Week 9_Ma Lanlan

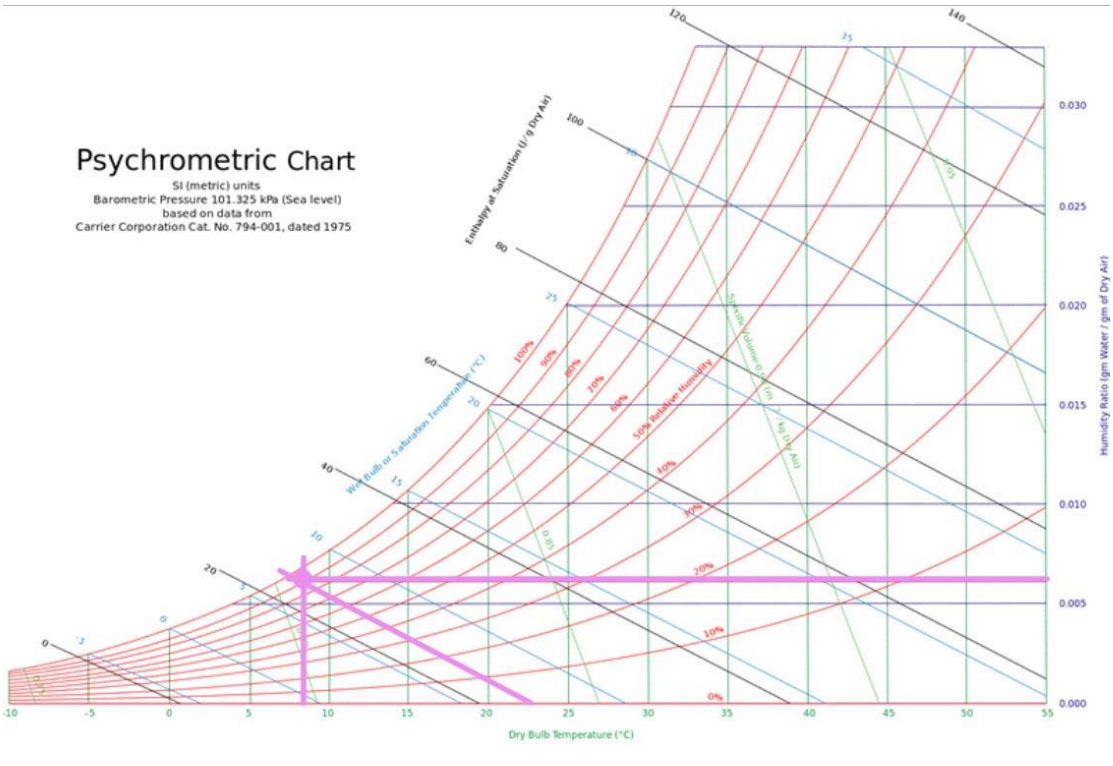
Task 1

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)

Humidity: 90% = Relative humidity: φ = 90%

Pressione atmosferica: 1019 hPa = total air pressure P = 101.9 kPa

Effective temperature: 7C° = 230 K



Utilizing the psychometric chart, we can notice that

-The absolute humidity $\omega = 0.0055$

-Twb = 6℃

$$\omega = \frac{0.622P_v}{P_a} = \frac{0.622P_v}{P - P_v} = 0.0055$$

$$P_v = 0.893_{circa}$$

$$\phi = \frac{m_v}{m_g} = 90\%$$

$$\text{m (for gasses in general)} \frac{P_v}{R_{sp,}\, T}$$

$$\text{for water vapor } R_{sp} = 0.4615$$

$$P_v\text{(pressure of water vapor)} = 0.893\text{ k Pa}$$

$$\text{Volume(V) of classroom, where}$$

$$m_v = \frac{0.893V}{0.4615 * 230} = 8.41 * 10^{-3}V$$

$$m_g = \frac{m_v}{90\%} = 9.34 * 10^{-3}V$$

Task 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		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**	(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)

Soln:

Number of occupants=2

Number of bed rooms=1

Height of the building=2.5m

Area of the floor=200 ㎡

Internal gains：

$Q_{igsensible} = 136 + 2.2A_{cf} + 22N_{oc} = 136 + 2.2 * (200) + 22 * 2 = 620W$

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

*I*nfiltrations

Given that

For a house with a good construction quality, unit leakage area $A_{ul} = 1.4cm^2 / m^2$

And the exposed surface $A_{es} = A_{wall} + A_{roof} = 200 + 144 = 344m^2$

cooling temperature $T_{cooling} = 24℃$, and heating temperature $T_{heating} = 20℃$ in Brindisi,

$\Delta T_{cooling} = 31.1 - 24 = 7.1℃ = 7.1K$

$\Delta T_{heating} = 20 - (-4.1) = 24.1℃ = 24.1K$

$DR = 7.1℃ = 7.1$

$$IDF_{heating} = 0.073 \frac{L}{s * Cm^2}$$

$$IDF_{cooling} = 0.33 \frac{L}{s * cm^2}$$

Infiltration airflow rate

$$Q_{i,heating} = A_L * IDF_{heating} = 481.6 * 0.073 = 35.15 \frac{L}{S}$$

$$Q_{i,cooling} = A_L * IDF_{cooling} = 481.6 * 0.033 = 15.89 \frac{L}{S}$$

The required miminum whole - building vetilation rate is

$$Q_v = 0.05A_{cf} + 3.5(N_{br} + 1) = 0.05 * 200 + 3.5 * (1 + 1) = 17 \frac{L}{S}$$

$$Q_{i-v,heating} = Q_{i,heating} + Q_v = 35.157 + 17 = 52.15 \frac{L}{S}$$

$$Q_{i-v,cooling} = Q_{i,cooling} + Q_v = 15.893 + 17 = 32.89 \frac{L}{S}$$

Given that

$C_{sensible} = 1.23$

$C_{latent} = 3010$

$\Delta\omega_{cooling} = 0.0039$

$$q_{inf - ventilation\ cooling\ sensible} = C_{sensible} Q_{i-v,cooling} \Delta T_{cooling} = 1.23 * 32.89 * 7.1 = 287.25w$$

$$q_{inf - ventilation\ cooling\ latent} = C_{latent} Q_{i-v,cooling} \Delta\omega_{cooling} = 3010 * 32.89 * 0.0039 = 386.13w$$

$$q_{inf - ventilation\ heating\ latent} = C_{sensible} Q_{i-v,heating} \Delta T_{cooling} = 1.23 * 52.15 * 24.1 = 1546w$$