Week 3

Tuesday, October 22, 2019 10:25 AM

PILAPIL, Nina Camille D.
10695066

ITEM 1

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

$$R_i = \frac{1}{h_i A} = \frac{1}{(10)(0.25)} = 0.40\ °C/W$$

$$R_f = \frac{L_f}{k_f A} = \frac{0.03}{(0.026)(0.25)} = 4.62\ °C/W$$

$$R_{P1} = R_{P2} = \frac{L_P}{k_p A} = \frac{0.02}{(0.22)(0.25)} = 0.36\ °C/W$$

$$R_o = \frac{1}{h_o A} = \frac{1}{(40)(0.25)} = 0.10\ °C/W$$

$$\frac{1}{R_{parallel}} = \frac{1}{R_{PC1}} + \frac{1}{R_b} + \frac{1}{R_{PC2}}$$

$$R_{PC1} = R_{PC2} = \frac{L}{k_{PC} A} = \frac{0.16}{(0.22)(0.015)} = 48.48\ °C/W$$

$$R_b = \frac{L_b}{k_b A} = \frac{0.16}{(0.72)(0.22)} = 1.01\ °C/W$$

$$\frac{1}{R_{parallel}} = \frac{1}{48.48} + \frac{1}{1.01} + \frac{1}{48.48}$$

$$R_{parallel} = 0.97\ °C/W$$

$$R_{total} = R_i + R_f + R_{p1} + R_{parallel} + R_{p2} + R_o$$

$$R_{total} = 0.40 + 4.62 + 0.36 + 0.97 + 0.36 + 0.10$$

$$R_{total} = 6.81\ °C/W$$

$$\dot{Q} = \frac{T_{\infty 1} - T_{\infty 2}}{R_{total}} = \frac{20 - (-10)}{6.81} = 4.41\ W$$

Solve the same question with the thickness of the brick increased to 32cm and comment on the results.

$$R_b = \frac{0.32}{(0.72)(0.22)} = 2.02\ °C/W$$

$$R_{PC} = \frac{0.32}{(0.22)(0.015)} = 96.97\ °C/W$$

$$\frac{1}{R_{parallel}} = \frac{1}{96.97} + \frac{1}{2.02} + \frac{1}{96.97}$$

$$R_{parallel} = 1.94\ °C/W$$

$$R_{total} = R_i + R_f + R_{p1} + R_{parallel} + R_{p2} + R_o$$

$$R_{total} = 0.40 + 4.62 + 0.36 + 1.94 + 0.36 + 0.10$$

$$R_{total} = 7.78\ °C/W$$

$$\dot{Q} = \frac{T_{\infty 1} - T_{\infty 2}}{R_{total}} = \frac{20 - (-10)}{7.78} = 3.86\ W$$

Conclusion: Doubling the thickness of a brick inside a composite wall does not significantly affect the thermal resistance of a wall nor, in effect, the rate of heat transfer.

ITEM 2

A wood frame wall that is build around 38 x 90mm wood studs with a center-to-center distance of 400mm. The 90mm wide cavity between the studs is filled with urethane rigid foam insulation. The inside is finished with 13mm gypsum wall board and the outside with 13mm plywood and 13 x 200mm wood bevel lapped siding. The insulated cavity constitutes 75% of the heat transmission area while the studs, plates, and sills constitute 21%. The headers constitute 4% of the area and they can be treated as studs.

Find the two R_{unit} values.

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

$$R_{wood} = 0.03 + 0.14 + 0.11 + 0.63 + 0.079 + 0.12 = 1.11\ m^2\ °C/W$$

$$R_{insulation} = 0.03 + 0.14 + 0.11 + 3.528 + 0.079 + 0.12 = 4.01\ \ m^2\ °C/W$$