WEEKLY SUBMISSION - TASK 03

- POTHUGANTI CHAITHANYA - Personal Code : 10711998
- Politecnico di Milano - M.Arch Sustainable Architecture & Landscape Design

1) Finalize the composite wall question by finding the heat transfer rate, and then solve the same question by finding the heat transfer rate, and then solve the same question while the thickness of the brick is increased to 32cm and comment on the results?

Sol: Composite wall with 16cm thick brick

$R_{total} = 6.81 \frac{^\circ c}{w}$

$Q = \frac{\Delta T}{R total} = \frac{30}{6.81} = 4.373\ W$

Composite wall with 32cm thick brick

Wall :

Height = 3m

Width = 5m

Brick :

Length = 32cm

Width = 22cm

K = 0.72 W/m°C

Plaster:

Bricks separated by 3cm thick plaster

K = 0.22 W/m°C

Foam :

K = 0.026 W/m°C

Outside:

$h_1 = 10$

$T_{out} = -10°C$

Inside:

$h_2 = 25$

$T_{in} = 20°C$

$R_{1conv} = \frac{1}{h1 * A} = \frac{1}{10 * 0.25} = 0.4 \frac{^\circ c}{w}$

$R_{foam} = \frac{L f}{K f * A} = \frac{0.03}{0.026 * 0.25} = 4.615 \frac{^\circ c}{w}$

$R_{plaster1} = R_{plaster2} = \frac{L p1}{K p1 * A} = \frac{0.32}{0.22 * 0.015} = 96.97 \frac{^\circ c}{w}$

$$R_{brick} = \frac{L_b}{K_b * A} = \frac{0.32}{0.72 * 0.022} = 2.02 \ \frac{^\circ c}{w}$$

$$\frac{1}{R_{total}} = \frac{1}{R_{p1}} + \frac{1}{R_b} + \frac{1}{R_{p2}} = \frac{1}{96.97} + \frac{1}{2.02} + \frac{1}{96.97} = 0.516 \ \frac{w}{^\circ c}$$

$$R_{total\ parallel} = \frac{1}{0.516} = 1.94 \ \frac{^\circ c}{w}$$

$$R_{plaster\ in} = R_{plaster\ out} = \frac{L_p}{K_p * A} = \frac{0.02}{0.022 * 0.25} = 0.363 \ \frac{^\circ c}{w}$$

$$R_{2conv} = \frac{1}{h_2 * A} = \frac{1}{25 * 0.25} = 0.16 \ \frac{^\circ c}{w}$$

$$R_{wall\ total} = R_{1conv} + R_{foam} + R_{plaster\ out} + R_{total\ parallel} + R_{plaster\ in} + R_{2conv}$$

$$R_{wall\ total} = 0.4 \ \frac{^\circ c}{w} + 4.615 \ \frac{^\circ c}{w} + 0.363 \ \frac{^\circ c}{w} + 1.94 \ \frac{^\circ c}{w} + 0.363 \ \frac{^\circ c}{w} + 0.16 \ \frac{^\circ c}{w}$$

$$= 7.841 \ \frac{^\circ c}{w}$$

$$Q = \frac{\Delta T}{R_{total}} = \frac{30}{7.841} = 3.826 \ W$$

Rate of heat transfer for composite wall with 32mm thick brick is 3.826 W
Whereas the rate of heat transfer for composite wall with 16mm thick brick is 4.41 W
Therefore by increasing the thickness of brick does not have much impact either on the resistance or the overall heat transfer.

1) Solve again the simplified wall calculation procedure replacing the glass fibre one with urethane rigid foam and while replacing the fibre board with plywood and find the two R_unit values?

Soln: Wooden wall with wooden studs:

Dimensions : 38mm , 90 mm
Center to center distance = 400mm
Insulation:
Thickness: 90mm
Filled with urethane rigid foam insulation
Inside finish :
13mm thick gypsum
Outside finish :
13mm polywood
13mm 200mm wood bevel lapped siding

Runit values

	Wood	Insulation
Outside air	0.03	0.03
Wood bevel (13mm * 200mm)	0.14	0.14
Polywood (13mm)	0.11	0.11
Urethane rigid foam (90mm)	No	$\frac{0.98 * 90}{25}$ = 3.528
Wood studs (90mm)	0.63	No
Gypsum board (13mm)	0.079	0.079
Inside surface	0.12	0.12

$R_{\text{with wood}} = 0.03 + 0.14 + 0.11 + 0.63 + 0.079 + 0.12 = 1.109\ m^2 \frac{^\circ c}{w}$

$R_{\text{with insulation}} = 0.03 + 0.14 + 0.11 + 3.528 + 0.079 + 0.12 = 4.007\ m^2 \frac{^\circ c}{w}$