

ORIGIN := 1

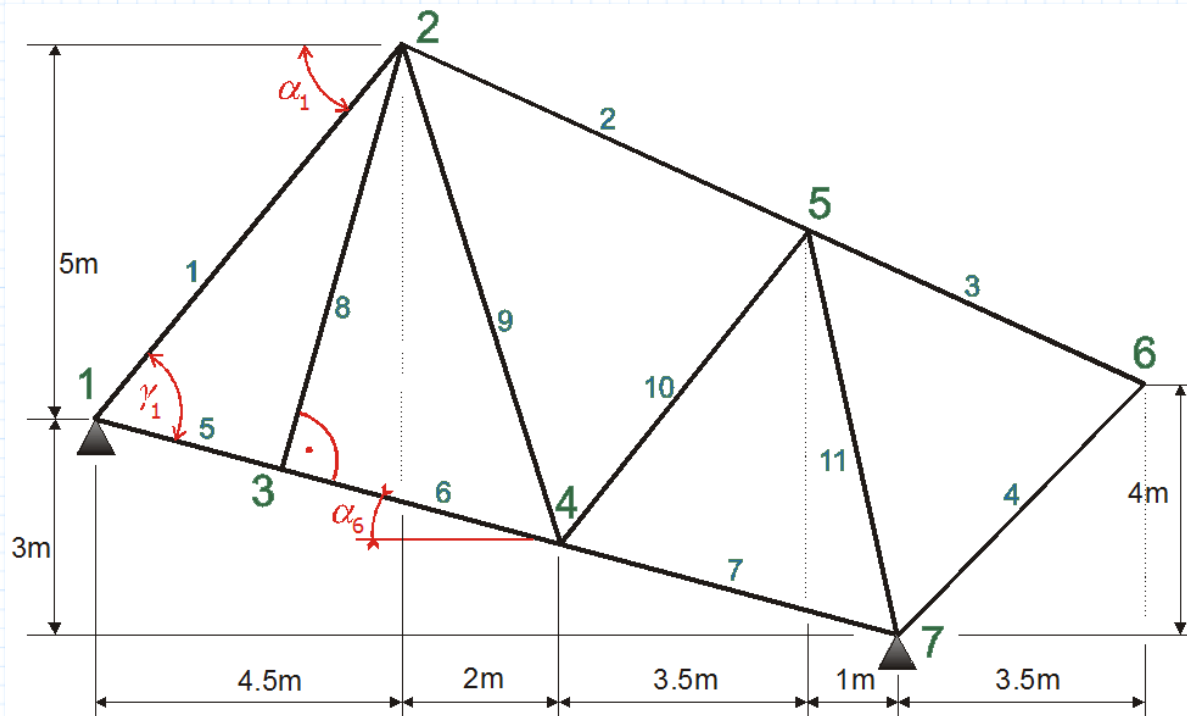
B2

$EA := 28 \text{ MN}$

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

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

Wyznaczyć bloki **J** macierzy sztywności elementów (1,2,8,10) kratownicy płaskiej.
Sładowe macierze podać z dokładnością do +/- 0.05 kN/m



$$\alpha_1 := \text{atan}\left(\frac{5}{4.5}\right) = 48.01279 \text{ deg}$$

$$\alpha_6 := \text{atan}\left(\frac{3}{11}\right) = 15.25512 \text{ deg}$$

$$\gamma_1 := \alpha_1 + \alpha_6 = 63.26791 \text{ deg}$$

$$l_1 := \sqrt{4.5^2 + 5^2} \text{ m} = 6.72681 \text{ m}$$

$$l_5 := l_1 \cdot \cos(\gamma_1) = 3.02585 \text{ m}$$

$$X_3 := l_5 \cdot \cos(\alpha_6) = 2.91923 \text{ m}$$

$$Y_3 := -l_5 \cdot \sin(\alpha_6) = -0.79615 \text{ m}$$

$$Y_5 := 5 \text{ m} - 4 \text{ m} \cdot \frac{5.5}{10} = 2.80000 \text{ m}$$

$$Y_4 := -3 \text{ m} \cdot \frac{6.5}{11} = -1.77273 \text{ m}$$

Element "1"

$$Lx := 4.5 \text{ m}$$

$$Ly := 5 \text{ m} = 5 \text{ m}$$

$$L := \sqrt{(Lx)^2 + (Ly)^2} = 6.726812 \text{ m}$$

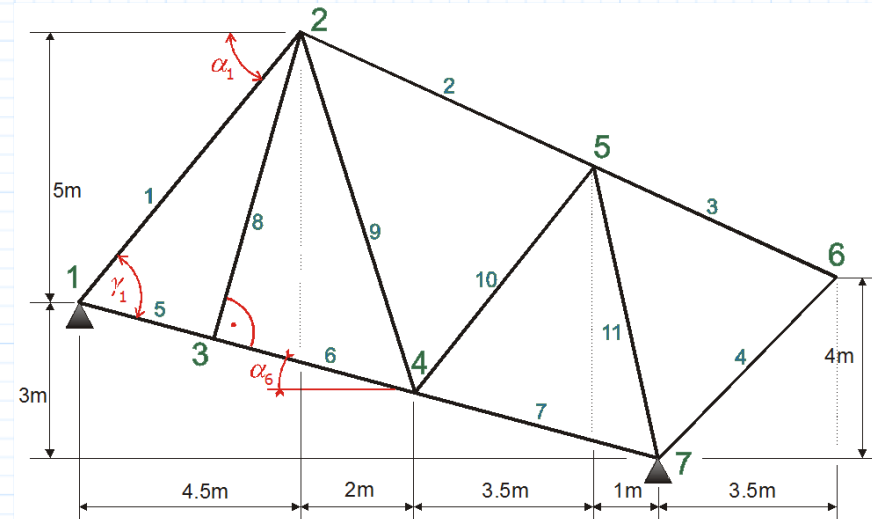
$$J^1 = \begin{bmatrix} 1862.8 & 2069.7 \\ 2069.7 & 2299.7 \end{bmatrix} \frac{kN}{m}$$

Element "2"

$$Lx := 5.5 \text{ m} \quad Ly := -4 \text{ m} \cdot \frac{5.5}{10} = -2.200000 \text{ m}$$

$$L := \sqrt{(Lx)^2 + (Ly)^2} = 5.923681 \text{ m}$$

$$J^2 = \begin{bmatrix} 4074.8 & -1629.9 \\ -1629.9 & 652.0 \end{bmatrix} \frac{kN}{m}$$



Element "8"

$$Lx := 4.5 \text{ m} - X3 = 1.580769 \text{ m}$$

$$Ly := 5 \text{ m} - Y3 = 5.796154 \text{ m}$$

$$L := \sqrt{(Lx)^2 + (Ly)^2} = 6.007847 \text{ m}$$

$$J^8 = \begin{bmatrix} 322.7 & 1183.1 \\ 1183.1 & 4337.9 \end{bmatrix} \frac{kN}{m}$$

Element "10"

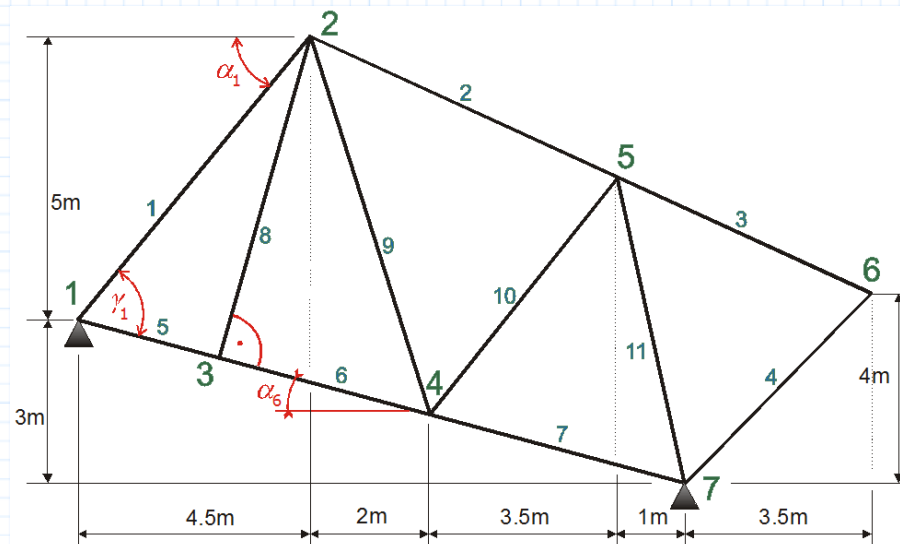
$$Lx := 3.5 \text{ m} = 3.5 \text{ m}$$

$$Ly := Y5 - Y4 = 4.572727 \text{ m}$$

$$L := \sqrt{(Lx)^2 + (Ly)^2} = 5.758458 \text{ m}$$

$$J^{10} = \begin{bmatrix} 1796.3 & 2346.8 \\ 2346.8 & 3066.1 \end{bmatrix} \frac{\text{kN}}{\text{m}}$$

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



Schemat agregacji macierzy sztywności kratownicy

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