Convective heart ~~transfer~~ is a phenomenon that is the transfer of heat from one place to another by the movement of fluids.

The convective heat transfer is usually dominant form of heat transfer in liquids and gases. During this lecture, we know that the air flow from the high pressure to the low pressure. The ~~intend~~ temperature we use caculate is not the indoor temperature. And also the temperature outdoor is also not the temperature of the external wall.

$$\begin{cases} \dot{Q}_{conv} = h A_s (T_s - T_\infty) \\ R_{conv} = \dfrac{1}{hA_s} \end{cases}$$

h we usually called the convection heat transfer coefficient.

$$\Rightarrow \dot{Q}_{conv} = \frac{T_s - T_\infty}{R_{conv}}$$

When the wall or glass increase the thickness, the convective heat transfer change? No, the Rate of the convective heat transfer depend on three factors: (1) Temperature difference
(2) Velocity of liquid or gas.
(3) kind of material.

The same question, we can get the function:

$$R_{total} = R_{conv_1} + R_{wall} + R_{conv_2}$$

$$\Rightarrow R_{total} = \frac{1}{h_1 \cdot A} + \frac{L}{KA} + \frac{1}{h_2 \cdot A} \ (°C/W)$$

$$\therefore \dot{Q} = \frac{T_{\infty_1} - T_{\infty_2}}{R_{total}}$$

T_{∞_1}: the indoor temperature
T_{∞_2}: the outdoor temperature

$$\Rightarrow \dot{Q} = \frac{T_{\infty_1} - T_1}{R_{conv_1}} = \frac{T_1 - T_2}{R_{wall}} = \frac{T_2 - T_{\infty_2}}{R_{conv_2}}$$

The solution of the Question after class.

$$A = 0.8m \times 1.5m = 1.2m^2$$

$$R_{conv_1} = \frac{1}{h_1 A} = \frac{1}{10 \frac{W}{m^2 \cdot °C} * 1.2m^2} \approx 0.0833 \frac{°C}{W}$$

$$R_{glass_1} = \frac{L}{k_{glass} \cdot A} = \frac{0.006m}{0.78 \frac{W}{m \cdot °C} \cdot 1.2m^2} \approx 0.0064 \frac{°C}{W} = R_{glass_2}$$

$$R_{air} = \frac{L}{k_{air} \cdot A} = \frac{0.013m}{0.026 \frac{W}{m \cdot °C} * 1.2m^2} \approx 0.4176 \frac{°C}{W}$$ (we consider the air doesn't move)

$$R_{conv_2} = \frac{1}{h_2 \cdot A} = \frac{1}{40 \frac{W}{m^2 \cdot °C} * 1.2m^2} \approx 0.0208 \frac{°C}{W}$$

$$\therefore R_{total} = R_{conv_1} + R_{glass_1} + R_{air} + R_{glass_2} + R_{conv_2}$$
$$= 0.0833 \frac{°C}{W} + 0.0064 \frac{°C}{W} + 0.0208 \frac{°C}{W} + 0.0064 \frac{°C}{W} + 0.0208 \frac{°C}{W}$$
$$= 0.5333 \frac{°C}{W}$$

$$\because \dot{Q} = \frac{T_{\infty_1} - T_1}{R_{conv_1}} = \frac{T_1 - T_2}{R_{wall}} = \frac{T_2 - T_{\infty_2}}{R_{conv_2}}$$

$$\therefore T_1 = T_{\infty_1} - \dot{Q} \cdot R_{conv_1} = 20°C - 56.2535 \cdot 0.0833 \frac{°C}{W} \approx 15.3°C$$