Demre Ertem Weekly Submission 9

3 Aralık 2019 Salı 22:44

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.

1 Dec 2019, 13.00
Humidity 78%
Temperature 8C
Atmosphere Pressure: 1019 hPa

$$\phi = \frac{m_v}{m_g} \quad --\rightarrow m_g \textit{the mass of water at sat condition}$$

$$\phi = \frac{m_v}{m_g} \; = \frac{P_v}{P_g} \; --\rightarrow P_g = P_{sat} 8\,°C = 1.061\ kPa$$

$$\phi \;\; = \frac{P_v}{P_g} \rightarrow P_V = \phi \times P_g = 0.8 * 1.061 = 0.82\ kPa$$

*Volume of AulaA: 30*10*5=1500 m^3*

m_v*=0.82*1500/(0.4615*(273+8))*

$$m_v = 9.475kg$$

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

Internal gains

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

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

Infiltration

First I should calculate how much is the maximum flow rate of air !!!!

First Let's find the leakage area

Table 3 Unit Leakage Areas

Construction	Description	A_{ul}, cm^2/m^2
Tight	Construction supervised by air-sealing specialist	0.7
Good	Carefully sealed construction by knowledgeable builder	1.4
Average	Typical current production housing	2.8
Leaky	Typical pre-1970 houses	5.6
Very leaky	Old houses in original condition	10.4

$$A_L = A_{es}A_{ul}$$

where

A_{es} = building exposed surface area, m^2
A_{ul} = unit leakage area, cm^2/m^2 (from Table 3)

Average quality -> $A_{ul} = 1.4\frac{cm^2}{m2}$

Exposed surface = Wall area +roof area

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

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

Table 5 Typical IDF Values, L/(s·cm²)

	Heating Design Temperature, °C					Cooling Design Temperature, °C			
H, m	−40	−30	−20	−10	0	10	30	35	40
2.5	0.10	0.095	0.086	0.077	0.069	0.060	0.031	0.035	0.040
3	0.11	0.10	0.093	0.083	0.072	0.061	0.032	0.038	0.043
4	0.14	0.12	0.11	0.093	0.079	0.065	0.034	0.042	0.049
5	0.16	0.14	0.12	0.10	0.086	0.069	0.036	0.046	0.055
6	0.18	0.16	0.14	0.11	0.093	0.072	0.039	0.050	0.061
7	0.20	0.17	0.15	0.12	0.10	0.075	0.041	0.051	0.068
8	0.22	0.19	0.16	0.14	0.11	0.079	0.043	0.058	0.074

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

$IDF_{cooling} = 0.031\frac{L}{s.cm^2}$

Now I can calculate the volume !

$$\dot{V}_{infiltration_{heating}} = A_L \times IDF = \ 481.6 * 0.065 = 31.3\frac{L}{s}$$

$$\dot{V}_{infiltration_{cooling}} = A_L \times IDF = \ 481.6 * 0.031 = 14.93\frac{L}{s}$$

$$Q_v = 0.05A_{cf} + 3.5(N_{br} + 1)$$

where

Q_v = required ventilation flow rate, L/s
A_{cf} = building conditioned floor area, m^2
N_{br} = number of bedrooms (not less than 1)

$\dot{V}_{ventilation} = 0.05\ A_{cf} + 3.5\ (N_{br} + 1) =$
.05*200+ 3.5* 2 = 17 L/S
$\dot{V}_{inf-ventilation_{heating}} = 31.3 + 17 = 48.3\ L/s$
$\dot{V}_{inf-ventilation_{cooling}} = 14.93 + 17 = 31.93\frac{L}{s}$

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

$$\dot{Q}_{inf-ventilation_{cooling_{sensible}}} = C_{sensible}\dot{V}\Delta T_{Cooling} = 1.23\ * 31.93 * 7.9 = 436.6\ W$$

$$\dot{Q}_{inf-ventilation_{cooling_{latent}}} = \ C_{latent}\dot{V}\Delta\omega_{Cooling} = 3010\ * 31.93\ *\ 0.0039 = 375.4\ W$$

$$\dot{Q}_{inf-ventilation_{heatingg_{sensible}}} = C_{sensible}\dot{V}\Delta T_{heating} = 1.23\ * 48.3 * 15.9 = 944.68\ W$$

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)