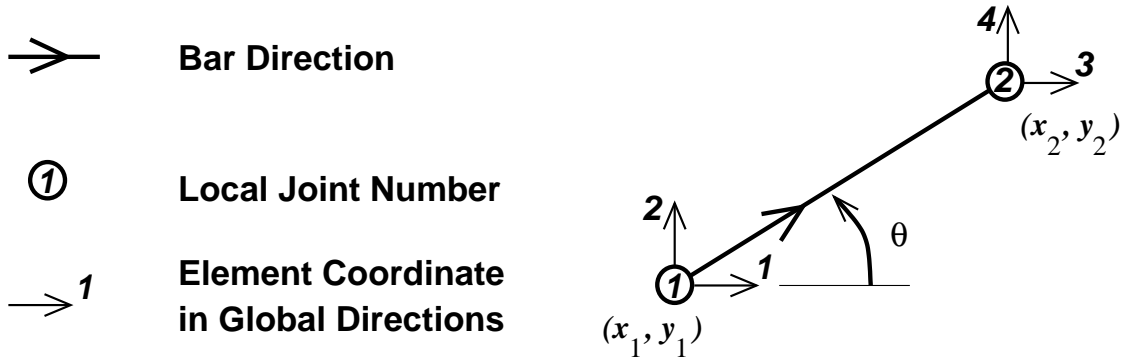


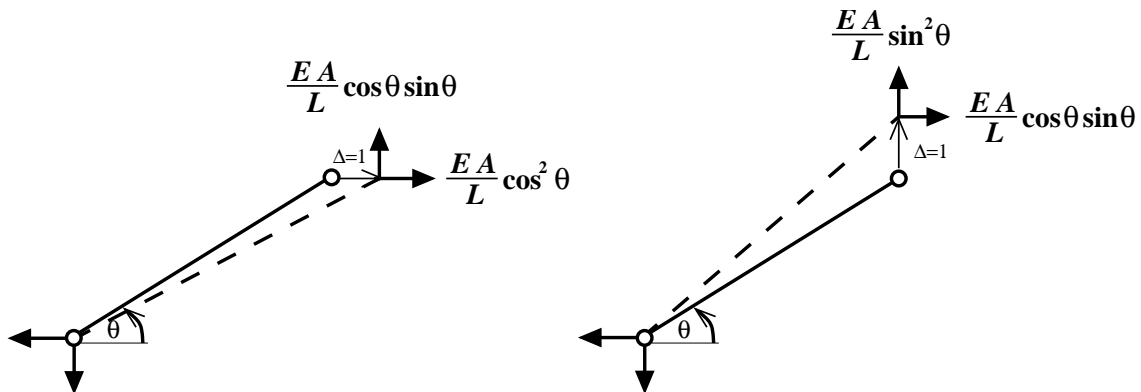
Duke University — CE 131L. Matrix Structural Analysis  
Stiffness Matrix Reference Sheet for 2D Truss Bars



$$L = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \quad c = (x_2 - x_1)/L \quad s = (y_2 - y_1)/L$$

$$\mathbf{k} = \frac{EA}{L} \begin{bmatrix} 1 & 0 & -1 & 0 \\ 0 & 0 & 0 & 0 \\ -1 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix} \quad \mathbf{K} = \frac{EA}{L} \begin{bmatrix} c^2 & cs & -c^2 & -cs \\ cs & s^2 & -cs & -s^2 \\ -c^2 & -cs & c^2 & cs \\ -cs & -s^2 & cs & s^2 \end{bmatrix}$$

$$T = \frac{EA}{L} [c(v_3 - v_1) + s(v_4 - v_2)]$$



Coordinate System	Local	Global
Element Deflection	$\mathbf{u}$	$\mathbf{v}$
Element Force	$\mathbf{q}$	$\mathbf{f}$
Element Stiffness	$\mathbf{k}$	$\mathbf{K}$
Structural Deflection	-	$\mathbf{d}$
Structural Loads	-	$\mathbf{p}$
Structural Stiffness	-	$\mathbf{K}_s$

$$\mathbf{q} = \mathbf{k} \mathbf{u} \quad \mathbf{f} = \mathbf{K} \mathbf{v} \quad \mathbf{p} = \mathbf{K}_s \mathbf{d}$$

$$\begin{bmatrix} a & b \\ c & d \end{bmatrix}^{-1} = \frac{1}{ad - bc} \begin{bmatrix} d & -b \\ -c & a \end{bmatrix}$$