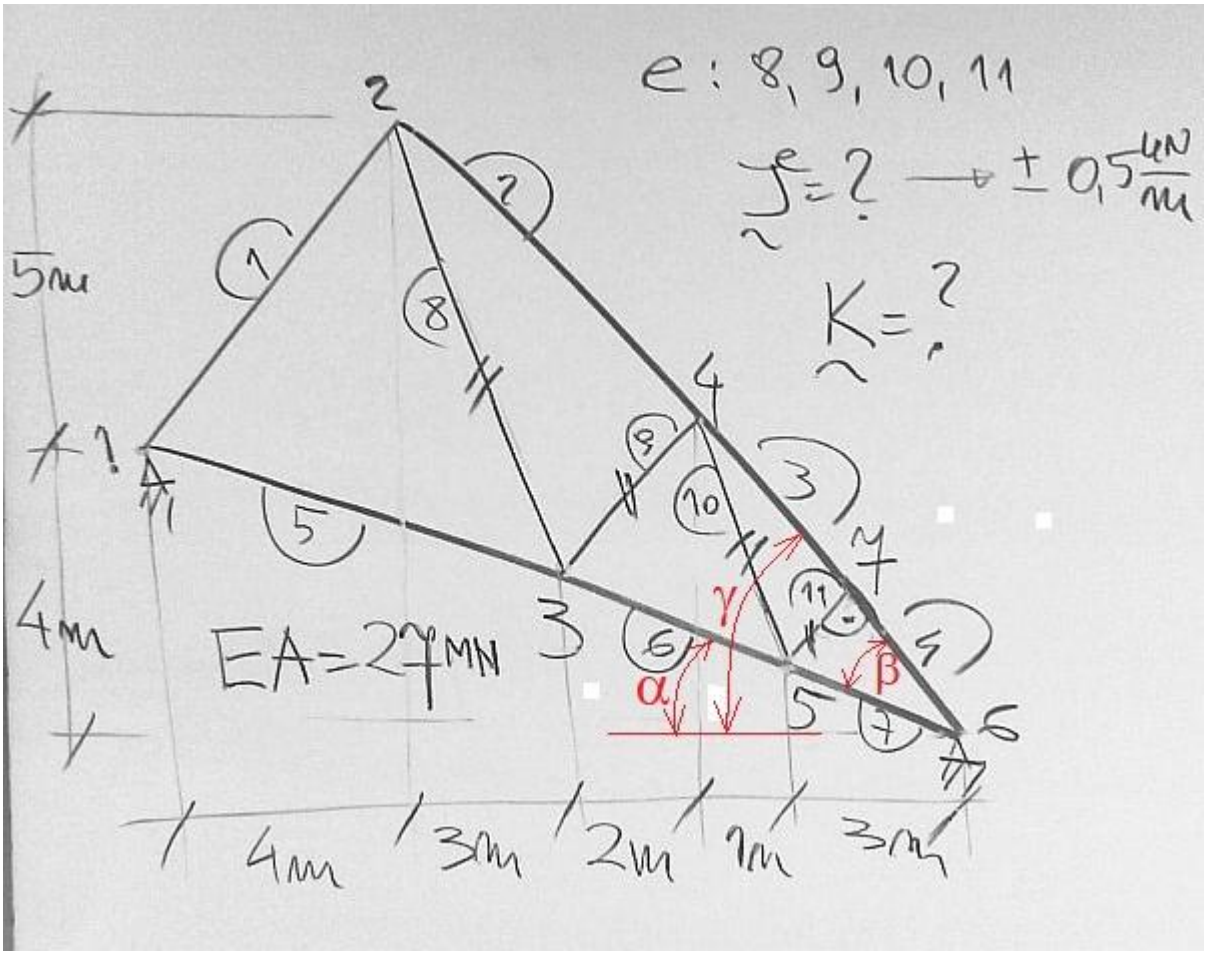
Macierze sztywności elementów kratownicy



elementy := (8 , 9 , 10 , 11) EA := 27MN

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

$\alpha := \operatorname{atan}\left(\frac{4}{13}\right) = 17.102729\cdot\mathrm{deg}$ $\gamma := \operatorname{atan}\left(\frac{9}{9}\right) = 45\cdot\mathrm{deg}$

$\beta := \gamma - \alpha = 27.897271\cdot\mathrm{deg}$ $L7 := \frac{3\mathrm{m}}{\cos(\alpha)} = 3.138801\,\mathrm{m}$

$L11 := L7\cdot\sin(\beta) = 1.468606\,\mathrm{m}$ $L4 := L7\cdot\cos(\beta) = 2.774034\,\mathrm{m}$

Element "8" - blok macierzy sztywności

$Lx := 3\mathrm{m}$ $Ly := -\left(5\mathrm{m} + \frac{7}{13}\cdot 4\mathrm{m}\right) = -7.153846\,\mathrm{m}$

$L := \sqrt{(Lx)^2 + (Ly)^2} = 7.757417\,\mathrm{m}$

$J := \frac{EA}{(L)^3}\cdot\begin{bmatrix}(Lx)^2 & Lx\cdot Ly\\ Lx\cdot Ly & (Ly)^2\end{bmatrix}$ $J = \begin{pmatrix}521 & -1241\\ -1241 & 2960\end{pmatrix}\cdot\frac{\mathrm{kN}}{\mathrm{m}}$

Element "9" - blok macierzy sztywności

$Lx := 2\mathrm{m}$ $Ly := 4\mathrm{m} - \frac{6}{13}\cdot 4\mathrm{m} = 2.153846\,\mathrm{m}$

$L := \sqrt{(Lx)^2 + (Ly)^2} = 2.939227\,\mathrm{m}$

$J := \frac{EA}{(L)^3}\cdot\begin{bmatrix}(Lx)^2 & Lx\cdot Ly\\ Lx\cdot Ly & (Ly)^2\end{bmatrix}$ $J = \begin{pmatrix}4253 & 4580\\ 4580 & 4933\end{pmatrix}\cdot\frac{\mathrm{kN}}{\mathrm{m}}$

Element "10" - blok macierzy sztywności

$Lx := 1\mathrm{m}$ $Ly := -\left(4\mathrm{m} - \frac{3}{13}\cdot 4\mathrm{m}\right) = -3.076923\,\mathrm{m}$

$L := \sqrt{(Lx)^2 + (Ly)^2} = 3.235345\,\mathrm{m}$

$J := \frac{EA}{(L)^3}\cdot\begin{bmatrix}(Lx)^2 & Lx\cdot Ly\\ Lx\cdot Ly & (Ly)^2\end{bmatrix}$ $J = \begin{pmatrix}797 & -2453\\ -2453 & 7548\end{pmatrix}\cdot\frac{\mathrm{kN}}{\mathrm{m}}$

Element "11" - blok macierzy sztywności

$Lx := L11\cdot\sin(\gamma) = 1.038462\,\mathrm{m}$ $Ly := L11\cdot\cos(\gamma) = 1.038462\,\mathrm{m}$

$L := \sqrt{(Lx)^2 + (Ly)^2} = 1.468606\,\mathrm{m}$

$J := \frac{EA}{(L)^3}\cdot\begin{bmatrix}(Lx)^2 & Lx\cdot Ly\\ Lx\cdot Ly & (Ly)^2\end{bmatrix}$ $J = \begin{pmatrix}9192 & 9192\\ 9192 & 9192\end{pmatrix}\cdot\frac{\mathrm{kN}}{\mathrm{m}}$