Week 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 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)

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

The weather today in Piacenza
Monday, 16 December 2019

	22:00	23:00
	LightRain	LightRain
Effective temperature	6 ° C	7 ° C
Perceived temperature	6 ° C	7 ° C
Rainfall	0 mm	0 mm
Humidity	96 %	95 %
Atmospheric pressure	1021 hPa	1020 hPa
Wind intensity	3 km / h	2 km / h
Wind direction	↳	↳

Humidity ϕ =95%
The total air pressure P =102 kPa
Effective temperature: 7 °C, i.e., the temperature in Kelvin temperature scale T =280 K

the absolute humidity ω = 0.0055
the web-bulb temperature Twb= 6 °C
ω=0.622Pv /Pa=0.622Pv /P−Pv =0.0055, P=102 kPa

$$\omega = \frac{0.622 \times P_V}{P - P_V} \qquad 0.0055 = \frac{0.622 \times P_V}{102 - P_V} \qquad \text{Pv}\approx 0.893 \text{ kPa}$$

Classroom volume: 300 m3 Dimension 5 . 10 . 6

R_v=0.4615

$$m_V = \frac{P_V V}{R_V T} \qquad m_V = \frac{0.893 \times 300}{0.4615 \times 280} \approx 2.07 \text{ kg}$$

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		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)

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

$q_{ig,l}=20+0.22A_{cf}+12N_{oc}=20+0.22*200+12*2=88$ W

for a house with a good construction quality, unit leakage area $A_{ul}=1.4cm^2/m^2$
and the exposed surface $A_{es}=A_{wall}+A_{roof}=200+144=344\ m^2$
thus, $A_L=A_{es}*A_{ul}=344*1.4=481.6\ cm^2$

cooling temperature $T_{cooling}=24$ °C, and heating temperature $T_{heating}=20$ °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
Given that $IDF_{heating}=0.073L/s*cm^2$,
$IDF_{cooling}=0.033L/s*cm^2$,
Calculate infiltration airflow rate,
$Q_{i,heating}=A_L*IDF_{heating}=481.6*0.073\approx35.157L/s$
$Q_{i,cooling}=A_L*IDF_{cooling}=481.6*0.033\approx15.893L/s$
The required miminum whole-building vetilation rate is
$Q_v=0.05A_{cf}+3.5(N_{br}+1)=0.05*200+3.5*(1+1)=17L/s$
$Q_{i-v,heating}=Q_{i,heating}+Q_v\approx35.157+17=52.157L/s$
$Q_{i-v,cooling}=Q_{i,cooling}+Q_v\approx15.893+17=32.893L/s$
Given that $C_{sensible}=1.23$, $C_{latent}=3010$, $\Delta\omega_{Cooling}=0.0039$
$q_{inf-ventilation\ cooling\ sensible}=C_{sensible}Q_{i-v,cooling}\ \Delta T_{Cooling}\approx1.23*32.893*7.1\approx287.25$ W
$q_{inf-ventilation\ cooling\ latent}=C_{latent}Q_{i-v,cooling}\ \Delta\omega_{Cooling}\approx3010*32.893*0.0039\approx386.13$ W
$q_{inf-ventilation\ heating\ sensible}=C_{sensible}Q_{i-v,heating}\ \Delta T_{heating}\approx1.23*52.157*24.1\approx1546.09$ W