Weekly Submission 2

Convective Heat Transfer

1. Convective Heat Transfer (Convection) is the transfer of heat energy between a surface and a moving fluids. Usually, the heat transfer occurs between two fluids, such as liquids and gases. However, the heat transfer is also possible between a solid and a moving liquid. For example, heat transfer can occur between the air outside of a wall and the wall itself.

   There are two types of Convective Heat Transfer. The first, Natural convection, is when the fluids move between different densities, without the help of an external force. For example, the cycle of air flowing occurs when hotter air rises because it is lighter in density than the cool air, which will move downward. The second, Forced Convection, is when the fluids move due to an external force, such as the wind or a fan forcing the air to move.

   Ultimately, the rate of convective heat transfer is affected by 1. the change in temperature, 2. the air velocity, and 3. the type of liquid or gas. The rate of heat convection into a wall will be equal to the rate of heat conduction through a wall, and both will be equal to the rate of heat convection from a wall.

2. Regarding the examples provided in the previous class: the first time I made a mistake was because I did not follow the order of operations correctly, and attempted to add before dividing, which I should have recognized was impossible.

   The second time, when I followed the order of operations correctly, I calculated the wrong anser because I failed to convert the units correctly. Instead of writing the 8mm glass as 0.008m, I wrote 0.08m.

3. Problem solving:

   Air-gap thickness= 13mm, glass thickness= 6mm, height= 0.8m, width= 1.5m, k of glass= 0.78, k of air-gap= 0.026, convective heat transfer coefficient on interior of window= 10, convective heat transfer coefficient on exterior of window= 40, A= (0.8m x 1.5m) = 1.20 m

   Rconv1 = 1 / h(1)A = 1 / (10 x 1.20) = 0.0833 C/W

   Rwall1 = L / k(2)A = 0.006 / (0.78 x 1.20) = 0.0064 C/W

   Rairgap = L / k(airgap)A = 0.013 / (0.026 x 1.20) = 0.4167 C/W

   Rwall2 = L / k(2)A = 0.006 / (0.78 x 1.20) = 0.0064 C/W

Rconv2 = 1 / h(2)A = 1 / (40 x 1.20) = 0.0208 C/W

Rtotal = Rconv1 + Rwall1 +Rairgap + Rwall2 + Rconv2

Rtotal = 0.0833 + 0.0064 + 0.4167 + 0.0064 + 0.0208 = 0.5336 C/W

Q = (T(infinity1) -T(infinity2)) / Rtotal = (20-(-10)) / 0.5336 = 56.2219 W

Q = (T(infinity1) - T1 / Rconv1

T1 = T(infinity1) - (Q x Rconv1) = 20 - (56.2219 x 0.0833) = 15.3167 C

We have optimal range for the air-gap's distance because we have reached a distance that allows the air inside to move, allowing the heat transfer in the air gap to shift from conduction to convection. Therefore, the rate of heat transfer in the double pane window glass decreases at a significant rate.