Problem set 6 (PS6) Due Monday February 27

PS6-1 Calculate the heat gain through one square foot of the wall structure specified in the Chicago Design Project Building for an outside temperature of 100 F and an inside temperature of 72 F. Assume still ambient air.

PS6-2 Calculate the heat gain through one square foot of the ceiling structure specified in the Chicago Design Project Building for an outside temperature of 100 F and an inside temperature of 72 F. Assume still ambient air.

PS6-3 Calculate the heat gain through one of the office windows specified in the Chicago Design Project Building for an outside temperature of 100 F and an inside temperature of 72 F. Assume still ambient air.

PS6-4 Calculate the heat loss through the slab specified in the Chicago Design Project Building for an outside temperature of -6 F and inside temperature of 72 F.

PS6-1

WALL	t	k	R	
outside			.68	Figure 5 - 2a
4 in face brick	4.	6.	.667	
1in air gap			.91	
8 in concrete block	8.	.96	8.333	
1 in air gap			.91	
vapor barrier	.009	2.4	0.	
4 in insulation	4.	.3	13.333	
gypsum	.75	1.08	.685	
inside			.68	Figure 5 - 2a
∑ Resistance			26.198	

$$U(\text{and}C_w) = \frac{1}{\sum \text{Resistance}} \qquad .0382$$

$$Q = U \times A \times (T_O - T_i) = .0382 \times (100 - 72) = 1.07 \text{ Btu/hr}$$

PS6-2

ROOF	t	k	R
outside			.61
.5 in stone chips	.5	9.96	.05
.4 in membrane	.4	.3	1.333
5 in insulation	5.	.3	16.667
2 in concrete	2.	12.	.167
.08 in steel pan	.08	312.	.0
inside			.61
∑ Ressistance			20.057

$$C_{roof} = \frac{1}{\sum \text{Resistance}} \qquad .050$$

CEILING	t	k	R
outside			.92
.75 acoustical tiler	.75	.48	1.563
inside			.92
∑ Ressistance			3.403

$$C_{ceiling} = \frac{1}{\sum \text{Resistance}} \qquad .294$$

$$A_{wall} = (2\times 235 + 2\times 114)\times 2 = 1396.$$

$$A_{roof} = 235\times 114 = 26{,}790$$

$$R' = \frac{1}{\frac{A_{wall}}{R_{wall}} + \frac{A_{roof}}{R_{roof}}} + \frac{1}{\frac{A_{ceiling}}{R_{wall}}} = \frac{1}{\frac{1396}{26.212} + \frac{26790}{20.57}} + \frac{1}{\frac{26790}{3.403}} = .000854$$

$$U = \frac{1}{R'\times R_{ceiling}} = \frac{1}{.000854\times 26.790.} = .04371$$

$$Q = U\times A\times (T_o - T_i) = .04371\times (100-72) = 1.224\text{Btu/hr}$$

PS6-3

WINDOW

5 ft x 7 ft Double pane .25 in. glass with .25 in argon between

Aluminum frame with thermal breaks

Table 5 - 5a,

U = .62

$$Q = U \times A \times (T_O - T_i) = .62 \times 5 \times 7 \times (100 - 72) = 607.6 \text{ Btu/hr}$$

PS6-4

SLAB

$$\text{Building Perimeter} = 2 \times 265 + 2 \times 114 = 818$$

$$\text{Insulation Conductance} = \frac{k}{\Delta x} = \frac{.26}{4} = .065$$

$$U_{\text{perimeter}} = .6 \text{ Btu/ft F}$$

$$Q = U_{\text{perimeter}} \times Perimeter \times (T_O - T_i)$$

$$Q = .6 \times 818 \times (-6 - 72) = -38{,}282 \text{ Btu/hr}$$