Week 3 Assignment

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Question 1

PART 1

$R_{wall.total}$= 6.81°C/W

Q_{dot} = 20-(-10)/6.81

= 4.41W

PART 2

3m high and 5m wide wall consists of long 32cm 22cm cross section horizontal bricks(k+0.72W/m°C) separated by 3cm thick plaster (k= 0.22 W/m °C)

2cm thk plaster layers on each side of the brick and 3cm thk rigid foam (k=0.026W/m °C) on the inner side of the wall. T_1 and T_2 are 20°C and -10°C respectively. And the convection heat transfer coefficients on the inner and outer sides are h_1 =10 W/m^2. °C and h_2 = 40W/m^2, respectively.

R_{1conv} = 1/h_1 x A_1 = 1/ 10 x (0.015+0.22+0.015) x 1

= 0.4 °C/W

R_{foam} = L_{foam}/ k_{foam} x A1 = 0.03/[0.026 x (0.015 + 0.22 + 0.015) x 1]

= 4.62 °C/W

$R_{plaster.up}$ = $R_{plaster.down}$ = $L_{p.up\ or\ dn}$/ k_p x $A_{p.up\ or\ p.dn}$

= 0.32/[0.22 x 0.015 x 1]

= 96.88°C/W

R_{brick} = L_{brick}/ k_{brick} x A_{brick}

= 0.32/[0.72 x 0.22 x 1]

= 2.02°C/W

1/ $R_{total(parallel)}$ = [1/$R_{plaster.up}$] + [1/R_{brick}] + [1/$R_{palster.down}$]

= [1/96.88] + [1/2.02] + [1/96.88]

= 0.516°C/W

$R_{total(parallel)}$ = 1.94°C/W

$R_{plaster.left}$ = $R_{plaster.right}$ = 0.02/[0.022 x (0.015+0.22+0.015) x 1]

= 0.363°C/W

$R_{2.conv.}$ = 1/ [40 x (0.015+0.22+0.015) x 1]

= 0.1°C/W

$R_{wall.total}$ = 0.4+4.62+0.363+1.94+0.363+0.1

= 7.79°C/W

Heat transfer

$Q_{dot} = T1 - T_{\infty} / R_{wall.total}$

= 20-(-10)/7.79

= 3.851W

By doubling the thickness of the brick in a composite wall does not change increase the thermal resistance of the whole wall, hence the rate if heat transfer does not significantly decrease.

Question 2

	Wood	Insulation
Outside Air	0.03	0.03
Wood Bevel (13mmx200mm)	0.14	0.14
Polywood(13mm)	0.11	0.11
Urethane Rigif Foam Ins.(90mm)	No	0.98x90/25 = 3.528
Wood studs (90mm)	0.63	No
Gypsum Board (13mm)	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)

= 1.109 m^2 °C/W

$R'_{with\ insulation}$ = (0.03+0.14+0.11+3.528+0.079+0.12)

= 4.007 m^2 °C/W