WEEK 3

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In this week's assignment you should first dfinlize 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
You should solve again the simplified wall calculation procedure replacing the glass fiber one with urethane rigif foam and while replacing the fiberboard with plywood and find the two R_unit values

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$$A_t = A_1 * A_2 = 3m * 5m = 15m^2 \; k = 0.72 \; W/m\,°C$$

$$k_p = 0.22 \; W/m\,°C$$
$$k_f = 0.026 \; W/m\,°C$$

$$T_{delta} = T_1 - T_2 = 20°C - (-10°C) = 30°C$$
$$h_1 = 10 \; W/m^2$$

$$h_2 = 40 \; W/m^2$$

Assuming one dimensional heat transfer and disregarding radiation, determine the rate of heat transfer through the wall.

$$R_{conv1} = \frac{1}{h_1 * A_1 - dimension} = \frac{1}{10\frac{W}{m^2} * (0.015 + 0.22 + 0.015)m * 1m} = 0.4\frac{W}{°C}$$

Foam

$$R_f = \frac{L_{foam}}{k_{foam} * A_1 - dimension} = \frac{0.03m}{0.026\frac{W}{m^2} * (0.015 + 0.22 + 0.015)m * 1m} = 4.615\frac{W}{°C}$$

Plaster

$$R_{p^{up}} = R_{p^{down}} = \frac{L_p{}^{up} or^{down}}{k_p * A_p^{up} or^{down}(1 - dimension)} = \frac{0.32m}{0.22\frac{W}{m\,°C} * 0.015m * 1m} = 96.97\frac{W}{°C}$$

$$R_{p_{left}} = R_{p_{right}} = \frac{L_p{}^{left} or^{right}}{k_p * A_p^{left} or^{right}(1 - dimension)} = \frac{0.02m}{0.22\frac{W}{m\,°C} * (0.015m + 0.22m_{0.015m}) * 1m} = 0.363\frac{W}{°C}$$

Brick

$$R_B = \frac{L_b}{k_b * A_b(1 - dimension)} = \frac{0.32m}{0.72\frac{W}{m\,°C} * 0.22m * 1m} = 2.02\,\frac{W}{°C}$$

$$\frac{1}{R_{total-parallel}} = \frac{1}{R_{p_{up}}} + \frac{1}{R_{p_{down}}} = \frac{1}{96.97\frac{W}{°C}} + \frac{1}{2.02\,\frac{W}{°C}} + \frac{1}{96.97\frac{W}{°C}} = 0.516\frac{W}{°C}$$

$$R_{total-parallel} = \frac{1}{0.516\frac{W}{°C}} = 1.94\frac{W}{°C}$$

$$R_{conv2} = \frac{1}{h_2 * A_1 - dimension} = \frac{1}{40\,\frac{W}{m^2} * (0.015 + 0.22 + 0.015)m * 1m} = 0.1\frac{W}{°C}$$

$$Rw_T(1 - dimen) = R_{conv1} + R_{conv2} + Rf + R_p{}^{left} + R_p^{right} + R_{total}$$

$$Rw_T(1 - dimen) = 0.4\,\frac{W}{°C} + 0.1\frac{W}{°C} + 4.615\frac{W}{°C} + 0.363\frac{W}{°C} + 0.363\frac{W}{°C} + 1.94\frac{W}{°C} = 7.781\frac{W}{°C}$$

Heat transfer rate:

$$. Q = \frac{T_{delta}}{R_{wall_{total}}} = \frac{30°C}{7.781\frac{W}{°C}} = 3.86W$$

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The two R_{unit} values:

	Wood	Insulation
Outside Air	0.03	0.03
Wood Bevel(13mm*200mm)	0.14	0.14
Polywood(13mm)	0.11	0.11
Urethane Rigif Foam Ins.(90mm)	No	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

$$R_{wood} = (0.11 + 0.63 + 0.14 + 0.12 + 0.03)m^2\ \frac{W}{°C} = 1.109\,m^2\frac{W}{°C}$$

$$R_{insulation} = (0.11 + 0.079 + 0.14 + 3.528 + 0.12 + 0.03) = 4.007\,m^2\ \frac{W}{°C}$$