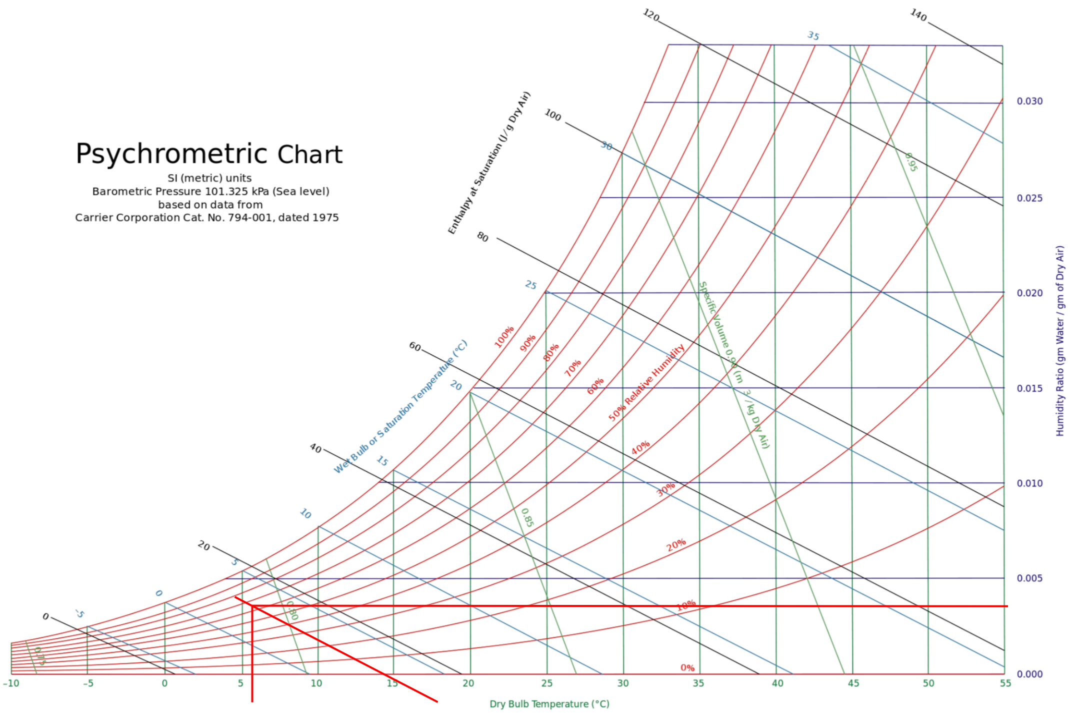
WEEK 9 SUBMISSION PAOLA GOBBI - 926210

1. **Use a weather forecast website, and utilize the psychrometric chart and the formula we went through in the class to determine the absoloute humidity, the wet-bulb temperature and the mass of water vapour in the air in ClassRoom A (Aula A) of Piacenza campus in the moment that you are solving this exercise (provide the inputs that you utilized)**

$P = 1017\ hPa \rightarrow 101{,}7\ KPa$

$T = 6°$

$\phi = 90\%$



ABSOLUTE HUMIDITY

$$\omega = 0{,}0052\ \frac{Kg_{water}}{Kg_{dry\ air}}$$

WET-BULB TEMPERATURE

$$T_{wb} = 5{,}2\ °C$$

MASS OF WATER VAPOR

$$\mathrm{V}_{room\ A} = 20 \cdot 6 \cdot 6 = 720\ m^2$$

$$P_v = \frac{P \cdot \omega}{0{,}622 + \omega} = \frac{101{,}7 \cdot 0{,}0052}{0{,}622 + 0{,}0052} = 0{,}84\ Kg$$

$$m_v = \frac{P_v \cdot \mathrm{V}}{R_v \cdot \mathrm{T}} = \frac{0{,}84 \cdot 720}{0{,}4615 \cdot (273 + 6)} = 4{,}7\ Kg$$

If I consider that when I am doing the exercise (Sunday), the Politecnico di Milano is closed, I assume as external temperature and humidity values for the calculation of the mass of vapor.

2. **Utilize the same methodology we went through in the class and determine the sensible and latent load corresponding to internal gains, the ventilation, and the infiltration in a house with a *good* construction quality and with the same geometry as that of the example which is located in Brindisi, Italy**

BRINDISI, Italy WMO#: **163200**

Lat: **40.65N** Long: **17.95E** Elev: **10** StdP: **101.2** Time Zone: **1.00 (EUW)** Period: **86-10** WBAN: **99999**

Annual Heating and Humidification Design Conditions

	Coldest Month	Heating DB 99.6%	Heating DB 99%	Humidification DP/MCDB and HR 99.6% DP	99.6% HR	99.6% MCDB	99% DP	99% HR	99% MCDB	Coldest month WS/MCDB 0.4% WS	0.4% MCDB	1% WS	1% MCDB	MCWS/PCWD to 99.6% DB MCWS	PCWD	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	
(1)	2	2.9	4.1	-5.1	2.5	7.2	-3.0	3.0	7.4	13.4	10.2	12.4	10.6	3.4	250	(1)

Annual Cooling, Dehumidification, and Enthalpy Design Conditions

	Hottest Month	Hottest Month DB Range	Cooling DB/MCWB 0.4% DB	0.4% MCWB	1% DB	1% MCWB	2% DB	2% MCWB	Evaporation WB/MCDB 0.4% WB	0.4% MCDB	1% WB	1% MCDB	2% WB	2% MCDB	MCWS/PCWD to 0.4% DB MCWS	PCWD	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	
(2)	8	7.1	32.8	23.6	31.1	24.3	29.9	24.3	27.2	29.7	26.3	29.0	25.6	28.3	4.2	180	(2)

	Dehumidification DP/MCDB and HR 0.4% DP	0.4% HR	0.4% MCDB	1% DP	1% HR	1% MCDB	2% DP	2% HR	2% MCDB	Enthalpy/MCDB 0.4% Enth	0.4% MCDB	1% Enth	1% MCDB	2% Enth	2% MCDB	Hours 8 to 4 & 12.8/20.6	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	
(3)	26.3	21.8	29.2	25.4	20.7	28.5	24.7	19.7	27.9	86.0	30.1	82.2	29.1	78.5	28.3	1236	(3)

Extreme Annual Design Conditions

	Extreme Annual WS 1%	2.5%	5%	Extreme Max WB	Extreme Annual DB Mean Min	Mean Max	Standard deviation Min	Standard deviation Max	n-Year Return Period Values of Extreme DB n=5 years Min	n=5 years Max	n=10 years Min	n=10 years Max	n=20 years Min	n=20 years Max	n=50 years Min	n=50 years Max	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	
(4)	11.3	9.9	8.7	31.4	0.4	37.3	1.4	3.0	-0.6	39.4	-1.4	41.1	-2.2	42.8	-3.2	44.9	(4)

$$h_{\text{building}} = 2{,}5\ m$$
$$A_{floor} = 200\ m^2$$
$$A_{wall} = 144\ m^2$$
$$N°\ occupants = 2$$
$$N°\ bedroom = 1$$

INTERNAL GAINS

$$\dot{Q}_{ig_{sensible}} = 136 + 2.2 \cdot A_{cf} + 22\, N_{oc} = 136 + 2.2 \cdot 200 + 22 \cdot 2 = 620\, W$$
$$\dot{Q}_{ig_{latent}} = 20 + 0.22 \cdot A_{cf} + 12\, N_{oc} = 20 + 0.22 \cdot 200 + 12 \cdot 2 = 88\, W$$

INFILTRATION

$A_{ul} = 1.4\ \frac{cm^2}{m2}$ (good quality)

$$A_{es} = A_{wall} + A_{roof}$$

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

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

$$IDF_{\mathrm{heating}} = 0.065\ \frac{L}{s.cm^2}$$

$$IDF_{cooling} = 0.032\ \frac{L}{s.cm^2}$$

$$\dot{V}_{infiltration_{\mathrm{heating}}} = A_L \times IDF_{\mathrm{heating}} = 481.6 \cdot 0.065 = 31.30 \frac{L}{s}$$

$$\dot{V}_{infiltration_{cooling}} = A_L \times IDF_{cooling} = 481.6 \cdot 0.032 = 15.41 \frac{L}{s}$$

VENTILATION

$$\dot{V}_{ventilation} = 0.05\, A_{cf} + 3.5\,(N_{br} + 1) = 0{,}05 \cdot 200 + 3{,}5 \cdot 2 = 17 \frac{L}{s}$$

$$\dot{V}_{infiltration-ventilation_{\mathrm{heating}}} = \dot{V}_{infiltration_{\mathrm{heating}}} + \dot{V}_{ventilation} = 31.30 + 17 = 48.30\ \frac{L}{s}$$

$$\dot{V}_{infiltration-ventilation_{cooling}} = \dot{V}_{infiltration_{cooling}} + \dot{V}_{ventilation} = 15.41 + 17 = 32.41\ \frac{L}{s}$$

$$C_{sensible} = 1.23$$

$$C_{latent} = 3010$$

$$\Delta\, T_{cooling} = 31.1\ - 24 = 7.1\ °C$$

$$\Delta\, T_{\text{heating}} = 20\ - (4.1) = 15.9\ °C$$

$$\dot{Q}_{inf-vent_{cooling_{sensible}}} = C_{sensible} \times \dot{V}_{inf-vent_{cooling}} \times \Delta T_{Cooling}$$
$$= 1.23\ \cdot 32.41 \cdot 7.1 = 283.04\ W$$

$$\dot{Q}_{inf-vent_{\text{heating}_{sensible}}} = C_{sensible} \times \dot{V}_{inf-vent_{\text{heating}}} \times \Delta T_{\text{heating}}$$
$$= 1.23\ \cdot 48.30 \cdot 15.9 = 944.6\ W$$

$$\omega_{out} = 0.0143 \frac{kg_{water}}{kg_{dryAir}}$$

$$\omega_{in} = 0.0093\ \frac{kg_{water}}{kg_{dryAir}}$$

$$\Delta\omega_{Cooling} = \omega_{out} - \omega_{in}\ = 0.0143 - 0.0093 = 0.005 \frac{kg_{water}}{kg_{DryAir}}$$

$$\dot{Q}_{inf-vent_{cooling_{latent}}} = \ C_{latent} \times \dot{V}_{inf-vent_{cooling}} \times \Delta\omega_{Cooling}$$
$$= 3010 \cdot 32.41\ \cdot\ 0.005 = 487.77\ W$$