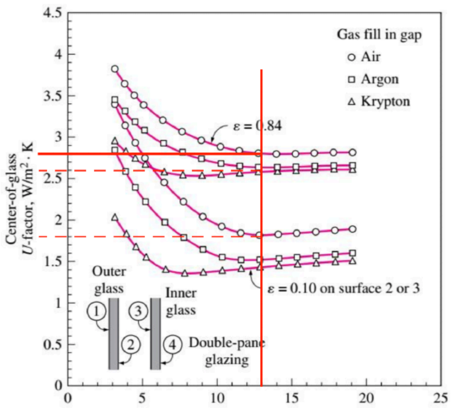
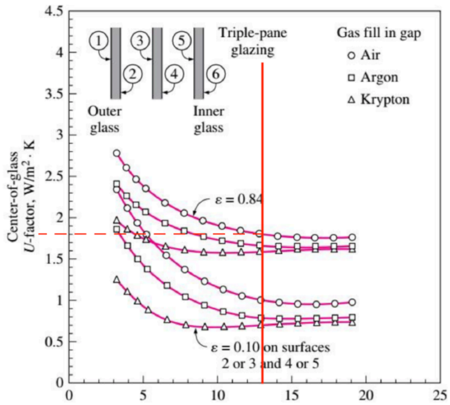
WEEK 8 YANG DICHENG

2019年11月26日 星期二　　下午9:15

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)





	BENCHMARK	1	2	3
GAP	13mm	13mm	13mm	13mm
ε	0.84	0.84	0.10	0.84
Panels	2	2	2	3
Gas	Air	Krypton	Air	Air
U_{factor}	2.8 W/m$_2$ K	2.6 W/m$_2$ K	1.8 W/m$_2$ K	1.8 W/m$_2$ K

1.Comparing the Benchmark with case 1 we could notice that the
U_{factor} Drops
when replace the air into the krypton in a double glass panels.

2. the second comparison shows that the U_{factor} decreases significantly while

using a low emissivity coating.

3. For the last one , and another layer of glass panel also will decreases the
U_{factor}

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 ?

Window frame with **wooden**

1- Fixed on west/14.4m^2

COOLING LOAD

$U_{window1,west1} = 2.84 W/m^2 \cdot K$

$CF_{window1,west1} = U_{window1,west1}(\Delta T_{COOLING} - 0.46DR)$
$= 2.84 \times (7.9 - 0.46 \times 11.9) \approx 6.89 W/m^2$

$PXI_{window1,west2} = E_D + E_d = 559 + 188 = 747$
$SHGC = 0.54$
$FF_s = 0.56$
$CF_{window1,west2} = PXI \times SHGC \times IAC \times FF_s$
$= 747 \times 0.54 \times 1 \times 0.56 \approx 225.89 W/m^2$

$CF_{window1,west} = CF_{window1,west1} + CF_{window1,west2} = 6.89 + 225.89 = 232.78 W/m^2$

$Q_{window1,west-c} = A \times CF_{window1,west} = 14.4 \times 232.78 \approx 3352.03 W$

HEATING LOAD

$Q_{window1,west-h} = A \times HF_{window1,west} = A \times U_{window1,west} \times \Delta T_{HEATING} = 14.4 \times 2.84 \times 24.8 \approx 1014.22W$

2- Fixed on south/3.6m^2

COOLING LOAD

$U_{window2,south1} = 2.84W/m^2 \cdot K$

$CF_{window2,south1} = U_{window2,south1}(\Delta T_{COOLING} - 0.46DR)$
$= 2.84 \times (7.9 - 0.46 \times 11.9) \approx 6.89W/m^2$

$PXI_{window2,south2} = E_D + E_d = 348 + 209 = 557$
$SHGC = 0.54$
$FF_s = 0.47$
$CF_{window2,south2} = PXI \times SHGC \times IAC \times FF_s$
$= 557 \times 0.54 \times 1 \times 0.47 \approx 141.37W/m^2$

$CF_{window2,south} = CF_{window2,south1} + CF_{window2,south2} = 6.89 + 141.37 = 148.26W/m^2$

$Q_{window2,south-c} = A \times CF_{window2,south} = 3.6 \times 148.26 \approx 553.74W$

HEATING LOAD

$Q_{window2,south-h} = A \times HF_{window2,south} = A \times U_{window2,south} \times \Delta T_{HEATING} = 3.6 \times 2.84 \times 24.8 \approx 253.56W$

3- Operable on south/3.6m^2

COOLING LOAD

$U_{window3,south1} = 2.87W/m^2 \cdot K$

$CF_{window3,south1} = U_{window3,south1}(\Delta T_{COOLING} - 0.46DR)$
$= 2.87 \times (7.9 - 0.46 \times 11.9) \approx 6.96W/m^2$

$PXI_{window3,south2} = E_D + E_d = 348 + 209 = 557$
$SHGC = 0.46$
$FF_s = 0.47$
$CF_{window3,south2} = PXI \times SHGC \times IAC \times FF_s$
$= 557 \times 0.46 \times 1 \times 0.47 \approx 120.42W/m^2$

$CF_{window3,south} = CF_{window3,south1} + CF_{window3,south2} = 6.96 + 120.42 = 127.38W/m^2$

$Q_{window3,south-c} = A \times CF_{window3,south} = 3.6 \times 127.38 \approx 458.57W$

HEATING LOAD

$Q_{window3,south-h} = A \times HF_{window3,south} = A \times U_{window3,south} \times \Delta T_{HEATING} = 3.6 \times 2.87 \times 24.8 \approx 256.23W$

$Q_{total-c} = Q_{window1,west-c} + Q_{window2,south-c} + Q_{window3,south-c} = 3352.03 + 553.74 + 458.57$
$= 4364.34W$
$Q_{total-h} = Q_{window1,west-h} + Q_{window2,south-h} + Q_{window3,south-h} = 1014.22 + 253.56 + 256.23$
$= 1524.01W$

Window frame with aluminium

1- Fixed on west/14.4m^2

COOLING LOAD

$U'_{window1,west1} = 3.61W/m^2 \cdot K$

$CF'_{window1,west1} = U'_{window1,west1}(\Delta T_{COOLING} - 0.46DR)$
$= 3.61 \times (7.9 - 0.46 \times 11.9) \approx 8.76W/m^2$

$PXI_{window1,west2} = E_D + E_d = 559 + 188 = 747$
$SHGC = 0.56$
$FF_s = 0.56$
$CF'_{window1,west2} = PXI \times SHGC \times IAC \times FF_s$
$= 747 \times 0.56 \times 1 \times 0.56 \approx 234.26W/m^2$

$CF'_{window1,west} = CF'_{window1,west1} + CF'_{window1,west2} = 8.76 + 234.26 = 243.02W/m^2$

$Q'_{window1,west-c} = A \times CF'_{window1,west} = 14.4 \times 243.02 \approx 3499.49W$

HEATING LOAD

$Q'_{window1,west-h} = A \times HF'_{window1,west} = A \times U'_{window1,west} \times \Delta T_{HEATING} = 14.4 \times 2.87 \times 24.8$
$\approx 1289.20W$

2- Fixed on south/3.6m^2

COOLING LOAD

$U'_{window2,south1} = 3.61W/m^2 \cdot K$

$CF'_{window2,south1} = U'_{window2,south1}(\Delta T_{COOLING} - 0.46DR)$
$= 3.61 \times (7.9 - 0.46 \times 11.9) \approx 8.76W/m^2$

$PXI_{window2,south2} = E_D + E_d = 348 + 209 = 557$
$SHGC = 0.56$
$FF_s = 0.47$
$CF'_{window2,south2} = PXI \times SHGC \times IAC \times FF_s$
$= 557 \times 0.56 \times 1 \times 0.47 \approx 146.60W/m^2$

$CF'_{window2,south} = CF'_{window2,south1} + CF'_{window2,south2} = 8.76 + 146.60 = 155.36W/m^2$

$Q'_{window2,south-c} = A \times CF'_{window2,south} = 3.6 \times 155.36 \approx 559.30W$

HEATING LOAD

$Q'_{window2,south-h} = A \times HF'_{window2,south} = A \times U'_{window2,south} \times \Delta T_{HEATING} = 3.6 \times 3.61 \times 24.8$

$\approx 322.30W$

3- Operable on south/3.6m^2

COOLING LOAD

$U'_{window3,south1} = 4.62W/m^2 \cdot K$

$CF'_{window3,south1} = U'_{window3,south1}(\Delta T_{COOLING} - 0.46DR)$
$= 4.62 \times (7.9 - 0.46 \times 11.9) \approx 11.21W/m^2$

$PXI_{window3,south2} = E_D + E_d = 348 + 209 = 557$
$SHGC = 0.55$
$FF_s = 0.47$
$CF'_{window3,south2} = PXI \times SHGC \times IAC \times FF_s$
$= 557 \times 0.55 \times 1 \times 0.47 \approx 143.98W/m^2$

$CF'_{window3,south} = CF'_{window3,south1} + CF'_{window3,south2} = 11.21 + 143.98 = 155.19W/m^2$

$Q'_{window3,south-c} = A \times CF'_{window3,south} = 3.6 \times 155.19 \approx 558.68W$

HEATING LOAD

$Q'_{window3,south-h} = A \times HF'_{window3,south} = A \times U'_{window3,south} \times \Delta T_{HEATING} = 3.6 \times 4.62 \times 24.8$
$\approx 412.47W$

$Q'_{total-c} = Q'_{window1,west-c} + Q'_{window2,south-c} + Q'_{window3,south-c} = 3499.49 + 559.30 + 558.68$
$= 4617.47W$
$Q'_{total-h} = Q'_{window1,west-h} + Q'_{window2,south-h} + Q'_{window3,south-h} = 1289.20 + 322.30 + 412.47$
$= 2026.67W$

$\Delta Q_{COOLING} = Q_{total-c} - Q'_{total-c} = 4364.34 - 4617.47 = -253.13W$
$\Delta Q_{HEATING} = Q_{total-h} - Q'_{total-h} = 1524.01 - 2026.67 = -502.66W$

So, it can be seen that frame with wooden has a greater resistance in cooling and heating than aluminium frame.