9th assignment

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.

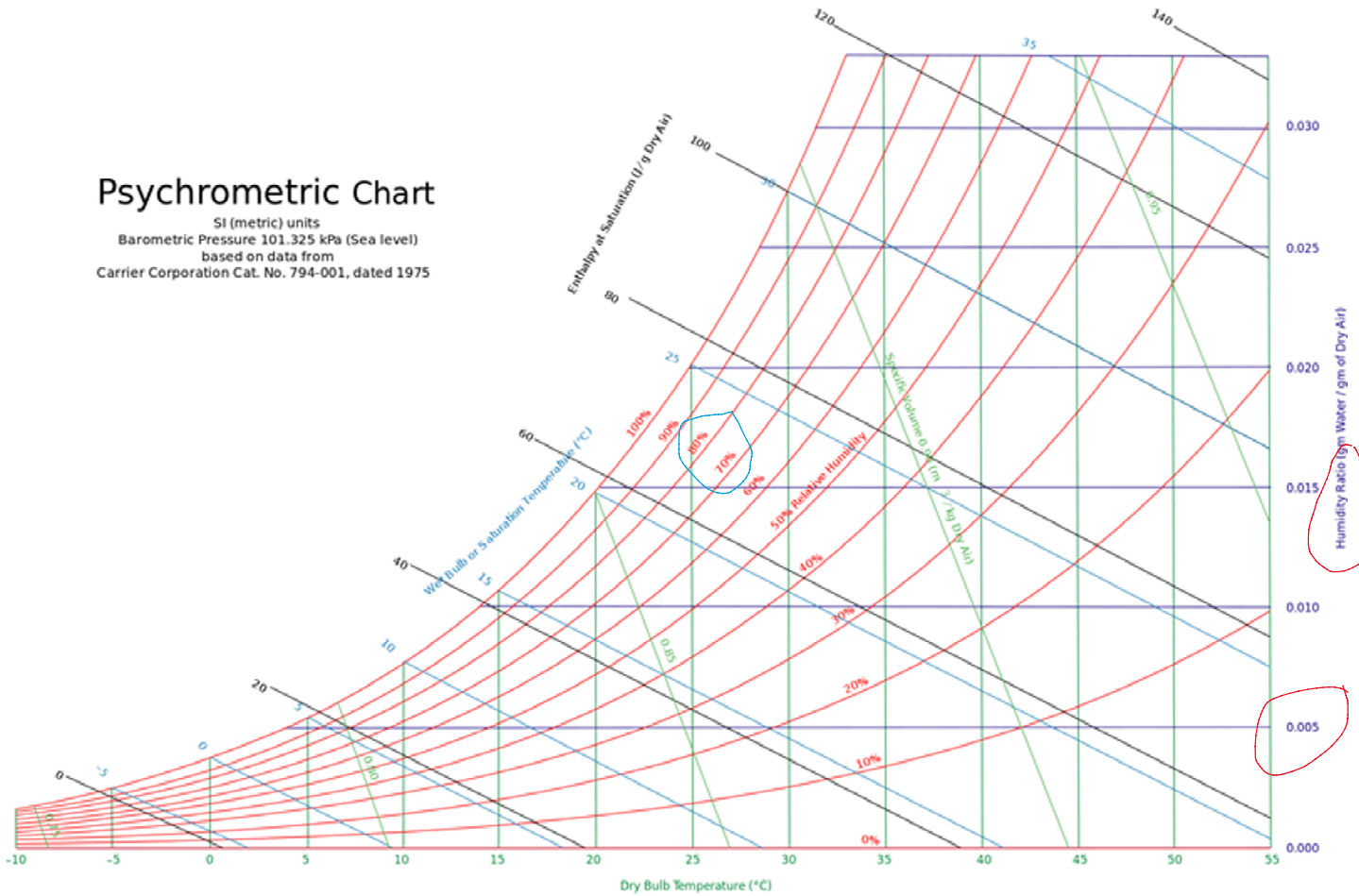
Task 2 Utilize the same methodology we went through in the class and determine the sensible and latent load corresponding to internal gains, the ventilation, and the infiltration in a house with a *good* construction quality and with the same geometry as that of the example which is located in Brindisi, Italy

TASK 1

DATE: 03.11.19 , 20.00 , Piacenza

Temperature: 6° C
Humidity: %74
Atmospheric Pressure: 101,3 kPa

Absolute Humidity Ratio: ~ 0.004gm



Mass of water at sat condition

$$\phi = \frac{m_v}{m_g} = \frac{P_v}{P_g} \longrightarrow P_g = P_{sat}6\ °C = 1{,}06\ kPa$$

$$\phi = \frac{P_v}{P_g} \rightarrow P_V = \phi \times P_g = 0.74 * 1{,}06 = 0{,}78\ kPa$$

AULA C volume : 20X10X4

V: 800m³

$$m = \frac{PV}{R_{sp.}T}$$

$$m_v = \frac{0{,}78\ * (10x20x4)}{0.461\ * (273 + 6)} = 3{,}78\ kg$$

TASK 2

A building with a height of **2.5 m** and an average construction quality, is located in Piacenza, considering two occupants and one bed room calculate, and a conditioned floor area of **200 m2** and wall area is **144** m2, calculate the internal gains, infiltration, and ventilation loads.

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

Table 3 Unit Leakage Areas

Construction	Description	A_{ul}, cm²/m²
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

Good 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)

H, m	Heating Design Temperature, °C					Cooling Design Temperature, °C			
	−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

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

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

$$\dot{V}_{infiltration_{heating}} = A_L \times IDF = \ 481{,}6 * 0.065 = 31{,}30 \frac{L}{s}$$

$$\dot{V}_{infiltration_{cooling}} = A_L \times IDF = \ 481{,}6 * 0.031 = 14{,}93 \frac{L}{s}$$

ventilation loads

$$\dot{V}_{ventilation} = 0.05\ A_{cf} + 3.5\ (N_{br} + 1)$$

$= 0.05*200+ 3.5* 2 = 17$ L/S

$$\dot{V}_{inf-ventilation_{heating}} = 31{,}3 + 17$$
$$= 48{,}3\ L/s$$

$$\dot{V}_{inf-ventilation_{cooling}} = 14{,}93 + 17$$

$$= 31{,}93\ L/s$$

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

$$\dot{Q}_{inf-ventilation_{cooling_{sensible}}} = C_{sensible} \dot{V} \Delta T_{Cooling}$$
$$= 1.23\ * 31{,}98 * 11{,}1 = 436{,}6\ W$$

$$\dot{Q}_{inf-ventilation_{cooling_{latent}}} = C_{latent} \dot{V} \Delta \omega_{Cooling}$$
$$= 3010\ * 31{,}98\ *\ 0.0039 = 575{,}4\ W$$

$$\dot{Q}_{inf-ventilation_{heatinggg_{sensible}}} = C_{sensible} \dot{V} \Delta T_{heating}$$
$$= 1.23\ * 48{,}3 * 15{,}9 = 944{,}6\ W$$

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%	99.6% DP	99.6% HR	99.6% MCDB	99% DP	99% HR	99% MCDB	0.4% WS	0.4% MCDB	1% WS	1% 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% DB	0.4% MCWB	1% DB	1% MCWB	2% DB	2% MCWB	0.4% WB	0.4% MCDB	1% WB	1% MCDB	2% WB	2% 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
	0.4%			1%			2%			0.4%		1%		2%		8 to 4 & 12.8/20.6
	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)