

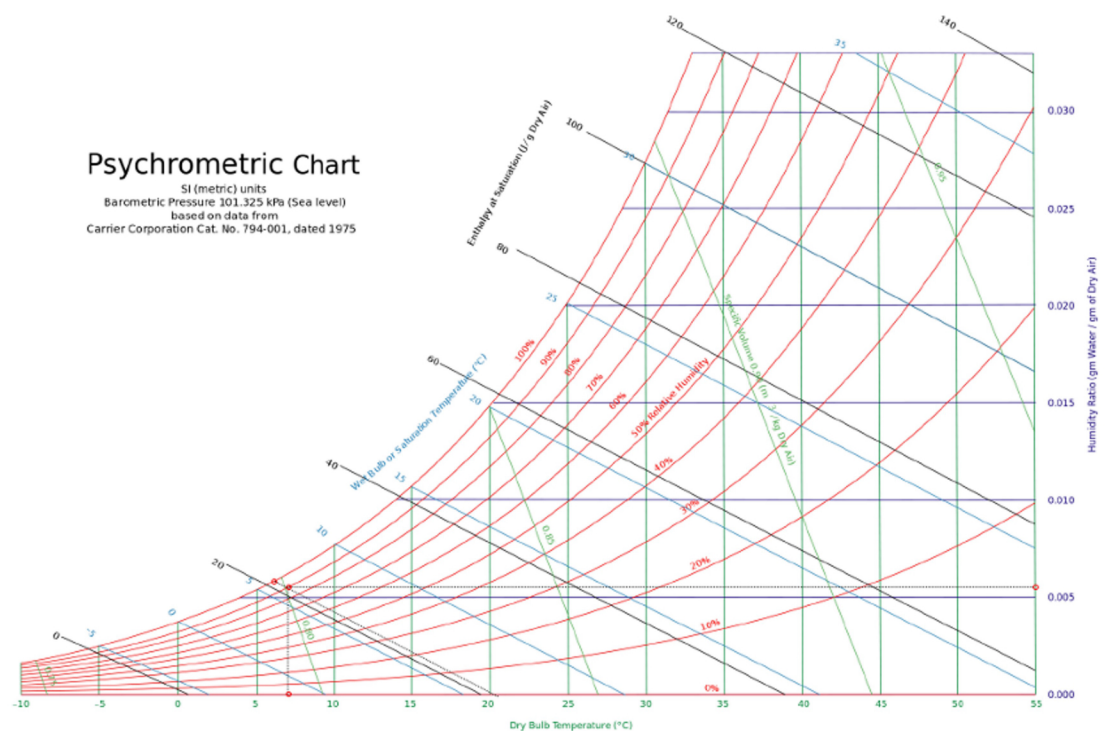
Task 1

The time now is 20:00, from the data given in the website <https://www.meteo-oggi.it/italia/regione-emilia-romagna/tempo-piacenza/>

umidità: 90%, i.e., the relative humidity
 ϕ
=90%;

pressione atmosferica: 1019 hPa, i.e., the total air pressure $P = 101.9$ kPa;

temperatura effettiva: 7
°C
, i.e., the temperature in Kelvin temperature scale $T = 230$ K



Utilize the psychrometric chart, we can see,

the humidity ratio, i.e., the absolute humidity
 ω
= 0.0055

the wet-bulb temperature
 $T_{wb} = 6$ °C

$\therefore \omega = 0.622 P_v P_a = 0.622 P_v P - P_v = 0.0055$, introduce $P = 101.9 \text{ kPa}$ into this equation, and solve it,

$$P_v \approx 0.893 \text{ kPa}$$

$$\text{autem, } \phi = m v m g = 90\% \dots (1)$$

for any ideal gas, $m = P V R_{sp} T$, during the class we were told that for water vapour, $R_{sp} = 0.4615$

introduce the pressure of water vapor

$P_v = 0.893 \text{ kPa}$, and define the volume of aula A is V , here we have:

$$m v = 0.893 V 0.4615 \times 230 \approx 8.41 \times 10^{-3} V$$

subordinate this value to equation (1), calculate the maximum water vapour $m g$,

$$m g = m v 90\% \approx 9.34 \times 10^{-3} V$$

Task 2

Internal gains,

Calculate the sensible cooling load from internal gains,

$$q_{ig, s} = 136 + 2.2 A_{cf} + 22 N_{oc} = 136 + 2.2 \times 200 + 22 \times 2 = 620 \text{ W}$$

Calculate the latent cooling load from internal gains,

$$q_{ig, l} = 20 + 0.22 A_{cf} + 12 N_{oc} = 20 + 0.22 \times 200 + 12 \times 2 = 88 \text{ W}$$

Infiltration,

for a house with a good construction quality, unit leakage area

$$A_{ul} = 1.4 \text{ cm}^2/\text{m}^2$$

and the exposed surface

$$A_{es} = A_{wall} + A_{roof} = 200 + 144 = 344 \text{ m}^2$$

thus,

$$A_L = A_{es} \times A_{ul} = 344 \times 1.4 = 481.6 \text{ cm}^2$$

Define the cooling temperature $T_{cooling} = 24\text{ }^{\circ}\text{C}$,
and heating temperature $T_{heating} = 20\text{ }^{\circ}\text{C}$

in Brindisi,
[Equazione]

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

$$\Delta T_{heating} = 20\text{ }^{\circ}\text{C} - (-4.1\text{ }^{\circ}\text{C}) = 24.1\text{ }^{\circ}\text{C} = 24.1\text{ K}$$

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

Given that $IDF_{heating} = 0.073\text{ Ls}\cdot\text{cm}^2$,

$$IDF_{cooling} = 0.033\text{ Ls}\cdot\text{cm}^2 ,$$

Calculate infiltration airflow rate,

$$Q_{i, \text{ heating}} = AL \cdot IDF_{heating} = 481.6 \cdot 0.073 \approx 35.157\text{ Ls}$$

$$Q_{i, \text{ cooling}} = AL \cdot IDF_{cooling} = 481.6 \cdot 0.033 \approx 15.893\text{ Ls}$$

The required minimum whole-building ventilation rate is

$$Q_v = 0.05A_{cf} + 3.5(N_{br} + 1) = 0.05 \cdot 200 + 3.5 \cdot (1 + 1) = 17\text{ Ls}$$

thus,

$$Q_{i-v, \text{ heating}} = Q_{i, \text{ heating}} + Q_v \approx 35.157 + 17 = 52.157\text{ Ls}$$

$$Q_{i-v, \text{ cooling}} = Q_{i, \text{ cooling}} + Q_v \approx 15.893 + 17 = 32.893\text{ Ls}$$

Given that

$$C_{sensible} = 1.23 , C_{latent} = 3010 , \Delta\omega_{cooling} = 0.0039$$

$$q_{inf-ventilation cooling sensible} = C_{sensible} Q_{i-v, \text{ cooling}} \Delta T_{cooling} \approx 1.23 \cdot 32.893 \cdot 7.1 \approx 287.25\text{ W}$$

$$q_{inf-ventilation cooling latent} = C_{latent} Q_{i-v, \text{ cooling}} \Delta\omega_{cooling} \approx 3010 \cdot 32.893 \cdot 0.0039 \approx 386.13\text{ W}$$

$$q_{inf-ventilation heating sensible} = C_{sensible} Q_{i-v, \text{ heating}} \Delta T_{heating} \approx 1.23 \cdot 52.157 \cdot 24.1 \approx 1546.09\text{ W}$$