WEEK 8

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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)

	U-Value W/m2	Difference W/m2	Percentage %
2 parallel planes with air	2.8	0.0	0
2 parallel planes with gas	2.6	0.2	7.14
2 parallel planes with air and coating	1.8	1.0	35.71
2 parallel planes with gas and coating	1.5	1.3	46.42
3 parallel planes with air	1.8	1.0	35.71
3 parallel planes with gas	1.6	1.2	42.85
3parallel planes with air and coating	1.0	1.8	64.28
3 parallel planes with gas and coating	0.75	2.05	79.21

Task 1

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?

Answer:

Cooling design temperature Tcooling = 24 °C
Heating design temperature Theating = 20 °C,
,ΔTcooling = 31.9 °C -24 °C = 7.9 °C = 7.9K
Treating = 20°C -(-4.8°C) = 24.8 °C = 24.8K
From the table of Piacenza DR = 11.9 °C = 11.9K

<u>The cooling load of the fixed window on the west</u>
qwindowwest = A x CFwindowwest

A = 14.4m2,

CFwindowwest(Heat Trasnfer Part) = Uwindowwest (ΔTcooling -0.46 DR) ,The window has a fixed heat absorbing double layer glass with a wooden frame, And so, Uwindowwest = 2.84 W/m2k

CF windowwest(Heat Trasnfer Part)= 2.84 x (7.9 K -0.46x11.9 K) = 6.89 W/m2k

PXI windowwest = ED + Ed = 559 +188 = 747

SHGC= 0.54

No internal shading, soIAC= 1 FFs = 0.56

CFwindowwest(Irradiation Part) = PXI x SHGC x IAC x FFs

qwindowwest = A x CFwindowwest = A x (CFwindowwest(Heat Trasnfer Part) + CFwindowwest(Irradiation Part)) =14.4 m2 x (6.89 +747x 0.54 x 1 x 0.56) = 3352.07 W

<u>The heating load of the fixed window on the west</u>

qwindowwest = A x HFwindowwest = A x Uwindowwest.ΔTheating
= 14.4 m2 x 2.84 x 24.8K = 1014.22 W
When the frame were to be aluminium, Uwindowwest = 3.61 ,

HSGC = 0.56

CF' windowwest (heat transfer part) = U'windowwest (ΔTcooling -0.46 DR)
=3.61 x (7.9 K -0.46 x 11.9 K) =8.76
Cooling load q'windowwest = A x CF' window = A x (CF'windowwest(Heat Transfer Part) + CF' windowwest(Irradiation Part))
= 14.4 m2 x (8.76 +747x 0.56 x 1 x 0.56) =3499.48 W Heating load q'windowwest
= A x HF'windowwest = A x U'windowwest. ΔTheating
= 14.4 m2 x 3.61 x 24.8 K = 1289.20 W

The cooling load of the fixed window on the south

q windowsouth = A x CFwindowsouth A = 3.6 m2,
CFwindowsouth(Heat Trasnfer Part) = Uwindowsouth (ΔTcooling -0.46 DR)

The window has a fixed heat absorbing double layer glass with a wooden frame, So, Uwindowwast=2.842.84 ,
CF windowsouth(Heat Transfer Part)= 2.842.84 x (7.9 K -0.46 x 11.9 K) = 6.89
PXI windowsouth = ED + Ed = 348 +209 = 557

SHGC = 0.55

No internal shading, so IAC =1

FFs = 0.47

CFwindowsouth(Irradiation Part) = PXI x SHGC x IAC x FFs qwindowsouth
= A x CFwindowsouth
=A x (CF windowsouth(Heat Transfer Part) + CF windowsouth(Irradiation Part))
=3.6 m2 x (6.89 +557 x 0.54 x 1 x 0.47) = 553.72 W

The heating load of the fixed window on the south

qwindowsouth = A x HFwindowsouth
= A xUwindowsouth ΔTTheating
= 3.6 m2 x 2.84 x 24.8K = 253.56 W
When the frame were to be aluminium, Uwindowsouth = 3.61

HSGC = 0.56

CF'windowsouth(Heat Trasnfer Part) = U'(winidow south)(ΔTcooling -0.46 DR)
=3.61 X (7.9 K -0.46 X 11.9 K)
= 8.76 W/m2k

Cooling load q'windowsouth = A X CF'windowsouth
= A X (CF'windowsouth(Heat Trasnfer Part) + CF'windowsouth(Irradiation Part))
= 3.6 m2 X (8.76 +557 X 0.56 X 1 X 0.47) = 559.30 W

Heating load q' windowsouth = A X HF'windowsouth
= A X U'windowsouth ΔTheating
= 3.6 m2 X 3.61 X 24.8 K = 322.30 W

The cooling load of the operable window on the south

q windowsouth = A X CFwindowsouth

A = 3.6 m2,

CFwindowsouth(Heat Trasnfer Part) =Uwindowsouth (ΔTcooling -0.46 DR)

The window has an operable heat absorbing double layer glass with a wooden frame,

So, Uwindowwast = 2.87

CF windowsouth(Heat Trasnfer Part) = 2.87 X (7.9 K -0.46 X 11.9 K) = 6.96

PXIwindowsouth = ED + Ed = 348 +209 = 557 S

HGC= 0.46

No internal shading, soIAC= 1

FFs = 0.47

CFwindowsouth(Irradiation Part) = PXI X SHGC X IAC X FFs q windowsouth
= A X CFwindowsouth
= A X (CFwindowsouth(Heat Trasnfer Part) + CF windowsouth(Irradiation Part))
=3.6 m2 X (6.96 +557 X 0.54 X 1 X 0.47) = 553.98 W

The heating load of theoperable window on the south

q windowsouth = A X HFwindowsouth
= A XUwindowsouth ΔTheating
= 3.6 m2 X 2.87 X 24.8K = 256.23 W

When the frame were to be aluminium, Uwindowsouth = 4.62

HSGC = 0.55

CF' windowsouth(Heat Trasnfer Part) = U' windowsouth (ΔTcooling -0.46 DR)
=4.62 X (7.9 K -0.46 X 11.9 K)
= 11.21

Cooling load q'windowsouth = A X CF'windowsouth
= A X (CF'windowsouth(Heat Trasnfer Part) + CF'windowsouth(Irradiation Part))
= 3.6 m2 X (11.21 +557 X 0.55 X 1 X 0.47) = 558.70 W

Heating load q'windowsouth = A X HF' windowsouth
= A X U'windowsouth ΔTTheating
= 3.6 m2 X 4.62 X 24.8 K = 412.47 W