CONECTIVE HEAT TRANSFER

Monday, October 14, 2019 9:44 PM

Politecnico di Milano
MSc. Sustainable Architecture and Landscape Design
15/october/2019
Fabiola Anahí Mogrovejo León

1. **Write a summary (in your own words about the convective heat transfer (half a page) and explain why increasing the thickness of a single pane glass does not increase the total resistance.**

   Convective heat transfer is a convection that occurs when the rate of heat loss of a body is proportional to the difference in temperatures, another factor to take into account is the force of the wind. There are two types of convection:

- The natural convection, that occurs when there is a movement of a fluid or a change in density.
- The force convection, that is external, depends of temperature and the speed of air.

   Every surface has a thermal resistance against heat flow, this depends of the object and the material, but also the thickness has a highly significant influence on the thermal resistance. The higher the thermal resistance, the lower is the heat loss.

   Once we now the value of the convective heat transfer, we can know the temperature of the solid in the inner or extern part.

   Increasing the thickness of a single pane glass does not have an important influence in heat transfer because h1 and h2 of $R_{conv_{\square}} = \frac{1}{h_1 \times A}$ are 10 times bigger than the resistance of a single glass panel.

2. **Write an explanation about what mistakes you made in the class that resulted in wrong answers.**

   The mistakes that I made in class were: wrong units conversion from mm to m and in the final equation of T_{S_1} I put the wrong signs - and + when solving the equation.

3. **Solve the same probelm as that of double pane window with the air-gap thickness of 13 mm and glass thickness of 6 mm, commment on your results and explain why we have an optimal range for the air-gap's distance.**

Total panel area:

$$A = \ 0.8 * 1.5 = 1.2$$

Resistances:

$$R_{g_1} = R_{g_2} = \frac{L_g}{\left(K_g \times A\right)} = \frac{0.006}{0.78 * 1.2} = 0.0064\,°\frac{C}{W}$$

$$R_{airGap} = \frac{L_{airGap}}{\left(K_{airGap} \times A\right)} = \frac{0.013}{0.026 * 1.2} = 0.4167\ °C/W$$

$$R_{conv_1} = \frac{1}{h_1 \times A} = (\frac{1}{10 * 1.2)} = 0.0833\,°C/W$$

$$R_{conv_2} = \frac{1}{h_2 \times A} = (\frac{1}{40 * 1.2)} = 0.0208\,°\frac{C}{W}$$

$$R_{tot} = R_{conv_1} + R_{conv_2} + 2 \times R_g + R_{airGap}$$

$$= 0.0833 + 0.0208 + 2 * 0.0064 + 0.4167 = 0.5336\,°\frac{C}{W}$$

Steady rate of heat transfer:

$$\dot{Q} = \frac{\Delta T}{R_{Tot}} = \frac{20°C - (-10°C)}{0.5336} = 56.22\,W$$

Temperature of the inner surface of the window:

$$\dot{Q} = \frac{T_{inff_1} - T_{s_1}}{R_{conv_1}} =\rightarrow 56.22 = \frac{20 - T_{s_1}}{0.0833} \rightarrow T_{S_1 = 15.3\ °C}$$