

WEEK 3 - ASSIGNMENT

1. Finding the heat transfer rate of the composite wall

1) Finding the total resistance of the wall:

$$R_T = R_{\text{conv1}} + R_{\text{foam}} + R_{\text{plaster1}} + R_{\text{total(plaster}^{\wedge}; \text{brick; plaster}_v)} + R_{\text{plaster2}} + R_{\text{conv2}}$$

$$R_T = 1/(10 \times 0.25) + 0.03/(0.026 \times 0.25) + 0.02/(0.22 \times 0.25) + 0.97 + 0.02/(0.22 \times 0.25) + 1/(40 \times 0.25)$$

$$R_T = 0.4 + 4.61 + 0.36 + 0.97 + 0.36 + 0.1 = 6.8 \text{ (C/W)}$$

2) Finding the rate of heat transfer through the wall:

$$Q = (T_{\text{inf1}} - T_{\text{inf2}})/6.8$$

$$Q = (20 - (-10))/6.8 = 30/6.8 = \mathbf{4.4117 \text{ (W)}}$$

Solving the same with the thickness of the brick = 32(cm) with comments on the results:

1) Finding the total resistance of the 3 parallel layers:

$$R_{\text{plaster}^{\wedge}} = R_{\text{plaster}_v} = L_{\text{plaster}^{\wedge}} / (k_{\text{plaster}^{\wedge}} \times A_{\text{plaster}^{\wedge}}) = 0.32 / (0.22 \times 0.015) = 96.96; 1/96.96 = 0.01 \text{ C/W}$$

$$R_{\text{brick}} = L_{\text{brick}} / (k_{\text{brick}} \times A_{\text{brick}}) = 0.32 / (0.72 \times 0.22) = 2.02 \text{ C/W}; 1/2.02 = 0.49 \text{ C/W}$$

$$R_{\text{total(3 layers in parallel)}} = 0.01 \times 2 + 0.49 = 0.51; 1/0.51 = 1.96 \text{ C/W}$$

2) Finding the total resistance of the wall:

$$R_{\text{total}} = R_{\text{conv1}} + R_{\text{foam}} + R_{\text{plaster1}} + R_{\text{total}} + R_{\text{plaster2}} + R_{\text{conv2}} \\ R_{\text{total}} = 0.4 + 4.61 + 0.36 + 1.96 + 0.36 + 0.1 = 7.79 \text{ C/W}$$

3) Finding the rate of heat transfer through the wall:

$$Q = (T_{\text{inf1}} - T_{\text{inf2}})/7.79$$

$$Q = (20 - (-10))/7.79 = 30/7.79 = \mathbf{3.851 \text{ W}}$$

4) Comments:

Comparing the result thickness of the brick=32cm, with the original brick=16cm, it is evident, that increasing the thickness of the brick only slightly increases the total resistance of the wall, and the rate of heat transfer drops insignificantly. The main phenomenon, that could change the rate more, is the thickness of the foam layer

3) Solving the simplified wall calculations procedure with a replacement of the glass fiber one > urethane rigid foam, fiberboard > plywood, and finding the two R_{unit} values:

	WOOD	INSULATION
Outside air	0.03	0.03
Wood bevel (13*200 (mm))	0.14	0.14
Plywood (13mm)	0.11	0.11
Urethane rigid foam (90mm)	-	3.528
Wood studs (90mm)	0.63	-
Gypsum (13mm)	0.079	0.079
Inside air	0.12	0.12
TOTAL R_{unit} values ($m^2 \cdot C$)/W:	1.109	4.007

