Week 9

Assignment 9

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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 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)

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

Relative humidity = 86%
Atmospheric pressure= 1028hPa
Total air pressure = 102.8kPa
Temperature effettive; 4 C
T = 277.15K

Absolute humidity (ω) = 0.0045
Wet bulb temperature = 3 C
ω = 0.622 Pv /(P - Pv) (kg of water vapor/ kg of dry air)

0.0045 = 0.622 Pv /(102.8 - Pv)

0.0045 (102.8 - Pv) = 0.622 Pv
Pv = 0.738kPa

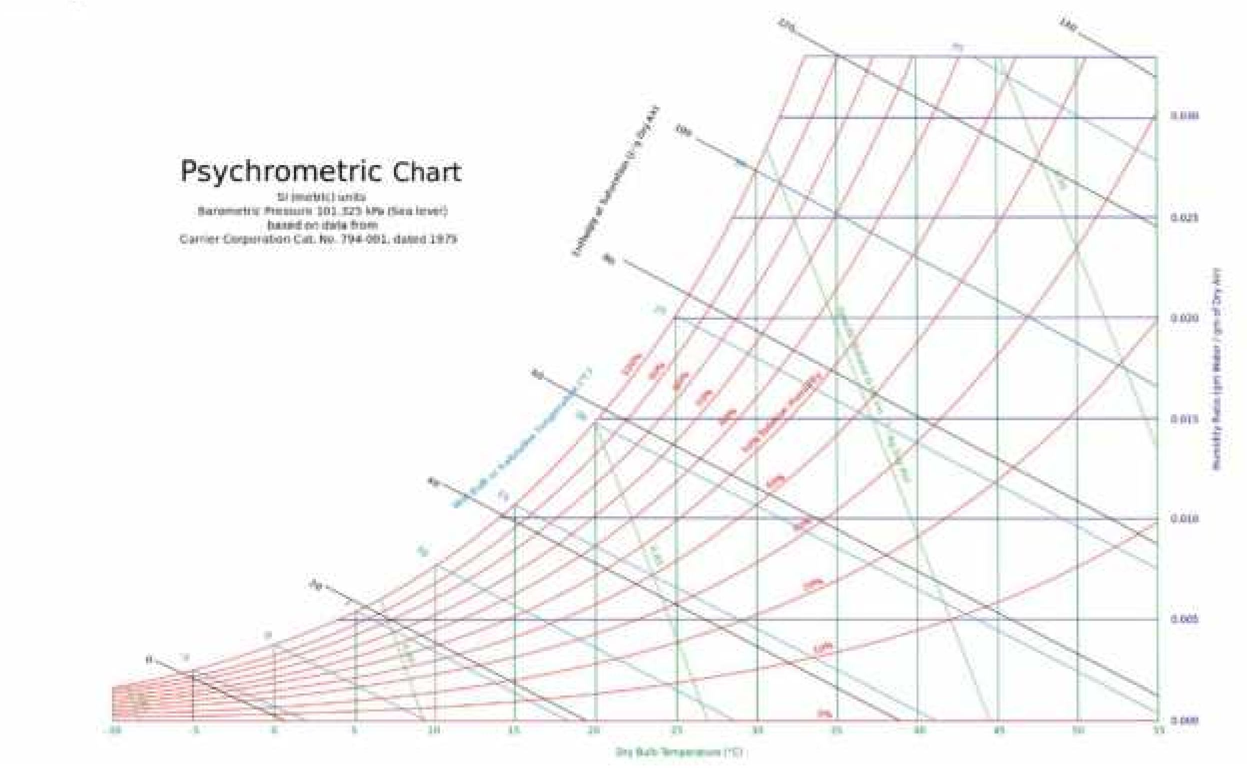
Aula dimensions: 16m by 8m by 4m

$$For\ Air\ M_a = \frac{P_a V_a}{R_a T} x(R_{sp} x T)$$

M_v= 0.738 x (16x8x4) / 0.4615 x(277.15 + 4) =2.912kg

M_g =mass of water at sat condition

$\phi=\frac{m_v}{m_g}=\frac{2.912}{86^{0\angle}}$ = 5.02kg



Task 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 99.6%	Heating DB 99%	Humidification DP/MCDB and HR 99.6% DP	99.6% HR	99.6% MCDB	99% DP	99% HR	99% MCDB	Coldest month WS/MCDB 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 DB/MCWB 0.4% DB	0.4% MCWB	1% DB	1% MCWB	2% DB	2% MCWB	Evaporation WB/MCDB 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 DP/MCDB and HR 0.4% DP	0.4% HR	0.4% MCDB	1% DP	1% HR	1% MCDB	2% DP	2% HR	2% MCDB	Enthalpy/MCDB 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-Year Return Period Values of Extreme DB 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)

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

Floor area: 200m2
Wall area: 144 m2
Height of building: 2.5m2

- **<u>Internal Gains</u>**

Q ig. sensible = 136 + 2.2 Acf + 22Noc
= 136 + 2.2 * 200 + 22* 2 = 620W

Q ig. latent = 20 + 0.22 Acf + 12Noc
= 20 + (0.22 x 200) + (12x 2) = 88W

- **<u>Infiltration</u>**

From the table Good quality - Aul =1.4 cm2 /m2
AL = Aes * A ul
= (200 +144) x 1.4 = 481.6 cm3

QL = AL *IDF

- From the tables; IDF heating = 0.073L/5cm2
- IDF cooling = 0.03L/5cm2

V infiltration heating(QL) = AL * IDF = 481.6 * 0.073 = 35.16L/s
V infiltration cooling (QL) = AL * IDF = 481.6 * 0.033 = 15.89L/s

- **<u>Ventilation</u>**

Qv (Vventilation) = 0.05*Acf + 3.5(Nbr + 1)
= 0.05 * 200 + 3.5*2 = 17L/s

Qv (Vinf-ventilation heating) = 35.16 + 17= 52.16L/s
Qv (Vinf-ventilation cooling) = 15.89 + 17= 32.89L/s

The required minimum whole building ventilation rate in Brindisi
Δ Tcooling = 31.1 °C −24 °C=7.1°C
=7.1 K

Δ T heating =21 °C −(−4. 1 °C)=25.1°C
=25.1 K

DR = 7.1 °C =7.1 K

$C_{sensible} = 1.23, C_{latent} = 3010$

ΔωCooling=0.0039

$$Q_{\cdot inf-ventilation_{cooling_{sensible}}} = C_{sensible} x V \Delta \mathrm{T}_{\mathrm{cooling}} = 1.23x32.89x7.1 = 287.25W$$

$$Q_{\cdot inf-ventilation_{cooling_{latent}}} = C_{latent} x V \Delta \mathrm{T}_{\mathrm{cooling}} = 3010x32.89x0.0039 = 386.13\ W$$

$$Q_{\cdot inf-ventilation_{heating_{sensible}}} = C_{sensible} x V \Delta \mathrm{T}_{\mathrm{heating}} = 1.23x52.16x25.1 =$$
1610.34 W

$Q_{inf-ventilation cooling latent} = C_{latent} * \dot{V} \Delta\omega_{Cooling} = 3010 * 32.89 * 0.0039 = 386.13\ W$