Datos generales

$T_{ext} = 10$ [ºC]

$T_{int} = 20$ [ºC]

$A_{puerta} = 1,8$ [m^2]

$\sigma = 5,67 \times 10^{-8}$ [$W/m^2 \cdot K^4$]

Datos ventanas

$\dot{Q}_{vent;1} = 120$ [W]

$n_{ventanas} = 14$

$A_{ventanas} = 2,25$ [m^2]

$A_{T;ventanas} = n_{ventanas} \cdot A_{ventanas}$

$k_{vidrio} = 0,9$ [W/m·K]

$k_{aire} = 0,025$ [W/m·K]

$T_3 = 15,8$ [ºC]

$T_4 = 11,65$ [ºC]

$e_{vidrio;simple} = 0,004$ [m]

$e_{vidrio;int} = 0,004$ [m]

$e_{vidrio;ext} = 0,006$ [m]

$e_{aire} = 0,012$ [m]

$c_{ventanas} = 250$ [€/ud]

$C_{T;vent} = n_{ventanas} \cdot c_{ventanas}$

$\varepsilon_1 = 0,9$

$\varepsilon_3 = 0,1$

$\varepsilon_4 = 0,9$

Datos fachada

$e_{hormigon} = 0,2$ [m]

$k_{hormigon} = 0,8$ [W/m·K]

$\varepsilon_{hormigon} = 0,9$

$T_{se} = 11$ [ºC]

$e_{SATE} = 0,06$ [m]

$k_{SATE} = 0,03$ [W/m·K]

$c_{SATE} = 10$ [€/m^2]

$A_{fachada} = A_{TOT} - A_{T;ventanas} - A_{puerta}$

$A_{TOT} = 10 \cdot 6 \cdot 4$

APARTADO 1

$h_{ext} = 25$ [W/m^2·K]

$\dot{q}_{fach;1} = h_{ext} \cdot (T_{se} - T_{ext}) + \varepsilon_{hormigon} \cdot \sigma \cdot ((T_{se} + 273)^4 - (T_{ext} + 273)^4)$

$\dot{q}_{fach;2} = (1 - 0{,}75) \cdot \dot{q}_{fach;1}$

APARTADO 2

$\dot{Q}_{vent;2} = \dot{Q}_{rad;2} + \dot{Q}_{cond;2}$

$$\dot{Q}_{rad;2} = A_{ventanas} \cdot \sigma \cdot \left[\frac{(T_3 + 273)^4 - (T_4 + 273)^4}{\frac{1}{\varepsilon_3} + \frac{1}{\varepsilon_4} - 1} \right]$$

$$\dot{Q}_{cond;2} = k_{aire} \cdot A_{ventanas} \cdot \left[\frac{T_3 - T_4}{e_{aire}} \right]$$

APARTADO 3

$$\dot{Q}_{vent;2} = k_{vidrio} \cdot A_{ventanas} \cdot \left[\frac{T_1 - T_3}{e_{vidrio;int}} \right]$$

$\dot{Q}_{vent;2} = h_{int} \cdot A_{ventanas} \cdot (T_{int} - T_1)$

APARTADO 4

$\eta_{caldera} = 0{,}9$

$c_{GN} = 0{,}06$ [€/kWh]

Cálculos ventanas

$$\Delta_{Q;vent} = (\dot{Q}_{vent;1} - \dot{Q}_{vent;2}) \cdot n_{ventanas} \cdot \frac{8760}{1000}$$

$$Ahorro_{vent} = \Delta_{Q;vent} \cdot \frac{c_{GN}}{\eta_{caldera}}$$

$$Retorno_{vent} = \frac{C_{T;vent}}{Ahorro_{vent}}$$

Cálculos fachada

$$\Delta_{Q;fach} = (\dot{q}_{fach;1} - \dot{q}_{fach;2}) \cdot A_{fachada} \cdot \frac{8760}{1000}$$

$$Ahorro_{fach} = \Delta_{Q;fach} \cdot \frac{c_{GN}}{\eta_{caldera}}$$

$$Retorno_{fach} = c_{SATE} \cdot \frac{A_{fachada}}{Ahorro_{fach}}$$

SOLUTION

$Ahorro_{fach}$ = 2684 [€/año]
$A_{fachada}$ = 206,7 [m^2]
A_{TOT} = 240 [m^2]
$A_{ventanas}$ = 2,25 [m^2]
c_{SATE} = 10 [€/m^2]
$c_{ventanas}$ = 250 [€/ud]
$\Delta Q_{,vent}$ = 11726 [kWh/año]
ε_3 = 0,1 [-]
$\varepsilon_{hormigon}$ = 0,9 [-]
e_{aire} = 0,012 [m]
e_{SATE} = 0,06 [m]
$e_{vidrio,int}$ = 0,004 [m]
h_{ext} = 25 [W/m^2·K]
k_{aire} = 0,025 [W/m·K]
k_{SATE} = 0,03 [W/m·K]
$n_{ventanas}$ = 14 [-]
$\dot{q}_{fach,1}$ = 29,65 [W/m^2]
$\dot{Q}_{rad,2}$ = 4,937 [W]
$\dot{Q}_{vent,2}$ = 24,39 [W]
$Retorno_{vent}$ = 4,477 [años]
T_1 = 15,85 [ºC]
T_4 = 11,65 [ºC]
T_{int} = 20 [ºC]

$Ahorro_{vent}$ = 781,7 [€/año]
A_{puerta} = 1,8 [m^2]
$A_{T,ventanas}$ = 31,5 [m^2]
c_{GN} = 0,06 [€/kWh]
$C_{T,vent}$ = 3500 [€]
$\Delta Q_{,fach}$ = 40267 [kWh/año]
ε_1 = 0,9 [-]
ε_4 = 0,9 [-]
$\eta_{caldera}$ = 0,9 [-]
$e_{hormigon}$ = 0,2 [m]
$e_{vidrio,ext}$ = 0,006 [m]
$e_{vidrio,simple}$ = 0,004 [m]
h_{int} = 2,611 [W/(m^2 K)]
$k_{hormigon}$ = 0,8 [W/m·K]
k_{vidrio} = 0,9 [W/m·K]
$\dot{Q}_{cond,2}$ = 19,45 [W]
$\dot{q}_{fach,2}$ = 7,413 [W/m^2]
$\dot{Q}_{vent,1}$ = 120 [W]
$Retorno_{fach}$ = 0,77 [años]
σ = 5,670E-08 [W/m^2·K^4]
T_3 = 15,8 [ºC]
T_{ext} = 10 [ºC]
T_{se} = 11 [ºC]