WEEKLY SUBMISSION - TASK 02

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SUMMARY OF CLASS - 2

The heat transfer per unit surface is defined as newton's law of cooling
The equation for convection as:

$Q_{conv} = hA_s(T_s - T_\infty)$

Where T_s = temperature on surface
A_s = surface area
h = convective heat transfer coefficient

And the convection resistance of the surface is the thermal resistance of the surface against heat convection.

$R_{conv} = \frac{1}{hAs}$

When the convection heat transfer is very large then the convection resistance becomes zero i.e., the surface offers no resistance to convection then the surface temperature is almost equal to outside temperature.
Higher the surface area lesser is the convection resistance.

Thermal resistance network:

Rate of heat convection from the wall is the difference of rate of heat convection into the wall and through the wall.

$$Q = \frac{T\infty 1 - T\infty 2}{Rtotal} = \frac{T\infty 1 - T\infty 2}{Rcov1 + Rwall + Rconv2}$$

$$Q = \frac{T\infty 1 - T1}{\frac{1}{h1A}} = \frac{T1 - T2}{\frac{L}{KA}} = \frac{T2 - T\infty 2}{\frac{1}{h2A}}$$

$$= \frac{T\infty 1 - T1}{Rcov1} = \frac{T1 - T2}{Rwall} = \frac{T2 - T\infty 2}{Rcov2}$$

Incresing the thicknes of glass doesnot have much effect on the resistance instead increasing the thickness of air gap between the 2 glasses will increase the resistance upto a certain level i.e., 13mm then it becomes constant upto 20mm thereafter the resistance again go down.

Explanation:
Increase in the thickness of single pane glass does not increase the resistance because area is inversely proportional to the resistance. When we compare the area of window with the thickness the impact of thickness will will always be less compared to area. Therefore even if we increase the thickness of glass the resistance won't change much.

2) I made a mistake in calculating the total resistance because instead of calculating separately I calculated it together for the 1st sum.

3) Calculate rate of heat transfer of a double pane window and it's surface temperatures?
Height $= 0.8$m
Width $= 1.5$m
k_1 (glass) $=0.78$ W°C
k_2 (of air gap) $= 0.026$
$h_1 = 10$
$h_2 = 40$
$T_{\infty 1} = 20$°C
$T_{\infty 2} = -10$°C
Thickness of glass $= 6$mm
Air gap thickness $= 13$mm

Sol:

$R_{conv1} = \frac{1}{h1A} = \frac{1}{(10)(1.2)} = 0.0833$

$R_{glass} = \frac{l}{K1A} = \frac{0.006}{(0.78)(1.2)} = 0.0064$

$R_{air\ gap} = \frac{l}{K1A} = \frac{0.013}{(0.026)(1.2)} = 0.4166$

$R_{conv2} = \frac{1}{h1A} = \frac{1}{(40)(1.2)} = 0.0208$

$R_{total} = 0.5335$

$Q = \frac{T\infty 1 - T\infty 2}{Rtotal} = \frac{30}{0.5335} = 56.232\ W$

$Q = \frac{T\infty 1 - T1}{Rcov1} = 56.232 = \frac{20 - T1}{0.0833}$

$T_1 = 15.32$°C

$Q = \frac{T1 - T2}{Rglass} = 56.232 = \frac{15.32 - T2}{0.0064}$

$T_2 = 14.96$°C

$$Q = \frac{T2 - T3}{Rair\ gap} = 56.232 = \frac{14.96 - T3}{0.4166}$$

T_3 = -8.47°C

$$Q = \frac{T3 - T4}{Rglass} = 56.232 = \frac{(-8.47) - T4}{0.0064}$$

T_4 = -8.83°C