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 thickenss to be 13 mm)

From the diagram, when the thickness of the gap is 13, and by changing the gas to Argon from air, the u-value of glass reduces from 2.8 W/m²K to 2.65 W/m²K. The U value decreases by 6.43%

When the gas is changes to Krypton the U value reduces to 2.6 W/m²K, which is a 7.14% decreases

The U_{centre}, changes by adding an extra plane, from the diagram, by adding an extra pane, the U value decreases from 2.8 W/m²K to 1.8 W/m²K, which is a 55.6% reduction in U-Value.

By cooling the glass surfaces with the files of low emissivity, by observing the diagram, when the thickness of the air gap is 13 mm and coating the glass surface with a low emissivity film of 0.1, the U value of the centre of the glass decreases from 2.8 W/m²K to 1.8 W/m²K which is a 55.6% reduction in U value.

Task2

Consider the house that we analysed in the alst 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 ?

$T_{cooling}$= 24®C => cooling design temperature

$T_{heating}$= 20®C => Heating design temperature

Therefore,

$\Delta T_{cooling}$=31.9®C -24®C = 7.9®C

$\Delta T_{heating}$=20®C – (-4.8®C) = 24.8®C

From the table,

DR = 11.9®C

$q_{West\ window}$ = A x $CF_{west\ window}$

A = 14.4m²

$CF_{west\ window} = U_{west}$ ($\Delta T_{cooling}$ – 0.46 DR

Therefore the window has a fixed heat absorbing double layer glass with a wooden fame

U_{window} W=2.84 W/m^{2}K

i.e. $CF_{west\ window}$= 6.89 W/m^2

P x L_{ww} = E_D + E_d = 559 +188 = 747

SHGC = 0.54

No internal shading so IAC = 1

FF_s=0.56

CF_{ww}(Irradition) = P x I + SHGC + AC + FF_s

$ɋ_{ww}$ = A x CF_{ww} = A x (CF_{ww} (Heat transfer) + CF_{ww}(Irradiation)

= 14.4 x (6.89 + 747 x 0.5 x 1 x 0.8

= 3.352.07 W

Calculating the heat load of the fixed window on west,

ɋ window west = A x HF_{ww} = A x U_{ww} $\Delta T_{heating}$

= 14.4 x 2.84 x 24.8 = 1014.22 W

When frame is aluminum

U_{ww} = 3.61, HSGC = 0.56

CF^1_{ww}(Heat transfer) = U^1_{ww} ($\Delta T_{cooling}$ – 0.46 DR)

= 3.61 x (7.9 = 0.46 x 11.9)

= 8.76 W/m^2

Cooling load $ɋ^1_{ww}$ = A x (CF^1_{ww} (heat transfer) + CF^1_{ww} (Iradiation)]

= 3499.48 W

Heating load $ɋ^1_{ww}$= A x HF^1_{ww} = A x U^1_{ww} $\Delta T_{heating}$ = 14.4 x 3.6 x 24.8 = 1289.2 W

Calculating te cooling load of the fixed window on south

q_{sw}= A x HF_{ws} = A x U_{sw} $\Delta T_{heating}$

= 3.6 x 2.8 x 24.8 = 256.56 W

When the frame is aluminum, U_{ws}= 3.6, HSU = 0.56

CF^1_{sw}(Heat Transfer) = $U^1_{sw}(\Delta T_{cooling}$ – 0.46 DR) = 3.61 x (7.9 = 0.46 x 11.9) = 8.76 W/m^2

Cooling load q^1_{sw} = A x CF^1_{sw} = 559.3 W

Heating load = A x HF^1_{sw} = 322.3 W

Calculating the cooling load on south window

q_{sw} = A x CF_{sw}

CF_{sw}(Heater transfer part) = 6.96 W/m^2

P x I_{sw} = ED + Ed = 348 + 209 = 557

SHGC = 0.46

No internal shading w, IAC = 1

FFs = 0.47

CF_{sw}(irradiation past) = P x I x SGHC + IAC + FFs = 553.98

q_{sw} = 256.23

When frame is aluminum

U_{sw}= 4.62 W/m^{2}K , HSGC = 0.55

CF^1_{sw} (Heating transfer past) = $U^1_{sw}(\Delta T_{cooling}$ = 0.46 DR) = 11.21 W/m^2

Cooling load q^1_{sw} = A x CF^1_{sw} = 558.7 W

Heating load q_{sw} = A x HF^1_{sw} = 412.47 W