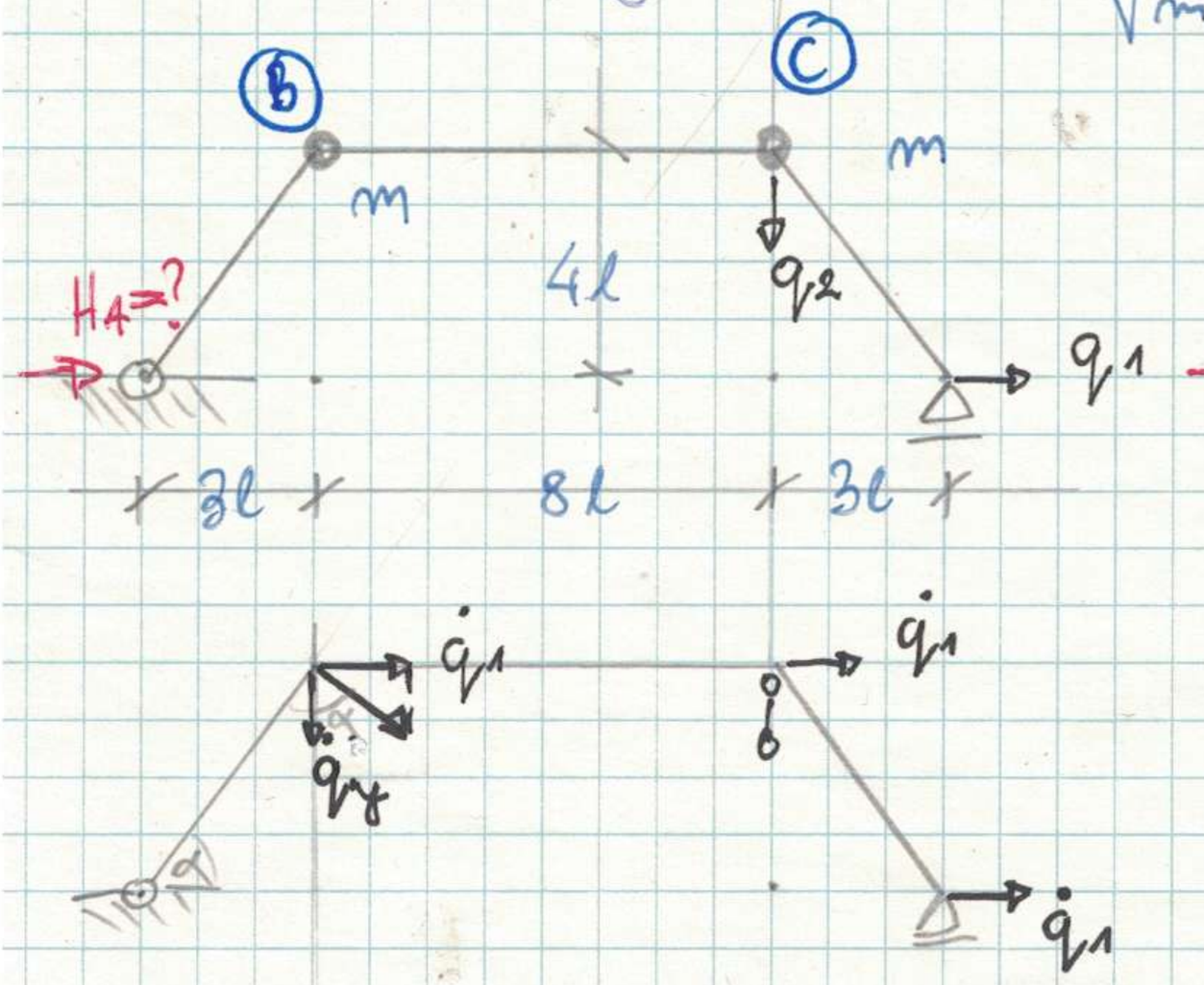
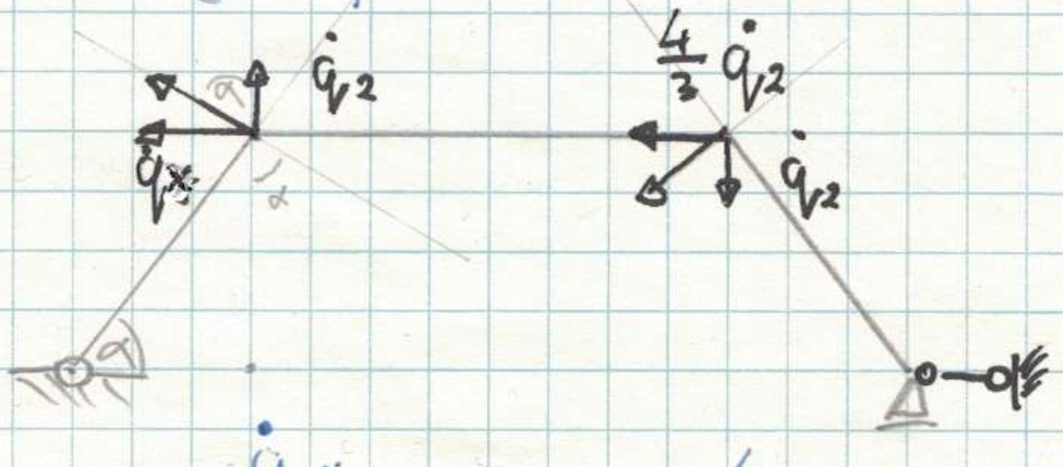
Kolokwium 2.2. MK 2 r.a. 2023/24

$EA \to \infty$ $EJ = const.$ $\Theta = \sqrt{\frac{EJ}{ml^3}}$

2 st. sw. dyn.



Plany prędkości

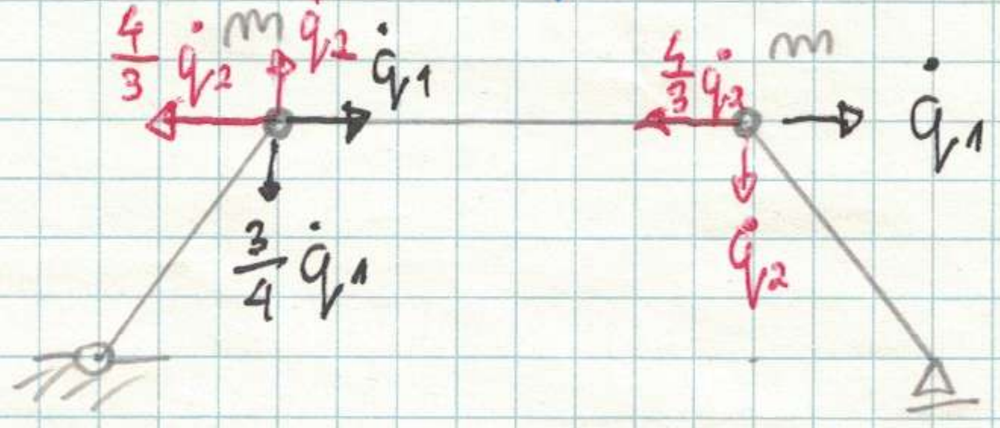


$$\frac{\dot{q}_1}{\dot{q}_y} = tg\,\alpha = \frac{4}{3}$$

$$\dot{q}_y = \frac{3}{4}\dot{q}_1$$

$$\frac{\dot{q}_x}{\dot{q}_2} = tg\,\alpha = \frac{4}{3}$$

$$\dot{q}_x = \frac{4}{3}\dot{q}_2$$



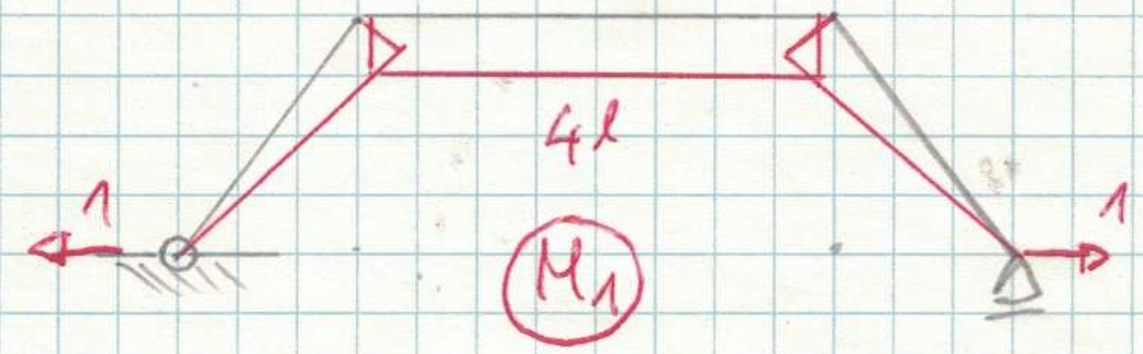
Macierz mas

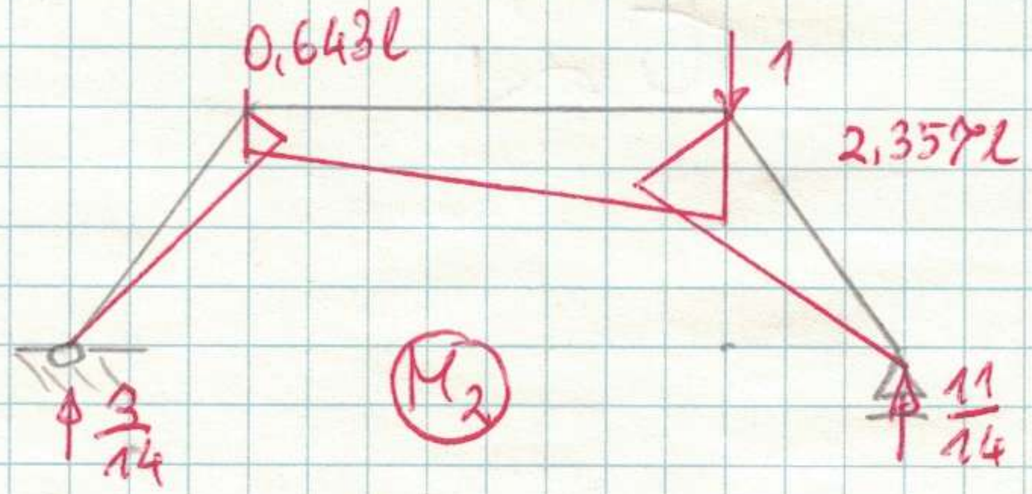
$$E_k = \frac{1}{2}\left[m\left(\left(\dot{q}_1 - \frac{4}{3}\dot{q}_2 \right)^2 + \left(\frac{3}{4}\dot{q}_1 - \dot{q}_2 \right)^2 \right) + m\left(\left(\dot{q}_1 - \frac{4}{3}\dot{q}_2 \right)^2 + \dot{q}_2^2 \right) \right] = \frac{1}{2}\left[2{,}563\, m\, \dot{q}_1^2 - 6{,}833\, m\, \dot{q}_1 \dot{q}_2 + 5{,}556\, m\, \dot{q}_2^2 \right]$$

$$M = m \begin{bmatrix} 2{,}563 & -3{,}417 \\ -3{,}417 & 5{,}556 \end{bmatrix}$$

Wektor amplitud obciążenia $Q = [\,P \;\; 0\,]$

Macierz podatności





$$d_{11} = \frac{1}{EJ}\left[2 \cdot \frac{1}{2} 4l \cdot 5l \cdot \frac{2}{3} 4l + 4l \cdot 8l \cdot 4l\right] = 181{,}333 \frac{l^3}{EJ}$$

$$d_{12} = \frac{1}{EJ}\left[\frac{1}{2} 4l \cdot 5l \cdot \frac{2}{3} 0{,}643l + 4l \cdot 8l \cdot \frac{1}{2}(0{,}643l + 2{,}357l)\right.$$

$$\left. + \frac{1}{2} 4l \cdot 5l \frac{2}{3} 2{,}357l\right] = 68{,}0 \frac{l^3}{EJ}$$

$$d_{22} = \frac{1}{EJ}\left[\frac{1}{2} \cdot 0{,}643l \cdot 5l \cdot \frac{2}{3} 0{,}643l + \frac{1}{2} 0{,}643l \cdot 8l \cdot \left(\frac{2}{3} 0{,}643l + \right.\right.$$

$$\left. + \frac{1}{3} 2{,}357l\right) + \frac{1}{2} 2{,}357l \cdot 8l \cdot \left(\frac{2}{3} 2{,}357l + \frac{1}{3} 0{,}643l\right)$$

$$\left. + \frac{1}{2} 2{,}357l \cdot 5l \cdot \frac{2}{3} 2{,}357l\right] = 29{,}907 \cdot \frac{l^3}{EJ}$$

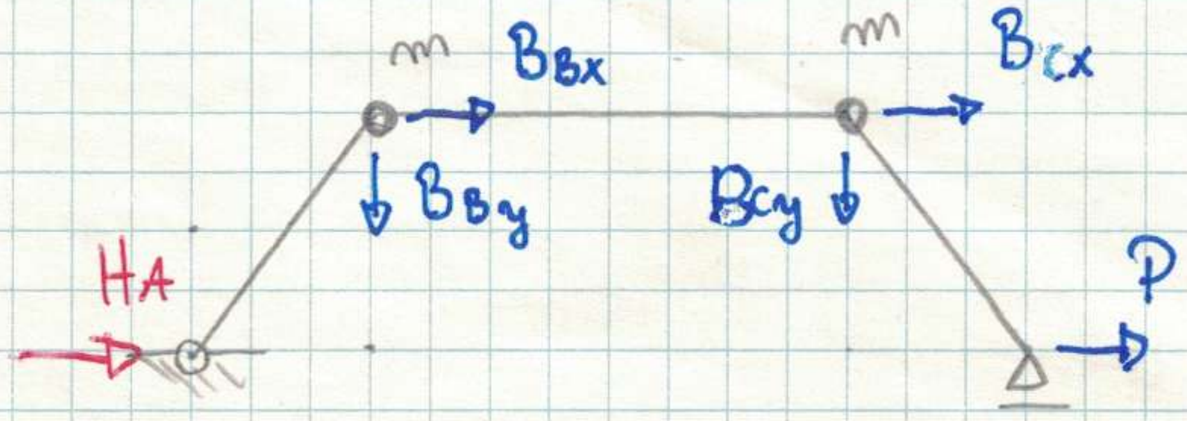
Równanie ruchu

$$(\underline{\underline{I}} - \Theta^2 D M)\, q_0 = D Q$$

Wektor amplitud przemieszczeń

$$q_0 = \begin{bmatrix} -2{,}261 \\ -1{,}413 \end{bmatrix} \frac{Pl^3}{EJ}$$

Amplitudy sił bezwładności



$$B_{Bx} = \Theta^2 m \left(q_1 - \frac{4}{3} q_2\right) = -0{,}376P$$

$$B_{By} = \Theta^2 m \left(\frac{3}{4} q_1 - q_2\right) = -0{,}282P$$

$$B_{cx} = \Theta^2 m \left(q_1 - \frac{4}{3} q_2\right) = -0{,}376P$$

$$B_{cy} = \Theta^2 m\, q_2 = -1{,}413P$$

$$H_A = -0{,}248\ P$$