Task 1: you should 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

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 % 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. Find the two R_{unit} values and determine the overall unit thermal resistance and the overall heat transfer coefficient (U).

Also determine the rate of heat loss through the walls of a house whose perimeter is 50 meter and the 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 % of the wall area is occupied by glazing

Answer

	Wood	Insulation
Outside air	0.03	0.03
Wood bevel (13*200mm)	0.14	0.14
Plywood(13mm)	0.11	0.11
Urethane Rigif Foam (90mm)	X	0.98*90/25=3.528
Wood Studs (90mm)	0.63	X
Gypsum board (13mm)	0.079	0.079
Inside surface	0.12	0.12

$R_{\text{with wood}}$ = (0,03+0,14+0,11+0,63+0,079+0.12)= 1,109 m_2°C/W

$R_{\text{with insulation}}$ = (0,03+0,14+0,11+3,528+0,079+0,12)= 4,007 m_2°C/W

$U_{\text{wood}} = 1/R'_{with\ wood}$ = 1/1,109=0,9017 $W/m^{2°}/C$

$U_{\text{insulation}} = 1/R'_{with\ insulation}$ = 1/4,007=0,2496 $W/m^2\ °C$

U total = $U_{wood}*A_{wood}/A_{total}+U_{insulation}*A_{insulation}/A_{total}$ =25%∗0,9017+75%∗0,2496=0,4126 $W/m^2°C$

R value = $1/Utotal$= 1/0,4126=2,4237 $m^{2°}C/W$
Q_{total}= $U_{total}*$ $U_{total}*\Delta T$=0,4126∗50∗25∗(1−20%)∗22−(−2)=990,24 W

Task 2 In 2 pages you should write a summary (in your own word, in your own words !!) of what you have learnt in this session about radiation and radiative heat transfer

Summary about radiation and radiative heat transfer

Definition

The thermal radiation is the emission of electromagnetic waves or electromagnetic radiation and they are generated by every type of objects that have a temperature higher than 0°C or – 273,15 °C. So the thermal radiation is related on the temperature and so the heat of the object and everything around us constantly emits thermal radiation. Radiation transfer occurs in solids, in liquids and gases and differs from conduction and convection because it doesn't require the presence of a material to take place. In fact to have a heat transfer in the case of the conduction and convection there will be the presence of two objects, instead in the radiation it's not necessary to have two object to have the phenomenon but the radiation transfer works when there is a hot object, so thermal radiation can occur in vacuum.

The type of electromagnetic radiation that is pertinent to heat transfer is the thermal radiation emitted as a result of energy transitions of molecules, atoms, and electrons of a substance. Temperature is a measure of the strength of these activities at the microscopic level, and the rate of thermal radiation emission increases with increasing temperature.
Thermal radiation is an electromagnetic wave that are rapidly moving fields of accelerated charges or charging electric currents give rise to electric and magnetic field. These waves transport energy and they are characterized by their wavelength (λ)and frequency (υ). These two properties are related by a law: λ =c / υ
C is the speed of propagation of a wave in that medium. The speed of light in a vacuum is equal to 2,9979*108 m/s. The frequency and the wavelength are inverse proportional so if lower is the value of frequency, higher is the value of wavelength and vice versa.
An easy example of an object that emits a lot quantity of radiation is the sun that its temperature is very high and its radiation reaches the earth and heat it. But also a light bulb that has a very less temperature than the sun emits radiation and we can see this radiation by light. By this example we can see that higher is temperature, higher is the emission of radiation.

There are different types of radiation like ultraviolet, microwaves, X rays, Cosmic rays, … in base of their wavelength and the wavelength is measured in μm. By the use of the electromagnetic wave spectrum we can understand which types of radiation are. The radiation usually isn't visible, only the Light is the visible portion of the electromagnetic spectrum that lies between 0,40 μm and 0,76 μm. For example almost the half of solar radiation is light and the remaining is ultraviolet (12%) and infrared.
The ultraviolet radiation has a wavelength between 0,01 μm and 0,40 μm and they are very dangerous because they can kill microorganism and cause serious damage to humans and other living beings. These rays are absorbed by the atmosphere and the ozone layer acts as a protective layer. The infrared is the type of radiation that causes heat and almost of the bodies at room temperature emit infrared. Their wavelength extends from 0,76 μm and 100 μm.
Different bodies emit different amount of radiation per unit surface area and the ideal type of body that emits the maximum amount of radiation by surface at a given temperature is called black body. Also a black body is able to absorbs all incident radiation, regardless of wavelength and direction so it's the perfect emitter and absorber of radiation. The propagation of the radiation is also uniform. It differs from the typical behavior of an object because in a real object the propagation isn't uniform, and it's not able to absorb all the incident radiation and it's not able to emit the maximum amount of radiation. The black body is used to serve as standard against which the radiative properties of real surfaces may be compared.

The radiation energy emitted by a blackbody is calculated by:

E (T) = σT^4 (W/m2)

σ is the Stefan-Boltzmann constant, while T is temperature in K. We can see how the amount of energy is related mostly to the temperature that the body has. In the equation the temperature has the power so it's weight is very important to the calculation of the energy.

This is the graphic related to the variation of the blackbody emissive power with wavelength for several temperatures.
We can see how the emitted radiation is a continuous function of wavelength. At any specified temperature, it increases with wavelength, reaches a peak, and then decreases with increasing wavelength. The temperature is fundamental because at any wavelength the amount of emitted radiation increases with increasing μ

temperature.