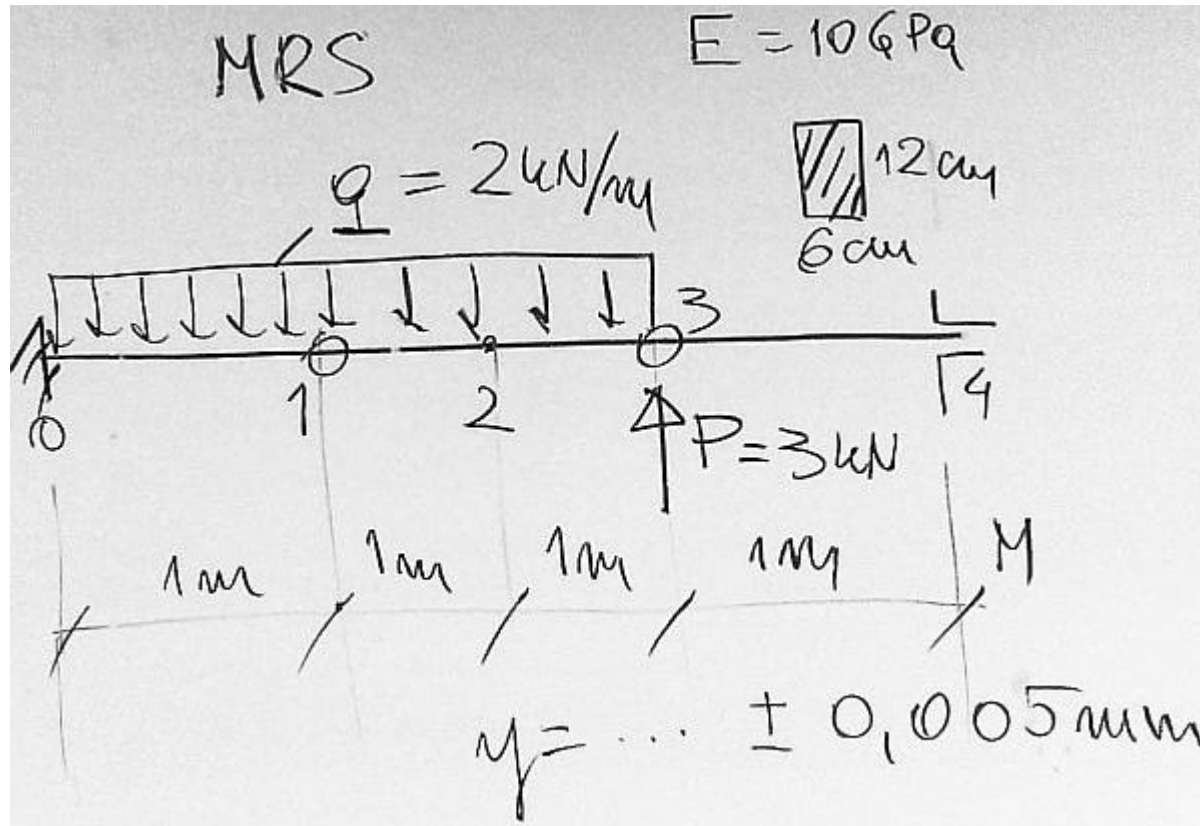


Metoda różnic skończonych - ugięcie belki



$$P := 3 \text{ kN} \quad q := 2 \frac{\text{kN}}{\text{m}} \quad E := 10 \text{ GPa}$$

$$L := 4 \text{ m} \quad b := 6 \text{ cm} \quad h := 12 \text{ cm} \quad J := b \cdot \frac{h^3}{12} = 864 \text{ cm}^4$$

$$T1 := \frac{q \cdot 2 \text{ m}}{2} = 2 \cdot \text{kN} \quad T3 := T1 \quad R0 := q \cdot 1 \text{ m} + T1 = 4 \cdot \text{kN} \quad R4 := T3 - P = -1 \cdot \text{kN}$$

$$M0 := q \cdot 1 \text{ m} \cdot 0.5 \text{ m} + T1 \cdot 1 \text{ m} = 3 \cdot \text{kN} \cdot \text{m} \quad M4 := T3 \cdot 1 \text{ m} - P \cdot 1 \text{ m} = -1 \cdot \text{kN} \cdot \text{m}$$

$$n := 4 \quad \Delta := \frac{L}{n} = 1 \text{ m} \quad \alpha := \frac{\Delta^2}{E \cdot J} \quad \alpha = 11.574 \cdot \frac{1}{\text{MN}}$$

$$M1(x) := R0 \cdot x - M0 - q \cdot \frac{x^2}{2}$$

$$M2(x) := R4 \cdot (L - x) - M4$$

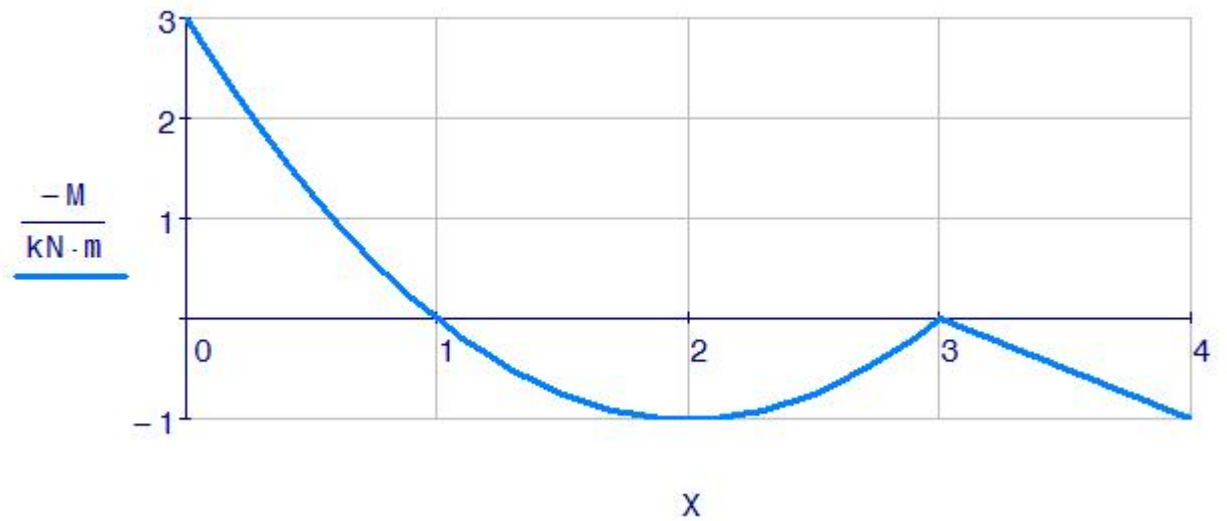
$$i := 0 .. n$$

$$X_i := i \cdot \Delta$$

$$i := 0 .. 3 \quad M_i := M1(X_i)$$

$$i := 3 .. n \quad M_i := M2(X_i)$$

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



Równania MRS

$$y_0 = 0 \quad \varphi_0 = 0$$

$$y_4 = 0 \quad \varphi_4 = 0$$

$$-2 y_0 + 2 y_1 = \alpha M_0$$

$$2 y_1 = \alpha M_0$$

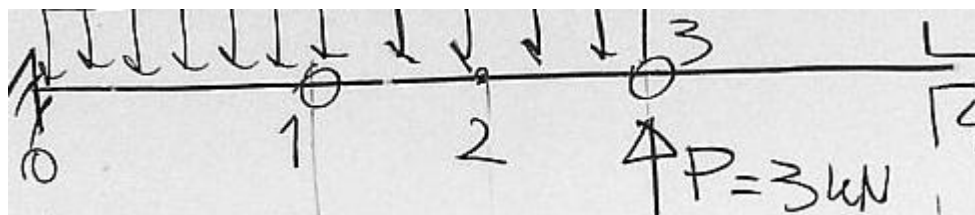
$$-2 y_4 + 2 y_3 = \alpha M_4$$

$$2 y_3 = \alpha M_4$$

$$y_1 - 2 y_2 + y_3 = \alpha M_2 \quad \text{-----} \rightarrow \quad y_1 - 2 y_2 + y_3 = \alpha M_2$$

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

$$\alpha = 11.574 \cdot \frac{1}{\text{MN}}$$



$$y = \begin{array}{|c|c|} \hline & 0 \\ \hline 0 & 0.00 \\ \hline 1 & -17.36 \\ \hline 2 & -11.57 \\ \hline 3 & 5.79 \\ \hline 4 & 0.00 \\ \hline \end{array} \cdot \text{mm}$$
