WEEK 9

TASK 1: Use a weather forecast website and utilize the psychometric chart and the formula to determine
a) the absolute humidity b) the wet bulb temperature
c) the mass of water vapor in class A

solution

a) Formula for absolute or specific humidity

$$\omega = \frac{0.622\ P_v}{P - P_v} \quad (\text{kg water vapor / kg dry air})$$

Data for weather: metro state .com

Relative humidity : 80% , Atmospheric pressure : 30 Hg = 101.59 kPa

Temperature : 6°C

To find P_v,

from the steam table, saturation pressure of water at 6°C is 0.935 KPa

$$\phi = \frac{P_v}{P_g} \Rightarrow P_v = \phi \times P_g = 0.8 \times 0.935 = 0.748\ KPa$$

$$P_a = P - P_v = 101.59 - 0.748 = 100.842\ KPa$$

$$\omega = \frac{0.622\ P_v}{P - P_v} = \frac{0.622 \times 0.748}{100.842} = \frac{0.4652}{100.842} = 0.00461$$

$\therefore \omega = 0.00461$ (kg of vapor / kg dry air)

b) wetbulb temperature.

By reading the psychrometric chart, the wet bulb temperature is 4°C.

∴ Wetbulb temperature = 4°C

c) The mass of water vapor in class A (5m×5m×3m)

$m = \frac{P_v}{R_{sp} \times T}$, assuming air is an ideal gas

$m_a = \frac{P_a V_a}{R_a \times T} = \frac{100.842 \times (5 \times 5 \times 3)}{0.287 \times (273+6)} = \frac{7563.15}{80.073}$

$m_a = 94.4531$ Kg

$m_v = \frac{P_v V_v}{R_v T} = \frac{0.748 \times (75)}{0.4615 \times (273+6)} = \frac{56.1}{128.758}$

$m_v = 0.0396$ kg

∴ mass of water vapour in class A is $m_v = 0.0396$kg

TASK 2 : Determine a) Sensible & latent load corresponding to internal gains b) ventilation c) infiltration

Solution

a) Sensible load = $q_{ig,s} = 136 + 2.2 A_{cf} + 22 N_{oc}$

$A_{cf} = 200$

$N_{oc} = 2$

$= 136 + 2.2 \times 200 + 22 \times 2$

$= 620$ W

∴ $q_{ig,s} = 620$ W

$q_{ig,l} = 20 + 0.22 A_{cf} + 12 N_{oc}$

$= 20 + 0.22 \times 200 + 12 \times 2$

$= 88 W$

∴ $q_{ig,l} = 88 W$

b) infiltration

$Q_i = A_L \cdot IDF$

$A_{uL} = 1.4 \frac{cm^2}{m^2}$ (C because good quality)

Exposed surface = Wall area x roof area

$A_{es} = 200 + 144 = 344 m^2$

$A_L = A_{es} \times A_{uL} = 344 \times 1.4$

$= 481.6 cm^2$

$IDF_{heating} = \frac{I_0 + H(\Delta t)[I_1 + I_2(A_{unflue}/A_L)]}{1000}$

$IDF\ heating = \frac{0.077 + 0.069}{2} = 0.073 \frac{L}{Scm^2}$

$IDf\ cooling = \frac{0.035 + 0.040}{2} = 0.0375 \frac{L}{Scm^2}$

$\therefore \dot{V}_{ih} = A_L \times IDF_{heating}$ (for heating)

$= 481.6 \times 0.073$

$= 35.156 \frac{L}{s}$

$V_{ic} = A_L \times IDF_{cooling}$ (for cooling)

$= 481.6 \times 0.0375$

$= 18.06 \frac{L}{s}$

c) Ventilation

$Q_v = 0.05 A_{cf} + 3.5 (N_{br} + 1)$

$= 0.05 \times 200 + 3.5 (1+1)$

$= 10 + 7$

$= 17 \frac{L}{s}$

$\dot{V}_{inf,\,ventilation.\,heating} = V_{ih} + Q_v = 35.156 + 17$

$= 52.156$ L/s

$V_{inf.\,ventilation.\,cooling} = V_{ic} + Q_v = 18.06 + 17$

$= 0.005$ L/s

~~$Q_{inf.\,vent,\,heating.\,latent} = $ Sensible $\times \dot{V} \Delta T$ cooling~~

$C_{sensible} = 1.23$

$C_{latent} = 3010$

$\Delta\omega_{cooling} = 0.0132 - 0.0093 = 0.0039$

$\Delta\omega_{heating} = 0.0190 - 0.0140 = 0.005$

$Q_{inf.ventilation\ cooling,\ sensible} = C_{sensible} \times V_{inf\ cooling} \times \Delta T_{cooling}$

$= 1.23 \times 35.06 \times 7.9$

$= 340.67\ W$

$Q_{inf.vent.cooling.latent} = C_{latent} \times V_{inf\ cooling} \times \Delta T_{cooling}$

$= 3010 \times 35.06 \times 0.0039$

$= 411.57\ W$

$Q_{inf\ vent.heating.sensible} = C_{sensible} \times V_{inf\ heating} \times \Delta T_{heating}$

$= 1.23 \times 52.156 \times 24.8$

$= 590.97\ W$

$Q_{inf\ vent\ heating\ sensible} = C_{latent} \times V_{inf\ heating} \times \Delta\omega_{heating}$

$= 3010 \times 52.156 \times 0.005$

$= 784.95\ W$