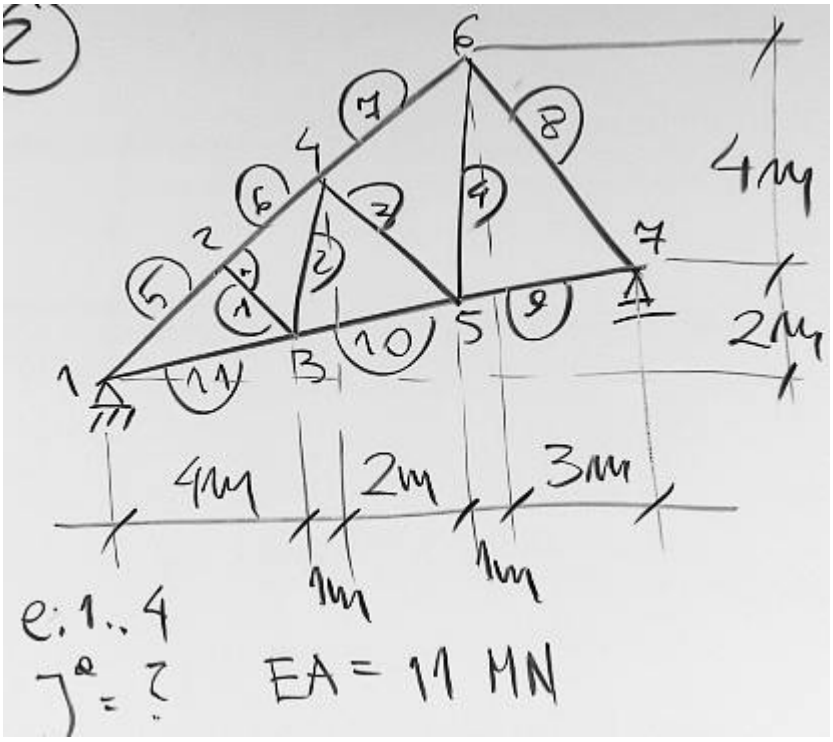
K2 - Macierze sztywności elementów kratownicy



elementy := (1 , 2 , 3 , 4) EA := 11MN *dokładnść ±0.05kN/m*

$\alpha := \operatorname{atan}\left(\frac{2}{11}\right) = 10.305 \cdot \mathrm{deg}$ $\beta := \operatorname{atan}\left(\frac{8}{6}\right) = 53.13 \cdot \mathrm{deg}$

$\gamma := \frac{\pi}{2} - \beta - \alpha = 26.56505 \cdot \mathrm{deg}$ $Y3 := 2\mathrm{m} \cdot \frac{4}{11} = 0.72727\mathrm{m}$

$L11 := \sqrt{(4\mathrm{m})^2 + Y3^2} = 4.06558\mathrm{m}$ $L1 := L11 \cdot \sin(\gamma) = 1.81818\mathrm{m}$

$Y5 := 2\mathrm{m} \cdot \frac{7}{11} = 1.27273\mathrm{m}$ $Y4 := 6\mathrm{m} \cdot \frac{5}{8} = 3.75000\mathrm{m}$

$Y2 := Y3 + L1 \cdot \sin(\beta) = 2.18182\mathrm{m}$ $X2 := 4\mathrm{m} - L1 \cdot \cos(\beta) = 2.90909\mathrm{m}$

Warunki brzegowe: $ux_1 = 0$ $uy_1 = 0$ $uy_7 = 0$

Element "1" - blok macierzy sztywności

$Lx := 4m - X2 = 1.09091\,m$ $\qquad$ $Ly := Y3 - Y2 = -1.45455\,m$

$L := \sqrt{(Lx)^2 + (Ly)^2} = 1.81818\,m$

$$J := \frac{EA}{(L)^3} \cdot \begin{bmatrix} (Lx)^2 & Lx \cdot Ly \\ Lx \cdot Ly & (Ly)^2 \end{bmatrix} \qquad J = \begin{bmatrix} 2178.0 & -2904.0 \\ (-2904.0) & 3872.0 \end{bmatrix} \frac{kN}{m}$$

Element "2" - blok macierzy sztywności

$Lx := 1m = 1\,m$ $\qquad$ $Ly := Y4 - Y3 = 3.022727\,m$

$L := \sqrt{(Lx)^2 + (Ly)^2} = 3.183847\,m$

$$J := \frac{EA}{(L)^3} \cdot \begin{bmatrix} (Lx)^2 & Lx \cdot Ly \\ Lx \cdot Ly & (Ly)^2 \end{bmatrix} \qquad J = \begin{bmatrix} 340.8 & 1030.2 \\ (1030.2) & 3114.1 \end{bmatrix} \frac{kN}{m}$$

Element "3" - blok macierzy sztywności

$Lx := 2m = 2\,m$ $\qquad$ $Ly := Y5 - Y4 = -2.477273\,m$

$L := \sqrt{(Lx)^2 + (Ly)^2} = 3.183847\,m$

$$J := \frac{EA}{(L)^3} \cdot \begin{bmatrix} (Lx)^2 & Lx \cdot Ly \\ Lx \cdot Ly & (Ly)^2 \end{bmatrix} \qquad J = \begin{bmatrix} 1363.3 & -1688.7 \\ (-1688.7) & 2091.6 \end{bmatrix} \frac{kN}{m}$$

Element "4" - blok macierzy sztywności

$Lx := 1m = 1\,m$ $\qquad$ $Ly := 6m - Y5 = 4.727273\,m$

$L := \sqrt{(Lx)^2 + (Ly)^2} = 4.831884\,m$

$$J := \frac{EA}{(L)^3} \cdot \begin{bmatrix} (Lx)^2 & Lx \cdot Ly \\ Lx \cdot Ly & (Ly)^2 \end{bmatrix} \qquad J = \begin{bmatrix} 97.5 & 460.9 \\ (460.9) & 2179.0 \end{bmatrix} \frac{kN}{m}$$

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