.2 Tests shall be completed and approved before any insulation is applied.

- 5.3 After tests have been completed, the system shall be drained and cleaned of all dust and foreign matter. All strainers, valves and fittings shall be cleaned of all dirt, fittings, and debris.

5.4 **Water Piping**

All water piping shall be tested and proven tight under Hydrostatic pressure of 1 1/2 times the design pressure unless stated otherwise in the specifications. prescribed pressure shall be maintained for four hours.

6. **Electrical Equipment :**

- 6.1 All electrical equipment shall be cleaned and adjusted on site before application of power.
- 6.2 The following tests shall be carried out :
- 6.2.1 Wire and cable continuity tests.
- 6.3 Insulation resistance tests, phase to phase and phase to earth, on all circuits and equipment, using a 500 Volts meggar. The meggar reading shall be not less than one megohm.
- 6.4 Earth resistance between conduit system and earth must not exceed half (1/2) CMH.
- 6.5 Phasing out and phase rotation tests.
- 6.6 Operating tests on all protective relays to prove their correct operation before energising the main equipment.
- 6.7 Operating tests on all starters, circuit breakers, etc.

7. **Performance Tests :**

- 7.1 The installation as a whole shall be balanced and tested upon completion, and all relevant information, including the following shall be submitted to the architects.
- 7.1.1 Air volume passing through each unit, duct, grilles, apertures.
- 7.1.2 Differential pressure readings across each filter, fan and coil, and through each pump.
- 7.1.3 Static pressure in each air duct.
- 7.1.4 Electrical current readings, in amperes of full and average load running, and starting, together with name plate current of each electrical motor.
- 7.1.5 Continuous recording over a specified period, of ambient wet and dry bulb temperatures under varying degrees of internal heat loads and use and occupation, in each zone of each part of the building.

- 7.2 Daily records should be maintained of hourly readings, taken under varying degrees of internal heat load and use and occupation, of wet and dry bulb temperatures, upstream "on coil" of each cooling coil. Also suction temperatures and pressures for each refrigerating unit. The current and voltage drawn by each machine.
- 7.3 Any other readings shall be taken which may subsequently be specified by the architect.
8. **Miscellaneous :**
- 8.1 The above tests are mentioned herein for general guidance and information only but not by way of limitation to the provisions of conditions of contract and specification.
- 8.2 The date of commencement of all tests listed above shall be subject to the approval of the architect, and in accordance with the requirements of this specification.
- 8.3 The contractor shall supply the skilled staff and all necessary instruments and carry out any test of any kind on a piece of equipment, apparatus, part of system or on a complete system if the architect requests such a test for determining specified or guaranteed data as given in the specification or on the drawings.
- 8.4 Any damage resulting from the tests shall be repaired And/or damaged material replaced, all the the satisfactorily of the architect.
- 8.5 In the event of any repair or any adjustment having to be made, other than normal running adjustment, the tests shall be void and shall be recommended after the adjustment or repairs have been completed.
- 8.6 The contractor must inform the architect when such tests are to be made, giving sufficient notice, in order that the architect or his nominated representative may be present.
- 8.7 Complete records of all tests must be kept and 3 copies of these and location drawings must be furnished to the architect.
- 8.8 The contractor may be required to repeat the test as required, should the ambient conditions at the time not given, in the opinion of the architect, sufficient and suitable indication of the effect and performance of the installation as a whole or of any part, as required.

End of Section 9

Section 10**Mode of Measurements****1. Unit Prices in the Schedule of Quantities :**

- 1.1 The item description in the schedule of quantities is in the form of a condensed resume. The unit price shall be held to include every thing necessary to complete the work covered by this item in accordance with the specifications and drawings. The sum total of all the individual item prices shall represent the total price of the installation ready to be handed over.
- 1.2 The unit price of the various items shall include the following :
- 1.2.1 All equipment, machinery, apparatus and materials required as well as the cost of any tests which the consultant may request in addition to the tests generally required to prove quality and performance of equipment.
- 1.2.2 All the labour required to supply and install the complete installation in accordance with the specifications.
- 1.2.3 Use of any tools, equipment, machinery, lifting tackle, scaffolding, ladders etc. Required by the contractor to carry out his work.
- 1.2.4 All the necessary measures to prevent the transmission of vibration.
- 1.2.5 The necessary material to isolate equipment foundations from the building structure, wherever necessary.
- 1.2.6 Storage and insurance of all equipment apparatus and materials.
- 1.3 The contractor's unit price shall include all equipment, apparatus, material and labour indicated in the drawings and/or specifications in conjunction with the item in question, as well as all additional equipment, apparatus, material and labour usual and necessary to make in question on its own (and within the system as a whole) complete even though not specifically shown, described or otherwise referred to.

2. Measurements of Piping, Fittings, Valves, Fabricated Items :**2.1 Pipe**

(Including water piping, steam piping, oil piping, IP gas piping, air piping, vacuum piping) etc.

- 2.1.1 All pipes shall be measured in linear metre (to the Nearest cm) along the axis of the pipes and rates shall be inclusive of all fittings e.g. Tees, bends, reducers, elbows etc. Deduction shall be made for valves in the line.

- 2.1.2 Exposing reinforcement in wall and ceiling and floor of possible and making good the same or installing anchor fasteners and inclusive of all items as specified in specifications and schedule of quantities.
- 2.1.3 Rates quoted shall be inclusive of providing and fixing Vibration pads and wooden pieces, wherever specified or required by the project co-ordinator.
- 2.1.4 Flexible connections, wherever required or specified shall be measured as part of straight length of same diameter, with no additional allowance being made for providing the same.
- 2.1.5 The length of the pipe for the purpose of payment will be taken through the centreline of the pipe and all fittings (e.g. Tees, bends, reducers, elbows, etc.) as through the fittings are also presumed to be pipe lengths. Nothing extra whatsoever will be paid for over and above for the fittings for valves and flanges, section 3.2 below applies.

2.2 **Valves and Flanges**

- 2.2.1 All the extra CI & cm flanged valves shall be measured according to the nominal size in mm and shall be measured by number. Such valves shall not be counted as part of pipe length hence deduction in pipe length will be made wherever valves occur.
- 2.2.2 All gun metal (gate & globe) valves shall include two Nos. of flanges and two numbers 150 mm long ms nipples, with one side threaded matching one of the valves, and other welded to the M.S. Slip-on-flange. Rate shall also include the necessary number of bolts, nuts and washers, 3 mm thick insertion gasket of required temp. grade and all items specified in the specifications.
- 2.2.3 The rates quoted shall be inclusive of making connections to the equipment, tanks, pumps etc. And the connection made with an installed pipe line shall be included in the rates as per the B.O.Q.

2.3 **Structural Supports**

Structural supports including supports fabricated from pipe lengths for pipes shall be measured as part of pipe line and hence no separate payment will be made. Rates shall be inclusive of hoisting, cutting, jointing, welding, cutting of holes and chases in walls, slabs or floors, painting supports and other items as described in specifications, drawings and schedule of quantities or as required a site by project co-ordinator.

3. **Insulation :**

- 3.1 The measurement for vessels, piping shall be made over the bare uninsulated surface area of the metal.

3.2 **Pipes, Ducts & Vessels**

3.2.1 **Pipes**

The measurements for installation of piping shall be made in linear metres through all valves, flanges, and fittings. Pipes/bends shall be measured along the centreline radius between tangent points. If the outer radius is R1 and the inner radius is R2. The centre line radius shall be measured as $(R1+R2)/2$. Measurement of all valves, flanges and fittings shall be measured with the running metre of pipe line as if they are also pipe lengths. Nothing extra over the above shall be payable for insulation over valves, flanges and fittings in pipe line/routings. Fittings that connect two or more different sizes of pipe shall be measured as part of the larger size.

3.2.3 **Vessels**

The area of standard dished and flat ends of vessels shall be the square of the diameter of the uninsulated body of the shell. Areas for other shapes shall be the actual calculated area. There shall be no deduction or additions for nozzles, handles ribs, dampers, expansion joints etc. All projections on vessels or tanks shall be measured separately as pipe/duct.

3.3 **Accessories Insulation**

3.3.1 The unit of measurement for accessories such as expansion tank, pumps, chiller heads etc. shall be uninsulated are in square metres.

3.3.2 In case of curved or irregular surfaces, measurements shall be taken along the curves.

3.3.3 The unit insulation price shall include all necessary adhesives, vapour proofing and finishing materials as well as additional labour and material required for fixing the insulation.

End of Section 10

Section 11**Schedule of Equipment Proposed**

<u>S.No.</u>	<u>Description</u>	<u>Unit</u>	<u>Condition of Services</u>
1.	<u>Airhandling Units - Floor Mounted</u>		
1.1	Type	--	Side Suction & Side Discharge
1.2	Air quantity	cfm	10000
1.3	Coil area (Min)	sqm	1.85
1.4	No. rows (min.)	No.	4
1.5	No. of fins/cm (min.)	No.	5
1.6	External static pressure	mmwg	40
1.7	Fan motor rating	kw	5.5
1.8	Type of motor enclosure	--	TEFC
1.9	Filters	--	Pre filters, Synthetic Type
1.10	Quantity	No.	1

End of Section 11

Section 12**Technical Data**

<u>S.No.</u>	<u>Description</u>	<u>Unit</u>	<u>Condition of Services</u>
1.	<u>Airhandling Units</u>		Floor Standing
1.1	Manufacturer	--	
1.1.1	Casing	--	
1.1.2	Coil	--	
1.1.3	Blower	--	
1.2	Type	--	
1.3	Overall Dimensions	l x w x h	
1.4	Unit weight	kg	
1.5	Air quantity	cfm	
1.6	Fan outlet velocity	fpm	
1.7	Design static pressure	mm	
1.8	Fan balancing static and/or dynamic	--	
1.9	<u>Coil Data</u>		
1.9.1	Cooling coil area	sqm	
1.9.2	No. of rows	Nos.	
1.9.3	No. of fins/cm	Nos.	
1.9.4	Tube material	--	
1.9.5	Tube dia		
1.9.6	Coil header material steel/copper	--	
<u>S.No.</u>	<u>Description</u>	<u>Unit</u>	<u>Condition of Services</u>

- 1.9.7 Thickness of tube mm
- 1.10 Fan motor output kw
- 1.11 Motor location : inside/
outside of fan section --
- 1.12 Type of casing finish
- 1.13 Type of drive Direct/Belt
- 1.14 **Type of Pre Air Filter**
 - 1.14.1 Cleanable/non cleanable
- 2. **Water Valves (Control Valve)**
 - 2.1 Type of water valve
 - 2.2 Operating voltage Volts

End of Section 12

Section 13**List of Approved `Makes'**

<u>S.No.</u>	<u>Items</u>	<u>Acceptable Makes</u>
1.	Airhandling unit	Zeco/Waves/Edgetech/ Lloyd
2	VFD of pump / AHU	Danfoss/Siemens/Fuji
3.	Blower of AHU	Yilida/Krugar/Greenheck
4.	Cooling coil	AHRI Approved
5.	Grills diffuser/louvers/fire dampers	Caryaire/Airmaster/Balance Air Equipments
6.	G.I. sheet	Tata/Sail/Jindal
7.	Flexible duct	UP Twiga/Caryaire
8.	<u>Controls</u>	
8.1	Thermostats	Danfoss/Honeywell/Johnson
9.	Electric motors	Siemens/Crompton/ ABB
10.	Power cables	Havells/Polycab/Finolex
11.	<u>Pipes</u>	
11.1	G.I.	Jindal-Hissar/Tata
11.2	M.S. upto 150 mm	Jindal Hissar/TATA
12.	<u>Valves</u>	
12.1	Butterfly valves	Audco/Advance/SKS/Castle
12.2	Pressure Independent Control Cum Balancing Valve	Honeywell/Danfoss/Johnson/Siemens
13.	Pressure gauge	Emerald/Fiebig/H.Guru
14.	Thermometer	Emerald/Fiebig/H.Guru
15.	<u>Insulation</u>	
15.1	Nitrile rubber	Armaflex/A-flex/K-flex

End of Section 13

Section 14**Test Proforma**

<u>S.No.</u>	<u>Item</u>	<u>Unit</u>	<u>Test Result</u>
1.	<u>Operating Conditions</u>		
1.1	Ambient conditions -Temp. D.B.	° C	
1.2	-Temp. W.B.	° C	
1.3	-R.H.	%	
2.	<u>Air Handling Units</u>		
2.1	Air quantity across coil	cmh	
2.2	Coil face area	sqm	
2.3	Air temperature -Entering dry bulb wet bulb -Leaving	° C ° C	
2.4	Water temperature -Entering -Leaving	° C ° C	
2.5	Water pressure -Entering -Leaving	mmHg. mmHg.	
2.6	Water flow rate	lpm	
2.7	Motor rating	kw	
2.8	Motor current at full load	Amps	
2.9	Specified cooling capacity	TR	
2.10	Computed cooling capacity	TR	
3.	<u>Outside Air Intakes</u>		
3.1	Face area	sqm	
3.2	Air quantity	cum/hr	
4.	<u>Room Conditions at Designed Parameter</u>		

4.1 Date & Time

4.2 Temperature ° C DB; WB
(A No. of readings shall be taken and averaged)

5. **Controls**

Report on test and functioning of all controls.

Notes :

a. **Test Instructions :**

1. All instruments for testing shall be provided by the HVAC contractor.
2. Thermometer used for measurement of temperature of water/refrigerant shall have graduations of 0.1° C and shall be got calibrated from N.P.L. or any recognized test house before hand.
3. Thermometers used in the psychrometers shall have graduations of 0.2° C and shall be calibrated as at (2) above.
4. Pressure gauges shall also be got calibrated before hand from a recognized test houses.
5. Orifice type of flow meters shall be used for measuring flow rate through the condensers and chillers.
6. Where ever the flow rate vs. pressure drop curves for the heat exchangers of the same mode, as installed, certified by project co-ordinator on the basis of tests conducted at manufacturer's works are produced, flow meters for measuring water flow rate through these may not be provided. Actual water flow shall in such a case, be computed with reference to these curves and the actual pressure drop measured at site.
7. Integrating type flow meters may be used for measuring water flow through the individual airhandling units.
8. Air flow rates shall be measured in the supply duct using pitot tube.

End of Section 14

Section 15**List of Drawings**

S.No.	Description	Sheet No.
1.	HVAC layout	01
2.	Schematic layout	02

End of Section 15

Section 16

Articles of Agreement

Article of agreement made at -----

This -----

Day of -----

Between -----

The employer which expression shall include its successors and assigns and all the persons for the time being in management of the employer of the one part and messers ----- (Hereinafter referred to as contractor's which expression shall include his/their respective heirs, successors, executors, administrators and assigns of the other part.

Whereas the employer invited tender for the works of airconditioning of ----- as per drawings, schedule of quantities, specifications, etc., describing the work to be prepared for -----

Whereas the contractor tendered for such work under tender date -----

Whereas the tender as submitted by the contractor was accepted by the employer, on the terms and conditions hereinafter specified.

Whereas the contractor had deposited with the Engineers Incharge on behalf of the employer, by bank draft a sum amounting to Rs. ----- for the due and faithful performance of the contract on the part of the contractor.

Now it is hereby agreed and declared between the parties whereto as follows :

- 1) In consideration of the payments to be made to the contractor's as hereafter provided in appendix, the contractor shall upon and subject to the conditions herein contained and the said conditions of contract execute and complete the work shown upon the drawings and such further detailed drawings as may be furnished to him and described in the said specifications and the said schedule of quantities. By
- 2) The employer shall pay the contractor such sums as shall become payable hereunder at the time and in the manner specified in the said conditions.
- 3) Time is the essence of the agreement and the contractor shall pay or allow the employer to deduct 5% of the contract value (which percentage shall be determined at the discretion of the engineers incharge and the employer depending upon the circumstances of the case) and subject to clause No.1, of the above agreement as liquidated damages for the period during which the said work shall remain incomplete beyond the time allowed in clause 1 above or beyond the time duly extended in writing as per said conditions. The employer may deduct such damages from any money due to the contractor.

4) The term Engineers Incharge in the said conditions shall mean and in the event of his/their death or ceasing to be the Engineers Incharge for the purpose of this agreement such other Engineers Incharge not being an Engineers Incharge or Engineers Incharge to whom the contractor shall object for reasons considered to be sufficient by the employer, provided always that the Engineers Incharge subsequently appointed shall not be entitled to disregard or overrule any decisions given by or under the authority or direction of the previous Engineers Incharge.

5) The plans, agreement and documents above mentioned shall form the basis of this agreement and the decisions of the said Engineers Incharge or the other engineers Incharge for the time being as mentioned in the said conditions. In reference to all matters of dispute as to materials and workmanship shall be final and binding on both parties.

6) The employer through the Engineers Incharge reserves to himself the right of altering the drawings and or adding to or omitting any item of work or of having portions of the same carried out departmentally or otherwise and such variations shall not vitiate this agreement.

7) This agreement comprises the work above and all subsidiary work therewith, even though such works may not be shown on the drawings, or described in the said specifications or the schedule of quantities.

8) All disputes and differences of any kind whatsoever arising out of or in connection with the contract or the carrying out of the works (whether during the progress of the works or after their completion) shall be referred to Director IIITD. The decision of the Director IIITD shall be final in this regard.

9) This invitation to tender and general instructions to contractors, agreement and schedule of conditions of contract, appendix, schedule of quantities and systems specifications, etc., hereto annexed form part of this contract.

This contract has been read by us and fully understood by us.

In witness whereof the parties hereto have set in their respective hands the day and the year herein above written -----

Signed by for an on behalf of the employer.

In the presence of

Signed by the said contractor

In the presence of

Section 17

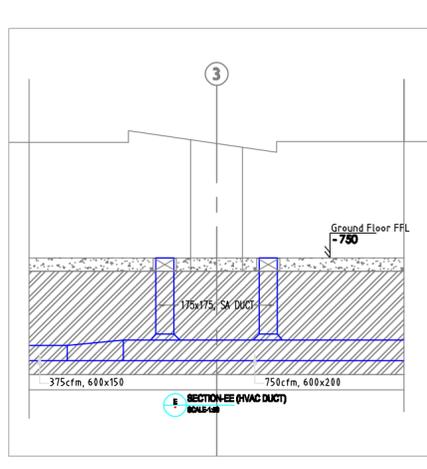
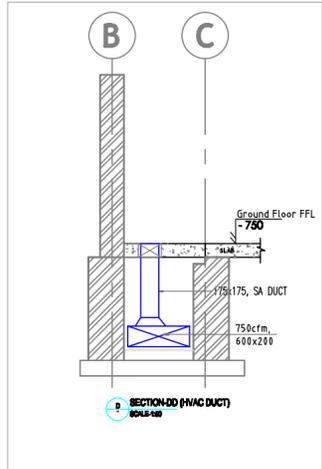
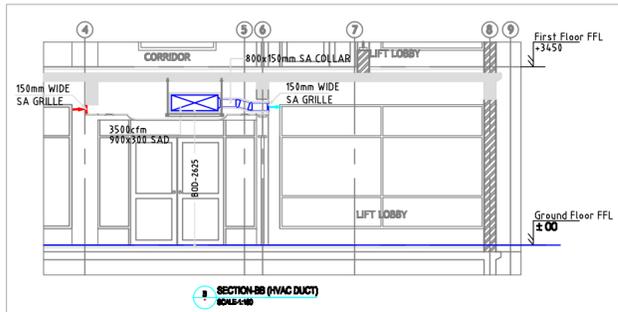
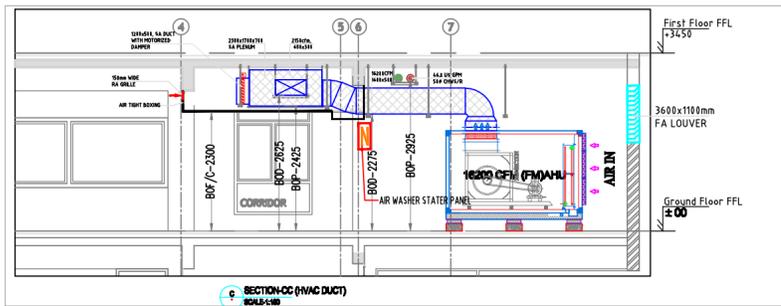
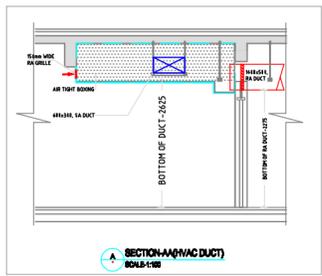
Schedule of Prices

**Modification, addition and alteration works in existing HVAC System for Airconditioning and ventilation of Ground floor of Library block at
Indraprastha Institute of Information Technology (IIIT) at New Delhi**

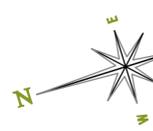
The prices are to be quoted in the below mentioned form and shall include the supply, installation, testing and commissioning at site of all the equipments, ancillary materials as specified and all such items what so ever which may be required to fulfil the intent and purpose as laid down in the specification and/or the drawings. The Contractor must execute the works in a manner without affecting the existing building structure / services and any damage to the existing structure /services /structure shall be to the account of the Contractor. For the tap off from existing lines entire works will be executed by the Contractor in coordination with the IIITD Project and FM teams.

S.No.	Description	Unit	Qty.	Rate Rs.	Amount Rs.
1	Airhandling Units (Floor Mounted Type)				
	Supply, installation, testing and commissioning of double skin airhandling units floor mounted horizontal type complete with fan EFF - 1 motor, plug fan, cooling coil-stainless steel condensate collecting pan, spring isolators, pre filters (EU4/MERV-7-8), variable frequency drive, complete as per specifications and drawings.				
1.1	10,000 cfm, 4 row coil cooling, 40 mmwg external S.P.	No.	1		
2	Chilled Water Piping				
	Supply, installation, testing and commissioning of 'C' class mild steel black steel pipes with all necessary fittings, supports, PUF insulation of 50 mm thick 36 kg/m ³ with 26 gauge aluminium cladding etc. as per specifications and drawings.				
2.1	Piping				
2.1.1	65 mm	Rm	20		
2.2	Butterfly Valves				
2.2.1	65 mm	Nos.	2		
2.3	PID Valves				
	Supply, installation, testing and commissioning of 2 way modulating valve cum pressure independent balancing valve along with actuator & proportionate thermostat, transformer complete as required and as per specifications of following sizes.				
2.3.1	65 mm dia	No.	1		
2.4	Y - Strainer				
2.4.1	65 mm	No.	1		
2.5	Pressure gauge	Nos.	2		
2.6	Thermometers	Nos.	2		
3	Drain Piping				
	Supply, installation testing & commissioning of 'A' class G.I. drain piping complete with fittings, supports insulation as per specification and drawings.				
3.1	40 mm dia	Rm	15		
4	Ducting				
	Supply, installation, testing and commissioning of site fabricated G.I. ducting along with vanes, splitter damper at each branch etc. as per specifications & drawings.				
4.1	G.I. Sheet Metal Ducting (Rectangular)				
4.1.1	0.63 mm (24 Gauge)	Sqm	75		
4.1.2	0.80 mm (22 Gauge)	Sqm	20		
4.1.3	1.00 mm (20 Gauge)	Sqm	25		

S.No.	Description	Unit	Qty.	Rate	Amount
				Rs.	Rs.
5	Insulation				
	Supply & installation of nitrile rubber insulation on ducts with prelaminated aluminium foil vapour barrier complete as per specifications and drawings.				
5.1	6 mm thick	Sqm	100		
6	Duct Acoustic Lining				
	Supply & installation of duct acoustic lining with fibre glass insulation of density 32 kg/m ³ covered with 26 Ga perforated Al. sheet with nuts and bolts complete as per standards, requirement and drawings.				
6.1	25 mm	Sqm	20		
7	Acoustic False Ceiling & Wall Panelling for AHU Room				
	Supply & installation of acoustical wall panelling (NRC 0.8) made of perforated aluminium sheet trays with 23% perforation, size 600mm X 600mm of metal thickness 1.5mm with acoustical fleece lining, mounted on a GI framework using 48mm X 48mm GI studs @ 600 c/c with 50mm , 32 Kg/m ³ glasswool covered with FGT tissue.	Sqm	Rate only		
8	Grilles / Diffuser				
	Supply, installation, testing and commissioning of aluminium powder coated supply and return air grilles/diffusers as per specifications and drawings.				
8.1	Aluminium supply air diffuser with damper.	Sqm	1.0		
8.2	Aluminium return air diffuser without damper.	Sqm	2.5		
8.3	Aluminium return air grills without damper.	Sqm	4.5		
9	Volume Control Damper				
	Supply & installation of extruded aluminium volume control damper with blades, adjustable lever, frame etc. as per specifications and drawings.	Sqm	1.0		
10	Fire Damper				
	Supply & installation of solenoid operated dampers complete with damper electric actuator, smoke/ heat detector, interlocking arrangement with blower motor complete as per specification and drawings.(Opening of fire damper in wall/ partition to be cut and later made good to a fire rating of similar capacity as the damper by HVAC contractor.) complete as per standards, requirement and drawings.				
10.1	Fire dampers	Sqm	1.0		
10.2	Actuator assembly	Nos.	1		
11	Power Cabling				
	Supply & installation of XLPE sheathed aluminium cables with for various equipments through walls/ceiling/cable tray with appropriate clamps & fixing arrangements including M.S. perforated cable tray as per specifications and drawings and as required.				
11.1	4C - 6 sqmm.	Rm	15		
12	Dismantling of Existing Airwasher				
	Dismantling removing shifting and placing of existing airwasher along with ducting, grilles, diffuser, false ceiling etc. as guided by Engineer - in - Charge to Dining Block IIInd floor .	Lot.	Lot.		
Total Rs.					



KEY PLAN

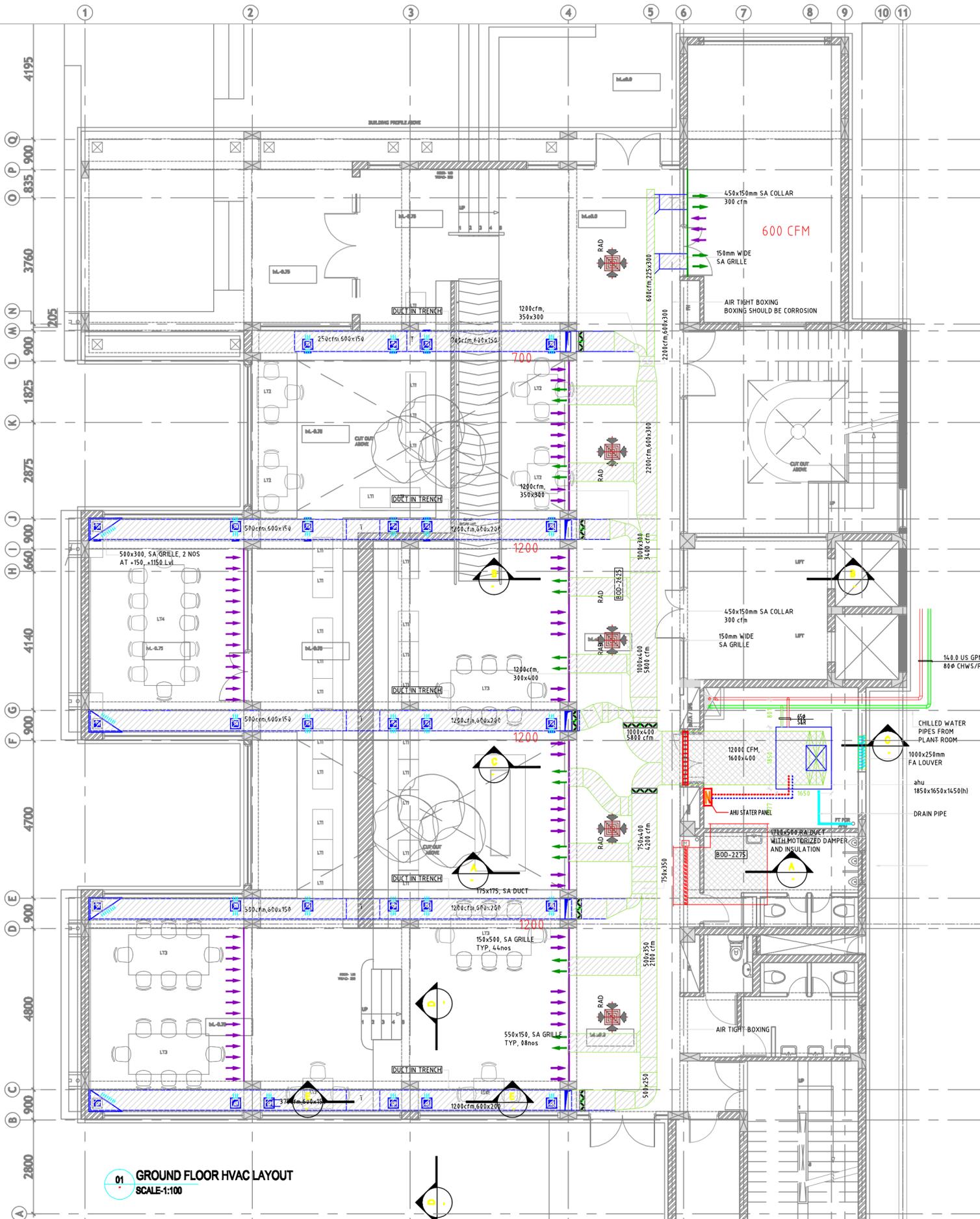


NOTES:

1. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE STATED.
2. ALL CIVIL WORK RELATED WITH HVAC SHALL BE DONE BY CLIENT'S FLOOR DRAIN IN EACH A.H.U. ROOM SHALL BE PROVIDED BY CLIENT.
3. ALL DIMENSIONS MENTIONED IN ARCHITECTS/INTERIORS DESIGNERS DRAWINGS SUCH AS BOTTOM OF BEAM, DEPTH OF BEAM LOCATION OF BEAM & HEIGHT OF FALSE CEILING/BOXING ETC. MUST BE CHECKED AT SITE AND IF FOUND ANY DISCREPANCY MUST BE REPORTED TO THE CONCERN PARTY.
4. ALL DIMENSIONS/NOTES MENTIONED IN THIS DRAWING IN CONNECTION WITH AIR CONDITIONING MUST BE ADVISED FOR PROPER FUNCTIONING AND SERVICING OF A/C EQUIPMENT.
5. ALL PIPE SIZES REFERS TO SCHEMATIC DWG.
6. WHEREVER DUCT COLLAR GOING INTO THE ROOM WALL OPENING SHALL BE 50 MM MORE INSIDE OF THE DUCT & ABOVE F/C SHOULD BE FULLY OPEN.
7. ALL CONDENSATE DRAIN PIPES TO BE INSULATED WITH THERMAL INSULATION AS PER SPECIFICATION.
8. ALL CONDENSATE DRAIN PIPES TO BE TERMINATED TO NEAREST D.P.
9. DOOR OF ALL FAN & AHU ROOMS SHOULD BE AIRTIGHT AND OUTSIDE OPENABLE.

LEGENDS

	FRESH AIR GRILLE		AIR TIGHT PARTITION ABOVE FALSE CEILING
	SUPPLY RETURN AIR GRILLE		SUPPLY AIR DUCT
	EXHAUST GRILLE		RETURN AIR DUCT
	SUPPLY AIR GRILLE		FRESH AIR DUCT
	CEILING SUSPENDED AHU		EXHAUST AIR DUCT
	INLINE FAN		MOTORIZED FIRE DAMPER
	ELECTRICAL PANEL		VOLUME CONTROL DAMPER
	CHILLED WATER SUPPLY		FIRE DAMPER
	CHILLED WATER RETURN		DRAIN PIPE



01 GROUND FLOOR HVAC LAYOUT
SCALE: 1:100

REVISED AS PER CLIENT COMMENT	N.D.	15.02.2014	01	
ISSUED FOR APPROVAL	N.D.	13.04.2013	00	
REMARKS		DRAWN	DATE	REVISION

REVISIONS

CLIENT :-
M/S. INDRAPRASTHA INSTITUTE OF INFORMATION TECHNOLOGY

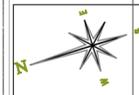
PROJECT :-
campus for Indraprastha Institute of Information Technology (IIIT) at Okhla Industrial Estate, Ph. III, NEW DELHI - 110020

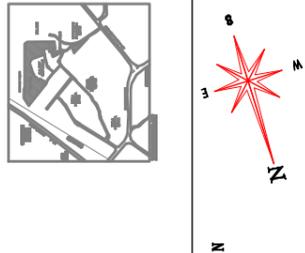
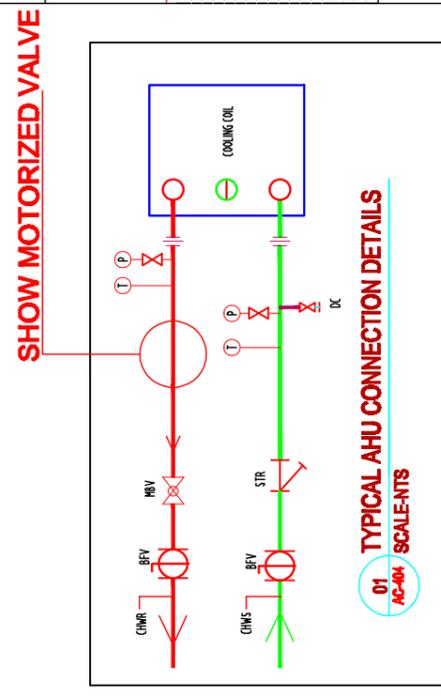
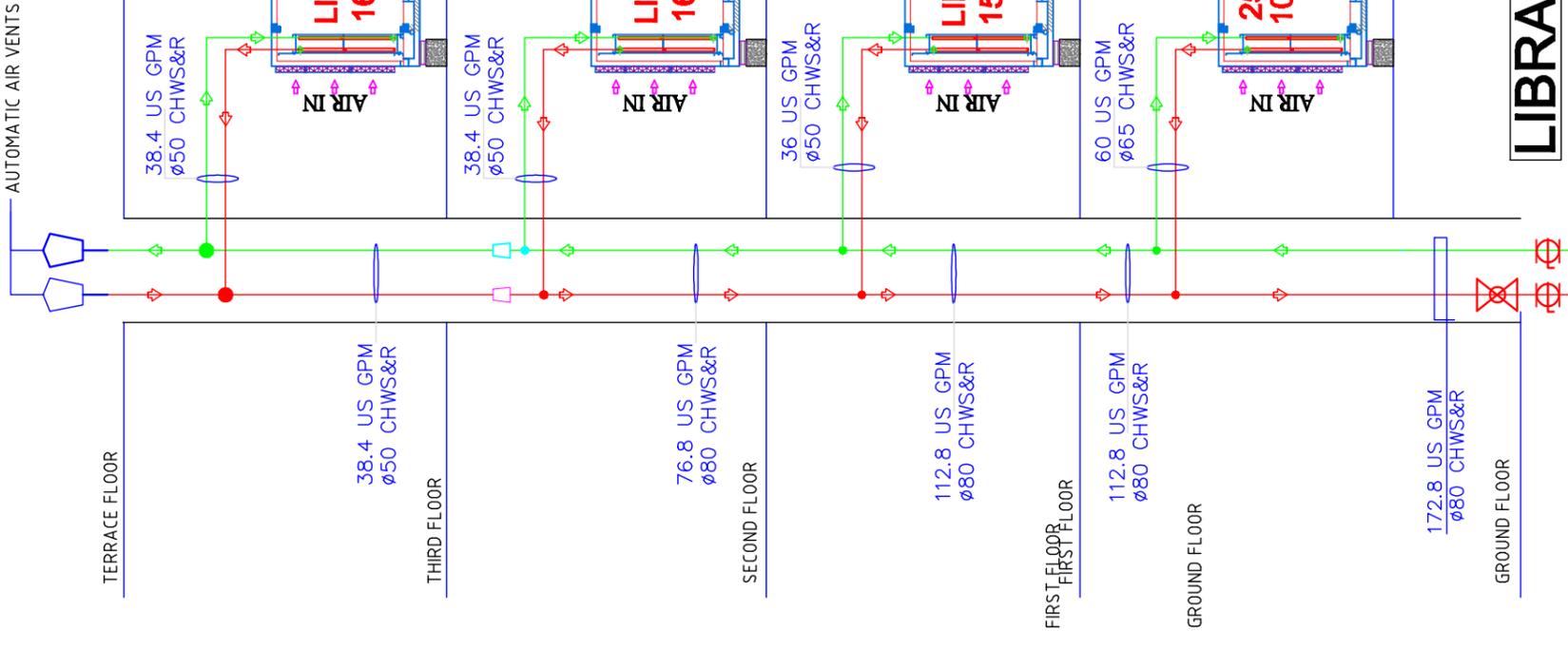
PROJECT CONSULTANTS:-

ARCHITECTS CONSULTANT:-

TITLE :-
GROUND FLOOR HVAC LAYOUT (LIBRARY BLOCK)

DRAWN	ZAMAN	DATE	03-11-14	DRG. NO.		REVISION	
CHECKED	ABHISHEK						
APPROVED					VJ/HVAC/17		01
SCALE - 1:100		SHEET SIZE - A2					





NOTES:

1. ALL WORKS ARE TO BE COMPLETED WITHIN THE SPECIFIED TIME FRAME.
2. ALL WORKS SHALL BE DONE BY CERTIFIED WORKERS IN EACH AREA.
3. ALL WORKS SHALL BE DONE WITHIN THE SPECIFIED TIME FRAME.
4. ALL WORKS SHALL BE DONE WITHIN THE SPECIFIED TIME FRAME.
5. ALL WORKS SHALL BE DONE WITHIN THE SPECIFIED TIME FRAME.
6. ALL WORKS SHALL BE DONE WITHIN THE SPECIFIED TIME FRAME.

NO.	REVISIONS	DATE	REASON
0		26/04/2013	

CLIENT :-
IMS, INDRAPRASTHA INSTITUTE OF INFORMATION TECHNOLOGY

PROJECT :-
Campus for Indraprastha Institute of Information Technology (IIIT) at Cyber Indraprastha Estate, Pt. II, NEW DELHI - 110020

PROJECT CONSULTANTS:-

ARCHITECTS CONSULTANTS:-

NO.	REVISIONS	DATE	REASON
0			

TITLE :-
SCHEMATIC (LIBRARY BLOCK)

NO.	REVISIONS	DATE	REASON
0			

SCALE - 1:25

SHEET NO. - 10

PROJECT NO. - 10