Task 1

A=10*25*5 T=10 P=100kpa $\phi = 65\%$

$$\phi = \frac{m_v}{m_g} = \frac{P_v}{P_g} \longrightarrow P_g = P_{sat} 10\ °C = 1.2276\ kPa$$

$$\phi = \frac{P_v}{P_g} \rightarrow P_V = \phi \times P_g = 0.65 * 1.2276 = 0.7979\ kPa$$

$$P_a = P - P_v = 100\ kPa - 0.80\ kPa = 99.20\ kPa$$

$$\omega = 0.622 \frac{P_v}{P_a} = 0.622 \frac{0.80}{99.20} = 0.005\ \frac{Kg_{vapour}}{kg_{dryAir}}$$

$$R_a = 0.287, R_v = 0.4615$$

$$m_a = \frac{99.20 * (10 * 25 * 5)}{0.287\ * (273 + 10)} = 1526.70\ \ kgof\ dry\ air$$

$$m_v = \frac{0.80\ * (10 * 25 * 5)}{0.4615\ * (273 + 10)} = 7.66\ kg$$

$$h_a = 1.005 * T = 1.005\ * 10 = 10.05 \frac{kJ}{kg_{dryAir}}$$

$$h_v = 2501.3 + 1.82\ * 10 = 2519.5 \frac{kJ}{kg_{water}}$$

$$h = h_a + \omega h_v = 10.05 + 0.005\ * 2519.5 = 22.65 \frac{kJ}{kg_{dryAir}}$$

Task 2

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

Internal gains

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

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

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

$$IDF_{heating} = 0.073 \frac{L}{s.cm^2} \qquad IDF_{cooling} = 0.033 \frac{L}{s.cm^2}$$

$$V_{infiltration_{heating}} = A_L \times IDF$$
$$= \ \ 481.6 * 0.073 = 35.16 \frac{L}{s}$$

$$V_{infiltration_{cooling}} = A_L \times IDF = \ \ 481.6 * 0.033$$
$$= 15.89 \frac{L}{s}$$

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)

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

.05*200+ 3.5* 2 = 17 L/S

$$V_{inf-ventilation_{heating}} = 35.16 + 17 = 52.16\ L/s$$

$$V_{inf-ventilation_{cooling}} = 15.89 + 17 = 32.89\ L/s$$

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

$$Q_{inf-ventilation_{cooling_{sensible}}} = C_{sensible} V \Delta T_{Cooling} = 1.23\ * 32.89 * (31.1 - 24.3) = 275.09\ W$$

$$Q_{inf-ventilation_{cooling_{latent}}} = \ C_{latent} V \Delta\omega_{Cooling} = 3010\ * 32.89\ *\ 0.0039 = 386.09 W$$

$$Q_{inf-ventilation_{heatingg_{sensible}}} = C_{sensible} V \Delta T_{heating} = 1.23\ * 52.16 * (20 - 4.1) = 1020.09\ W$$