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10:48 PM

Date: 20/10/2019
Task: Week 3

1- Finalize the composite wall question by finding the heat transfer rate Q dot:

Indoor Temperature= 20 °C
Outdoor Temperature= -10 °C

R total = 6.8164 °C/W
ΔT = 20-(-10)=30 °C

$\dot{Q}$ = (T indoor - T outdoor)/R total= 30/6.8134 = 4.4031 W

2- 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
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
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
outer sides are h1=10 W/m2 · °C and h2 =25 W/m2 · °C,
respectively. Assuming one-dimensional heat transfer and
disregarding radiation, determine the rate of heat transfer
through the wall.
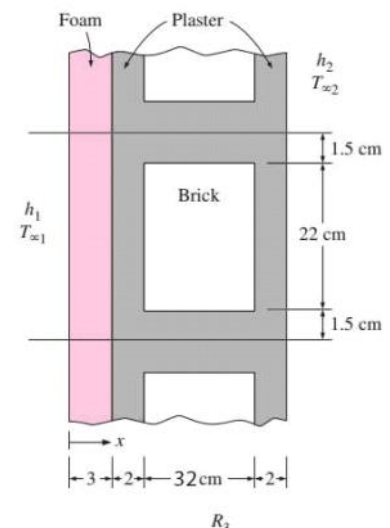
R conv 1 = 1/h1.A = 1/(10*0.25)=0.4 °$\frac{C}{W}$
R conv 2 = 1/h2.A = 1/(40*0.25)=0.1 °C/W

R conduction in series

R cond. Foam = L/(Kf.A) = 0.03/(0.026*0.25)=4.6154 °C/W

R_plaster 1 = R_plaster 2 = L/(K.A) = 0.02/(0.22*0.25)=0.3636 $°C/W$

R conduction in parallel

R pc1= R pc2= L/(K.A) = 0.32/(0.22*0.015) = 96.9697 $°C/W$

R brick= L/K.A= 0.32/(0.72*0.22)=2.0202 $°C/W$

1/R total = 1/ R pc1 + 1/R brick + 1/R pc2= 1/96.9697 + 1/2.0202 + 1/96.9697=0.5156
R total = 1/0.5156=1.9395 $°C/W$

R total = R conv. 1+ R cond. foam + R pc1 + R pc2 + R total parall. + R conv. 2 =
= 0.4+4.6154+0.3636+1.9395+0.3636+0.1=7.7821 $°C/W$

Heat Transfer $\dot{Q}$ = (Tind - Tout)/ R tot = (20-(-10))/7.7821=3.855 W

Comparing :

$\dot{Q}$ (16 cm brick)= 4.4031 W
$\dot{Q}$ (32 cm brick)= 3.8550 W

Thermal resistance of the brick has approximately doubled by doubling the thickness of the brick
Also, the heat transfer rate Q dot for the new brisk thickness of 32 cm has decreased as well from
4.4031 W to 3.8550 W. However, the decrease is not enough compared to the cost that was probably
paid. The investment should me in the foam insulation layer, by making it thicker for example.

3- **Solve again the simplified wall calculation procedure replacing the glass fiber one with urethane rigid foam and while replacing the fiberboard with plywood and find the two R values.**

	Wood (A	Insulation (B
Outside	0.03	0.03
Wood bevel	0.14	0.14
Plywood	0.11	0.11
Urethane rigid	no	0.98*(90/25)=3.528
Wood Studs	0.63	no
Gypsum board	0.079	0.079
Inside Surface	0.12	0.12

R with wood (section A)= 0.03+0.14+0.11+0.63+0.079+0.12=1.109 (m2.$°C$)/W

R with insulation (section B)= 0.03+0.14+0.11+3.528+0.079+0.12=4.007 (m2.$°C$)/W