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EXAMPLE AND SUMMARY

$$\therefore R_{conv1} = \frac{1}{h_1 A} = \frac{1}{10 * 0.8 * 1.5} = 0.0833 \frac{℃}{W}$$

$$\therefore R_{wall1}\, x\, 2 = \frac{L_1}{k_1 A} = \frac{0.006}{0.78 * 0.8 * 1.5} = \frac{0.006}{0.936} = 0.0064\, x\, 2 = 0.0128 \frac{℃}{W}$$

$$\therefore R_{wall2} = \frac{L_2}{k_2 A} = \frac{0.013}{0.026 * 0.8 * 1.5} = \frac{0.006}{0.0312} = 0.1923 \frac{℃}{W}$$

$$\therefore R_{conv2} = \frac{1}{h_2 A} = \frac{1}{40 * 0.8 * 1.5} = 0.0208 \frac{℃}{W}$$

$$\therefore R_{total} = R_{conv1} + R_{wall1} + R_{wall2} + R_{conv2}$$

$$\therefore R_{total} = 0.0833 + 0.0128 + 0.1923 + 0.0208$$

$$\therefore R_{total} = 0.3092 \frac{℃}{W}$$

$$\therefore \dot{Q} = \frac{T_{\infty 1} - T_{\infty 2}}{R_{total}}$$

$$\therefore \dot{Q} = \frac{20 - (-10)}{0.3092} = \frac{30}{0.3092}$$

$$\therefore \dot{Q} = 97.02\, W$$

As we see L is directly propotional to R, increasing Air cavity gap will increase the resistance(R) due to which conductive heat transfer will be decreased as R is invertly propotional to conductive heat transfer (Q).Thus, increasing air cavity and thickness of the glass will lower down the rate of heat transfer.

Mistakes made in the class :

In the class while solving an example, I put a value of L = 0.08 & 0.0010 instead of 0.008 & 0.010 m. It was a mistake of converting length value from mm to meter.

Short summary about the convective heat transfer:

Convective heat transfer is basically referred as convection which means exchanging or transferring heat from any possible medium of air and liquid through solid objects.

According to newton's law of cooling (convection), area (A) of a barrier between two different mediums having temperature difference is always directly proportional to convection which also means the more the area of a barrier, the more convection will be happening. Furthermore, the more R(resistance value) of a material would be, the rate of the convection would be lesser as R is inversely proportional to Q_{conv}.

Moreover, rate of heat convection from wall or any other material is a resultant of the difference between the rate of heat conductive into the wall and rate of heat conduction through the wall.

In the formula of resistance of convection $R_{conv} = \frac{1}{hA}$, h stands as homogenious temperature of the room which depends on the speed of the wind in the perticular medium or environment.

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

As L is directly proportional to the resistant (R), increasing the value of L would increase the value of R but in case of single pane glass window Area of the glass is always going to be more than the thickness of glass. Moreover, $R_{wall} = \frac{L}{kA}$ depicts that the more the A (area) the lesser the R (resistance) which means even if the value of L increased, it's always going to have lesser impact than the value of A because it will always be higher the glass thickness. Therefore, increasing the thickness of a single pane glass does not increase the total resistance.