week4. ADAMI,AMIRMOHAMMAD

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 urethane rigif foam insulation. The inside is finished with 13-mm gypsum wallboard and the outside with 13 mm polywood and 13 mm 200 mm wood belvel lapped siding. The insulated cavity 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).

Find the two R_{unit} values, determine the overall unit thermal resistance (the R_{value}) and the overall heat transfer coefficient (the U_{factor}).

Also, determine the rate of heat loss through the walls of a house whose perimeter is 50 m and wall height is 2.5m in Las Vegas, Nevada, whose winter design temperature is -2°C. Take the indoor design temperture to be 22°C and assume 20 percent of the wall area is occupied by glazing.

Answer:

	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)	No	0.98*90/25=3.528
Wood studs(90mm)	0.63	No
Gypsum board(13mm)	0.079	0.079
Inside surface	0.12	0.12

$$R'_{withwood} = 0.03 + 0.14 + 0.11 + 0.63 + 0.079 + 0.12 = 1.109\ ㎡ \cdot ℃/W$$

$$R'_{withinsulation} = 0.03 + 0.14 + 0.11 + 3.528 + 0.079 + 0.12 = 4.007\ ㎡ \cdot ℃/W$$

$$U_{wood} = \frac{1}{R'_{withwood}} = \frac{1}{1.109} = 0.902 \frac{w}{㎡ \cdot ℃}$$

$$U_{insulation} = \frac{1}{R'_{insulation}} = \frac{1}{4.007} = 0.2496 \frac{w}{㎡ \cdot ℃}$$

$$R = \frac{R'}{A} \rightarrow \frac{1}{R} = \frac{A}{R'}$$

$$\frac{1}{R'_{total}} = \frac{1}{R'_{wood}} + \frac{1}{R'_{insulation}}$$

$$\rightarrow$$

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

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

$$A_{total} * U_{total} = A_{wood} * U_{wood} + A_{insulation} * U_{insulation}$$

$$\rightarrow \frac{A_{total} * U_{total}}{A_{total}} = \frac{A_{wood} * U_{wood}}{A_{total}} + \frac{A_{insulation} * U_{insulation}}{A_{total}}$$

$$\rightarrow U_{total} = \frac{A_{wood} * U_{wood}}{A_{total}} + \frac{A_{insulation} * U_{insulation}}{A_{total}} = 25\% * 0.902 + 75\% * 0.2496 = 0.412 \frac{W}{m^2 \cdot °C}$$

$$R_{value} = \frac{1}{U_{total}} = \frac{1}{0.4126} = 2.424 \frac{m^2 \cdot °C}{W}$$

$$\dot{Q}_{total} = U_{total} * A_{total} * \Delta T = 0.412 * 50 * 2.5 * (1 - 20\%) * 22°C - (-2°C) = 990.24W$$

Task 2: In 2 pages you shoudl 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

Radiation:

Thermal radiation is the emission of electromagnetic waves from all matter that has a temperature greater than absolute zero, T= 0 K or −273.15 °C, due to the heat of the material, the characteristics of whch depend on its temperature. 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. That explains the temperature in the physical field: 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. Since absolute zero is an idealized physical condition, thermal radiation happens almost in all objects, regardless of the material form of the object, whether it is solid, liquid or gas, basically everything around us keeps emitting thermal radiation to its surroundings.

A significant difference between thermal radiation and other mechanisms of heat transfer is, thermal radiation does not need the presence of a material medium to take place. So thermal radiation can occur in vacuum."

Radiative Heat Transfer：

The thermal radiation is continually emitted from every part of the surface of the object that has a temperature greater than absolute zero into every direction. 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. At any wavelength, the amount of emitted radiation increases with increasing temperature.

Black Body:

Surfaces emit thermal radiation and reflect electromagnetic waves at the same time. If we assume an object that emits radiation but does not reflect any electromagnetic waves, it is a “black body”, which is an idealized body that doesn’t exist in real life. A blackbody emits the maximum amount of radiation by a surface at a given temperature, and absorbs all incident radiation, regardless of wavelength and direction.