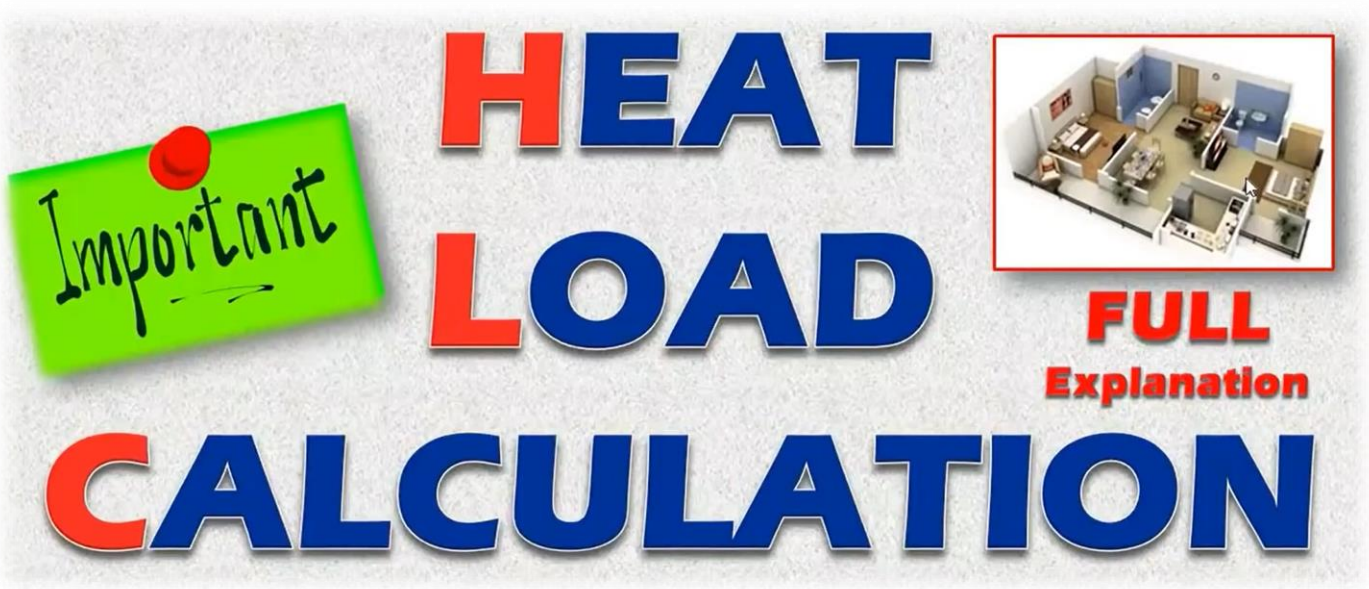


PROCEDURE

Step by Step

EXPLAINED

PREPARED BY

HVAC SIMPLIFIED™

www.hvacsimplified.in

What is HVAC Load Calculation.....?

- An HVAC Load Calculation is a mathematical process for measuring several aspects of a building in order to determine the best size, application and style of HVAC system.

- The purpose is to ensure energy efficiency while also maximizing comfort.

- Load calculations have been completed for several years, however, with new technology come quicker and more consistent methods to complete this important step.

Factors to considering during Cooling load requirement

- It is necessary for air conditioning designers to know about the heat source and their nature before designing of air conditioning system.

- Building detailed layout.
- Building orientation.
- Ambient condition.
- Use of Space.
- Physical dimension of space.
- Indoor design condition.
- Filtration level required.
- Glass area exposed to sun.
- Occupancy.
- Lighting load.
- Equipment load.
- Fresh air requirement.

HUMAN COMFORT

Application of HVAC System

- Residential
- Commercial
- Industrial
- Educational
- Pharmaceuticals
- Hospitals
- Malls/Offices
- And many more….

Air Conditioning Load Estimate

- The air conditioning load is to provide the basis of selecting the conditioning equipment.

- The load is designed for maximum conditions of heat such as :
  - Peak month.
  - Peak day and
  - Peak time of the year.

- The design load is divided into two types.
  - Outdoor Load
  - Indoor Load

HUMAN COMFORT

OUTDOOR LOADS :

- Heat flow through the exterior wall, ceilings, floors, windows and doors due to temperature difference between two sides.

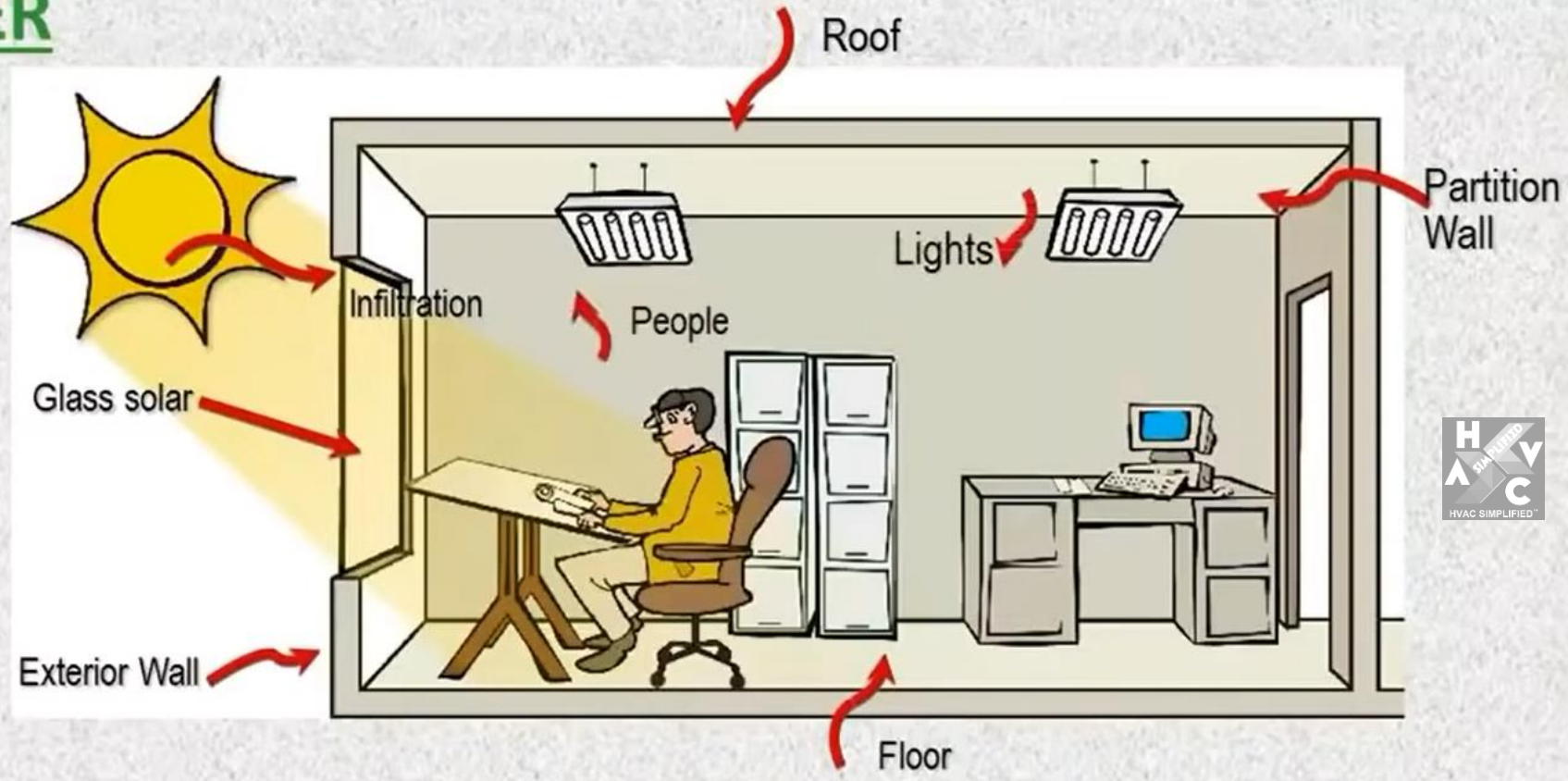
LOAD DUE TO SOLAR RADIATION

- Heat from the Sun absorbed by the wall and roof and later transferred to room by conduction.
- Heat transmitted directly by radiation through glass of Window.
- Heat received form infiltration air from windows and doors due to frequent openings.

INDOOR LOADS :

- ❑ People
- ❑ Light
- ❑ Appliances
- ❑ Miscellaneous sources.

HEAT TRANFER



- Heat gain from outdoors through the roof, exterior walls, skylights, and windows. (This includes the effects of the sun shining on these exterior surfaces.)
- Solar radiation heat gain through skylights and windows.
- Conduction heat gain from adjoining spaces through the ceiling, interior partition walls, and floor.
- Internal heat gains due to people, lights, appliances, and equipment in the space.

EXAPMLE

E20 FORM

COOLING & DEHUMIDIFICATION

HEAT LOAD ESTIMATE FORM

Table 1-T-100 : Cooling and Dehumidifying

Heat Load Estimate Form

Job Name
Address
Space Used for
Size x = Sq.Ft.x = Cu. Ft.

Item	Area of quantity	Sun Gain or Temp. Diff.	Factor	Btu / Hour
SOLAR GAIN GLASS				
	Glass	Sq. Ft. x	x	
	Glass	Sq. Ft. x	x	
	Glass	Sq. Ft. x	x	
	Glass	Sq. Ft. x	x	
Sky Light		Sq. Ft. x	x	
SOLAR AND TRAINS GAIN – WALLS AND ROOF				
	Wall	Sq. Ft. x	x	
	Wall	Sq. Ft. x	x	
	Wall	Sq. Ft. x	x	
	Wall	Sq. Ft. x	x	
	Wall	Sq. Ft. x	x	
Roof Sun		Sq. Ft. x	x	
Roof Shaded		Sq. Ft. x	x	
TRAIN GAIN EXCEPT WALLS AND ROOF				
All Glass		Sq. Ft. x	x	
Partition		Sq. Ft. x	x	
Ceiling		Sq. Ft. x	x	
Floor		Sq. Ft. x	x	
INFILTRATION AND OUTSIDE AIR				
Infiltration		Cfm x	X 1.08	
Outside Air		Cfm x °F	BF X 1.08	
INTERNAL HEAT				
People		People		
Power		H.P. / KW		
Lights			x 1.08	
Appliances Etc.			x	
ROOM SENSIBLE HEAT				
Supply		Supply		
Duct		Duct		
Heat Gain%		Leak Loss %		
EFFECTIVE ROOM SINSIBLE HEAT				
ROOM LATENT HEAT				
Infiltration	cfm x	gr/lb x	0.68	
Outside Air	cfm x	gr/lb x	BF x 0.68	
People		People x		
Steam		Lb / hr x 1080		
Appliances, Etc.				
Vapor Train				
Room Latent Heat Sub Total				
Supply Duct Leakage Loss		% + SAFETY FACTOR %		
EFFECTIVE ROOM LATENT HEAT				
EFFECTIVE ROOM TOTAL HEAT				
Sensible : Cfm x 0f x (1-BF) x 1.08				
Latent : cfm x gr / lb x (1-BF) x 0.68				
Grand Total Heat Sub Total				

Heat Gain%	Leak Loss			
TONS = GRAND TOTAL HEAT*				

Estimated for	Local Time		Peak Load	Local Time Sun Time	
CONDITIONS	DB	WB	%RH	DP	Gr/Lb
Outside					
Room					
Difference		x x x	x x x	xx	

Selected Room Conditions DB WB %RH

_____ People x $\frac{\text{VENTILATION}}{\text{INFILTRATION}}$ $cfm\ Person$ _____

_____ Sq. Ft. x _____ cfm / Sq. ft. = _____ cfm. Ventilation

SWINGING
REVOLVING DOORS – PEOPLE X CFM / PERSON = ___
Open Doors _____ x _____ CRM / DOOR = _____
Exhaust Fan
Crack _____ Feet x _____ cfm / Ft = _____

SENSIBLE HEAT FACTOR AND APPARATUS DEWPOINT

$\frac{Eff\ room\ sens\ Heat}{Eff\ room\ Total\ heat}$ = _____ Sens Heat Factor (ESHF)

Indicated adp _____ °F Selected adp. _____ °F

(1 – BF) (Room Temp. ADP = _____ Dehumidified rise

$\frac{Room\ Sensible\ Heat}{1.08 \times Dehumidified\ rise}$ = _____ Dehumidified cfm

NOTES

Q = HEAT FLOW (BTU/HR)

$$Q = U \times A \times \Delta T$$

U – Overall heat transfer coefficient of the material. [U = 1/ΣR]

A – Area of the surface in Square Feet.

Δ T – Temperature Outside – Temperature Inside.

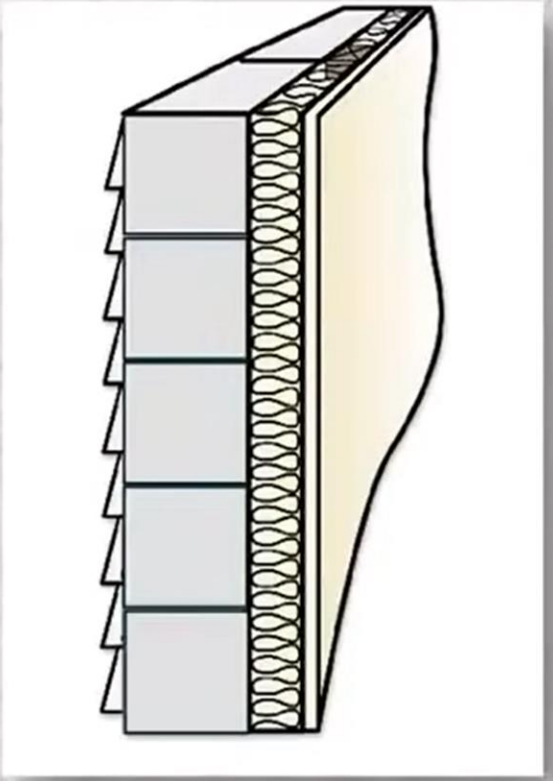
WALL / ROOF HEAT LOAD

$$Q = U \times A \times \Delta T$$

U – Overall heat transfer coefficient of the material. [U = 1/ΣR]

A – Area of the surface in Square Feet.

Δ T – Temperature Outside – Temperature Inside.



GLASS HEAT LOAD

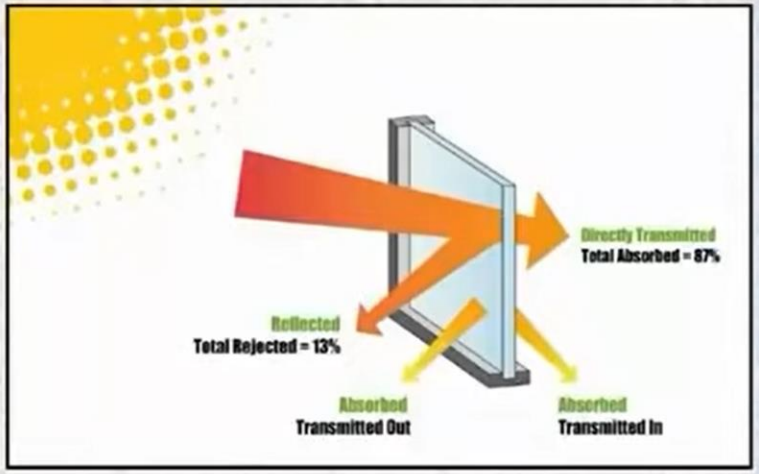
$$Q = A \times SC \times SCL$$

Q = heat gain by solar radiation through glass, Btu/hr [W]

A = total surface area of the glass, ft^2 [m^2]

SC = shading coefficient of the window, dimensionless

SCL = solar cooling load factor, $Btu/hr \cdot ft^2$ [W/m^2]



HEAT LOAD CALCULATION

A. SOLAR HEAT GAIN FOR (W) WALL, (F) FLOOR & (R) ROOF.

B. SOLAR HEAT GAIN FOR (G) GLASS (WINDOWS).

C. EFFECTIVE ROOM (E.R.S.H.L) SENSIBLE HEAT LOAD.

D. EFFECTIVE ROOM (E.R.L.H.L) LATENT HEAT LOAD.

E. EFFECTIVE ROOM (E.R.T.H.L) TOTAL HEAT LOAD.

F. EFFECTIVE ROOM (E.R.S.H.F) SENSIBLE HEAT FACTOR.

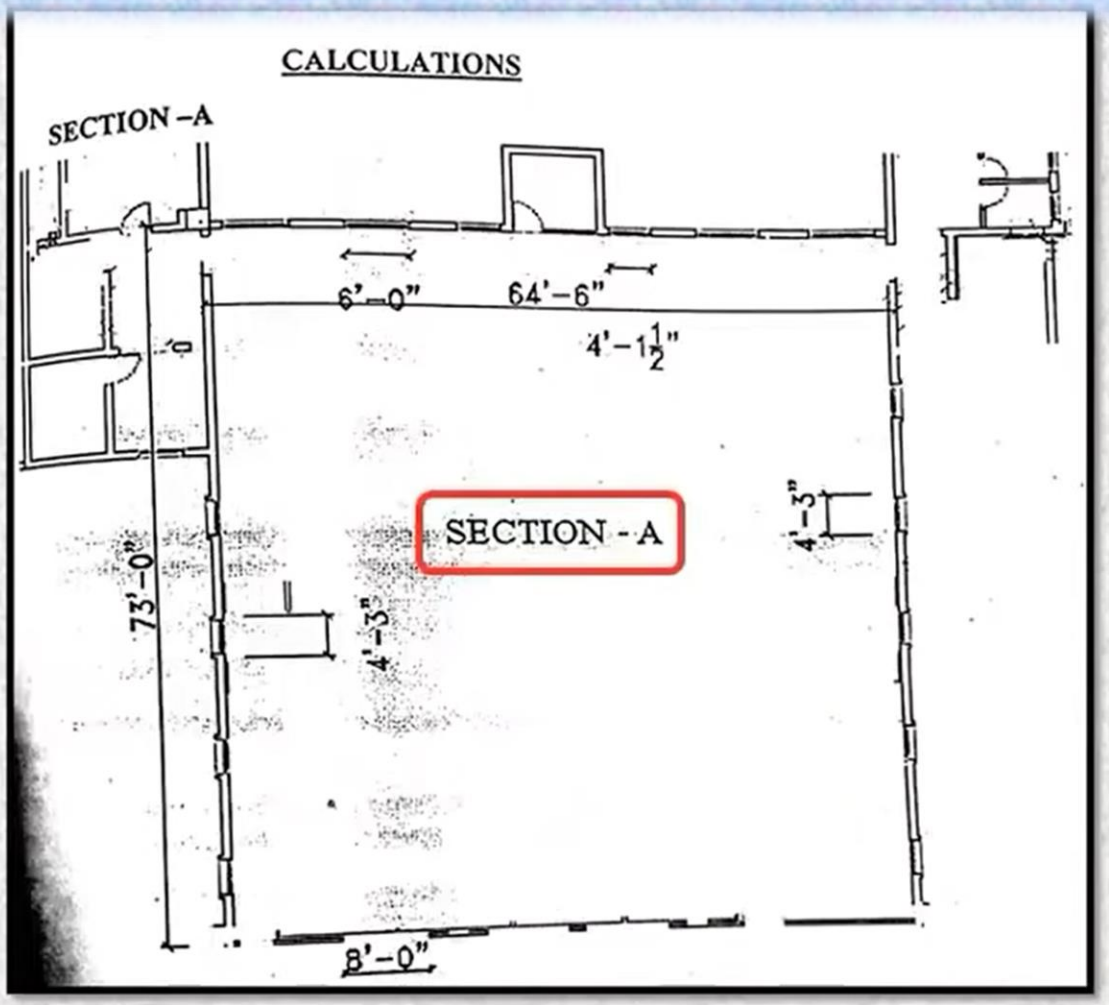
G. DEHUMIDIFIED (CFM) AIR FLOW.

HEAT LOAD CALCULATION

A. SOLAR HEAT GAIN FOR WALL AND FLOOR

$$Q = U \times A \times \Delta T$$

Condition Of Wall	Area in Sq.Ft	Temperature Difference in F	U Factor	BTU/Hr
West Partition	730	29	0.36	7621.20
North Exposed	451	31	0.3	4198.95
South Partition	645	29	0.36	6733.80
Floor	4708.5	29	0.19	25943.84
			Total	44497.79



SECTION - A

Number of Person = 110

Total Floor Area = 4708.5 Sq.Ft

HEAT LOAD CALCULATION

A. SOLAR HEAT GAIN FOR WALL AND FLOOR

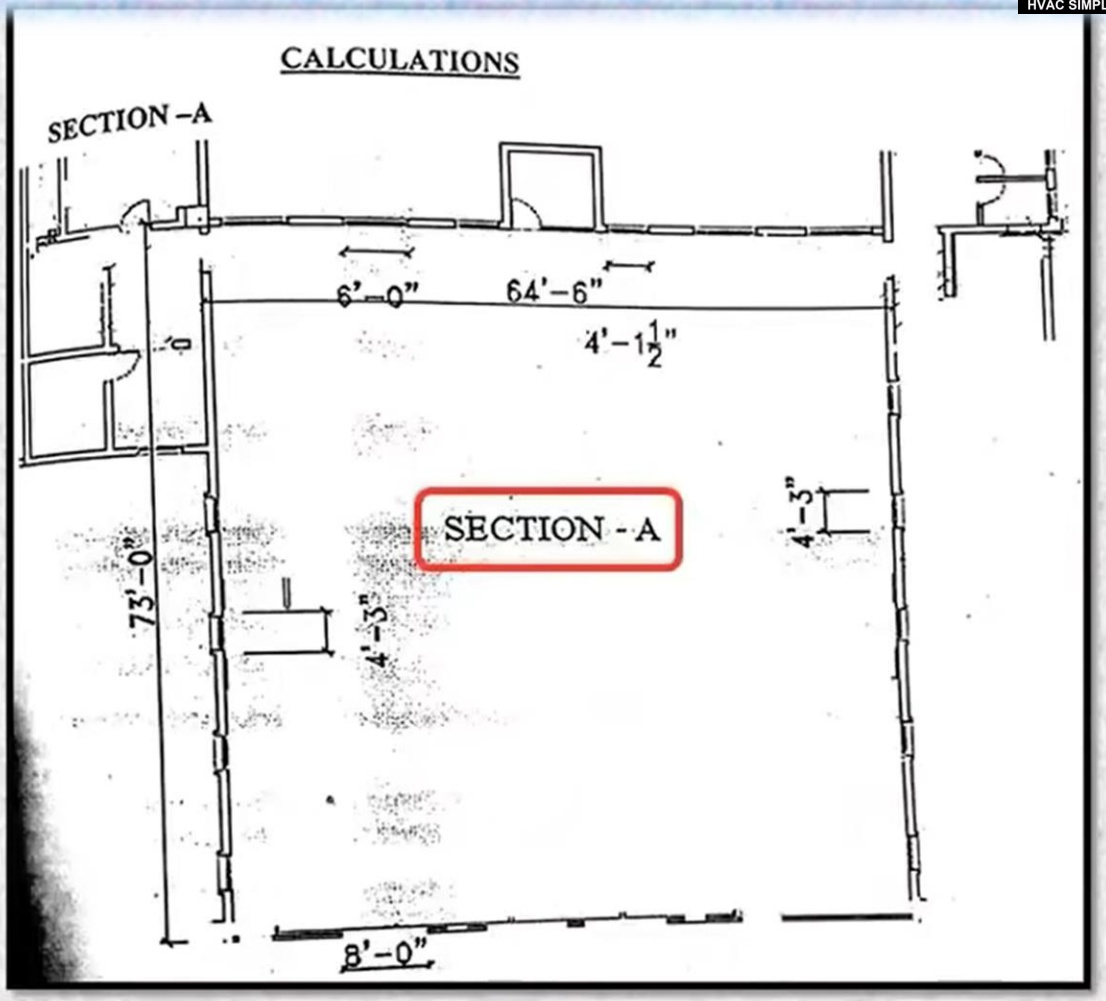
$$Q = U \times A \times \Delta T$$

Condition Of Wall	Area in Sq.Ft	Temperature Difference in F	U Factor	BTU/Hr
West Partition	730	29	0.36	7621.20
North Exposed	451.5	31	0.3	4198.95
South Partition	645	29	0.36	6733.80
Floor	4708.5	29	0.19	25943.84
			Total	44497.79

B. SOLAR HEAT GAIN FOR GLASS

$$Q = A \times SC \times SCL$$

Condition Of Wall	Area in Sq.Ft	SC	SCL	BTU/Hr
North Exposed	193.5	0.8	16.08	2489.28
			Total	2489.28



SECTION - A

Number of Person = 110

Total Floor Area = 4708.5 Sq.Ft

HEAT LOAD CALCULATION

C. EFFECTIVE ROOM SENSIBLE HEAT LOAD (E.R.S.H.L)

1. Outside Air

$$= \frac{\text{Volume of the room (ft3) x No. of air changes}}{60} = \frac{4708.5 \times 10 \times 2}{60} = 1569.5 \text{ CFM}$$

2. Q_s (Sensible Heat)

= CFM x (Δt) x (bf) x 1.08
= 1569.5 x 34 x 0.15 x 1.08
= **8,644.8 btu/hr.**

(Δt) = Outside Temperature – Inside Temperature
1.08 = (0.224 x 60) / 13.5
Where :
13.5 = Specific Volume of moist air at 70F DBT,
0.224 = Specific heat of moist air at 70F and 50%RH
and
0.15 = bf
245 = Sensible Heat Contribution in Room (ASHRAE)

3. Internal Heat

= No. of People x Sensible Heat Gain.
= 110 x 245
= **17,150 btu/hr**

4. Light Load

= Total area (sq.ft) x lighting load (watts) x 3.4
= 4708.5 x 2 x 3.4
= **32,017.8 btu/hr**

5. Equipment Load

= No. of Equipment x Load x equipment load (watts) x 3.4
= 90 x 300 x 3.4
= **91,800 btu/hr**

6. Total Sensible Heat Load (A + B + C)

= 44,497.78 + 2,492,28 + 8,644.8 + 17,150 + 32,017.8 + 91,800 = 206,402.66 btu/hr
Safety Factor 8%

7. Effective Room Sensible Heat Load = 222,914.87 btu/hr

HEAT LOAD CALCULATION

D. EFFECTIVE ROOM LATENT HEAT LOAD (E.R.L.H.L)

1. Q_L (Latent Heat) = Outside air CFM x (Δw) x (bf) x 0.68

= 1569.5 x 36 x 0.15 x 0.68

= 5,763.204 btu/hr.

(Δw) = Outside Humidity Ration – Indoor Humidity Ration
0.15 = bf
205 = Latent Heat Contribution in Room (ASHRAE)

2. Latent Heat Internal Load = No. of People x Latent Heat Gain.

= 110 x 205

= 22,550 btu/hr

3. Total Latent Heat Load = 5,763.204 + 22,550 = 28,313.204 btu/hr

(1 + 2)

Safety Factor 8%

4. Effective Room Latent Heat Load = 30,578 btu/hr

HEAT LOAD CALCULATION

E. EFFECTIVE ROOM TOTAL HEAT LOAD (E.R.T.H.L)

E.R.T.H.L = E.R.S.H.L + E.R.L.H.L

= 222,914.87 + 30,578

= 253,492.87 btu/hr

TR = E.R.T.H.L / 12,000

= 253,492.87 / 12000

= 21.12 TR (22 TR approx.)

F. EFFECTIVE ROOM SENSIBLE HEAT FACTOR

$$\frac{\text{E.R.S.H.L}}{\text{E.R.T.H.L}} \quad \frac{222{,}914.87}{253{,}492.87} = 0.88$$

G. DEHUMIDIFIED (C.F.M)

$$\frac{\text{E.R.S.H.L}}{1.08 \times (\text{RT} - \text{ADP})} \quad \frac{222{,}914.87}{1.08 \times (72 - 54)} \quad 11466.81 \text{ CFM}$$

HEAT LOAD CALCULATION

E. EFFECTIVE ROOM TOTAL HEAT LOAD (E.R.T.H.L)

E.R.T.H.L = E.R.S.H.L + E.R.L.H.L

= 222,914.87 + 30,578

= 253,492.87 btu/hr

TR = E.R.T.H.L / 12,000

= 253,492.87 / 12000

= 21.12 TR (22 TR approx.)

F. EFFECTIVE ROOM SENSIBLE HEAT FACTOR

$$\frac{\text{E.R.S.H.L}}{\text{E.R.T.H.L}} \quad \frac{222{,}914.87}{253{,}492.87} = 0.88$$

G. DEHUMIDIFIED (C.F.M)

$$\frac{\text{E.R.S.H.L}}{1.08 \times (\text{RT} - \text{ADP})} \quad \frac{222{,}914.87}{1.08 \times (72 - 54)} \quad \text{11466.81 CFM}$$

Capacity : 22 TR

Air Flow : 11467 CFM


Thank you