Technical Environmental System/ Dr. Behzad NAJAFi

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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.

According to the table we know

Outside air =0.03

Wood Bevel (13mmx200mm) =0.14

Plywood (13mm) = 0.11

Urethane Rigid Foam Ins. = 3.528 [0.98x90/25]

Wood Stud (90mm) = 0.63

Gypsum Board (13mm) = 0.079

Inside Surface = 0.12

Rwood = 0.03+0.14+0.11+0.63+0.079+0.12 = **1.109 m2°C/W**

Rinsulation = 0.03+0.14+0.11+3.528+0.079+0.12 = **4.007 m2°C/W**

Uwood = 1/Rwood = 1/1.109 = **0.902 W/m2°C**

Uinsulation = 1/Rinsulation = 1/4.007 = **0.25 W/m2°C**

Utotal = (U x farea)wood + (U x farea)insulation = 0.902 x 0.25 + 0.25 x 0.75 = **0.413 W/m2°C**

ΔT = 22-(-2) = 24°C

Q = U overall x A Total x ΔT = 0.413 x 125 x 0.8 x 24 = **991.2 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

Radiation:

Heat transfer by Radiation is an Electromagnetic radiation. It generated by the inner movement of the particles inside a matter (molecules and atoms). Motions are caused by charge acceleration and produce the electromagnetic radiation, resulting a radiation of energy away from the body through surface boundary. Heat transfer by Radiation is the of thermal energy into electromagnetic energy or light.All objects (solid, liquid, and gaseous) can absorb and emit radiation.Heat transfer by radiation doesn’t require a direct contact between the heat source and the heated object. Most common example: we feel the heat of the sun in daylight time even it is far away and we are not touching it.

Thermal Radiation (intensity of the energy flux) depends on

1. Properties of the surface it is emitting from
2. Temperature
3. Spectral absorption
4. Spectral emissive power

Radiation happens at any temperature, with an increasing rate of emission with increasing temperature.

Black body :

Radiations don't consist of a single frequency, which makes it not uniformal, meaning that raditions goes in different directions different intensities. If there is a formality and unicity of radiations and frequencies, we will be in "Black Body Radiation".

A Black Body is an idealized opaque non-reflective body (absorbs all incident radiation reflects none). A BlackBody Radiation has a specific spectrum of wavelengths. This is inversely proportional to intensity of body temperature). This Spectrum of wavelengths is assumed to be uniform and constant. A Black Body at room temperature appears black, since it is radiating in the Spectrum (not perceived by the human eye).

The Stefan–Boltzmann law of thermal radiation for a black body states that the rate of radiation energy from the surface per unit area is proportional to the fourth power of the temperature of the body.

$$q = \sigma A \left(T_1^4 - T_2^4\right)$$

Q : rate of energy emission from the surface,
A : surface area of the radiator
σ : the Setfan–Boltzmann cons
T1 :Black Body number 1 surface temperature
T2 : Black Body number 2 surface temperature

Efficient Radiation:

When we have radiation from a solid surface, we will be having mediums like: vacuum, gas… Molecules and atoms of medium can absorb as well, reflect, and transmit the radiation energy. However, the medium is a vacuum (no molecules and atoms), the radiation is fully transmitted. Which means radiation is more efficient in a vacuum than other mediums.

Example of Radiation Heat Transfer*:*

Low emissivity film (low-E) placed on a window glass pane:
Why: reduce the heat transfer from a surface, suppressing radiative heat flow.

How: limiting the amount of radiation that leaves the window, increasing the amount of heat that is retained inside the window.

Heating a tin can containing water on a Bunsen burner:
The flames produce radiation (since there is noe direct contact, we have air in between the fire and the can). Radiation heats the tin can. The tin can transfers heat to water by conduction heat method. Warm heated warm rises up du to convective heat transfer.