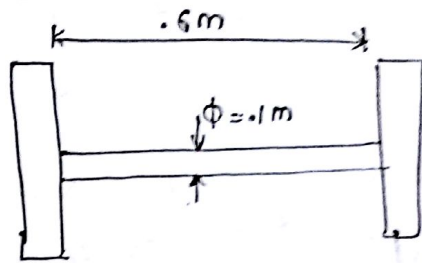


$$J_1 \ddot{\theta}_1 + k(\theta_1 - \theta_2) = 0$$

$$J_2 \ddot{\theta}_2 + k(\theta_2 - \theta_1) = 0$$

$$\begin{bmatrix} J_1 & 0 \\ 0 & J_2 \end{bmatrix} \begin{bmatrix} \ddot{\theta}_1 \\ \ddot{\theta}_2 \end{bmatrix} + \begin{bmatrix} k & -k \\ -k & k \end{bmatrix} \begin{bmatrix} \theta_1 \\ \theta_2 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$



$$J_1 = 22.6 \text{ kg m}^2$$

$$J_2 = 5.66 \text{ kg m}^2$$

$$k_t = 1.3 \times 10^6 \text{ N m/rad}$$

$$G = 0.8 \times 10^{11} \text{ N/m}^2$$

$$\omega_1 = 0$$

$$\omega_2 = 537.4715 \text{ rad/s}$$

$$\begin{bmatrix} \phi_1 \\ \phi_2 \end{bmatrix} \text{ Normal modes}$$

$$\phi_1 = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$$

$$\phi_2 = \begin{bmatrix} 1 \\ -4 \end{bmatrix}$$

$$\phi = \begin{bmatrix} 1 & 1 \\ 1 & -4 \end{bmatrix}$$

$$\underline{M} = \begin{bmatrix} M_1 \\ M_2 \end{bmatrix}$$

$$J_{ij} = \begin{bmatrix} J_{11} & J_{12} \\ J_{21} & J_{22} \end{bmatrix} = \begin{bmatrix} 1 & 1 \\ 1 & -4 \end{bmatrix} \begin{bmatrix} 22.6 & 0 \\ 0 & 5.66 \end{bmatrix} \begin{bmatrix} 1 & 1 \\ 1 & -4 \end{bmatrix}$$

modal inertia mass matrix

$$\begin{bmatrix} J_{11} & J_{12} \\ J_{21} & J_{22} \end{bmatrix} = \begin{bmatrix} 28.26 & 0 \\ 0 & 113.16 \end{bmatrix} = \phi^T J \phi$$

modal stiffness matrix

$$\begin{bmatrix} k_{11} & k_{12} \\ k_{21} & k_{22} \end{bmatrix} = \begin{bmatrix} 0 & 0 \\ 0 & 3.275 \times 10^7 \end{bmatrix} = \phi^T K \phi$$

$$\psi_1 = \frac{1}{\sqrt{28.26}} \begin{bmatrix} 1 \\ 1 \end{bmatrix} = \begin{bmatrix} 0.1881 \\ 0.1881 \end{bmatrix}$$

$$\psi_2 = \frac{1}{\sqrt{113.16}} \begin{bmatrix} 1 \\ -4 \end{bmatrix} = \begin{bmatrix} 0.094 \\ -0.376 \end{bmatrix}$$

$$\begin{bmatrix} \psi_1 \\ \psi_2 \end{bmatrix} \text{ Mass Normalized mode shapes}$$