

WEEK ASSIGNMENT 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).

Type	U factor	%
2 Panes with air	2,8 W/m ²	
2 Panes with gas (krypton)	2,6 W/m ²	7,14%
2 Panes with gas and low emissivity coating	1,4 W/m ²	50%
2 Panes with air and low emissivity coating	1,8 W/m ²	35,71%
3 Panes with air	1,8 W/m ²	35,71%
3 Panes with gas (krypton)	1,6 W/m ²	42,85%
3 Panes with gas and coating	0,8 W/m ²	71,42%
3 Panes with air and coating	1,1 W/m ²	60,71%

Task 2

Consider the house that we analysed 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 aluminium ?

COOLING

West window fixed (wooden)

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

$$CF_{ip} = PXI \times SHGC \times IAC \times FF_s = 747 * 0.54 * 1 * 0.56 = 217.82 \text{ W/m}^2$$

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

$$Q = CF_{\text{total}} * A$$

$$Q = 224.72 * 14.4 = 3236 \text{ W}$$

West window fixed (aluminium)

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

$$CF_{\text{ip}} = \text{PXI} \times \text{SHGC} \times \text{IAC} \times \text{FFs} = 747 * 0.56 * 1 * 0.56 = 234.25 \text{ W/m}^2$$

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

$$Q = CF_{\text{total}} * A$$

$$Q = 243 * 14.4 = 3500 \text{ W}$$

$$Q_2 - Q_1 = 264 \text{ W}$$

South window fixed (wooden)

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

$$CF_{\text{ip}} = \text{PXI} \times \text{SHGC} \times \text{IAC} \times \text{FFs} = 557 * 0.54 * 1 * 0.47 = 141.36 \text{ W/m}^2$$

$$CF_{\text{total}} = 148.26 \text{ W/m}^2$$

$$Q = CF_{\text{total}} * A$$

$$Q = 148.26 * 3.6$$

$$Q = 533.73 \text{ W}$$

South window fixed (aluminium)

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

$$CF_{\text{ip}} = \text{PXI} \times \text{SHGC} \times \text{IAC} \times \text{FFs} = 557 * 0.56 * 1 * 0.47 = 146.6 \text{ W/m}^2$$

$$CF_{\text{total}} = 155.35 \text{ W/m}^2$$

$$Q = CF_{\text{total}} * A$$

$$Q = 155.35 * 3.6$$

$$Q = 559.2 \text{ W}$$

$$Q_2 - Q_1 = 25.47 \text{ W}$$

South window operable (wooden)

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

$$CF_{ip} = PXI \times SHGC \times IAC \times FFs = 557 * 0.46 * 1 * 0.47 = 120.4 \text{ W/m}^2$$

$$CF_{total} = 127.4 \text{ W/m}^2$$

$$Q = CF_{total} * A$$

$$Q = 127.4 * 3.6$$

$$Q = 458.64 \text{ W}$$

South window operable (aluminium)

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

$$CF_{ip} = PXI \times SHGC \times IAC \times FFs = 557 * 0.55 * 1 * 0.47 = 144 \text{ W/m}^2$$

$$CF_{total} = 155.2 \text{ W/m}^2$$

$$Q = CF_{total} * A$$

$$Q = 155.2 * 3.6$$

$$Q = 558.72 \text{ W}$$

$$Q_2 - Q_1 = 100.08 \text{ W}$$

HEATING

West window fixed (wooden)

$$HF = U * \Delta T_{heating} = 2.84 * 24.8 = 70.4 \text{ W/m}^2$$

$$Q = HF * A$$

$$Q = 70.4 * 14.4 = 1014.2 \text{ W}$$

West window fixed (aluminum)

$$HF = U * \Delta T_{heating} = 3.61 * 24.8 = 89.52 \text{ W/m}^2$$

$$Q = HF * A$$

$$Q = 89.52 * 14.4 = 1289.2 \text{ W}$$

$$Q_2 - Q_1 = 275 \text{ W}$$

South window fixed (wooden)

$$HF = U * \Delta T_{\text{heating}} = 2.84 * 24.8 = 70.4 \text{ W/m}^2$$

$$Q = HF * A$$

$$Q = 70.4 * 3.6 = 253.4 \text{ W}$$

South window fixed (aluminium)

$$HF = U * \Delta T_{\text{heating}} = 3.61 * 24.8 = 89.52 \text{ W/m}^2$$

$$Q = HF * A$$

$$Q = 89.52 * 3.6 = 322.3 \text{ W}$$

$$Q_2 - Q_1 = 68.9 \text{ W}$$

South window operable (wooden)

$$HF = U * \Delta T_{\text{heating}} = 2.87 * 24.8 = 71.87 \text{ W/m}^2$$

$$Q = HF * A$$

$$Q = 71.87 * 3.6 = 256.2 \text{ W}$$

South window operable (aluminium)

$$HF = U * \Delta T_{\text{heating}} = 4.62 * 24.8 = 114.57 \text{ W/m}^2$$

$$Q = HF * A$$

$$Q = 114.57 * 3.6 = 412.45 \text{ W}$$

$$Q_2 - Q_1 = 156.26 \text{ W}$$