Politecnico di Milano University
M.Arch Sustainable Architecture and Landscape Design
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WEEKLY SUBMISSION - TASK 05

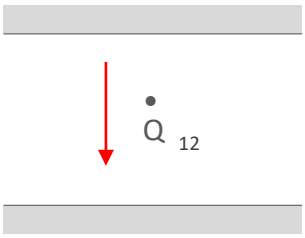
01. In you own words write a summary of the topics about radiative heat transfer we went through including the definitions of emissivity, absorptivity and reflectivity, the view factor, the heat exchange between two black surfaces, the heat exchange between the two gray surface and finally the definition of radiative resistance.
02. Solve the last example you solved in the class (radiative heat exchange between two parallel plates, awhile considering the two emissivities to be 0.1, what can you conclude from the result?

ANSWERS:

01.

Emissivity:
It is the level of emissivity that a surface or object has at a given temperature.
Because it is a ratio between the radiation emitted by the real object and a black body (perfect emitter and absorber) varies between 0 and 1 (the closer to 1, the closer to a black body)
Absorptivity:
Portion of energy received by a given surface or object that is absorbed.
Reflectivity:
Portion of energy received by a given surface or object that is reflected.
Transmissivity:
Portion of energy received by a given surface or object that passes through it.
View Factor:
Portion of radiation that leaves the emitter and is received by the other surface or object. Knowing that radiation emission happens in all directions, the portion received by the other surface is just a small fraction of radiation that has navigated in that particular direction.
Heat Exchange Between Two Black Surfaces:
Black surfaces absorb and emit the maximum radiation, so, the heat exchange between them will be the difference of total energy received by surface 2 from surface 1 ($Eb_1 x A_1 x F_{1-2}$) and the total energy received by surface 1 from surface 2 ($Eb_2 x A_2 x F_{2-1}$)
Heat Exchange Between Two Gray Surfaces:
Since they are not like black bodies (perfect absorber and emitter) part of the radiation that reach a surface will be reflected and other will be absorb. The part of the radiation that is reflected plus the portion of radiation that is emitted by the surface itself is called radiosity.
So, the heat exchange between two gray surfaces is the difference between the radiation leaving entire surface 1 and the radiation that arrives in surface 2.
Radiative Resistance:
Resistance of a particular medium to transfer radiation from one surface to another.

02.



$\varepsilon_1 = 0.1$

$T_1 = 800\ K$

$\varepsilon_2 = 0.1$

$T_2 = 500\ K$

$$\dot{Q}_{12} = \frac{A\,\sigma\,(T_1^4 - T_2^4)}{\frac{1}{\varepsilon_1} + \frac{1}{\varepsilon_2} - 1} \longrightarrow \dot{Q}_{12} = \frac{5.67 \times 10^{-8}\,(800^4 - 500^4)}{\frac{1}{0.1} + \frac{1}{0.1} - 1}$$

$$\dot{Q}_{12} = \frac{5.67\,(3{,}471)}{10 + 10 - 1} = \frac{19{,}680.57}{19} = 1{,}035.8\ W$$

Conclusion:

The emissivity and radiative heat exchange are directly proportional as by making small changes in surface emissivity (from 0.2 and 0.7 to 0.1 and 0.1, respectively) it is possible to achieve a significant improvement in heat transfer by reducing this exchange by over 2,000 W.