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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
Domenica, 01 Dicembre 2019

	22:00	23:00
	pioggia	LightRain
Temperatura effettiva	8°C	8°C
Temperatura percepita	7°C	7°C
Precipitazioni	1 mm	1 mm
Umidità	95 %	95 %
Pressione atmosferica	1017 hPa	1017 hPa
Intensità del vento	6 km/h	5 km/h
Direzione del vento	NO	O
Probabilità di nebbia	0 %	0 %
Punto di rugiada	7°C	7°C
Nuvole	100 %	100 %
Nuvole basse	100 %	100 %
Nuvole medie	100 %	100 %
Nuvole alte	45 %	100 %

$$T = 8°C$$
$$\phi = 95\%$$
$$P = 101.7\ KPa$$
$$Aula\ A = 10m \times 5m \times 4m$$
$$Saturation\ pressure\ of\ water\ 8°C = 1.079\ KPa$$

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

$$P_g = P_{sat} 8°C = 1.079\ kPa$$

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

$$P_v = \mathrm{P_g} \times \phi$$
$$P_v = 1.079 \times 0.95$$
$$P_v = 1.029 kPa$$

$$P_a = P - P_v$$
$$P_a = 101.7\ kPa - 1.029\ kPa$$
$$P_a = 100.671\ kPa$$

$$\omega = 0.622 \frac{P_v}{P_a}$$
$$\omega = 0.622 \frac{1.029}{100.671}$$
$$\omega = 0.0063 \frac{Kg_{vapor}}{Kg_{dryair}}$$

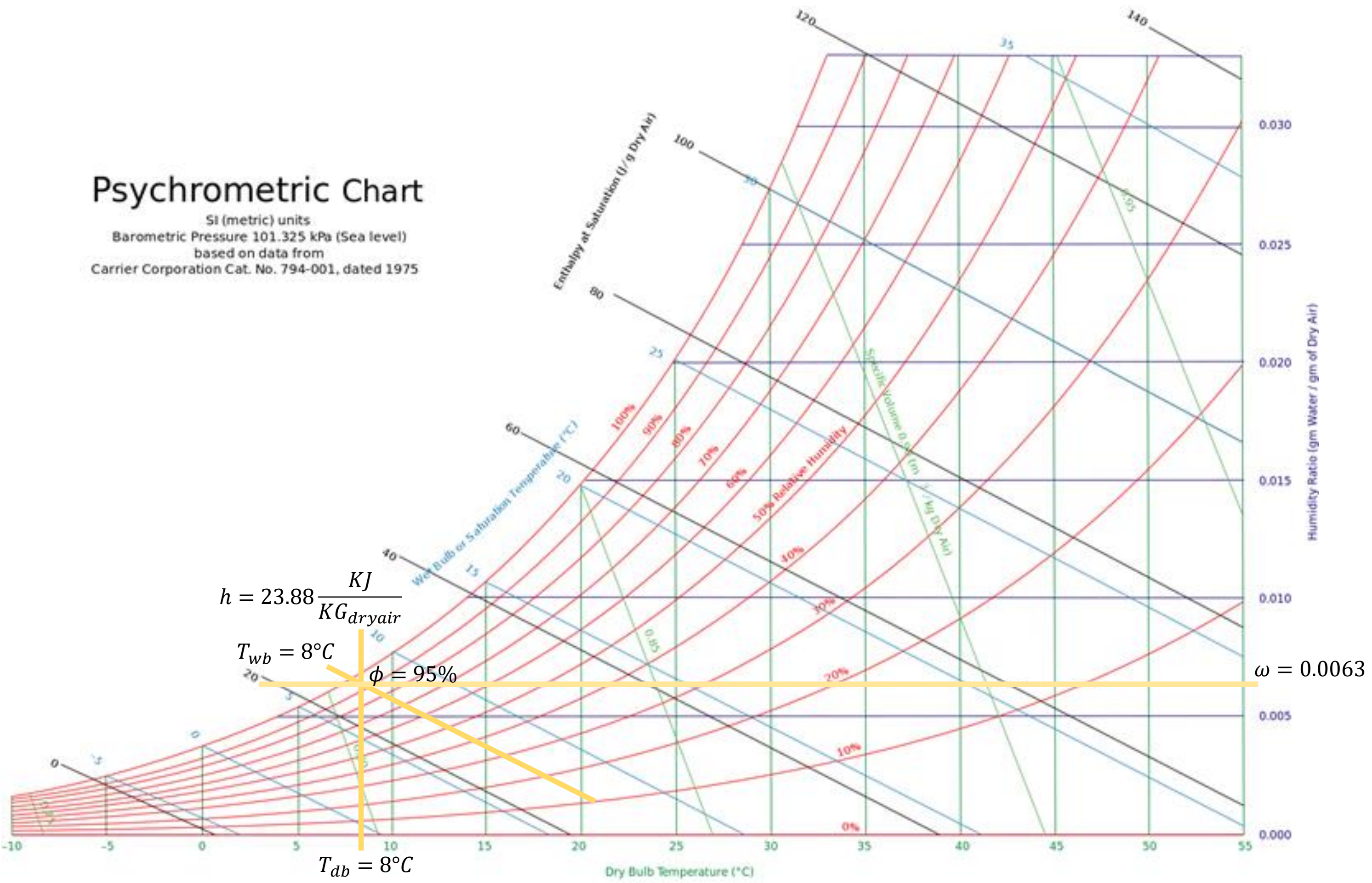
$$m_a = \frac{P_a V_a}{R_a T}$$
$$m_a = \frac{100.671 \times (10 \times 5 \times 4)}{0.287 \times (273 + 8)}$$
$$m_a = 249.65\ Kg$$

$$m_v = \frac{P_v V_a}{R_v T}$$
$$m_v = \frac{1.029 \times (10 \times 5 \times 4)}{0.4615 \times (273 + 8)}$$
$$m_v = 1.58\ Kg$$

$$h = h_a + \omega h_v$$
$$h = 8.04 + 0.0063 \times 2515.86$$
$$h = 23.88$$

$$h_a = 1.005 \times 8°C$$
$$h_a = 8.04 \frac{kJ}{kg_{dryair}}$$

$$h_v = 2501.3 + 1.82(8°C)$$
$$h_v = 2515.86 \frac{kJ}{kg_{water}}$$



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

h = 2.5m
area = 200 m2
Wall area = 144 m2
Good quality construction Aul=1.4 cm2/m2
Location: Brindisi, Italy
Two occupants
One bedroom

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

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

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

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	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)

$$IDF_{heating} = 0.06369 \frac{L}{s \times cm^2}$$

$$V_{infiltration_{heating}} = A_L \times IDF = 481.6\ cm^2 \times 0.06369 \frac{L}{s \times cm^2} = 30.6731 \frac{L}{s}$$

$$IDF_{cooling} = 0.03188 \frac{L}{s \times cm^2}$$

$$V_{infiltration_{cooling}} = A_L \times IDF = 481.6\ cm^2 \times 0.03188 \frac{L}{s \times cm^2} = 15.3534 \frac{L}{s}$$

$$V_{ventilation} = 0.05\ A_{cf} + 3.5(N_{br} + 1) = 0.05 \times 200m^2 + 3.5 \times 2 = 17 \frac{L}{s}$$

$$V_{inf-ventilation_{heating}} = 30.67 \frac{L}{s} + 17 \frac{L}{s} = 47.67 \frac{L}{s}$$

$$V_{inf-ventilation_{cooling}} = 15.35 \frac{L}{s} + 17 \frac{L}{s} = 32.35 \frac{L}{s}$$

$$Qinf - ventilation_{cooling_{sensible}} = C_{sensible} V \Delta T_{cooling} = 1.23 \times 32.35 \frac{L}{s} \times 7.1 = 282.51\ W$$

$$Qinf - ventilation_{cooling_{latent}} = C_{latent} V \Delta \omega_{cooling} = 3010 \times 32.35 \frac{L}{s} \times 0.0039 = 379.75\ W$$

$$Qinf - ventilation_{heating_{sensible}} = C_{sensible} V \Delta T_{heating} = 1.23 \times 47.67 \frac{L}{s} \times 15.9 = 932.28\ W$$

$$Qinf - ventilation_{heating_{latent}} = C_{latent} V \Delta \omega_{heating} = 3010 \times 47.67 \frac{L}{s} \times 0.0065 = 932.66\ W$$