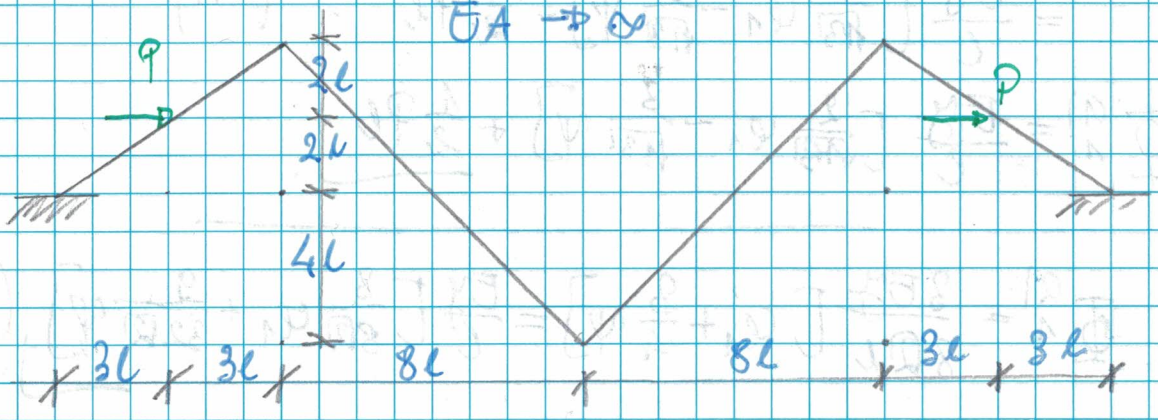
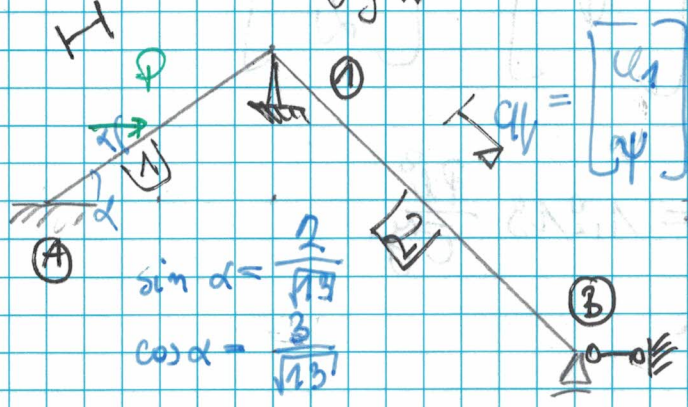
Kolokwium 2.1. MK1 r.a. 2023/2024

$EJ = const.$

$EA \to \infty$

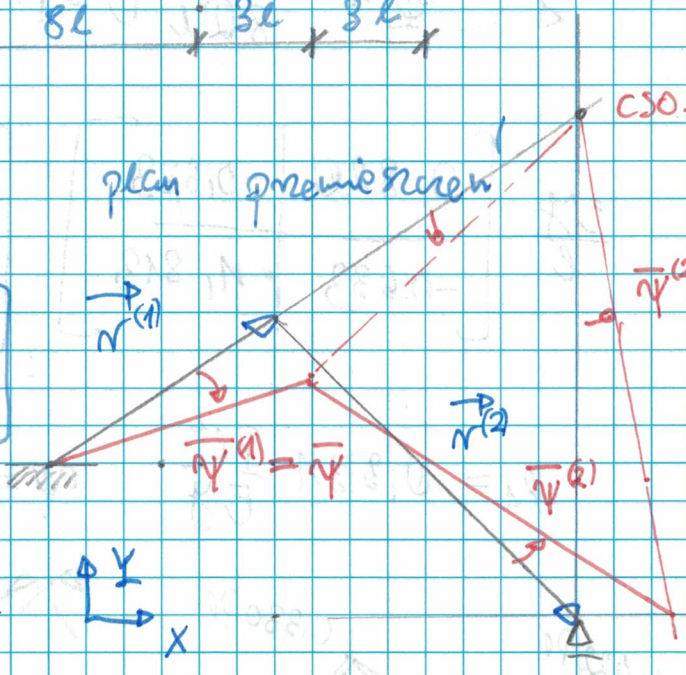


Schemat podbudowy



$\overline{q} = \begin{bmatrix} \overline{\varepsilon_1} \\ \overline{\psi} \end{bmatrix}$

plan przemieszczeń



$\vec{r}^{(1)} = [6l, 4l]$ $\quad \vec{r}^{(2)} = [8l, -8l]$

met. analityczna

$0 = 0 - 6l\overline{\psi}^{(1)} - 8l\overline{\psi}^{(2)}$ $\quad \overline{\psi}^{(1)} = \overline{\psi}$ $\quad \overline{\psi}^{(2)} = -\frac{3}{4}\overline{\psi}$

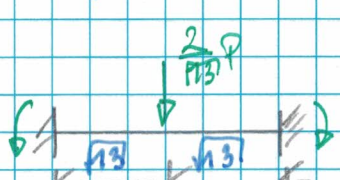
r. r. MP

$$\overline{\Phi}_1^{(1)} + \overline{\Phi}_1^{(2)} = 0 \quad (1)$$

$$\left(\overline{\Phi}_A^{(1)} + \overline{\Phi}_1^{(1)}\right)\overline{\psi} + \overline{\Phi}_1^{(2)}\left(-\frac{3}{4}\overline{\psi}\right) + P \cdot \overline{\psi} \cdot 2l = 0 \qquad \overline{\psi} = -1$$

$$-\left(\overline{\Phi}_A^{(1)} + \overline{\Phi}_1^{(1)}\right) + \frac{3}{4}\overline{\Phi}_1^{(2)} - 2Pl = 0$$

Momenty wyjściowe



$$\overline{\Phi}_A^{(01)} = -\frac{1}{8}\frac{2}{\sqrt{13}}P \cdot 2\sqrt{13}\,l = -\frac{1}{2}Pl$$

$$\overline{\Phi}_1^{(01)} = \frac{1}{2}Pl$$

WT

1)

$$\Phi_1^{(1)} = \frac{2EJ}{2\sqrt{3}\,l}\left[\varphi_1 - 3\psi\right] - \frac{1}{2}Pl =$$

$$= \frac{EJ}{l}\left[\frac{1}{\sqrt{3}}\varphi_1 - \frac{3}{\sqrt{3}}\psi\right] - \frac{1}{2}Pl \qquad (-1)$$

$$\Phi_1^{(1)} = \frac{EJ}{l}\left[\frac{2}{\sqrt{3}}\varphi_1 - \frac{3}{\sqrt{3}}\psi\right] + \frac{1}{2}Pl$$

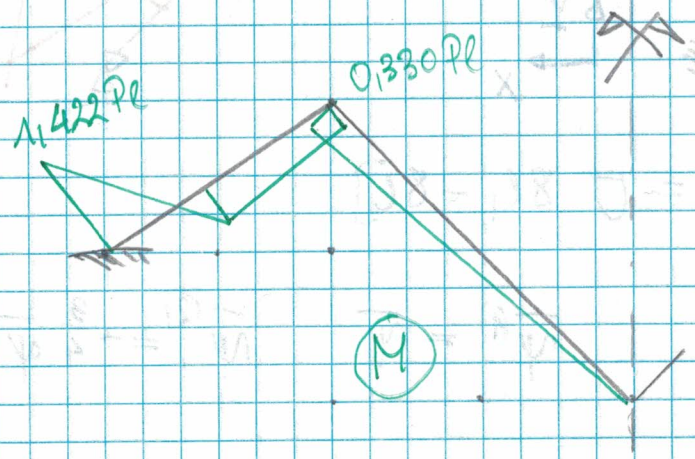
---

2)

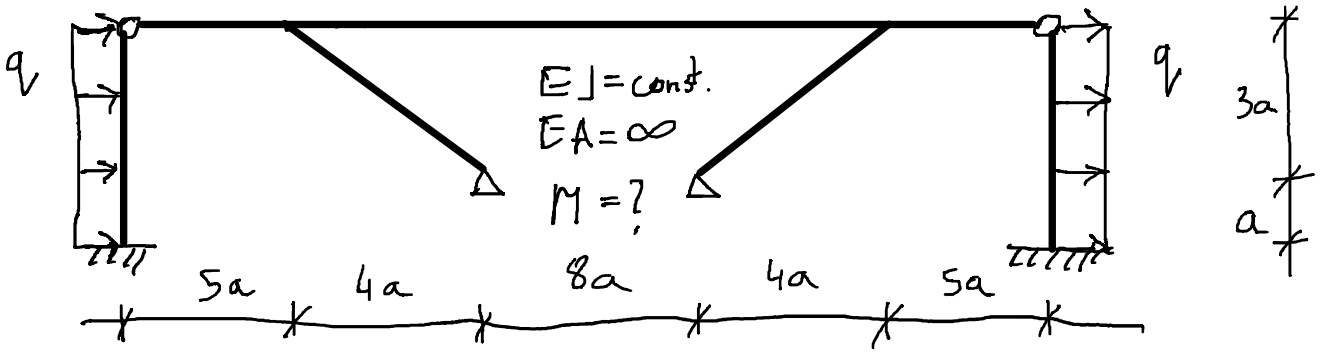
$$\Phi_1^{(2)} = \frac{3EJ}{8\sqrt{2}\,l}\left[\varphi_1 + \frac{3}{4}\psi\right] = \frac{EJ}{l}\left[\frac{3}{8\sqrt{2}}\varphi_1 + \frac{9}{32\sqrt{2}}\psi\right] \quad \left(\frac{3}{2}\right.$$

$$\frac{EJ}{l}\left[\begin{array}{c|c} 0{,}820 & -0{,}633 \\ \hline -0{,}633 & 1{,}813 \end{array}\right]\left[\begin{array}{c} \varphi_1 \\ \psi \end{array}\right] = \left[\begin{array}{c} -0{,}5 \\ \hline 2 \end{array}\right] Pl$$

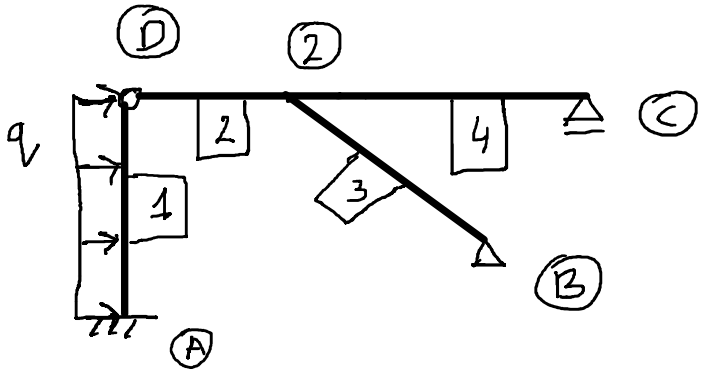
$$\varphi_1 = 0{,}331\,\frac{Pl^2}{EJ} \qquad \psi = 1{,}213\,\frac{Pl^2}{EJ}$$



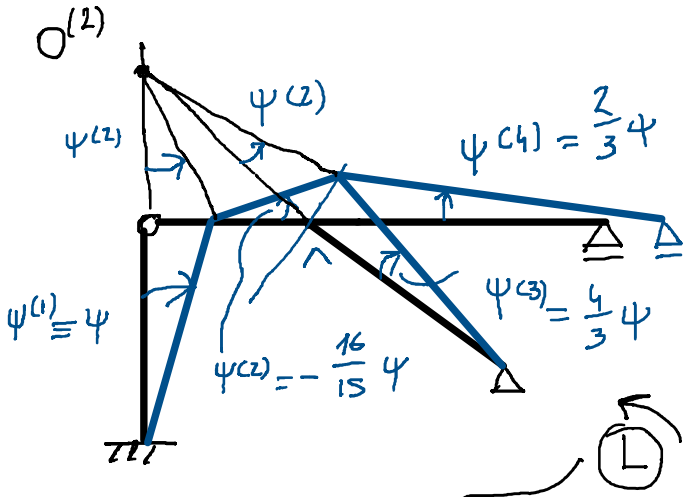
K2.1 9 I 2025



SCHEMAT POŁÓWKOWY



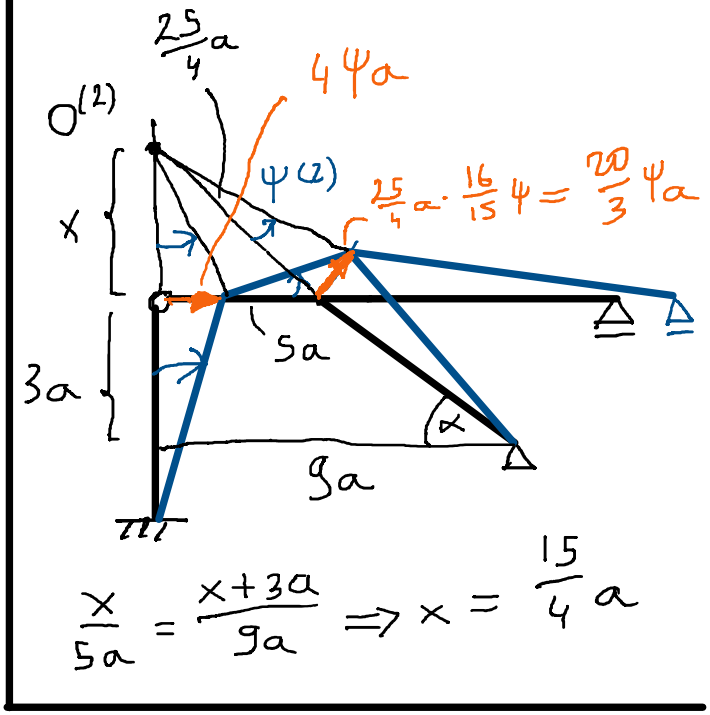
PLAN PRZEMIESZCZEŃ



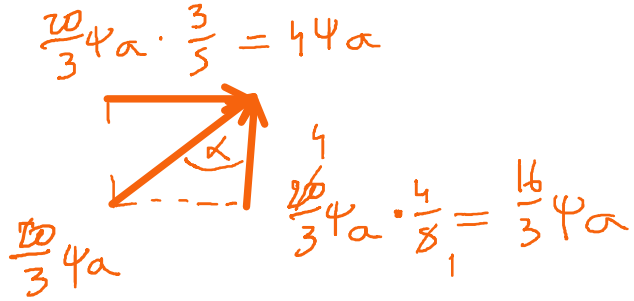
$$\psi^{(2)} = \frac{4\psi a}{\frac{15}{4}a} = -\frac{16}{15}\psi$$

$$\psi^{(3)} = \frac{20}{3}\psi a / 5a = \frac{4}{3}\psi$$

— ciągły prostów



$$\frac{x}{5a} = \frac{x+3a}{9a} \Rightarrow x = \frac{15}{4}a$$

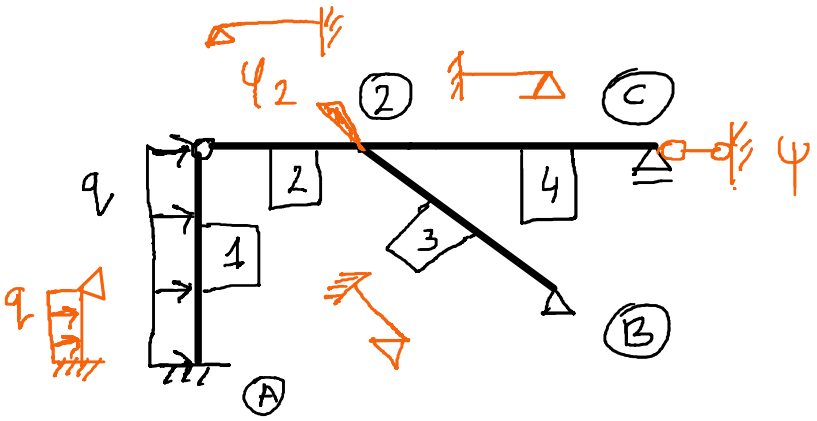


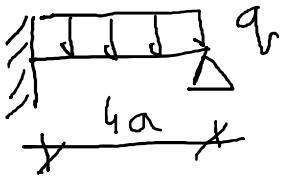
$$\psi^{(4)} = \frac{16}{3}\psi a / 8a = \frac{2}{3}\psi$$

$$\psi^{(1)} \equiv \psi$$

UGW

$$q = \begin{bmatrix} \varphi_2 \\ \psi \end{bmatrix}$$





$$\phi_A^{(1)} = -\frac{q(4a)^2}{8} = -2qa^2$$

RRMP

1) $\phi_2^{(2)} + \phi_2^{(3)} + \phi_2^{(4)} = 0$

2) $\phi_A^{(1)} \cdot \bar{\psi}^{(1)} + \phi_2^{(2)} \cdot \bar{\psi}^{(2)} + \phi_2^{(3)} \cdot \bar{\psi}^{(3)} + \phi_2^{(4)} \cdot \bar{\psi}^{(4)} + \bar{L}_{\substack{obc \\ zew}} = 0$

$$\bar{L}_{\substack{obc \\ zew}} = q \cdot 4a \cdot 2\bar{\psi}a = 8\bar{\psi}qa^2$$

WZORY TRANSFORM.

$$\phi_A^{(1)} = \frac{3EJ}{4a}\left[-\psi^{(1)}\right] - 2qa^2$$

$$\phi_2^{(2)} = \frac{3EJ}{5a}\left[\varphi_2 - \psi^{(2)}\right]$$

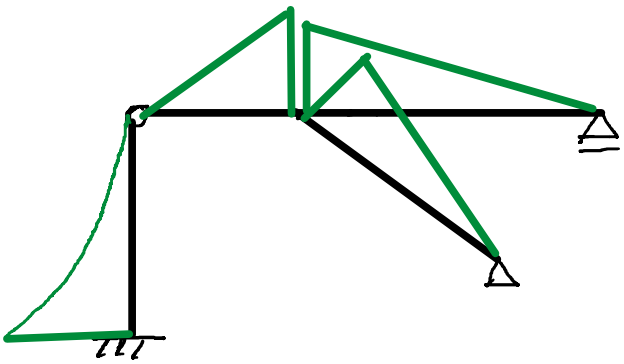
$$\phi_2^{(3)} = \frac{3EJ}{5a}\left[\varphi_2 - \psi^{(3)}\right]$$

$$\phi_2^{(4)} = \frac{3EJ}{8a}\left[\varphi_2 - \psi^{(4)}\right]$$

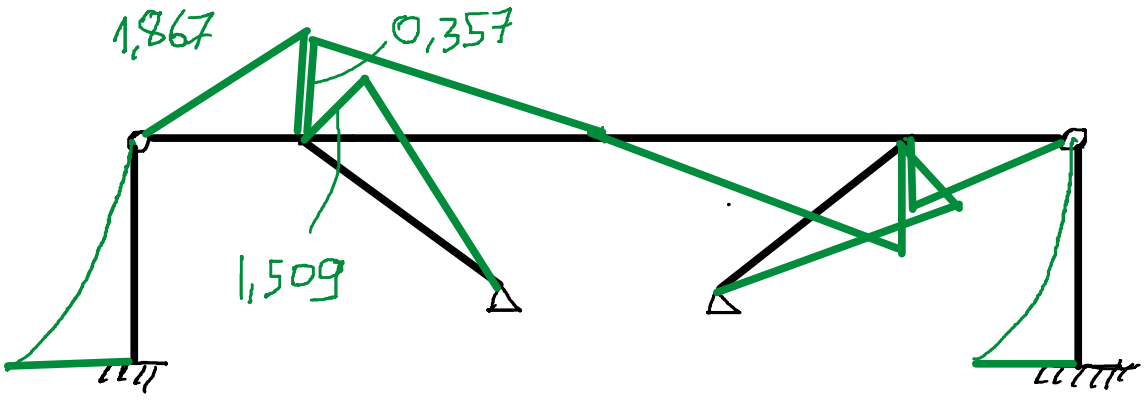
· po podstawieniu w 2) $\bar{\psi} = -1$, w po podstawieniu reszty wielkości do równań, otrzymamy

$$\frac{EJ}{a}\begin{bmatrix} 1{,}575 & -0{,}41 \\ -0{,}41 & 2{,}666 \end{bmatrix}\begin{bmatrix} \varphi_2 \\ \psi \end{bmatrix} = qa^2\begin{bmatrix} 0 \\ 6 \end{bmatrix}$$

$$\Rightarrow \begin{cases} \varphi_2 = 0{,}610 \ \frac{qa^3}{EJ} \\ \psi = 2{,}344 \ \frac{qa^3}{EJ} \end{cases}$$



$M\,[qa^2]$



$$\Sigma M_{(2)} \cong 0$$