4th *WEEK'S* SUBMISSION

1. SUMMARY ABOUT RADIATION AND RADIATIVE HEAT TRANSFERT, EMISSIVITY, ABSORPTIVITY AND REFLECTIVITY, THE VIEW FACTOR, THE HEAT EXCHANGE BETWEEEN TWO BLACK SURFACES, THE HEAT EXCHANGE BETWEEN THE TWO GRAY SURFACE AND FINALLY THE DEFINITION OF RADIATIVE RESISTANCES

In addition to convection and conduction there is another type of way in which heat is transmitted and it is the **radiation**.

This mode of heat transfer occurs even in the **absence of matter**.

- EMISSIVITY

We can describe as the **capacity** of a material to **emit a radiation**. Considering our situation, we can assume as a thermal radiation emit by a surface.
We use letter **ε** for the emissivity and we can calculate by the **fraction between amount of thermal energy emitted by a body and the energy emitted by a black body**.
If the emissivity of a body is **equal to 1** we can consider it a **black body.**
The real bodies have an emissivity less than 1.

$$\varepsilon = \frac{E}{Eb}$$

- ABSORPTIVITY

We can describe as the **capacity** of a material to **absorb a radiation**. Considering our situation, we can assume as a thermal radiation absorb by a surface.
We use letter **α** for the absorptivity and we can calculate by the **fraction between the amount of absorbed thermal radiation and the incident thermal radiation**.
The value of absorptivity is including **between 0 and 1.**

$$\alpha = \frac{Gabs}{G}$$

There is a relation between emissivity and absorptivity and is expressed by the Kirchoff law.

$$\varepsilon(T) = \alpha(T)$$

This formula means that emissivity and absorptivity are the same for a body at a certain temperature.

- REFLECTIVITY

We can describe as the **capacity** of a material to reflect **a radiation**. Considering our situation, we can assume as a thermal radiation reflected by a surface.
We use letter **ρ** for the reflectivity and we can calculate by the **fraction between the amount of reflected thermal radiation and the incident thermal radiation**.
The value of absorptivity is including **between 0 and 1.**

$$\rho = \frac{G_{ref}}{G}$$

- VIEW FACTOR

We can describe as the fraction of the radiation that **is leaving a surface and that is intercepted by another surface.**
This view factor depends only from the area (A) and we use letter **F** for this factor.

- THE HEAT EXCHANGE BETWEEN TWO BLACK SURFACES

In the heat exchange between two black bodies, their emissive power is equal to:

$E_b\ (T) = \sigma T^4\ (W/m^2)$

the radiation exchanged by the surface S_1 is: $E_{b1} \times A_1$
the radiation exchanged by the surface S_2 is: $E_{b2} \times A_2$

These two surfaces also absorb each radiation, so the heat exchange between these bodies can be calculated as:

$$\dot{Q}_{12} = A_1 \times E_{b1} \times F_{1,2} - A_2 \times E_{b2} \times F_{2,1}$$

$$\dot{Q}_{12} = A_1 \times F_{1,2} \times \sigma\ (T^4_1 - T^4_2)$$

- THE HEAT EXCHANGE BETWEEN TWO GREY SURFACES

Grey and opaque surfaces can absorb just a fraction of the thermal radiation compared to black bodies, but their emissive power can be calculated as for a black body.

$E_b\ (T) = \sigma T^4_i\ (W/m^2)$

It is possible to find the heat exchange between two grey surfaces through this formula:

$$\dot{Q}_i = A_i\ (J_i \times G_i)$$

J is the radiosity
G is the incident radiation

The radiosity J can be found as: $\varepsilon_i Eb_i + (1 - \varepsilon_i) G_i$ (W/m^2)

- RADIATIVE RESISTANCE

Radiative resistance is a value to measure the energy related with loss resistance which is converted in heat radiation, the energy lost by radiation resistance is converted in radio waves.

The formula to calculate it is: $R_i = \frac{1 - \varepsilon_i}{A_i\ \varepsilon_i}$

2. SOLVE THE LAST EXAMPLE DONE IN CLASS CONSIDERING THE TWO EMISSIVITIES TO BE 0.1, WHAT CAN YOU CONCLUDE FROM THE RESULT?

A_1 = 1,5 m^2
ϵ_1 = 0.1
ϵ_2 = 0.1
T_1 = 298 K
T_2 = 308 K
$\sigma = 5.67 \times 10^{-8}$ (W/m^2 x K^4)

$$\dot{Q}_{12} = \frac{A\sigma\,(T_1^4 - T_2^4)}{\frac{1}{\epsilon 1}+\frac{1}{\epsilon 2}-1} \qquad \dot{Q}_{12} = \frac{1{,}5 \text{ x } (5.67 \text{ x } 10^{-8}) \text{ x } (308^4 - 298^4)}{\frac{1}{0.1}+\frac{1}{0.1}-1} = 4{,}982 \text{ W}$$

$$F_{1,2} = \frac{1}{\frac{1}{\epsilon 1}+\frac{1}{\epsilon 2}-1} \qquad F_{1,2} = \frac{1}{\frac{1}{0.1}+\frac{1}{0.1}-1} = 0{,}052$$

when $F_{1,2}$ = 0.01

$$\dot{Q}_{12} = A_1 \text{ x } F_{1,2} \text{ x } \sigma T^4_1 - A_1 \text{ x } F_{1,2} \text{ x } \sigma T^4_2 = A_1 \text{ x } F_{1,2} \text{ x } \sigma\,(T^4_1 - T^4_2)$$

$$\dot{Q}_{12} = 1{,}5 \text{ x } 0{,}01 \text{ x } 5.67 \text{ x } 10^{-8}\,(308^4 - 298^4) = 0{,}947$$

From the values obtained, we can see that the emissivity (ϵ) can widely affect the radiative heat exchange between surfaces.