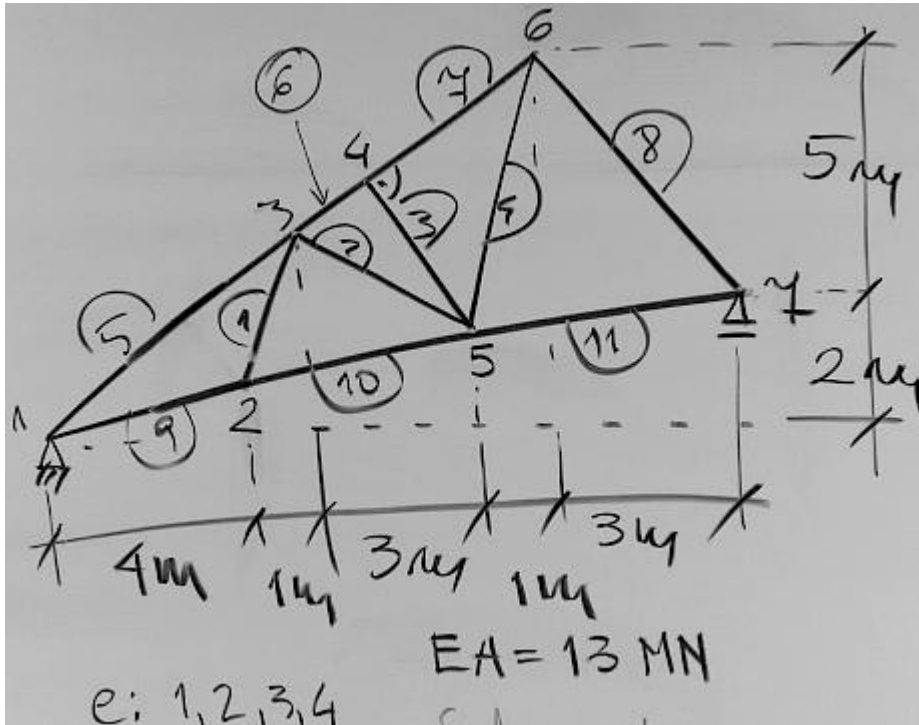


## K1 - Macierze sztywności elementów kratownicy



elementy := (1, 2, 3, 4)

EA := 13MN

dokładność  $\pm 0.05 \text{ kN/m}$

$$\alpha := \text{atan}\left(\frac{2}{12}\right) = 9.462 \cdot \text{deg}$$

$$\beta := \text{atan}\left(\frac{9}{7}\right) = 52.125 \cdot \text{deg}$$

$$\gamma := \frac{\pi}{2} - \beta - \alpha = 28.41266 \cdot \text{deg}$$

$$L15 := \sqrt{64 + \left(\frac{2 \cdot 8}{12}\right)^2} \text{ m} = 8.11035 \text{ m}$$

$$L3 := L15 \cdot \sin(\gamma) = 3.85906 \text{ m}$$

$$L13 := L15 \cdot \cos(\gamma) = 7.13341 \text{ m}$$

$$X4 := L13 \cdot \sin(\beta) = 5.63077 \text{ m}$$

$$Y4 := L13 \cdot \cos(\beta) = 4.37949 \text{ m}$$

$$Y2 := 2 \text{ m} \cdot \frac{4}{12} = 0.66667 \text{ m}$$

$$Y5 := 2 \text{ m} \cdot \frac{8}{12} = 1.33333 \text{ m}$$

$$Y3 := 7 \text{ m} \cdot \frac{5}{9} = 3.88889 \text{ m}$$

Warunki brzegowe:

$$u_{x1} = 0 \quad u_{y1} = 0$$

$$u_{y7} = 0$$

### *Element "1" - blok macierzy sztywności*

$$L_x := 1\text{m} = 1.00000\text{m}$$

$$L_y := Y_3 - Y_2 = 3.22222\text{m}$$

$$L := \sqrt{(L_x)^2 + (L_y)^2} = 3.37383\text{m}$$

$$J := \frac{EA}{(L)^3} \cdot \begin{bmatrix} (L_x)^2 & L_x \cdot L_y \\ L_x \cdot L_y & (L_y)^2 \end{bmatrix} \quad J = \begin{bmatrix} 338.5 & 1090.8 \\ (1090.8) & 3514.7 \end{bmatrix} \frac{\text{kN}}{\text{m}}$$

### *Element "2" - blok macierzy sztywności*

$$L_x := 3\text{m} = 3\text{m}$$

$$L_y := Y_5 - Y_3 = -2.555556\text{m}$$

$$L := \sqrt{(L_x)^2 + (L_y)^2} = 3.940922\text{m}$$

$$J := \frac{EA}{(L)^3} \cdot \begin{bmatrix} (L_x)^2 & L_x \cdot L_y \\ L_x \cdot L_y & (L_y)^2 \end{bmatrix} \quad J = \begin{bmatrix} 1911.6 & -1628.4 \\ (-1628.4) & 1387.1 \end{bmatrix} \frac{\text{kN}}{\text{m}}$$

### *Element "3" - blok macierzy sztywności*

$$L_x := 8\text{m} - X_4 = 2.369231\text{m}$$

$$L_y := Y_5 - Y_4 = -3.046154\text{m}$$

$$L := \sqrt{(L_x)^2 + (L_y)^2} = 3.859055\text{m}$$

$$J := \frac{EA}{(L)^3} \cdot \begin{bmatrix} (L_x)^2 & L_x \cdot L_y \\ L_x \cdot L_y & (L_y)^2 \end{bmatrix} \quad J = \begin{bmatrix} 1269.7 & -1632.5 \\ (-1632.5) & 2099.0 \end{bmatrix} \frac{\text{kN}}{\text{m}}$$

### *Element "4" - blok macierzy sztywności*

$$L_x := 1\text{m} = 1\text{m}$$

$$L_y := 7\text{m} - Y_5 = 5.666667\text{m}$$

$$L := \sqrt{(L_x)^2 + (L_y)^2} = 5.754226\text{m}$$

$$J := \frac{EA}{(L)^3} \cdot \begin{bmatrix} (L_x)^2 & L_x \cdot L_y \\ L_x \cdot L_y & (L_y)^2 \end{bmatrix} \quad J = \begin{bmatrix} 68.2 & 386.6 \\ (386.6) & 2191.0 \end{bmatrix} \frac{\text{kN}}{\text{m}}$$

	1	2	3	4	5	6	7	
	$\mathbf{j^5+j^9}$	$-\mathbf{j^9}$	$-\mathbf{j^5}$					1
	<b>Symetria</b>	$\mathbf{j^1+j^9+j^{10}}$	$-\mathbf{j^1}$		$-\mathbf{j^{10}}$			2
		<b>Symetria</b>	$\mathbf{j^1+j^2+j^5+j^6}$	$-\mathbf{j^6}$	$-\mathbf{j^2}$			3
<b>K =</b>			<b>Symetria</b>	$\mathbf{j^3+j^6+j^7}$	$-\mathbf{j^3}$	$-\mathbf{j^7}$		4
				<b>Symetria</b>	$\mathbf{j^2+j^3+j^4+j^{10}+j^{11}}$	$-\mathbf{j^4}$	$-\mathbf{j^{11}}$	5
					<b>Symetria</b>	$\mathbf{j^4+j^7+j^8}$	$-\mathbf{j^8}$	6
						<b>Symetria</b>	$\mathbf{j^8+j^{11}}$	7