WEEK 9 -SUBMISSION

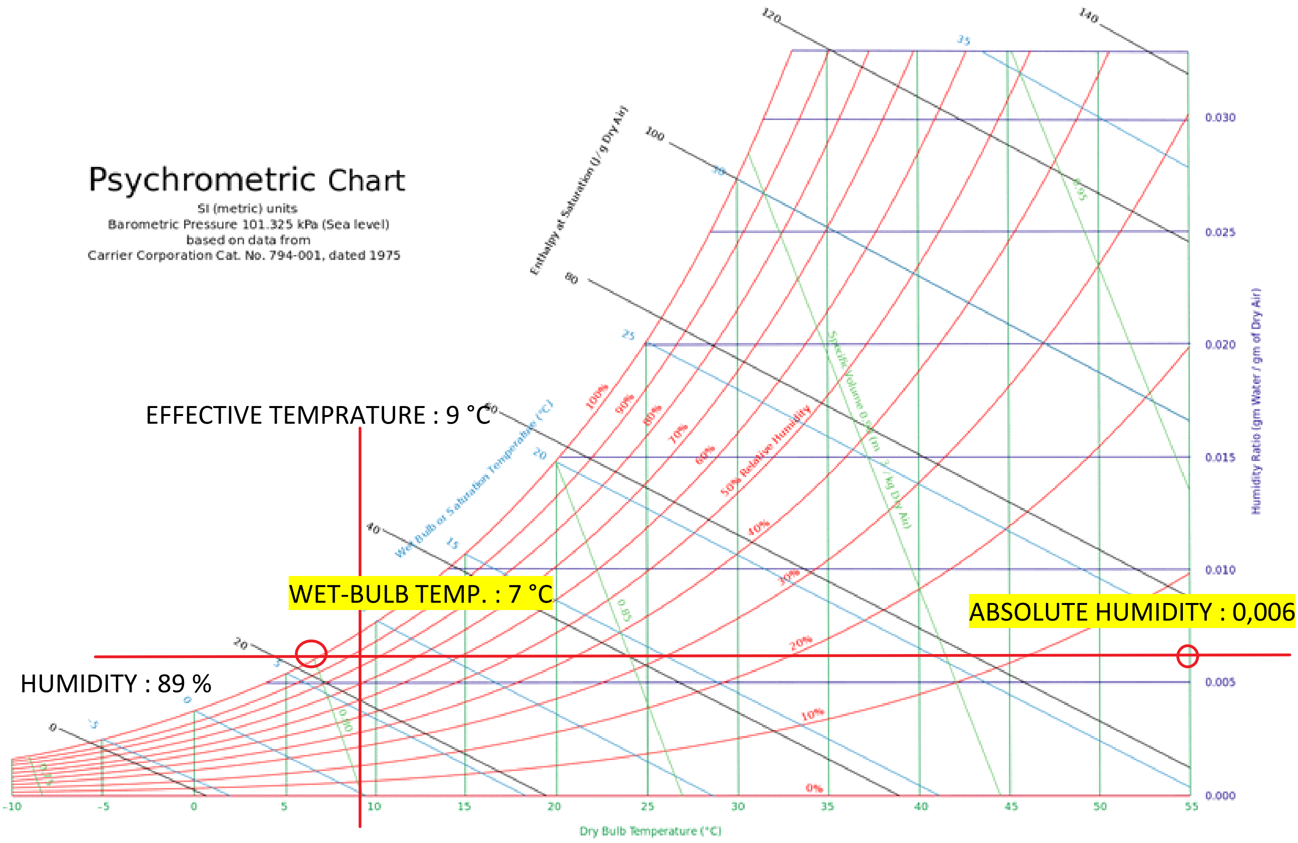
TASK 1 - Use a weather forecast website, and utilize the psychrometric chart and the formula we went through in the class to determine the (A) absoloute humidity,(B) the wet-bulb temperature and (C) the mass of water vapour in the air in ClassRoom A (Aula A) of Piacenza campus in the moment that you are solving this exercise (provide the inputs that you utilized)

Note: I supposed that the dimensions of the AULA A

The weather today in Piacenza
Monday, 02 December 2019

	1:00 pm	14:00	4:00 pm	18:00	8:00 pm	21:00	22:00
	PartlyCloud	PartlyCloud	LightCloud	LightCloud	PartlyCloud	Cloud	PartlyCloud
Effective temperature	10 ° C	10 ° C	9 ° C	6 ° C	7 ° C	7 ° C	8 ° C
Perceived temperature	10 ° C	10 ° C	8 ° C	5 ° C	7 ° C	6 ° C	7 ° C
Rainfall	0 mm	0 mm	0 mm	0 mm	0 mm	0 mm	0 mm
Humidity	79 %	77 %	89 %	90 %	90 %	92 %	91 %
Atmospheric pressure	1016 hPa	1015 hPa	1016 hPa	1017 hPa	1019 hPa	1019 hPa	1020 hPa
Wind intensity	8 km / h	6 km / h	6 km / h	6 km / h	3 km / h	6 km / h	5 km / h
Wind direction	NO	OR	NO	OR	S	SELF	IS
Probability of fog	0 %	0 %	0 %	0 %	0 %	0 %	0 %
Dew point	6 ° C	6 ° C	7 ° C	5 ° C	5 ° C	6 ° C	6 ° C
Clouds	65 %	55 %	16 %	24 %	86 %	100 %	76 %
Low clouds	4 %	0 %	15 %	7 %	38 %	100 %	49 %
Medium clouds	34 %	54 %	2 %	23 %	84 %	85 %	70 %
High clouds	55 %	7 %	0 %	0 %	0 %	0 %	0 %

According to table;
ROOM : 20 x 5 x 5 mt
EFFECTIVE TEMPRATURE : 9 °C
HUMIDITY : 89 %
ATMOSPHERIC PRESSURE : 1016 hPa



According to Psychrometric Chart;

(A); ABSOLUTE HUMIDITY : 0,006 gm water/gm dry air

(B); WET-BULB TEMPERATURE : 7°C

(C) THE MASS OF WATER VAPOUR;

$$\phi = \frac{m_v}{m_g} = \frac{P_v}{P_g} \dashrightarrow P_g = P_{sat}7\ ^\circ C = 1{,}016\ \ kPa$$

$$\phi = \frac{P_v}{P_g} \rightarrow P_V = \phi \times P_g = 0.89 * 1{,}016 = 0.90\ kPa$$

Mass of water vapour $M_V = P_V \times V_{room} / R_v \times T$

= 0,90 x (20x5x5) / 0,4615 x (273+7)

= 450 / 129,22

= 3.48 kg of water vapour (C)

TASK 2 - Utilize the same methodology we went through in the class and determine the sensible and latent load corresponding to (A)internal gains, (B)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.

Building height : 2,5 mt
Floor area : 200 m^2
Wall area : 144 m^2
2 occupants
1 bedroom
Good construction quality
Located in Brindisi, Italy

(A) Internal Gains :

$$q_{ig,s} = 136 + 2.2A_{cf} + 22N_{oc}$$

$$q_{ig,l} = 20 + 0.22A_{cf} + 12N_{oc}$$

where

$q_{ig,s}$ = sensible cooling load from internal gains, W
$q_{ig,l}$ = latent cooling load from internal gains, W
A_{cf} = conditioned floor area of building, m^2
N_{oc} = number of occupants (unknown, estimate as $N_{br} + 1$)

$q_{ig,sensible}$ = 136 + 2,2 x 200 + 22 x 2 = 620 W
$q_{ig,latent}$ = 20 + 0,22 x 200 + 12 x 2 = 88 W

(B) Ventilation and Infiltration :

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

where

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

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

Situation	Include	Exclude
Ceiling/roof combination (e.g., cathedral ceiling without attic)	Gross surface area	
Ceiling or wall adjacent to attic	Ceiling or wall area	Roof area
Wall exposed to ambient	Gross wall area (including fenestration area)	
Wall adjacent to unconditioned buffer space (e.g., garage or porch)	Common wall area	Exterior wall area
Floor over open or vented crawlspace	Floor area	Crawlspace wall area
Floor over sealed crawlspace	Crawlspace wall area	Floor area
Floor over conditioned or semiconditioned basement	Above-grade basement wall area	Floor area
Slab floor		Slab area

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

$A_{es} = A_{wall} + A_{roof}$

$= 144 + 200 = 344\ m^2$

$A_L = 344\ m^2 \times 1{,}4\ cm^2/m^2 = 481{,}6\ cm^2$

$$Q_i = A_L \,\mathrm{IDF}$$

where

A_L = building effective leakage area (including flue) at reference pressure difference = 4 Pa, assuming discharge coefficient $C_D = 1$, cm^2

IDF = infiltration driving force, $L/(s \cdot cm^2)$

Table 5 Typical IDF Values, $L/(s \cdot cm^2)$

	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 L / s. cm2

IDF $_{cooling}$ = 0,042 L / s. cm2

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

	(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)

$$\dot{V}_{infiltration_{heating}} = A_L \times IDF$$

= 481,6 x 0,065 = 31,304 L / s

$$\dot{V}_{infiltration_{cooling}} = A_L \times IDF$$

= 481,6 x 0,042 = 20,227 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)

$$\dot{V}_{ventilation} = 0{,}05A_{cf} + 3{,}5\ (N_{br} + 1)$$

= 0,05 x 200 + 3,5 x (1 + 1) = 17 L/s

$$\dot{V}_{inf-ventilation_{heating}} = \dot{V}_{infiltration_{heating}} + \dot{V}_{ventilation}$$

= 31,304 + 17 = 48,304 L/s

$$\dot{V}_{inf-ventilation_{cooling}} = \dot{V}_{infiltration_{cooling}} + \dot{V}_{ventilation}$$

= 20,227 + 17 = 37,227 L/s