

WEEK 4 SUBMISSION

QUESTION 1:

Determine the overall unit thermal resistance (the R-value) and the overall heat transfer coefficient (the U-factor) of a wood frame wall that is built around 38-mm 90-mm wood studs with a center-to-center distance of 400 mm. The 90-mm-wide cavity between the studs is filled with glass fiber insulation. The inside is finished with 13-mm gypsum wallboard and the outside with 13-mm wood fiber board and 13-mm 200-mm wood bevel lapped siding. The insulated cavity constitutes 75 percent of the heat transmission area while the studs, plates, and sills constitute 21 percent. The headers constitute 4 percent of the area, and they can be treated as studs. Also, determine the rate of heat loss through the walls of a house whose perimeter is 50 m and wall height is 2.5 m in Las Vegas, Nevada, whose winter design temperature is -2°C. Take the indoor design temperature to be 22°C and assume 20 percent of the wall area is occupied by glazing.

ANSWER 1:

According to the table we could know:

Outside Air	0.03
Wood Bevel(13mm*200mm)	0.14
Plywood(13mm)	0.11
Urethane Rigid Foam Ins.(90mm)	$0.98 \times 90 / 25 = 3.528$
Wood Stud(90mm)	0.63
Gypsum Board(13mm)	0.079
Inside Surface	0.12

$$R_{\text{wood}} = 0.03 + 0.14 + 0.11 + 0.63 + 0.079 + 0.12 = 1.109 \text{ m}^2\text{C/W}$$

$$R_{\text{insulation}} = 0.03 + 0.14 + 0.11 + 3.528 + 0.079 + 0.12 = 4.007 \text{ m}^2\text{C/W}$$

$$U_{\text{wood}} = 1 / R_{\text{wood}} = 1 / 1.109 = 0.902 \text{ W/m}^2\text{C}$$

$$U_{\text{insulation}} = 1 / R_{\text{insulation}} = 1 / 4.007 = 0.25 \text{ W/m}^2\text{C}$$

$$U_{\text{total}} = (U \times \text{farea})_{\text{wood}} + (U \times \text{farea})_{\text{insulation}} = 0.902 \times 0.25 + 0.25 \times 0.75 = 0.413 \text{ W/m}^2\text{C}$$

$$\Delta T = 22 - (-2) = 24^\circ\text{C}$$

$$Q = U_{\text{total}} A_s \Delta T = 0.413 \times 125 \times 0.8 \times 24 = 991.2 \text{ W}$$

QUESTION 2:

Write a summary of what you have learnt in this session about radiation and radiative heat transfer

ANSWER 2:

Heat transfer is a complex phenomenon that is often divided into three basic ways, namely heat conduction, heat convection and heat radiation. The radiation is one of them. An object radiates electromagnetic waves is because of it has temperature, the higher temperature the larger heat it radiates. It has 3 main characters:

1. Radiant energy can be freely propagated through vacuum without any intermediate medium;
2. All objects with a temperature higher than 0K can continuously emit radiant energy, and can also continuously absorb radiant energy from other objects;
3. Thermal radiation not only has the transfer of energy, but also has the conversion of energy form. It is converted from thermal energy to radiant energy when it is emitted, and converted from radiant energy to heat when it is absorbed.