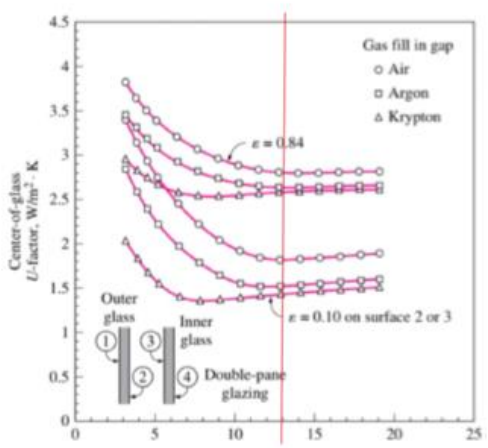
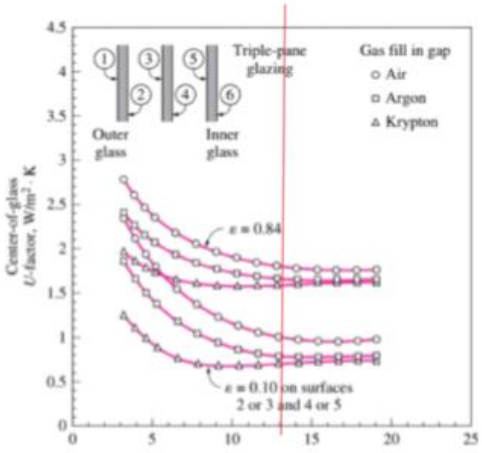
TASK 1





PANEL WITH AIR GAP 13mm			U-VALUE	EFFECT %
D-PG	AIR BETWEEN	N-COATING	2.80	0%
D-P	ARGON	N-COATING	2.65	5%
D-P	KRYPTON	N-COATING	2.60	7%
D-P	AIR	COATING IP	1.80	36%
D-P	ARGON	COATING IP	1.55	45%
D-P	KRYPTON	COATING IP	1.40	50%
TP	AIR	NO-COATING	1.80	36%
TP	ARGON	NO-COATING	1.65	41%
TP	KRYPTON	NO-COATING	1.55	45%
TP	AIR	COATING IP	1.00	64%
TP	ARGON	COATING IP	0.8	71%
TP	KRYPTON	COATING IP	0.70	75%

TASK 2

PIACENZA, Italy WMO#: 160840

Lat: 44.92N Long: 9.73E Elev: 138 StdP: 99.68 Time Zone: 1.00 (EUW) Period: 89-10 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	-6.2	-4.8	-11.6	1.4	3.1	-8.8	1.8	1.8	8.8	5.6	7.7	6.2	2.1	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)
8	11.9	33.1	22.7	31.9	22.4	30.3	21.8	24.6	30.2	23.7	29.2	22.9	28.3	2.4	90

(2)

Answer:

First of all, define the cooling design temperature $T_{cooling} = 24\ °C$, and heating design temperature $T_{heating} = 20\ °C$, thus

$\Delta T_{cooling} = 31.9\ °C - 24\ °C = 7.9\ °C = 7.9K$

$\Delta T_{heating} = 20°C - (-4.8°C) = 24.8\ °C = 24.8K$

From the table above, $DR = 11.9\ °C = 11.9K$

Calculating the cooling load of the fixed window on the west:

$q_{window_{west}} = A \times CF_{window_{west}}$

$A = 14.4m^2$,

$CF_{window_{west}(Heat\ Trasnfer\ Part)} = U_{window_{west}}(\Delta T_{cooling} - 0.46\ DR)$

∵The window has a fixed heat absorbing double layer glass with a wooden frame,

$\therefore U_{window_{west}} = 2.84\ \frac{W}{m^2K}$

i.e., $CF_{window_{west}(Heat\ Trasnfer\ Part)} = 2.84\ \frac{W}{m^2K} \times (7.9\ K - 0.46 \times 11.9\ K) \approx 6.89\ \frac{W}{m^2}$

$PXI_{window_{west}} = E_D + E_d = 559 + 188 = 747$

$SHGC = 0.54$

No internal shading, so $IAC = 1$

$FF_g = 0.56$

$CF_{window_{west}(Irradiation\ Part)} = PXI \times SHGC \times IAC \times FF_g$

Table 10 Peak Irradiance, W/m²

Exposure		Latitude								
		20°	25°	30°	35°	40°	45°	50°	55°	60°
North	E_D	125	106	92	84	81	85	96	112	136
	E_d	128	115	103	93	84	76	69	62	55
	E_t	253	221	195	177	166	162	164	174	191
Northeast/Northwest	E_D	460	449	437	425	412	399	386	374	361
	E_d	177	169	162	156	151	147	143	140	137
	E_t	637	618	599	581	563	546	529	513	498
East/West	E_D	530	543	552	558	560	559	555	547	537
	E_d	200	196	193	190	189	188	187	187	187
	E_t	730	739	745	748	749	747	742	734	724
Southeast/Southwest	E_D	282	328	369	405	436	463	485	503	517
	E_d	204	203	203	204	205	207	210	212	215
	E_t	485	531	572	609	641	670	695	715	732
South	E_D	0	60	139	214	283	348	408	464	515
	E_d	166	193	196	200	204	209	214	219	225
	E_t	166	253	335	414	487	557	622	683	740
Horizontal	E_D	845	840	827	806	776	738	691	637	574
	E_d	170	170	170	170	170	170	170	170	170
	E_t	1015	1010	997	976	946	908	861	807	744

Table 13 Fenestration Solar Load Factors FF_s

Exposure	Single Family Detached	Multifamily
North	0.44	0.27
Northeast	0.21	0.43
East	0.31	0.56
Southeast	0.37	0.54
South	0.47	0.53
Southwest	0.58	0.61
West	0.56	0.65
Northwest	0.46	0.57
Horizontal	0.58	0.73

$q_{window_{west}} = A \times CF_{window_{west}} = A \times (CF_{window_{west}(Heat\ Trasnfer\ Part)} + CF_{window_{west}(Irradiation\ Part)})$

$\approx 14.4\ m^2 \times (6.89 + 747 \times 0.54 \times 1 \times 0.56)\frac{W}{m^2} \approx 3352.07\ W$

Calculating the heating load of the fixed window on the west:

$q_{window_{west}} = A \times HF_{window_{west}} = A \times U_{window_{west}}\ \Delta T_{heating}$

$= 14.4\ m^2 \times 2.84\frac{W}{m^2K} \times 24.8K \approx 1014.22\ W$

When the frame were to be aluminium, $U_{window_{west}} = 3.61\frac{W}{m^2K}$, $HSGC = 0.56$

$CF'_{window_{west}(Heat\ Trasnfer\ Part)} = U'_{window_{west}}\left(\Delta T_{cooling} - 0.46\ DR\right)$

$= 3.61\frac{W}{m^2K} \times (7.9\ K - 0.46 \times 11.9\ K) \approx 8.76\ \frac{W}{m^2}$

Cooling load $q'_{window_{west}} = A \times CF'_{window_{west}}$

$= A \times \left(CF'_{window_{west}(Heat\ Trasnfer\ Part)} + CF'_{window_{west}(Irradiation\ Part)}\right)$

$\approx 14.4\ m^2 \times (8.76 + 747 \times 0.56 \times 1 \times 0.56)\frac{W}{m^2} \approx 3499.48\ W$

Heating load $q'_{window_{west}} = A \times HF'_{window_{west}} = A \times U'_{window_{west}}\ \Delta T_{heating}$

$= 14.4\ m^2 \times 3.61\frac{W}{m^2K} \times 24.8\ K \approx 1289.20\ W$

Calculating the cooling load of the fixed window on the south:

$q_{window_{south}} = A \times CF_{window_{south}}$

$A = 3.6\ m^2$,

$CF_{window_{south}(Heat\ Trasnfer\ Part)} = U_{window_{south}}\left(\Delta T_{cooling} - 0.46\ DR\right)$

∵The window has a fixed heat absorbing double layer glass with a wooden frame,

$\therefore U_{window_{wast}} = 2.84\ \frac{W}{m^2K}$

i.e., $CF_{window_{south}(Heat\ Trasnfer\ Part)} = 2.84\frac{W}{m^2K} \times (7.9\ K - 0.46 \times 11.9\ K) \approx 6.89\ \frac{W}{m^2}$

$PXI_{window_{south}} = E_D + E_d = 348 + 209 = 557$

$SHGC = 0.55$

No internal shading, so IAC =1

$FF_s = 0.47$

$CF_{window_{south}(Irradiation\ Part)} = PXI \times SHGC \times IAC \times FF_s$

$q_{window_{south}} = A \times CF_{window_{south}} = A \times (CF_{window_{south}(Heat\ Trasnfer\ Part)} + CF_{window_{south}(Irradiation\ Part)})$

$\approx 3.6\ m^2 \times (6.89 + 557 \times 0.54 \times 1 \times 0.47)\frac{W}{m^2} \approx 553.72\ W$

Calculating the heating load of the fixed window on the south:

$q_{window_{south}} = A \times HF_{window_{south}} = A \times U_{window_{south}}\ \Delta T_{heating}$

$\approx 3.6\ m^2 \times (6.89 + 557 \times 0.54 \times 1 \times 0.47)\frac{W}{m^2} \approx 553.72\ W$

Calculating the heating load of the fixed window on the south:

$q_{window_{south}} = A \times HF_{window_{south}} = A \times U_{window_{south}}\ \Delta T_{heating}$

$= 3.6\ m^2 \times 2.84\frac{W}{m^2K} \times 24.8K \approx 253.56\ W$

When the frame were to be aluminium, $U_{window_{south}} = 3.61\frac{W}{m^2K}$, $HSGC = 0.56$

$CF'_{window_{south}(Heat\ Trasnfer\ Part)} = U'_{window_{south}}\ (\Delta T_{cooling} - 0.46\ DR)$

$$= 3.61\ \frac{W}{m^2 K} \times (7.9\ K - 0.46 \times 11.9\ K) \approx 8.76\ \frac{W}{m^2}$$

Cooling load $q'_{window_{south}} = A \times CF'_{window_{south}}$

$$= A \times \left(CF'_{window_{south}(Heat\ Trasnfer\ Part)} + CF'_{window_{south}(Irradiation\ Part)}\right)$$

$$\approx 3.6\ m^2 \times (8.76 + 557 \times 0.56 \times 1 \times 0.47)\ \frac{W}{m^2} \approx 559.30\ W$$

Heating load $q'_{window_{south}} = A \times HF'_{window_{south}} = A \times U'_{window_{south}}\ \Delta T_{heating}$

$$= 3.6\ m^2 \times 3.61\ \frac{W}{m^2 K} \times 24.8\ K \approx 322.30\ W$$

Calculating the cooling load of the operable window on the south:

$q_{window_{south}} = A \times CF_{window_{south}}$

$A = 3.6\ m^2$,

$CF_{window_{south}(Heat\ Trasnfer\ Part)} = U_{window_{south}}\ (\Delta T_{cooling} - 0.46\ DR)$

∵The window has an operable heat absorbing double layer glass with a wooden frame,

$\therefore U_{window_{west}} = 2.87\ \frac{W}{m^2 K}$

i.e., $CF_{window_{south}(Heat\ Trasnfer\ Part)} = 2.87\ \frac{W}{m^2 K} \times (7.9\ K - 0.46 \times 11.9\ K) \approx 6.96\ \frac{W}{m^2}$

$PXI_{window_{south}} = E_D + E_d = 348 + 209 = 557$

SHGC = 0.46

*No internal shading, so IAC =*1

$FF_s = 0.47$

$CF_{window_{south}(Irradiation\ Part)} = PXI \times SHGC \times IAC \times FF_s$

$q_{window_{south}} = A \times CF_{window_{south}} = A \times (CF_{window_{south}(Heat\ Trasnfer\ Part)} + CF_{window_{south}(Irradiation\ Part)})$

$$\approx 3.6\ m^2 \times (6.96 + 557 \times 0.54 \times 1 \times 0.47)\ \frac{W}{m^2} \approx 553.98\ W$$

Calculating the heating load of the fixed window on the south:

$q_{window_{south}} = A \times HF_{window_{south}} = A \times U_{window_{south}}\ \Delta T_{heating}$

$$= 3.6\ m^2 \times 2.87\ \frac{W}{m^2 K} \times 24.8K \approx 256.23\ W$$

When the frame were to be aluminium, $U_{window_{south}} = 4.62\ \frac{W}{m^2 K}$, $HSGC = 0.55$

$CF'_{window_{south}(Heat\ Trasnfer\ Part)} = U'_{window_{south}}\ (\Delta T_{cooling} - 0.46\ DR)$

$$= 4.62\ \frac{W}{m^2 K} \times (7.9\ K - 0.46 \times 11.9\ K) \approx 11.21\ \frac{W}{m^2}$$

Cooling load $q'_{window_{south}} = A \times CF'_{window_{south}}$

$$= A \times \left(CF'_{window_{south}(Heat\ Trasnfer\ Part)} + CF'_{window_{south}(Irradiation\ Part)}\right)$$

$$\approx 3.6\ m^2 \times (11.21 + 557 \times 0.55 \times 1 \times 0.47)\ \frac{W}{m^2} \approx 558.70\ W$$

Heating load $q'_{window_{south}} = A \times HF'_{window_{south}} = A \times U'_{window_{south}}\ \Delta T_{heating}$

$$= 3.6\ m^2 \times 4.62\ \frac{W}{m^2 K} \times 24.8\ K \approx 412.47\ W$$