Week8_sconde 10634529

1.
The $U_{value}$of a window:

$$\mathrm{U_{window}} = \frac{(U_{centre} * A_{centre}) + (U_{edge} * A_{edge}) + (U_{frame} * A_{frame})}{A_{window}}$$

$$\frac{1}{U_{double\ pane\ window}} = \frac{1}{\mathrm{h}_i} + \frac{1}{\mathrm{h}_{space}} + \frac{1}{\mathrm{h}_o} \; ; \mathrm{h}_{space} = \mathrm{h}_{radiation} = \mathrm{h}_{conv.\ space}$$

*U and h change according to the type of gas

According to the diagrams given in the presentation:
-Gap thickness is 13mm
-Gas type: Argon
-the $U_{value}$of the centre of the glass decreases from $2.8\frac{W}{m^2K}\ to\ 2.65\frac{W}{m^2K}$
-5.3%

-Gap thickness is 13mm
-Gas type: Krypton
-the $U_{value}$of the centre of the glass decreases from $2.8\frac{W}{m^2K}\ to\ 2.6\frac{W}{m^2K}$
-7.1%

*U and h changed when we added an extra pane
-Gap thickness is 13mm
-Gas type: air
-Extra pane
-the U_{value} decreases from $2.8\frac{W}{m^2K}\ to\ 1.8\frac{W}{m^2K}$
-35.7%

-Gap thickness is 13mm
-Gas type: air
-Extra pane +coating film with emissivity of 0.1
-the U_{value} decreases from $2.8\frac{W}{m^2K}\ to\ 1.8\frac{W}{m^2K}$
-35.7%

2.

Case 1. Fixed window on West:

A. Cooling Load:

Frame: Wood

$Q_{window} = A * CF_{window}$; $A = 14.4m^2$

$$CF_{window\ with\ Heat\ Trans} = U_{window}(\delta T_{cooling} - 0.46\ DR) - 2.84(7.9 - 0.46 - 11.9)$$

$$= 6.89\frac{W}{m^2}$$

$$PXI_{window} = ED + Ed = 559 + 188 = 747\ ;SHGC = 0.54\ ;IAC = 1\ ;Ffs = 0.56$$

$$CF_{window\ with\ Radiation} = PXI * SHGC * IAC * FFs = 747 * 0.54 * 1 * 0.56$$

=225.9

$$Q_{window} = A * CF_{window} = A(CF_{window\ Heat\ transfer} + CF_{window\ Radiation}) = 14.4(6.89 + 225.9)$$

=3352.17 W

B. Heating Load:

Frame: Aluminum

$$Q_{Window} = A * HF_{window} = A * U_{window\ with\ \delta T_{heating}} = 14.4(6.89 + 225.9)$$

=253.56 W

$$U_{window} = 3.61\ ;HSGC = 0.56$$

$$U_{window} = A * HFwindow = A_{window}\left((\delta T_{cooling} - 0.46\ DR) = 3.61(7.9 - 0.46 * 11.9)\right)$$

=8.76 W/m^2

Cooling Load:

$$Q_{window} = A * CF_{window} = A(CF_{window\ Heat\ transfer} + CF_{window\ Radiation}) = 14.4(8.76 + 234.26)$$

$$= 3499.49\ W$$

Heating Load

$$Q_{window} = A * HF_{window} = A * U_{window} * \delta T_{heating} = 14.4 * 3.61 * 24.8$$

$$= 1289.2\ W$$

Case 2. Fixed window on South:

A. Cooling Load:

Frame: Wood

$Q_{window} = A * CF_{window}$; $A = 14.4m^2$

$$CF_{window\ with\ Heat\ Trans} = U_{window}(\delta T_{cooling} - 0.46\ DR) - 2.84(7.9 - 0.46 - 11.9)$$

$$= 6.89\frac{W}{m^2}$$

$$CF_{window\ with\ Radiation} = PXI * SHGC * IAC * FFs = 557 * 0.56 * 0.47$$

=146.60

$$Q_{window} = A * CF_{window} = A(CF_{window\ Heat\ transfer} + CF_{window\ Radiation}) = 3.6(6.89 + 146.60)$$

=552.56 W

B. Heating Load:

Frame: Wood

$Q_{window} = A * CF_{window}$; $A = 14.4m^2$

$$CF_{window\ with\ Heat\ Trans} = U_{window}(\delta T_{cooling} - 0.46\ DR) - 2.84(7.9 - 0.46 - 11.9)$$

$= 6.89 \frac{W}{m^2}$

$$PXI_{window} = ED + Ed = 559 + 188 = 747\ ; SHGC = 0.54\ ; IAC = 1\ ; Ffs = 0.56$$

$$CF_{window\ with\ Radiation} = PXI * SHGC * IAC * FFs = 747 * 0.54 * 1 * 0.56$$

=225.9

$Q_{window} = A * CF_{window} = A(CF_{window\ Heat\ transfer} + CF_{window\ Radiation}) = 14.4(6.89 + 225.9)$

=3352.17 W

Frame: Aluminum

$$Q_{Window} = A * HF_{window} = A * U_{window\ with\ \delta T_{heating}} = 3.6 * 2.84 * 24.8$$
$$= 253.56\ W$$

$$U_{window} = 3.61\ ; HSGC = 0.56$$

$$U_{window} = A * HFwindow = A_{window}\left(\left(\delta T_{cooling} - 0.46\ DR\right) = 3.61(7.9 - 0.46 * 11.9)\right)$$

=8.76 W/m²

Cooling Load:

$Q_{window} = A * CF_{window} = A(CF_{window\ Heat\ transfer} + CF_{window\ Radiation}) = 3.6(8.76 + 146.60)$

=559.3 *W*

Heating Load:

$$Q_{window} = A * HF_{window} = A * U_{window} * \delta T_{heating} = 3.6 * 3.61 * 24.8$$
$$Q_{window} = 322.3\ W$$

Case 3. Operable window on South:

Cooling Load for the Operable Window:

$$Q_{window} = A * CF_{window}; A = 3.6m^2$$

$$CF_{window\ with\ Heat\ Trans} = U_{window}(\delta T_{cooling} - 0.46\ DR) - 2.87(7.9 - 0.46 - 11.9)$$

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

$$CF_{window\ with\ Radiation} = PXI * SHGC * IAC * FFs = 557 * 0.46 * 0.47$$

=120.42

$Q_{window} = A * CF_{window} = A * (CF_{window\ Heat\ transfer} + CF_{window\ Radiation}) = 3.6(6.96 + 141.36)$

=553.97 W

Heating Load:

$$Q_{Window} = A * HF_{window} = A * U_{window\ with\ \delta T_{heating}} = 3.6 * 2.84 * 24.8$$
$$= 253.56\ W$$

Aluminum Frame:

$$U_{window} = 3.61\ ; HSGC = 0.56$$

$$CF_{window\ with\ Heat\ Trans} = U_{window}\left(\delta T_{cooling} - 0.46\ DR\right) - 4.62(7.9 - 0.46 - 11.9)$$
$$= 11.21 \frac{W}{m^2}$$

Cooling Load:

$$Q_{window} = A * CF_{window} = A * \left(CF_{window\ Heat\ transfer} + CF_{window\ Radiation}\right) = 3.6(11.21 + 143.98)$$
$$= 558.7\ W$$

Heat Load:

$$Q_{Window} = A * HF_{window} = A * U_{window\ with\ \delta T_{heating}} = 3.6 * 4.62 * 24.8$$
$$= 412.47\ W$$