Er. H.P. Singh
Executive Engineer

ਪੰਜਾਬ ਟੈਕਨੀਕਲ ਯੂਨੀਵਰਸਿਟੀ ਜਲੰਧਰ
PTU PUNJAB TECHNICAL UNIVERSITY
Estd. Under Punjab Technical University Act, 1996
(Punjab Act No. I of 1997)

Ref. No. PTU/CC/356/26939

Dated 16-5-11

Sh. Chander Mohan,
House No. 202, Sector 36-A,Chandigarh.

The Director,
Department of Technical Education and
Industrial raining, Punjab,
Plot No. 1, Sector-36A, Chandigarh.

Sh. H.S. Bains,
Registrar, Punjab Technical University,
Jalandhar.

Sh. A. N. Chowdhry (Special Invitee),
3-B, Jyoti Nagar, Jalandhar.

Col. Dharminder Kumar Thakur (Special Invitee)
307-B, GH-II, Sikha Apartments,
Mansa Devi Complex, Panchkula, Haryana

Sh. S.L. Kaushal,
Advisor/Architecture,
2865, Sector 42-C, Chandigarh.

Dr. Nachattar Singh,
Advisor to VC and Dean (P&D),
Punjab Technical University, Jalandhar.

Dr. Buta Singh (Special Invitee),
Dean/Academics, Registrar,
Punjab Technical University, Jalandhar.

Sh. N. S. Bhatti (Special Invitee),
3040, Sector 19-D, Chandigarh

Sh. P. S. Saini (Special Invitee)
Hospital Engineer, PGI
H.No. 3334, Sector 24-D, Chandigarh

Sub : Construction of new campus of Punjab Technical University – 26th meeting of the Standing Building Construction Committee.

Dear Sir,

26th meeting of the Standing Building Construction Committee shall be held under the Chairmanship of Dr. R. S. Khandpur, Director General, PGSC at 11.30 hours on 26.05.2011 in his office at SCO 60-61, Sector 34-A, Chandigarh. Agenda and Agenda note for the meeting are enclosed.

You are requested to make it convenient to attend the meeting.

Thanking you

Yours Sincerely,

HPS 16/05/11
(H. P. Singh)
Executive Engineer

Copy to :
i. Dr. R. S. Khandpur, DG, PGSC, SCO 60-61, Sector 34-A, Chandigarh.
ii. Sh. Rajiv Aggarwal, M/s Archigroup Architects, A-14, Sector-15, Noida -201301.

PUNJAB TECHNICAL UNIVERSITY, JALANDHAR

Sub : Agenda for the 26th meeting of the Standing Building Construction Committee.

Item No. 26.1 :	To confirm the Minutes of 25th meeting of Standing Building Construction Committee held on 20.04.2011.
Item No. 26.2 :	Action taken on various items discussed during previous meetings of Standing Building Construction Committee.
Item No. 26.3 :	To discuss and approve the design basis reports submitted by the Architect in respect of structural design, HVAC, Electrical, Plumbing and Fire Fighting systems of two towers, one library and one seminar hall of proposed PIT at main campus, Kapurthala.
Item No. 26.4 :	Any other point with the permission of the Chair.

PUNJAB TECHNICAL UNIVERSITY, JALANDHAR

Sub : Agenda Note for the 26th meeting of the Standing Building Construction Committee.

Item No. 26.1 : **To confirm the Minutes of 25th meeting of Standing Building Construction Committee held on 20.04.2011.**

The minutes of 25th meeting of Standing Building Construction Committee held on 20.04.2011 were circulated on 27.04.2011. These minutes are to be confirmed.

Item No. 26.2 : **Action taken on various items discussed during previous meetings of Standing Building Construction Committee.**

Action taken on various items discussed during previous meeting of Standing Building Construction Committee is as under:

- Applications for recruitment of one Asstt. Executive Engineer (Civil) and one Asstt. Engineer (Civil) required for construction cell has been received and their scrutiny is in progress.

- Notice inviting bids for appointment of Architect for Architectural services for establishment of new Punjab Institute of Technology at Mansa, Ludhiana & Barnala, PTU's Regional campus at Mohali and other future works has been issued and bids are due for submission on 19.05.2011.

- The Architect has submitted the design basis reports in respect of structural design, HVAC, Electrical, Plumbing and Fire Fighting systems of two towers, one library and one seminar hall of proposed PIT at main campus, Kapurthala and same are being discussed in the present meeting.

Item No. 26.3 : **To discuss and approve the design basis reports submitted by the Architect in respect of structural design, HVAC, Electrical, Plumbing and Fire Fighting systems of two towers, one library and one seminar hall of proposed PIT at main campus, Kapurthala.**

During the 23rd meeting of Standing Building Construction Committee held on 15.03.2011, the Conceptual plans of proposed buildings (two towers, one library and one seminar hall) of proposed PIT at main campus, Kapurthala were approved and Architect was advised to start work on services of these buildings. The Architect has submitted design basis reports in respect of structural design, HVAC, Electrical, Plumbing and Fire Fighting systems of these buildings. These design basis reports are to be discussed and approved. These reports are enclosed alongwith.

Item No. 26.4 : **Any other point with the permission of the Chair.**

1. DESIGN PHILOSOPHY

This document covers the design philosophy for the design of PTU Phase-2 Institute Buildingds
The bldg has the following features:

a) The work consists of two institute buildings, one library and one seminar hall. All are independent buildings.
b) the Bldg have overhead water tank on the terrace of all blocks.
c) The Bldg have lift facility & the lift machine room is on the terrace of all blocks.
d) The typical storey height in all the blocks is approx. 4 m, except for seminar hall which may be around 6m
e) The column to column spacing is as per plan.
f) The flooring system consists of slabs resting on beams.
g) All the internal partition walls shall be 115 mm thick brick wall, whereas the external walls, stairwell walls and the lift core walls shall be 230 mm thick brick wall with stone cladding.
h) **The expansion/separation joint shall be provided as per IS:456, IS:1893, IS:4326**

The following are the sizes of the various structural elements proposed for the building in general:

1) **Thickness of Slabs**

a) Thickness of slabs: There will be three types of slab as per thickness requirement

i) Slab 1	100 mm	v) Slab 5	140 mm
ii) Slab 2	110 mm	vi) Slab 6	150 mm
iii) Slab 3	120 mm		
iv) Slab 4	125 mm		

2) **Beams**

i) Primary Beam	300 x 600/750/900 mm
ii) Secondary Beam	230/300 x 600/750 mm

3) **Columns**

The priliminary size of the columns would be 300 x 300 to 900mm.

2. MATERIALS

2.1 Grade of materials

a) **The grade of concrete shall be M25 for** beams,slabs **& columns above ground and Higher grade below ground for columns & Foundations.**
b) The grade of reinforcement steel shall be Fe500 **(TMT** Bars) **for all.**
c) PCC shall have a mix of 1:4:8

2.2 Unit weight of materials

The unit wt. of materials to be used in design are as mentioned below:

a)	RCC	25 kN/m³
b)	PCC	24 kN/m³
c)	Brick Masonry (230 thk with plaster)	22 kN/m³
d)	Brick Masonry (115 thk with plaster)	22 kN/m³
e)	Terracing (Brick Coba)	20 kN/m³
f)	Cinder/Brick coba Fill in sunken portion	16 kN/m³
g)	Glazing	2 kN/m²
h)	Stone cladding	1.5 kN/m²
i)	Soil	to be confirmed with the soil report

3. LOADING

The various loads to be carried by the structure are as follows:

i) **Dead Load (as per IS 875 (Part 1))**

a) The self weight of the beams and columns shall be input as SELFWEIGHT command in STAAD Pro

b) Self weight of normal slab

i) 100 mm thick slab	= 0.100 x 25	= 2.5 kN/sqm
ii) 110 mm thick slab	= 0.110 x 25	= 2.75 kN/sqm
iii) 120 mm thick slab	= 0.120X25	= 3.0 kN/sqm
iv) 125 mm thick slab	= 0.125x25	= 3.13 kN/sqm
iv) 140 mm thick slab	= 0.14x25	= 3.5 kN/sqm

c) Floor Finish (60 mm thk on floors) & Terrace (200mm thk.) 0.060 x 24 = 1.45 kN/sqm; 0.150 x 20 = 3.00 kN/sqm

as per unit weight given above

d) 230 thk masonry = 0.23 x (3.0-0.45) x 22 = 12.90 kN/m

0.23 x (3-0.6) x 22 on the basis of a 3.0 floor to floor height beam not less than 450mm depth envisaged for 230 thk walls.

e) 115 thk masonry = 0.115 x (3.0-0.45) x 22 = 7.04 kN/m

0.115 x (3-0.6) x 22 on the basis of a 3.0 floor to floor height

ii) **Live Load (as per IS 875 (Part 2))**

a)	Class Room	= 3.00	kN/sqm
b)	Passage, Balconies	= 4.00	kN/sqm
c)	Toilet	= 2.00	kN/sqm
d)	Stairs	= 4.00	kN/sqm
f)	Lift M/C Room (Impact Loading)	= 10.00	kN/sqm
g)	Terrace	= 1.50	kN/sqm
k)	Over head water tank	as per size of Water Tank	
l)	office	= 3.00	kN/sqm
m)	laboratories	= 3.00	kN/sqm
n)	libraries	= 6.00	kN/sqm

iii) **Seismic Load (as per IS 1893: 2002)**

The following parameters would be considered for seismic loading as per IS 1893:2002, IS 13920:1993

Zone	IV
Zone Factor	0.24
Importance Factor	1.5
Response Reduction Factor	5*
Damping	5%

* The ductile deatailing of the structural elememts would be done as per IS 13920:2002, and so the building falls in the category of "Special RC Moment Resisting Frame", hence RF=5 is considered for design.

iv) **Wind Load (as per IS 875 (Part 3))**

Note: Buildings are less than 35m height in Zone 4 of earthquake. Hence earthquake forces shall govern over wind forces. Therfore, only seismic analysis has been performed for less than 35m height.

v) **Temperature & Shrinkage Load**

As the lateral dimension of the building after the provision of Expansion joint does not exceed 45m, therefore as per clause 19.5.1 IS 456-2000, the effects due to temperature & shrinkage can be ignored in design.

4. INPUT LOADS AS PER AREA USE

The Input Loads on floors depending up on the type of use are as follows

i) Room (125 thick slab)

a)	Self wt. of slab		= 3.13 kN/sqm
b)	FF		= 1.45 kN/sqm
		Total DL	= 4.58 kN/sqm
c)	LL		= 3.00 kN/sqm
		Total	= 7.58 kN/sqm

ii) Pantry(100 thick slab)

a)	Self wt. of slab		= 2.5 kN/sqm
b)	FF		= 1.45 kN/sqm
c)	Filling of 150 mm (brick coba)		= 2.40 kN/sqm
		Total DL	= 6.35 kN/sqm
c)	LL		= 3.00 kN/sqm
		Total	= 9.35 kN/sqm

iv) Passages (100mm thick slab)

a) Self wt. of slab		= 2.5 kN/sqm
b) FF		= 1.45 kN/sqm
	Total DL	= 3.95 kN/sqm
c) LL		= 4.00 kN/sqm
	Total	= 7.95 kN/sqm

v) Stairs

a) Self wt. of slab (175THK.)		= 5.21 kN/sqm
b) Wt. of Steps (165mm Riser)		= 2.45 kN/sqm
c) FF		= 1.65 kN/sqm
d) CP		= .15 kN/sqm
	Total DL	= 9.46 kN/sqm
e) LL		= 4.0 kN/sqm
	Total	= 14.46 kN/sqm

vi) Lift M/C Room

a) Self wt. of slab (150 Thk)		= 3.75 kN/sqm
b) FF		= 1.45 kN/sqm
	Total DL	= 5.2 kN/sqm
c) LL*		= 10.00 kN/sqm
	Total	= 15.20 kN/sqm

*LL on lift m/c room accounts for 50% impact, i.e., full load of the m/c

vii) Terrace

a) Self wt. of slab		= 3.5 kN/sqm	
c) Brick tile + Brick coba (250 thk)		= 5.00 kN/sqm	
	Total DL	= 8.50 kN/sqm	As per unit weight
e) LL		= 1.50 kN/sqm	given above
	Total	= 10.00 kN/sqm	

viii) office (125 thick slab)

a) Self wt. of slab		= 3.13 kN/sqm
b) FF		= 1.45 kN/sqm
	Total DL	= 4.58 kN/sqm
e) LL		= 3.00 kN/sqm
	Total	= 7.58 kN/sqm

ix) labortary(125 thick slab)

a) Self wt. of slab		= 3.13 kN/sqm
b) FF		= 1.45 kN/sqm
	Total DL	= 4.58 kN/sqm
e) LL		= 3.00 kN/sqm
	Total	= 7.58 kN/sqm

x) libraries (140 thick slab)

a) Self wt. of slab		= 3.5 kN/sqm
b) FF		= 1.45 kN/sqm
	Total DL	= 4.95 kN/sqm
e) LL		= 6.00 kN/sqm
	Total	= 10.95 kN/sqm

6. LOAD COMBINATIONS

The various load combinations to be used in design

A	**Ultimate Limit State (E.Q. Load)**
1	1.5(DL+LL)
2	1.5(DL+EQX)
3	1.5(DL-EQX)
4	1.5(DL+EQZ)
5	1.5(DL-EQZ)
6	1.2(DL+LL+EQX)
7	1.2(DL+LL-EQX)
8	1.2(DL+LL+EQZ)
9	1.2(DL+LL-EQZ)
10	1.5(0.6 DL+EQX)
11	1.5(06 DL-EQX)
12	1.5(0.6 DL+EQZ)
13	1.5 (0.6 DL-EQZ)

C	**Serviceability Limit State**
1	DL+LL
2	DL+EQX
3	DL-EQX
4	DL+EQZ
5	DL-EQZ
6	DL+LL+EQX
7	DL+LL-EQX
8	DL+LL+EQZ
9	DL+LL-EQZ

Note:

DL: Dead Load

LL: Live Load

EQX: Seismic Load in X Direction

EQZ: Seismic Load in Z Direction

5. DEFLECTIONS

The deflections due to service loads should not exceed the following values:

a) **Vertical Deflections:**

i) The final deflection due to all loads including the effects of temperature, creep and shrinkage and measured from the as-cast level of the supports, floors, roofs and all other horizontal members should not exceed span/250.

ii) The deflection including the effects of temperature, creep and shrinkage occuring after the erection of partitions and the application of finishes should not exceed span/350 or 20 mm, whichever is less

b) **Horizontal Deflections:**

i) Drift due to EQ: The interstorey drift should not exceed H/250 where H is the storey height.

6. DESIGN BASIS FOR TANK STRUCTURES

The water tanks/liquid retaining structures would be designed as per the provisions of IS 3370

7. COVER FOR STRUCTURAL ELEMENTS

The clear cover for the various structural elements accordinly would be as follows:

a) Slabs	20 mm	Walls	25 mm
b) Beams	25 mm	Fdm.	50 mm
c) Columns	40 mm		

8. STRUCTURAL WATER PROOFING

The structural water proofing shall be done as per the contract specifications.

9. LIST OF STANDARDS/ REFERENCES

1) IS 456 : 2000 - Code of Practice for Plain and Reinforced Concrete
2) IS 875 (Part 1 to 5): 1987 - Code of Practice for Design Loads (Other Than Earthquake) for Buildings and Structures
3) IS 1893 (Part1) : 2002 - Criteria for Earthquake Resistant Design of Structures
4) IS 13920 : 1993 - Code of Practice for Ductile Detailing of Reinforced Concrete Structures subjected to Seismic Forces
5) SP 16 : Design Aids to IS 456 : 1978
6) SP 34 : Handbook on Concrete Reinforcement and Detailing
7) Reinforced Concrete Designer's Handbook by Reynolds and Steedman

PTU, Phase III

HVAC Design Basis Report

May 3, 2011

Client:
PUNJAB TECHNICAL UNIVERSITY
JALANDHAR

Architect:
ARCHIGROUP ARCHITECTS (REGD.)
A-14, First Floor, Sector 15, Noida
Tel: 0120- 4312431

Consultant:
V.S. KUKREJA & ASSOCIATES (P) LTD.
165-A, Gautam Nagar, Adjoining Gulmohar Commercial Complex, New Delhi-49
Tel: 011-26520175

[This report covers the HVAC design basis for construction of two colleges, one seminar block, a library and an open air theatre, in phase III of Punjab Technical University, Jalandhar]

AIR CONDITIONING SYSTEM

GENERAL

The project consists of developing various buildings in the existing Punjab Technical University Campus.

The Buildings to be developed are 2 nos. College buildings, a library building and a seminar hall.

The buildings are envisaged to be air conditioned (Only Cooling to be provided).

The following factors are assumed for various seasons for designing the HVAC system of the Buildings:-

a) Outside Conditions

i) Summer:

D.B.	-	43.30° C	(110°F)
W.B.	-	23.86° C	(75°F)

ii) Monsoon:

D.B.	-	35.00° C	(95°F)
W.B.	-	28.30° C	(83°F)

iv) Lighting Load - As per the use of the area under consideration.

b) Inside Conditions

Lecture Hall, Tutorial, Library, Seminar Hall etc.

i) Summer & Monsoon

D.B.	-	26.0±1.0° C (79±2° F)
R.H.	-	55%±5%
Fresh Air	-	17 CFM/ Person

Laboratory, Common Room, Cafeteria etc.

ii) Summer & Monsoon

D.B.	-	26.0±1.0° C (79±2° F)
R.H.	-	55%±5%
Fresh Air	-	21 CFM/ Person

c) Design Criteria

Fresh Air	Lecture Hall, Tutorial, Library, Seminar Hall etc – 17 CFM/Person Laboratory, Common Room, Cafeteria etc – 21 CFM/Person
Lighting Load	2.0 watt/sift (Labs, Tutorial, library etc)

d) **Factor Considered**

i) **Glass:**

Solar heat gain factor = 0.56

U-VALUE = 1.13 BTU / Hr – Sq.ft. - °F

ii) **Walls:**

'U' Value = 0.35 BTU / Hr – Sq.ft. - °F.

iii) **Roof:**

'U' Value = 0.12 BTU / Hr – Sq.ft. - °F (assuming the roof is Insulated.)

iv) **Internal Partition:**

'U' Value = 0.35 BTU / Hr – Sq.ft. - °F.

HVAC Design Conditions:

The following factors have been considered for the design of HVAC services:

- Individual and quickly responding temperature control for each area
- Draft-free air distribution
- Toilet room exhaust
- Acceptable noise level
- Reliability
- Ease of maintenance
- Operating efficiency
- Use of space

SPECIAL REQUIREMENT

It is suggested that the top roof of the building should be insulated with a minimum of 50 mm thick expanded polyurethane (thermocole or equivalent) of minimum 16 Kg/Cum density; all the glass panes be covered with heat reflecting film. In addition Double glazed units (DGUs) are to be provided in the library.

LOAD ESTIMATION & EQUIPMENT SELECTION

The Air Conditioning loads and the recommended indoor units for the College 1, College 2 & Library Block are as follows:

HEAT LOAD SUMMARY FOR COLLEGE BUILDING-1

S. NO.	CONDITIONED SPACE	BASIS OF DESIGN: ACTUAL AIR CONDITIONED AREA	HEIGHT	INSIDE DESIGN CONDITION			OCCUPANCY	LIGHT LOAD	EQPT LOAD	DESIGN DATA SUMMARY: SUMMER LOAD	MONSOON LOAD	SUMMER DEHUMIDIFIED CFM	MONSOON DEHUMIDIFIED CFM	REQUIRED FRESH AIR QTY	INDOOR UNIT SELECTED	
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(I)	(J)	(K)	(L)	(M)	TYPE	(TRxQTY)
		SQ.FT.	FT.	MIN VENTILATION RATE CFM/PERSON	TEMP (°C)	RH	NOS.	W/SQ.FT.	KW	TR	TR	CFM	CFM	CFM		
1	**Ground Floor**															
1.1	Associate Professor	328	12.0	21.0	26.0±1	55±5%	12	8	7.2	4.44	4.62	1589	1555	252	Hi-Wall	1.5x3=4.50 1.0x1=1.0
1.2	Boy Common Room	315	12.0	21.0	26.0±1	55±5%	14	2.00	1.0	2.93	3.25	831	656	294	Hi-Wall	2.0x1=2.0 1.5x1=1.5
1.3	Clerical	172	12.0	21.0	26.0±1	55±5%	4	2.00	5.0	1.40	1.35	492	416	84	Hi-Wall	1.5x1=1.5
1.4	Director PA Room	192	12.0	21.0	26.0±1	55±5%	2	2.00	1.8	0.95	0.75	359	247	42	Hi-Wall	1.0x1=1.0
1.5	Director's Room	288	12.0	17.0	26.0±1	55±5%	9	2.00	1.8	2.11	2.11	683	551	153	Hi-Wall	2.0x1=2.0
1.6	Girls Common Room	372	12.0	21.0	26.0±1	55±5%	13	2.00	1.0	3.27	3.29	1023	759	273	Hi-Wall	2.0x2=4.0
1.7	Library	584	12.0	17.0	26.0±1	55±5%	35	2.00	1.0	5.90	6.81	1607	1386	595	Tower Unit	3.5x2=7.0
1.8	Professor Room-3	200	12.0	21.0	26.0±1	55±5%	5	2.00	1.0	1.31	1.32	418	318	105	Hi-Wall	1.5x1=1.5
1.9	Professor Room-4	174	12.0	21.0	26.0±1	55±5%	3	2.00	1.0	1.06	0.94	376	271	63	Hi-Wall	1.5x1=1.5
1.10	Professor Room-1	190	12.0	21.0	26.0±1	55±5%	5	2.00	2.70	1.55	1.45	526	393	105	Hi-Wall	1.5x1=1.5
1.11	Professor Room-2	190	12.0	21.0	26.0±1	55±5%	5	2.00	2.70	1.55	1.45	526	393	105	Hi-Wall	1.5x1=1.5
1.12	Research Lab-1	1292	12.0	21.0	26.0±1	55±5%	18	2.00	2.00	7.33	6.75	2687	2231	378	Tower Unit Hi-Wall	3.5x2=7.0 1.0x1=1.0
1.13	Research Lab-2	1292	12.0	21.0	26.0±1	55±5%	18	2.00	2.00	7.33	6.75	2687	2231	378	Tower Unit Hi-Wall	3.5x2=7.0 1.0x1=1.0
1.14	Research Lab-3	1292	12.0	21.0	26.0±1	55±5%	18	2.00	2.00	7.33	6.75	2687	2231	378	Tower Unit Hi-Wall	3.5x2=7.0 1.0x1=1.0
1.15	Research lab-4	1355	12.0	21.0	26.0±1	55±5%	20	2.00	2.00	6.51	6.44	2241	1906	420	Tower Unit Hi-Wall	3.5x2=7.0 1.0x1=1.0
1.16	Tutorial-3	420	12.0	17.0	26.0±1	55±5%	28	2.00	1.00	5.05	5.27	1438	1014	476	Hi-Wall	2.0x2=4.0 1.5x1=1.5

1.17	Tutorial-2	420	12.0	17.0	26.0±1	55±5%	29	2.00	1.00	5.05	5.27	1438	1014	476	Hi-Wall	2.0x2=4.0 1.5x1=1.5
1.18	Tutorial-1	430	12.0	17.0	26.0±1	55±5%	43	2.00	1.00	5.87	7.36	1352	1161	731	Hi-Wall	2.0x4=8.0
1.19	Lecture Hall-01	968	12.0	17.0	26.0±1	55±5%	62	2.00	0.50	8.85	10.87	2121	1816	1054	Tower Unit	3.0x4=12.0
	Sub Total	10474.0								79.8	82.8	25082.8	20549.7	6362.0		
2	First Floor															
2.1	Assistant Professor-1	103	12.0	21.0	26.0±1	55±5%	3.00	2.00	1.9	0.82	0.82	266	206	63	Hi-Wall	1.0x1=1.0
2.2	Assistant Professor-2	103	12.0	21.0	26.0±1	55±5%	3.00	2.00	1.9	0.82	0.82	266	206	63	Hi-Wall	1.0x1=1.0
2.3	Assistant Professor-3	485	12.0	21.0	26.0±1	55±5%	8.00	2.00	1.6	2.79	2.51	980	725	168	Hi-Wall	1.5x2=3.0
2.4	Assistant Professor-4	484	12.0	21.0	26.0±1	55±5%	6.00	2.00	1.2	2.60	2.28	964	759	126	Hi-Wall	1.5x2=3.0
2.5	Assistant Professor-5	140.0	12.0	21.0	26.0±1	55±5%	3.0	2.0	1.5	2.3	2.3	955	1005	63.0	Hi-Wall	1.0x1=1.0 1.5x1=1.5
2.6	Associate Profisser-5	145	12.0	21.0	26.0±1	55±5%	3	2.00	1.4	1.32	1.11	493	365	63	Hi-Wall	1.5x1=1.5
2.7	Associate Profisser-6	592	12.0	21.0	26.0±1	55±5%	8	2.00	1.4	3.52	3.16	1312	1077	168	Hi-Wall	2.0x1=2.0 1.5x1=1.5
2.8	Associate Professor-7	179	12.0	21.0	26.0±1	55±5%	3	2.00	1.2	1.66	1.63	646	647	63	Hi-Wall	2.0x1=2.0
2.9	Research Lab-5	1292	12	21	26.0±1	55±5%	18	2	2	7.39	6.71	3016	2297	378	Tower Unit Hi-Wall	3.5x2=7.0 1.0x1=1.0
2.1	Research Lab-6	1292	12	21	26.0±1	55±5%	18	2	2	7.39	6.71	3016	2297	378	Tower Unit Hi-Wall	3.5x2=7.0 1.0x1=1.0
2.11	Research Lab-7	1292	12	21	26.0±1	55±5%	18	2	2	7.39	6.71	3016	2297	378	Tower Unit Hi-Wall	3.5x2=7.0 1.0x1=1.0
2.12	Tutorial-5	420	12.0	21.0	26.0±1	55±5%	28	2.00	1.0	5.41	5.97	1456	1025	588	Hi-Wall	2.0x3=6.0
2.13	Tutorial-6	420	12.0	21.0	26.0±1	55±5%	28	2.00	1.0	5.41	5.97	1456	1025	588	Hi-Wall	2.0x3=6.0
2.14	Tutorial-4	430	12.0	17.0	26.0±1	55±5%	43	2.00	1.0	5.87	7.36	1352	1161	731	Hi-Wall	2.0x4=8.0
2.15	Tutorial-7	385	12.0	17.0	26.0±1	55±5%	36	2.00	1.0	4.70	5.90	1189	1009	612	Hi-Wall	2.0x3=6.0
2.16	Tutorial-8	430	12	17	26.0±1	55±5%	32	2	1	4.69	5.55	1290	1060	544	Hi-Wall	2.0x2=4.0 1.5x1=1.5
2.17	Tutorial-9	646	12	17	26.0±1	55±5%	60	2	1	7.95	10.16	1775	1561	1020	Hi-Wall	2.0x4=8.0 1.5x2=3.0
2.18	Tutorial-10	700	12	17	26.0±1	55±5%	30	2	1.5	5.68	6.20	1663	1387	510	Hi-Wall	2.0x3=6.0 1.0x1=1.0
2.19	Lecture Hall-2	968	12.0	17.0	26.0±1	55±5%	62	2.00	0.50	8.85	10.87	2121	1816	1054	Tower Unit	3.0x4=12.0
2.20	Clerical Room	170	12.0	21.0	26.0±1	55±5%	4	2.00	4.7	1.47	1.36	523	418	84	Hi-Wall	1.5x1=1.5
2.21	Professor Room-5	200	12.0	21.0	26.0±1	55±5%	5	2.00	1.0	1.42	1.33	468	328	105	Hi-Wall	1.5x1=1.5
2.22	Professor Room-6	200	12.0	21.0	26.0±1	55±5%	5	2.00	1.0	1.30	1.30	413	309	105	Hi-Wall	1.5x1=1.5
	Sub Total	11076.0								90.8	96.7	28634.4	22980.3	7852.0		

3	**Second Floor**															
3.1	**Associate Professor**	328	12.0	21.0	26.0±1	55±5%	12	8	7.2	4.44	4.62	1589	1555	252	Hi-Wall	1.5x3=4.50 1.0x1=1.0
3.2	Boy Common Room	315	12	21	26.0±1	55±5%	14	2	1	2.93	3.25	831	656	294	Hi-Wall	2.0x1=2.0 1.5x1=1.5
3.3	Clerical	172	12.0	21.0	26.0±1	55±5%	4	2.00	5.0	1.40	1.35	492	416	84	Hi-Wall	1.5x1=1.5
3.4	Director PA Room	192	12.0	21.0	26.0±1	55±5%	2	2.00	1.8	0.95	0.75	359	247	42	Hi-Wall	1.0x1=1.0
3.5	Director's Room	288	12.0	17.0	26.0±1	55±5%	9	2.00	1.8	2.11	2.11	683	551	153	Hi-Wall	2.0x1=2.0
3.6	Girls Common Room	372	12.0	21.0	26.0±1	55±5%	13	2.00	1.0	3.27	3.29	1023	759	273	Hi-Wall	2.0x2=4.0
3.7	Library	584	12.0	17.0	26.0±1	55±5%	35	2.00	1.0	5.90	6.81	1607	1386	595	Tower Unit	3.5x2=7.0
3.8	Professor Room-3	200	12.0	21.0	26.0±1	55±5%	5	2.00	1.0	1.31	1.32	418	318	105	Hi-Wall	1.5x1=1.5
3.9	Professor Room-4	174	12.0	21.0	26.0±1	55±5%	3	2.00	1.0	1.06	0.94	376	271	63	Hi-Wall	1.5x1=1.5
3.10	Professor Room-1	190	12.0	21.0	26.0±1	55±5%	5	2.00	2.70	1.55	1.45	526	393	105	Hi-Wall	1.5x1=1.5
3.11	Professor Room-2	190	12.0	21.0	26.0±1	55±5%	5	2.00	2.70	1.55	1.45	526	393	105	Hi-Wall	1.5x1=1.5
3.12	Research Lab-1	1292	12	21	26.0±1	55±5%	18	2	2	7.33	6.75	2687	2231	378	Tower Unit Hi-Wall	3.5x2=7.0 1.0x1=1.0
3.13	Research Lab-2	1292	12	21	26.0±1	55±5%	18	2	2	7.33	6.75	2687	2231	378	Tower Unit Hi-Wall	3.5x2=7.0 1.0x1=1.0
3.14	Research Lab-3	1292	12	21	26.0±1	55±5%	18	2	2	7.33	6.75	2687	2231	378	Tower Unit Hi-Wall	3.5x2=7.0 1.0x1=1.0
3.15	Research lab-4	1355	12	21	26.0±1	55±5%	20	2	2	6.51	6.44	2241	1906	420	Tower Unit Hi-Wall	3.5x2=7.0 1.0x1=1.0
3.16	Tutorial-3	420	12	17	26.0±1	55±5%	28	2	1	5.05	5.27	1438	1014	476	Hi-Wall	2.0x2=4.0 1.5x1=1.5
3.17	Tutorial-2	420	12	17	26.0±1	55±5%	28	2	1	5.05	5.27	1438	1014	476	Hi-Wall	2.0x2=4.0 1.5x1=1.5
3.18	Tutorial-1	430	12.0	17.0	26.0±1	55±5%	43	2.00	1.00	5.87	7.36	1352	1161	731	Hi-Wall	2.0x4=8.0
3.19	Lecture Hall-01	968	12.0	17.0	26.0±1	55±5%	62	2.00	0.50	8.85	10.87	2121	1616	1054	Tower Unit	3.0x4=12.0
	Sub Total	10474.0								79.8	82.8	25082.8	20549.7	6362.0		
4	**Third Floor**															
4.1	Assistant Professor-1	103	12.0	21.0	26.0±1	55±5%	3.00	2.00	1.9	0.82	0.82	266	206	63	Hi-Wall	1.0x1=1.0
4.2	Assistant Professor-2	103	12.0	21.0	26.0±1	55±5%	3.00	2.00	1.9	0.82	0.82	266	206	63	Hi-Wall	1.0x1=1.0
4.3	Assistant Professor-3	485	12.0	21.0	26.0±1	55±5%	8.00	2.00	1.6	2.79	2.51	980	725	168	Hi-Wall	1.5x2=3.0
4.4	Assistant Professor-4	484	12.0	21.0	26.0±1	55±5%	6.00	2.00	1.2	2.60	2.28	964	759	126	Hi-Wall	1.5x2=3.0
4.5	Assistant Professor-5	140.0	12.0	21.0	26.0±1	55±5%	3.0	2.0	1.5	2.3	2.3	955	1005	63	Hi-Wall	1.0x1=1.0 1.5x1=1.5

4.6	Associate Profisser-5	145	12.0	21.0	26.0±1	55±5%	3	2.00	1.4	1.32	1.11	493	365	63	Hi-Wall	1.5x1=1.5
4.7	Associate Profisser-6	592	12.0	21.0	26.0±1	55±5%	8	2.00	1.4	3.52	3.16	1312	1077	168	Hi-Wall	2.0x1=2.0 1.5x1=1.5
4.8	Associate Professor-7	179	12.0	21.0	26.0±1	55±5%	3	2.00	1.2	1.66	1.63	646	647	63	Hi-Wall	2.0x1=2.0
4.9	Research Lab-5	1292.00	12.00	21.00	26.0±1	55±5%	18.00	2.00	2.00	7.39	6.71	3016	2297	378	Tower Unit Hi-Wall	3.5x2=7.0 1.0x1=1.0
4.1	Research Lab-6	1292.00	12.00	21.00	26.0±1	55±5%	18.00	2.00	2.00	7.39	6.71	3016	2297	378	Tower Unit Hi-Wall	3.5x2=7.0 1.0x1=1.0
4.1	Research Lab-7	1292.00	12.00	21.00	26.0±1	55±5%	18.00	2.00	2.00	7.39	6.71	3016	2297	378	Tower Unit Hi-Wall	3.5x2=7.0 1.0x1=1.0
4.12	Tutorial-5	420	12.0	21.0	26.0±1	55±5%	28	2.00	1.0	5.41	5.97	1456	1025	588	Hi-Wall	2.0x3=6.0
4.13	Tutorial-6	420	12.0	21.0	26.0±1	55±5%	28	2.00	1.0	5.41	5.97	1456	1025	588	Hi-Wall	2.0x3=6.0
4.14	Tutorial-4	430	12.0	17.0	26.0±1	55±5%	43	2.00	1.0	5.87	7.36	1352	1161	731	Hi-Wall	2.0x4=8.0
4.15	Tutorial-7	385	12.0	17.0	26.0±1	55±5%	36	2.00	1.0	4.70	5.90	1189	1009	612	Hi-Wall	2.0x3=6.0
4.16	Tutorial-8	430	12.00	17.00	26.0±1	55±5%	32.00	2.00	1.00	4.69	5.55	1290	1060	544	Hi-Wall	2.0x2=4.0 1.5x1=1.5
4.17	Tutorial-9	646	12.00	17.00	26.0±1	55±5%	60.00	2.00	1.00	7.95	10.16	1775	1561	1020	Hi-Wall	2.0x4=8.0 1.5x2=3.0
4.18	Tutorial-10	700	12.00	17.00	26.0±1	55±5%	30.00	2.00	1.50	5.68	6.20	1663	1387	510	Hi-Wall	2.0x3=6.0 1.0x1=1.0
4.19	Lecture Hall-2	968	12.0	17.0	26.0±1	55±5%	62	2.00	0.50	8.85	10.87	2121	1816	1054	Tower Unit	3.0x4=12.0
4.20	Clerical Room	170	12.0	21.0	26.0±1	55±5%	4	2.00	4.7	1.47	1.36	523	418	84	Hi-Wall	1.5x1=1.5
4.21	Professor Room-5	200	12.0	21.0	26.0±1	55±5%	5	2.00	1.0	1.42	1.33	468	328	105	Hi-Wall	1.5x1=1.5
4.22	Professor Room-6	200	12.0	21.0	26.0±1	55±5%	5	2.00	1.0	1.30	1.30	413	309	105	Hi-Wall	1.5x1=1.5
	Sub Total	**11076.0**								**90.8**	**96.7**	**28634.4**	**22980.3**	**7852.0**		
5	**Fourth Floor**															
5.1	Associate Professor	328	12.0	21.0	26.0±1	55±5%	12	8	7.2	4.44	4.62	1589	1555	252	Hi-Wall	1.5x3=4.50 1.0x1=1.0
5.2	Boy Common Room	315	12.0	21.0	26.0±1	55±5%	14	2.00	1.0	2.93	3.25	831	656	294	Hi-Wall	2.0x1=2.0 1.5x1=1.5
5.3	Clerical	172	12.0	21.0	26.0±1	55±5%	4	2.00	5.0	1.40	1.35	492	416	84	Hi-Wall	1.5x1=1.5
5.4	Director PA Room	192	12.0	21.0	26.0±1	55±5%	2	2.00	1.8	0.95	0.75	359	247	42	Hi-Wall	1.0x1=1.0
5.5	Director's Room	288	12.0	17.0	26.0±1	55±5%	9	2.00	1.8	2.11	2.11	683	551	153	Hi-Wall	2.0x1=2.0
5.6	Girls Common Room	372	12.0	21.0	26.0±1	55±5%	13	2.00	1.0	3.27	3.29	1023	759	273	Hi-Wall	1.5x2=3.0
5.7	Library	584	12.0	17.0	26.0±1	55±5%	35	2.00	1.0	5.90	6.81	1607	1386	595	Tower Unit	3.5x2=7.0
5.8	Professor Room-3	200	12.0	21.0	26.0±1	55±5%	5	2.00	1.0	1.31	1.32	418	318	105	Hi-Wall	1.5x1=1.5

5.9	Professor Room-4	174	12.0	21.0	26.0±1	55±5%	3	2.00	1.0	1.06	0.94	376	271	63	Hi-Wall	1.5x1=1.5
5.10	Professor Room-1	190	12.0	21.0	26.0±1	55±5%	5	2.00	2.70	1.55	1.45	526	393	105	Hi-Wall	1.5x1=1.5
5.11	Professor Room-2	190	12.0	21.0	26.0±1	55±5%	5	2.00	2.70	1.55	1.45	526	393	105	Hi-Wall	1.5x1=1.5
5.12	Research Lab-1	1292	12.0	21.0	26.0±1	55±5%	18	2.00	2.00	7.33	6.75	2687	2231	378	Tower Unit Hi-Wall	3.5x2=7.0 1.0x1=1.0
5.13	Research Lab-2	1292	12.0	21.0	26.0±1	55±5%	18	2.00	2.00	7.33	6.75	2687	2231	378	Tower Unit Hi-Wall	3.5x2=7.0 1.0x1=1.0
5.14	Research Lab-3	1292	12.0	21.0	26.0±1	55±5%	18	2.00	2.00	7.33	6.75	2687	2231	378	Tower Unit Hi-Wall	3.5x2=7.0 1.0x1=1.0
5.15	Research lab-4	1355	12.0	21.0	26.0±1	55±5%	20	2.00	2.00	6.51	6.44	2241	1906	420	Tower Unit Hi-Wall	3.5x2=7.0 1.0x1=1.0
5.16	Tutorial-2	420	12.0	17.0	26.0±1	55±5%	28	2.00	1.00	5.05	5.27	1438	1014	476	Hi-Wall	2.0x2=4.0 1.5x1=1.5
5.17	Tutorial-3	420	12.0	17.0	26.0±1	55±5%	28	2.00	1.00	5.05	5.27	1438	1014	476	Hi-Wall	2.0x2=4.0 1.5x1=1.5
5.18	Tutorial-1	430	12.0	17.0	26.0±1	55±5%	43	2.00	1.00	5.87	7.36	1352	1161	731	Hi-Wall	2.0x4=8.0
5.19	Lecture Hall-01	968	12.0	17.0	26.0±1	55±5%	62	2.00	0.50	8.85	10.87	2121	1816	1054	Tower Unit	3.0x4=12.0
5.20	Dry Canteen	145	12.0	21.0	26.0±1	55±5%									Hi-Wall	1.0x1=1.0
	Sub Total	10619.0														
6	Fifth Floor									79.8	82.8	25082.0	20549.7	6362.0		
6.1	Assistant Professor-1	103	12.0	21.0	26.0±1	55±5%	3.00	2.00	1.9	0.89	0.87	295	233	63	Hi-Wall	1.0x1=1.0
6.2	Assistant Professor-2	103	12.0	21.0	26.0±1	55±5%	3.00	2.00	1.9	0.89	0.87	295	233	63	Hi-Wall	1.0x1=1.0
6.3	Assistant Professor-3	485	12.0	21.0	26.0±1	55±5%	12.00	2.00	1.6	3.53	3.43	1176	912	252	Hi-Wall	1.5x2=3.0
6.4	Assistant Professor-4	484	12	21	26.0±1	55±5%	9.0	2.0	1.2	3.2	3.0	1147	931	189	Hi-Wall	1.5x2=3.0
6.5	Assistant Professor-5	140	12.0	21.0	26.0±1	55±5%	3	2.00	1.5	2.43	2.37	996	1041	63	Hi-Wall	1.0x1=1.0 1.5x1=1.5
6.6	Associate Profisser-5	145	12.0	21.0	26.0±1	55±5%	3	2.00	1.4	1.41	1.18	535	403	63	Hi-Wall	1.5x1=1.5
6.7	Associate Profisser-6	592	12.00	21.00	26.0±1	55±5%	12.00	2.00	1.35	4.33	4.14	1540	1291	252	Hi-Wall	2.0x1=2.0 1.5x1=1.5
6.8	Associate Professor-7	179	12.0	21.0	26.0±1	55±5%	3	2.00	1.2	1.77	1.72	698	694	63	Hi-Wall	2.0x1=2.0
6.9	Research Lab-5	1292	12.00	21.00	26.0±1	55±5%	18.00	2.00	2.00	7.39	6.71	3016	2297	378	Tower Unit Hi-Wall	3.5x2=7.0 1.0x1=1.0
6.1	Research Lab-6	1292	12.00	21.00	26.0±1	55±5%	18.00	2.00	2.00	7.39	6.71	3016	2297	378	Tower Unit Hi-Wall	3.5x2=7.0 1.0x1=1.0
6.11	Research Lab-7	1292	12.00	21.00	26.0±1	55±5%	18.00	2.00	2.00	7.39	6.71	3016	2297	378	Tower Unit Hi-Wall	3.5x2=7.0 1.0x1=1.0

6.12	Tutorial-5	420	12.0	21.0	26.0±1	55±5%	28	2.00	1.0	5.68	6.17	1578	1136	588	Hi-Wall	2.0x3=6.0
6.13	Tutorial-6	420	12.0	21.0	26.0±1	55±5%	28	2.00	1.0	5.68	6.17	1578	1136	588	Hi-Wall	2.0x3=6.0
6.14	Tutorial-4	430	12.0	17.0	26.0±1	55±5%	43	2.00	1.0	6.15	7.57	1476	1274	731	Hi-Wall	2.0x4=8.0
6.15	Tutorial-7	385	12.0	17.0	26.0±1	55±5%	36	2.00	1.0	4.95	6.09	1301	1110	612	Hi-Wall	2.0x3=6.0
6.16	Tutorial-8	430	12.0	17.0	26.0±1	55±5%	32	2.00	1.0	4.97	5.76	1414	1173	544	Hi-Wall	2.0x3=6.0
6.17	Tutorial-9	646	12.0	17.0	26.0±1	55±5%	60	2.00	1.0	8.36	10.47	1961	1731	1020	Hi-Wall	2.0x4=8.0 1.5x2=3.0
6.18	Tutorial-10	700	12.0	17.0	26.0±1	55±5%	30	2.00	1.50	6.13	6.54	1865	1571	510	Hi-Wall	2.0x2=4.0 2.5x1=2.5
6.19	Clerical Room	170	12.0	21.0	26.0±1	55±5%	4	2.00	4.71	1.57	1.44	572	462	84	Hi-Wall	2.0x1=2.0
6.20	Professor Room-5	200	12.0	21.0	26.0±1	55±5%	5	2.00	1.00	1.55	1.43	526	381	105	Hi-Wall	1.5x1=1.5
6.21	Professor Room-6	200	12.0	21.0	26.0±1	55±5%	5	2.00	1.00	2.43	1.40	471	362	105	Hi-Wall	1.5x1=1.5
6.22	Lecture Hall-01	968	12.0	17.0	26.0±1	55±5%	62	2.00	0.50	8.85	10.87	2121	1816	1054	Tower Unit	3.0x4=12.0
	Sub Total	11076.0								82.6	86.5	26902.0	21758.2	6735.0		
	Grand Total	64795.0								503.6	528.3	159419.3	129367.8	41525.0		

HEAT LOAD SUMMARY FOR COLLEGE BUILDING-2

S. NO.	CONDITIONED SPACE	ACTUAL AIR CONDITIONED AREA	HEIGHT	INSIDE DESIGN CONDITION			OCCUPANCY	LIGHT LOAD	EQPT LOAD	SUMMER LOAD	MONSOON LOAD	SUMMER DEHUMIDIFIED CFM	MONSOON DEHUMIDIFIED CFM	REQUIRED FRESH AIR QTY	INDOOR UNIT SELECTED	
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(I)	(J)	(K)	(L)	(M)	TYPE	(TRxQTY)
		SQ.FT.	FT.	MIN VENTILATION RATE CFM/PERSON	TEMP (°C)	RH	NOS.	W/SQ.FT.	KW	TR	TR	CFM	CFM	CFM		
1	Ground Floor															
1.1	Associate Professor	312	12	21	26.0±1	55±5%	12	8	8	4.32	4.24	1533	1345	252	Hi-Wall	1.0x2=2.0 1.5x2=3.0
1.2	Boys Common Room	323	12.0	21.0	26.0±1	55±5%	14	2.00	0.5	3.42	3.61	1053	853	294	Hi-Wall	2.0x1=2.0 1.5x1=1.5
1.3	Clerical Room	194	12.0	21.0	26.0±1	55±5%	4	2.00	4.1	1.45	1.31	518	392	84	Hi-Wall	1.5x1=1.5
1.4	Director's PA Room	215	12.0	21.0	26.0+1	55+5%	3	2.00	2.0	1.14	0.98	409	292	63	Hi-Wall	1.5x1=1.5
1.5	Director's Room	323	12.0	21.0	26.0±1	55±5%	9	2.00	2.0	2.15	2.24	655	508	189	Hi-Wall	2.5x1=2.5
1.6	Girls Common Room	410	12.0	21.0	26.0±1	55±5%	14	2.00	1.0	4.09	4.17	1356	1151	294	Hi-Wall	2.0x2=4.0
1.7	Lecture Hall-01	968	12.0	17.0	26.0±1	55±5%	62	2.00	0.5	9.11	11.06	2239	1917	1054	Tower Unit	3.0x4=12.0
1.8	Library	581	12.0	17.0	26.0±1	55±5%	35	2.00	1.0	5.39	6.48	1377	1211	595	Tower Unit	3.0x1=3.0 3.5x1=3.5
1.9	Professor Room-01	215	12.0	21.0	26.0±1	55±5%	3	2.00	0.93	1.20	0.99	437	299	63	Hi-Wall	1.5x1=1.5
1.10	Professor Room-02	215	12.0	21.0	26.0±1	55±5%	3	2.00	0.93	1.20	0.99	437	299	63	Hi-Wall	1.5x1=1.5
1.11	Professor Room-03	150	12.0	21.0	26.0±1	55±5%	3	2.00	2.0	1.07	0.93	380	268	63	Hi-Wall	1.0x1=1.0
1.12	Professor Room-04	168	12.0	21.0	26.0±1	55±5%	3	2.00	2.0	1.07	0.96	377	281	63	Hi-Wall	1.0x1=1.0
1.13	Research Lab-1	1140	12.0	21.0	26.0±1	55±5%	18	2.00	2.0	6.56	6.10	2338	1881	378	Tower Unit	3.5x2=7.0
1.14	Research Lab-2	1140	12.0	21.0	26.0±1	55±5%	18	2.00	2.00	6.56	6.10	2338	1881	378	Tower Unit	3.5x2=7.0
1.15	Research Lab-3	1140	12.0	21.0	26.0±1	55±5%	18	2.00	2.00	6.56	6.10	2338	1881	378	Tower Unit	3.5x2=7.0
1.16	Research Lab-4	1140	12.0	21.0	26.0±1	55±5%	18	2.00	2.00	6.56	6.10	2338	1881	378	Tower Unit	3.5x2=7.0
1.17	Technician Room-01	86	12.0	21.0	26.0+1	55±5%	2	2.00	2.00	0.57	0.54	190	134	42	Hi-Wall	1.0x1=1.0
1.18	Technician Room-02	86	12.0	21.0	26.0±1	55±5%	2	2.00	2.00	0.82	0.68	300	209	42	Hi-Wall	1.0x1=1.0
1.19	Technician Room-03	108	12.0	21.0	26.0±1	55±5%	3	2.00	2.00	0.97	0.89	335	244	63	Hi-Wall	1.0x1=1.0
1.20	Technician Room-04	97	12.0	21.0	26.0±1	55±5%	3	2.00	2.00	0.82	0.76	267	176	63	Hi-Wall	1.0x1=1.0
1.21	Tutorial-01	425	12.0	17.0	26.0±1	55±5%	43	2.00	0.50	6.32	7.59	1557	1284	731	Hi-Wall	2.0x4=8.0
1.22	Tutorial-02	420	12.0	17.0	26.0±1	55±5%	28	2.00	1.00	4.33	5.10	1112	925	476	Hi-Wall	2.0x2=4.0 1.5x1=1.5
1.23	Tutorial-03	420	12.0	17.0	26.0±1	55±5%	28	2.00	1.00	4.33	5.10	1112	925	476	Hi-Wall	2.0x2=4.0 1.5x1=1.5

1.24	[illegible]	80	12.0	21.0	26.0±1	55±5%									Hi-Wall	1.0x1=1.0
	Sub Total	[illegible]														
2	First Floor									80.0	83.0	24995.2	20234.6	6482.0		
2.1	Tutorial-07	430	12.0	17.0	26.0±1	55±5%	30.00	2.00	1.0	5.29	6.03	1483	1295	510	Hi-Wall	2.0x3=6.0
2.2	Tutorial-08	430	12.0	17.0	26.0±1	55±5%	30.00	2.00	1.0	5.29	6.03	1483	1295	510	Hi-Wall	2.0x3=6.0
2.3	Tutorial-09	592	12.0	17.0	26.0±1	55±5%	58.00	2.00	1.0	7.37	9.56	1576	1369	986	Hi-Wall	2.0x2=4.0 1.5x4=6.0
2.4	Tutorial-10	646	12.0	17.0	26.0±1	55±5%	30.00	2.00	1.0	5.14	5.77	1415	1155	510	Hi-Wall	1.5x4=6.0
2.5	Associate Professor-01	162	12.0	21.0	26.0±1	55±5%	3	2.00	1.23	1.52	1.40	581	520	63	Hi-Wall	1.5x1=1.5
2.6	Assistant Professor-01	108	12.0	21.0	26.0±1	55±5%	3	2.00	1.0	1.80	1.75	708	710	63	Hi-Wall	2.0x1=2.0
2.7	Assistant Professor-02	410	12.0	21.0	26.0±1	55±5%	12	2.00	2.0	3.08	3.12	969	744	252	Hi-Wall	1.0x4=4.0
2.8	Associate Professor-04	581	12.0	21.0	26.0±1	55±5%	12	2.00	2.0	3.74	3.85	1269	1134	252	Hi-Wall	1.0x4=4.0
2.9	Assistant Professor-03	108	12.0	21.0	26.0±1	55±5%	2	2.00	2.0	0.85	0.69	314	215	42	Hi-Wall	1.0x1=1.0
2.10	Assistant Professor-04	108	12.0	21.0	26.0±1	55±5%	2	2.00	2.0	0.85	0.69	314	215	42	Hi-Wall	1.0x1=1.0
2.11	Associate Professor-02	162	12.0	21.0	26.0±1	55±5%	3	2.00	2.0	1.34	1.11	502	363	63	Hi-Wall	1.5x1=1.5
2.12	Research Lab-1	1140	12.0	21.0	26.0±1	55±5%	18	2.00	2.0	6.56	6.10	2338	1881	378	Tower Unit	3.5x2=7.0
2.13	Research Lab-2	1140	12.0	21.0	26.0±1	55±5%	18	2.00	2.0	6.56	6.10	2338	1881	378	Tower Unit	3.5x2=7.0
2.14	Research Lab-3	1140	12.0	21.0	26.0±1	55±5%	18	2.00	2.0	6.56	6.10	2338	1881	378	Tower Unit	3.5x2=7.0
2.15	Clerical Room	194	12.0	21.0	26.0±1	55±5%	4	2.00	4.12	1.45	1.31	518	392	84	Hi-Wall	1.5x1=1.5
2.16	Lecture Hall-01	968	12.0	17.0	26.0±1	55±5%	62	2.00	0.5	9.11	11.06	2239	1917	1054	Tower Unit	3.0x4=12.0
2.17	Tutorial-03	420	12.0	17.0	26.0±1	55±5%	28	2.00	1.0	4.33	5.10	1112	925	476	Hi-Wall	2.0x2=4.0 1.5x1=1.5
2.18	Tutorial-02	420	12.0	17.0	26.0±1	55±5%	28	2.00	1.0	4.33	5.10	1112	925	476	Hi-Wall	2.0x2=4.0 1.5x1=1.5
2.19	Tutorial-01	425	12.0	17.0	26.0±1	55±5%	43	2.00	0.5	6.32	7.59	1557	1284	731	Hi-Wall	2.0x4=8.0
2.20	Technician Room-03	108	12.0	21.0	26.0±1	55±5%	3	2.00	2.0	0.97	0.89	335	244	63	Hi-Wall	1.0x1=1.0
2.21	Technician Room-02	86	12.0	21.0	26.0±1	55±5%	2	2.00	2.0	0.82	0.68	300	209	42	Hi-Wall	1.0x1=1.0
2.22	Technician Room-01	86	12.0	21.0	26.0±1	55±5%	2	2.00	2.0	0.57	0.54	190	134	42	Hi-Wall	1.0x1=1.0
2.23	Professor Room-04	168	12.0	21.0	26.0±1	55±5%	3	2.00	2.0	1.07	0.96	377	281	63	Hi-Wall	1.0x1=1.0
2.24	Professor Room-03	150	12.0	21.0	26.0±1	55±5%	3	2.00	2.0	1.07	0.93	380	268	63	Hi-Wall	1.0x1=1.0
2.25	Assistant Professor-05	400	12.0	21.0	26.0±1	55±5%	12	2.00	2.0	2.73	2.94	809	645	252	Hi-Wall	1.0x3=3.0
	Sub Total	10582.0														
3	Second Floor									88.7	95.4	26556.1	21884.6	7773.0		
3.1	Associate Professor	312	12	21	26.0±1	55±5%	12	8	8	4.32	4.24	1533	1345	252	Hi-Wall	1.0x2=2.0 1.5x2=3.0
3.2	Boys Common Room	323	12.0	21.0	26.0±1	55±5%	14	2.00	0.5	3.42	3.61	1053	853	294	Hi-Wall	2.0x1=2.0 1.5x1=1.5
3.3	Clerical Room	194	12.0	21.0	26.0±1	55±5%	4	2.00	4.1	1.45	1.31	518	392	84	Hi-Wall	1.5x1=1.5
3.4	Director's PA Room	215	12.0	21.0	26.0±1	55±5%	3	2.00	2.0	1.14	0.98	409	292	63	Hi-Wall	1.5x1=1.5
3.5	Director's Room	323	12.0	21.0	26.0±1	55±5%	9	2.00	2.0	2.15	2.24	655	503	189	Hi-Wall	2.5x1=2.5

3.6	Girls Common Room	410	12.0	21.0	26.0±1	55±5%	14	2.00	1.0	4.09	4.17	1356	1151	294	Hi-Wall	2.0x2=4.0
3.7	Lecture Hall-01	968	12.0	17.0	26.0±1	55±5%	62	2.00	0.5	9.11	11.06	2239	1917	1054	Tower Unit	3.0x4=12.0
3.8	Library	581	12.0	17.0	26.0±1	55±5%	35	2.00	1.0	5.39	6.48	1377	1211	595	Tower Unit	3.0x1=3.0 3.5x1=3.5
3.9	Professor Room-01	215	12.0	21.0	26.0±1	55±5%	3	2.00	0.93	1.20	0.99	437	299	63	Hi-Wall	1.5x1=1.5
3.10	Professor Room-02	215	12.0	21.0	26.0±1	55±5%	3	2.00	0.93	1.20	0.99	437	299	63	Hi-Wall	1.5x1=1.5
3.11	Professor Room-03	150	12.0	21.0	26.0±1	55±5%	3	2.00	2.0	1.07	0.93	380	268	63	Hi-Wall	1.0x1=1.0
3.12	Professor Room-04	168	12.0	21.0	26.0±1	55±5%	3	2.00	2.0	1.07	0.96	377	281	63	Hi-Wall	1.0x1=1.0
3.13	Research Lab-1	1140	12.0	21.0	26.0±1	55±5%	18	2.00	2.00	6.56	6.10	2338	1881	378	Tower Unit	3.5x2=7.0
3.14	Research Lab-2	1140	12.0	21.0	26.0±1	55±5%	18	2.00	2.00	6.56	6.10	2338	1881	378	Tower Unit	3.5x2=7.0
3.15	Research Lab-3	1140	12.0	21.0	26.0±1	55±5%	18	2.00	2.00	6.56	6.10	2338	1881	378	Tower Unit	3.5x2=7.0
3.16	Research Lab-4	1140	12.0	21.0	26.0±1	55±5%	18	2.00	2.00	6.56	6.10	2338	1881	378	Tower Unit	3.5x2=7.0
3.17	Technician Room-01	86	12.0	21.0	26.0±1	55±5%	2	2.00	2.00	0.57	0.54	190	134	42	Hi-Wall	1.0x1=1.0
3.18	Technician Room-02	86	12.0	21.0	26.0±1	55±5%	2	2.00	2.00	0.82	0.68	300	209	42	Hi-Wall	1.0x1=1.0
3.19	Technician Room-03	108	12.0	21.0	26.0±1	55±5%	3	2.00	2.00	0.97	0.89	335	244	63	Hi-Wall	1.0x1=1.0
3.20	Technician Room-04	97	12.0	21.0	26.0±1	55±5%	3	2.00	2.00	0.82	0.76	267	176	63	Hi-Wall	1.0x1=1.0
3.21	Tutorial-01	425	12.0	17.0	26.0±1	55±5%	43	2.00	0.50	6.32	7.59	1557	1284	731	Hi-Wall	2.0x4=8.0
3.22	Tutorial-02	420	12.0	17.0	26.0±1	55±5%	28	2.00	1.00	4.33	5.10	1112	925	476	Hi-Wall	2.0x2=4.0 1.5x1=1.5
3.23	Tutorial-03	420	12.0	17.0	26.0±1	55±5%	28	2.00	1.00	4.33	5.10	1112	925	476	Hi-Wall	2.0x2=4.0 1.5x1=1.5
3.24	DRY CANTEEN	80	12.0	21.0	26.0±1	55±5%									Hi-Wall	1.0x1=1.0
	Sub Total	**10356.0**								**80.0**	**83.0**	24995.2	**20234.6**	**6482.0**		
4	**Third Floor**															
4.1	Tutorial-07	430	12.0	17.0	26.0±1	55±5%	30.00	2.00	1.0	5.29	6.03	1483	1295	510	Hi-Wall	2.0x3=6.0
4.2	Tutorial-08	430	12.0	17.0	26.0±1	55±5%	30.00	2.00	1.0	5.29	6.03	1483	1295	510	Hi-Wall	2.0x3=6.0
4.3	Tutorial-09	592	12.0	17.0	26.0±1	55±5%	58.00	2.00	1.0	7.37	9.56	1576	1369	986	Hi-Wall	2.0x2=4.0 1.5x4=6.0
4.4	Tutorial-10	646	12.0	17.0	26.0±1	55±5%	30.00	2.00	1.0	5.14	5.77	1415	1155	510	Hi-Wall	1.5x4=6.0
4.5	Associate Professor-01	162	12.0	21.0	26.0±1	55±5%	3	2.00	1.23	1.52	1.40	581	520	63	Hi-Wall	1.5x1=1.5
4.6	Assistant Professor-01	108	12.0	21.0	26.0±1	55±5%	3	2.00	1.0	1.80	1.75	708	710	63	Hi-Wall	2.0x1=2.0
4.7	Assistant Professor-02	410	12.0	21.0	26.0±1	55±5%	12	2.00	2.0	3.08	3.12	969	744	252	Hi-Wall	1.0x4=4.0
4.8	Associate Professor-04	581	12.0	21.0	26.0±1	55±5%	12	2.00	2.0	3.74	3.85	1269	1134	252	Hi-Wall	1.0x4=4.0
4.9	Assistant Professor-03	108	12.0	21.0	26.0±1	55±5%	2	2.00	2.0	0.85	0.69	314	215	42	Hi-Wall	1.0x1=1.0
4.10	Assistant Professor-04	108	12.0	21.0	26.0±1	55±5%	2	2.00	2.0	0.85	0.69	314	215	42	Hi-Wall	1.0x1=1.0
4.11	Associate Professor-02	162	12.0	21.0	26.0±1	55±5%	3	2.00	2.0	1.34	1.11	502	363	63	Hi-Wall	1.5x1=1.5
4.12	Research Lab-1	1140	12.0	21.0	26.0±1	55±5%	18	2.00	2.0	6.56	6.10	2338	1881	378	Tower Unit	3.5x2=7.0
4.13	Research Lab-2	1140	12.0	21.0	26.0±1	55±5%	18	2.00	2.0	6.56	6.10	2338	1881	378	Tower Unit	3.5x2=7.0
4.14	Research Lab-3	1140	12.0	21.0	26.0±1	55±5%	18	2.00	2.0	6.56	6.10	2338	1881	378	Tower Unit	3.5x2=7.0
4.15	Clerical Room	194	12.0	21.0	26.0±1	55±5%	4	2.00	4.12	1.45	1.31	518	392	84	Hi-Wall	1.5x1=1.5
4.16	Lecture Hall-01	968	12.0	17.0	26.0±1	55±5%	62	2.00	0.5	9.11	11.06	2239	1917	1054	Tower Unit	3.0x4=12.0

4.17	Tutorial-03	420	12.0	17.0	26.0±1	55±5%	28	2.00	1.0	4.33	5.10	1112	925	476	Hi-Wall	2.0x2=4.0 1.5x1=1.5
4.18	Tutorial-02	420	12.0	17.0	26.0±1	55±5%	28	2.00	1.0	4.33	5.10	1112	925	476	Hi-Wall	2.0x2=4.0 1.5x1=1.5
4.19	Tutorial-01	425	12.0	17.0	26.0±1	55±5%	43	2.00	0.5	6.32	7.59	1557	1284	731	Hi-Wall	2.0x4=8.0
4.20	Technician Room-03	108	12.0	21.0	26.0±1	55±5%	3	2.00	2.0	0.97	0.89	335	244	63	Hi-Wall	1.0x1=1.0
4.21	Technician Room-02	86	12.0	21.0	26.0±1	55±5%	2	2.00	2.0	0.82	0.68	300	209	42	Hi-Wall	1.0x1=1.0
4.22	Technician Room-01	86	12.0	21.0	26.0±1	55±5%	2	2.00	2.0	0.57	0.54	190	134	42	Hi-Wall	1.0x1=1.0
4.23	Professor Room-04	168	12.0	21.0	26.0±1	55±5%	3	2.00	2.0	1.07	0.96	377	281	63	Hi-Wall	1.0x1=1.0
4.24	Professor Room-03	150	12.0	21.0	26.0±1	55±5%	3	2.00	2.0	1.07	0.93	380	268	63	Hi-Wall	1.0x1=1.0
4.25	Assistant Professor-05	400	12.0	21.0	26.0±1	55±5%	12	2.00	2.0	2.73	2.94	809	645	252	Hi-Wall	1.0x3=3.0
	Sub Total	**10582.0**								**88.7**	**95.4**	**26556.1**	**21884.6**	**7773.0**		
5	**Fourth Floor**															
5.1	Associate Professor	312	12	21	26.0±1	55±5%	12	8	8	4.32	4.24	1533	1345	252	Hi-Wall	1.0x2=2.0 1.5x2=3.0
5.2	Boys Common Room	323	12.0	21.0	26.0±1	55±5%	14	2.00	0.5	3.42	3.61	1053	853	294	Hi-Wall	1.5x2=3.0
5.3	Clerical Room	194	12.0	21.0	26.0±1	55±5%	4	2.00	4.1	1.45	1.31	518	392	84	Hi-Wall	1.5x1=1.5
5.4	Director's PA Room	215	12.0	21.0	26.0±1	55±5%	3	2.00	2.0	1.14	0.98	409	292	63	Hi-Wall	1.5x1=1.5
5.5	Director's Room	323	12.0	21.0	26.0±1	55±5%	9	2.00	2.0	2.15	2.24	655	503	189	Hi-Wall	2.5x1=2.5
5.6	Girls Common Room	410	12.0	21.0	26.0±1	55±5%	14	2.00	1.0	4.09	4.17	1356	1151	294	Hi-Wall	2.0x2=4.0
5.7	Lecture Hall-01	968	12.0	17.0	26.0±1	55±5%	62	2.00	0.5	9.11	11.06	2239	1917	1054	Tower Unit	3.0x4=12.0
5.8	Library	581	12.0	17.0	26.0±1	55±5%	35	2.00	1.0	5.39	6.48	1377	1211	595	Tower Unit	3.0x1=3.0 3.5x1=3.5
5.9	Professor Room-01	215	12.0	21.0	26.0±1	55±5%	3	2.00	0.93	1.20	0.99	437	299	63	Hi-Wall	1.5x1=1.5
5.10	Professor Room-02	215	12.0	21.0	26.0±1	55±5%	3	2.00	0.93	1.20	0.99	437	299	63	Hi-Wall	1.5x1=1.5
5.11	Professor Room-03	150	12.0	21.0	26.0±1	55±5%	3	2.00	2.0	1.07	0.93	380	268	63	Hi-Wall	1.0x1=1.0
5.12	Professor Room-04	168	12.0	21.0	26.0±1	55±5%	3	2.00	2.0	1.07	0.96	377	281	63	Hi-Wall	1.0x1=1.0
5.13	Research Lab-1	1140	12.0	21.0	26.0±1	55±5%	18	2.00	2.00	6.56	6.10	2338	1881	378	Tower Unit	3.5x2=7.0
5.14	Research Lab-2	1140	12.0	21.0	26.0±1	55±5%	18	2.00	2.00	6.56	6.10	2338	1881	378	Tower Unit	3.5x2=7.0
5.15	Research Lab-3	1140	12.0	21.0	26.0±1	55±5%	18	2.00	2.00	6.56	6.10	2338	1881	378	Tower Unit	3.5x2=7.0
5.16	Research Lab-4	1140	12.0	21.0	26.0±1	55±5%	18	2.00	2.00	6.56	6.10	2338	1881	378	Tower Unit	3.5x2=7.0
5.17	Technician Room-01	86	12.0	21.0	26.0±1	55±5%	2	2.00	2.00	0.57	0.54	190	134	42	Hi-Wall	1.0x1=1.0
5.18	Technician Room-02	86	12.0	21.0	26.0±1	55±5%	2	2.00	2.00	0.82	0.68	300	209	42	Hi-Wall	1.0x1=1.0
5.19	Technician Room-03	108	12.0	21.0	26.0±1	55±5%	3	2.00	2.00	0.97	0.89	335	244	63	Hi-Wall	1.0x1=1.0
5.20	Technician Room-04	97	12.0	21.0	26.0±1	55±5%	3	2.00	2.00	0.82	0.76	267	176	63	Hi-Wall	1.0x1=1.0
5.21	Tutorial-01	425	12.0	17.0	26.0±1	55±5%	43	2.00	0.50	6.32	7.59	1557	1284	731	Hi-Wall	2.0x4=8.0
5.22	Tutorial-02	420	12.0	17.0	26.0±1	55±5%	28	2.00	1.00	4.33	5.10	1112	925	476	Hi-Wall	2.0x2=4.0 1.5x1=1.5
5.23	Tutorial-03	420	12.0	17.0	26.0±1	55±5%	28	2.00	1.00	4.33	5.10	1112	925	476	Hi-Wall	2.0x2=4.0 1.5x1=1.5
5.24	DRY CANTEEN	80	12.0	21.0	26.0±1	55±5%									Hi-Wall	1.0x1=1.0

	Sub Total	10356.0								80.0	83.0	24995.2	20234.6	6462.0		
6	Fifth Floor															
6.1	Tutorial-07	430	12.0	17.0	26.0±1	55±5%	30.00	2.00	1.0	5.56	6.24	1608	1408	510	Hi-Wall	2.0x2=4.0 2.5x1=2.5
6.2	Tutorial-08	430	12.0	17.0	26.0±1	55±5%	30.00	2.00	1.0	5.56	6.24	1608	1408	510	Hi-Wall	2.0x2=4.0 2.5x1=2.5
6.3	Tutorial-09	592	12	17	26.0±1	55±5%	58	2	1	7.7522	9.84568	1747.241	1524.08	986	Hi-Wall	2.0x2=4.0 1.5x4=6.0
6.4	Tutorial-10	646	12.0	17.0	26.0±1	55±5%	30.00	2.00	1.0	5.55	6.09	1602	1325	510	Hi-Wall	1.5x4=6.0
6.5	Associate Professor-01	162	12.0	21.0	26.0±1	55±5%	3	2.00	1.23	1.62	1.48	628	563	63	Hi-Wall	1.5x1=1.5
6.6	Assistant Professor-01	108	12.0	21.0	26.0±1	55±5%	3	2.00	1.0	1.86	1.80	740	739	63	Hi-Wall	2.0x1=2.0
6.7	Assistant Professor-02	410	12.0	21.0	26.0±1	55±5%	12	2.00	2.0	3.34	3.32	1087	852	252	Hi-Wall	1.0x4=4.0
6.8	Associate Professor-04	581	12.0	21.0	26.0±1	55±5%	12	2.00	2.0	4.11	4.13	1437	1287	252	Hi-Wall	1.0x4=4.0
6.9	Assistant Professor-03	108	12.0	21.0	26.0±1	55±5%	2	2.00	2.0	0.92	0.74	345	244	42	Hi-Wall	1.0x1=1.0
6.10	Assistant Professor-04	108	12.0	21.0	26.0±1	55±5%	2	2.00	2.0	0.92	0.74	345	244	42	Hi-Wall	1.0x1=1.0
6.11	Associate Professor-02	162	12.0	21.0	26.0±1	55±5%	3	2.00	2.0	1.44	1.19	549	405	63	Hi-Wall	1.5x1=1.5
6.12	Research Lab-1	1140	12.0	21.0	26.0±1	55±5%	18	2.00	2.0	7.29	6.66	2668	2181	378	Hi-Wall Tower Unit	1.5x1=1.5 3.5x2=7.0
6.13	Research Lab-2	1140	12.0	21.0	26.0±1	55±5%	18	2.00	2.0	7.29	6.66	2668	2181	378	Hi-Wall Tower Unit	1.5x1=1.5 3.5x2=7.0
6.14	Research Lab-3	1140	12.0	21.0	26.0±1	55±5%	18	2.00	2.0	7.29	6.66	2668	2181	378	Hi-Wall Tower Unit	1.5x1=1.5 3.5x2=7.0
6.15	Clerical Room	194	12.0	21.0	26.0±1	55±5%	4	2.00	4.12	1.58	1.40	574	443	84	Hi-Wall	1.5x1=1.5
6.16	Lecture Hall-01	968	12.0	17.0	26.0±1	55±5%	62	2.00	0.5	9.72	11.53	2519	2171	1054	Tower Unit	3.0x4=12.0
6.17	Tutorial-03	420	12.0	17.0	26.0±1	55±5%	28	2.00	1.0	4.60	5.31	1234	1035	476	Hi-Wall	2.0x2=4.0 1.5x1=1.5
6.18	Tutorial-02	420	12.0	17.0	26.0±1	55±5%	28	2.00	1.0	4.60	5.31	1234	1035	476	Hi-Wall	2.0x2=4.0 1.5x1=1.5
6.19	Tutorial-01	425	12.0	17.0	26.0±1	55±5%	43	2.00	0.5	6.59	7.79	1680	1396	731	Hi-Wall	2.0x4=8.0
6.20	Technician Room-03	108	12.0	21.0	26.0±1	55±5%	3	2.00	2.0	1.04	0.94	366	272	63	Hi-Wall	1.0x1=1.0
6.21	Technician Room-02	86	12.0	21.0	26.0±1	55±5%	2	2.00	2.0	0.87	0.72	324	232	42	Hi-Wall	1.0x1=1.0
6.22	Technician Room-01	86	12.0	21.0	26.0±1	55±5%	2	2.00	2.0	0.63	0.58	215	156	42	Hi-Wall	1.0x1=1.0
6.23	Professor Room-04	168	12.0	21.0	26.0±1	55±5%	3	2.00	2.0	1.17	1.04	426	325	63	Hi-Wall	1.5x1=1.5
6.24	Professor Room-03	150	12.0	21.0	26.0±1	55±5%	3	2.00	2.0	1.17	1.00	424	307	63	Hi-Wall	1.5x1=1.5
6.25	Assistant Professor-05	400	12.0	21.0	26.0±1	55±5%	12	2.00	2.0	2.98	3.13	925	750	252	Hi-Wall	1.0x3=3.0
	Sub Total	10582.0								95.5	100.5	29618.0	24662.3	7773.0		
	Grand Total	62814.0								513.0	540.4	157715.7	129135.2	42765.0		

HEAT LOAD SUMMARY FOR LIBRARY

S. NO.	CONDITIONED SPACE	ACTUAL AIR CONDITIONED AREA	HEIGHT	INSIDE DESIGN CONDITION			OCCUPANCY	LIGHT LOAD	EQPT LOAD	SUMMER LOAD	MONSOON LOAD	SUMMER DEHUMIDIFIED CFM	MONSOON DEHUMIDIFIED CFM	REQUIRED FRESH AIR QTY	INDOOR UNIT SELECTED	
	BASIS OF DESIGN									DESIGN DATA SUMMARY						
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(I)	(J)	(K)	(L)	(M)	TYPE	(TRxQTY)
		SQ.FT.	FT.	MIN VENTILATION RATE CFM/PERSON	TEMP (°C)	RH	NOS.	W/SQ.FT.	KW	TR	TR	CFM	CFM	CFM		
1	Ground Floor															
1.1	CAFETERIA AREA	2200	12.0	17.0	26.0±1	55±5%	136.00	2.00	1.0	18.21	23.34	4114	3712	2312	Tower Unit	3.0x8=24.0
1.2	READING ROOM	7910	12.0	17.0	26.0±1	55±5%	140.00	2.00	1.0	47.26	43.42	17178	14282	2380	Package Unit Tower Unit	11.0x2=22.0 4.0x6=24.0
1.3	Librarian	215	12.0	17.0	26.0±1	55±5%	9.00	2.00	0.93	1.74	1.94	515	458	153	Hi-wall	2.0x1=2.0
1.4	General Administration	365	12.0	21.0	26.0±1	55±5%	5.00	2.00	2.0	2.54	2.25	974	823	105	Hi-wall	1.5x2=3.0
1.5	PA Librarian	150	12.0	21.0	26.0±1	55±5%	3	2.00	2.0	1.13	1.08	417	362	63	Hi-wall	1.5x1=1.5
	Sub Total	10840.0								70.9	72.0	23198.9	19636.4	5013.0		
2	First Floor															
2.1	AUDIO VISUL ROOM	1453	12.0	17.0			56	2.00	1.0	13.91	14.84	4606	4347	952	Tower Unit	4.0x4=16.0
2.2	INDEXING	6155	12.0	17.0			116	2.00	1.0	27.62	28.33	8995	7709	1972	Package Unit	17.0x2=34.0
2.3	MEETING	1028	12.0	17.0			24	2.00	1.0	6.04	6.09	2011	1717	408	Tower Unit	3.0x2=6.0
2.4	Server Room	269	12.0	0.0			0	2.00	18.6	3.03	2.39	1375	1290	0.0	Hi-wall	1.5x2=3.0
2.5	Technical Staff	269	12.0	21.0			12	2.00	2.0	2.54	2.81	723	575	252	Hi-wall	1.5x2=3.0
2.6	Back Office	500	12.0	21.0			10	2.00	2.0	2.76	2.73	896	690	210	Hi-wall	1.5x2=3.0
	Sub Total	9674.0								55.9	57.2	18605.8	16328.8	3794.0		
3	Second Floor															
3.1	LIBRARY	18884	12.0	21.0	26.0±1	55±5%	250.00	2.00	0.5	85.31	83.89	29811	25672	5250	Package Unit Hi-wall	17.0x5=85.0 1.0x4=4.0
	Sub Total	18884.0								85.3	83.9	29810.5	25672.1	5250.0		
	Grand Total	39398.0								212.1	213.1	72615.2	61637.3	14057.0		

HEAT LOAD SUMMARY FOR SEMINAR HALL

	BASIS OF DESIGN									DESIGN DATA SUMMARY						
S. NO.	CONDITIONED SPACE	ACTUAL AIR CONDITIONED AREA	HEIGHT	INSIDE DESIGN CONDITION			OCCUPANCY	LIGHT LOAD	EQPT LOAD	SUMMER LOAD	MONSOON LOAD	SUMMER DEHUMIDIFIED CFM	MONSOON DEHUMIDIFIED CFM	REQUIRED FRESH AIR QTY	INDOOR UNIT SELECTED	
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(I)	(J)	(K)	(L)	(M)	TYPE	(TRxQTY)
		SQ.FT.	FT.	MIN VENTILATION RATE CFM/PERSON	TEMP (°C)	RH	NOS.	W/SQ.FT.	KW	TR	TR	CFM	CFM	CFM		
1	Ground Floor															
1.1	Seminar Hall	1700	12.0	17.0	26.0±1	55±5%	150.00	1.50	5.0	22.66	25.64	6121	5392	2550	Ductable	5.5 X4
															Hi wall	1.5X2
1.2	Entrance Lobby	695	12.0	17.0	26.0±1	55±5%	70.00	2.00	3.0	13.75	17.10	3745	3743	1470	Ductable	8.5 X 1 + 5.5 X 1
	Sub Total	2395.0								36.4	42.7	9866.2	9135.4	4020.0		

EQUIPMENT SELECTION

Based on the above environmental conditions, the air conditioning load is designed independently for

1. College Building - I
2. College Building - II
3. Library Building
4. Seminar Hall

To meet the above referred load, we have following options:

1. **Water-cooled water chilling machines with Screw Compressors**

In this system the main plant is located in the plant room within the building or outside the building. The cooling towers are located on a well-ventilated place, external of the building and the AHUs are housed in the AHU Rooms or are ceiling suspended. This system can sustain the high ambient temperature. Suitable for any configuration using machines from 100TR to 400 TR. Depending on various capacities IKW /TR is 0.65 to 0.8 for compressor and will be more with other equipment such as AHU, condenser pump, chill water pump and cooling tower etc.

The disadvantage with the system is the high requirement of soft water. The cost for water and softening plant for such a high requirement of water is very high. As such there is a crisis of water. Hence due to the water requirement the capital cost and running cost increase for this scheme.

2. **Air-cooled water chilling machines with Screw Compressors**

In this system the main plant is located on the terrace of the building or outside of the building. There are NO cooling towers in the system. Suitable for any configuration using machines from 100Tr to 400Tr. IKW /TR are 1.2 to 1.5. IKW will be more with other equipment such as AHU, chill water pump etc. IKW per TR will increase as per the increased ambient temperature.

The disadvantage with this system is to select a higher nominal capacity equipment to meet the derating factor due to ambient. Hence the running cost is high.

3. **Air-cooled Split Units**

In this system each indoor unit has individual outdoor unit with single or multi compressors, depending on the capacity. The indoor unit can be of different types such as Hi-wall, Floor standing tower, cassette, and ductable units.

The non-ductable split units are available with rotary compressors or scroll compressors. Ductable spilt units are available with scroll compressor.

A. Non-ductable split unit with **rotary compressor** – These units has one to one connection of indoor to outdoor units. The refrigerant pipe circuits are separate for each compressor. The biggest limitation of this type unit is the refrigerant pipe length. The most of the time the permissible refrigerant pipe length is 7 meters. Exceeding this permissible length, the unit will attract deration factor. The derating factor can be more than 25% upto the pipe length of 12 meters. This results in an excessive wastage of energy which is such a precious commodity and thereby excessive electricity bills.

B. Non-ductable split unit with **scroll compressor** – These types of compressors are popular due to its efficiency and versatility. These units also have one to one connection of indoor to outdoor units. In this case the refrigerant pipes are separate for each compressor. The biggest advantage of this unit is the refrigerant pipe length. The permissible refrigerant pipe length is 50 meters (70 meters equivalent length). Due to the scroll technology the refrigerant can be pump in to the refrigerant pipe effectively such a high length.

4. **Variable Refrigerant Volume/Flow Air Cooled System**

Variable Refrigerant Volume / Flow Systems were introduced in Japan more than 20 years ago, have become popular in many countries including India. VRV/VRF systems are used in approximately 50% of medium sized commercial buildings and one-third of large commercial buildings.

The following advantages are there:

- The units will consist of high efficiency air-cooled scroll microprocessor controlled compressors with all the latest materials and technology.

- VRV/VRF systems are flexible and diverse with a single condensing unit connected to up to 32 indoor units thus combining multiple condensing units for up to several hundred tons. Overall COP and SEER remain high due to effective zone control.
- VRV/VRF systems use Hydro fluorocarbon (HFC), non-CFC containing refrigerant with Zero Ozone Depletion Potential (ODP) and are 15% more efficient than R-22 systems.
- Saving in electric energy even on part load.
- IKW /TR is 1.1 including indoor. IKW per tone decreases on the part load.
- Pipe length from indoor to outdoor units is approx. 150 m.

The different aspects for this project considering different HVAC schemes are summarized as below.

S. No	Area	HVAC Schemes		
		Split unit Rotary Comp	**Split unit Scroll comp**	**VRV/VRF**
1	College Building –I & II	**Advantage:** ○ Individual control of the units. ○ Flexibility in the installation of the indoor units. ○ In case of breakdown of compressor particular units will be non operational. Hence rest of the units can be operational. However, no diversity available. ○ Floor standing tower type indoor units are available. ○ Permissible length of the refrigerant pipe is only 8mt. after which the de-rating starts in account of pipe length. ○ The units are available with almost all manufacturers ○ The installation cost is low **Disadvantage:** ○ Permissible refrigerant piping is upto 8 mtr. ○ More number of outdoor units hence more space	**Advantage:** ○ Individual control of the units. ○ Flexibility in the installation of the indoor units. ○ In case of breakdown of compressor particular units will be non operational. Hence rest of the units can be operational. However, no diversity available. ○ The permissible refrigerant pipe is 50 rmtr (Effective length 70rmt) ○ Derating factor is low. ○ Floor standing tower type indoor units are available. ○ Units are available with Daikin, Mitsubishi, LG. manufacturers in India. **Disadvantage:**	**Advantage:** ○ Almost negligible derating factor. ○ Long length of refrigerant pipe permissible ○ Eco friendly refrigerant. ○ Less number of outdoor units, hence less requirement of space. ○ Saving in energy at part load. ○ Diversity in the load possible. ○ The units are available with almost all manufacturers ○ Individual control of the units. ○ Flexibility in the installation of the indoor units. **Disadvantage:** ○ Floor standing

		requirement. ○ High derating in the cooling capacity. ○ CFC base refrigerant. ○ More point of operation & maintenance ○ Handling of condensate drain pipe in case of floor standing tower type indoor units is difficult because the pipe has to run at lower then floor level. *Looking at the building the indoor & outdoor units can be located at distances of 15 mtr to 50 mtr, depending on the different areas of the floor. These lengths of piping are calculated in view of different locations available to place the outdoor units. Please refer the scheme drawing no SUR-01.* **The number of outdoor units shall be approximately 632 nos both the building.**	○ More number of outdoor units hence more space requirement. ○ CFC best refrigerant. ○ More point of operation & maintenance ○ These units are available with some manufacturer ○ The installation cost is comparatively high then rotary compressor *These units take care of refrigerant piping considering the three available locations to place the outdoor units. The scheme is explain in the drawing no. SUS-01.* **The number of outdoor units shall be approximately 632 nos both the building.** **There will be approximately 52 nos outdoor units on each floor.**	lower type indoor units are not available. ○ Better skill requirement for maintenance. ○ The installation cost is higher than both type spilt unit *All the outdoor units can be located at terrace of the respective buildings. This will facilitate a single point operation & maintenance of the compressors. The scheme has been explained in the drawing no. VRF-01.* **The number of outdoor units shall be approximately 16 nos both the building.**

S. No	Area	HVAC Schemes		
		Split unit Rotary Comp	**Split unit Scroll comp**	**VRV/VRF**
2	Library Block Scheme drawing no. LIB-01	**Advantage & Disadvantage:** ○ Same as above *The library is a large indoor volume and indoor ductable units and floor towers are possible, this may be a feasible system.* **Numbers of outdoor units are approximately 28 nos.**	**Advantage & Disadvantage:** ○ Same as above *Ductable split units are considered for bigger areas. Looking at the distance between in the indoor & outdoor units this scheme can be considered.* **No.of outdoor units are approximately 28 nos.**	**Advantage & Disadvantage:** ○ Same as above **Number of outdoor units are approximately 6 nos.**
3	Seminar Hall Scheme drawing no. SCM-01	**Advantage:** ○ Same as that above. **Disadvantage:** ○ Same as that above. Only few units can be used. **Number of outdoor units are approximately 8 nos.**	**Advantage:** ○ Same as that above. **Disadvantage:** ○ Same as that above. Ductable units can be used. **Number of outdoor units is approximately 8 nos.**	**Advantage:** ○ Same as that above. **Disadvantage:** ○ Same as that above. **Floor standing towers units are not in use in this scheme. So VRF/VRV system can be used.** **Number of outdoor units are approximately 2 nos.**

Recommendation of schemes:

Keeping all the above factors in mind our recommendation of air-conditioning schemes for various buildings are as follow:

1. **College Building I &II**

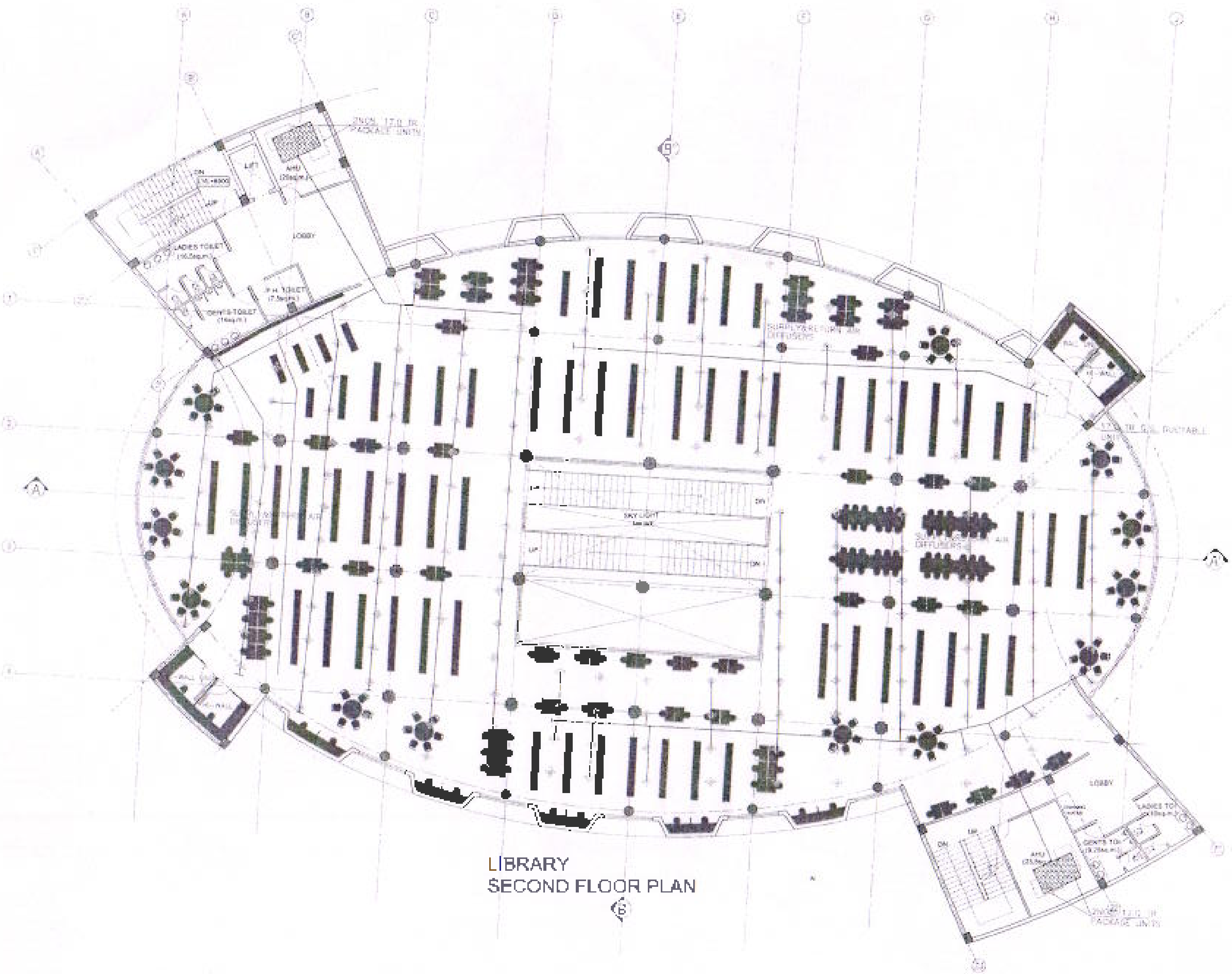
   A first preference, Air Cooled Variable Refrigerant Volume/Flow machines may be installed for these buildings. As a alternative split units with scroll compressor may be installed.

2. **Library Building**

   Non ductable and Ductable split /air cooled package units with scroll compressor. The split units with rotary compressor are not suitable since the volume for air-conditioning is large.

3. **Seminar Hall**

   Non ductable and Ductable split /air cooled package units with scroll compressor.



LIBRARY
SECOND FLOOR PLAN

DATE	REV.	DESCRIPTION	BY

V.S. KUKREJA & ASSOCIATES PVT. LTD.
CONSULTING ENGINEERS
165-A,GAUTAM NAGAR
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ARCHITECTS:

Archigroup Architects (regd
Studio : P.No. A-14,First Floor,
Sector 15,Noida,
Uttar pardesh(U.P)
Phone : 0120-4312430-31

PROJECT
PUNJAB TECHNICAL UNIVERSITY, JALANDHAR PHASE-IIA

TITLE:
LIBRARY SECOND FLOOR PLAN

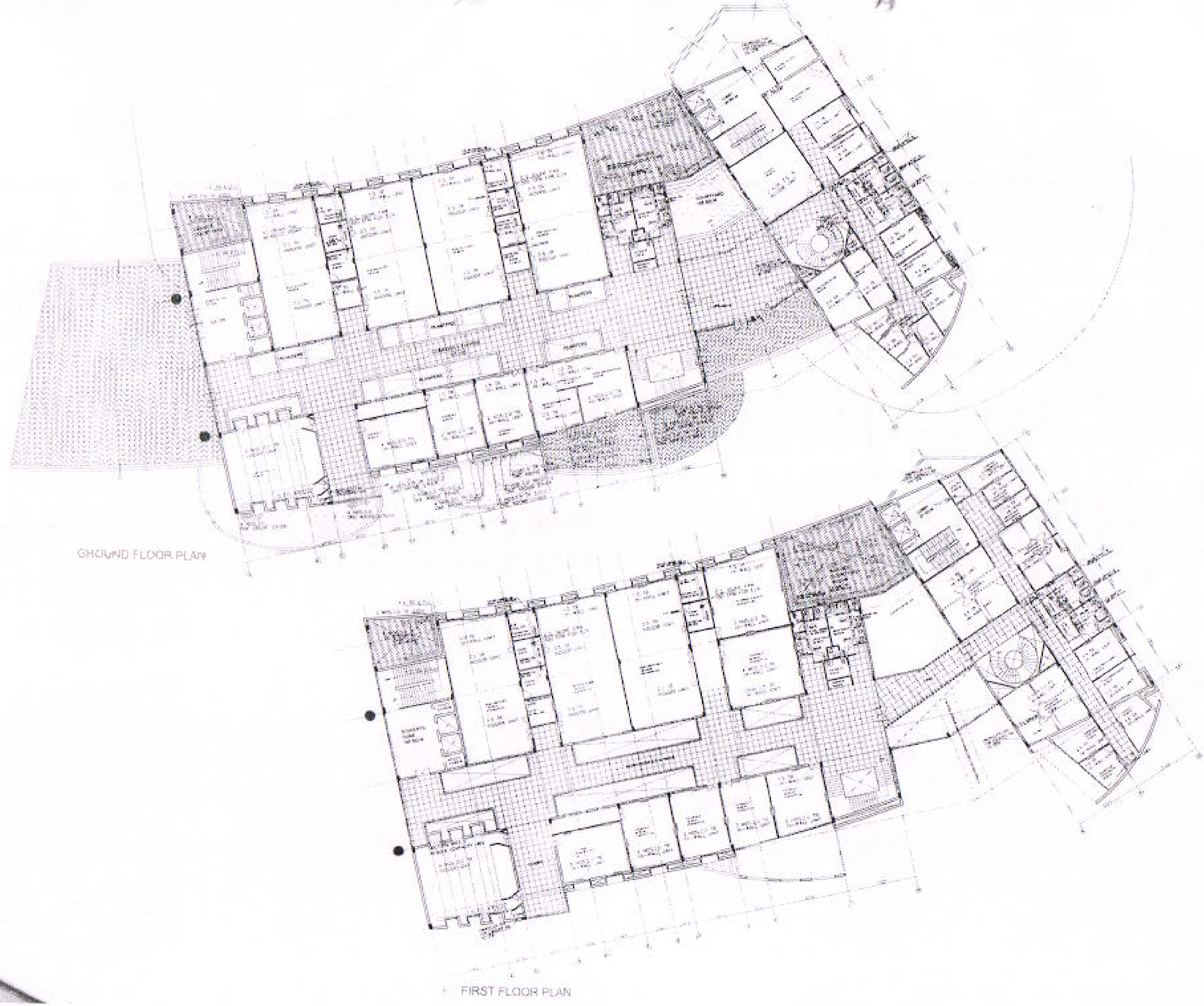
SUB TITLE:
AIR-CONDITIONING SCHEMES

JOB NO.	VKPL-1853
DATE	06.04.2011
SCALE	1 : 125
DRAWN	GOUTAM
CHKD. BY	JAWAID

N

DRG.NO. : LIB - 01

F:\DRAWINGS & DOCUMENTS\



DATE	REV	DESCRIPTION

Archigroup Architects (reg

PROJECT

PUNJAB TECHNICAL UNIVERSITY, JALANDHAR PHASE-IIA

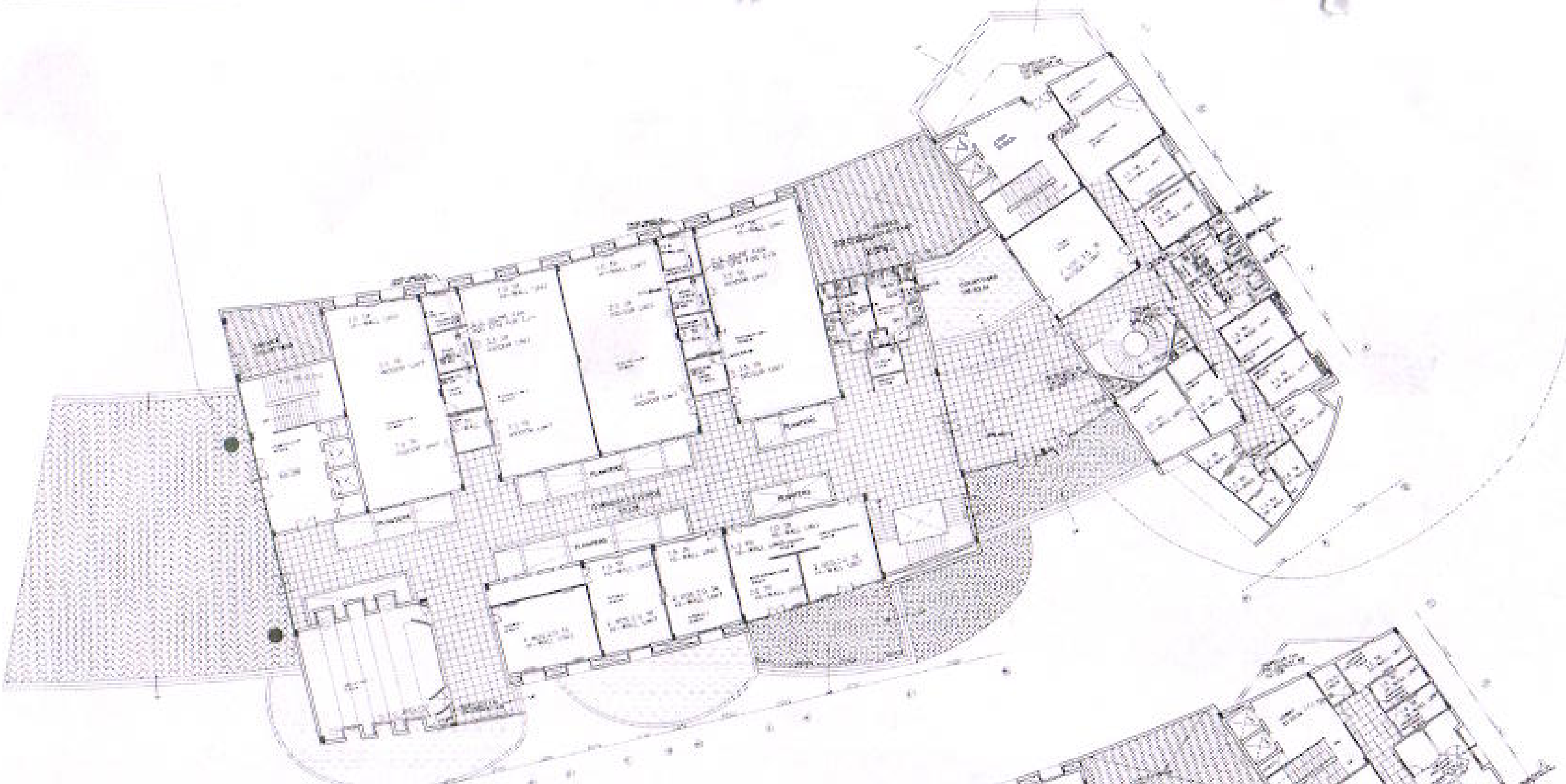
TITLE

GROUND &FIRST FLOOR PLAN
COLLEGE BUILDING-I

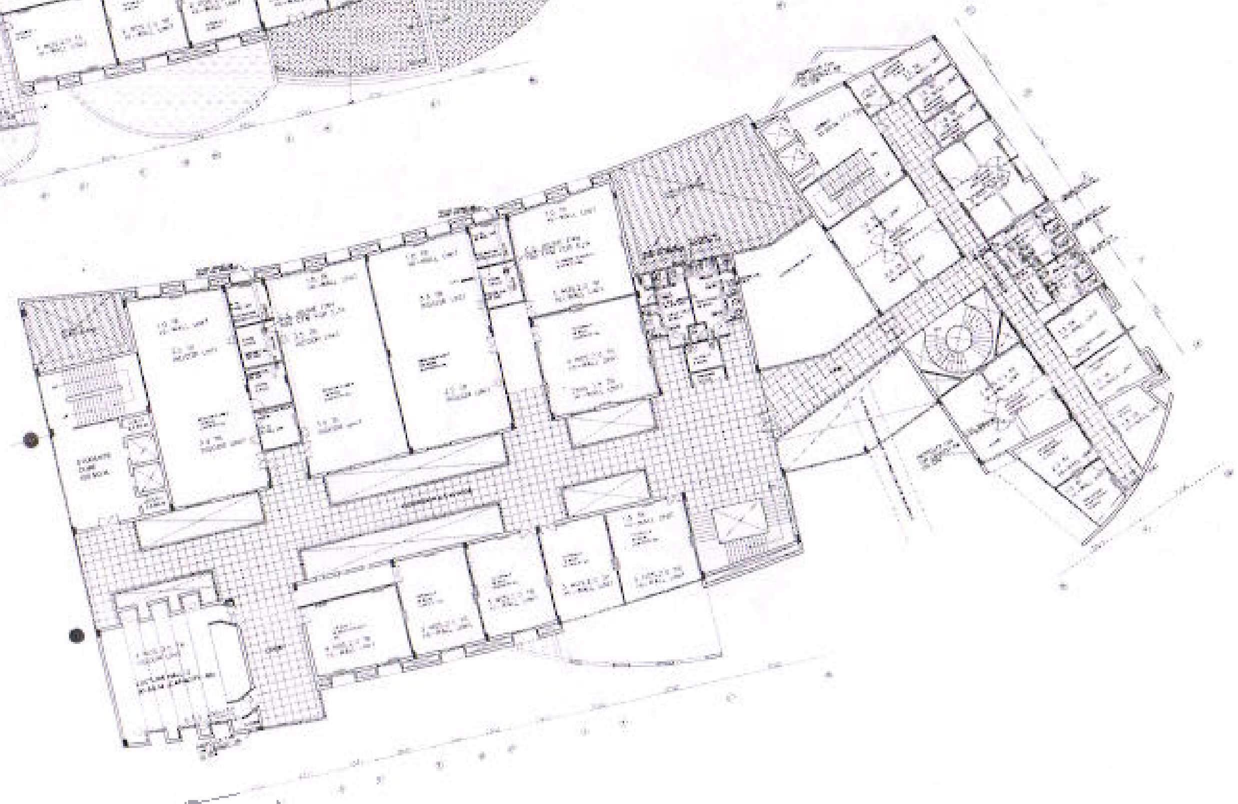
JOB NO.	[illegible]
DATE	[illegible]
SCALE	1 : 100
DRAWN	GOUTAM
CHKD. BY	[illegible]

N

DRG NO. : SUR - 01



GROUND FLOOR PLAN



FIRST FLOOR PLAN

DATE	REV.	DESCRIPTION	BY

ARCHITECTS:

Archigroup Architects (regd.)

PROJECT

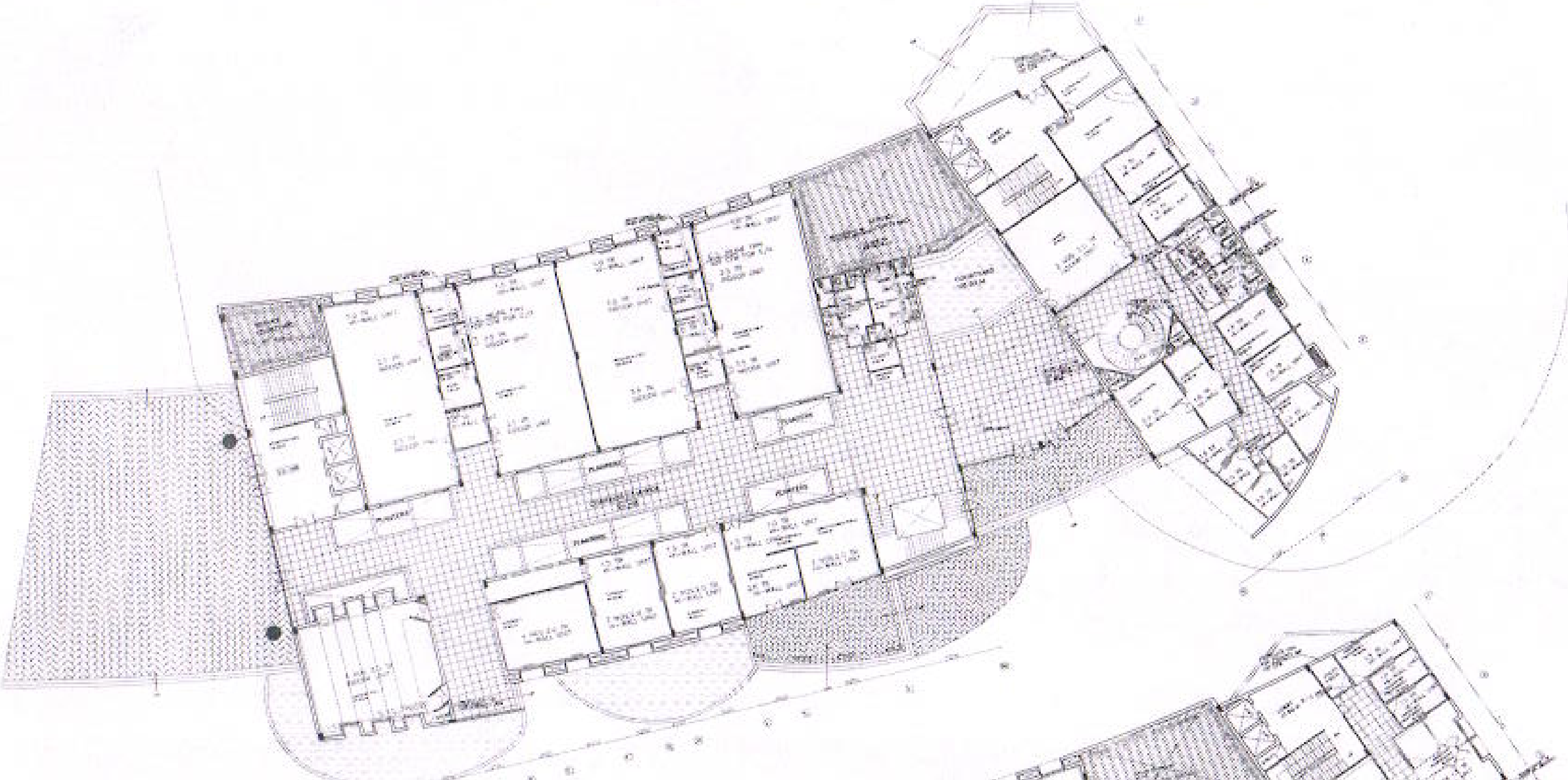
PUNJAB TECHNICAL UNIVERSITY, JALANDHAR PHASE-IIA

TITLE: GROUND & FIRST FLOOR PLAN COLLEGE BUILDING-1

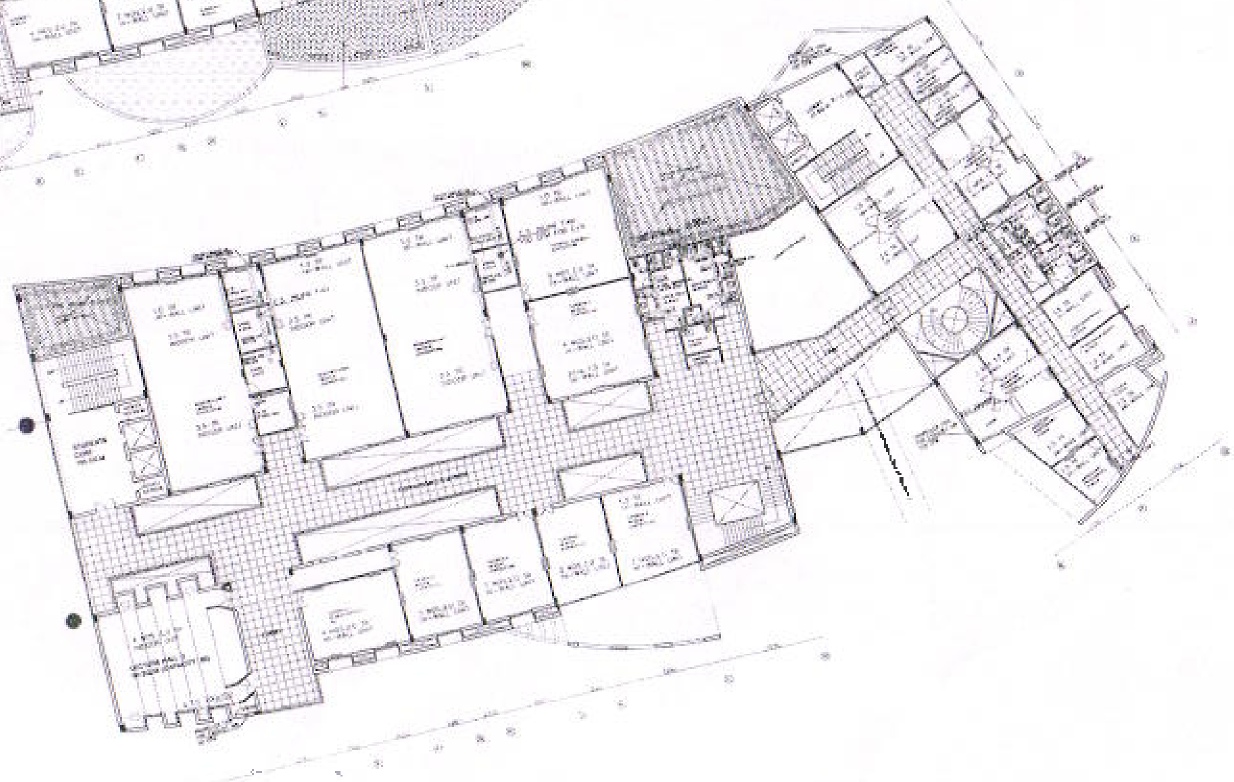
AIR-CONDITIONING SCHEMES (SPLIT UNIT WITH VRF SYSTEM)

JOB NO.	
DATE	
SCALE	1 : 125
DRAWN	GOUTAM
CHKD. BY	JAWAD

DRG NO. : VRF - 03



GROUND FLOOR PLAN



FIRST FLOOR PLAN

DATE	REV.	DESCRIPTION	BY

V.S. KUKREJA & ASSOCIATES PVT. LTD.
CONSULTING ENGINEERS

ARCHITECTS:

Archigroup Architects (regd.)

PROJECT

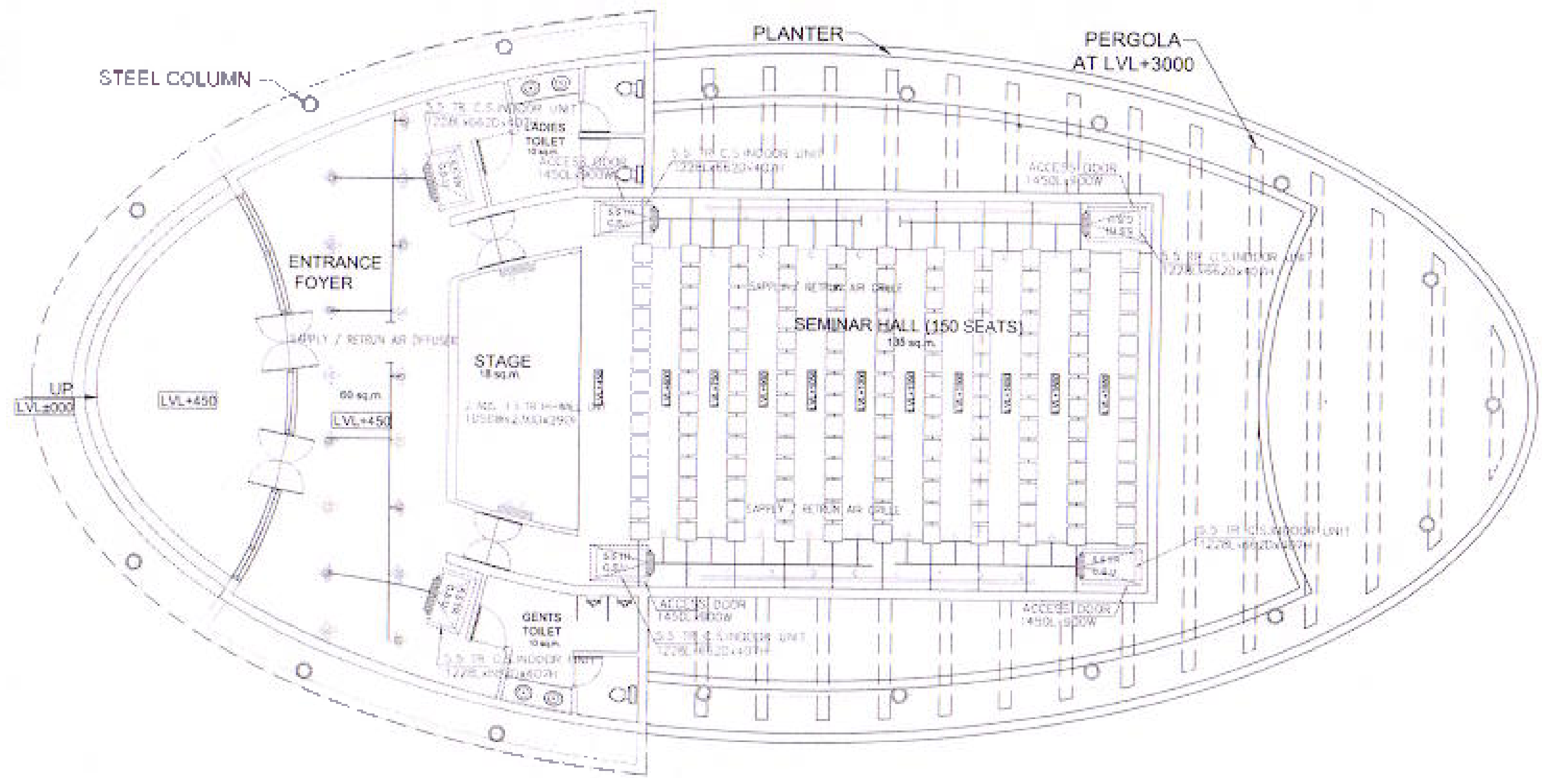
PUNJAB TECHNICAL UNIVERSITY, JALANDHAR PHASE-IIA

TITLE: GROUND AND FIRST FLOOR PLAN COLLEGE BUILDING-1

SUB TITLE: AIR-CONDITIONING SCHEMES (SPLIT UNIT WITH SCROLL COMPRESSOR)

JOB NO.	VKPL-1053
DATE	08.04.2011
SCALE	1 : 125
DRAWN	GOUTAM
CHKD. BY	JAWAID

DRG. NO. : SUS - 02



V.S. KUKREJA & ASSOCIATES PVT. LTD. CONSULTING ENGINEERS	Archigroup Architects (regd.) Studio : P.No. A-14, First Floor, Sector 15, Noida, Uttar pardesh(U.P) Phone : 0120-4312430-31	PROJECT: PUNJAB TECHNICAL UNIVERSITY, JALANDHAR	SUB TITLE: AIR-CONDITIONING SCHEMES	TITLE: SEMINAR HALL

JOB NO.	
DATE	
SCALE	1 : 100
DRAWN	GOUTAM
CHKD. BY	JAVED
DRG.NO.:	SEM - 01

PTU, Phase III

Electrical Design Basis Report

April 27, 2011

Client:
PUNJAB TECHNICAL UNIVERSITY
JALANDHAR

Architect:
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Consultant:
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[This report covers the Electrical design basis for construction of two colleges, one seminar block, a library and an open air theatre, in phase III of Punjab Technical University, Jalandhar]

DESIGN BASIS REPORT FOR PHASE III ELECTRICAL INSTALLATION WORKS FOR PUNJAB TECHNICAL UNIVERSITY, JALANDHAR

OBJECTIVES

The **objective of this report** is to present the design considerations for various elements of the electrical systems and low voltage systems like Electronic Fire Detection, provisions only for Voice & Data Networks, Public Address and Electronic Security systems. This will form a basis for the process of development and approval of the final design for electrical systems to suit the client's brief, purpose and budget before final preparation of design, tenders and Schedules of Quantities.

The **objective of the design** will be to provide a robust, reliable and safe electrical power distribution system based on principles of ready-to-use energy efficient practices and clean energy technologies wherever feasible, and to ensure an easy-to-maintain, cost effective and flexible system in line with the best available in local and international markets.

STANDARDS + CODES

All aspects of design shall conform to relevant portions of the following:

- National Building Code of India 2005
- Energy Conservation Building Code 2007
- Bureau of Indian Standards
- International Electrotechnical Commission
- CPWD General Specifications for Electrical Works (Internal) 2005

ELECTRICAL LOAD ANALYSIS

The electrical load requirement for lighting and small power (e.g. computers, servers, photocopiers, scanners, faxes and other lab equipments), UPS load and HVAC have been estimated empirically based on the areas proposed and considering the approximate load for External Lighting & Plumbing. The conclusions have been tabulated below, while the details for individual buildings are listed later.

PRELIMINARY ELECTRICAL LOAD CALCULATION (PHASE III)

S.NO.	DESCRIPTION	Area (Sq.ft)	Emergency load	Total Connected	Diversity	Max. Demand
			In kW	In kW		In kW
1	College Building 1	137,190.00	145.74	1,322.90	0.70	926.03
2	College Building 2	136,275.40	145.17	1,317.90	0.70	922.53
3	Library	49,227.00	506.90	506.90	0.70	354.83
4	Seminar Hall-1	2,853.55	1.78	22.02	0.70	15.42
	OTHER LOADS					
5	External Lighting (Assumed)		35.00			-
6	Plumbing Load (Assumed)		80.00			-
	Total Load		**914.59**	**3,169.72**		**2,218.80**
	FUTURE PHASE					
7	College Building 3	129568.48	137.65	1,249.40	0.70	874.58
8	College Building 4	132118.92	140.36	1,274.00	0.70	891.80
9	College Building 5	134420.16	142.80	1,296.19	0.70	907.33
10	Seminar Hall-2	4196.40	2.62	32.39	0.70	22.67
11	Seminar Hall-3	2853.55	1.78	22.02	0.70	15.42
12	Plumbing Load (Future)		100.00			
	Grand Total Load		**1,439.81**	**7,043.72**		**4,930.60**
	Simultaneous Utillzation Coefficient				**0.80**	**3,944.48**

The following assumptions have been made in the calculations:

Light and small power load: 2.5w per sft.
AC load (for certain designated areas): 8.0w per sft.
Entire Library load is being considered on generator back-up
For other buildings, 25% of lighting, fans and small power is being considered on generator back up
All lifts in all blocks are considered on generator

Connected Load in Kw	:	7043.72
Demand Load in kW	:	3944.48
Connected Load in kVA	:	8804.65
Demand Load in kVA	:	4930.60
Taking 85% efficiency	:	5800.71

Emergency Connected Load in kW	:	1439.81
Emergency Demand Load in kW	:	1007.86
Emergency Connected Load in kVA	:	1799.76
Emergency Demand Load in kVA	:	1259.83
Taking 85% efficiency	:	1482.15

Recommended Ratings & Configuration:
Transformers : 4nos x 1600KVA **DG Sets : 3nos x 500KVA**

DETAILED BUILDING WISE LOADS

COLLEGE BUILDING-1

S.No	Description	Light & Small Power	A/C Load	Emer-gency	Lab Equipment*	Total Connected	Diversit-y	Max. Demand
		kW	kW	kW	kW	kW		kW
1	Ground Floor	57.84	95.72	14.46	100.00	253.56	0.7	177.49
2	First Floor	56.49	87.59	14.12	60.00	204.08	0.7	142.85
3	Second floor	56.49	87.59	14.12	60.00	204.08	0.7	142.85
4	Thired floor	56.49	87.59	14.12	45.00	189.09	0.7	132.35
5	Fourth floor	57.84	95.72	14.46	60.00	213.56	0.7	149.49
6	Fifth floor	57.84	95.72	14.46	45.00	199.56	0.7	138.99
		-						
	Other Loads					-		-
7	Lift Load 4nos (4@15kW)			60.00		60.00	0.7	42.0
	Grand Total Load	342.98	454.20	145.74	370.00	1,322.90		926.03

*Provision for Electrical loads- 25 kW per lab For Ground floor, 20kw per lab for first floor and 15kW per lab for all subsequent floors be kept as PTU recommendation.

COLLEGE BUILDING-2

S.No	Description	Light & Small Power	A/C Load	Emer-gency	Lab Equipment*	Total Connected	Diversit-y	Max. Demand
		kW	kW	kW	kW	kW		kW
1	Ground Floor	61.20	101.49	15.30	100.00	262.69	0.7	183.88
2	First Floor	55.15	90.81	13.79	60.00	205.96	0.7	144.17
3	Second floor	55.82	86.60	13.95	60.00	202.41	0.7	141.69
4	Thired floor	55.15	90.81	13.79	45.00	190.96	0.7	133.67
5	Fourth floor	56.89	92.71	14.22	60.00	209.60	0.7	146.72
6	Fifth floor	56.49	84.79	14.12	45.00	186.26	0.7	130.40
	Other Loads							
7	Lift Load 4nos (4@15kW)			60.00		60.00	0.7	42.0
	Grand Total Load	**340.69**	**445.72**	**145.17**	**370.00**	**1,317.90**		**922.53**

*Provision for Electrical loads 25 kW per lab For Ground floor, 20kw per lab for first floor and 15kW per lab for all subsequent floors be kept as PTU recommendation.

SEMINAR HALL

S.No	Description	Light & Small Power	A/C Load	Emer-gency	Total Connected	Diversit-y	Max. Demand
		kW	kW	kW	kW		kW
1	Ground Floor	7.13	14.89	1.78	22.02	0.7	15.42
	Grand Total Load	**7.13**	**14.89**	**1.78**	**22.02**		**15.42**

LIBRARY

S.No	Description	Light & Small Power	A/C Load	Emer-gency	Total Connected	Diversit-y	Max. Demand
		kW	kW	kW	kW		kW
1	Ground Floor	34.30	102.84	137.14	137.14	0.7	96.00
2	First Floor	34.97	99.94	134.91	134.91	0.7	94.44
3	Second floor	53.80	166.05	219.85	219.85	0.7	153.89
	Other Loads						
4	**Lift Load1nos (1@15kW)**			15.00	15.00	0.7	10.5
	Grand Total Load	**123.07**	**265.99**	**506.90**	**506.90**		**354.83**

DESIGN CONSIDERATIONS

This is covered under the following subheads:

Subhead A : Substation & Power Distribution Plan,
Subhead B : Point Wiring
Subhead C : Lighting & Fan
Subhead D : Fire Detection & Voice Evacuation System;
Subhead E : UPS System
Subhead F : LV Services: Voice, Data, & Security System
Subhead G : External Development (Electrical)

A SUBSTATION & POWER DISTRIBUTION

A.1 SEB Power

In Phase I, the meter for 11kV HT supply was installed and commissioned at the North East corner of the site. From there the main HT cable was taken to the Administration Block substation (at the centre of the site) and terminated at a Ring Main Unit. Now for the Phase III substation it is proposed to have this HT line tapped from the existing RMU in the Admin Substation and carried to a new substation in the Academic section of the site.

All 11KV supply - from HT RMU in Admin Substation to HT RMU in Academic Substation, and from HT VCB to HT side of the transformer will be carried with **11kV grade XLPE Cables**.

Transformers: As per load calculation, keeping transformer losses in mind and assuming working efficiency of 85%, the following transformer configuration and rating is proposed:

Total estimated connected load	:	7050 kW or 8800 kVA
Total expected diversified load	:	3950 kW or 4950 kVA
Total capacity required (@85% efficiency)	:	5800 kVA
Configuration proposed	:	4no. 1600kVA

Given the estimated load it is suggested that for the complete Academic Section a total of 4nos transformers of 1600kVA capacity each be taken and these will be designed to operate under parallel operation if required. However, for the first few designated buildings, we are considering two Transformers of 1600kVA. These will be Oil cooled and naturally aspirated (ONAN) type but must be with copper windings and should preferably have an On-Load Tap Changer (OLTC) of nominal rating -15% to +5% on the HT side of the transformer.

A.2 D.G.Sets and Power Back-up Facilities

It is proposed to back-up power for generators for the following:

- Entire Library load is being considered on generator back-up
- For other buildings, 25% of lighting, fans and small power is being considered on generator back up

This would be made available by equally sized diesel generator sets. It is also proposed to have modularity for DG Sets which allows for better loading, performance flexibility and ease in spares and maintenance.

It is therefore proposed to have a final configuration of **3 nos. 500kVA D.G. Sets**. For Phase – II now we would suggest 2nos 500kVA D.G. Sets be installed and the remaining one be installed later. The two D.G. Sets would be connected onto a common bus but with bus coupler. These sets will be provided with individual AMF panels for automatic starting in case of power failure. It is not intended to either synchronise the sets or share the loads. There will be a manual selection of sets to run for various load conditions. The AMF panels will also be supplied with manual override facilities.

It is proposed to locate the sets on ground floor level so that servicing, operation and maintenance is consolidated for more efficiency. The sets would be located in open area and based on **sound attenuated acoustically treated all-weather containers** to conform to CPCB norms and mounted on independent foundations to minimize the **transfer of vibrations** to the main structure.

The exact location of the DG Sets would have to be determined on the basis of overall planned capacities and locations of other services.

A.3 Power Distribution

LT supply from the transformers and the DG Sets would be carried by LT XLPE aluminum Armoured cable to the Main LT panel.

LT Panels will be factory fabricated, cubicle type, Form 3, indoor duty floor standing units with provisions for cable entries from top and bottom as required. Bus-bar chambers will be bolted type with louvers for heat dissipation, while cable alleys would be hinged type with half turn knobs for easy access. The location of main LT Panel is proposed on Ground floor of the Academic Substation.

All switchgear would be fuseless with breaking capacities calculated at each level of protection. All **Air Circuit Breakers (ACBs)** would be draw-out type and motor operated in case of transformer and DG Set incomers and bus-couplers for integration with the automation system.

All **MCCBs** would have rotary operating handle. Protection for the larger ratings of ACBs and MCCBs will be with solid state relays with variable settings for pick-up currents and delay times.

Multi-parametric **metering** (voltage, current, frequency, power factor, power, energy – active and reactive) shall be provided for all incoming equipment breakers. All outgoing feeders shall have ammeters for monitoring output loads.

All **cabling** will be XLPE insulated steel armoured cable with aluminium conductors for sizes above 16sq.mm and with copper conductors for sizes of 16sq.mm and below. The cabling design will take into account the RLC losses through appropriate sizing and application of recommended derating factors.

Control of **power factor** has also been considered on the LV side, and appropriate locations and sizing of reactive power banks will be worked out at the detailed engineering stage, taking into account both linear and non-linear loads. The design will attempt to maintain power factor at the main panel at 0.95, using automatic correction relays and fixed capacitors.

A.4 Earthing

Earthing would be carried out using copper conductors for all equipments' neutral earthing point. Earth mat would be created to ensure path of minimum resistance. Pipe earthing would be used for equipotential bonding of Feeder Pillars for external lighting and for far flung smaller load centres.

A.5 Ring Main

Power will be carried to the floors by means of Rising Mains with sandwich type busducts with aluminium conductors. There would be tap-off points at each floor. There would be two rising mains in the electrical shaft, each rated for 75% of the total required capacity for "limited redundancy" – i.e. in the event of failure or maintenance of one of the Rising Mains at least 75% of the total load can still be fed from the remaining serviceable Rising Mains. On any floor the "Main Board" on the floor would receive supply from both Rising Mains through a changeover switch. This would ensure that even in the event of maintenance or break-down of any one Rising Main the individual floors would still receive power.

B POINT WIRING:

Point wiring shall be carried out using Fire Resistant (FR) grade PVC insulated wire with multi-stranded copper conductors carried in MS pipe. Switches proposed to be used are contemporary modular type switches with screwless cover plates.

There shall be separate DBs for "Normal" power (which will feed the power outlets and some lights), for "Emergency" power (which will feed all fans and some lights) and "UPS" power (which will have the provision to be connected to either a centralized UPS or a zonal UPS or directly from the "Emergency" panel depending on the importance of the load at that particular point in time).

C LIGHTING & FANS:

Lighting levels have been designed for in adherence to the BIS. For some typical areas the following levels are being followed:

AREA	LUX LEVEL	AREA	LUX LEVEL
Labs & Classrooms	300 - 350	Staff, Common Rooms	200 - 250
Corridors, Lobbies, Stairs	70 - 100	Reading Rooms & Offices	300 - 350

For certain key areas computerized simulation of the lighting levels have been adopted to ensure that appropriate lighting levels would be maintained even after ageing and deterioration of lamp output or fitting fatigue.

However, it must also be clearly understood that since the utilization of this building is predominantly during daytime, suitable energy conservation methods have been adopted to optimize the lighting levels. Areas away from windows have been given higher lumen packages while those nearer natural sources of light have lower lumen packages. In areas like the library and the computer centres which are likely to have evening and night time operational hours, uniform lighting in all areas will be considered.

Also keeping in mind the flexibility of usage of internal spaces, we have made special provisions to make the lighting and fans layout as modular as possible.

Fluorescent light will be the preferred source of light for maximum lumen/ watt package. Fittings with conversion efficiencies of 65% and above are selected for areas requiring 300 lux and above. Suitable mirror optic louvers have considered minimizing the cut-off angle of direct light incident on the screens. Compact fluorescent light has been selected for corridors and lobbies as they are the highest usage areas.

Fans will be provided for all rooms - including rooms with AC.

D FIRE DETECTION & VOICE EVACUATION SYSTEM:

Addressable type of fire detection system is proposed to be used to give the highest grade of fire detection facility. Locations of all detectors and alarm sounders shall be as per NFPA 72 and would be worked out in coordination with the proposed reflected ceiling plans of the common areas.

Optical type smoke detectors shall be used in most areas (Ionization type detectors shall not be used anywhere due to international consensus on the reduction of radioactive material disposal.)

Rate of rise heat detectors shall be planned for all potentially smoky areas.

Hybrid system – conventional detectors (without individual addresses) addressed in zones through addressable Monitor Modules – shall be used in common areas and corridors to optimize cost. Addressable **Manual Call Points** fitted with "Break-Glass" units shall be strategically located near all exit points.

Audio-visual alarm, in the event of fire, shall be provided by means of piezo electric sounders and strobe lights.

The Main Fire Alarm Panel shall be located in the **Fire Control Room** preferably at the Ground Floor.

Additional **addressable control modules** will be provided per floor for the control of AHU dampers, pressurizing fans, etc.

All exit staircases will have the Fireman's telephone jack.

E UPS SYSTEM / INVERTER SYSTEM

Before determining the capacity of UPS system to be used, inputs on number of computers and server load requirements and AV power needs to be quantified. The basic systems to be covered by the UPS would be computer load, server racks, the projectors, audio equipment, Fire Alarm Panel and public address system.

UPS size will depend upon the computer load, load requirement for server racks, requirement of back up for projectors, audio equipment load and public address system. After complete information of these inputs we will be work out the size of UPS.

For emergency lighting Invertors will be provided for only library to have some lights...

F LV SERVICES

F.1. Data and Voice System Provisions

The scope of design and execution would consider only the provision of Mild Steel (MS) conduiting for the Data & Voice Networks i.e. we would not be considering the actual cabling and the outlets for the computer system. Inputs of locations of Data & Voice points would be marked on the layout drawings and given to the University for approval.

F.2 SECURITY / PA SYSTEM

Provision for installing a CCTV system would be made to monitor the Main Entries & Exits of the building. The system itself – the cameras, monitors and cabling - will not be included in the scope of design and execution as it would be best to be integrated at the time of commissioning and handing over.

PA system provisions will be made for seminar hall, Library, corridor. Wiring, outlets & hardware is not being considered.

G EXTERNAL DEVELOPMENT (ELECTRICAL)

External lighting would be designed for in a manner to ensure the security of people at various hours on all roads, pedestrian paths. In addition lighting for the landscaped areas would be integrated so that the luminaries blend and contribute to the aesthetic nature of the landscape design. Particular care would be taken to minimize upward spill of light to ensure compliance with "Night Sky" criterion.

Lamp sources with maximum efficiency and high colour rendering index would be selected. For larger lumen packages Metal Halide (MH) lamps would be used, for medium level requirements CFLs would be used and LEDs would be used for steps, contours and effect lighting.

PTU, PHASE III

Plumbing & Fire Fighting Design Basis Report

April 25, 2011

Client:
PUNJAB TECHNICAL UNIVERSITY
JALANDHAR

Architect:
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Tel: 0120- 4312431

Consultant:
V.S. Kukreja & Associates (P) Ltd.
165-A, Gautam Nagar, Adjoining Gulmohar Commercial Complex, New Delhi-49
Tel: 011-26520175

[This report covers the Plumbing & firefighting design basis for construction of two colleges, one seminar block, a library and an open air theatre, in phase III of Punjab Technical University, Jalandhar]

SANITARY ENGINEERING AND FIRE FIGHTING SERVICES

GENERAL

The project consists of developing various buildings in the existing Punjab Technical University Campus.

The Buildings to be developed are 2 nos. College buildings, library building and a Seminar hall.

1.0 INTRODUCTION

1.1 Water supply and wastewater disposal constitute a very important part of the services in a building. Maintenance of hygiene and cleanliness are indispensable to the well being of the occupants as a whole.

1.2 This report intends to highlight the details of the following proposed services, which are to be provided from the point view of Sanitary Engineering, Fire Fighting and other allied services.

- Water Supply System
- Wastewater Disposal System
- Sewerage and drainage system including disposal
- Sewage Treatment Plant and Recycling of Waste Water
- Rain Water Harvesting
- Fire fighting system

1.3 It is proposed to design the services, storage capacities and piping network of the buildings in totality.

2.0 WATER SUPPLY SYSTEM

2.1 **Total Water Requirement Calculation:** The consolidated and distributed water requirement as per I.S. specifications and Govt. manuals shall be as below:

S. No.	Type of Building	Population	Water Requirement (LPCD)	Total Water Requirement (Liters per Day)
A)	**COLLEGE BUILDING - 1**			
1	Students	360	45	16200
2	Teachers	78	45	3510
3	Technical Staff	21	45	945
4	Support Staff	36	45	1620
5	IV class staff	36	45	1620
6	Laboratory requirement			5000
B)	**COLLEGE BUILDING - 2**			
1	Students	360	45	16200
2	Teachers	78	45	3510
3	Technical Staff	21	45	945
4	Support Staff	36	45	1620
5	IV class staff	36	45	1620
6	Laboratory requirement			5000
C)	**SEMINAL HALL**	150	15	2250
D)	**i) LIBRARY**	450	45	20250
	ii) STAFF	10	45	450
F)	Cafeteria		L.S	5000
G)	BACK WASH FOR FILTER, etc.		L.S	5000
	TOTAL			90740
			Or, say	95000

TOTAL WATER REQUIREMENT = 90,740 LITERS PER DAY

OR SAY = 95, 000 LITERS PER DAY

Horticulture water requirement to be calculated at the rate of 5 liters per sqm per day.

Green area coverage = 13,890 sq.m @ 5 l/sq.m = 13890 x 5 l/sqm = **69,450 Liters per day**

Or Say Total = 70 KL

Quantity of Water Available after Sewage Treatment:

1.	Waste water available	=	80% of 95000 lpd
		=	**76, 000 lpd**
2.	Treated water available after Treatment	=	90% of 76,000 lpd
		=	**68,400 lpd**

2.2 Source of Water

2.2.1 Since municipal water supply not exist in the vicinity of project site it will be necessary to develop own infrastructure to fulfill the entire requirement. It is proposed to meet the total water requirement for the campus by other source / external supply such as bore wells etc. Although there are two tube wells existing on site, one near Academic area and another near residential area. Both tube wells are inter - connected by water supply line for domestic as well horticulture purposes. Minimum one no. bore well also proposed having a discharge of 15000 lph will be required to fulfill the requirement.

2.2.2 However, it is also proposed to design a sewage treatment plant in such a way that effluent will be recycled for flushing and horticulture.

2.3 Storage

Considering minimum requirement of storage for one day (excluding for horticulture purpose), the capacity in underground tanks and overhead tanks shall be as follows:

Water Tanks

Under Ground Tank		
	(a) Raw water tank (Compartment No -1)	**35 Cu.m**
	(b) Treated water tank (Compartment No-2)	**35 Cu.m**
	(c) Recycled waste water tank	**30 Cu.m**
Overhead Tank at Terrace Level		
	(a) For fire fighting (Static) (On educational building terraces)	**25 Cu.m**
	(b) For fire fighting (Static) (On Library building terrace)	**5 Cu.m**
	(c) For Treated Water tank	**15 Cu.m**
	(d) For Flushing Water tank	

2.4 Quality of Water Supply

Since, the water will be required for different purposes i.e. for drinking, cooking, in laboratories in the toilets etc., it has to be of a required standard quality. The exact treatment of water will be suggested after getting the bore well water test report for potability.

However, as a standard, the water shall be passed through a multi grade filter and disinfected with UV Sterilizer prior to the supply to the buildings.

It is also advisable to maintain a strict monitoring system on the quality of the water during the operation of the system.

It is proposed to locate all the pumps and equipments in the underground pump room which shall accommodate all major pumps and equipments and electrical panels etc.

2.5 Water Supply System

2.5.1 The water from the sources will be brought into compartment No. 1, which will serve as a raw water storage tank. The water from raw water tank shall be pump by centrifugal pump of respective discharge and head for treatment through filtration and disinfected with UV Sterilizer and then stored in Treated water tank compartment No. 2.

2.5.2 The compartment No. 2 termed as treated water tank shall supply the water through a hydro-pneumatic pumping system from the under ground domestic water tanks to overhead tank. Water shall be distributed to various user points for consumption by gravity from the overhead tanks. In this scheme, automatic electronic level controllers will be installed in the terrace tank of each building and also a solenoid valve will be installed in the water supply pipe for filling of the over head tank. As soon as the over head tank will be full, the level controller will automatically close the solenoid valve. This would have the following advantages:

a) The over head water tanks will be refilled automatically.

b) Closing of valves in this way would help in increasing the pressure in the main water supply ring mains. Due to this increase in the pressure, the blocks at the farther end would also be able to get optimum amount of water to fill up their over head water tanks in shorter time period.

c) It would also help to reduce the nuisance of water over flowing from the over head tanks as the water supply pipe line for each block would be closed after the over head tank has been filled. This would be a very important step in the conservation of water, which is such a precious resource today.

After the above process, the level controller will automatically open the solenoid valve after the tank is half empty so that water can enter the tanks again on resumption of water supply in the ring mains.

2.5.3 An under ground ring main shall be provided along the building periphery / boundary of the academic zone which will be connected directly to the bore well and Sewage Treatment Plant. Water will be pump by centrifugal pumping system arrangement for horticulture. Garden hydrants will be provided on the ring main.

2.5.4 Pump room of approximately size = 8 x 5 m shall be proposed nearby Underground Water tank. All pump and equipment for water treatment and supply system will be placed inside the pump room.

3. HOT WATER SYSTEM

It is suggested that a 1000 litres per day solar water heating system with an electrical backup may be provided on top of each college building to supply hot water to the laboratories.

4. MATERIALS FOR WATER SUPPLY

4.1. All the external pipes to be used for water supply shall be CI LA / Galvanized steel tubes confirming to I.S.1239 medium class of superior quality. Fittings shall be malleable iron/brass as applicable.

4.2. For internal works, the pipes running on the terrace, shaft are proposed to be G.I pipe and in the wall chases to the various fixtures of CPVC pipes.

4.3 Valves on branches, main line and pumps shall have ball valve / butterfly valve of good approved quality, as per requirement.

5. Soil, Waste, Vent & Rain Water Disposal Pipe System

5.1 The system will be designed based on two pipes (stack) system as recommended in code of practice for soil and waste pipes above ground (I.S. 5329 - 1964).

5.2 Minimum diameter of pipes shall be adopted as:

- All main soil pipes -- 100mm
- All branch soil pipes -- 100mm
- All main waste pipes -- 100mm
- All branch waste pipes -- 50mm
- All main soil and waste pipes stack -- 150mm
- Wash basin/Sink waste connection to floor trap -- 32/40/50mm

5.3 All soil, waste, vent & rain water pipes running vertically, shall be exposed and approachable, in vertical shafts as per architectural design.

5.4 Each connection from the fixtures shall be provided with access doors for cleaning (door junctions).

5.5 Where two or three fixtures are connected to a single horizontal pipe leading to a vertical stack (in toilets), clean-out plugs are provided at starting point. The clean-out plugs shall be flush with the top of floor.

5.6 All traps shall be with a minimum water seal of 50mm.

5.7 Materials

(a) All soil, waste, vent and anti-syphonage pipes and fittings 50mm and above shall be CI centrifugally cast.

6. SEWERAGE SYSTEM

6.1 Soil waste from water closets and urinals etc. will be collected by horizontal and vertical soil pipes and discharged directly to the manholes. Waste water from wash basins, sinks, and from other waste fixtures shall be collected separately by waste pipes and be discharged through gully traps into the manhole of the external sewerage system.

The external sewerage system shall be running around the building periphery having manholes in front of each shaft. The main sewer line will carry the whole sewage by gravity up to the Sewage Treatment Plant.

6.2 Design Parameters

The following parameters shall be considered for design of sewerage system:

(i)	Flow of sewage	=	0.8 of water supply)
(ii)	Peak Flow	=	3 x average flow
(iii)	Min. velocity of flow in pipes flowing half full	=	0.75 m/sec
	Max Velocity of flow	=	2.0 m/sec.
(iv)	Min. depth for sewers	=	0.9m
(v)	Infiltration Factor	=	Add 8.33% of average discharge
	(For surface run off, subsoil water conditions etc.)		

(vii) Formula for calculation for design of sewer lines shall be by Manning's formula:

$$V = \frac{1}{n} S^{1/2} R^{2/3}$$

Where,

V = Velocity in m/sec.
R = Hydraulic radius in m
S = Slope or hydraulic gradient in m/m
n = Manning's co-efficient

(viii) Manning's co-efficient **n = 0.015**

6.3 Appurtenances & Materials' Specifications

6.3.1 Pipes

(a) **S.W. Pipes**

For dia 150mm to 250mm Grade 'A' as per IS: 651 depending on site conditions with laying and jointing and bedding as per IS: 4127-1983

(b) **R.C.C. Pipes Class NP2**
For dia 250mm and above as per IS: 458, for normal slopes and general site conditions.

(c) **R.C.C. Pipes Class NP3**

For road crossings, for heavy loading conditions as per IS:458.

All R.C.C. pipes shall be laid as per IS: 873 - 1985 and as per "Manual on Sewerage and Sewage Treatment" by Ministry of Urban Development, New Delhi.

(d) **C.I. Pipes Class LA**

For steep slopes and exposed pipe as per IS: 1536.

6.3.2 **Manholes**

(a) The manholes shall be constructed of brick masonry as per standard specifications of National Building Code.

(b) Minimum Depths of Manhole - 0.9m

(c) **Spacing**

(i) Manholes shall be provided at all junctions, change of directions, and change in diameters, as per connection requirement.

(ii) A distance of 30 metres on the main trunk sewer lines, depending on dia. of pipe and local conditions.

(d) **Manhole Covers**

(i) Medium/heavy duty for manholes.

7. Sewage Treatment Plant

It is proposed to treat the domestic sewage in a scientific manner through a properly planned sewage treatment plant. The objective is to stabilize the decomposable organic matters present in sewage so as to get an effluent and sludge having characteristics which are within safe limits, and which can be recycled and re-utilized for various purposes to help in maintaining the ecology of nature and save energy resources. The treatment process for sewage/effluent and the location of the final waste water disposal shall be based on the following considerations:

- Use of Treated Sewage.
- Aesthetics of the area and nearby inhabitation.
- Wind direction
- Availability of suitable land.
- Initial Cost of the system
- Recurring Cost of the system.

7.1 Salient Features of STP

(A) Characteristics of Influent

• B.O.D (5 days at 20°C) (mg/lit)	--	250 –300
• Suspended solids (mg/lit)	--	400 – 600
• PH	--	6.5 – 8.5

(B) Characteristic of Effluent (after treatment)

- B.O.D (5 days 20°C) (mg/lit) less than 20mg/lit.
- Suspended solids mg/lit less than 30mg/lit.

The technology suggested to be used for Sewage treatment will be FAB.

7.2 PROCESS DESCRIPTION: FAB Process

Sewage generated from the buildings will reach the last manhole of trunk sewer line from where it shall be passed through a bar screen of suitable size before entering the equalization cum collection tank. There shall be suitable arrangement for cleaning and lifting the coarse material from the platform near the screen chamber.

From equalization tank the sewage shall be lifted through submersible automatic control pumps into adjoining FAB aeration tank. The equalization tank shall also have provision of the aeration system to keep the sewage in the homogeneous condition.

In the FAB aeration tank of required capacity wastewater will be mixed with microorganisms in presence of dissolved oxygen. Microorganisms will assimilate organic impurities. The FAB aeration tank will be supplied through two positive displacement (roots type) air blowers (1 working + 1 standby) located out side the tank. Submerged air diffusers will provide mixing and oxygen for the needs of microorganisms. The blowers will be sized to maintain dissolved oxygen level in the aeration tank of approximately 2 mg/lit.

From the FAB aeration tank mixed liquor will flow by gravity into adjoining Plate Settler of required capacity. The solids will settle in the plate settler tank. A sludge return pump will be provided for pumping the settled sludge from the plate settler tank back to the aeration tank. Plate settler tank will also be provided with skimmer system to pump floating scum back to the aeration tank to keep the plate settler surface clean.

An overflow weir with scum baffle will be provided in plate settler to take treated wastewater out of the plate settler.

From the plate settler, treated wastewater will flow by gravity into adjoining clarified water tank. From this tank the water will be lifted with a submersible pump and passed through a pressure sand filter, an activated carbon filter and softener and stored in a soft water tank. Water from this tank will be lifted with suitable submersible pumps for further use for Air Conditioning purpose. In case of extra effluent the arrangement shall be made to dispose off into municipal sewer.

Excess sludge from the plate settler tank will be taken periodically into sludge holding tank. In this tank sludge will be aerated for self-stabilization. Air will be shut off periodically and superannuate water will be transferred to the aeration tank creating stabilized sludge. This stabilized sludge shall be dried in filter presses and the stabilized sludge shall be lifted from tank into the tanker for outside transportation / disposal for further use for agriculture / horticulture purposes.

8. RAIN WATER DISPOSAL

8.1 Roof Drainage:

Vertical rain water pipes provided as per requirement and will collect the rainwater pipe through khurrahs and this will discharge into masonry storm water drains with SFRC Covers or Piping cum manhole storm water drainage system.

Drainage system shall be designed on the parameters setup by the metrology department and various statutory codes. Rooftop rainwater is generally clean does not require any pretreatment before discharging into Rain water Harvesting wells. Rain water from roof shall first be discharged into the harvesting wells and excess water from the wells shall be overflow into the surface drain.

8.2 Surface Drainage:

Surface drainage consisting of surface drains and underground storm water disposal pipes will be provided so that there is no accumulation of rain water. Before discharging into rain water harvesting wells bar screens and silt traps have been incorporated to remove the silt, heavier particles and other objectionable material which can cause the choking of the percolation well. Surface rain water separately collected in the external masonry storm water drains with SFRC Covers or Piping cum manhole storm water drainage system and discharge into the rain water harvesting chamber.

The final disposal of the rain water collected from the overflow of the rain water harvesting system will be in the proposed retention pond in Phase I

8.3 Design/Technical Parameters

8.3.1

Min. velocity of flow in pipes	=	0.6 m/sec or as per site
Max Velocity of flow	=	2.0 m/sec.
Min. Free board		
a. For drains upto 300 mm width	=	75 mm
b. For drains upto 900 mm width	=	150 mm

8.3.2 The run off for designing of drainage = As per Metrological Data

8.3.3 The design of drains is based on Manning's formula, for flow due to gravity

$$V = \frac{1}{n} R^{2/3} S^{1/2}$$

Where V = Velocity in m/sec.
R = Hydraulic mean radius in m
S = Hydraulic gradiant in m/metre
n = Manning's co-efficient

8.3.4 **Manning's Co-efficient**

(a) For R.C.C. pipes n = **0.015**
(b) For brick masonry channel with neat coat of cement plaster n = **0.013**

9. RAIN WATER HARVESTING

The main emphasis given in the planning of the storm water drainage system is on recharging the underground aquifer of the area while having the safe disposal of storm water without flooding the campus. A network of storm water disposal drains will be planned which will finally dispose off into a percolation well for direct injection of collected storm water into the ground water. Bar screens and silt traps have been incorporated before the percolation wells to remove the silt, heavier particles and other objectionable material which can cause the choking of the percolation well. Type of percolation wells etc. will be decided after detailed hydrological and geological survey analysis results are obtained.

WHY DO WE REQUIRE RAIN WATER HARVESTING AND GROUND WATER RECHARGE?

- To meet ever increasing demand for water in urban areas.
- To reduce the runoff that is choking the storm drains.
- To avoid the flooding of roads.
- To augment the ground water storage and control decline of water levels.
- To improve the quality of ground water.

THE ADVANTAGES OF RAIN WATER HARVESTING AND GROUND WATER RECHARGE

- This is an ideal solution of water problem where there is inadequate ground water supply or surface resources are either lacking or insignificant.
- To utilize the rainfall runoff, which is going to sewer or storm drains.
- Rainwater is pure, free from organic matter and soft in nature.
- It will help in reducing the flood hazard.
- To improve the quality of existing ground water through dilution.
- Rainwater may be harnessed at place of need and may be utilized at time of need.
- The structures required for harvesting the rainwater are simple, economical and eco-friendly.

The drainage system shall be led to various percolation wells catering to different parts of the catchments area. Silt traps will be provided at inlet to each percolation well. The overflow from percolation wells will be inter connected and the overflow will be in the river flowing along the plot.

IMPORTANT INDIAN STANDARDS PLUMBING & SANITARY WORK

	TITLE
IS 651-1965	Specification for salt Glazed stoneware pipes and fittings (First revision).
IS 782-1978	Specification for caulking lead.
IS 1172-1971	Code of basic requirements for water supply, drainage and sanitation (revised).
IS 1239-1968 (Part-I)	Specifications for mild steel tube, tubular and other steel pipe fittings.
IS 1239-1968 (Part-II)	Specifications for mild steel tube, tubular and other steel pipe fittings.
IS 1537-1976	Specification for vertically cast iron pressure pipes for water, gas and sewage.
IS 1536-1976	Specification for centrifugally Cast (Spun) Iron pressure pipes for water, gas and sewage.
IS 1538 (Part 1 to 23)	Specification for Cast Iron fittings for pressure pipes for water, gas and sewage.
IS 1626-1960	AC building pipes, gutters and fittings (Spigot and socket type).
IS 1726-1960	Code for cast iron manhole frame and cover.
IS 1729-1979	Specification for Sand cast iron Spigot and Ventilating pipes, fittings and accessories.
IS 1742-1960	Code of practice for building drainage.
IS 2064-1962	Code of practice for selection, installation and maintenance of sanitary appliances.
IS 2065-1963	Code of practice for water supply to buildings.
IS 3114-1965	Code of practice for laying of C.I. Pipes.
IS 3589-1981	Specification for electrically welded steel pipes for water, gas and sewage.
IS 3989-1970	Centrifugally cast spun iron and socket soil and ventilating pipe, fittings and accessories.
IS 4111-1967	Code of practice for Ancillary structure in sewerage system.

IS 4127-1967	Code of Practice for laying glazed stone ware pipe.
IS 4515	Specification for unplasticized PVC pipe fittings.
IS 4985-1981	Specification for unplasticized PVC pipes for portable water supplies.
IS 1703-1984	Ball Valves
IS 2548-1970	Toilet Seat Cover
IS 4736-1986	Galvanizing G.I. Pipes
IS 780-1984	Cast iron sluice valves
IS 778-1984	Full way valves
IS 2692-1978	Brass ferrule
IS 458-1971	R.C.C. pipes

National building code for water supply, drainage and sanitation Part IX Plumbing services section 1 & 2.

The installation shall also be in conformity with the bye-laws and requirements of the local authority is so far as these become applicable to the installation. Where-ever this specification calls for a higher standard of materials and/or workmanship then those required by any of the above regulations and standards, hence these specification shall take precedence over the said regulations and standards. Wherever drawings and specifications require something that may violate the regulations, the regulation shall govern.

FIRE FIGHTING SERVICES

1.0 PREAMBLE

Most accidental fires have a small, insignificant beginning, but a terrible ending. They advance rapidly from the incipient stage to a devastating stage and soon go out of control. And fire is no sojourner and travels rapidly to engulf large areas with least delay. The end result is always horrible and needs no further description.

1.1 AIM

The present objective is to put forth a Fire Protection and Safety Scheme for the campus in conformity with existing standards and practices.

2.0 Details of the building

2.1 The fire fighting will be designed as per the recommendations of the National Building Code of India-Part IV, 2005. The Occupancy wise classification will be as under:

Group-A: Educational Buildings (15 m and above but not exceeding 30 m in height)
Subdivision: All others / training institutions

Group-B: Business buildings (Above 10 m but not exceeding 15m in height)
Subdivision: Library

2.2 Considering that the purpose of the buildings, as well as the height of the structure and mixed occupancy, it will be necessary to provide a proper and adequate fire fighting system based on the requirements of the National Building Code 2005.

2.3 The proposed fire fighting shall be consisting of static U.G water storage tank of capacity 50 KL, with a provision of fire brigade inlet and suction connections with pump capacity 2280 l/m electrical as well diesel driven pump which have met from the existing static underground water storage tank of capacity = 100 KL and Pumps from Pump room made in Phase – I.

Minimum Requirement for Fire Fighting System as per NBC – 2005 (Table No.-23)

S.No.	Description	As Per (NBC)	
1	Fire Extinguisher	Required	Provided
2	Hose Reel	Required	Provided
3	Dry Riser	Not Required	Not Provided
4	Wet Riser	Required	Provided
5	Down Comer	Required	Provided
6	Yard Hydrant	Not Required	Not Provided
7	Automatic Sprinkler System	Not Required	Provided only in Library building.
8	Manually Operated Electric Fire Alarm System	Required	Provided
9	Automatic Detection Alarm System	Required	Provided
10	Underground Static Water Storage Tank	Required (50 KL)	Will be met from existing 100 KL U.G tank
11	Terrace Tank	Required	Provided
12	Pump Near UG Tank	Required	Will be met from existing Pump.
13	Pump at Terrace	Required	Provided

2.4 Vertical wet riser cum down comer of 100mm dia M.S. pipes will be taken to provide pressurized water to the single outlet hydrant landing valve on each floor as per requirement and then connected commonly to an over head tank and pump. Along with wet riser system, portable fire extinguishers are to be provided at all accessible positions.

2.5 An over head tank of 25000 l capacity and pump of 900 lpm @ 45 m head will also be provided for the building which come under educational building while the building coming under business building will be provided with over head tank of 5000 l capacity and pump of 450 lpm @ 40 m head for firefighting system will be connected to the risers through a non-return valve and also connected to the suction of the pumps in the under ground pump room.

2.6 A fire hose cabinet with complete fire fighting accessories shall be provided with following specifications:

- 2 nos., 63mm dia and 15m long rubberized fabric lined hose pipe as per I.S:636 type-II.
- Gunmetal male and female instantaneous type coupling as per I.S:903 with I.S. specifications.
- Gunmetal branch pipe with nozzle as per I.S:903
- First-aid fire hose reels with 20mm dia 30m long with 5mm bore gunmetal nozzle as per I.S:884 - 1969.
- Fireman's axe.

2.7 Also it has been proposed to provide following portable type fire extinguishers.

- 9 lit. water expelling type.
- 4.5 lt. CO_2 Type.
- 5 kg ABC type.
- Dry chemical powder type of 10kg/5kg capacity.

2.8 Sprinkler system although not specified by NBC, we recommend sprinkler should be provided in Library building for the safety of documents and casualty.

2.9 Sprinklers shall be provided in all the floors of the library building, each sprinkler covering an area of upto 100-120 sqft, & connected to the same pressurized system with provision for an automatic alarm system in case of activation. The sprinkler shall be automatically activated at a temperature of $57^{o}C$-68^{o} C.

2.10 Also, upright sprinkler pendant shall be provided in the areas where the depth between the soffit of the main slab and the false ceiling is more than 750mm.

2.11 The delivery pipes for the sprinkler pumps and main fire pumps shall be interconnected.

IMPORTANT INDIAN STANDARDS FOR FIRE FIGHTING WORK

	TITLE
IS 1239-1968 (Part-I)	Specifications for mild steel tube, tubular and other steel pipe fittings.
IS 1239-1968 (Part-II)	Specifications for mild steel tube, tubular and other steel pipe fittings.
IS 1536-1976	Specification for centrifugally Cast (Spun) Iron pressure pipes with flanges for water, gas and sewage.
IS 1538 (Part 1 to 23)	Specification for Cast Iron fittings for pressure pipes for water, gas and sewage.
IS 1726-1960	Code for cast iron manhole frame and cover.
IS 3589-1981	Specification for electrically welded steel pipes for water, gas and sewage.
IS 4736-1986	Galvanizing G.I. Pipes
IS 636-1988	Non percolating flexible fire fighting delivery hose (third revision)
IS 694-1990	PVC insulated cables for working voltages upto and including 1.100 volts (third revision)
IS 778-1984	Copper alloy gate, globe and check valves for water works purposes (fourth revision) (Amendment 2)
IS 780-1984	Sluice valves for water works purposes (50 to 300 mm) size (sixth revision) (amendment 3)
IS 884-1985	Specification for first-aid hose-reel for fire fighting (for fixed installations) (first revision) (with amendment No.1)
IS 900-1992	Code of practice for installation and maintenance of induction motors (second revision)
IS 901-1988	Specification for couplings, double male and double female, instantaneous pattern for fire fighting (third revision)
IS 902-1992	Suction hose coupling for fire fighting of purposes (third revision)
IS 903-1984	Specification of fire hose delivery couplings branch pipe, nozzles and nozzle spanner (third revision) (Amendment 5)

IS 937-1981	Specification for washers for water fittings for fire fighting purposes (revised) (with amendment No, 1)
IS 1520-1980	Horizontal centrifugal pumps for clear cold, fresh water (second revision)
IS 1536-1976	Horizontally cast iron pressure pipes for water, gas & sewage (first revision) (with Amendments No. 1 to 4)
IS 1554-1988 Part I	PVC insulated (heavy duty) electric cables (working voltage upto and including 1100 volts (third revision)
IS 1554-1988 Part II	PVC insulated (heavy duty) electric cables (working voltage from 3.3 KV upto and including 11 KV (second revision)
IS 1648-1961	Code of practice for fire safety of buildings (General) Fire fighting equipment and its maintenance (with amendment No.1)
IS 3624-1987	Pressure and vacuum gauges (Second revision)
IS 4736-1968	Hot-dip zinc coatings on steel tubes (with Amendment No.1)
IS 5290-1983	Specification for landing valves (second revision) (with Amendments No.6)
IS 5312- 1984 Part I	Swing check type reflux (non return) valves Part I-single door pattern (with amendments nos. 1 & 2)
IS 5312- 1986 Part II	Swing check type reflux (non return) valves Part II-Multi door pattern (with amendments nos. 1 & 2)
IS 7285	Seamless cylinders for storage of gas at high pressure.
IS 2189-1962	Code of practice for Automatic Fire alarm system
IS 2195-1962	Specification for heat sensitive fire detectors
IS 732-1973	Code of practice for electrical wiring installation
	UL 168 Underwriters Laboratory specification for smoke detector.