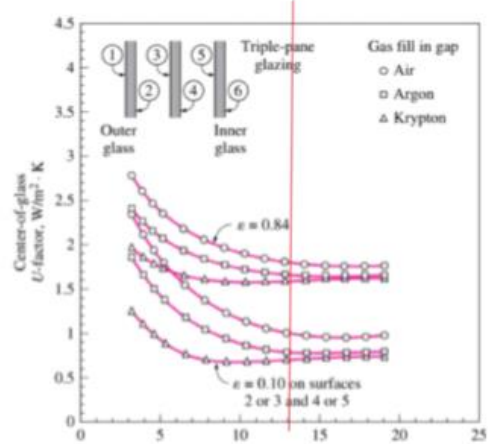
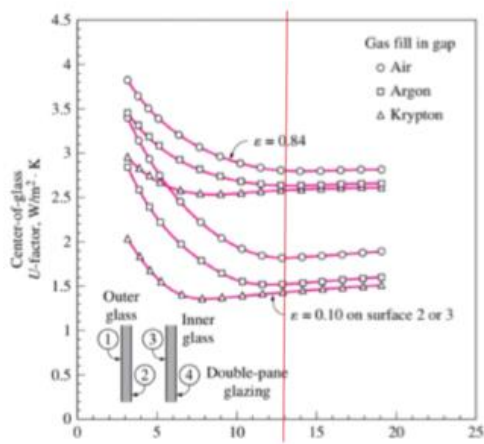


## TASK 1



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%



$$q_{\text{window}_{\text{west}}} = A \times CF_{\text{window}_{\text{west}}} = A \times (CF_{\text{window}_{\text{west}}}(\text{Heat Transfer Part}) + CF_{\text{window}_{\text{west}}}(\text{Irradiation Part}))$$

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

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

$$q_{\text{window}_{\text{west}}} = A \times HF_{\text{window}_{\text{west}}} = A \times U_{\text{window}_{\text{west}}} \Delta T_{\text{heating}}$$

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

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

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

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

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

$$= A \times (CF'_{\text{window}_{\text{west}}}(\text{Heat Transfer Part}) + CF'_{\text{window}_{\text{west}}}(\text{Irradiation Part}))$$

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

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

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

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

$$q_{\text{window}_{\text{south}}} = A \times CF_{\text{window}_{\text{south}}}$$

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

$$CF_{\text{window}_{\text{south}}}(\text{Heat Transfer Part}) = U_{\text{window}_{\text{south}}} (\Delta T_{\text{cooling}} - 0.46 \text{ DR})$$

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

$$\therefore U_{\text{window}_{\text{west}}} = 2.84 \frac{\text{W}}{\text{m}^2 \text{K}}$$

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

$$PXI_{\text{window}_{\text{south}}} = E_D + E_d = 348 + 209 = 557$$

$$SHGC = 0.55$$

No internal shading, so  $IAC = 1$

$$FF_s = 0.47$$

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

$$q_{\text{window}_{\text{south}}} = A \times CF_{\text{window}_{\text{south}}} = A \times (CF_{\text{window}_{\text{south}}}(\text{Heat Transfer Part}) + CF_{\text{window}_{\text{south}}}(\text{Irradiation Part}))$$

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

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

$$q_{\text{window}_{\text{south}}} = A \times HF_{\text{window}_{\text{south}}} = A \times U_{\text{window}_{\text{south}}} \Delta T_{\text{heating}}$$

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

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

$$q_{\text{window}_{\text{south}}} = A \times HF_{\text{window}_{\text{south}}} = A \times U_{\text{window}_{\text{south}}} \Delta T_{\text{heating}}$$

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

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

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

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

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

$$= A \times (CF'_{\text{window}_{\text{south}}(\text{Heat Transfer Part})} + CF'_{\text{window}_{\text{south}}(\text{Irradiation Part})})$$

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

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

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

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

$$q_{\text{window}_{\text{south}}} = A \times CF_{\text{window}_{\text{south}}}$$

$$A = 3.6 m^2,$$

$$CF_{\text{window}_{\text{south}}(\text{Heat Transfer Part})} = U_{\text{window}_{\text{south}}} (\Delta T_{\text{cooling}} - 0.46 DR)$$

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

$$\therefore U_{\text{window}_{\text{south}}} = 2.87 \frac{W}{m^2 K}$$

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

$$PFI_{\text{window}_{\text{south}}} = E_D + E_d = 348 + 209 = 557$$

$$SHGC = 0.46$$

No internal shading, so IAC = 1

$$FF_s = 0.47$$

$$CF_{\text{window}_{\text{south}}(\text{Irradiation Part})} = PFI \times SHGC \times IAC \times FF_s$$

$$q_{\text{window}_{\text{south}}} = A \times CF_{\text{window}_{\text{south}}} = A \times (CF_{\text{window}_{\text{south}}(\text{Heat Transfer Part})} + CF_{\text{window}_{\text{south}}(\text{Irradiation Part})})$$

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

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

$$q_{\text{window}_{\text{south}}} = A \times HF_{\text{window}_{\text{south}}} = A \times U_{\text{window}_{\text{south}}} \Delta T_{\text{heating}}$$

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

**When the frame were to be aluminium,  $U_{\text{window}_{\text{south}}} = 4.62 \frac{W}{m^2 K}$ ,  $SHGC = 0.55$**

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

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

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

$$= A \times (CF'_{\text{window}_{\text{south}}(\text{Heat Transfer Part})} + CF'_{\text{window}_{\text{south}}(\text{Irradiation Part})})$$

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

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

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