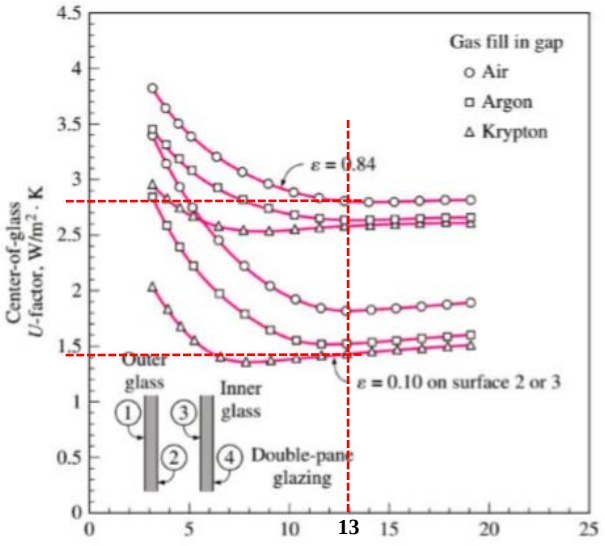
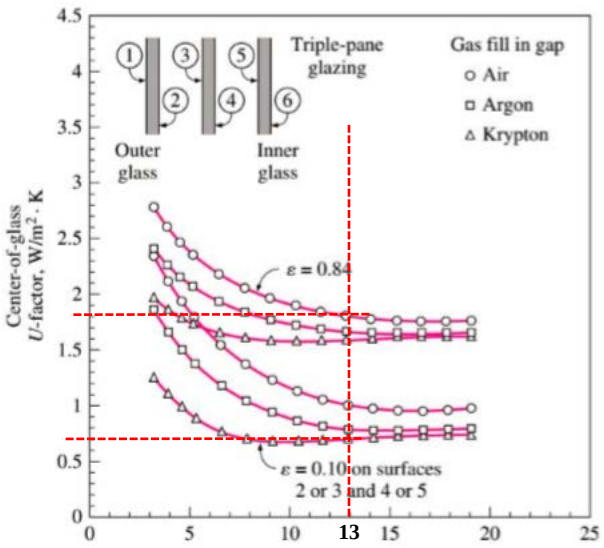
Assignment 8

Tala El Zein

Question 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)





ε value	0.84			0.1			0.84			0.1		
number of panes	2	2	2	2	2	2	3	3	3	3	3	3
Gas	air	argon	krypton	air	argon	krypton	air	argon	krypton	air	argon	krypton
U-value	2.8	2.65	2.6	1.8	1.5	1.4	1.8	1.7	1.6	1	0.8	0.7
% of change		5.63	7.14	35.71	46.42	50	35.71	39.28	42.85	64.28	71.42	75

Question 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?

Location: Piacenza; **Latitude:** 44.92 N; **Longitudinal:** 9.73 E; **Elevation:** 138

T (heat)= 24°C; T (cool)= 20°C
Therefore, $\Delta T_{heating}$= 20- (-4.8)= 24.8°C $\Delta T_{cooling}$= 31.9- 24= 7.9°C

DR= 11.9°C (from table)

Calculating load of **fixed Wooden** window on the **WEST= 14.4 m2:**

a) Cooling

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

$CF_{ip} = PXI * SHGC* IAC * FF_s = 747* 0.54* 1* 0.56= 217.8\ W/m^2$

CF (total)= 224.7 W/m^2

Q (cooling)= CF(total) * A= 224.7* 14.4= 3235.7W

b) Heating

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

Q (heating)= HF* A= 70.4*14.4= 1013.8 W

Calculating load of **fixed Aluminum** window on the **WEST= 14.4 m2:**

a) Cooling

$CF_{ht} = U (\Delta T_{cooling} - 0.46*DR) = 3.61 (7.9-0.46*11.9) = 8.8\ W/m^2$

$CF_{ip} = PXI * SHGC* IAC * FF_s = 747* 0.56* 1* 0.56= 234.3\ W/m^2$

CF (total)= 243.1 W/m^2

Q (cooling)= CF(total) * A= 243.1* 14.4= 3500.64 W

b) Heating

HF= U* $\Delta T_{heating}$ = 3.61* 24.8= 89.5 W/m^2

Q (heating)= HF* A= 89.5*14.4= 1288.8 W

Calculating load of **fixed Wooden** window on the **SOUTH= 3.6 m2:**

a) Cooling

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

$CF_{ip} = PXI * SHGC* IAC * FF_s = 557* 0.54* 1* 0.47= 141.4\ W/m^2$

$CF\ (total)= 148.3\ W/m^2$

Q (cooling)= CF(total) * A= 148.3* 3.6= 533.9 W

b) Heating

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

Q (heating)= HF* A= 70.4*3.6= 253.4 W

Calculating load of **fixed Aluminum** window on the **SOUTH= 3.6 m2:**

a) Cooling

$CF_{ht} = U (\Delta T_{cooling} - 0.46*DR) = 3.61 (7.9-0.46*11.9) = 8.8\ W/m^2$

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

$CF\ (total)= 155.4\ W/m^2$

Q (cooling)= CF(total) * A= 155.4* 3.6= 559.4 W

b) Heating

$HF= U* \Delta T_{heating} = 3.61* 24.8= 89.5\ W/m^2$

Q (heating)= HF* A= 89.5*3.6= 322.2 W

Calculating load of **operable Wooden** window on the **SOUTH= 3.6 m2:**

a) Cooling

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

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

$CF\ (total)= 127.4\ W/m^2$

Q (cooling)= CF(total) * A= 127.4* 3.6= 458.6 W

b) Heating

$HF = U^* \Delta T_{heating} = 2.87^* 24.8 = 71.2\ W/m^2$

Q (heating)= HF* A= 71.2*3.6= 256.3 W

Calculating load of **operable Aluminum** window on the **SOUTH= 3.6 m2:**

a) Cooling

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

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

$CF\ (total) = 155.2\ W/m^2$

Q (cooling)= CF(total) * A= 155.2* 3.6= 558.7 W

b) Heating

$HF = U^* \Delta T_{heating} = 4.62^* 24.8 = 114.6\ W/m^2$

Q (heating)= HF* A= 114.6 *3.6= 412.6 W