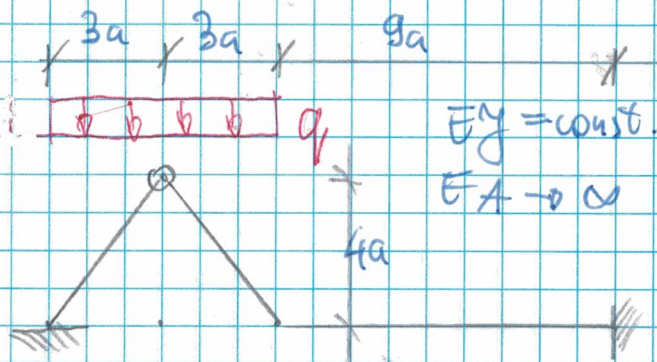
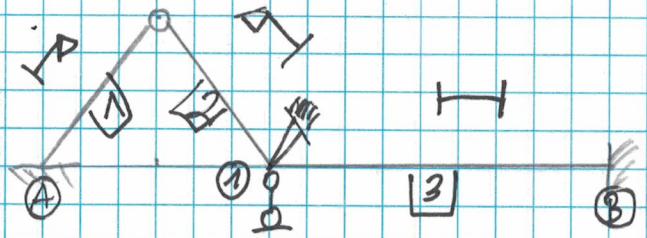


$M_A = ?$

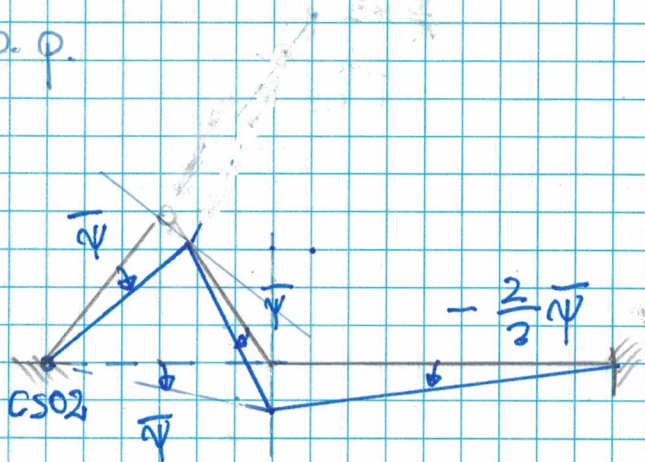


UGW



p.p.

r.r. NP

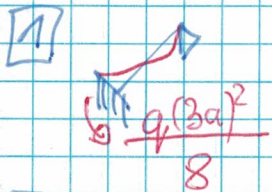


$$\bar{I}_1^{(1)} + \bar{I}_1^{(3)} = 0$$

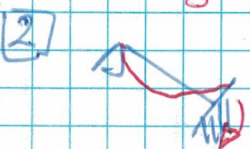
$$\bar{I}_A^{(1)} \psi + \bar{I}_1^{(2)} \psi + (\bar{I}_1^{(3)} + \bar{I}_B^{(3)}) \left(-\frac{2}{5}\psi\right) + \bar{I}_{abc} = 0$$

$$\bar{I}_{abc} = 3qa \cdot \psi \cdot \frac{3}{2}a + 3qa \cdot \left(\psi \cdot 3a + \psi \cdot \frac{3}{2}a\right) = 18qa^2 \psi$$

WT



$$\bar{I}_A^{(1)} = \frac{3EY}{5a} [-\psi] + \frac{9}{8} qa^2 = \frac{EY}{a} \left[-\frac{3}{5}\psi\right] - \frac{9}{8} qa^2 \cdot (-1)$$



$$\bar{I}_1^{(2)} = \frac{3EY}{5a} [\psi_1 - \psi] + \frac{9}{8} qa^2 = \frac{EY}{a} \left[\frac{3}{5}\psi_1 - \frac{3}{5}\psi\right] + \frac{9}{8} qa^2 \cdot (-1)$$

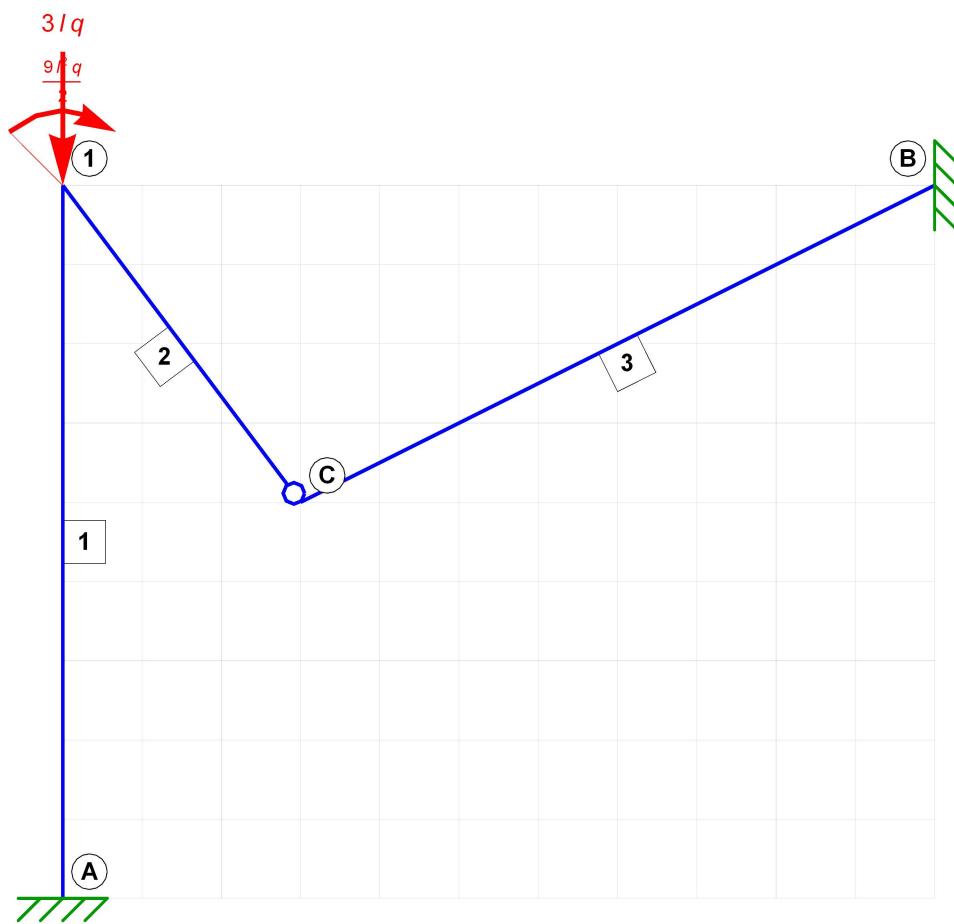


$$\bar{I}_1^{(3)} = \frac{2EY}{9a} \left[2\psi_1 - 3\left(-\frac{2}{5}\psi\right)\right] = \frac{EY}{a} \left[\frac{4}{9}\psi_1 + \frac{4}{9}\psi\right]$$

$$\bar{I}_B^{(3)} = \frac{EY}{a} \left[\frac{2}{9}\psi_1 + \frac{4}{9}\psi\right] \cdot \left(\frac{2}{3}\right)$$

$$\frac{EY}{a} \begin{bmatrix} \frac{3}{5} + \frac{4}{9} & -\frac{3}{5} + \frac{4}{9} \\ -\frac{3}{5} + \frac{4}{9} & \frac{3}{5} + \frac{3}{5} + \frac{8}{9} \cdot \frac{2}{3} \end{bmatrix} \begin{bmatrix} \psi_1 \\ \psi \end{bmatrix} = \begin{bmatrix} -\frac{9}{8} \\ -\frac{9}{8} \end{bmatrix} qa^2$$

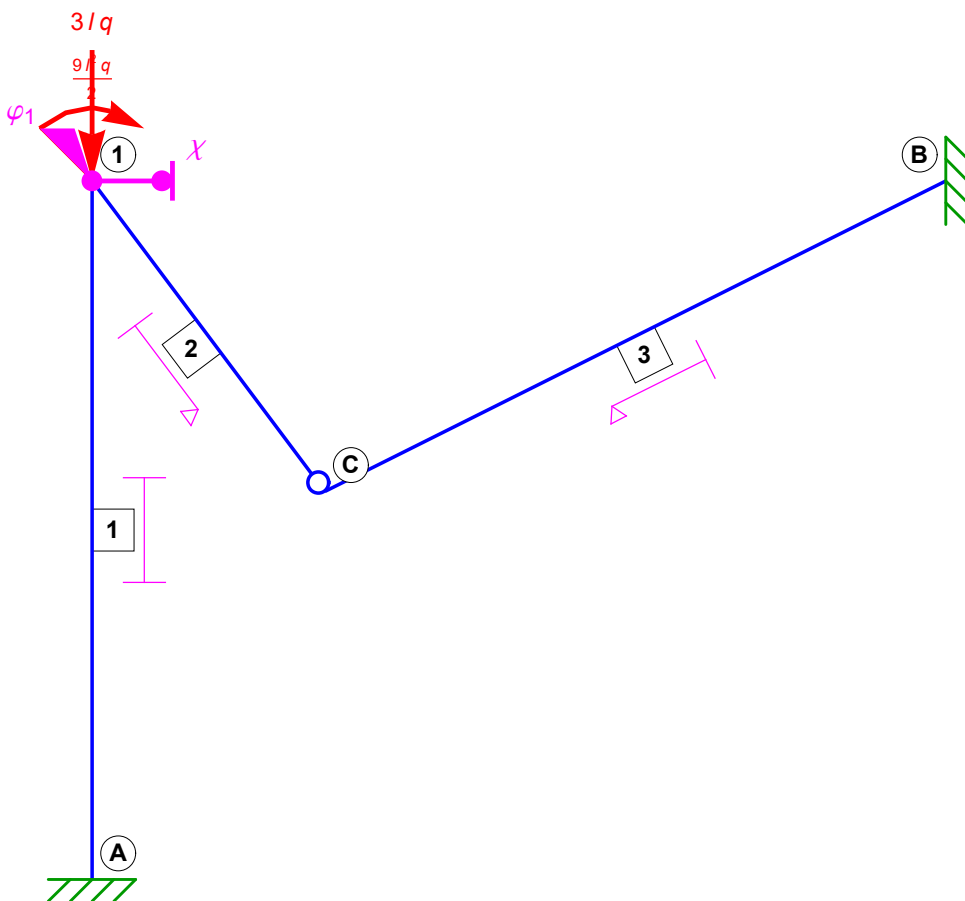
$\psi_1 = 0,424 \frac{qa^3}{EY}$
 $\psi = 10,078 \frac{qa^3}{EY}$
 $M_A = \bar{I}_A^{(1)} = \frac{EY}{a} \left[-\frac{3}{5} \cdot 10,078 \frac{qa^3}{EY} - \frac{9}{8} qa^2\right] = -17,172 qa^2$



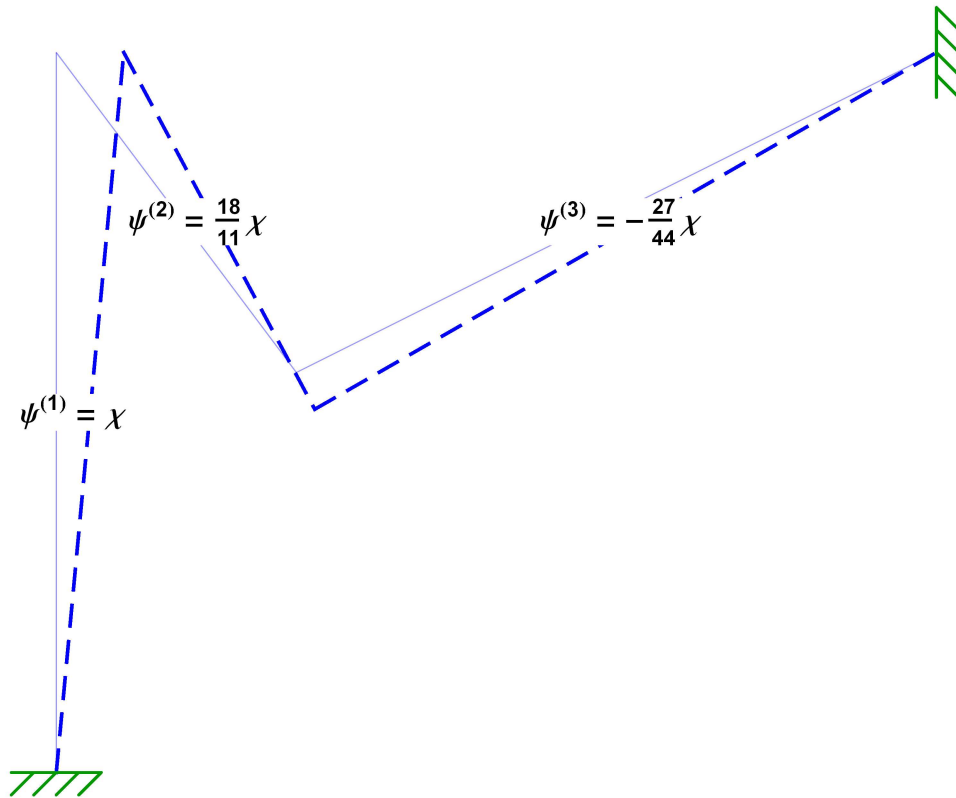
Wektor niewiadomych:

$$\mathbf{q} = \begin{pmatrix} \varphi_1 \\ \chi \end{pmatrix}$$

Układ geometrycznie wyznaczalny:



Plan przemieszczeń:



$$\psi^{(1)} = \chi$$

$$\psi^{(2)} = \frac{18}{11} \chi$$

$$\psi^{(3)} = -\frac{27}{44} \chi$$

W konstrukcji nie występują wyjściowe siły brzegowe.

Wzory transformacyjne:

$$\Phi_A^1 = \frac{EJ}{1} \left[\frac{2}{9} \varphi_1 - \frac{2}{3} \chi \right]$$

$$\Phi_1^1 = \frac{EJ}{1} \left[\frac{4}{9} \varphi_1 - \frac{2}{3} \chi \right]$$

$$\Phi_1^2 = \frac{EJ}{1} \left[\frac{3}{5} \varphi_1 - \frac{54}{55} \chi \right]$$

$$\Phi_B^3 = \frac{EJ}{1} \left[\frac{81}{176\sqrt{5}} \chi \right]$$

Równania równowagi:

$$\Phi_1^1 + \Phi_1^2 - \frac{9}{2} l^2 q = 0$$

$$\left(\Phi_A^1 + \Phi_1^1 \right) \bar{\chi} + \Phi_1^2 \cdot \frac{18}{11} \bar{\chi} + \Phi_B^3 \cdot \left(-\frac{27}{44} \bar{\chi} \right) = \bar{0}$$

$$\frac{EJ}{1} \begin{pmatrix} \frac{47}{45} & -\frac{272}{165} \\ -\frac{272}{165} & \frac{5336}{1815} + \frac{2187}{7744\sqrt{5}} \end{pmatrix} \begin{pmatrix} \varphi_1 \\ \chi \end{pmatrix} = l^2 q \begin{pmatrix} \frac{9}{2} \\ 0 \end{pmatrix}$$

Rozwiązanie metody przemieszczeń:

$$\mathbf{q} = \begin{pmatrix} \varphi_1 \\ \chi \end{pmatrix} = \frac{l^3 q}{EJ} \begin{pmatrix} 28.449 \\ 15.295 \end{pmatrix}$$

Momenty brzegowe:

$$\Phi_A^1 = -3.875 \text{ l}^2 \text{ q}$$

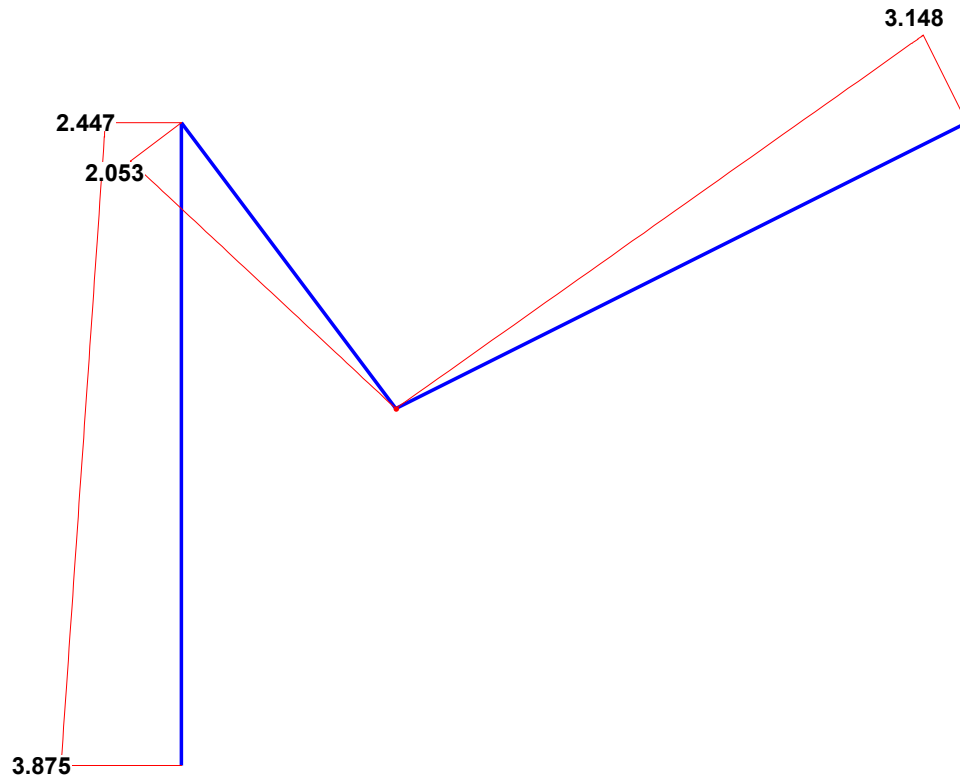
$$\Phi_1^1 = 2.447 \text{ l}^2 \text{ q}$$

$$\Phi_1^2 = 2.053 \text{ l}^2 \text{ q}$$

$$\Phi_B^3 = 3.148 \text{ l}^2 \text{ q}$$

Wykres momentów zginających:

$M[\text{l}^2 \text{ q}]$:



Deformacja konstrukcji:

