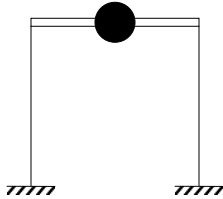


SDOF Shear Building



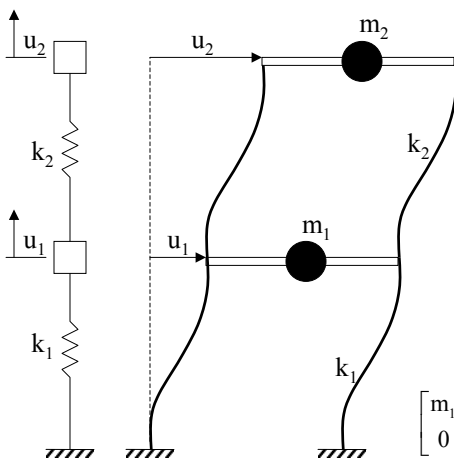
$$m = \text{lumped mass} = m_{\text{roof}} + 2 \left(\frac{1}{2} m_{\text{col}} \right)$$

$$k = 2k_{\text{col}} = 2 \frac{12EI_c}{h^3} = \frac{24EI_c}{h^3}$$

$$m\ddot{u} + ku + c\dot{u} = -m\ddot{u}_g$$

1

2-Story Shear Building (2DOF)



$$m_2 = m_{2\text{roof}} + 2 \left(\frac{1}{2} m_{\text{col}} \right)$$

$$m_1 = m_{1\text{floor}} + 4 \left(\frac{1}{2} m_{\text{col}} \right)$$

$$k_2 = 2k_{\text{col}2}$$

$$k_1 = 2k_{\text{col}1}$$

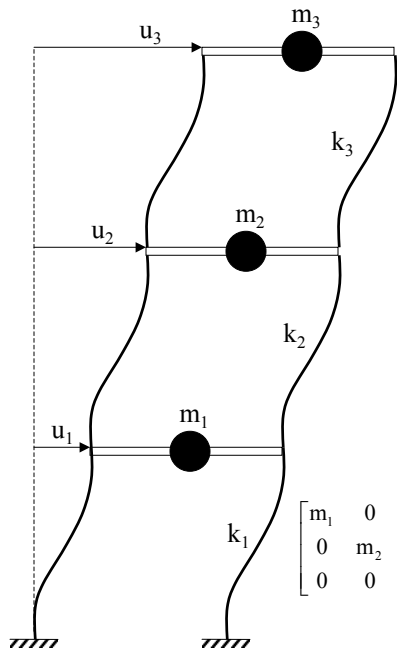
$$m_2\ddot{u}_2 + k_2(u_2 - u_1) = -m_2\ddot{u}_g$$

$$m_1\ddot{u}_1 + k_1(u_1 - u_2) + k_2u_1 = -m_1\ddot{u}_g$$

$$\begin{bmatrix} m_1 & 0 \\ 0 & m_2 \end{bmatrix} \begin{bmatrix} \ddot{u}_1 \\ \ddot{u}_2 \end{bmatrix} + \begin{bmatrix} (k_1 + k_2) & -k_2 \\ -k_2 & k_2 \end{bmatrix} \begin{bmatrix} u_1 \\ u_2 \end{bmatrix} = - \begin{bmatrix} m_1 \\ m_2 \end{bmatrix} \ddot{u}_g$$

or $\underline{M}\ddot{\underline{u}} + \underline{K}\underline{u} = -\underline{M}\ddot{\underline{u}}_g$ where $\underline{1}$ is the Identity Matrix

2



3-Story Shear Building (3DOF)

$$m_3 \ddot{u}_3 + k_3(u_3 - u_2) = -m_3 \ddot{u}_g$$

$$m_2 \ddot{u}_2 + k_3(u_2 - u_3) + k_2(u_2 - u_1) = -m_2 \ddot{u}_g$$

$$m_1 \ddot{u}_1 + k_1(u_1 - u_2) + k_2 u_1 = -m_1 \ddot{u}_g$$

$$\begin{bmatrix} m_1 & 0 & 0 \\ 0 & m_2 & 0 \\ 0 & 0 & m_3 \end{bmatrix} \begin{bmatrix} \ddot{u}_1 \\ \ddot{u}_2 \\ \ddot{u}_3 \end{bmatrix} + \begin{bmatrix} (k_1 + k_2) & -k_2 & 0 \\ -k_2 & (k_2 + k_3) & -k_3 \\ 0 & -k_3 & k_3 \end{bmatrix} \begin{bmatrix} u_1 \\ u_2 \\ u_3 \end{bmatrix} = - \begin{bmatrix} m_1 \\ m_2 \\ m_3 \end{bmatrix} \ddot{u}_g$$

For n DOF,

$$\underline{M} = \begin{bmatrix} m_1 & & & & & & & & & \\ & m_2 & & & & & & & & \\ & & - & & & & & & & \\ & & & - & & & & & & \\ & & & & - & & & & & \\ & & & & & - & & & & \\ & & & & & & m_m & & & \\ & & & & & & & - & & \\ & & & & & & & & - & \\ & & & & & & & & & m_n \end{bmatrix}$$

$$\underline{K} = \begin{bmatrix} (k_1 + k_2) & -k_2 & 0 & - & - & - & - & - & - & 0 \\ -k_2 & (k_2 + k_3) & -k_3 & 0 & - & - & - & - & - & 0 \\ 0 & - & - & - & - & - & - & - & - & \\ 0 & & - & - & - & - & - & - & - & \\ | & & & - & - & - & - & - & - & \\ | & & & & - & - & - & - & - & \\ 0 & & & & & - & - & - & - & \\ | & & & & & & 0 & -k_m & (k_m + k_{m+1}) & -k_{m+1} & 0 \\ | & & & & & & & & - & - & 0 \\ | & & & & & & & & & - & -k_n \\ 0 & 0 & - & - & - & - & - & 0 & -k_n & k_n \end{bmatrix}$$

