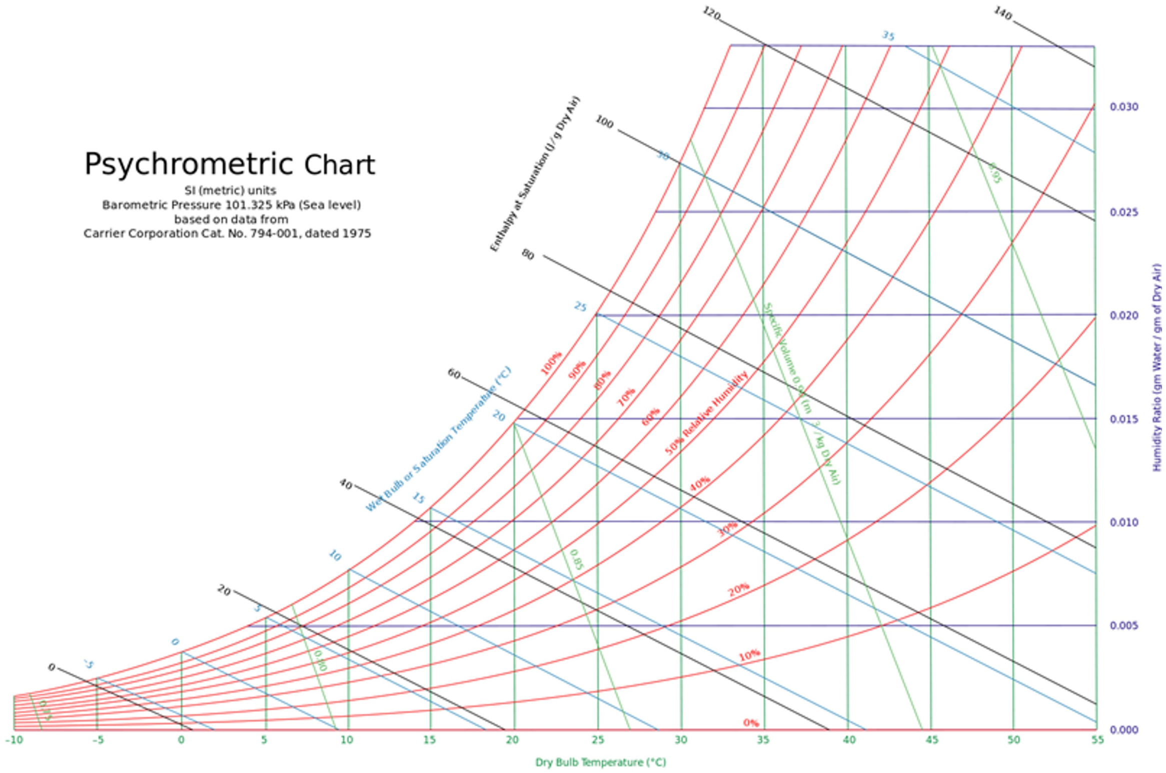
TASK 1

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.

Date: 01 Dec 2019, 13.00, Piacenza
Relative Humidity: 78%
Temprature: $8°C$
Athmosphere Pressure: 1019 hPa = 101.9 kPa (The color chart is appropriate)



Absoloute humidity: 0.005
Wet-bulb temprature: $6°C$

Mass of water vapuor:

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

$$\phi = \frac{P_v}{P_g} \rightarrow P_V = \phi \times P_g = 0.78 * 1.061 = 0.82\ kPa$$

V of Aula A: 30*10*4
V=1200 m^3

$$m_v = \frac{0.82 * (30 * 10 * 4)}{0.4615 * (273 + 8)}$$

m_v=7.58 kg

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

Height: 2.5 m
Floor area: 200 m2
Wall Area: 144 m2
Construction quality: good
One bedroom
Brindisi; two occupants

A- Internal Gains

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

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

B- Infiltration

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 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

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

where

A_{es} = building exposed surface area, m²
A_{ul} = unit leakage area, cm²/m² (from Table 3)

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

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

$$\dot{V}_{infiltration_{heating}} = A_L \times IDF = \quad 481.6 * 0.065 = 31.304 \frac{L}{s}$$

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

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

C- Ventilation

$$\dot{V}_{ventilation} = 0.05 \, A_{cf} + 3.5 \, (N_{br} + 1) = 0.05*200+ 3.5* 2 = 17 \ \ L/S$$

$$\dot{V}_{inf-ventilation_{heating}} = 31.304 + 17 = 48.304 \frac{L}{s}$$

$$\dot{V}_{inf-ventilation_{cooling}} = 14.98 + 17 = 31.98 \ \frac{L}{s}$$

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

where

Q_v = required ventilation flow rate, L/s
A_{cf} = building conditioned floor area, m²

$$\dot{V}_{inf-ventilation_{cooling}} = 14.98 + 17 = 31.98\ \frac{L}{s}$$

where

Q_v = required ventilation flow rate, L/s
A_{cf} = building conditioned floor area, m²
N_{br} = number of bedrooms (not less than 1)

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

$$\dot{Q}_{inf-ventilation_{cooling_{sensible}}} = C_{sensible}\dot{V}\Delta T_{Cooling} = 1.23\ * 31.98 * 11.1 = 436.62\ W$$

$$\dot{Q}_{inf-ventilation_{cooling_{latent}}} = \ C_{latent}\dot{V}\Delta\omega_{Cooling} = 3010\ * 31.98\ *\ 0.0039 = 375.41\ W$$

$$\dot{Q}_{inf-ventilation_{heatingg_{sensible}}} = C_{sensible}\dot{V}\Delta T_{heating} = 1.23\ * 48.304 * 15.9 = 944.68\ W$$

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%	99.6%			99%			0.4%		1%				
				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)