# WEEK 2 YANG DICHENG

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## Convective Heat Transfer

Heat transfer between a soild and a moving fluid is called convection, When a surface and a moving fluid with different temperatures, Heat energy will transferred between them.

Convective heat transfer can be:

- Forced Convection
- Natural Convection

Forced convection occurs when a fluid flow is reduced by an force (eg: pump, fan, etc)

Narural Convection is caused by the density differences, the light fluid ( Hot ) goes up and the heavy fluid ( cold ) goes down.

The rate of convective heat transfer depends on:

(1) Temperature Difference
(2) Velocity of Liquid or Gas
(3) Kind of Liquid or Gas

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

In this case, total resistance is including the resistane of **indoor convection**, **outdoor convection** and the **conduction of glass** itself.

$$R_{total} = R_{conv_1} + R_{wall} + R_{conv2} = \frac{1}{h_1 A} + \frac{L}{kA} + \frac{1}{h_2 A}$$

In this formula, $k_{glass}$ is way small than $h_{conv1}$ , $h_{conv2}$ , Therefore the thickness of glass CAN NOT brings too much influence to the total resistane.

The more efficient way to increase the total resistance is creative a **Convection** than simply increasing the glass's **Conduction Resistance** .

## Explanation of Mistake

Compare with **Condution**, **Convection** could reduces the heat transfer more effectively.

That’s because they are too **different system**, under that condition, the **Thermal Resistance** is more relevant with the **materials** of the wall than **thickness** of the wall.

## Double Pane Window Caculation

$$A_{glass} = 0.8m * 1.5m = 1.2m^2$$

$$R_{conv1} = \frac{1}{h_1 A} = \frac{1}{10 * 1.2} \approx 0.0833 \text{ ℃/W}$$

$$R_{conv2} = \frac{1}{h_2 A} = \frac{1}{40 * 1.2} \approx 0.0208 \text{ ℃/W}$$

$$R_{glass} = \frac{L_g}{k_g A} = \frac{0.006}{0.78 * 1.2} \approx 0.0064 \text{ ℃/W}$$

$$R_{air} = \frac{L_a}{k_a A} = \frac{0.013}{0.026 * 1.2} \approx 0.4167 \ ℃/\mathrm{W}$$

$$R_{total} = R_{conv1} + R_{glass} + R_{air} + R_{glass} + R_{conv2}$$
$$= 0.0833 + 0.0208 + 0.0064 + 0.4167 + 0.0064 \ \ = 0.5332 \ ℃/\mathrm{W}$$

$$\dot{Q} = \frac{\Delta T}{R_{total}} = \frac{30}{0.5332} = 56.26W$$

*According:*

$$\dot{Q} = \frac{T_{inff1} - T\_S1}{R_{conv1}}$$

*Therefore:*

$$T_{S1} \approx 15.32℃$$

## Optimal Range for the Air-gap's Distance

There is a **threshold** for the distance of air gap between 2 glass. When the distance over than threshold, the air inside will begins flowing, the **conduction** of air will transformed into **convection**.

According from the caculation, $R_{air}$ compares with other $R_{conv}$ is more significant, therefore we use this **Distance Threshold** as an **Optimal Range** when we caculating the distance between the air gap