#Week 3 In this week's assignment you should first finalize 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.

Heat loss through a composite wall

A 3 m. high and 5 m. wide wall consists of long 32 m. 22 m. cross section horizontal bricks (k=0.72 W/m °C) separated by 3cm 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 3cm 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 side 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 through the wall.

R total= 6.81 °C/W

$$\dot{Q} = \frac{\Delta T}{R_{Wall}} = \frac{20 - (-10)}{6.81° \frac{C}{W}} = \mathbf{4.405\ W}$$

R conv1 = 1/ h1*A= 1/(10*0.25) = 0.4 °C/W

R foam= Lf/ Kf*A= 0.03/ (0.026*0.25) = 4.615°C/W

R plaster1= R plaster2 = Lp1/Kp * Ap1 = 0.02/ (0.22*0.25)= 0.363 °C/W

R plaster up = R plaster down = Lp1/Kp * Ap = 0.32/ (0.22*0.015) = 96.967 °C/W

R Brick= Lb/Kb * Ab = 0.32 / 0.1584 = 2.0202 °C/W

R conv2 = 1/ h* A = 1/(40*0.25) = 0.1 °C/W

R total= Rc1 + Rf + Rp1 + Rp2 + (1/R pu) +(1/R pd) + (1/Rb)+ Rc2

= 0.4 + 4.615 + 0.363 + 0.363 + (1/ 96.967) + (1/ 96.967) + (1/ 2.0202) + 0.1 = **6.3486 °C/W**

$$\dot{Q} = \frac{\Delta T}{R_{Wall}} = \frac{20 - (-10)}{6.3486° \frac{C}{W}} = \mathbf{4.72\ W}$$

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 unit values.

	wood	insulation
Outside Air	0.03	0.03
Wood bevel lapped siding 13mm x 200 mm	0.14	0.14
Plywood 13mm	0.11	0.11
Urethane rigid foam 90 mm	NO	0.98*90/25=3.528
Wood stud 90 mm	0.63	NO
Plaster gypsum board 13mm	0.79	0.079
Inside surface	0.12	0.12

R with wood= 0.03 + 0.14 +0.11 + 0.63 + 0.079 + 0.12 = 1.109 m2°C /w

R with insulation = 0.03 + 0.14 + 0.11 + 3.528 + 0.079 + 0.12= 4 m2°C/W