NASTARAN TAFAZOLI **WEEK 8**

TASK 1.

Using the diagrams given in the presentation calculate how much (%) is the effect of applying different modifications (changing the gas, adding an extra pane, using a low emissivity coating) on the U value with respect to a benchmark case of double layer with air and no coating ? (keep the gap thickness to be 13 mm)

	U	Difference	Percentage
2 Parallel plans with air	2,8 W/m2		
2 Parallel plans with gas	2,6 W/m2	0,2 W/m2	7,14%
2 Parallel plans with air and coating	1,8 W/m2	1,0 W/m2	35,71%
2 Parallel plans with gas and coating	1,5 W/m2	1,3 W/m2	46,42%
3 Parallel plans with air	1,8 W/m2	1,0 W/m2	35,71%
3 Parallel plans with gas	1,6 W/m2	1,2 W/m2	42,85%
3 Parallel plans with air and coating	1,0 W/m2	1,8 W/m2	64,28%
3 Parallel plans with gas and coating	0,75 W/m2	2,05 W/m2	73,21%

TASK 2.

Consider the house that we analyzed in the last two examples, calculate the heating and cooling load of the other windows which are fixed 14.4 m2 on the west, fixed 3.6 m2 on the south and an operable 3.6 m2 on the south (the same window and frame type). How much does the total value change if I change the frame of the window from wooden one to aluminum ?

COOLING

WEST WINDOW FIXED - WOODEN

$$CF_{ht} = U(\Delta T\_cooling \quad - 0.46\ DR)$$

$$CF_{ht} = 2.84\ \frac{W}{m^2 K}\ (7.9K \quad - 0.46 \times 11.9)$$

$$\underline{W}$$

WEST WINDOW FIXED - ALUMINUM

$$CF_{ht} = U(\Delta T\_cooling \quad - 0.46\ DR)$$

$$CF_{ht} = 3.61\ \frac{W}{m^2 K}\ (7.9K \quad - 0.46 \times 11.9)$$

$$\underline{W}$$

DIFFERENCES

$$W$$

$CF_{ht} = 6.9 \ _2 m$

$CF_{ip} = PXI \times SHGC \times IAC \times FF_s$

$CF_{ip} = 747 \times 0.54 \times 1 \times 0.56$

$CF_{ip} = 217.82 \ \frac{W}{m^2}$

$\boldsymbol{CF_{total} = 224.72 \ \frac{W}{m^2}}$

$Q_{COOLING} = CF_{total} \times Area$

$Q_{COOLING} = 224.72 \ \frac{W}{m^2} \times 14.4 \ m^2$

$\boldsymbol{Q_{COOLING} = 3235.96 \ W}$

SOUTH WINDOW FIXED - WOODEN

$CF_{ht} = U(\Delta T\_cooling \quad - 0.46 \ DR)$

$CF_{ht} = 2.84 \frac{W}{m^2 K}(7.9K \quad - 0.46 \times 11.9)$

$CF_{ht} = 6.9 \frac{W}{m^2}$

$CF_{ip} = PXI \times SHGC \times IAC \times FF_s$

$CF_{ip} = 557 \times 0.54 \times 1 \times 0.47$

$CF_{ip} = 141.36 \frac{W}{m^2}$

$\boldsymbol{CF_{total} = 148.26 \frac{W}{m^2}}$

$Q_{COOLING} = CF_{total} \times Area$

$Q_{COOLING} = 148.26 \frac{W}{m^2} \times 3.6 \ m^2$

SOUTH WINDOW OPERABLE - WOODEN

$CF_{ht} = U(\Delta T\_cooling \quad - 0.46 \ DR)$

$CF_{ht} = 2.87 \frac{W}{m^2 K}(7.9K \quad - 0.46 \times 11.9)$

$CF_{ht} = 6.96 \frac{W}{m^2}$

$_{ht} \quad ^2$
m

$CF_{ip} = PXI \times SHGC \times IAC \times FF_s$

$CF_{ip} = 747 \times 0.56 \times 1 \times 0.56$

$CF_{ip} = 234.25 \ \frac{W}{m^2}$

$\boldsymbol{CF_{total} = 243 \ \frac{W}{m^2}}$

$Q_{COOLING} = CF_{total} \times Area$

$Q_{COOLING} = 243 \ \frac{W}{m^2} \times 14.4 \ m^2$

$\boldsymbol{Q_{COOLING} = 3499.33 \ W}$

$CF \quad = 8.75$

$\boldsymbol{Q_{COOLING} = 533.73 \ W}$

SOUTH WINDOW FIXED - ALUMINUM

$CF_{ht} = U(\Delta T\_cooling \quad - 0.46 \ DR)$

$CF_{ht} = 3.61 \frac{W}{m^2 K}(7.9K \quad - 0.46 \times 11.9)$

$CF_{ht} = 8.75 \frac{W}{m^2}$

$CF_{ip} = PXI \times SHGC \times IAC \times FF_s$

$CF_{ip} = 557 \times 0.56 \times 1 \times 0.47$

$CF_{ip} = 146.6 \frac{W}{m^2}$

$\boldsymbol{CF_{total} = 155.35 \frac{W}{m^2}}$

$Q_{COOLING} = CF_{total} \times Area$

$Q_{COOLING} = \frac{155.35 m}{W_{2\,2} \times 3.6 \ m}$

$CF_{ip} = PXI \times SHGC \times IAC \times FF_s$

$CF_{ip} = 557 \times 0.46 \times 1 \times 0.47$

$CF_{ip} = 120.4 \frac{W}{m^2}$

$\boldsymbol{CF_{total} = 127.38 \frac{W}{m^2}}$

$CF_{ht} = 1.85 \quad ^2$
m

$CF_{ip} = 16.43 \ \frac{W}{m^2}$

$\boldsymbol{CF_{total} = 18.28 \frac{W}{m^2}}$

$\boldsymbol{Q_{COOLING} = 263.37 \ W}$

$\boldsymbol{Q_{COOLING} = 559.2 \ W}$

DIFFERENCES

$CF_{ht} = 1.85 \frac{W}{m^2}$

$CF_{ip} = 5.24 \frac{W}{m^2}$

$\boldsymbol{CF_{total} = 7.09 \frac{W}{m^2}}$

$\boldsymbol{Q_{COOLING} = 25.47 \ W}$

$Q_{COOLING} = CF_{total} \times Area$

$Q_{COOLING} = \frac{127.38 \ m}{W}$

$_2{}^2 \times 3.6\ m$

$\boldsymbol{Q_{COOLING} = 458.58\ W}$

SOUTH WINDOW OPERABLE - ALUMINUM

$CF_{ht} = U(\Delta T\_cooling \quad - 0.46\ DR)$

$CF_{ht} = 4.62 \frac{W}{m_2 K} (7.9K \quad - 0.46 \times 11.9)$

$CF_{ht} = 11.2 \frac{W}{m_2}$

$CF_{ip} = PXI \times SHGC \times IAC \times FF_s$

$CF_{ip} = 557 \times 0.55 \times 1 \times 0.47$

$CF_{ip} = 143.98 \frac{W}{m_2}$

$\boldsymbol{CF_{total} = 155.18 \frac{W}{m_2}}$

$Q_{COOLING} = CF_{total} \times Area$

$Q_{COOLING} = \frac{155.18}{m^{W}_{2\ 2} \times 3.6\ m}$

$\boldsymbol{Q_{COOLING} = 558.6\ W}$

DIFFERENCES

$CF_{ht} = 4.24 \frac{W}{m_2}$

$CF_{ip} = 23.58 \frac{W}{m_2}$

$\boldsymbol{CF_{total} = 27.8 \frac{W}{m_2}}$

$\boldsymbol{Q_{COOLING} = 100.02\ W}$

HEATING

WEST WINDOW FIXED - WOODEN

$HF = U \times \Delta T\_heating$

$HF = 2.84 \frac{W}{m_2 K} \times 24.8\ K$

$HF = 70.4 \frac{W}{m_2}$

$Q_{HEATING} = HF \times Area$

$Q_{HEATING} = 70.4 \frac{W}{m_2} \times 14.4\ m_2$

$\boldsymbol{Q_{HEATING} = 1014.2\ W}$

WEST WINDOW FIXED - ALUMINUM

$HF = U \times \Delta T\_heating$

$HF = 3.61 \frac{W}{m_2 K} \times 24.8\ K$

$HF = 89.52 \frac{W}{m_2}$

$Q_{HEATING} = HF \times Area$

$Q_{HEATING} = 89.52 \frac{W}{m_2} \times 14.4\ m_2$

$\boldsymbol{Q_{HEATING} = 1289.2\ W}$

DIFFERENCES

$HF = 19.12 \frac{W}{m_2}$

$\boldsymbol{Q_{HEATING} = 275\ W}$

SOUTH WINDOW FIXED - WOODEN

$$HF = U \times \Delta T\_heating$$

$$HF = 2.84 \frac{W}{m_2 K} \times 24.8\ K$$

$$\mathrm{H}F = 70.4 \frac{W}{m_2}$$

$$Q_{HEATING} = HF \times Area$$

$$Q_{HEATING} = 70.4 \frac{W}{m^2} \times 3.6\ m_2$$

$$\boldsymbol{Q_{HEATING} = 253.4\ W}$$

SOUTH WINDOW FIXED - ALUMINUM

$$HF = U \times \Delta T\_heating$$

$$HF = 3.61 \frac{W}{m_2 K} \times 24.8\ K$$

$$\mathrm{H}F = 89.52 \frac{W}{m_2}$$

$$Q_{HEATING} = HF \times Area$$

$$Q_{HEATING} = 89.52 \frac{W}{m^2} \times 3.6\ m_2$$

$$\boldsymbol{Q_{HEATING} = 322.3\ W}$$

DIFFERENCES

$$\mathrm{H}F = 19.12 \frac{W}{m_2}$$

$$\boldsymbol{Q_{HEATING} = 68.9\ W}$$

SOUTH WINDOW OPERABLE - WOODEN

$$HF = U \times \Delta T\_heating$$

$$HF = 2.87 \frac{W}{m_2 K} \times 24.8\ K$$

$$\mathrm{H}F = 71.87 \frac{W}{m_2}$$

$$Q_{HEATING} = HF \times Area$$

$$Q_{HEATING} = \frac{71.87}{m^2} \frac{W}{2\ 2} \times 3.6\ m$$

$$\boldsymbol{Q_{HEATING} = 256.2\ W}$$

SOUTH WINDOW OPERABLE - ALUMINUM

$$HF = U \times \Delta T\_heating$$

$$HF = 4.62 \frac{W}{m_2 K} \times 24.8\ K$$

$$\mathrm{H}F = 114.57 \frac{W}{m_2}$$

$$Q_{HEATING} = HF \times Area$$

$$Q_{HEATING} = \frac{114.57}{m^2} \frac{W}{2\ 2} \times 3.6\ m$$

$$\boldsymbol{Q_{HEATING} = 412.45\ W}$$

DIFFERENCES

$$\mathrm{H}F = 42.7 \frac{W}{m_2}$$

$$\boldsymbol{Q_{HEATING} = 156.25\ W}$$