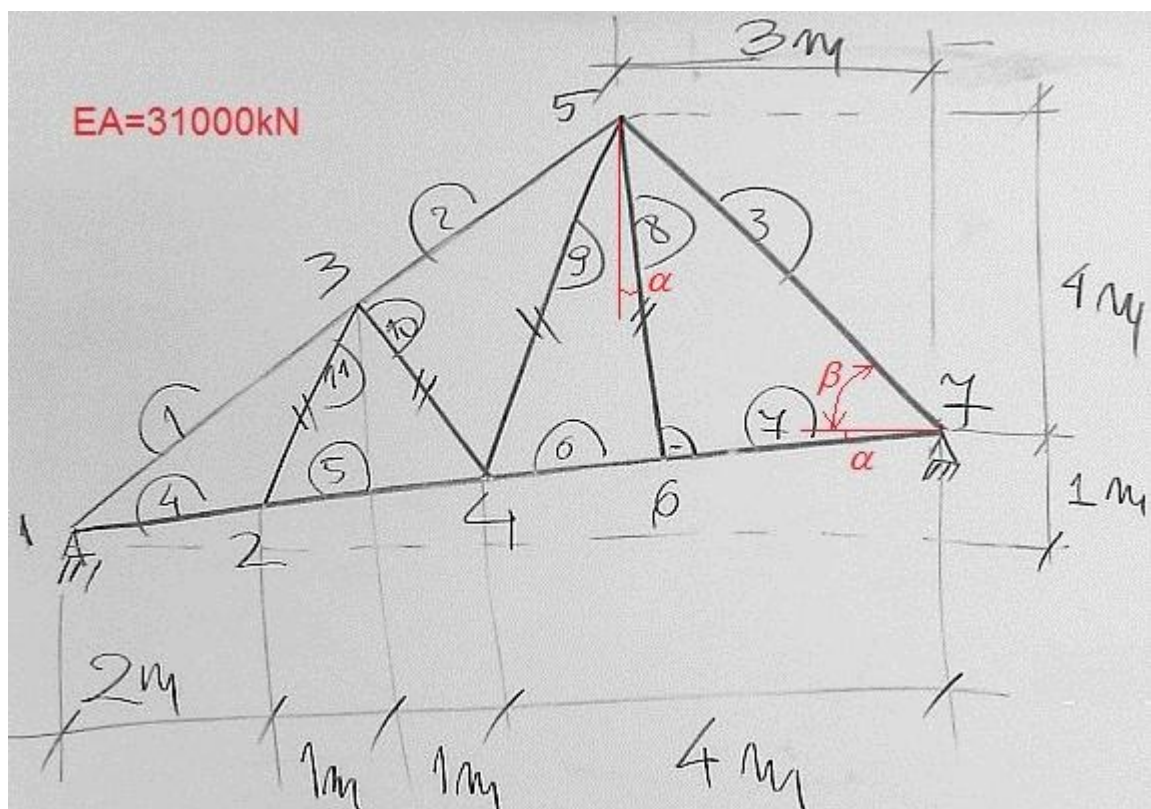


Macierze sztywności elementów kratownicy



elementy := (8, 9, 10, 11) EA := 31MN

$$\mathbf{K} = \begin{bmatrix}
 \begin{matrix} 1 & 2 & 3 & 4 & 5 & 6 & 7 \end{matrix} \\
 \begin{matrix} \mathbf{J^1+J^4} & -\mathbf{J^4} & -\mathbf{J^1} & & & & \end{matrix} \\
 \begin{matrix} & \mathbf{J^4+J^5+J^{11}} & -\mathbf{J^{11}} & -\mathbf{J^5} & & & \end{matrix} \\
 \begin{matrix} & & \mathbf{J^1+J^2+} \\ & & \mathbf{+J^{10}+J^{11}} & -\mathbf{J^{10}} & -\mathbf{J^2} & & \end{matrix} \\
 \begin{matrix} & & & \mathbf{J^5+J^6+} \\ & & & \mathbf{+J^9+J^{10}} & -\mathbf{J^9} & -\mathbf{J^6} & \end{matrix} \\
 \begin{matrix} \text{Symetria} & \text{Symetria} & \text{Symetria} & \text{Symetria} & \mathbf{J^2+J^3+} \\ & & & & \mathbf{+J^8+J^9} & -\mathbf{J^8} & -\mathbf{J^3} \end{matrix} \\
 \begin{matrix} & & & & & \mathbf{J^6+J^7+J^8} & -\mathbf{J^7} \end{matrix} \\
 \begin{matrix} & & & & & & \mathbf{J^3+J^7} \end{matrix} \\
 \begin{matrix} 1 \\ 2 \\ 3 \\ 4 \\ 5 \\ 6 \\ 7 \end{matrix}
 \end{bmatrix}$$

$$\alpha := \operatorname{atan}\left(\frac{1}{8}\right) = 7.125016 \cdot \text{deg}$$

$$\beta := \operatorname{atan}\left(\frac{4}{3}\right) = 53.130102 \cdot \text{deg}$$

$$\gamma := \alpha + \beta = 60.255119 \cdot \text{deg}$$

$$L3 := \frac{3\text{m}}{\cos(\beta)} = 5\text{m}$$

$$L7 := L3 \cdot \cos(\gamma) = 2.480695\text{m}$$

$$L8 := L3 \cdot \sin(\gamma) = 4.341216\text{m}$$

Element "8" - blok macierzy sztywności

$$Lx := L8 \cdot \sin(\alpha) = 0.538462\text{m}$$

$$Ly := -L8 \cdot \cos(\alpha) = -4.307692\text{m}$$

$$L := \sqrt{(Lx)^2 + (Ly)^2} = 4.341216\text{m}$$

$$J := \frac{EA}{(L)^3} \cdot \begin{bmatrix} (Lx)^2 & Lx \cdot Ly \\ Lx \cdot Ly & (Ly)^2 \end{bmatrix} \quad J = \begin{pmatrix} 110 & -879 \\ -879 & 7031 \end{pmatrix} \cdot \frac{\text{kN}}{\text{m}}$$

Element "9" - blok macierzy sztywności

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

$$Ly := 4\text{m} + 1\text{m} \cdot \frac{4}{8} = 4.500000\text{m}$$

$$L := \sqrt{(Lx)^2 + (Ly)^2} = 4.609772\text{m}$$

$$J := \frac{EA}{(L)^3} \cdot \begin{bmatrix} (Lx)^2 & Lx \cdot Ly \\ Lx \cdot Ly & (Ly)^2 \end{bmatrix} \quad J = \begin{pmatrix} 316 & 1424 \\ 1424 & 6408 \end{pmatrix} \cdot \frac{\text{kN}}{\text{m}}$$

Element "10" - blok macierzy sztywności

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

$$Ly := -\left(5\text{m} \cdot \frac{3}{5} - 1\text{m} \cdot \frac{4}{8}\right) = -2.500000\text{m}$$

$$L := \sqrt{(Lx)^2 + (Ly)^2} = 2.692582\text{m}$$

$$J := \frac{EA}{(L)^3} \cdot \begin{bmatrix} (Lx)^2 & Lx \cdot Ly \\ Lx \cdot Ly & (Ly)^2 \end{bmatrix} \quad J = \begin{pmatrix} 1588 & -3970 \\ -3970 & 9925 \end{pmatrix} \cdot \frac{\text{kN}}{\text{m}}$$

Element "11" - blok macierzy sztywności

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

$$Ly := 5\text{m} \cdot \frac{3}{5} - 1\text{m} \cdot \frac{2}{8} = 2.750000\text{m}$$

$$L := \sqrt{(Lx)^2 + (Ly)^2} = 2.926175\text{m}$$

$$J := \frac{EA}{(L)^3} \cdot \begin{bmatrix} (Lx)^2 & Lx \cdot Ly \\ Lx \cdot Ly & (Ly)^2 \end{bmatrix} \quad J = \begin{pmatrix} 1237 & 3402 \\ 3402 & 9357 \end{pmatrix} \cdot \frac{\text{kN}}{\text{m}}$$