submission week **9**

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1 Use a weather forecast website and utilize the psychrometric chart and the formula to determine the absolute humidity, the wet-bulb temperature and the mass of water vapor in the air in Classroom A of Piacenza campus in the moment that you are solving this exercise (provide the inputs that you utilized).

Il tempo oggi in Piacenza
Domenica, 01 Dicembre 2019

19:00

pioggia

Temperatura effettiva	7°C
Temperatura percepita	7°C
Precipitazioni	3 mm
Umidità	90 %
Pressione atmosferica	1018 hPa

dimensions classroom A:
lenght 20 m
width 6 m
weight 6 m

ABSOLUTE HUMIDITY

$$\omega = 0.0056 \frac{kg_{vapour}}{kg_{dryair}}$$

WET-BULB TEMPERATURE

$$T_{wb} = 6.24\,°C$$

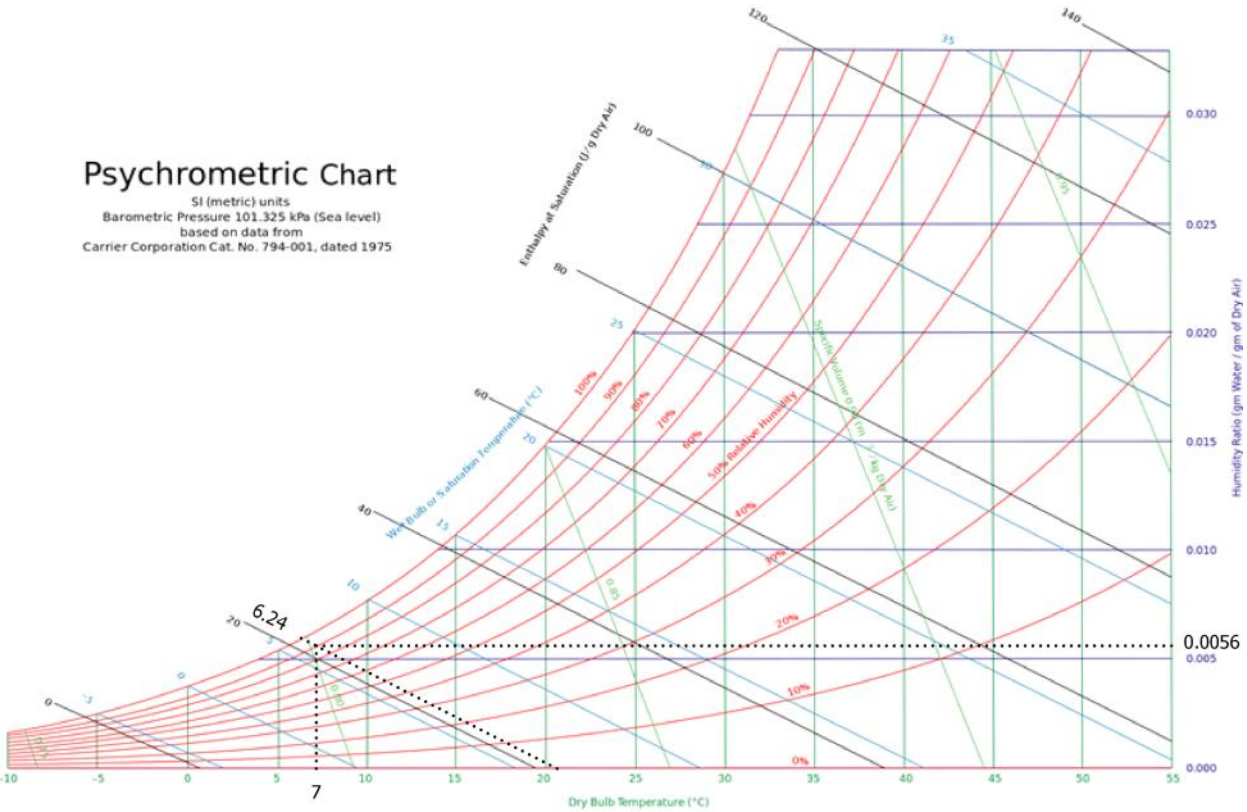
MASS OF WATER VAPOR

Assuming that at the moment that I am solving the exercise the internal temperature and the relative humidity of classroom A are the same as the external ones because on Sunday the campus is closed we have:

$$m_v = \frac{P_v \times V}{R_v \times T} = \frac{0.90 * 720}{0.4615 * (273 + 7)} = 5.01\,Kg$$

$$P_v = \varnothing\, P_g = \varnothing\, P_{sat}@7°C = 0.90 * 1 = 0.90\,KPa$$

$$V = 20\,m * 6m * 6m = 720\,m^3$$



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.

building height: 2.5m
conditioned floor area: 200 m^2
wall area: 144 m^2
number of occupants: 2
number of bedrooms: 2

out temperature: 31.1 °C
in temperature: 24
relative humidity: 50%

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		Humidification DP/MCDB and HR						Coldest month WS/MCDB				MCWS/PCWD to 99.6% DB		
		99.6%	99%	99.6%			99%			0.4%		1%				
				DP	HR	MCDB	DP	HR	MCDB	WS	MCDB	WS	MCDB	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						Evaporation WB/MCDB						MCWS/PCWD to 0.4% DB		
			0.4%		1%		2%		0.4%		1%		2%				
			DB	MCWB	DB	MCWB	DB	MCWB	WB	MCDB	WB	MCDB	WB	MCDB	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									Enthalpy/MCDB						Hours 8 to 4 & 12.8/20.6	
	0.4%			1%			2%			0.4%		1%		2%			
	DP	HR	MCDB	DP	HR	MCDB	DP	HR	MCDB	Enth	MCDB	Enth	MCDB	Enth	MCDB		
	(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			Extreme Max WB	Extreme Annual DB				n-Year Return Period Values of Extreme DB								
					Mean		Standard deviation		n=5 years		n=10 years		n=20 years		n=50 years		
	1%	2.5%	5%		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	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)

INTERNAL GAINS

$$\dot{Q}_{ig_{sensible}} = 136 + 2.2 \ * A_{cf} + 22\ N_{oc} = 136 + 2.2 * 200 + 22 * 2 = 620\ W$$

$$\dot{Q}_{ig_{latent}} = 20 + 0.22 * A_{cf} + 12\ N_{oc} = 20 + 0.22 * 200 + 12 * 2 = 88\ W$$

INFILTRATION

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

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

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

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

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

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

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

VENTILATION

$\dot{V}_{ventilation} = 0.05\ A_{cf} + 3.5\ (N_{br} + 1) = 0.05 * 200 + 3.5 * 2 = 17\ \frac{L}{s}$

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

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

$C_{sensible} = 1.23$

$C_{latent} = 3010$

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

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

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

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

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

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

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

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