

1. Write a summary about the convective heat transfer and explain why increasing the thickness of a single pane glass does not increase the total resistance.

Heat energy transferred between a surface and a moving fluid with different temperatures is known as **convection**.

It happens between two moving fluids, such as fluid and fluids, gas and gas or fluid and gas.

There are two different types of convection:

1. **NATURAL CONVECTION:** is a type of flow in which the fluids motion with different temperatures is not generated by any external source, like pump, fan or mixer.
 2. **FORCED CONVECTION:** is a type of flow with fluids that have different temperatures which are generated by external source.
- Increasing the thickness of the glass help to increase the resistance of the glass too, but it has a very low value, so it does not influence the total resistance of the window. Instead increase the thickness of air can be decisive for the total calculation.

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

In the exercise B made in the class, my mistake was to fail calculated the equivalence from millimeters to meters.

$$8 \text{ mm} = 0,08 \text{ m} \quad \text{X}$$

$$8\text{mm} = 0,008 \text{ m} \quad \checkmark$$

3. Solve the same problem as that of double pane window with 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.

$$h = 0,8 \text{ m}$$

$$w = 1,5 \text{ m}$$

$$K_G = 0,78 \text{ W/m}^\circ\text{C}$$

$$K_A = 0,026 \text{ W/m}^\circ\text{C}$$

$$h_1 = 10 \text{ W/m}^2 \text{ }^\circ\text{C}$$

$$h_2 = 40 \text{ W/m}^2 \text{ }^\circ\text{C}$$

Surface area of the window:

$$A = 0,8 \text{ m} \times 1,5 \text{ m} = 1,2 \text{ m}^2$$

$$R_G = \frac{L}{k \cdot A} = \frac{0,006 \text{ m}}{0,78 \text{ W/m} \cdot ^\circ\text{C} \cdot 1,2 \text{ m}^2} = 0,0064 \text{ }^\circ\text{C/W}$$

$$R_A = \frac{L}{k \cdot A} = \frac{0,013 \text{ m}}{0,026 \text{ W/m} \cdot ^\circ\text{C} \cdot 1,2 \text{ m}^2} = 0,4167 \text{ }^\circ\text{C/W}$$

$$R_{CONV1} = \frac{1}{h_1 \cdot A} = \frac{1}{10 \text{ W/m}^2 \cdot ^\circ\text{C} \cdot 1,2 \text{ m}^2} = 0,0833 \text{ }^\circ\text{C/W}$$

$$R_{CONV2} = \frac{1}{h_2 \cdot A} = \frac{1}{40 \text{ W/m}^2 \cdot ^\circ\text{C} \cdot 1,2 \text{ m}^2} = 0,0208 \text{ }^\circ\text{C/W}$$

Total thermal resistance of the window:

$$\begin{aligned} R_{TOT} &= R_{CONV1} + R_{WALL} + R_{CONV2} \\ &= 0,0833 \text{ }^\circ\text{C/W} + (0,0064 \text{ }^\circ\text{C/W} \cdot 2) + 0,4167 \text{ }^\circ\text{C/W} + 0,0208 \text{ }^\circ\text{C/W} = 0,5336 \text{ }^\circ\text{C/W} \end{aligned}$$

Heat Transfer through the window:

$$\dot{Q} = \frac{T_{\infty 1} - T_{\infty 2}}{R_{TOT}} = \frac{20^{\circ}\text{C} - 10^{\circ}\text{C}}{0,5336 \text{ W}/^{\circ}\text{C}} = 56,2219 \text{ W}$$

The temperature of the internal surface of the window:

$$\dot{Q} = \frac{T_{\infty 1} - T_1}{R_{CONV1}}$$

$$T_1 = T_{\infty 1} - (\dot{Q} \cdot R_{CONV1}) = 20^{\circ}\text{C} - 4,6832^{\circ}\text{C} = +15,3167^{\circ}\text{C}$$