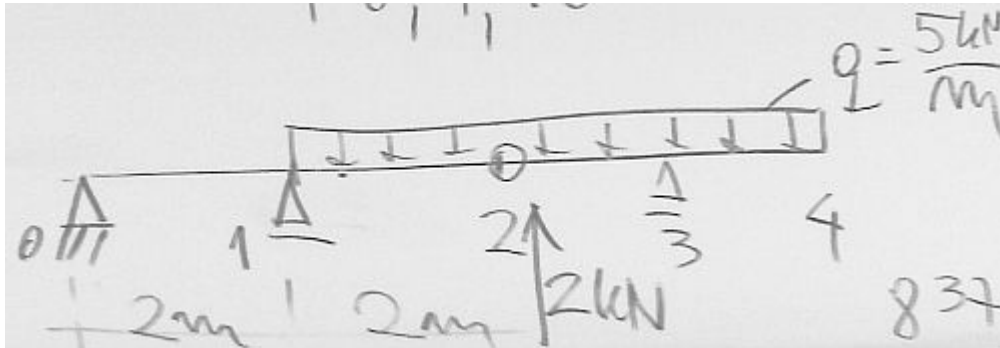


## Metoda różnic skończonych - ugięcie belki



$$P := 2\text{ kN} \quad q := 5 \frac{\text{kN}}{\text{m}} \quad E := 15\text{ GPa}$$

$$L := 8\text{ m} \quad b := 10\text{ cm} \quad h := 15\text{ cm} \quad J := b \cdot \frac{h^3}{12} = 2.813 \times 10^3 \cdot \text{cm}^4$$

$$R3 := q \cdot 4\text{ m} = 20 \cdot \text{kN} \quad R0 := P - q \cdot 1\text{ m} = -3 \text{ kN} \quad R1 := q \cdot 6\text{ m} - P - R0 - R3 = 11 \text{ kN}$$

$$n := 4 \quad \Delta := \frac{L}{n} = 2\text{ m} \quad \alpha := \frac{\Delta^2}{E \cdot J} \quad \alpha = 9.481 \cdot \frac{1}{\text{MN}}$$

$$M1(x) := R0 \cdot x \quad M2(x) := M1(x) - q \cdot \frac{(x - 2\text{ m})^2}{2} + R1 \cdot (x - 2\text{ m})$$

$$M3(x) := M2(x) + P \cdot (x - 4\text{ m}) \quad M4(x) := M3(x) + R3 \cdot (x - 6\text{ m})$$

$$i := 0..n \quad X_i := i \cdot \Delta$$

$$i := 0..1 \quad M_i := M1(X_i)$$

$$i := 1..2 \quad M_i := M2(X_i)$$

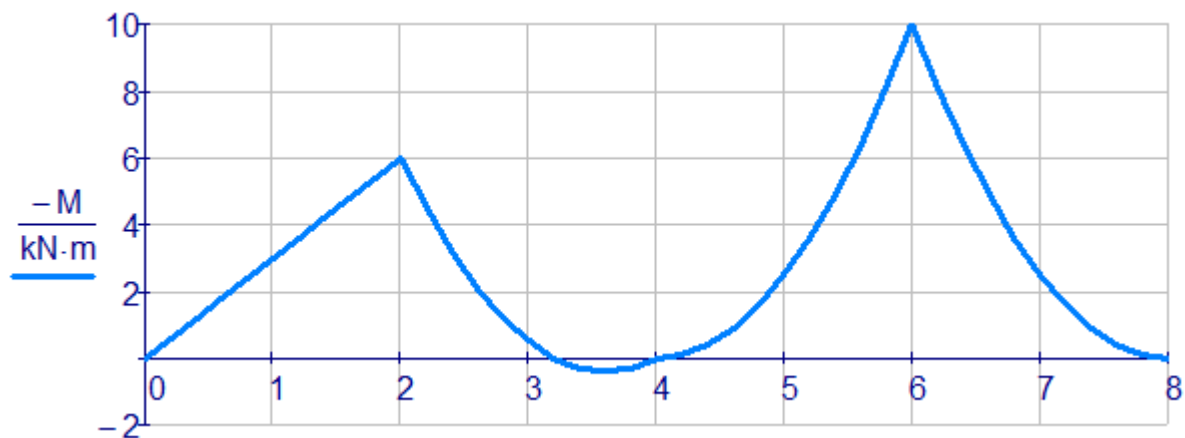
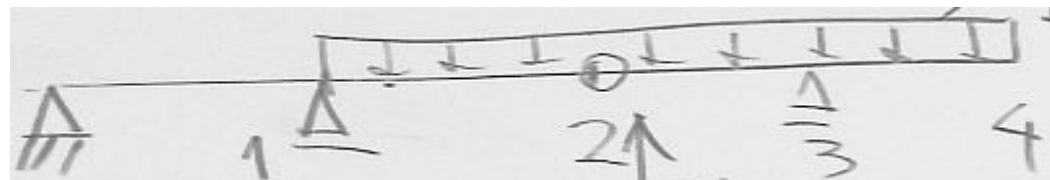
$$i := 2..3 \quad M_i := M3(X_i)$$

$$i := 3..n \quad M_i := M4(X_i)$$

$$M = \begin{array}{|c|c|} \hline & 0 \\ \hline 0 & 0 \\ \hline 1 & -6 \\ \hline 2 & 0 \\ \hline 3 & -10 \\ \hline 4 & 0 \\ \hline \end{array} \cdot \text{kN} \cdot \text{m} \quad X = \begin{array}{|c|c|} \hline & 0 \\ \hline 0 & 0 \\ \hline 1 & 2 \\ \hline 2 & 4 \\ \hline 3 & 6 \\ \hline 4 & 8 \\ \hline \end{array} \text{m}$$

*Równania MRS*

$$M = \begin{array}{|c|c|} \hline & 0 \\ \hline 0 & 0 \\ \hline 1 & -6 \\ \hline 2 & 0 \\ \hline 3 & -10 \\ \hline 4 & 0 \\ \hline \end{array} \cdot \text{kN} \cdot \text{m} \quad y = \begin{array}{|c|c|} \hline & 0 \\ \hline 0 & 0.0 \\ \hline 1 & 0.0 \\ \hline 2 & -56.9 \\ \hline 3 & 0.0 \\ \hline 4 & -37.9 \\ \hline \end{array} \cdot \text{mm}$$



$$y_0 = 0 \quad y_1 = 0 \quad y_3 = 0$$

$$y_0 - 2y_1 + y_2 = \alpha M_1$$

$$y_2 - 2y_3 + y_4 = \alpha M_3$$

$$\alpha = 9.48148 \frac{1}{\text{MN}}$$