Week Assigment 2

CONVECTIVE HEAT TRANSFER SUMMARY

- Beside heat conduction, second of three ways of heat transfer is *convection heat transfer*.

- *Convective heat transfer* is transfer of heat between a solid and a moving fluid. Usually, this is the most common form of heat transfer in liquids and gases. This action also can happend between two moving fluids, without solid, in three relations: liquid-liquid, gas-gas and liquid-gas relation.

- The main reason why convective heat transfer happens is temperature difference, inconstancy and variability between the moving fluid and solid or moving fluid. In most cases, heat is finding its transfer way from warmer objects to the less hotter ones.

- There are two ways of convective heat transfer:

a) *Natural convection*
b) *Forced convection*

- *Forced and Natural convections*, as types of convective heat transfer, also use principles of heat transfer from hotter to cooler objects. Forced convection happens when the contact is occurred between two moving fluids or a solid and a moving fluid, with different temperatures, due to some external force. On the contrary, natural convection represents same contact but without external force.

QUESTION

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

A: Glass, like a material, has miniatury small coeficiency of the thermal resistance compared to the thermal resistance of convection. By increasing thickness of a glass, we will not significantly increase total thermal resistance. Only thing that's going to happen is litteraly slightly enlarged thermal resistance of glass and total thermal resistance will stay almost the same because glass influence is quiet small in this case.

MISTAKES REVISION

I almost never got proper final result because i was rounding numbers all the time, obviously in not proper way. I am really unpatient sometimes and i didn't spent time on rechecking formula for second problem and wrote $T_2 - T_\infty$, instead of opposite and right way $T_\infty - T_2$.

CONVECTIVE HEAT TRANSFER PROBLEM

Consider a 0.8-m-high and 1.5-m-wide double-pane window consisting of two 6-mm-thick layers of glass (k= 0.78 W/m.°C) separated by a 13-mm-wide stagnant air space (k= 0.026 W/m.°C). Determine the steady rate of heat transfer through this double-pane window and the temperature of its inner surface. Take the convection heat transfer coefficients on the inner and outer surfaces of the window to be h1= 10 W/m2 · °C and h2=40 W/m2 · °C, which includes the effects of radiation.

- *Total area:*

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

- *Conduction of a 6-mm glass layers:*

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

- *Resistance of the conduction of air gap:*

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

- *Convection between inner air and the glass:*

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

- *Convection between oughter air and the glass:*

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

- *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 the window:*

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

- *The temperature of the inner surface of the window:*

$$\dot{Q} = \frac{T_{inff_1} - T_{s_1}}{R_{conv_1}} = \rightarrow 56.23\ \text{W} = \frac{20 - T_{s_1}}{0.0833} \rightarrow T_{S_1} = 15.31°C$$