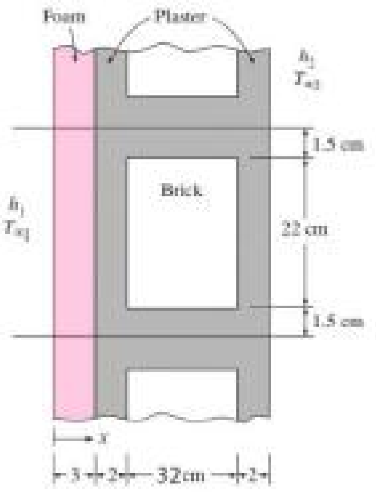
1.Finalize the composite wall question by finding the heat transfer rate

R total = 6.8164 ℃/W

Q= $\Delta T/$ 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 =40 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 ℃/W

R foam = L/(K.A) = 0.03/(0.026*0.25)=4.6154 ℃/W

R plaster1 = R plaster2 = L/(K.A) = 0.02/(0.22*0.25)=0.3636 ℃/W

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

R plaster3 = R plaster3 = L/(K.A) = 0.32/(0.22*0.015) = 96.9697 ℃/W

1/R p&b= 1/ R plaster3 + 1/R brick + 1/R plaster3= 1/96.9697 + 1/2.0202 + 1/96.9697=0.5156

R p&b=1.9395 ℃/W

R conv 2 = 1/h2.A = 1/(40*0.25)=0.1

R total= R conv 1 +R foam+ R plaster1+ R plaster2+ R brick+ R p&b+ R conv 2

= 0.4+4.6154+0.3636+1.9395+0.3636+0.1=7.7821 ℃/W

Q=(T1 – T2)/ R total = (20-(-10))/7.7821=3.855 W

Conclusion:

Only add the thickness of a brick inside a composite wall doesn't significantly increase the thermal resistance of the whole wall. 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.

Determine the overall unit thermal resistance(the R-value) and the overall heat transfer coefficient(the U-factor) of a wall frame wall that is built around 38-mm 90-mm wood studs with a center-to-center distance of 400mm. The 90-mm-wide cavity between the studs is filled with urethane rigif foam. The inside is filled with 13-mm gypsum wallboard and outside with 13-mm plywood and 13-mm 200-mm wood bevel lapped siding. The insulated cavity constitutes 75% heat transmission area while the studs, plates, and sills constitutes 21%. The headers constitutes 4% of the area, and they can be treated as studs.

	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 wood (section A)= 0.03+0.14+0.11+0.63+0.079+0.12=1.109 (m2. ℃)/W
R insulation (section B)= 0.03+0.14+0.11+3.528+0.079+0.12=4.007 (m2. ℃)/W