Task 1: Use a weather forecast website, and utilize the psychrometric chart and the formula we went through in the class to determine the absolute humidity, the wet-bulb temperature and the mass of water vapor 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)

Il tempo oggi in Piacenza
Martedì, 03 Dicembre 2019

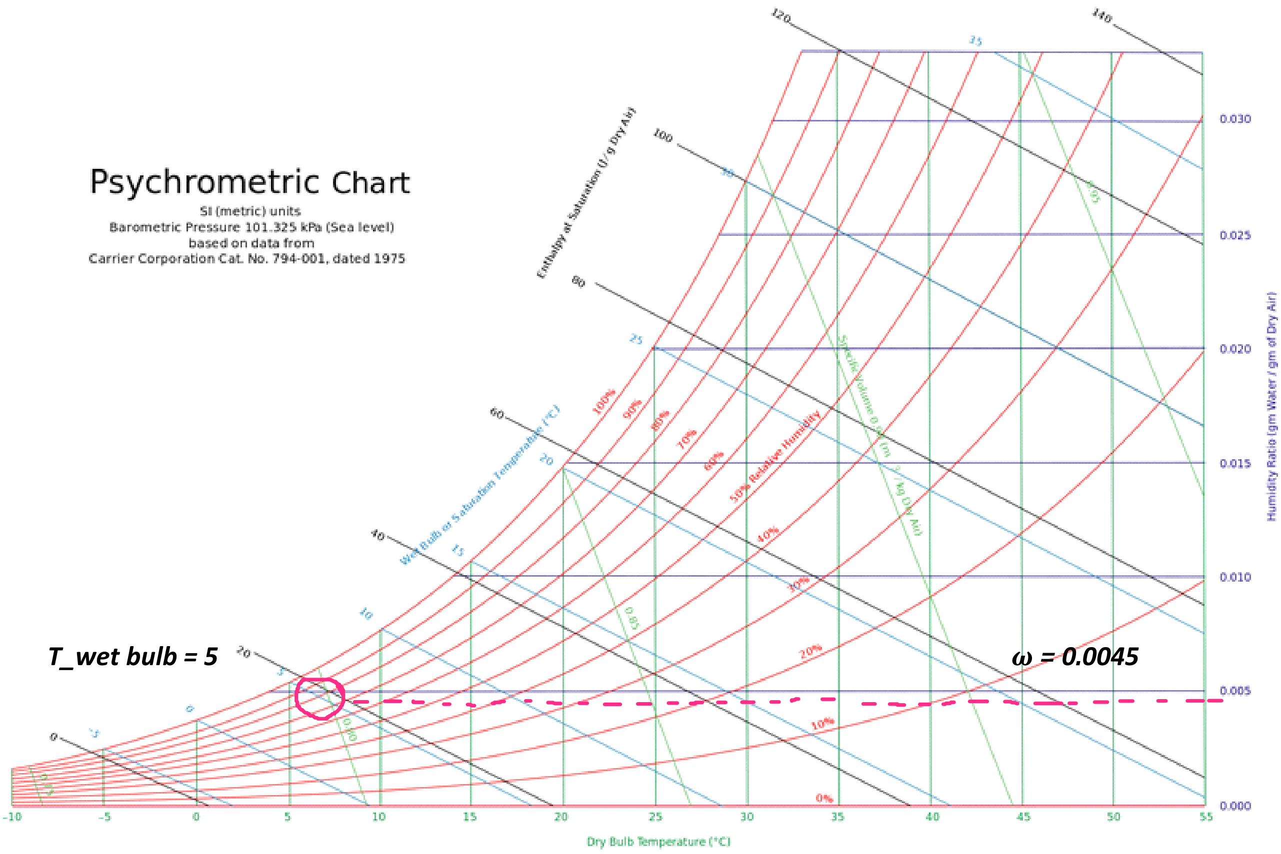
	13:00	14:00	16:00	18:00	20:00	21:00	22:00
	LightCloud	LightCloud	PartlyCloud	LightCloud	Sun	Sun	Sun
Temperatura effettiva	9°C	10°C	8°C	6°C	4°C	2°C	2°C
Temperatura percepita	7°C	10°C	6°C	4°C	2°C	0°C	0°C
Precipitazioni	0 mm	0 mm	0 mm	0 mm	0 mm	0 mm	0 mm
Umidità	67 %	65 %	69 %	70 %	75 %	83 %	87 %
Pressione atmosferica	1025 hPa	1025 hPa	1025 hPa	1026 hPa	1027 hPa	1027 hPa	1028 hPa
Intensità del vento	15 km/h	14 km/h	9 km/h	9 km/h	7 km/h	8 km/h	8 km/h
Direzione del vento	E	E	E	E	SE	SE	SE
Probabilità di nebbia	0 %	0 %	0 %	0 %	0 %	0 %	0 %
Punto di rugiada	3°C	3°C	3°C	1°C	-1°C	0°C	-1°C
Nuvole	21 %	13 %	42 %	15 %	2 %	3 %	3 %
Nuvole basse	11 %	7 %	42 %	15 %	2 %	3 %	3 %
Nuvole medie	18 %	12 %	2 %	0 %	1 %	0 %	0 %
Nuvole alte	0 %	0 %	0 %	0 %	0 %	0 %	0 %

December 3 | 16:00 | Piacenza, PC, Italy.

P = **102.5 kPa**;
Φ = **69%**;
T = **8 C or** T = **281 K**;
P_g = **1.079 kPa;**
Considering Aula A as **10m*8m*5m**

We need to determine:

1) the absolute humidity - ω
2) the wet-bulb temperature - T_wet bulb
3) the mass of water vapor in the air - m



The absolute humidity formula:

$$\omega = 0.622\frac{P_v}{P_a}$$

$$\omega = 0.622\frac{0.744}{101.756} = \mathbf{0.0045}\ \boldsymbol{kg_v/kg_a}$$

$$\phi = \frac{m_v}{m_g} = \frac{P_v}{P_g}$$

$P_v = P_g * \phi$ = *1.079 * 0.69 =* ***0.744 kPa***

$$P_a = P - P_v = 102.5 - 0.744 = \mathbf{101.756}\ \boldsymbol{kPa}$$

$$m_a = \frac{P_a V_a}{R_a T} = \frac{101.756 * (10 * 8 * 5)}{0.287 * 281} = \mathbf{504.69}\ \boldsymbol{kg}$$

$$m_v = \frac{P_v V_a}{R_v T} = \frac{0{,}744 * (10 * 8 * 5)}{0.4615 * 281} = \mathbf{2.29}\ \boldsymbol{kg}$$

Task 1: 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		Humidification DP/MCDB and HR						Coldest month WS/MCDB				MCWS/PCWD to 99.6% DB	
				99.6%			99%			0.4%		1%			
		99.6%	99%	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

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

	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

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

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**

$A_{es}=200+144=$**344** m^2
$A_L=A_{es}\times A_{ul}=344\times 1.4=$**481.6** cm^2

Table 5 Typical IDF Values, L/(s·cm²)

H, m	Heating Design Temperature, °C −40	−30	−20	−10	0	Cooling Design Temperature, °C 10	30	35	40
2.5	0.10	0.095	0.086	0.077	0.069	0.060	0.031	0.035	0.040
3	0.11	0.10	0.093	0.083	0.072	0.061	0.032	0.038	0.043
4	0.14	0.12	0.11	0.093	0.079	0.065	0.034	0.042	0.049
5	0.16	0.14	0.12	0.10	0.086	0.069	0.036	0.046	0.055
6	0.18	0.16	0.14	0.11	0.093	0.072	0.039	0.050	0.061
7	0.20	0.17	0.15	0.12	0.10	0.075	0.041	0.051	0.068
8	0.22	0.19	0.16	0.14	0.11	0.079	0.043	0.058	0.074

$IDF_{heating}=$**0.063** L/(s.cm^2)
$IDF_{cooling}=$**0.031** L/(s.cm^2)

$\dot{V}_{(infiltration\_heating)}=A_L\times IDF=\ 481.6*0.063=$**30.34 L/s**
$\dot{V}_{(infiltration\_cooling)}=A_L\times IDF=\ 481.6*0.31=$**14.92 L/s**

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

$\dot{V}_{(inf\text{-}ventilation\_heating)}=30.34+17=$**47.34 L/s**
$\dot{V}_{(inf\text{-}ventilation\_cooling)}=14.92+17=$**31.92 L/s**

C_sensible=1.23 , C_latent=3010

$\dot{Q}_{(inf\text{-}ventilation\_(cooling\_sensible))}=C_{sensible}\ \dot{V}\ \Delta T_{Cooling}=1.23*31.92*7.1=$**278 W**
$\dot{Q}_{(inf\text{-}ventilation\_(cooling\_(latent)))}=C_{latent}\ \dot{V}\ \Delta\omega_{Cooling}=3010*31.92*0.0039=$**374 W**

$\dot{Q}_{(inf\text{-}ventilation\_(heatingg\_sensible))}=C_{sensible}\ \dot{V}\ \Delta T_{heating}=1.23*47.34*15.9=$**925.28 W**