WEEK_5 Againi

In your own words (which means in your own words) write a summary of the topics about radiative heat transfer we went through including the definitions of emissivity, absorptivity and reflectivity, the view factor, the heat exchange between two black surfaces, the heat exchange between the two gray surface and finally the definition of radiative resistances

SUMMARY

Irradiation (G): It is the incident radiation that affects the bodies.

Radiosity (J): It is the sum between the emissive power (E) proper of the object and the reflected irradiation as result of a radiation (G) affecting the object.

Emissivity (ϵ): It is the relation between how much radiation emitted by an object and radiation emitted by black body. $0 <= \epsilon <= 1$. In this scale, 0 is the minor value and 1 is a black body.

Absorptivity (α): When an incident radiation affects an object, it is the amount of energy absorbed by the material

Reflectivity (p): When an incident radiation affects an object, it is the amount of energy reflected by the surface of the material.

Transmissivity (t): When an incident radiation affects a semitransparent object, it is the amount of energy transmitted through the material.

In semitransparent surfaces, the sum of Absorptivity, Reflectivity and Transmissivity is equal to 1. In opaque surfaces, there is not transmissivity, so, the sum of absorptivity and reflectivity is equal to 1.
In grey and diffuse surfaces, the emissivity at certain temperature is equal to the absorptivity in the same temperature.

View factor (F): It is the emission generated at certain object and received by other object. It does not depend on the surface properties.
$A_i \times F_{ij} = A_f \times F_{ji}$

The reciprocity law defines the relation between two surfaces, the area and the view factor produced by each one of them.

Radiation heat transfer, black surfaces: The radiation heat transfer from one surface to another is defined by the multiplication of the area, the view factor and the emissivity generated by the black body, equal to σT^4

Radiation heat transfer, grey surfaces: Grey surfaces are not like black bodies, which absorb all the radiation. In grey surfaces we talk about radiosity, that is the sum between reflected radiation and emitted radiation by the body. As it is already known, emitted radiation is a ratio of the emissive power of a black body that can be expressed as ϵE_b and the reflected radiation is $p_i G_i$.
To find the heat transfer of a grey surface it is necessary to subtract the radiation leaving the entire surface and the radiation incident in the entire surface.

Net radiation heat transfer: It occurs between two surfaces in which each one of them emits and receives radiation. It can be defined as the subtract of the heat radiation produced by each surface and absorbed by the other one. In case of black bodies, it is defined by the next equation:

$$Q_{net} = Q_{12} - Q_{21}$$
$$Q_{net} = A \times F \times \sigma(T_1^4 - T_2^4)$$

In case of grey surfaces to find the heat exchange from a grey surface with the environment it is necessary to apply the next formula:

$$Q = \frac{Ai\,\epsilon\,(Eb - Ji)}{1-\epsilon}$$

Radiative resistance: It is the resistance produced by the media to transfer radiation. It is found between the emissive power of the surface i and the radiosity produced by the same surface. It is defined by the equation:

$R_i = \frac{1-\epsilon i}{Ai\ \epsilon i}$

Solve the last example you solved in the class (radiative heat exchange between two parallel plates) a while considering the two emissivity to be 0.1, what can you conclude from the result?

RADIATIVE HEAT EXCHANGE BETWEEN TWO PARALLEL PLATES

$\epsilon_{1=}$ 0.2
$\epsilon_{1=}$ 0.7
$A_{1=}$1.5 m
$F_{12=}$ 0.01
T_1 = 800 K
T_2 = 500K

$$Q_{12} = \frac{A\sigma(T_1^4 - T_2^4)}{\frac{1}{\epsilon_1} + \frac{1}{\epsilon_2} - 1}$$

$$\frac{Q_{12}}{A} = \frac{5{,}67 \times 10^{-8}(800^4 - 500^4)}{\frac{1}{0{,}2} + \frac{1}{0{,}7} - 1}$$

$$\frac{Q_{12}}{A} = 3625.36\ W/m^2$$

$\epsilon_{1=}$ 0.1
$\epsilon_{1=}$ 0.1
$A_{1=}$1.5 m
$F_{12=}$ 0.01
T_1 = 800 K
T_2 = 500K

$$Q_{12} = \frac{A\sigma(T_1^4 - T_2^4)}{\frac{1}{\epsilon_1} + \frac{1}{\epsilon_2} - 1}$$

$$\frac{Q_{12}}{A} = \frac{5{,}67 \times 10^{-8}(800^4 - 500^4)}{\frac{1}{0{,}1} + \frac{1}{0{,}1} - 1}$$

$$\frac{Q_{12}}{A} = 1035.81\ W/m^2$$

The emissivity of the surface is directly proportional to the radiative heat exchange. In the first case, we have two surfaces with higher emissivity so the heat exchange between them is higher. In the case we have less emissivity in both surfaces, the heat exchange is lower per square meter.
If we change the emissivity, the heat transfer would change also, no matter that the other factors are the same. In this case, lower the emissivity is, the lower the heat transfer will be.