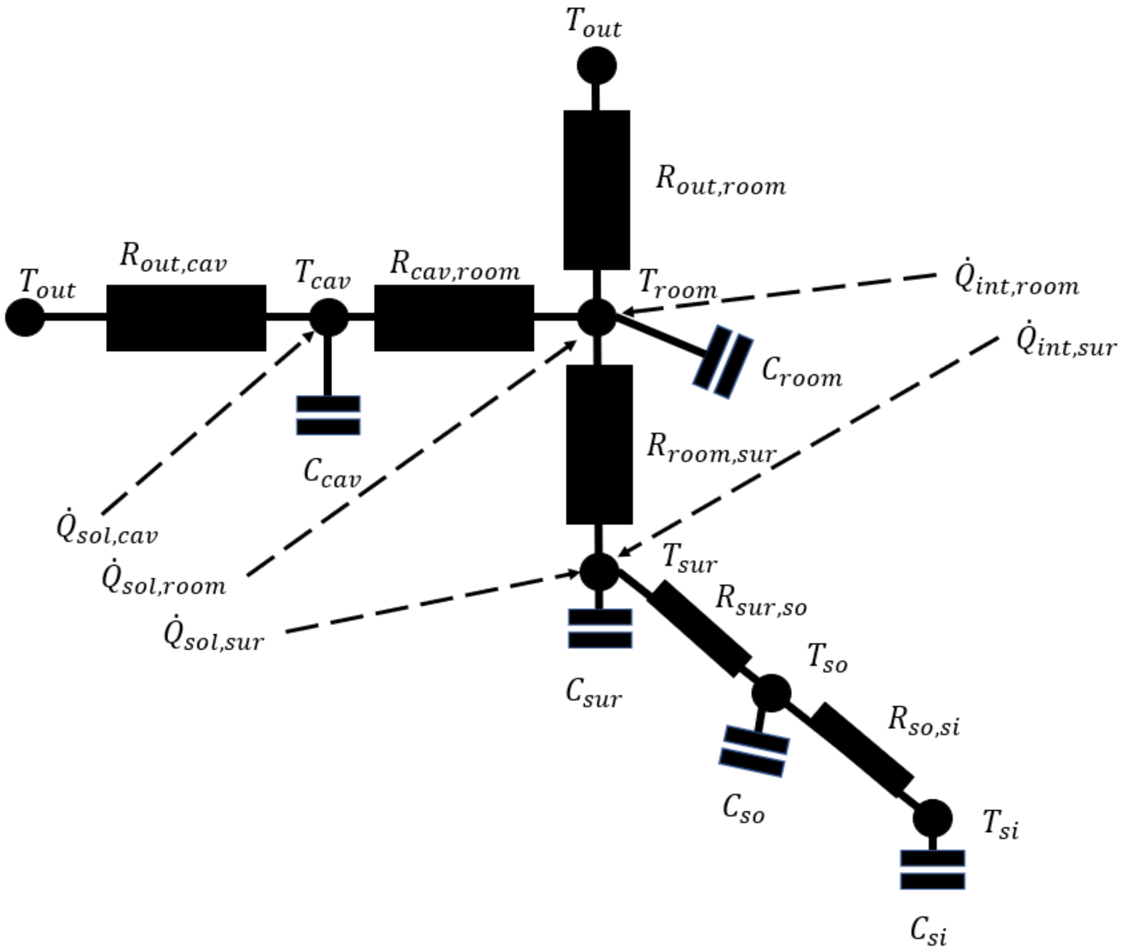

$$C_{cav}\frac{dT_{cav}}{dt} = \frac{T_{out}-T_{cav}}{R_{out,cav}} + \frac{T_{room}-T_{cav}}{R_{cav,room}} + \dot{Q}_{sol,cav}$$

$$C_{room}\frac{dT_{room}}{dt} = \frac{T_{out}-T_{room}}{R_{out,room}} + \frac{T_{sur}-T_{room}}{R_{room,sur}} + \frac{T_{cav}-T_{room}}{R_{cav,room}} + \dot{Q}_{sol,room} + \dot{Q}_{int,room}$$

$$C_{sur}\frac{dT_{sur}}{dt} = \frac{T_{room}-T_{sur}}{R_{room,sur}} + \frac{T_{so}-T_{sur}}{R_{sur,so}} + \dot{Q}_{sol,sur} + \dot{Q}_{int,sur}$$

$$C_{so}\frac{dT_{so}}{dt} = \frac{T_{sur}-T_{so}}{R_{sur,so}} + \frac{T_{si}-T_{so}}{R_{si,so}}$$

$$C_{si}\frac{dT_{si}}{dt} = \frac{T_{so}-T_{si}}{R_{so,si}}$$

$$x^T = [T_{cav}, T_{room}, T_{sur}, T_{so}, T_{si}]$$

$$u^T = [T_{out}, \dot{Q}_{sol,cav}, \dot{Q}_{sol,room}, \dot{Q}_{int,room}, \dot{Q}_{sol,sur}, \dot{Q}_{int,sur}, \frac{dT_{so}}{dt}]$$

$$y = \dot{Q}_{rslab} = \frac{T_{sur}-T_{so}}{R_{sur,so}} + \frac{T_{si}-T_{so}}{R_{si,so}} - C_{so}\frac{dT_{so}}{dt}$$

$$\begin{bmatrix} \frac{dT_{cav}}{dt} \\ \frac{dT_{room}}{dt} \\ \frac{dT_{sur}}{dt} \\ \frac{dT_{so}}{dt} \\ \frac{dT_{si}}{dt} \end{bmatrix} = \begin{bmatrix} (\frac{-1}{R_{out,cav}C_{cav}} + \frac{-1}{R_{cav,room}C_{cav}}), \frac{1}{R_{cav,room}C_{cav}}, 0, 0, 0 \\ \frac{1}{R_{cav,room}C_{room}}, (\frac{-1}{R_{out,room}C_{room}} + \frac{-1}{R_{room,sur}C_{room}} + \frac{-1}{R_{cav,room}C_{room}}), \frac{1}{R_{room,sur}C_{room}}, 0, 0 \\ 0, \frac{1}{R_{room,sur}C_{sur}}, (\frac{-1}{R_{room,sur}C_{sur}} + \frac{-1}{R_{sur,so}C_{sur}}), \frac{1}{R_{sur,so}C_{sur}}, 0 \\ 0, 0, \frac{1}{R_{sur,so}C_{so}}, (\frac{-1}{R_{sur,so}C_{so}} + \frac{-1}{R_{si,so}C_{so}}), \frac{1}{R_{si,so}C_{so}} \\ 0, 0, 0, \frac{1}{R_{so,si}}, \frac{-1}{R_{so,si}} \end{bmatrix} \begin{bmatrix} T_{cav} \\ T_{room} \\ T_{sur} \\ T_{so} \\ T_{si} \end{bmatrix} + \begin{bmatrix} \frac{1}{R_{out,cav}C_{cav}}, 1, 0, 0, 0, 0, 0 \\ \frac{1}{R_{out,room}C_{room}}, 0, 1, 1, 0, 0, 0 \\ 0, 0, 0, 0, 1, 1, 0 \\ 0, 0, 0, 0, 0, 0, 0 \\ 0, 0, 0, 0, 0, 0, 0 \end{bmatrix} \begin{bmatrix} T_{out} \\ \dot{Q}_{sol,c} \\ \dot{Q}_{sol,ro} \\ \dot{Q}_{int,ro} \\ \dot{Q}_{sol,s} \\ \dot{Q}_{int,s} \\ \frac{dT_{so}}{dt} \end{bmatrix}$$

$$y = \dot{Q}_{rslab} = \begin{bmatrix} 0 & 0 & \frac{1}{R_{sur,so}} & (\frac{-1}{R_{sur,so}} + \frac{-1}{R_{si,so}}) & \frac{1}{R_{si,so}} \end{bmatrix} \begin{bmatrix} T_{cav} \\ T_{room} \\ T_{sur} \\ T_{so} \\ T_{si} \end{bmatrix} + \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & -C_{so} \end{bmatrix} \begin{bmatrix} T_{out} \\ \dot{Q}_{sol,cav} \\ \dot{Q}_{sol,room} \\ \dot{Q}_{int,room} \\ \dot{Q}_{sol,sur} \\ \dot{Q}_{int,sur} \\ \frac{dT_{so}}{dt} \end{bmatrix}$$

$$A = \begin{bmatrix} (\frac{-1}{R_{out,cav}C_{cav}} + \frac{-1}{R_{cav,room}C_{cav}}) & \frac{1}{R_{cav,room}C_{cav}} & 0 & 0 & 0 \\ \frac{1}{R_{cav,room}C_{room}} & (\frac{-1}{R_{out,room}C_{room}} + \frac{-1}{R_{room,sur}C_{room}} + \frac{-1}{R_{cav,room}C_{room}}) & \frac{1}{R_{room,sur}C_{room}} & 0 & 0 \\ 0 & \frac{1}{R_{room,sur}C_{sur}} & (\frac{-1}{R_{room,sur}C_{sur}} + \frac{-1}{R_{sur,so}C_{sur}}) & \frac{1}{R_{sur,so}C_{sur}} & 0 \\ 0 & 0 & \frac{1}{R_{sur,so}C_{so}} & (\frac{-1}{R_{sur,so}C_{so}} + \frac{-1}{R_{si,so}C_{so}}) & \frac{1}{R_{si,so}C_{so}} \\ 0 & 0 & 0 & \frac{1}{R_{so,si}} & \frac{-1}{R_{so,si}} \end{bmatrix}$$

$$B = \begin{bmatrix} \frac{1}{R_{out,cav}C_{cav}} & 1 & 0 & 0 & 0 & 0 & 0 \\ \frac{1}{R_{out,room}C_{room}} & 0 & 1 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

$$c = \begin{bmatrix} 0 & 0 & \frac{1}{R_{sur,so}} & (\frac{-1}{R_{sur,so}} + \frac{-1}{R_{si,so}}) & \frac{1}{R_{si,so}} \end{bmatrix}$$

$$d = \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & -C_{so} \end{bmatrix}$$