

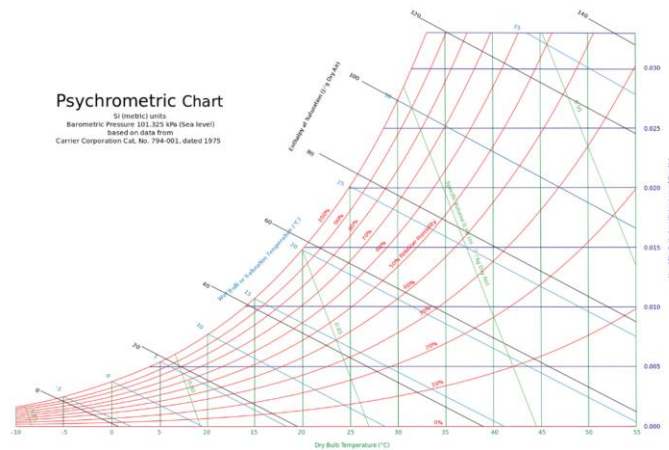
Question 1

Relative humidity ; 90%

Atmospheric pressure= 1028hPa

Therefore total air pressure = 102.8kPa

Temperature effettiva; 2°C; T = 275.15K



From the chart;

Wet bulb Temperature= 1 °C

Absolute humidity $\omega = 0.0035$

$$\omega = \frac{0.622 P_v}{P - P_v} = 0.0035 \frac{kg_{vapour}}{kg_{dryAir}}$$

$P_v = 0.575 \text{ kPa}$

If we take the room to be 12 by 8 by 4.5m

Formula for air; $m_a = \frac{P_a V_a}{R_a T}$ $R_{sp.} = \frac{R_{global}}{M_{gas}}$

$$m_v = \frac{0.575 * (12 * 8 * 4.5)}{0.4615 * (275.15 + 2)}$$

$$= 1.94 \text{ kg}$$

m_g = mass of water at sat condition

$$\phi = \frac{m_v}{m_g} = \frac{1.94}{2.26}$$

$$= 86\%$$

$$m_g = 2.26 \text{ kg}$$

Question 2

Height of building 2.5m²

Floor area 200 m²

Wall area 144 m²

Internal Gains

$$\begin{aligned}Q_{\text{ig, sensible}} &= 136 + 2.2 A_{\text{cf}} + 22N_{\text{oc}} \\&= 136 + 2.2 * 200 + 22 * 2 \\&= 620\text{W}\end{aligned}$$

$$\begin{aligned}Q_{\text{ig, latent}} &= 20 + 0.22 A_{\text{cf}} + 12N_{\text{oc}} \\&= 20 + 0.22 * 200 + 12 * 2 \\&= 88\text{W}\end{aligned}$$

Infiltration

$$\text{Good quality } (A_{ul}) = 1.4 \text{ cm}^2 / \text{m}^2$$

$$A_{\text{es}} = \text{Roof area} = 200 + 144$$

$$A_L = A_{\text{es}} * A_{ul} = (200 + 144) * 1.4 = 481.6 \text{ cm}^3$$

$$V_{\text{infiltration heating}} = A_L * \text{IDF}$$

$$\text{IDF}_{\text{heating}} = 0.073 \text{ L}/5\text{cm}^2$$

$$\text{IDF}_{\text{cooling}} = 0.03 \text{ L}/5\text{cm}^2$$

$$V_{\text{infiltration heating}}(Q_L) = A_L * \text{IDF} = 481.6 * 0.073 = 35.16 \text{ L/s}$$

$$V_{\text{infiltration cooling}}(Q_L) = A_L * \text{IDF} = 481.6 * 0.033 = 15.89 \text{ L/s}$$

Ventilation

$$V_{\text{ventilation}} = 0.05 * A_{\text{cf}} + 3.5(N_{\text{br}} + 1) = 0.05 * 200 + 3.5 * 2 = 17 \text{ L/s}$$

$$V_{\text{inf-ventilation heating}} = 35.16 + 17 = 52.16 \text{ L/s}$$

$$V_{\text{inf-ventilation cooling}} = 15.89 + 17 = 32.89 \text{ L/s}$$

$$\Delta T_{\text{cooling}} = 31.1 \text{ }^\circ\text{C} - 24 \text{ }^\circ\text{C} = 7.1 \text{ }^\circ\text{C} = 7.1 \text{ K}$$

$$\Delta T_{\text{heating}} = 21 \text{ }^\circ\text{C} - (-4.1 \text{ }^\circ\text{C}) = 25.1 \text{ }^\circ\text{C} = 25.1 \text{ K}$$

$$\text{DR} = 7.1 \text{ }^\circ\text{C} = 7.1 \text{ K}$$

$$C_{\text{sensible}} = 1.23, C_{\text{latent}} = 3010 \quad \Delta\omega_{\text{Cooling}} = 0.0039$$

$$\dot{Q}_{\text{inf-ventilation cooling sensible}} = C_{\text{sensible}} * \dot{V} \Delta T_{\text{Cooling}} = 1.23 * 32.89 * 7.1 = 287.25 \text{ W}$$

$$\dot{Q}_{\text{inf-ventilation cooling latent}} = C_{\text{latent}} * \dot{V} \Delta\omega_{\text{Cooling}} = 3010 * 32.89 * 0.0039 = 386.13 \text{ W}$$