

Week 4 Assignment

Question 1: Task 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.

Total heat transfer through wall

Section A (R-unit urethane)

Outside (Winter)	0.03
13-mm 200-mm wood bevel lapped siding	0.14
13-mm Polywood	0.11
38-mm 90-mm wood studs	NO
90 mm urethane rigid foam	$(90/25) \cdot 0.98 = 3.528$
13-mm gypsum wallboard	0.079
Inside	0.12

R-unit urethane = $\sum R_{\text{units}} = 4,007 \text{ m}^2 \cdot ^\circ\text{C} / \text{W}$

Section B (R-unit wood)

Outside (winter)	0.03
13-mm 200-mm wood bevel lapped siding	0.14
13-mm Polywood	0.11
38-mm 90-mm wood studs	0.63
90 mm urethane rigid foam	NO
13-mm gypsum wallboard	0.079
Inside	0.12

R-wood = $\sum R_{\text{units}} = 1,109 \text{ m}^2 \cdot ^\circ\text{C} / \text{W}$

$$\begin{cases} R' = R \times A \\ 1/R'_{\text{tot}} = 1/R'_{\text{urethane}} + 1/R'_{\text{wood}} \end{cases} \Rightarrow \frac{A_{\text{tot}}}{R'_{\text{tot}}} = \frac{A_{\text{wood}}}{R'_{\text{wood}}} + \frac{A_{\text{urethane}}}{R'_{\text{urethane}}}$$

$$\Rightarrow U_{\text{tot}} \times A_{\text{tot}} = U_{\text{wood}} \times A_{\text{wood}} + U_{\text{u}} \times A_{\text{urethane}}$$

$$\begin{cases} U_{\text{wood}} = \frac{1}{1,109} \\ U_{\text{urethane}} = \frac{1}{4,007} \end{cases} \Leftrightarrow \begin{cases} \frac{A_{\text{wood}}}{A_{\text{tot}}} = 0,25 \text{ (25\%)} \\ \frac{A_{\text{urethane}}}{A_{\text{tot}}} = 0,75 \text{ (75\%)} \end{cases} \Rightarrow U_{\text{TOT}} = \frac{0,25}{1,109} + \frac{0,75}{4,007}$$

$$U_{\text{TOT}} = 0,14126 \text{ W/m}^2\text{C}$$

$$\Rightarrow Q_{\text{tot}} = U_{\text{TOT}} \times A_{\text{TOT}} \times \Delta T$$

$$= 0,14126 \times 25 \times 50 \times 0,8 \times (22 - (-2))$$

$$\boxed{Q_{\text{tot}} = 990,24 \text{ W}}$$

Question 2: In 2 pages you should write a summary, in your own words of what you have learnt in this session about radiation and radiative heat transfer.

Definition

As learnt and mentioned in previous classes and assignments, the three methods of heat transfer through mediums are: conduction; through solid materials, convection; through fluids (gases and liquids), and the third is radiation, which is heat transfer through vacuum or void.

Radiation is the most different and special method of heat transfer, because heat transfer doesn't require a medium to move and transfer, but also it occurs through solids and fluids. Radiation is a form of energy that transfers through waves, due to instability of atomic particles producing electromagnetic radiation to which in that way energy is transferred. In other words, electromagnetic (EM) waves are transferring energy, these waves are just as any other waves as in frequency, and wavelength; expressed in this equation:

$$\lambda = \frac{c}{\nu}$$

Where;

ν , is frequency

λ , is wavelength

and c , is the speed of propagation of a wave in that medium.

A fact worth mentioning is that the difference of temperature is the factor that identifies the rate of thermal radiation emission.

The range of all types of electromagnetic (EM) radiation is called electromagnetic spectrum, ranging from electrical power waves to the cosmic rays, going through the radio and TV waves, microwaves, infrared, visible, ultraviolet, and x-rays. Concluding to that all bodies emit radiation to a certain level.

Light

Light is the visible part of the EM spectrum, since our natural light source is the sun, the electromagnetic radiation emitted by the sun is known as solar radiation. Almost half of solar radiation is light (i.e., it falls into the visible range), with the remaining being ultraviolet and infrared.

Black Body Radiation

The black body is a cosmic phenomenon, of which is the perfect emitter and absorbent of heat, so the thermal electromagnetic radiation within or surrounding a body in thermodynamic equilibrium with its environment is called the black body radiation.

Whereas the radiation energy emitted by a blackbody is:

$$E_b(T) = \sigma T^4 \quad (\text{W/m}^2)$$

Blackbody emissive power is:

$$\sigma = 5.670 \times 10^{-8} \text{ W/m}^2 \cdot \text{K}^4$$

Stefan–Boltzmann constant.