

ORIGIN := 1

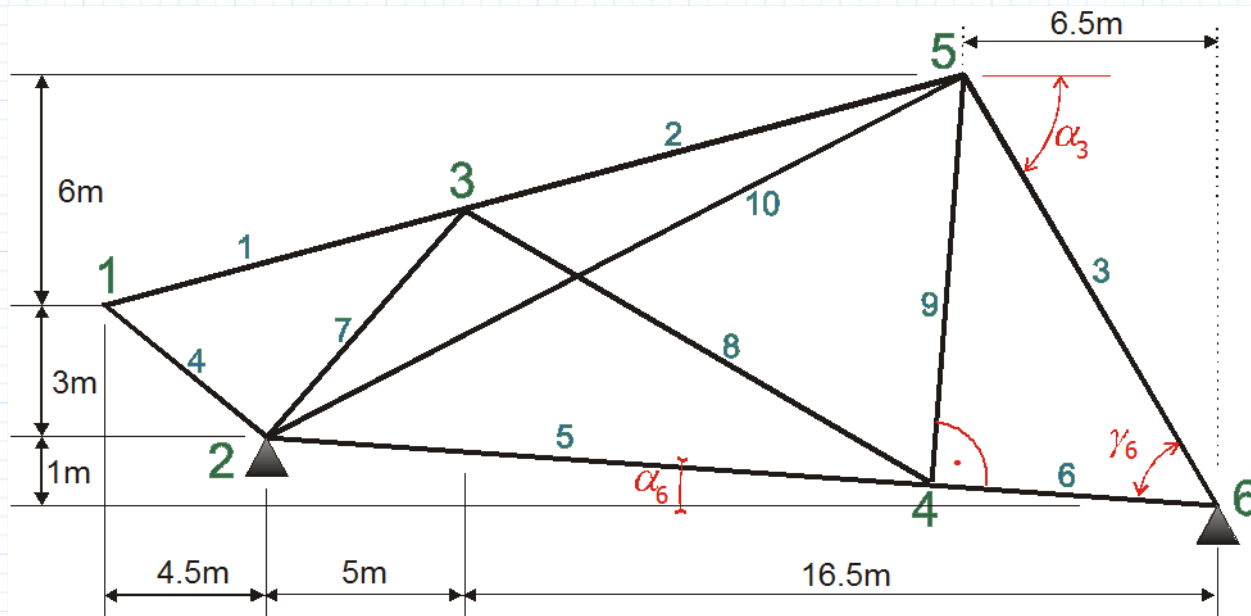
$EA := 28 \text{ MN}$

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

$$J(Lx, Ly) := \frac{EA}{L(Lx, Ly)^3} \begin{bmatrix} Lx^2 & Lx \cdot Ly \\ Lx \cdot Ly & Ly^2 \end{bmatrix}$$

A1

Wyznaczyć bloki **J** macierzy sztywności elementów (2,7,9,10) kratownicy płaskiej.
Sładowe macierze podać z dokładnością do +/- 0.05 kN/m



$$Y4 := l6 \cdot \sin(\alpha6) = 0.32326 \text{ m}$$

$$\alpha3 := \text{atan}\left(\frac{10}{6.5}\right) = 56.97613 \text{ deg}$$

$$\alpha6 := \text{atan}\left(\frac{1}{21.5}\right) = 2.66300 \text{ deg}$$

$$\gamma6 := \alpha3 - \alpha6 = 54.31313 \text{ deg}$$

$$l3 := \sqrt{6.5^2 + 10^2} \text{ m}$$

$$l3 = 11.92686 \text{ m}$$

$$l6 := l3 \cdot \cos(\gamma6) = 6.95759 \text{ m}$$

$$X4 := 26 \text{ m} - l6 \cdot \cos(\alpha6) = 19.04992 \text{ m}$$

Element "2"

$$Lx := 10 \text{ m}$$

$$Ly := 6 \text{ m} \cdot \frac{10}{19.5} = 3.07692 \text{ m}$$

$$L := \sqrt{(Lx)^2 + (Ly)^2} = 10.462670 \text{ m}$$

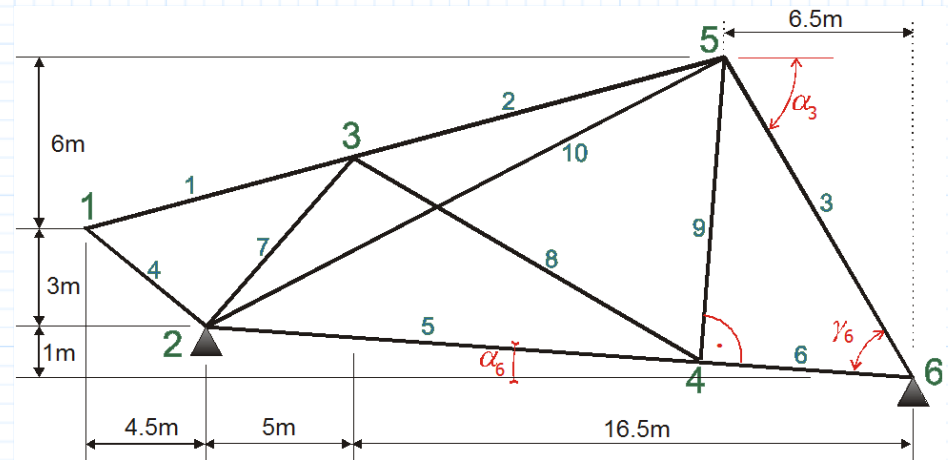
$$J^2 = \begin{bmatrix} 2444.7 & 752.2 \\ 752.2 & 231.5 \end{bmatrix} \frac{kN}{m}$$

Element "7"

$$Lx := 5 \text{ m} \quad Ly := \left(3 + 6 \cdot \frac{9.5}{19.5} \right) \text{ m} = 5.923077 \text{ m}$$

$$L := \sqrt{(Lx)^2 + (Ly)^2} = 7.751312 \text{ m}$$

$$J^7 = \begin{bmatrix} 1503 & 1780.5 \\ 1780.5 & 2109.2 \end{bmatrix} \frac{kN}{m}$$



Element "9"

$$Lx := 19.5 \text{ m} - X4 = 0.450081 \text{ m}$$

$$Ly := 10 \text{ m} - Y4 = 9.67674 \text{ m}$$

$$L := \sqrt{(Lx)^2 + (Ly)^2} = 9.687202 \text{ m}$$

$$J^9 = \begin{bmatrix} 6.2 & 134.1 \\ 134.1 & 2884.2 \end{bmatrix} \frac{kN}{m}$$

Element "10"

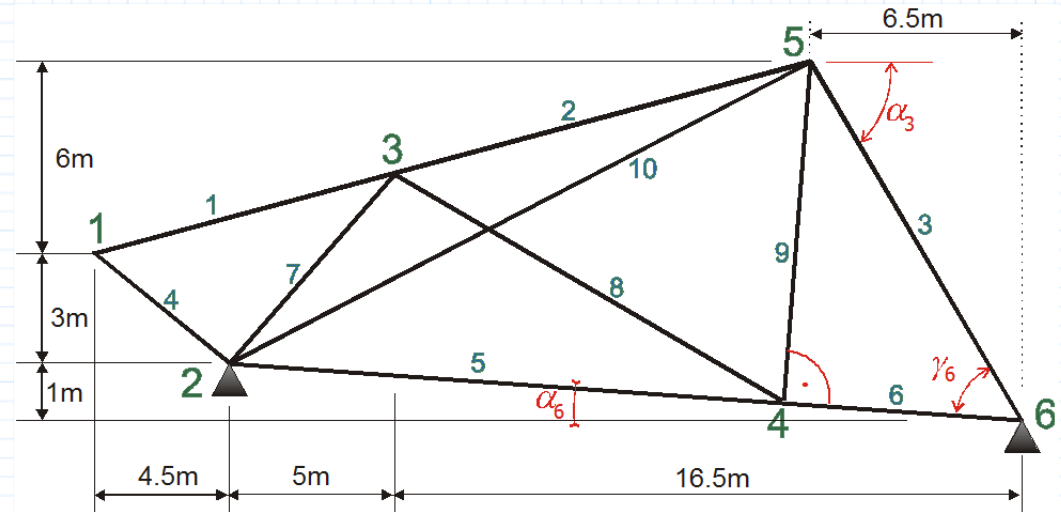
$$Lx := 15 \text{ m}$$

$$Ly := 9 \text{ m}$$

$$L := \sqrt{(Lx)^2 + (Ly)^2} = 17.492856 \text{ m}$$

$$J^{10} = \begin{bmatrix} 1177 & 706.2 \\ 706.2 & 423.7 \end{bmatrix} \frac{kN}{m}$$

$$O := \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix} \frac{kN}{m} \quad \leftarrow \text{Blok "zerowy"}$$



Schemat agregacji macierzy sztywności kratownicy

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