| Parameter | Value | Units | Parameter | Value | Units |
|---|---|---|---|---|---|
| House length ($L_1$) | 20 | m | Area of windows | 1 | m² |
| | | | Area of walls | 236 | m² |
| House width ($L_2$) | 10 | m | Wall thermal coefficient | 136.8 | J/h·m· °C |
| House height ($L_3$) | 4 | m | Window thermal coefficient | 2808 | J/h·m· °C |
| Roof angle ($\beta$) | 40 | deg | Thickness of windows | 0.07 | m |
| Number of windows | 4 | - | Thickness of walls | 0.20 | m |

Consider that the normal comfort temperature of the mentioned household's owner is 19⁰C and the household is subjected to an hourly average ambient temperature variation given below on a very hot summer day

| Time | Temperature [⁰C] |
|---|---|
| 12am-1pm | 30 |
| 1pm-2pm | 30 |
| 2pm-3pm | 31 |
| 3pm-4pm | 30 |

Considering a time granularity of 1 hour and the household has a regulated indoor temperature of 19⁰C at 12 am, draw the graphs of the HVAC power consumption for 6 minutes (0.1 hour) of time granularity for the period between 12 am and 4 pm both for the case of set temperature value of 21⁰C and calculate the total energy consumption value for the mentioned case for a HVAC unit of 3 kW, with COP of 2 and ∓1 ⁰C dead-band limits. Firstly, solve the question numerically. Then, solve the same problem using the code you write as an m-file in MATLAB to verify the obtained numerical results.

**Formulas:**

$$V_h = \left(L_{1,h} \times L_{2,h} \times L_{3,h}\right) + \left(tan(\beta) \times L_{1,h} \times L_{2,h}\right)$$

$$M_{a,h} = V_h \times \delta_{air}$$

$$R_{eq,h} = \frac{1}{N}\sum_i \frac{l_{i,h}}{\sigma_{i,h}A_{i,h}}$$

$$T_{in,h,t} = \left(\left(1 - \frac{\Delta T}{1000 \times M_{a,h} \times c_a \times R_{eq,h}}\right) \times T_{in,h,t-1}\right) + \left(\left(\frac{\Delta T}{1000 \times M_{a,h} \times c_a \times R_{eq,h}}\right) \times T_{air,b,t-1}\right) - u_{AC,h,t-1} \times \left(\frac{COP_h \times P_{AC,h} \times \Delta T}{0.000277 \times M_{a,h} \times c_a}\right), \forall t > 1$$

$$p_{AC,h,t} = P_{AC,h} \times u_{AC,h,t}, \forall t$$

$$\sum_h p_{AC,h,t} \leq max\left(P_{total,ref,t}\right), \forall t \in [t_1, t_2]$$

$$avg\left(\sum_h p_{AC,h,t}\right) \leq avg\left(P_{total,ref,t}\right), \forall t \in [t_1, t_2]$$