

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/m ²		
2 Parallel plans with gas	2,6 W/m ²	0,2 W/m ²	7,14%
2 Parallel plans with air and coating	1,8 W/m ²	1,0 W/m ²	35,71%
2 Parallel plans with gas and coating	1,5 W/m ²	1,3 W/m ²	46,42%
3 Parallel plans with air	1,8 W/m ²	1,0 W/m ²	35,71%
3 Parallel plans with gas	1,6 W/m ²	1,2 W/m ²	42,85%
3 Parallel plans with air and coating	1,0 W/m ²	1,8 W/m ²	64,28%
3 Parallel plans with gas and coating	0,75 W/m ²	2,05 W/m ²	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**

$$CF_{ht} = U(\Delta T_{cooling} - 0.46 DR)$$

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

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

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

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

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

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

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

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

$$Q_{COOLING} = 3235.96 W$$

WEST WINDOW FIXED - ALUMINUM

$$CF_{ht} = U(\Delta T_{cooling} - 0.46 DR)$$

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

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

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

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

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

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

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

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

$$Q_{COOLING} = 3499.33 W$$

DIFFERENCES

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

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

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

$$Q_{COOLING} = 263.37 W$$

SOUTH WINDOW FIXED - WOODEN

$$CF_{ht} = U(\Delta T_{cooling} - 0.46 DR)$$
$$CF_{ht} = 2.84 \frac{W}{m^2 K} (7.9K - 0.46 \times 11.9)$$
$$CF_{ht} = 6.9 \frac{W}{m^2}$$

$$CF_{ip} = PXI \times SHGC \times IAC \times FF_s$$
$$CF_{ip} = 557 \times 0.54 \times 1 \times 0.47$$
$$CF_{ip} = 141.36 \frac{W}{m^2}$$

$$CF_{total} = 148.26 \frac{W}{m^2}$$
$$Q_{COOLING} = CF_{total} \times Area$$
$$Q_{COOLING} = 148.26 \frac{W}{m^2} \times 3.6 m^2$$
$$Q_{COOLING} = 533.73 W$$

SOUTH WINDOW FIXED - ALUMINUM

$$CF_{ht} = U(\Delta T_{cooling} - 0.46 DR)$$
$$CF_{ht} = 3.61 \frac{W}{m^2 K} (7.9K - 0.46 \times 11.9)$$
$$CF_{ht} = 8.75 \frac{W}{m^2}$$

$$CF_{ip} = PXI \times SHGC \times IAC \times FF_s$$
$$CF_{ip} = 557 \times 0.56 \times 1 \times 0.47$$
$$CF_{ip} = 146.6 \frac{W}{m^2}$$

$$CF_{total} = 155.35 \frac{W}{m^2}$$
$$Q_{COOLING} = CF_{total} \times Area$$
$$Q_{COOLING} = 155.35 \frac{W}{m^2} \times 3.6 m^2$$
$$Q_{COOLING} = 559.2 W$$

DIFFERENCES

$$CF_{ht} = 1.85 \frac{W}{m^2}$$
$$CF_{ip} = 5.24 \frac{W}{m^2}$$
$$CF_{total} = 7.09 \frac{W}{m^2}$$
$$Q_{COOLING} = 25.47 W$$

SOUTH WINDOW OPERABLE - WOODEN

$$CF_{ht} = U(\Delta T_{cooling} - 0.46 DR)$$
$$CF_{ht} = 2.87 \frac{W}{m^2 K} (7.9K - 0.46 \times 11.9)$$
$$CF_{ht} = 6.96 \frac{W}{m^2}$$

$$CF_{ip} = PXI \times SHGC \times IAC \times FF_s$$
$$CF_{ip} = 557 \times 0.46 \times 1 \times 0.47$$
$$CF_{ip} = 120.4 \frac{W}{m^2}$$

$$CF_{total} = 127.38 \frac{W}{m^2}$$
$$Q_{COOLING} = CF_{total} \times Area$$
$$Q_{COOLING} = 127.38 \frac{W}{m^2} \times 3.6 m^2$$
$$Q_{COOLING} = 458.58 W$$

SOUTH WINDOW OPERABLE - ALUMINUM

$$CF_{ht} = U(\Delta T_{cooling} - 0.46 DR)$$
$$CF_{ht} = 4.62 \frac{W}{m^2 K} (7.9K - 0.46 \times 11.9)$$
$$CF_{ht} = 11.2 \frac{W}{m^2}$$

$$CF_{ip} = PXI \times SHGC \times IAC \times FF_s$$
$$CF_{ip} = 557 \times 0.55 \times 1 \times 0.47$$
$$CF_{ip} = 143.98 \frac{W}{m^2}$$

$$CF_{total} = 155.18 \frac{W}{m^2}$$
$$Q_{COOLING} = CF_{total} \times Area$$
$$Q_{COOLING} = 155.18 \frac{W}{m^2} \times 3.6 m^2$$
$$Q_{COOLING} = 558.6 W$$

DIFFERENCES

$$CF_{ht} = 4.24 \frac{W}{m^2}$$
$$CF_{ip} = 23.58 \frac{W}{m^2}$$
$$CF_{total} = 27.8 \frac{W}{m^2}$$
$$Q_{COOLING} = 100.02 W$$

HEATING

WEST WINDOW FIXED - WOODEN

$$HF = U \times \Delta T_{heating}$$
$$HF = 2.84 \frac{W}{m^2 K} \times 24.8 K$$
$$HF = 70.4 \frac{W}{m^2}$$

$$Q_{HEATING} = HF \times Area$$
$$Q_{HEATING} = 70.4 \frac{W}{m^2} \times 14.4 m^2$$

$$Q_{HEATING} = 1014.2 W$$

WEST WINDOW FIXED - ALUMINUM

$$HF = U \times \Delta T_{heating}$$
$$HF = 3.61 \frac{W}{m^2 K} \times 24.8 K$$
$$HF = 89.52 \frac{W}{m^2}$$

$$Q_{HEATING} = HF \times Area$$
$$Q_{HEATING} = 89.52 \frac{W}{m^2} \times 14.4 m^2$$

$$Q_{HEATING} = 1289.2 W$$

DIFFERENCES

$$HF = 19.12 \frac{W}{m^2}$$

$$Q_{HEATING} = 275 W$$

SOUTH WINDOW FIXED - WOODEN

$$HF = U \times \Delta T_{heating}$$
$$HF = 2.84 \frac{W}{m^2 K} \times 24.8 K$$
$$HF = 70.4 \frac{W}{m^2}$$

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

$$Q_{HEATING} = 253.4 W$$

SOUTH WINDOW FIXED - ALUMINUM

$$HF = U \times \Delta T_{heating}$$
$$HF = 3.61 \frac{W}{m^2 K} \times 24.8 K$$
$$HF = 89.52 \frac{W}{m^2}$$

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

$$Q_{HEATING} = 322.3 W$$

DIFFERENCES

$$HF = 19.12 \frac{W}{m^2}$$

$$Q_{HEATING} = 68.9 W$$

SOUTH WINDOW OPERABLE - WOODEN

$$HF = U \times \Delta T_{heating}$$
$$HF = 2.87 \frac{W}{m^2 K} \times 24.8 K$$
$$HF = 71.87 \frac{W}{m^2}$$

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

$$Q_{HEATING} = 256.2 W$$

SOUTH WINDOW OPERABLE - ALUMINUM

$$HF = U \times \Delta T_{heating}$$
$$HF = 4.62 \frac{W}{m^2 K} \times 24.8 K$$
$$HF = 114.57 \frac{W}{m^2}$$

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

$$Q_{HEATING} = 412.45 W$$

DIFFERENCES

$$HF = 42.7 \frac{W}{m^2}$$

$$Q_{HEATING} = 156.25 W$$