WEEK 9 SUBMISSION

QUESTION 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)

ANSWER 1:

Il tempo oggi in Piacenza
Mercoledì, 04 Dicembre 2019

	05:00	07:00	10:00	14:00	18:00	19:00	21:00
	LightCloud	PartlyCloud	Sun	Sun	LightCloud	PartlyCloud	PartlyCloud
Temperatura effettiva	2°C	0°C	4°C	7°C	2°C	1°C	0°C
Temperatura percepita	1°C	-3°C	3°C	5°C	0°C	-1°C	-2°C
Precipitazioni	0 mm	0 mm	0 mm	0 mm	0 mm	0 mm	0 mm
Umidità	83 %	93 %	79 %	66 %	88 %	89 %	93 %
Pressione atmosferica	1027 hPa	1027 hPa	1027 hPa	1025 hPa	1025 hPa	1025 hPa	1025 hPa
Intensità del vento	5 km/h	8 km/h	5 km/h	9 km/h	6 km/h	6 km/h	6 km/h
Direzione del vento	E	E	NE	E	S	SW	SW
Probabilità di nebbia	0 %	0 %	0 %	0 %	0 %	0 %	0 %
Punto di rugiada	0°C	-1°C	1°C	1°C	0°C	0°C	-1°C
Nuvole	13 %	59 %	12 %	9 %	17 %	70 %	91 %
Nuvole basse	6 %	8 %	12 %	9 %	2 %	1 %	0 %
Nuvole medie	0 %	0 %	0 %	0 %	0 %	0 %	0 %
Nuvole alte	8 %	56 %	0 %	0 %	16 %	70 %	91 %

According to the table

$T = 4℃$

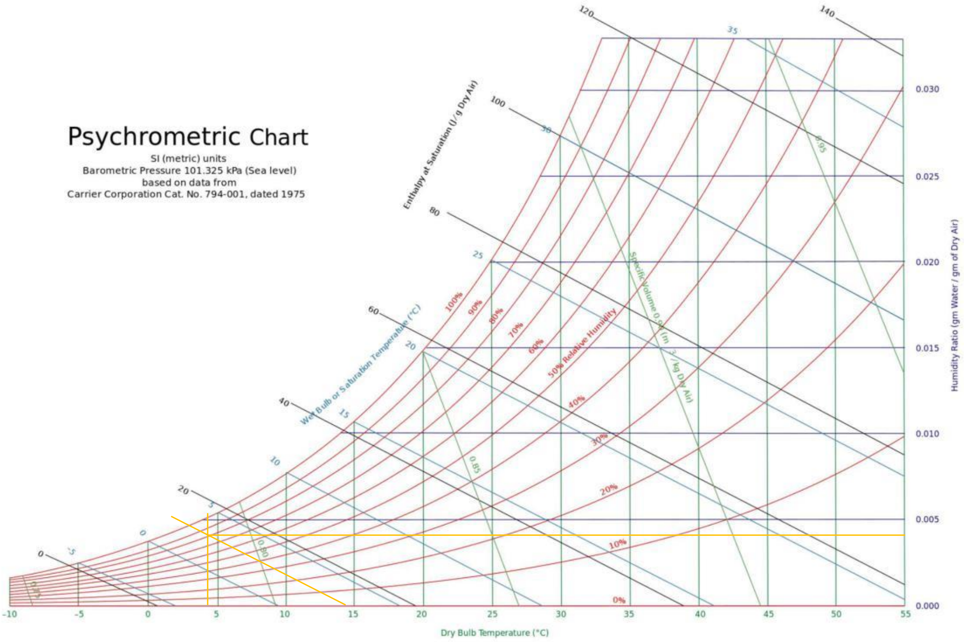
$\omega = 79\%$

$P = 102.7kPa$

Water saturation pressure at 4 degree C:

0.813 kPa

$ClassroomA: 12m \times 6m \times 5m$



From the chart,

$$T_{wb} = 3℃$$
$$\omega = 0.004$$

$$\omega = \frac{0.622P_v}{P_a} = \frac{0.622P_v}{P - P_v} = 0.004$$

introduce

$$P = 102.7kP_a$$

$$P_v = 0.656kP_a$$

For ideal gas

$$m = \frac{PV}{R_{sp} \cdot T}$$

$$R_{sp} = 0.4615$$

$$m_v = \frac{PV}{R_{sp} \cdot T} = \frac{0.656 \times (12 \times 6 \times 5)}{0.4615 \times (273 + 4)} = 1.847kg$$

$$m_g = \frac{m_v}{\phi} = \frac{1.847}{79\%} = 2.338kg$$

$$h_a = 1.005 \times 3 = 3.015kJ / kg_{dryair}$$

$$h_v = 2501.3 + 1.82 \times 3 = 2506.76kJ / kg_{water}$$

$$h = h_a + \omega h_v = 3.015 + 0.004 \times 2506.76 = 13.04kJ / kg_{dryAir}$$

QUESTION 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

ANSWER 2:

Good quality construction $A_{ul} = 1.4cm^2 / m^2$

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

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

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

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

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	$\boxed{4.1}$	-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	$\boxed{31.1}$	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)

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

$$IDF_{heating} = 0.032 \frac{L}{s \cdot cm^2}$$

$$\dot{V}_{\inf iltration_{heating}} = A_l \times IDF = 481.6 \times 0.065 = 31.304 \frac{L}{s}$$

$$\dot{V}_{\inf iltration_{cooling}} = A_l \times IDF = 481.6 \times 0.032 = 15.411 \frac{L}{s}$$

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

$$\dot{V}_{\inf - ventilation_{heating}} = 31.304 + 17 = 48.30 \frac{L}{s}$$

$$\dot{V}_{\inf - ventilation_{cooling}} = 15.411 + 17 = 32.41 \frac{L}{s}$$

$$\dot{Q}_{\inf - ventilation_{heating_{sensible}}} = C_{sensible} \dot{V} \Delta T_{heating} = 1.23 \times 48.30 \times 15.9 = 944.60 W$$

$$\dot{Q}_{\inf - ventilation_{heating_{latent}}} = C_{latent} \dot{V} \Delta \omega_{heating} = 3010 \times 48.30 \times 0.0065 = 944.99 W$$

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

$$\dot{Q}_{\inf - ventilation_{cooling_{latent}}} = C_{latent} \dot{V} \Delta \omega_{cooling} = 3010 \times 32.41 \times 0.0039 = 380.46 W$$