Week3_suluderya

In this week's assignment you should first definilize the composite wall question by finding the heat transfer rate, and then solve the same question while the thickness of the brick is increased to 32 cm and comment on the results.

A 3 m high and 5 m wide wall consists of long 32 cm 22 cm cross section horizontal bricks (k =0.72 W/m · °C) separated by 3 cm thick plaster layers (k =0.22 W/m · °C). There are also 2 cm thick plaster layers on each side of the brick and a 3-cm-thick rigid foam (k 0.026 W/m · °C) on the inner side of the wall The indoor and the outdoor temperatures are 20°C and -10°C, and the convection heat transfer coefficients on the inner and the outer sides are h1=10 W/m2 · °C and h2 =40 W/m2 · °C, respectively.Assuming one-dimensional heat transfer and disregarding radiation, determine the rate of heat transfer through the wall.

$$R_i = 1/\ 10\ *\ 0.25$$
$$= 0.4\ °C\ /w$$

$$R_f = 0.03\ /\ 0.026\ \ 0.25$$
$$= 4.615\ °C\ /w$$

$$R_{p_{c_1}} = R_{p_{c_2}} = \frac{L_{p_{c_1}}}{k_p \times A_{p_{c_1}}} = \frac{0.32}{0.22 * 0.015} = 96.97\ °C/W$$

$$R_b = \frac{L_b}{k_b \times A_b} = \frac{0.32}{0.72 * 0.22} = 2.02\ °C/W$$

$$\frac{1}{R_{tot_{parallel}}} = \frac{1}{R_b} + \frac{1}{R_{p_{c_1}}} + \frac{1}{R_{p_{c_2}}} = \frac{1}{2.02} + 2\ * \left(\frac{1}{96{,}97}\right)$$
$$= 0{,}516\ °\frac{C}{W}$$

$$\rightarrow \frac{1}{R_{tot_{parallel}}} = 0{,}516\ W/°C \dashrightarrow R_{tot_{parallel}} = \frac{1}{0{,}516}$$
$$= \ 0.97°C/W$$

$$R_{P_1} = R_{P_2} = \frac{L_{p_1}}{k_p \times A_{p_1}} = \frac{0.02}{(0.22 * 0.25)} = 0.363\ °C/W$$

$$R_{\downarrow o} = \frac{1}{h_0 \times A} = \frac{1}{40 * 0.25} = 0.1\ °C/W$$

$$R_{total} = R_i + R_o + 2 * R_{P_1} + R_{tot_{parallel}} + R_{foam}$$

Heat transfer rate is;

$$R_{total} = 7.781 \circ \frac{C}{W}$$

$\dot{Q} = \frac{\Delta T}{Rtot}$ = 20°C–(−10°C) / 7.781 $\circ \frac{C}{W}$

$$\dot{Q} = 3.855\ W$$

Previous question calculation was (within the 16cm brick wall) ;

$$R_{total} = 6{,}81 \circ \frac{C}{W}$$

$\dot{Q} = \frac{\Delta T}{Rtot}$ = 20°C–(−10°C) / 6,81 $\circ \frac{C}{W}$

$$\dot{Q} = 4{,}405\ W$$

The finding that we reach according to the comparison of 32cm and 16cm brick wall ; increasing the wall thickness to two times did not change much. Doubling of brick wall does not double thermal resistance at all.

A wooden frame wall that is built around 38mm 90mm with the center to center ratio is 400mm. The 90mm wide cavity between the wooden studs is filled with urethane rigif foam insulation. The inside is finished with 13-mm gypsum wallboard and the outside with 13 mm polywood and 13-mm 200-mm wood bevel lapped siding. The insulated cavity stitutes 75 percent of the heat transmission area while the studs, plates, and sills constitute 21 percent. The headers constitute 4 percent of the area, and they can be treated as studs.

The two Runit values :

	Wood Section	Insulation Section	
Outside Air	0.03	0.03	
Wood Bevel (13mm*200mm)	0.14	0.14	
Plywood (13mm)	0.11	0.11	
Urethane Rigid Foam Insulation (90mm)	X	(90*0.98) / 25 = 3.528	
Wood Studs (90mm)	0.63	X	
Gypsum Board (13mm) Inside surface	0.079	0.079	
Inside surface	0.12	0.12	

$R_{with\ wood} = (0.03 + 0.14 + 0.11 + 0.63 + 0.079 + 0.12)m^2$

$= 1.109m^2°C/w$

$R_{within} = (0.03 + 0.14 + 0.11 + 3.528 + 0.079 + 0.12)$

$= 4.007m^2°C/w$