Assignment 9. F.TorresPérez

lunes, 16 de diciembre de 2019 09:30 p. m.

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)

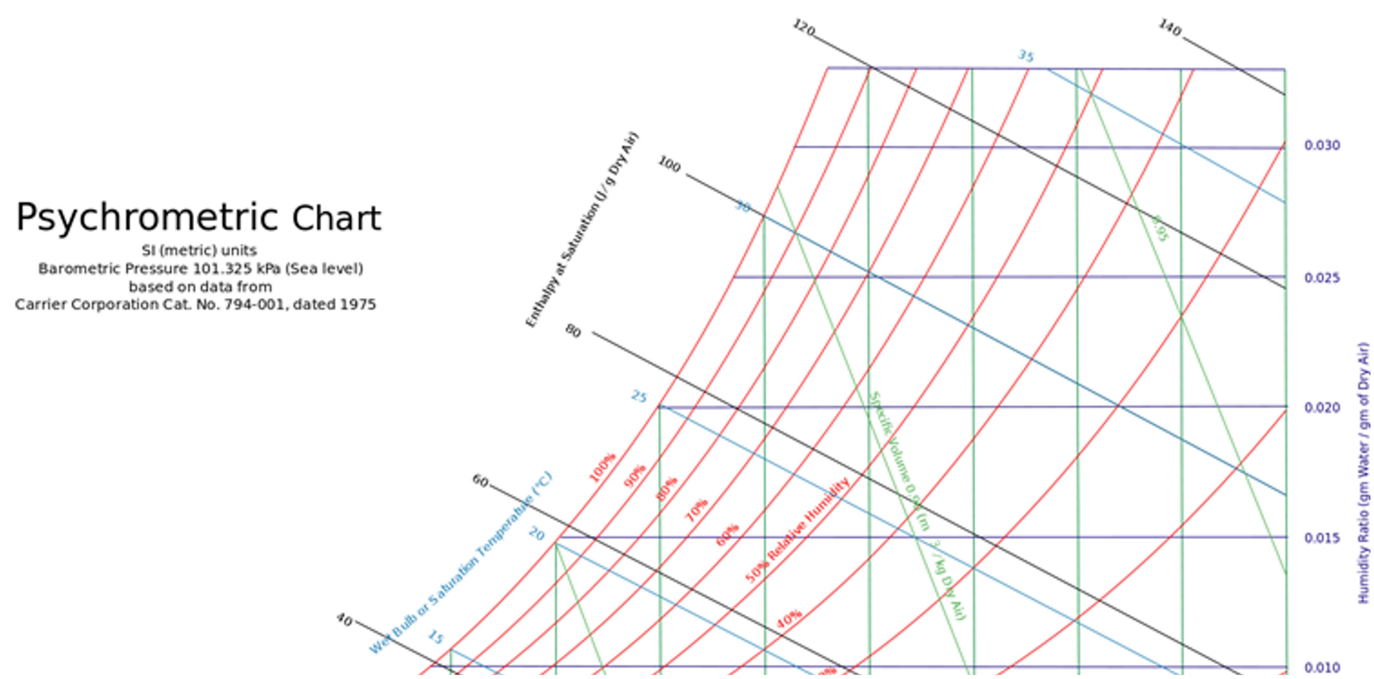
Aula A = *10m x 5m x 4m*
Temperature = *7°C*
Saturation pressure of water = *1.0021 kPa*
Atmospheric pressure = *102 kPa*
Relative humidity = *84%*
$R_v = 0.4615$

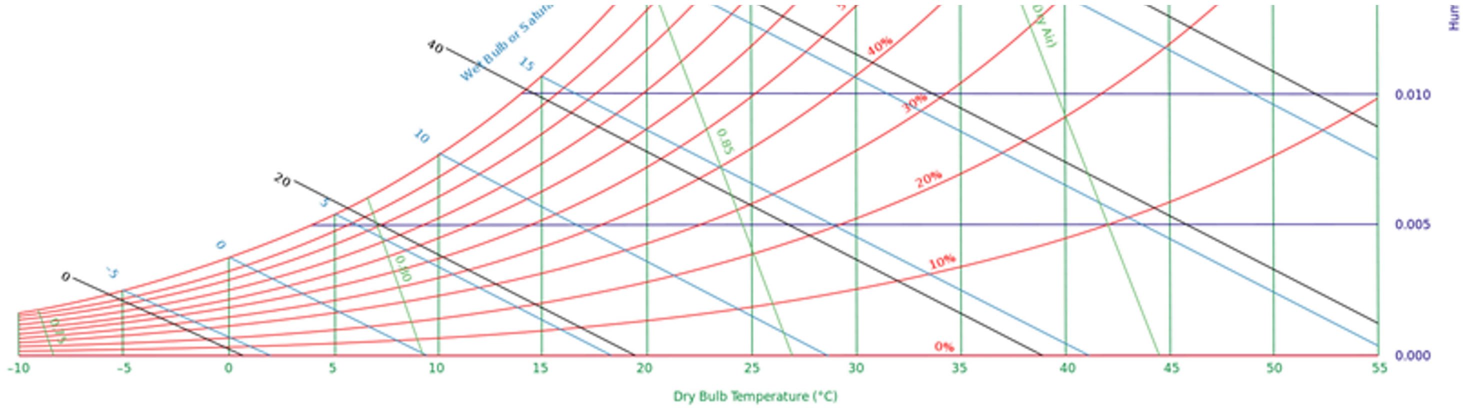
$$\phi = \frac{m_v}{m_g} = \frac{P_v}{P_g}$$
$$P_v = \phi \, x \, P_g = 0.84 \, x \, 1.0021 = 0.84 \, kPa$$
$$P_a = P - P_v = 102 \, kPa - 0.84 \, kPa = 101.16 \, kPa$$

Absolute humidity
$$\omega = 0.622 \frac{P_v}{P_a} = 0.622 \frac{0.84}{101.16} = 0.0052 \frac{kg_{vapour}}{kg_{dryAir}}$$

Mass of water vapor
$$m = \frac{PV}{R_{sp}T} \; ; \; m_v = \frac{P_v V_v}{R_v T}$$
$$m_v = \frac{0.84 \, x \, (10 \, x \, 5 \, x \, 4)}{0.4615 \, x (273 + 7)} = 1.3 \, kg \; water \; vapor$$

Enthalpy
$$h = h_a + w h_v = (1.005 \, x \, 7) + 0.0052 \, (2501 + (1.82 \, x \, 7)) = 20.11 \, \frac{kJ}{kg_{dryAir}}$$





Wet-bulb temperature
≃ 5.5°C

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 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)

Building height = 2.5m
Floor area = 200 m^2
Number of occupants = 2
Number of bedrooms = 1
Wall area = 144 m^2

Temperature for cooling and heating

$T_{cooling} = 31.1\ ℃$
$T_{heating} = 4.1\ ℃$

Temperature difference

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

$\Delta T_{heating} = 20 - 4.1 = 15.9\ ℃$

Internal gains

$\dot{Q}_{ig_{sensible}} = 136 + 2.2A_{cf} + 22N_{oc} = 136 + 2.2\ x\ 200 + 22\ x\ 2 = 620\ W$

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

Infiltration

$A_{ul} = 1.4\ \frac{cm^2}{m^2}$

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

$A_L = A_{es}\ x\ A_{ul} = 344\ x\ 1.4 = 481.6\ cm^2$

$IDF_{heating} = 0.065\ \frac{L}{s.cm^2}$

$IDF_{cooling} = 0.032\ \frac{L}{s.cm^2}$

$\dot{Q}_{i_{heating}} = A_L\ x\ IDF = 481.6\ x\ 0.065 = 31.30\ \frac{L}{s}$

$\dot{Q}_{i_{cooling}} = A_L\ x\ IDF = 481.6\ x\ 0.032 = 15.41\ \frac{L}{s}$

Ventilation

$\dot{Q}_v = 0.05A_{cf} + 3.5(N_{br} + 1) = 0.05\ x\ 200 + 3.5\ x\ 2 = 17\ \frac{L}{s}$

$\dot{Q}_{inf-ventilation_{heating}} = 31.30 + 17 = 48.30\ \frac{L}{s}$

$\dot{Q}_{inf-ventilation_{cooling}} = 15.41 + 17 = 32.41\ \frac{L}{s}$

$\dot{Q}_{inf-ventilation_{cooling_{sensible}}} = C_{sensible}\dot{V}\Delta T_{cooling} = 1.23\ x\ 32.41\ x\ 7.1 = 283.04\ W$

$\dot{Q}_{inf-ventilation_{cooling_{latent}}} = C_{latent}\dot{V}\Delta\omega_{cooling} = 3010\ x\ 32.41\ x\ 0.0045 = 438.99\ W$

$\dot{Q}_{inf-ventilation_{heating_{sensible}}} = C_{sensible}\dot{V}\Delta T_{heating} = 1.23\ x\ 48.30\ x\ 15.9 = 944.60\ W$

$\dot{Q}_{inf-ventilation_{heating_{latent}}} = C_{latent}\dot{V}\Delta\omega_{heating} = 3010\ x\ 48.30\ x\ 0.0046 = 668.76\ W$