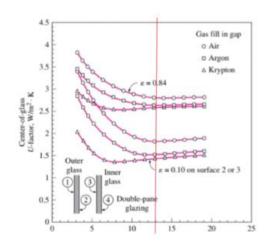
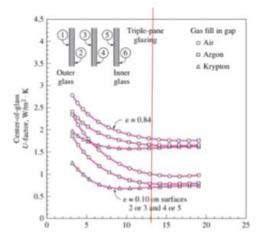
TASK 1





P/	ANEL WITH AIR GAP 13	mm	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%

PIACENZA, Italy WMO#: 160840 Lat 44.92N 9.73E Long: 138 StdP: 99.68 Period: 89-10 (b) (d) -11.6 (d) 22.7 33.1 22.4 21.8 23.7 22.9

Answer:

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

$$\Delta T_{cooling} = 31.9 \, ^{\circ}C \, -24 \, ^{\circ}C = 7.9 \, ^{\circ}C = 7.9 K$$

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

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

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

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

$$A = 14.4m^2$$
.

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

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

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

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

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

SHGC = 0.54

No internal shading, so IAC = 1

$$FF_{s} = 0.56$$

 $\mathit{CF}_{window_{west}(Irradiation\,Part)} = \mathit{PXI} \times \mathit{SHGC} \times \mathit{IAC} \times \mathit{FF}_{\mathit{S}}$

Table	Table 10 Peak Irradiance, W/m ²								
		Latitude							
Exposure	20"	25"	30°	35"	40°	45°	50^	55°	68*
North /	p 125	106	92	84	81	85	96	112	136
	J 129	115	103	93	84	76	69	62	55
	, 25	221	195	1.77	166	162	164	174	191
Northeast/Northwest E	n 460	449	437	425	412	399	386	374	361
	J 17	1 169	162	156	151	147	143	140	137
1	, 63	618	599	581	563	546	529	513	495
East West /	n 530	543	552	558	560	559	555	547	537
	280	196	193	190	189	188	187	187	187
	730	739	745	748	749	747	742	734	724
Southeast/Southwest I	p 283	328	369	405	436	463	485	503	517
	200	203	203	204	205	207	210	212	215
	, 4E	5 531	572	609	641	670	695	715	732
South 2	(a 1	60	139	214	283	348	405	464	515
	7 166	5 193	196	200	204	209	214	219	225
	, 166	253	335	414	487	557	622	683	740
Horizontal 8	o 84	5 840	827	806	776	738	691	637	574
1	17	170	170	170	170	170	170	170	170
	, 1015								

Table 13 Fenestration Solar Load Factors FF

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

$$\begin{split} q_{window_{west}} &= A \times \mathit{CF}_{window_{west}} = A \times (\mathit{CF}_{window_{west}}(\mathit{Heat}\,\mathit{Trasnfer}\,\mathit{Part}) + \mathit{CF}_{window_{west}}(\mathit{Irradiation}\,\mathit{Part})) \\ &\approx 14.4\,\mathit{m}^2 \times (6.89 + 747 \times 0.54 \times 1 \times 0.56)\,\frac{\mathit{W}}{\mathit{m}^2} \approx 3352.07\,\mathit{W} \end{split}$$

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

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

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

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

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

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

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

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

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

 $\textit{Heating load } q'_{window_{west}} = \textit{A} \times \textit{HF'}_{window_{west}} = \textit{A} \times \textit{U'}_{window_{west}} \, \Delta \textit{T}_{\textit{heating}}$

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

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,

$$\therefore U_{window_{wast}} = 2.84 \frac{w}{m^2 \kappa}$$

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

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

SHGC = 0.55

No internal shading, so IAC =1

 $FF_s = 0.47$

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

 $q_{window_{south}} = A \times CF_{window_{south}} = A \times (CF_{window_{south}(Heat Trasnfer Part)} + CF_{window_{south}(Irradiation Part)})$ $\approx 3.6 \ m^2 \times (6.89 + 557 \times 0.54 \times 1 \times 0.47) \frac{W}{m^2} \approx 553.72 \ W$

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

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

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

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

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

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

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

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

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

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

$$= A \times (CF'_{window_{court}}(HeatTrasnferPart) + CF'_{window_{court}}(IrradiationPart))$$

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

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

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

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

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

 $A = 3.6 \text{ m}^2$

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

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

$$A U_{window_{wast}} = 2.87 \frac{W}{m^2 K}$$

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

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

SHGC = 0.46

No internal shading, so IAC =1

 $FF_s = 0.47$

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

 $q_{window_{south}} = A \times \mathit{CF}_{window_{south}} = A \times (\mathit{CF}_{window_{south}(Heat\,Trasnfer\,Part)} + \mathit{CF}_{window_{south}(Irradiation\,Part)})$

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

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

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

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

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

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

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

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

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