

CHARACTERISTIC SURFACES:

DBT_{WINTER} = 1°F

DBT/WBT_{SUMMER} = 89/72°F

$A_1 = 30 \times 12 - 4 \times (5 \times 5) = 280 \text{ ft}^2$

$A_2 = 4 \times (5 \times 5) = 80 \text{ ft}^2$

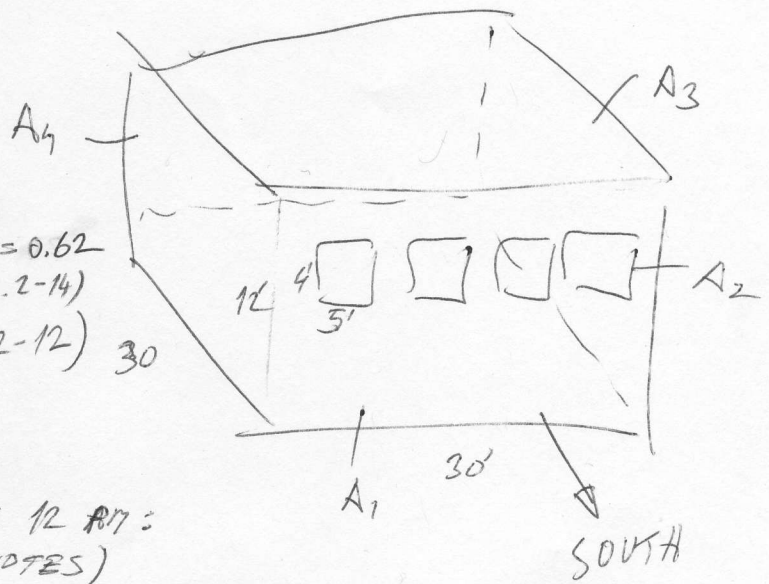
$A_3 = 30 \times 30 = 900 \text{ ft}^2$

$A_4 = 3 \times (30 \times 12) = 1080 \text{ ft}^2$ SHGC = 0.62

WINDOW: $U = 0.47 \frac{\text{Btu}}{\text{ft}^2 \cdot \text{F}}$

WALLS: TYPE F, $U = 0.1 \frac{\text{Btu}}{\text{ft}^2 \cdot \text{F}}$ (TAB. 2-14)

ROOF: $U = 0.120 \frac{\text{Btu}}{\text{ft}^2 \cdot \text{F}}$ (TAB. 2-12)



EXTERNAL LOADS:

CRITICAL HOUR IS JULY 12 PM:
(SEE CLASS NOTES)

12 PM:

SOUTH WALL:

$Q_1 = A_1 \cdot U_1 \cdot TETD = 280 \text{ ft}^2 \cdot 0.1 \frac{\text{Btu}}{\text{ft}^2 \cdot \text{F}} \cdot 10^\circ \text{F} = 280 \frac{\text{kBtu}}{\text{h}}$

WINDOWS: FROM MANUFACTURED

$Q_2 = A_2 \cdot U_2 \cdot \Delta T + A_2 \cdot SC \cdot SHGC \cdot SHGF = 80 \text{ ft}^2 \cdot 0.47 \frac{\text{Btu}}{\text{ft}^2 \cdot \text{F}} \cdot 14^\circ \text{F} + 80 \text{ ft}^2 \cdot 0.71 \cdot 100 \frac{\text{Btu}}{\text{ft}^2} = \dots \frac{\text{kBtu}}{\text{h}}$

ROOF: $SC = \frac{SHGC}{0.87} = \frac{0.62}{0.87} \approx 0.71$

$Q_3 = A_3 \cdot U_3 \cdot TETD = 900 \text{ ft}^2 \cdot 0.12 \frac{\text{Btu}}{\text{ft}^2 \cdot \text{F}} \cdot 30^\circ \text{F} = 3.2 \frac{\text{kBtu}}{\text{h}}$

SHADED WALLS: SAME LIKE FOR NORTH WALL

$Q_4 = A_4 \cdot U_4 \cdot TETD = 1080 \text{ ft}^2 \cdot 0.1 \frac{\text{Btu}}{\text{ft}^2 \cdot \text{F}} \cdot 9^\circ \text{F} = \dots \frac{\text{kBtu}}{\text{h}}$

EXTERNAL SENSIBLE TOTAL:

$Q_1 + Q_2 + Q_3 + Q_4 + Q_{\text{INFILTRAT AND VENTILAT}} = Q_{\text{EXTER. SENSIBLE}}$

INTERNAL LOADS:

OCCUPANTS: $n = 10$ OCCUPANTS

OFFICE & MODERATE ACTIVITY

$Q_5 = n \cdot Q_{\text{PER PER}} = 10 \cdot 250 \frac{\text{Btu}}{\text{h}} = 2500 \frac{\text{Btu}}{\text{h}}$

FROM TABLE IN HAND OUTS!
 $Q_{\text{SENS}} \text{ PER PERSON} = 250 \frac{\text{Btu}}{\text{h}}$
 $Q_{\text{LATENT}} \text{ PER PERS} = 200 \frac{\text{Btu}}{\text{h}}$

COMPUTERS & OFFICE EQUIPMENT:

FOR 12 PM

$$Q_6 = \underbrace{30' \times 30'}_{\text{FLOOR AREA}} \times \rho_{\text{EQUIP PER UNIT OF FLOOR}} = 900 \text{ ft}^2 \times 1 \frac{\text{W}}{\text{ft}^2} = 900 \text{ W} = \dots \frac{\text{Btu}}{\text{h}}$$

LIGHTS:

$$Q_7 = 30' \times 30' \times \rho_{\text{LIGHT PER UNIT OF FLOOR}} = 900 \text{ ft}^2 \times 1.5 \frac{\text{W}}{\text{ft}^2} = 1350 \text{ W} = \dots \frac{\text{Btu}}{\text{h}}$$

$$Q_{\text{INTERNAL}}^{\text{SENSIBLE}} = Q_5 + Q_6 + Q_7 = \dots \frac{\text{Btu}}{\text{h}}$$

INFILTRATION AND VENTILATION

INF.: $ACH^{\text{INFILT}} = 0.5 \frac{1}{\text{HOUR}}$ $\dot{V}_{\text{INFILT}} = \dot{V}_{\text{BUILD}} \cdot ACH = 30' \times 30' \times 12' \times 0.5 \frac{1}{\text{HOUR}} = 5400 \frac{\text{ft}^3}{\text{HOUR}} = 90 \frac{\text{ft}^3}{\text{min}}$

$$\dot{m}^{\text{INF}} = \dot{V}_{\text{INF}} \rho_{\text{AIR}} = 90 \frac{\text{ft}^3}{\text{min}} \cdot 0.0745 \frac{\text{lb}}{\text{ft}^3} = 6.7 \frac{\text{lb}}{\text{min}} = 402 \frac{\text{lb}}{\text{HOUR}}$$

VENT.: FROM ASHRAE STANDARD 62 $\dot{V}_{\text{PER PERSON}} = 20 \frac{\text{ft}^3}{\text{MIN PERSON}}$

$$\dot{V}_{\text{VENT}} = n \cdot \dot{V}_{\text{PER PERSON}} = 10 \cdot 20 = 200 \frac{\text{ft}^3}{\text{min}}$$

$$\dot{m}^{\text{VENT}} = \dot{V}_{\text{VENT}} \rho_{\text{AIR}} = 200 \frac{\text{ft}^3}{\text{min}} \cdot 0.0745 = 894 \frac{\text{lb}}{\text{HOUR}}$$

$$Q_{\text{INFILT}}^{\text{SENS}} = \dot{m}^{\text{INF}} \cdot c_{p, \text{AIR}} \cdot (T_{\text{OUT}} - T_{\text{IN}}) = 402 \frac{\text{lb}}{\text{h}} \cdot 1 \frac{\text{Btu}}{\text{lb} \cdot \text{F}} \cdot (89 - 75) = \dots \frac{\text{Btu}}{\text{h}}$$

$$Q_{\text{VENTIL.}}^{\text{SENS}} = \dot{m}^{\text{INF}} \cdot c_{p, \text{AIR}} \cdot (T_{\text{OUT}} - T_{\text{IN}}) = 894 \frac{\text{lb}}{\text{h}} \cdot 1 \frac{\text{Btu}}{\text{lb} \cdot \text{F}} \cdot (89 - 75) \text{ F} = \dots \frac{\text{Btu}}{\text{h}}$$

$$Q_{\text{INFILTRATION + VENTILATION}}^{\text{SENSIBLE}} = Q_{\text{VENT}}^{\text{SENS}} + Q_{\text{INF}}^{\text{SENS}} = \dots \frac{\text{Btu}}{\text{h}}$$

TOTAL SENSIBLE:

$$Q^{\text{SENSIBLE}} = Q_{\text{EXTERNAL}}^{\text{SENS}} + Q_{\text{INTERNAL}}^{\text{SENSIBLE}}$$

LATENT COOLING LOAD:

(3)

OCCUPANTS:

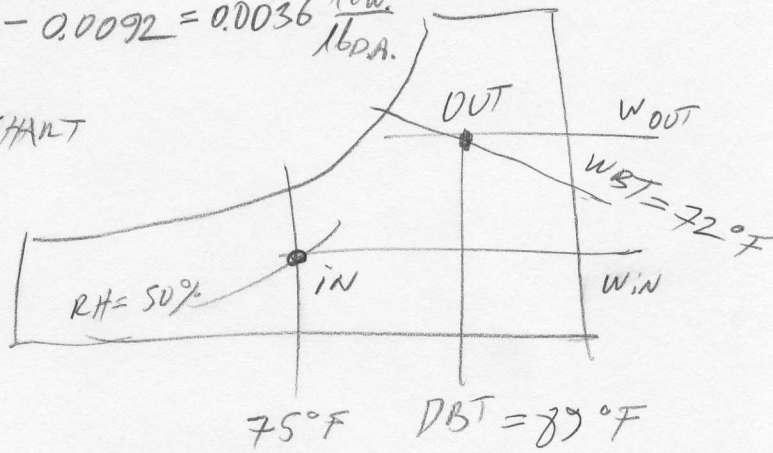
$$Q_{\text{LATENT PER PERSON}} = 200 \frac{\text{Btu}}{\text{h PER PERSON}}$$

$$Q_{\text{OCCUPANTS}}^{\text{LATENT}} = m \cdot Q_{\text{LAT PER PERSON}} = 10 \cdot 200 = 2000 \frac{\text{Btu}}{\text{h}}$$

INFILTRATION:

$$\Delta W = W_{\text{OUT}} - W_{\text{IN}} = 0.0128 - 0.0092 = 0.0036 \frac{\text{lb}_w}{\text{lb}_{\text{D.A.}}}$$

FROM PSYCHROM. CHART



$$Q_{\text{INFILT}}^{\text{LATENT}} = m_{\text{INF}} \cdot \Delta W \cdot h_{fg} = 402 \frac{\text{lb}_{\text{D.A.}}}{\text{h}} \cdot 0.0036 \frac{\text{lb}_w}{\text{lb}_{\text{D.A.}}} \cdot 1000 \frac{\text{Btu}}{\text{h lb}_w} = \dots \frac{\text{Btu}}{\text{h}}$$

$$Q_{\text{VENTIL}}^{\text{LATENT}} = m_{\text{VENT}} \cdot \Delta W \cdot h_{fg} = 894 \frac{\text{lb}_{\text{D.A.}}}{\text{h}} \cdot 0.0036 \frac{\text{lb}_w}{\text{lb}_{\text{D.A.}}} \cdot 1000 \frac{\text{Btu}}{\text{h lb}_w} = \dots \frac{\text{Btu}}{\text{h}}$$

TOTAL LATENT:

$$Q_{\text{LATENT}} = Q_{\text{INFILT}}^{\text{LAT.}} + Q_{\text{VENT}}^{\text{LAT}} + Q_{\text{OCCUP}}^{\text{LATENT}} = \dots \frac{\text{Btu}}{\text{h}}$$

TOTAL COOLING LOAD

$$Q_{\text{TOTAL}} = Q_{\text{LAT}} + Q_{\text{SENS}} = \dots \frac{\text{Btu}}{\text{h}}$$