1. Summary about the convective heat transfer

Heat transfer is achieved by three methods, heat conduction, convection and heat radiation. In the actual heat transfer process, these three methods are often happening at the same time. Since the thermal conductivity of the fluid is small, there is only little heat been transferred in this way. So convection is the main heat transfer mode of the fluid.

Convection heat transfer is a kind of heat transfer. It is a process in which heat moves through a gas or liquid as the hotter part rises and the cooler part sinks. The circulation flows and blends with each other, eventually, making the temperature uniform.

The main factors affecting thermal convection are: temperature difference, surface area, convection heat transfer coefficient. When the convection heat transfer coefficient (h)is infinite, the resistance approaches zero and the heat transfer becomes zero. The formulas are as follow：

Q_{conv}=（T_s-T_∞）/R_{conv} (W)

R_{conv}=1/hA_s (℃/W)

2. Explain why increasing the thickness of a single pane glass does not increase the total resistance

The conduction resistance of a single pane glass is far less (around 10 times) than the convection resistance of the air. Although increasing the thickness may contribute to the increase of resistance of glass, the total resistance will not change significantly.

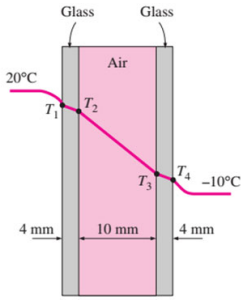
3. Write an explanation about what mistakes you made in the class

I did the tasks correctly in the class.

4. QUESTION

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). Commment on your results and explain why we have an optimal range for the air-gap's distance

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 h_1 =10 $\frac{W}{m^2°C}$ and h_2= 40 $\frac{W}{m^2°C}$, which includes the effects of radiation.



Steady rate of heat transfer:

$A=0.8*1.5=1.2m^2$

$R_{conv}=R_{conv1}+R_{conv2}=1/h_1*A+1/h_2*A=1/(10*1.2)+1/(40*1.2)=0.10416\ ℃/W$

$R_g=R_{g1}+R_{g2}=(L/kA)*2=[0.006/(0.78*1.2)]*2=0.01282\ ℃/W$

$R_{airspace}= L/kA=0.013/(0.026*1.2)= 0.41666\ ℃/W$

$R_{total}=R_g+ R_{airspace} + R_{conv}=0.53364℃/W$

$\dot{Q}=\Delta T/ R_{total}=30/0.53364= 56.21767\ W$

Temperature of its inner surface:

$T_{\infty 1}-T_1=\dot{Q}* R_{conv1}= 56.21767*0.08333=4.6848℃$

$T_1=T_{\infty 1}-\dot{Q}* R_{conv1}=20-4.6848=15.3152℃$

Optimal range for the air-gap's distance

When the air gap’s distance is in an optimal range, the air can be considered as still in which there is only conduction. When the gap exceed the optimal range, the heat will be transferred by convection.