





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	Light Rain
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 %

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

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

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

$$P_v = P_g \times \phi$$

$$P_v = 1.079 \times 0.95$$

$$P_v = 1.029 \text{ kPa}$$

$$P_a = P - P_v$$

$$P_a = 101.7 \text{ kPa} - 1.029 \text{ kPa}$$

$$P_a = 100.671 \text{ kPa}$$

$$m_a = \frac{P_a V_a}{R_a T}$$

$$m_a = \frac{100.671 \times (10 \times 5 \times 4)}{0.287 \times (273 + 8)}$$

$$m_a = 249.65 \text{ Kg}$$

$$h_a = 1.005 \times 8^{\circ}\text{C}$$

$$h_a = 8.04 \frac{\text{kJ}}{\text{kg dryair}}$$

$$P_g = P_{\text{sat}} 8^{\circ}\text{C} = 1.079 \text{ kPa}$$

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

$$\omega = 0.622 \frac{1.029}{100.671}$$

$$\omega = 0.0063 \frac{\text{kg vapor}}{\text{kg dryair}}$$

$$m_v = \frac{P_v V_a}{R_v T}$$

$$m_v = \frac{1.029 \times (10 \times 5 \times 4)}{0.4615 \times (273 + 8)}$$

$$m_v = 1.58 \text{ Kg}$$

$$h_v = 2501.3 + 1.82(8^{\circ}\text{C})$$

$$h_v = 2515.86 \frac{\text{kJ}}{\text{kg water}}$$

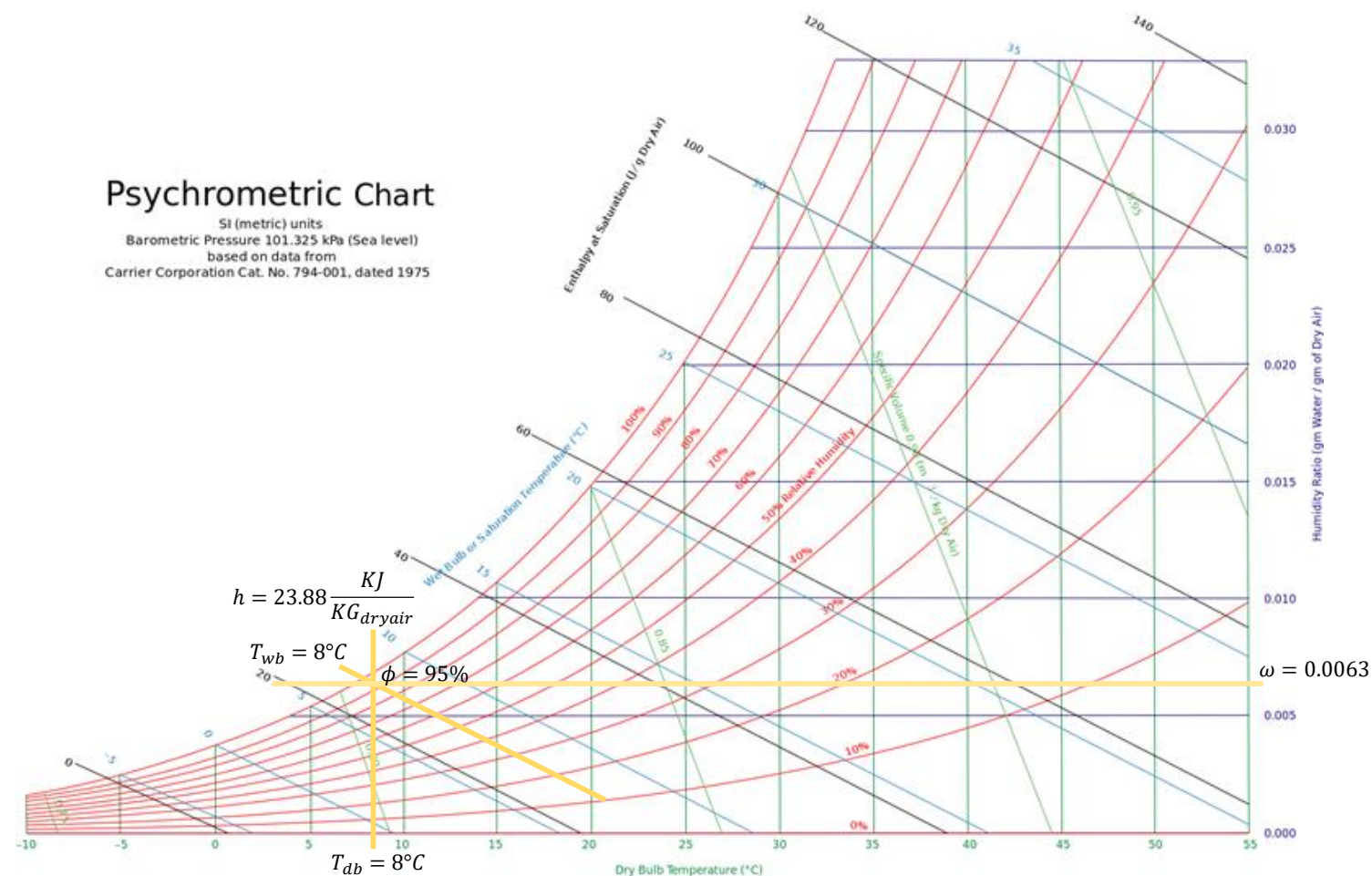
$$h = h_a + \omega h_v$$

$$h = 8.04 + 0.0063 \times 2515.86$$

$$h = 23.88$$

Psychrometric Chart

SI (metric) units
 Barometric Pressure 101.325 kPa (Sea level)
 based on data from
 Carrier Corporation Cat. No. 794-001, dated 1975



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 A_{ul} = 1.4 cm²/m²
 Location: Brindisi, Italy
 Two occupants
 One bedroom

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

$$Q_{ig_{sensible}} = 136 + 2.2 \times 200 + 22 \times 2$$

$$Q_{ig_{sensible}} = 620 \text{ W}$$

$$Q_{ig_{latent}} = 20 + 0.22 \times A_{cf} + 12N_{oc}$$

$$Q_{ig_{latent}} = 20 + 0.22 \times 200 + 12 \times 2$$

$$Q_{ig_{latent}} = 88 \text{ W}$$

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

$$A_L = 344 \times 1.4 = 481.6 \text{ cm}^2$$

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%	99.6%			99%			0.4%		1%			
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)
(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
(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
(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

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)

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

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

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

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

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

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

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

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

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

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

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