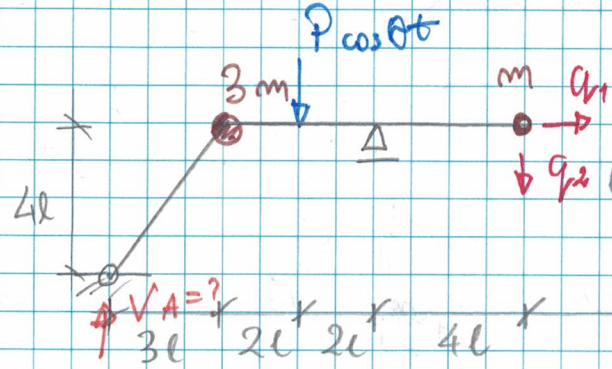
Kolokwium 2.1. MK2 r.a. 2024/25

$EJ = const.$

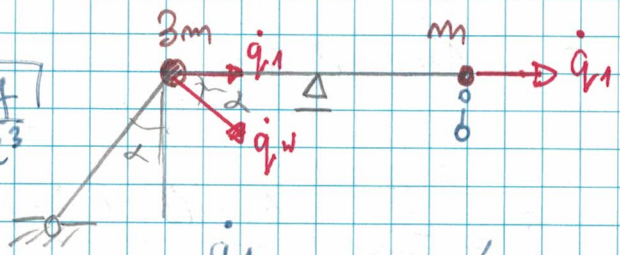
$EA \to \infty$

$\Theta = \frac{1}{i\omega}\sqrt{\frac{EJ}{ml^3}}$



$m_d = 2$

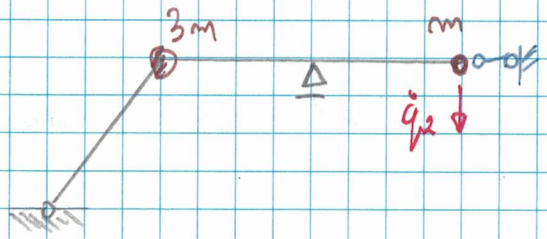
P.P. q_1



$\frac{\dot{q}_1}{\dot{q}_2} = \cos\alpha = \frac{4}{5}$

$\dot{q}_2 = \frac{5}{4}\dot{q}_1$

P.P. q_2

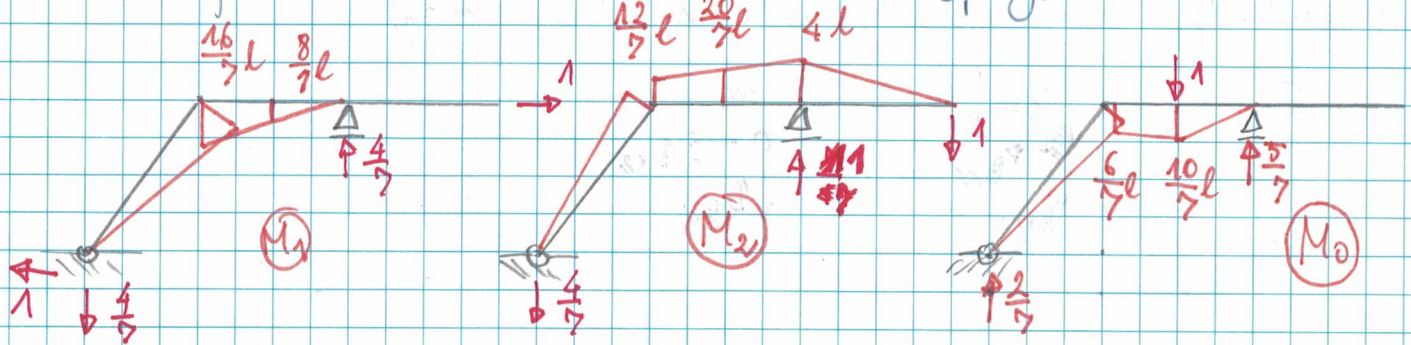


$$E_k = \frac{1}{2}\left[3m\left(\frac{5}{4}\dot{q}_1\right)^2 + m\left(\dot{q}_1^2 + \dot{q}_2^2\right)\right] =$$

$$= \frac{1}{2}\left[5{,}688\, m\, \dot{q}_1^2 + m\, \dot{q}_2^2\right]$$

$$M1 = \begin{bmatrix} 5{,}688 & 0 \\ 0 & 1 \end{bmatrix} m$$

Macierz podatności i wektor obc. zastępczych



$$d_{11} = \frac{1}{EJ}\left[\frac{1}{2}\frac{16}{7}l \cdot 4l \cdot \frac{2}{3}\frac{16}{7}l + \frac{1}{2}\frac{16}{7}l \cdot 5l \cdot \frac{2}{3}\frac{16}{7}l\right] = 15{,}674\,\frac{l^3}{EJ}$$

$$d_{12} = \frac{1}{EJ}\left[\frac{1}{2}\frac{16}{7}l \cdot 5l \cdot \left(-\frac{2}{3}\frac{12}{7}l\right) + \frac{1}{2}\frac{16}{7}l \cdot 4l \cdot \left(-\frac{2}{3}\frac{12}{7}l - \frac{1}{3}4l\right)\right] = -17{,}850\,\frac{l^3}{EJ}$$

$$d_{22} = \frac{1}{EJ}\left[\frac{1}{2}\frac{12}{7}l \cdot 5l \cdot \frac{2}{3}\frac{12}{7}l + \frac{1}{2}\frac{12}{7}l \cdot 4l \cdot \left(\frac{2}{3}\frac{12}{7}l + \frac{1}{3}4l\right) +\right.$$

$$\left. + \frac{1}{2}4l \cdot 4l \cdot \left(\frac{2}{3}4l + \frac{1}{3}\frac{12}{7}l\right) + \frac{1}{2}4l \cdot 4l \cdot \frac{2}{3}4l\right] = 60{,}626\,\frac{l^3}{EJ}$$

$$d_{10} = \frac{1}{EJ}\left[\frac{1}{2}\frac{6}{7}l \cdot 5l \cdot \frac{2}{3}\frac{16}{7}l + \frac{1}{2}\frac{6}{7}l \cdot 2l \cdot \left(\frac{2}{3}\frac{16}{7}l + \frac{1}{3}\frac{8}{7}l\right) +\right.$$

$$\left. + \frac{1}{2}\frac{10}{7}l \cdot 2l \cdot \left(\frac{2}{3}\frac{8}{7}l + \frac{1}{3}\frac{16}{7}l\right) + \frac{1}{2}\frac{8}{7}l \cdot 2l \cdot \frac{2}{3}\frac{10}{7}l\right] = 8{,}163\,\frac{l^3}{EJ}$$

$$d_{20} = \frac{1}{EJ}\left[\frac{1}{2}\frac{10}{7}l \cdot 5l \cdot \frac{2}{3}\left(-\frac{20}{7}l\right) + \frac{1}{2}\frac{10}{7}l \cdot 2l \cdot \left(-\frac{2}{3}\frac{20}{7}l - \frac{1}{3}\frac{10}{7}l\right)\right.$$

$$\left. + \frac{1}{2}\frac{20}{7}l \cdot 2l \cdot \left(-\frac{2}{3}\frac{10}{7}l - \frac{1}{3}\frac{6}{7}l\right) + \frac{1}{2}\frac{10}{7}l \cdot 2l \cdot \left(-\frac{2}{3}\frac{20}{7}l - \frac{1}{3}4l\right)\right] =$$

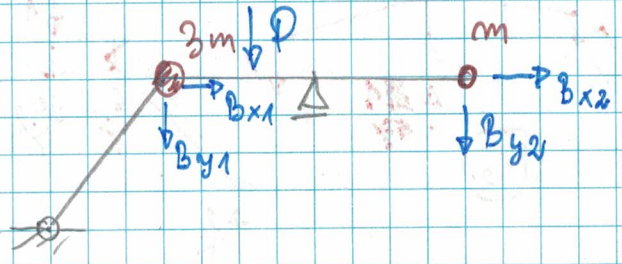
$$= -12{,}468\,\frac{l^3}{EJ}$$

$$\mathbb{D} = \frac{l^3}{EJ}\begin{bmatrix} 15{,}673 & -17{,}850 \\ -17{,}850 & 60{,}626 \end{bmatrix} \qquad \mathbb{D}_0 = \begin{bmatrix} 8{,}163 \\ -12{,}408 \end{bmatrix}\frac{l^3}{EJ}$$

Równanie ruchu $(\mathbb{1} - \Theta^2 \mathbb{D}\mathbb{M})\, q_{j0} = \mathbb{D}_0 P$

$$q_{j0} = \begin{bmatrix} -39{,}207 \\ 69{,}578 \end{bmatrix}\frac{Pl^3}{EJ}$$ – wektor amplitud przemieszczeń

Amplitudy sił działających na konstrukcję



$$B_{x1} = 3m \cdot \Theta^2 \cdot q_{01} = -1{,}176\,P$$
$$B_{y1} = 3m \cdot \Theta^2 \cdot \frac{3}{4} q_{01} = -0{,}882\,P$$

$$B_{x2} = m \cdot \Theta^2 \cdot q_{01} = -0{,}392\,P$$
$$B_{y2} = m \cdot \Theta^2 \cdot q_{02} = 0{,}696\,P$$

$\sum M_A = 0 \qquad B_{y1} \cdot 3l + P \cdot 5l + B_{y2} \cdot 11l + (B_{x1} + B_{x2}) \cdot 4l - V_B \cdot 7l = 0$

$$V_B = 0{,}533\,P$$

$\sum F_z = 0 \qquad V_A - B_{y1} - P - B_{y2} + V_B = 0$

$$V_A = 0{,}280\,P$$