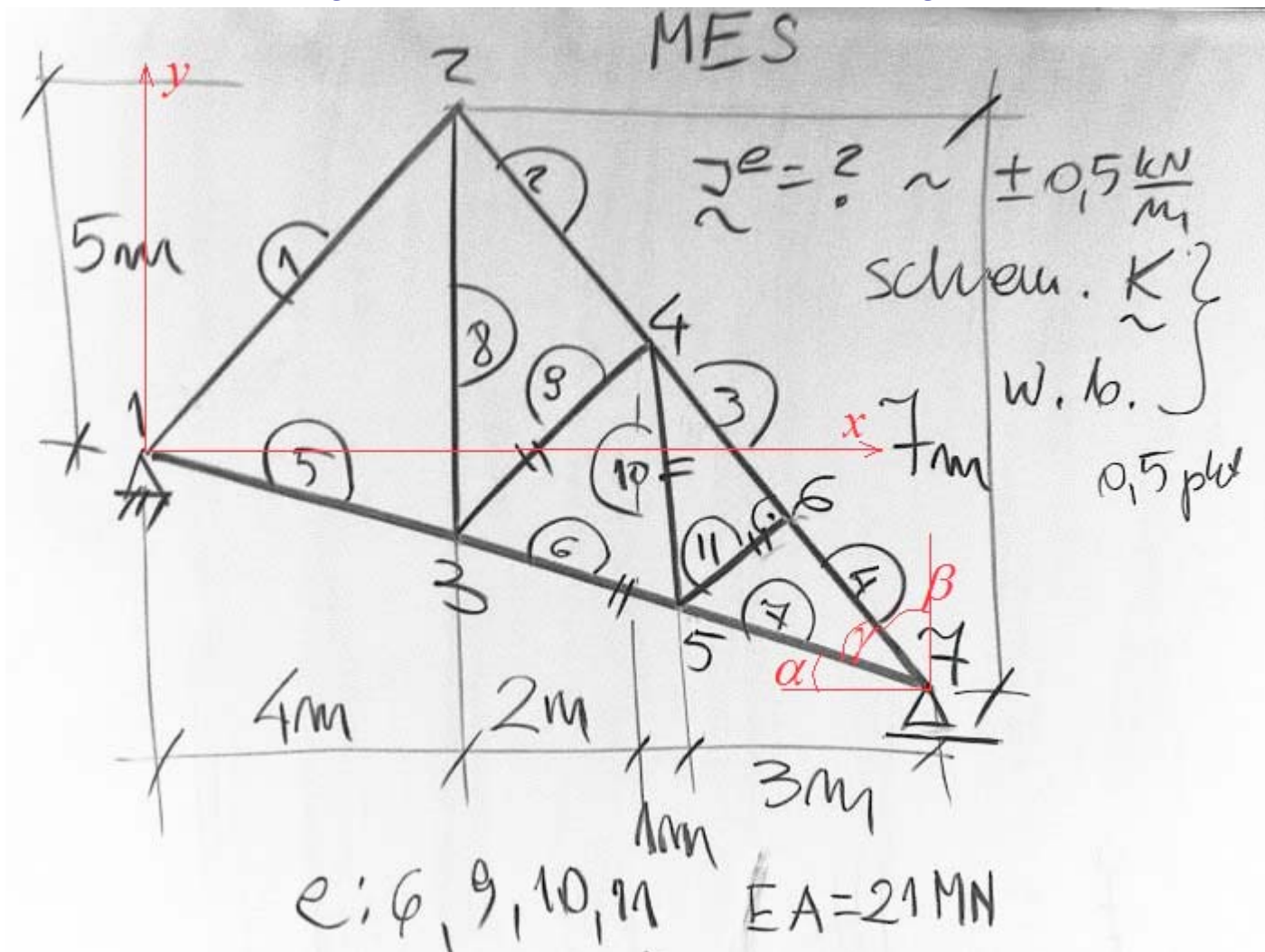


K1 - Macierze sztywności elementów kratownicy



elementy := (6, 9, 10, 11) $EA := 21 \text{ MN}$ *dokładność $\pm 0.5 \text{ kN/m}$*

$$\alpha := \text{atan}\left(\frac{2}{10}\right) = 11.31 \cdot \text{deg}$$

$$\beta := \text{atan}\left(\frac{6}{7}\right) = 40.601 \cdot \text{deg}$$

$$\gamma := \frac{\pi}{2} - \beta - \alpha = 38.08877 \cdot \text{deg}$$

$$L7 := \frac{3 \text{ m}}{\cos(\alpha)} = 3.05941 \text{ m}$$

$$L4 := L7 \cdot \cos(\gamma) = 2.40793 \text{ m}$$

$$L11 := L7 \cdot \sin(\gamma) = 1.88729 \text{ m}$$

$$Y3 := -2 \text{ m} \cdot 0.4 = -0.8 \text{ m}$$

$$Y5 := -2 \text{ m} \cdot 0.7 = -1.4 \text{ m}$$

$$Y4 := 7 \text{ m} \cdot \frac{4}{6} - 2 \text{ m}$$

$$X6 := 10 \text{ m} - L4 \cdot \sin(\beta) = 8.43294 \text{ m}$$

$$Y6 := -2 \text{ m} + L4 \cdot \cos(\beta) = -0.17176 \text{ m}$$

Warunki brzegowe:

$$u_{x1} = 0$$

$$u_{y1} = 0$$

$$u_{y7} = 0$$

Element "6" - blok macierzy sztywności

$$L_x := 3\text{m} = 3.00000\text{m}$$

$$L_y := Y_5 - Y_3 = -0.60000\text{m}$$

$$L := \sqrt{(L_x)^2 + (L_y)^2} = 3.059412\text{m}$$

$$J := \frac{EA}{(L)^3} \cdot \begin{bmatrix} (L_x)^2 & L_x \cdot L_y \\ L_x \cdot L_y & (L_y)^2 \end{bmatrix} \quad J = \begin{bmatrix} 6600 & -1320 \\ (-1320) & 264 \end{bmatrix} \frac{\text{kN}}{\text{m}}$$

Element "9" - blok macierzy sztywności

$$L_x := 2\text{m} = 2\text{m}$$

$$L_y := Y_4 - Y_3 = 3.466667\text{m}$$

$$L := \sqrt{(L_x)^2 + (L_y)^2} = 4.002222\text{m}$$

$$J := \frac{EA}{(L)^3} \cdot \begin{bmatrix} (L_x)^2 & L_x \cdot L_y \\ L_x \cdot L_y & (L_y)^2 \end{bmatrix} \quad J = \begin{bmatrix} 1310 & 2271 \\ (2271) & 3937 \end{bmatrix} \frac{\text{kN}}{\text{m}}$$

Element "10" - blok macierzy sztywności

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

$$L_y := Y_5 - Y_4 = -4.066667\text{m}$$

$$L := \sqrt{(L_x)^2 + (L_y)^2} = 4.187813\text{m}$$

$$J := \frac{EA}{(L)^3} \cdot \begin{bmatrix} (L_x)^2 & L_x \cdot L_y \\ L_x \cdot L_y & (L_y)^2 \end{bmatrix} \quad J = \begin{bmatrix} 286 & -1163 \\ (-1163) & 4729 \end{bmatrix} \frac{\text{kN}}{\text{m}}$$

Element "11" - blok macierzy sztywności

$$L_x := X_6 - 7\text{m} = 1.432941\text{m}$$

$$L_y := Y_6 - Y_5 = 1.228235\text{m}$$

$$L := \sqrt{(L_x)^2 + (L_y)^2} = 1.887295\text{m}$$

$$J := \frac{EA}{(L)^3} \cdot \begin{bmatrix} (L_x)^2 & L_x \cdot L_y \\ L_x \cdot L_y & (L_y)^2 \end{bmatrix} \quad J = \begin{bmatrix} 6414 & 5498 \\ (5498) & 4713 \end{bmatrix} \frac{\text{kN}}{\text{m}}$$

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