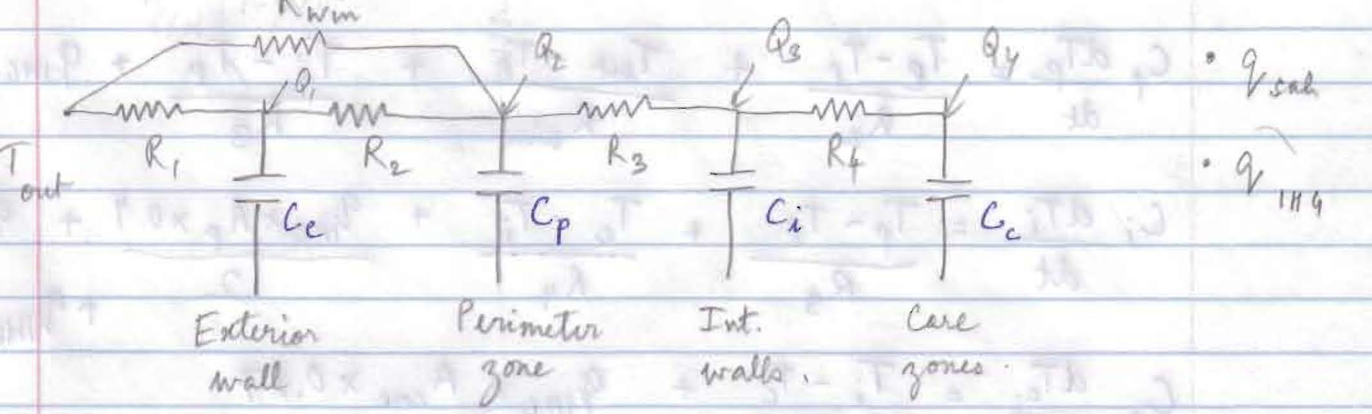
OBJECTIVE: To train a building model to estimate heating or cooling load.

NETWORK: (ONE FLOOR)



Q_1: $q_{sol}(1-w) + q_{IHG,rad}/2$

Q_2: $q_{IHG,conv}$

Q_3: $q_{IHG,rad}/2 + q_{sol} \times w$

Q_4: $q_{IHG,core}$.

* A_p = perimeter zone area
* A_c = core zone area.

$$u = [q_{sol}, q_{IHG}, T_{out}]$$

$$x = [T_e, T_p, T_i, T_c] \qquad y = [T_p, T_c]$$

$$\text{Output} = q_{load} = \Sigma \dot{m} C_p (\Delta T).$$

$$= \dot{m} C_p (T_p - T_{\substack{\cancel{desired} \\ setpt}}) + \dot{m} C_p (T_c - T_{\substack{\cancel{desired} \\ set\,pt}})$$

Equations :

$$C_e \frac{dT_e}{dt} = \frac{T_{out} - T_e}{R_1} + \frac{T_p - T_e}{R_2} + q_{sol}(1-w) + \frac{q_{IHG} \times A_{p} \times 0.4}{2}$$

$$C_p \frac{dT_p}{dt} = \frac{T_e - T_p}{R_2} + \frac{T_{out} - T_p}{R_{win}} + \frac{T_i - T_p}{R_3} + q_{IHG} \times A_p \times 0.6$$

$$C_i \frac{dT_i}{dt} = \frac{T_p - T_i}{R_3} + \frac{T_c - T_i}{R_4} + \frac{q_{IHG} \times A_p \times 0.4}{2} + q_{sol} \cdot w + q_{IHG} A_c \times 0.3$$

$$C_c \frac{dT_c}{dt} = \frac{T_i - T_c}{R_4} + q_{IHG} \times A_{core} \times 0.87$$

$$\dot{x} = A \quad x$$

$$\begin{bmatrix} \dot{T}_e \\ \dot{T}_p \\ \dot{T}_i \\ \dot{T}_c \end{bmatrix} = \begin{bmatrix} \frac{-1}{C_e R_1} \frac{-1}{C_e R_2} & \frac{1}{C_e R_2} & 0 & 0 \\ \frac{1}{C_p R_2} & \frac{1}{C_p}\left(\frac{-1}{R_2} \frac{-1}{R_3} \frac{-1}{R_{win}}\right) & \frac{1}{C_p R_3} & 0 \\ 0 & \frac{1}{C_i R_3} & \frac{-1}{C_i R_3} \frac{-1}{C_i R_4} & \frac{1}{C_i R_4} \\ 0 & 0 & \frac{1}{C_c R_4} & \frac{-1}{C_c R_4} \end{bmatrix} \begin{bmatrix} T_e \\ T_p \\ T_i \\ T_c \end{bmatrix}$$

$$
\begin{array}{cc}
B & u \\
\begin{bmatrix}
\frac{(1-w)}{C_e} & \frac{A_{peri} \times 0.4}{2C_e} & \frac{1}{C_e R_1} \\
0 & \frac{A_{peri} \times 0.6}{C_p} & \frac{1}{C_p R_{win}} \\
\frac{w}{C_i} & \frac{A_{peri} \times 0.4}{2C_i} & 0 \\
0 & \frac{A_{core} \times 0.7}{C_c} & 0
\end{bmatrix}
&
\begin{bmatrix}
q_{sol} \\
q_{IHG} \\
T_{out}
\end{bmatrix}
\end{array}
$$

$$
y = C \quad x \quad + D \quad u
$$

$$
\begin{bmatrix} T_p \\ T_c \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 & 1 \end{bmatrix} \begin{bmatrix} T_p \\ T_c \end{bmatrix} + \begin{bmatrix} 0 & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} 0 \end{bmatrix}
$$

Heating load $= \dot{m} C_p (T_p - T_{sp}) + \dot{m} C_p (T_c - T_{sp})$