WEEK ASSIGNMENT 2

QUESTIONS:

1 write a summary (in your own word ! (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

2 write an explanation about what mistakes you made in the class that resulted in wrong answers!!

3 solve the same problem as that of double pane window with the air-gap thickness of 13 mm and glass thickness of 6 mm, comment on your results and explain why we have an optimal range for the air-gap's distance!

ANSWERS:

1. Convective heat transfer

Convective heat transfer (convection) is a way of heat transfer that happens from one place to another by moving fluids (liquid and gas, liquid and liquid, gas and gas, etc.) or fluid and solid (gas and solid).

When fluid is heated and is moving away it carries along thermal energy. It can happen in different occasions: one is between two moving fluids and the other one is between solid and a moving fluid.

Just like in other heat transfers, convection is caused by temperature differences between fluids or between the solid and fluid.

There are two types of convection: **forced convection** and **natural convection** (free convection). In both convection the heat is transferred from the hotter part to the cooler part, and the difference is between contact of fluids or fluid and solid. If the contact is due to external force it is forced convection and if there is no external force we are talking about natural (free) convection.

Why increasing the thickness of a single pane glass does not increase the total resistance?

By simple comparation between thermal resistance of glass and thermal resistance between air and glass we can conclude that thermal resistance of glass is small in this comparation. In this case total thermal resistance will not be changed even if the glass thermal resistance will be increased.

2. Explanation:

Unfortunately, because of surgery I was not able to attend the class, but after taking material from my classmates and following the materials and presentation I succeeded in solving problems without mistakes.

3. Solution:

The area of the surface:

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

The thermal resistance of the conduction of a 6-mm-thick layers of glass:

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

The thermal resistance of the conduction of air gap:

$$R_{airGap} = \frac{L_{airGap}}{(K_{airGap} \times A)} = \frac{0.013}{0.026 * 1.2} = 0.4166\ °C/W$$

The thermal resistance of the convection between inner air and the glass:

$$R_{conv_1} = \frac{1}{\mathrm{h}_1 \times A} = (\frac{1}{10 * 1.2}) = 0.0833\ °C/W$$

The thermal resistance of the convection between oughter air and the glass:

$$R_{conv_2} = \frac{1}{\mathrm{h}_2 \times A} = (\frac{1}{40 * 1.2}) = 0.0208\ °C/W$$

Total thermal resistance of the window:

$$R_{total} = R_{conv_1} + R_{conv_2} + 2 \times R_g + R_{airGap}$$
$$= 0.0833 + 0.0208 + 2 * 0.0064 + 0.4166 = 0.5335\ °C/W$$

Heat transfer through this double−pane window is:

$$\dot{Q} = \frac{\Delta T}{R_{Total}} = \frac{30}{0.5335} = 56.23\ W$$

The temperature of the inner surface of the window is:

$$\dot{Q} = \frac{T_{inf_1} - T_{s_1}}{R_{conv_1}} \rightarrow 56.23\ \text{W} = \frac{20 - T_{s_1}}{0.0833} \rightarrow T_{S_1} = 15.31°C$$

Trapped air helps reduce heat loss, it keeps warm air on the inside.