Week3_sconde

1)

Given:

$$A_t = A_1 * A_2 = 3m * 5m = 15m^2$$
$$k = 0.72 \, W/m\,°C$$

$k_p = 0.22 \, W/m\,°C$
$k_f = 0.026 \, W/m\,°C$

$$T_{delta} = T_1 - T_2 = 20°C - (-10°C) = 30°C$$
$$h_1 = 10 \, W/m^2$$

$h_2 = 40 \, W/m^2$

Assuming one dimensional heat transfer and disregarding radiation, determine the rate of heat transfer through the wall.

$$R_{conv1} = \frac{1}{h_1 * A_1 - dimension} = \frac{1}{10\frac{W}{m^2} * (0.015 + 0.22 + 0.015)m * 1m} = 0.4\frac{W}{°C}$$

*Foam

$$R_f = \frac{L_{foam}}{k_{foam} * A_1 - dimension} = \frac{0.03m}{0.026\frac{W}{m^2} * (0.015 + 0.22 + 0.015)m * 1m} = 4.615\frac{W}{°C}$$

*Plaster

$$R_{p^{up}} = R_{p^{down}} = \frac{L_p^{\,up} \, or^{\,down}}{k_p * A_p^{up} \, or^{\,down}(1 - dimension)} = \frac{0.32m}{0.22\frac{W}{m\,°C} * 0.015m * 1m} = 96.97\frac{W}{°C}$$

$$R_{p_{left}} = R_{p_{right}} = \frac{L_p^{\,left} \, or^{\,right}}{k_p * A_p^{left} \, or^{\,right}(1 - dimension)} = \frac{0.02m}{0.22\frac{W}{m\,°C} * (0.015m + 0.22m_{0.015m}) * 1m}$$
$$= 0.363\frac{W}{°C}$$

*Brick

$$R_B = \frac{L_b}{k_b * A_b(1 - dimension)} = \frac{0.32m}{0.72\frac{W}{m\,°C} * 0.22m * 1m} = 2.02\frac{W}{°C}$$

$$\frac{1}{R_{total-parallel}} = \frac{1}{R_{p_{up}}} + \frac{1}{R_{p_{down}}} = \frac{1}{96.97\frac{W}{°C}} + \frac{1}{2.02\frac{W}{°C}} + \frac{1}{96.97\frac{W}{°C}} = 0.516\frac{W}{°C}$$

$$R_{total-parallel} = \frac{1}{0.516\frac{W}{°C}} = 1.94\frac{W}{°C}$$

$$R_{conv2} = \frac{1}{h_2 * A_1 - dimension} = \frac{1}{40\frac{W}{m^2} * (0.015 + 0.22 + 0.015)m * 1m} = 0.1\frac{W}{°C}$$

$$Rw_T(1 - dimen) = R_{conv1} + R_{conv2} + Rf + R_p^{left} + R_p^{right} + R_{total}$$

$$Rw_T(1 - dimen) = 0.4\frac{W}{°C} + 0.1\frac{W}{°C} + 4.615\frac{W}{°C} + 0.363\frac{W}{°C} + 0.363\frac{W}{°C} + 1.94\frac{W}{°C} = 7.781\frac{W}{°C}$$

*Heat transfer rate:

$$.Q = \frac{T_{delta}}{R_{wall_{total}}} = \frac{30°C}{7.781\frac{W}{°C}} = 3.86W$$

2) *The two R_{unit} values*:

Answer:

	Wood	Insulation
Outside Air	0.03	0.03
Wood Bevel(13mm*200mm)	0.14	0.14
Polywood(13mm)	0.11	0.11
Urethane Rigif Foam Ins.(90mm)	No	0.98*90/25=3.528
Wood Studs(90mm)	0.63	No
Gypsum Board(13mm)	0.079	0.079
Inside Surface	0.12	0.12

$$R_{wood} = (0.11 + 0.63 + 0.14 + 0.12 + 0.03)m^2\frac{W}{°C} = 1.109\ m^2\frac{W}{°C}$$

$$R_{insulation} = (0.11 + 0.079 + 0.14 + 3.528 + 0.12 + 0.03) = 4.007\ m^2\frac{W}{°C}$$