WEEK 8 :

Michibane

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)

The U_value of a window :

$U_{window} = (U_{center} * A_{center} + U_{edge} * A_{edge} + U_{frame} * A_{frame})/A_{window}$

$1/U_{doublepanecenter} = 1/h_i + 1/h_{space} + 1/h_o$; $h_{space} = h_{radiationspace} + h_{convectionspace}$

=>U and h change according to the type of gas

According to the diagrams given in the presentation :

- Gap thickness is 13 mm
- Type of gas:ARGON
- In this case, the U_value of the center of the glass decreases from 2,8 w/m²k to 2,65 w/m²k
- percentage : 5,3 %

- Gap thickness is 13 mm
- Type of gas:KRYPTON
- In this case, the U_value of the center of the glass decreases from 2,8 w/m²k to 2,6 w/m²k
- percentage : 7,1 %

=>U and h change when we add an extra pane

- In case of 13mm of tickness, gas : air , an extra pane :
- the U_value decreases from 2,8 to 1,8
- percentage : 35,7 %

- In case of 13mm of tickness, gas : air , an extra pane + a coating film that has an emmisivity of 0,1:
- the U_value decreases from 2,8 to 1,8
- percentage : 35,7 %

TASK 2 :

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 ?

CASE 1 : FIXED WINDOW ON WEST :

1.1 Cooling load :

Frame : wood

$q_{windowW} = A*CF_{windowW}$; A= 14,4 m²

$Cf_{windowWheattransfer} = U_{windowW}$ ($\Delta T_{cooling}$-0,46 DR) = 2,84*(7,9-0,46*11,9)
$Cf_{windowWheattransfer}$ =6,89 w/m²

$PXI_{windowW} = E_D+E_d$ = 559+188=747 ; SHGC =0,54 ; IAC = 1 ; Ffs = 0,56

$Cf_{windowWirradiation}$ = PXI*SHGC*IAC*FFs = 747*0,54*1*0,56
$Cf_{windowWirradiation}$ =225,9

$q_{windowW} = A*CF_{windowW} = A*(CF_{windowWheattransfer} + CF_{windowWirradiation})$= 14,4 * (6,89+225,9)

$q_{windowW}$ = 3352,17 W

1.2 Heating load :

Frame : aluminium

$q_{windowW} = A*HF_{windowW} = A*U_{windowW}\ \Delta T_{heating}$ = 14,4*2,84*24,8
$q_{windowW}$ = 1014,22 W

$U_{windowW}$ = 3,61 ; HSGC=0,56

$CF'_{windowWheattransfer} = U'_{windowW}$ *(($\Delta T_{cooling}$-0,46 DR) =3,61*(7,9-0,46*11,9)
$CF'_{windowWheattransfer}$ = 8,76

Cooling load :

$q'_{windowW} = A*CF'_{windowW} = A*(CF'_{windowWheattransfer} + CF'_{windowWirradiation})$
=14,4* (8,76+234,26)
$q'_{windowW}$ =3499,49 W

Heating load :

q'windowW = A*HF'windowW = A*U'windowW* ΔTheating = 14,4*3,61*24,8
q'windowW = 1289,2 W

CASE 2: FIXED WINDOW ON SOUTH:

1.1 Cooling load :

Frame : wood

qwindowS = A*CFwindowS ; A= 3,6 m²
CfwindowSheattransfer = UwindowS (ΔTcooling-0,46 DR) = 2,84*(7,9-0,46*11,9)
CfwindowSheattransfer =6,89 w/m²

PXIwindowS = ED+Ed = 348+209=557 ; SHGC =0,56 ; IAC = 1 ; Ffs = 0,47

CfwindowSirradiation = PXI*SHGC*IAC*FFs = 557*0,56*1*0,47
CfwindowSirradiation = 146,60

qwindowS = A*CFwindowS = A*(CFwindowSheattransfer + CFwindowSirradiation)= 3,6 * (6,89+146,60)
qwindowW = 552,56 W

1.2 Heating load :

Frame : aluminium

qwindowS = A*HFwindowS= A*UwindowS ΔTheating = 3,6*2,84*24,8
qwindowW = 253,56 W

UwindowS = 3,61 ; HSGC=0,56

CF'windowSheattransfer = U'windowS *((ΔTcooling-0,46 DR) =3,61*(7,9-0,46*11,9)
CF'windowWheattransfer = 8,76 W/m²

Cooling load :

q'windowS = A*CF'windowS = A*(CF'windowSheattransfer + CF'windowSirradiation) =3,6* (8,76+146,60)
q'windowS=559,3 W

Heating load :

q'windowS = A*HF'windowS = A*U'windowS* ΔTheating = 3,6*3,61*24,8
q'windowW = 322,3 W

CASE 3: OPERABLE WINDOW ON SOUTH:

COOLING LOAD FOR THE OPERABLE:

qwindowS = A*CFwindowS ; A= 3,6 m²

$Cf_{windowSheattransfer} = U_{windowS}$ ($\Delta T_{cooling}$-0,46 DR) = 2,87*(7,9-0,46*11,9)
$Cf_{windowSheattransfer}$ =6,96 w/m²

$PXI_{windowS}$ = ED+Ed = 348+209=557 ; SHGC =0,46 ; IAC = 1 ; Ffs = 0,47

$Cf_{windowSirradiation}$ = PXI*SHGC*IAC*FFs = 557*0,46*1*0,47
$Cf_{windowSirradiation}$ = 120,42

$q_{windowS}$ = A*$CF_{windowS}$ = A*($CF_{windowSheattransfer}$ + $CF_{windowSirradiation}$)= 3,6 * (6,96+141,36)
$q_{windowS}$ = 533,97 W

HEATING LOAD **(fixed window):**

$q_{windowS}$ = A*$HF_{windowS}$= A*$U_{windowS}$ $\Delta T_{heating}$ = 3,6*2,87*24,8
$q_{windowW}$ = 256,23 W

with aluminium frame :

$U_{windowS}$ = 3,61 ; HSGC=0,56

$CF'_{windowSheattransfer}$ = $U'_{windowS}$ *(($\Delta T_{cooling}$-0,46 DR) =4,62*(7,9-0,46*11,9)
$CF'_{windowWheattransfer}$ = 11,21 W/m²

Cooling load :

$q'_{windowS}$ = A*$CF'_{windowS}$ = A*($CF'_{windowSheattransfer}$ + $CF'_{windowSirradiation}$) =3,6* (11,21+143,98)
$q'_{windowS}$=558,7 W

Heating load :

$q'_{windowS}$ = A*$HF'_{windowS}$ = A*$U'_{windowS}$* $\Delta T_{heating}$ = 3,6*4,62*24,8
$q'_{windowS}$= 412,47 W