Week2

Tasks：

1 write a summary (in your own words !, (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 resistane

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

3 solve the same probelm as that of double pane window with 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 !

1.1Summary:

Convection is the main mode of the heat transfer of liquid and gas. When heating or cooling by convection, two conditions must be satisfied simultaneously: one is that the material can flow, and the other is that the heating method must be able to promote the material flow.

Convection can be divided into two types: natural convection and forced convection. Natural convection is a natural flow caused by the change of density or pressure inside the fluid due to the uneven temperature of the fluid. Forced convection is due to external force or contact with high temperature object, forced and flow, called forced convection.

Controlling convection of gases and liquids is the main means of increasing or decreasing heat transfer.Open door window to be able to promote indoor and outdoor air convection in summer, achieve heat dissipation purpose.Close the door and window in winter, can avoid indoor and outdoor air convection, achieve warm purpose.Curtains are sometimes hung to prevent convective airflow from reaching the window, further reducing the heat loss in the room.

The main factors affecting thermal convection are temperature difference, thermal conductivity and the thickness and cross-sectional area of thermal conductivity.The higher the thermal conductivity, the smaller the thickness, the more heat conduction.

1.2The reason the thickness of a single pane glass does not increase the total resistance.

Here's why this happens, according to our calculations in class, Glass is a material with little thermal resistance, the thermal conductivity of glass is very high, therefore, increasing the thickness of glass cannot effectively improve the total thermal resistance.

2. Explanation about the mistakes

There was a mistake in the calculation of glass thermal resistance in class. Due to incorrect conversion of glass thickness, the thermal resistance of glass is ten times higher. However, this is a low-level problem. In future calculation, I will pay more attention to unit conversion.

3.1Calculation:

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

$$Rg1 = Rg2 = \frac{Lg}{Kg * A} = \frac{0.006}{0.78*1.2} = 0.0064\,℃/W$$

$$Rairgap = \frac{Lairgap}{Kairgap*A} = \frac{0.013}{0.026*1.2} = 0.4167℃/W$$

$$R\text{conv}1 = \frac{1}{h1*A} = \frac{1}{10*1.2} = 0.0833℃/W$$

$$R\text{conv}2 = \frac{1}{h2*A} = \frac{1}{40*1.2} = 0.0208℃/W$$

$$R\text{total} = Rg*2 + R\text{airgap} + R\text{conv}1 + R\text{conv}2 = 0.0128 + 0.4167 + 0.0833 + 0.0208 = 0.5336℃/W$$

$$\dot{Q} = \frac{\Delta T}{Rtotal} = \frac{20 + 10}{0.5336} = 56.2219W$$

$$T1 = T\infty 1 - \dot{Q} * \text{Rconv}1 = 20\text{-}56.2219*0.0833 \approx 15.32℃$$

3.2 Why we have an optimal range for the air-gap's distance

When the space between the glass is enlarged to a certain extent, convection will occur between the glass, and the air flow between the glass will lead to the increase of heat conduction efficiency, thus reducing the insulation effect. Therefore, the space between the two layers of insulating glass should be maintained between 6~13mm.