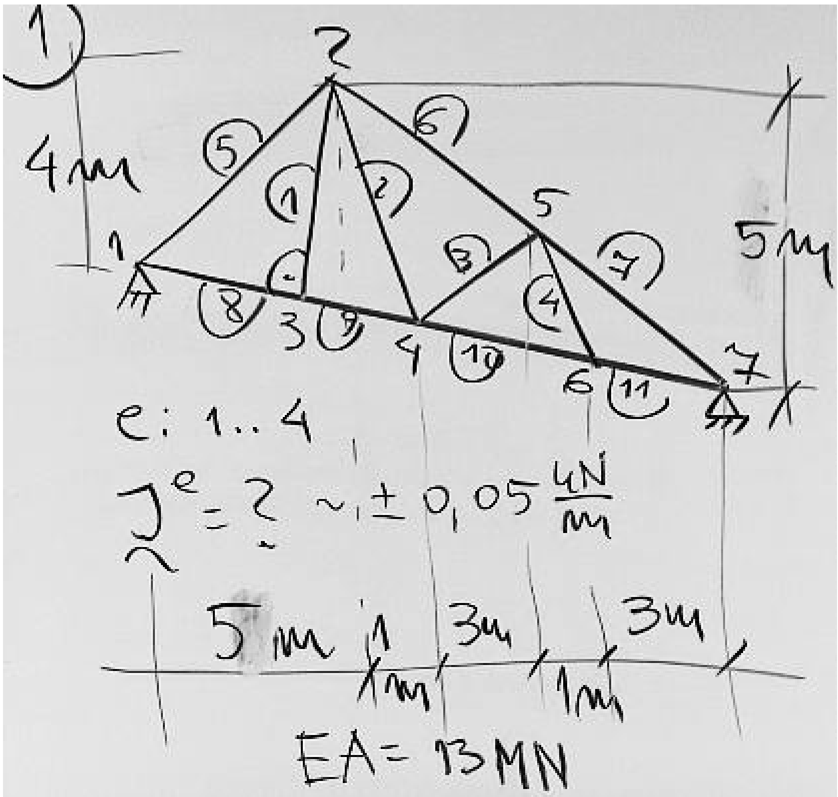
K1 - Macierze sztywności elementów kratownicy



$\text{elementy} := (1, 2, 3, 4)$ $\qquad EA := 13MN$ $\qquad$ *dokładnść ±0.05kN/m*

$\alpha := \operatorname{atan}\left(\frac{1}{13}\right) = 4.399 \cdot deg$ $\qquad \beta := \operatorname{atan}\left(\frac{8}{5}\right) = 57.995 \cdot deg$

$\gamma := \frac{\pi}{2} - \beta - \alpha = 27.60668 \cdot deg$ $\qquad L27 := \sqrt{64 + 25}\,m = 9.43398\,m$

$L1 := L27 \cdot \sin(\gamma) = 4.3717\,m$ $\qquad X3 := 5m - L1 \cdot \sin(\alpha) = 4.6647\,m$

$Y3 := 4m - L1 \cdot \cos(\alpha) = -0.35882\,m$ $\qquad Y4 := -1m \cdot \frac{6}{13} = -0.4615\,m$

$Y6 := -1m \cdot \frac{10}{13} = -0.7692\,m$ $\qquad Y5 := 5m \cdot \frac{4}{8} - 1m = 1.5000\,m$

Warunki brzegowe: $\quad ux_1 = 0 \quad uy_1 = 0 \quad ux_7 = 0 \quad uy_7 = 0$

Element "1" - blok macierzy sztywności

$Lx := 5m - X3 = 0.33529\,m$ $\qquad$ $Ly := 4m - Y3 = 4.35882\,m$

$$L := \sqrt{(Lx)^2 + (Ly)^2} = 4.37170\,m$$

$$J := \frac{EA}{(L)^3} \cdot \begin{bmatrix} (Lx)^2 & Lx \cdot Ly \\ Lx \cdot Ly & (Ly)^2 \end{bmatrix} \qquad J = \begin{bmatrix} 17.5 & 227.4 \\ (227.4) & 2956.2 \end{bmatrix} \frac{kN}{m}$$

Element "2" - blok macierzy sztywności

$Lx := 1m = 1\,m$ $\qquad$ $Ly := Y4 - 4m = -4.461538\,m$

$$L := \sqrt{(Lx)^2 + (Ly)^2} = 4.572234\,m$$

$$J := \frac{EA}{(L)^3} \cdot \begin{bmatrix} (Lx)^2 & Lx \cdot Ly \\ Lx \cdot Ly & (Ly)^2 \end{bmatrix} \qquad J = \begin{bmatrix} 136.0 & -606.8 \\ (-606.8) & 2707.2 \end{bmatrix} \frac{kN}{m}$$

Element "3" - blok macierzy sztywności

$Lx := 3m = 3\,m$ $\qquad$ $Ly := Y5 - Y4 = 1.961538\,m$

$$L := \sqrt{(Lx)^2 + (Ly)^2} = 3.58436\,m$$

$$J := \frac{EA}{(L)^3} \cdot \begin{bmatrix} (Lx)^2 & Lx \cdot Ly \\ Lx \cdot Ly & (Ly)^2 \end{bmatrix} \qquad J = \begin{bmatrix} 2540.7 & 1661.2 \\ (1661.2) & 1086.2 \end{bmatrix} \frac{kN}{m}$$

Element "4" - blok macierzy sztywności

$Lx := 1m = 1\,m$ $\qquad$ $Ly := Y6 - Y5 = -2.269231\,m$

$$L := \sqrt{(Lx)^2 + (Ly)^2} = 2.4798\,m$$

$$J := \frac{EA}{(L)^3} \cdot \begin{bmatrix} (Lx)^2 & Lx \cdot Ly \\ Lx \cdot Ly & (Ly)^2 \end{bmatrix} \qquad J = \begin{bmatrix} 852.5 & -1934.5 \\ (-1934.5) & 4389.9 \end{bmatrix} \frac{kN}{m}$$

$$
\mathbf{K} = \begin{array}{cccccccc}
1 & 2 & 3 & 4 & 5 & 6 & 7 & \\
\left[\begin{array}{c} \mathbf{J}^5+\mathbf{J}^8 \\ \text{Symetria} \\ \\ \\ \\ \\ \\ \end{array}\right. &
\begin{array}{c} -\mathbf{J}^5 \\ \mathbf{J}^1+\mathbf{J}^2+\mathbf{J}^5+\mathbf{J}^6 \\ \text{Symetria} \\ \\ \\ \\ \\ \end{array} &
\begin{array}{c} -\mathbf{J}^8 \\ -\mathbf{J}^1 \\ \mathbf{J}^1+\mathbf{J}^8+\mathbf{J}^9 \\ \text{Symetria} \\ \\ \\ \\ \end{array} &
\begin{array}{c} \\ -\mathbf{J}^2 \\ -\mathbf{J}^9 \\ \mathbf{J}^2+\mathbf{J}^3+\mathbf{J}^9+\mathbf{J}^{10} \\ \text{Symetria} \\ \\ \\ \end{array} &
\begin{array}{c} \\ -\mathbf{J}^6 \\ \\ -\mathbf{J}^3 \\ \mathbf{J}^3+\mathbf{J}^4++\mathbf{J}^6+\mathbf{J}^7 \\ \text{Symetria} \\ \\ \end{array} &
\begin{array}{c} \\ \\ \\ -\mathbf{J}^{10} \\ -\mathbf{J}^4 \\ \mathbf{J}^4+\mathbf{J}^{10}+\mathbf{J}^{11} \\ \text{Symetria} \end{array} &
\left.\begin{array}{c} \\ \\ \\ \\ -\mathbf{J}^7 \\ -\mathbf{J}^{11} \\ \mathbf{J}^7+\mathbf{J}^{11} \end{array}\right] &
\begin{array}{c} 1 \\ 2 \\ 3 \\ 4 \\ 5 \\ 6 \\ 7 \end{array}
\end{array}
$$