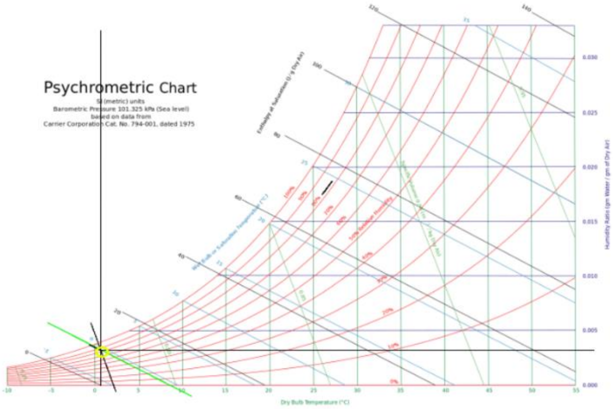
Question 1 : Utilize the psychrometric chart to determine the absolute humidity, the wet-bulb temperature and the mass of water vapor in the air in Class Room A (Aula A) of Piacenza campus:

From The Weather Forecast Website:

- Relative humidity = 82%
- Atmospheric pressure= 1023hPa
- Total air pressure = 102.3kPa
- Temperature effettiva; 1C = 33.8F
- T = 274.15K

From The Psychrometric Chart:



- The Absolute Humidity = 0.003
- The Wet-Bulb Temperature = -0.9
- The Mass Of Water Vapor In The Air = 0.49104 kPa

ω = 0.622 Pv /(P - Pv) (kg of water vapor/ kg of dry air)

0.003 = 0.622 Pv /(102.8 - Pv)

0.003 (102.3 - Pv) = 0.622 Pv

Pv = 0.49104 kPa

We assume our classroom to be 16m by 8m by 4m

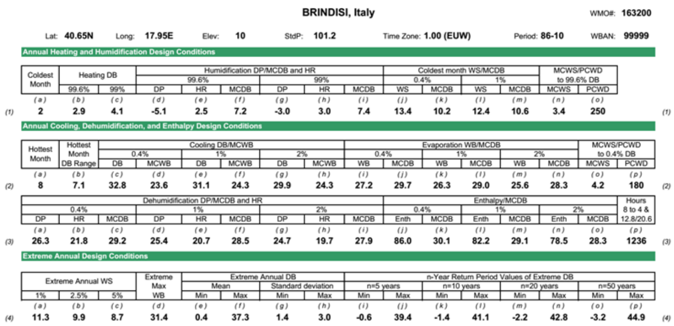
For air ma= Pa Va / RaT *(Rsp* T)

mv= 0.49104 * (16*8*4) / 0.4615 * (274.15+ 4) =0.4968kg

mg =mass of water at sat condition

$\phi = mv / mg$ = 0.4968/ 82% = 0.6058kg

Question 2 : 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.



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 99.6%	Heating DB 99%	Humidification 99.6% DP	Humidification 99.6% HR	Humidification 99.6% MCDB	Humidification 99% DP	Humidification 99% HR	Humidification 99% MCDB	Coldest month 0.4% WS	Coldest month 0.4% MCDB	Coldest month 1% WS	Coldest month 1% MCDB	MCWS/PCWD to 99.6% DB MCWS	MCWS/PCWD to 99.6% DB 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 0.4% DB	Cooling 0.4% MCWB	Cooling 1% DB	Cooling 1% MCWB	Cooling 2% DB	Cooling 2% MCWB	Evaporation 0.4% WB	Evaporation 0.4% MCDB	Evaporation 1% WB	Evaporation 1% MCDB	Evaporation 2% WB	Evaporation 2% MCDB	MCWS/PCWD to 0.4% DB MCWS	MCWS/PCWD to 0.4% DB 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 0.4% DP	Dehumidification 0.4% HR	Dehumidification 0.4% MCDB	Dehumidification 1% DP	Dehumidification 1% HR	Dehumidification 1% MCDB	Dehumidification 2% DP	Dehumidification 2% HR	Dehumidification 2% MCDB	Enthalpy 0.4% Enth	Enthalpy 0.4% MCDB	Enthalpy 1% Enth	Enthalpy 1% MCDB	Enthalpy 2% Enth	Enthalpy 2% MCDB	Hours 8 to 4 & 12.8/20.6	
	(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 1%	Extreme Annual WS 2.5%	Extreme Annual WS 5%	Extreme Max WB	Extreme Annual DB Mean Min	Extreme Annual DB Mean Max	Extreme Annual DB Standard deviation Min	Extreme Annual DB Standard deviation Max	n=5 years Min	n=5 years Max	n=10 years Min	n=10 years Max	n=20 years Min	n=20 years Max	n=50 years Min	n=50 years 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)

- Height of building - 2.5m2
- Floor area – 200m2
- Wall area - 144 m

1. Internal Gains

Q ig. sensible = 136 + 2.2 Acf + 22Noc = 136 + 2.2 * 200 + 22* 2 = 620W

Q ig. latent = 20 + 0.22 Acf + 12Noc = 20 + 0.22 * 200 + 12* 2 = 88W

Infiltration From the table

Good quality - Aul =1.4 cm2 /m2

AL = Aes * A ul = (200 +144) * 1.4 = 481.6 cm3

QL = AL *IDF

From the tables:

- IDF heating = 0.073L/5cm2
- IDF cooling = 0.03L/5cm2

$V_{\text{infiltration heating}}$(QL) = AL * IDF = 481.6 * 0.073 = 35.16L/s

$V_{\text{infiltration cooling}}$ (QL) = AL * IDF = 481.6 * 0.033 = 15.89L/s

Ventilation

Qv ($V_{\text{ventilation}}$) = 0.05*Acf + 3.5(Nbr + 1) = 0.05 * 200 + 3.5*2 = 17L/s

Qv ($\text{Vinf-}_{\text{ventilation heating}}$) = 35.16 + 17= 52.16L/s

Qv ($\text{Vinf}_{\text{-ventilation cooling}}$) = 15.89 + 17= 32.89L/s

The required minimum whole building ventilation rate in Brindisi

$\Delta T_{\text{cooling}}$ = 31.1 °C −24 °C=7.1°C =7.1 K

$\Delta T_{\text{heating}}$=21 °C −(−4. 1 °C)=25.1°C =25.1 K

DR = 7.1 °C =7.1 K

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

$\Delta\omega$Cooling=0.0039

$\dot{Q}\text{inf}_{\text{ventilationcoolingsensible}} = C_{\text{sensible}} * \dot{V}\Delta T\text{Cooling}$ = 1.23 ∗ 32.89 ∗ 7.1 = 287.25 W

$\dot{Q}\text{inf}-_{\text{ventilationcoolinglatent}} = C_{\text{latent}} * \dot{V}\Delta\omega\text{Cooling}$ = 3010 ∗ 32.89 ∗ 0.0039 = 386.13 W

$Qinf -_{ventilation\text{heating}gsensible} = C_{sensible} V \Delta T_{\text{heating}}$ = 1.23 ∗ 52.16 ∗ 25.1 = 1610.34