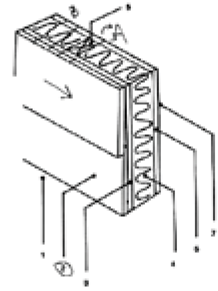
Determine the overall unit thermal resistance (the R-value) and the overall heat transfer coefficient (the U-factor) of a wood frame wall that is built around 38-mm 90-mm wood studs with a center-to-center distance of 400 mm. The 90-mm-wide cavity between the studs is filled with **urethane rigif foam**. The inside is finished with 13-mm gypsum wallboard and the outside with 13 mm **plywood** 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 (this means 75% of area is insulation and 25% can be considered wood)

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:

	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)	/	3.528
Wood Studs(90mm)	0.63	No
Gypsum Borad(13mm)	0.079	0.079
Inside Surface	0.12	0.12

$$\Delta T = 22 - (-2) = 24$$

$$R'_{\text{withwood}} = 0.03 + 0.14 + 0.11 + 0.63 + 0.079 + 0.12 = 1.109 m^{2\circ} C / W$$

$$R'_{\text{withins}} = 0.03 + 0.14 + 0.11 + 3.528 + 0.079 + 0.12 = 4.007 m^{2\circ} C / W$$

$$\frac{1}{R_{\text{total}}} = \frac{1}{R_{wood}} + \frac{1}{R_{ins}}$$

$$R' = R * A$$

$$R = \frac{R'}{A}$$

$$\frac{1}{\frac{R'_{total}}{A_{total}}} = \frac{1}{\frac{R'_{wood}}{A_{wood}}} = \frac{1}{\frac{R'_{ins}}{A_{ins}}}$$

$$\frac{A_{\text{total}}}{R'_{total}} = \frac{A_{wood}}{R'_{wood}} + \frac{A_{ins}}{R'_{ins}}$$

From the presentation

$$U = \frac{1}{R'}$$

$$U_{\text{total}} * A_{\text{total}} = U_{\text{wood}} * A_{wood} + U_{ins} * A_{ins}$$

Divide everything by A_{total}

$$\therefore U_{total} = \frac{A_{withwood}}{A_{total}} \cdot U_{withwood} + \frac{A_{withinsulation}}{A_{total}} \cdot U_{withinsulation}$$

$$\therefore U_{total} = 25\% \cdot U_{withwood} + 75\% \cdot U_{withinsulation}$$

$$= 25\% \cdot \frac{1}{R'_{withwood}} + 75\% \cdot \frac{1}{R'_{withinsulation}} = 25\% \cdot \frac{1}{1.109 \frac{m^2\,℃}{W}} + 75\% \cdot \frac{1}{4.007 \frac{m^2\,℃}{W}}$$

$$= 0.4126 \frac{W}{m^2\,℃}$$

$$\text{R} - \text{value} = \frac{1}{U_{total}} = \frac{1}{0.4126 \frac{W}{m^2\,℃}} = 2.4237 \frac{m^2\,℃}{W}$$

From the definition of U

$$\dot{Q}_{total} = U_{total} \cdot A_{total} \cdot \Delta T = 0.4126 \frac{W}{m^2\,℃} \cdot 50m \cdot 2.5m \cdot 80\% \cdot [22\,℃ - (-2\,℃)]$$

$$= 990.24W$$

summary

This lesson introduces radiation. Radiation is the phenomenon of a hot wire radiating energy from the outer surface of an object. The characteristic of radiation is that as long as the temperature of an object is above zero, its surface radiates continuously to its surroundings, while continuously absorbing radiant heat from other objects and absorbing radiant heat between the object and its surroundings.

Two things that involve heat exchange. No direct contact is required.Any object is the same. The ability to radiate outward. Radiation from the outside is absorbed and reflected, with projections like glass and plastic. However, most building materials are opaque to the wires. The radiant energy projected onto the opaque surface is partially absorbed and partially reflected back. At the same time, the greater the material's radiation capacity, the greater the external radiation absorption capacity. On the contrary, the smaller the radiation capacity, the smaller the absorption capacity. In color, white surfaces reflect light the most, and long-wave radiation is much less reflective than black surfaces. The main determinant of absorption and reflection.

The heat radiation characteristic of material is the color of material surface, the nature of material and the smoothness of material surface. But for shortwave radiation, the color of the material is the main factor.

Any object has the ability to radiate and absorb external radiation, so any two independent objects in space can exchange radiant heat with each other. If two bodies have different temperatures, hot bodies radiate outward. Excess heat is absorbed by the heat to get more heat, whereas cold objects do the opposite.

So it's an exchange of radiative heat between two objects. However, when two objects have the same temperature but are in equilibrium, there is still radiation transfer. This course also introduces you to blackbody. Any object has the properties of continuous radiation, absorption and reflection of electromagnetic waves. The electromagnetic wave of radiation is different in each wave band, that is, it has a certain spectral distribution. This spectral distribution is related to the nature and temperature of the object itself, so it is called thermal radiation. To study the laws of thermal radiation that do not depend on the physical properties of matter, physicists.

The ideal object, the black body, is defined as the standard object in the study of thermal radiation.
Black objects, ideal objects, as the standard of radiation properties compared with real surface, it can emit the maximum amount of radiation on one surface.

Given temperature; Absorbs all incoming radiation, regardless of wavelength or direction.In any case, completely absorb any wavelength of foreign radiation object. There is no reflection of anything with an absorption ratio of one.

In blackbody radiation, the color of light changes with temperature,there are shades of orange and blue and white. The color of the light is the same as the color of the light.

Surrounded by a black body at a certain temperature. The temperature of this black body.The higher the "black body" temperature of the light source,The more blue there is in the spectrum, the less red there is. For example, the color of incandescent lamp is warm white with a color temperature of 4700k.The temperature of fluorescent lamps is 6000 degrees.