Week-9-Fatemeh Kazemi

Tuesday, December 3, 2019 8:46 PM

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)

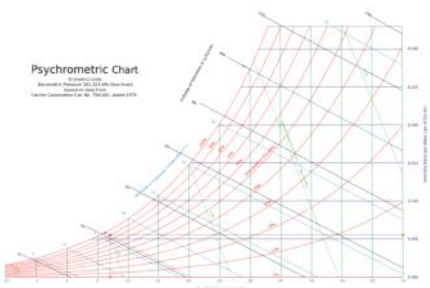
[Weather Forecast Website example]

Umidità: Relative humidity, Pressione atmosferica: Air total pressure (1 hPa: 0.1 kPa), Temperatura effettiva: temperature to be utilized.

Il tempo oggi in Piacenza
Lunedì, 02 Dicembre 2019

	13:00	14:00	16:00	18:00	20:00	21:00	22:00
	PartlyCloud	PartlyCloud	LightCloud	LightCloud	PartlyCloud	Cloud	PartlyCloud
Temperatura effettiva	10°C	10°C	9°C	6°C	7°C	7°C	8°C
Temperatura percepita	10°C	10°C	8°C	5°C	7°C	6°C	7°C
Precipitazioni	0 mm	0 mm	0 mm	0 mm	0 mm	0 mm	0 mm
Umidità	79 %	77 %	89 %	90 %	90 %	92 %	91 %
Pressione atmosferica	1016 hPa	1015 hPa	1016 hPa	1017 hPa	1019 hPa	1019 hPa	1020 hPa

The time now is 8 pm from the data given in the website :
relative humidity is =90%
Total air presure = 101.9 kPa
Tempurture in kelvin scale T= 230 K



absoulte humidty $\omega = 0{,}0055$

balb temperature $T_{wb} = 6°c$

$$\omega = \frac{0{,}622 P_v}{P_a} = \frac{0{,}622 P_v}{P - P_v} = 0{,}0055$$

intarduce $P = 101{,}9$ Kpa

$P_v \approx 0{,}893$ Kpa

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

for any Ideal gas => water vapour, $R_{sp} = 0{,}4615$

$P_v = 0{,}893$ Kpa

$$m_v = \frac{0{,}893\,V}{0{,}4615 \times 230} \approx 8{,}41 \times 10^{-3}\,V$$

$$m_g = \frac{m_v}{90\%} \simeq 9{,}34 \times 10^{-3}\,V$$

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 99.6%	Heating DB 99%	Humidification 99.6% DP	99.6% HR	99.6% MCDB	99% DP	99% HR	99% MCDB	Coldest month 0.4% WS	0.4% MCDB	1% WS	1% MCDB	MCWS/PCWD to 99.6% DB 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 0.4% DB	0.4% MCWB	1% DB	1% MCWB	2% DB	2% MCWB	Evaporation 0.4% WB	0.4% MCDB	1% WB	1% MCDB	2% WB	2% MCDB	MCWS/PCWD to 0.4% DB 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 0.4% DP	0.4% HR	0.4% MCDB	1% DP	1% HR	1% MCDB	2% DP	2% HR	2% MCDB	Enthalpy 0.4% Enth	0.4% MCDB	1% Enth	1% MCDB	2% Enth	2% MCDB	Hours 8 to 4 & 12.8/20.6	
	(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 1%	2.5%	5%	Extreme Max WB	Extreme Annual DB Mean Min	Mean Max	Standard deviation Min	Standard deviation Max	n=5 years Min	n=5 years Max	n=10 years Min	n=10 years Max	n=20 years Min	n=20 years Max	n=50 years Min	n=50 years 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)

internal gains:

calculate the sensible cooling load from internal gains:

$$q_{ig,s} = 136 + 2.2 A_{cf} + 22 N_{bc} = 136 + 2.2 * 22 * 200 + 22 * 2 = 620 W$$

calculate cooling f int gains.

$$q_{ig,l} = 20 + 0{,}22 A_{cf} + 12 N_{bc} = 20 + 0{,}22 * 200 + 12 * 2 = 88 W$$

infiltration:

$$A_{ul} = 1{,}4\ cm^2/m^2$$

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

thus, $A_L = A_{es} \times A_{ul} = 344 \times 1{,}4 = 481{,}6\ cm^2$

$T_{cooling} = 24°C \quad T_{heating} = 20°C$

$$\Delta T_{cooling} = 31{,}1°C - 24°C = 7{,}1°C = 7{,}1 K$$

$$\Delta T_{heating} = 20°C - (-4{,}1°C) = 24{,}1°C = 24{,}1 K$$

$$DR = 7{,}1°C = 7{,}1 K$$

$$IDF_{heating} = 0{,}073 \frac{L}{s \times cm^2}$$

$$IDF_{cooling} = 0{,}033 \frac{L}{s \times cm^2}$$

airflow rate:

$$Q_{i,heating} = A_L + IDF_{heating} = 481{,}6 \times 0{,}073 \approx 35{,}157 \frac{L}{s}$$

$$Q_{i\ cooling} = A_L \times IDT_{cooling} = 481{,}6 \times 0{,}033 \approx 15{,}893 \frac{L}{s}$$

min whole building ventilation:

$$Q_v = 0{,}05 A_{cf} + 3{,}5(N_{br} + 1) = 0{,}05 \times 200 + 3{,}5 \times (1+1) = 17 \frac{L}{s}$$

$$Q_{i-v\,heating} = Q_{i,\ heating} + Q_v \approx 35{,}157 + 17 = 52{,}157 \frac{L}{s}$$

$$Q_{i-v\,cooling} = Q_{i\,cooling} + Q_v \approx 15{,}893 + 17 = 32{,}893 \frac{L}{s}$$

Given that $C_{sensible} = 1{,}23$, $C_{latent} = 3010$, $\Delta w_{cooling} = 0{,}0039$

$$q_{inf-v_{cs}} = C_s Q_{ivc} \Delta T_c \approx 1{,}23 \times 32{,}893 \times 7{,}1 = 287{,}25 W$$

$$q_{inf-v_{cl}} = C_L Q_{i-vc} \Delta W_c \approx 3010 \times 32{,}893 \times 0{,}0039 = 386{,}13 W$$

$$q_{inf-vhs} = C_s Q_{i\_vh} \Delta T_{heating} = 1{,}23 \times 52{,}157 \times 24{,}1 = 1546{,}09\,W$$