WEEK 4_GAN HUI 10712558

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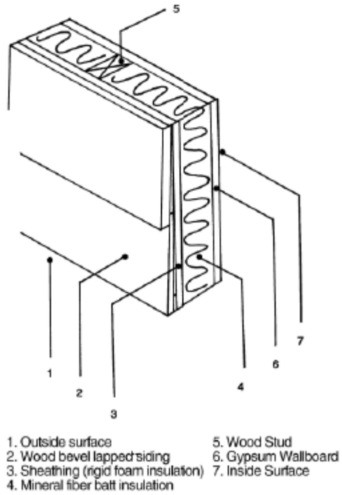
1.complete the modified example of simplified wall calculations that you went through in the assignment of week 3 and find the total heat transfer through wall.

QUESTION:

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 fiberboard 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

	Wood	Insulation
Outside air	0.03	0.03
Wood bevel lapped siding	0.14	0.14
Plywood,13mm	0.11	0.11
Urethane rigid foam	No	0.98*90/25=3.528
Wood studs	0.63	No
Gypsum board 13mm	0.079	0.079
Inside surface	0.12	0.12



$R_{withwood}$=0.03+0.14+0.11+No+0.63+0.079+0.12=1.109㎡ • ℃/W

$R_{withins}$=0.03+0.14+0.11+3.528+No+0.079+0.12=4.007㎡ • ℃/W

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

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

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

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

$$1/R' = U$$

$$U_{wood} = \frac{1}{R'_{wood}} = \frac{1}{1.109} = 0.9017$$

$$U_{ins} = \frac{1}{R'_{ins}} = \frac{1}{4.007} = 0.2495$$

$$U_{tot} \times A_{tot} = U_{wood} \times A_{wood} + U_{ins} \times A_{ins}$$

$$U_{tot} = U_{wood} \times \frac{A_{wood}}{A_{tot}} + U_{ins} \times \frac{A_{ins}}{A_{tot}} = 0.25 \times U_{wood} + 0.75 \times U_{ins} = 0.25 * 0.9017 + 0.75 * 0.2496 = 0.4126 \frac{W}{m^2 °C}$$

$$Q_{tot} = U_{tot} \times A_{tot} \times \Delta T = 0.4126 * 100 * 24 = 990.24\, W$$

2.summary of what you have learnt in this session about radiation and radiative heat transfer.

Radiation happens everywhere. We can see this phenomenon in our daily life. For example, people always feel warm when they around the fire, the fire, transferring heat to the surroundings, that is radiation. Radiation is different from conduction and convection. Radiation is the emission or transmission of energy in solids and liquids and gases, it does not depend on the material medium. Thermal radiation can also happen in vacuum.

Electromagnetic waves are formed when an electric field comes in contact with a magnetic field. Electromagnetic waves are characterized by their frequency v or wavelength λ. The formula about wavelength is λ=c/v. c, the speed of propagation of a wave in that medium.
(c = c_0/n,c_0=2.9979X10^8 m/s, the speed of light in a vacuum.
n, the index of refraction of that medium
n =1 for air and most gases, n = 1.5 for glass, and n = 1.33 for water)

Temperature has an effect on thermal radiation. The rate of thermal radiation emission increases with increasing temperature. Thermal radiation happens almost in all objects when the temperature above absolute zero.

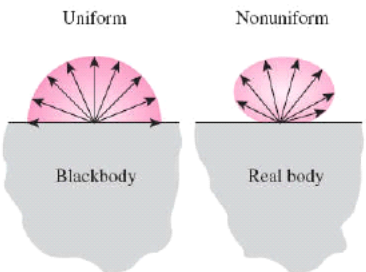
The light we can see in our daily life such as sunshine and artificial light is in the visible range. It is called light source. Different colors have different wavelength ranges and the radiation emitted by bodies at room temperature falls into the infrared region of the spectrum, which extends from 0.76 to 100 μm.

TABLE 12–1

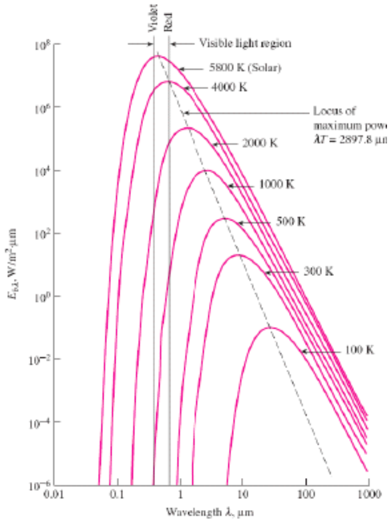
The wavelength ranges of different colors

Color	Wavelength band
Violet	0.40–0.44 μm
Blue	0.44–0.49 μm
Green	0.49–0.54 μm
Yellow	0.54–0.60 μm
Orange	0.60–0.67 μm
Red	0.63–0.76 μm

Black body is an idealized physical body. A blackbody emits the maximum amount of radiation by a surface at a given temperature. It can absorb all the incident radiation, regardless of wavelength and direction.



The black body radiation is related to temperature. The temperature increases with wavelength after reaching the peak it decreases with increasing wavelength. The surfaces at $T < 800$ K emit cannot be seen by human's eyes, they are not visible to the eye unless they reflect light coming from other sources.



The variation of the blackbody emissive power with wavelength for several temperatures.