

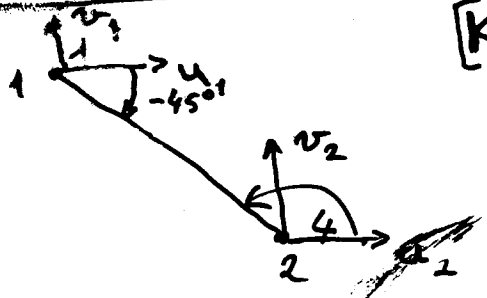
$F = 1000 \text{ N}$      $E = 200 \text{ GPa}$   
 $\theta = 30^\circ$   
 $A_2 = A_3 = A_1 = 100 \times 10^{-6} \text{ m}^2$      ~~$A_2 = 50 \times 10^{-6}$~~   
 ~~$A_3 = 25 \times 10^{-6} \text{ m}^2$~~

$$[K] = \begin{bmatrix} c^2 & cs & -c^2 & -cs \\ s^2 & -cs & -s^2 & cs \\ \text{Symmetric} & & & \\ c^2 & cs & & \\ & & s^2 & \end{bmatrix} \frac{AE}{L}$$

Correspondance Table:

Local		Global	
$u_1^1$	$\delta_1^1$	$u_1$	$\delta_1$
$v_1^1$	$\delta_2^1$	$v_1$	$\delta_2$
$u_2^1$	$\delta_3^1$	$u_4$	$\delta_7$
$v_2^1$	$\delta_4^1$	$v_4$	$\delta_8$
$u_1^2$	$\delta_1^2$	$u_2$	$\delta_3$
$v_1^2$	$\delta_2^2$	$v_2$	$\delta_4$
$u_2^2$	$\delta_3^2$	$u_4$	$\delta_7$
$v_2^2$	$\delta_4^2$	$v_4$	$\delta_8$
$u_1^3$	$\delta_1^3$	$u_3$	$\delta_5$
$v_1^3$	$\delta_2^3$	$v_3$	$\delta_6$
$u_2^3$	$\delta_3^3$	$u_4$	$\delta_7$
$v_2^3$	$\delta_4^3$	$v_4$	$\delta_8$

Element # 1



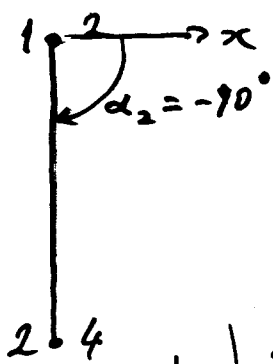
$$[K] \{ \delta \} = \{ F \}$$

$\cos(-45^\circ) = \frac{1}{\sqrt{2}}$   
 $\sin(-45^\circ) = -\frac{1}{\sqrt{2}}$   
 $c^2 = \frac{1}{2}$   
 $s^2 = \frac{1}{2}$   
 $cs = -\frac{1}{2}$

$$[K^1] = \frac{A \times E}{L} \begin{bmatrix} \frac{1}{2} & -\frac{1}{2} & \frac{1}{2} & \frac{1}{2} \\ -\frac{1}{2} & \frac{1}{2} & \frac{1}{2} & -\frac{1}{2} \\ & & \frac{1}{2} & -\frac{1}{2} \\ & & -\frac{1}{2} & \frac{1}{2} \end{bmatrix} \begin{matrix} 1 \\ 2 \\ 7 \\ 8 \end{matrix}$$

$$[K^1] = \begin{bmatrix} \frac{1}{2} & -\frac{1}{2} & 0 & 0 & 0 & 0 & -\frac{1}{2} & \frac{1}{2} \\ -\frac{1}{2} & \frac{1}{2} & 0 & 0 & 0 & 0 & \frac{1}{2} & -\frac{1}{2} \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ -\frac{1}{2} & \frac{1}{2} & 0 & 0 & 0 & 0 & \frac{1}{2} & -\frac{1}{2} \\ \frac{1}{2} & -\frac{1}{2} & 0 & 0 & 0 & 0 & -\frac{1}{2} & \frac{1}{2} \end{bmatrix} \times \frac{AE}{L_1}$$

Element # 2



$$c = 0 \quad s = -1$$

$$c^2 = 0 \quad s^2 = 1$$

$$cs = 0$$

$$[K^2] = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & -1 \\ 0 & 0 & 0 & 0 \\ -1 & 0 & 0 & 1 \end{bmatrix}$$

$$[K^2] = \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & -1 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix} \times \frac{AE}{L_2}$$

Symmetric

~~1~~



5

[K]

~~A x E~~

	1	2	3	4	5	6	7	8	
	$\frac{1}{2L_1}$	$-\frac{1}{2L_1}$	0	0	0	0	$-\frac{1}{2L_1}$	$\frac{1}{2L_1}$	1
		$\frac{1}{2L_1}$	0	0	0	0	$\frac{1}{2L_1}$	$-\frac{1}{2L_1}$	2
			0	0	0	0	0	0	3
				$\frac{1}{L_2}$	0	0	0	$-\frac{1}{L_2}$	4
					$\frac{3}{4L_3}$	$\frac{\sqrt{3}}{4L_3}$	$-\frac{3}{4L_3}$	$-\frac{\sqrt{3}}{4L_3}$	5
						$\frac{1}{4L_3}$	$-\frac{\sqrt{3}}{4L_3}$	$-\frac{1}{4L_3}$	6
							$\frac{1}{2L_1} + \frac{3}{4L_3}$	$\frac{1}{2L_1} + \frac{\sqrt{3}}{4L_3}$	7
								$\frac{1}{2L_1} + \frac{1}{4L_3}$	8

$$[K] \begin{Bmatrix} \delta_1 = 0 \\ \delta_2 = 0 \\ \delta_3 = 0 \\ \delta_4 = 0 \\ \delta_5 = 0 \\ \delta_6 = 0 \\ \delta_7 \\ \delta_8 \end{Bmatrix} = \begin{Bmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ -1000 \times \sin 30 \\ -1000 \times \cos 30 \end{Bmatrix}$$

Solve

$$\frac{A \times E}{L} \begin{bmatrix} K_{77} & K_{78} \\ K_{87} & K_{88} \end{bmatrix} \begin{Bmatrix} \delta_7 \\ \delta_8 \end{Bmatrix} = \begin{Bmatrix} -1000 \times \sin 30 \\ -1000 \cos 30 \end{Bmatrix}$$