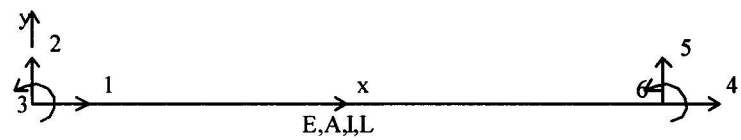
FRAME ELEMENT (C=COSθ , S=SINθ)

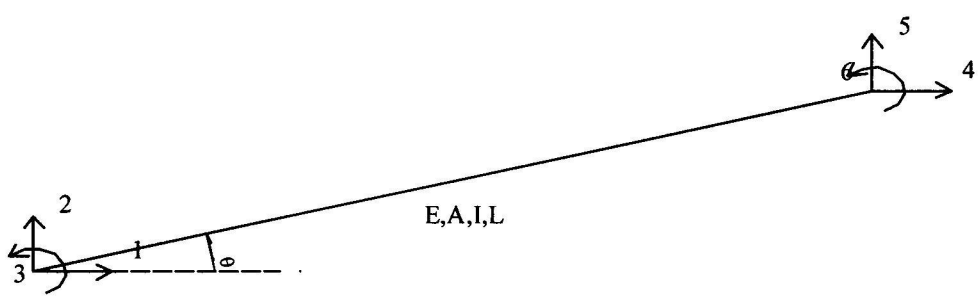
MEMBER STIFFNESS MATRIX IN LOCAL COORDINATES **ROTATION MATRIX**

$$[K'] = \begin{bmatrix} \frac{EA}{L} & 0 & 0 & \frac{-EA}{L} & 0 & 0 \\ 0 & \frac{12EI}{L^3} & \frac{6EI}{L^2} & 0 & -\frac{12EI}{L^3} & \frac{6EI}{L^2} \\ 0 & \frac{6EI}{L^2} & \frac{4EI}{L} & 0 & -\frac{6EI}{L^2} & \frac{2EI}{L} \\ \frac{-EA}{L} & 0 & 0 & \frac{EA}{L} & 0 & 0 \\ 0 & -\frac{12EI}{L^3} & -\frac{6EI}{L^2} & 0 & \frac{12EI}{L^3} & -\frac{6EI}{L^2} \\ 0 & \frac{6EI}{L^2} & \frac{2EI}{L} & 0 & -\frac{6EI}{L^2} & \frac{4EI}{L} \end{bmatrix} \quad [R] = \begin{bmatrix} C & S & 0 & 0 & 0 & 0 \\ -S & C & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & C & S & 0 \\ 0 & 0 & 0 & -S & C & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix}$$



MEMBER STIFFNESS MATRIX IN GLOBAL COORDINATES $[K] = [R^T][K'][R]$

$$[K] = \begin{bmatrix} C^2\frac{EA}{L}+S^2\frac{12EI}{L^3} & CS\frac{EA}{L}-CS\frac{12EI}{L^3} & -S\frac{6EI}{L^2} & -C^2\frac{EA}{L}-S^2\frac{12EI}{L^3} & -CS\frac{EA}{L}+CS\frac{12EI}{L^3} & -S\frac{6EI}{L^2} \\ CS\frac{EA}{L}-CS\frac{12EI}{L^3} & S^2\frac{EA}{L}+C^2\frac{12EI}{L^3} & C\frac{6EI}{L^2} & -CS\frac{EA}{L}+CS\frac{12EI}{L^3} & -S^2\frac{EA}{L}-C^2\frac{12EI}{L^3} & C\frac{6EI}{L^2} \\ -S\frac{6EI}{L^2} & C\frac{6EI}{L^2} & \frac{4EI}{L} & S\frac{6EI}{L^2} & -C\frac{6EI}{L^2} & \frac{2EI}{L} \\ -C^2\frac{EA}{L}-S^2\frac{12EI}{L^3} & -CS\frac{EA}{L}+CS\frac{12EI}{L^3} & S\frac{6EI}{L^2} & C^2\frac{EA}{L}+S^2\frac{12EI}{L^3} & CS\frac{EA}{L}-CS\frac{12EI}{L^3} & S\frac{6EI}{L^2} \\ -CS\frac{EA}{L}+CS\frac{12EI}{L^3} & -S^2\frac{EA}{L}-C^2\frac{12EI}{L^3} & -C\frac{6EI}{L^2} & CS\frac{EA}{L}-CS\frac{12EI}{L^3} & S^2\frac{EA}{L}+C^2\frac{12EI}{L^3} & -C\frac{6EI}{L^2} \\ -S\frac{6EI}{L^2} & C\frac{6EI}{L^2} & \frac{2EI}{L} & S\frac{6EI}{L^2} & -C\frac{6EI}{L^2} & \frac{4EI}{L} \end{bmatrix}$$



TRUSS ELEMENT $[K] = [R^T][K'][R]$ (C=COSθ , S=SINθ)

MEMBER STIFFNESS MATRIX IN LOCAL COORDINATES

$$[K'] = \frac{EA}{L}\begin{bmatrix} 1 & 0 & -1 & 0 \\ 0 & 0 & 0 & 0 \\ -1 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

ROTATION MATRIX

$$[R] = \begin{bmatrix} C & S & 0 & 0 \\ -S & C & 0 & 0 \\ 0 & 0 & C & S \\ 0 & 0 & -S & C \end{bmatrix}$$

MEMBER STIFFNESS MATRIX IN GLOBAL COORDINATES

$$[K] = \frac{EA}{L}\begin{bmatrix} C^2 & CS & -C^2 & -CS \\ CS & S^2 & -CS & -S^2 \\ -C^2 & -CS & C^2 & CS \\ -CS & -S^2 & CS & S^2 \end{bmatrix}$$