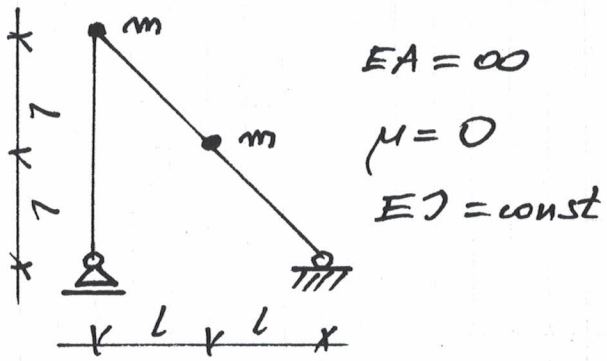
Egzamin pisemny z Mechaniki Konstrukcji II, 8 IX 2025 r.

Imię i NAZWISKO				
Prowadzący ćwiczenia, nr grupy				
ocena zadania 1	ocena zadania 2	ocena zadania 3	ocena egz. pis.	Ocena ostateczna z egzaminu
				Ocena łączna

Zadanie 1

Dana jest rama z prętów nieważkich z masami skupionymi. Obliczyć częstości drgań własnych.

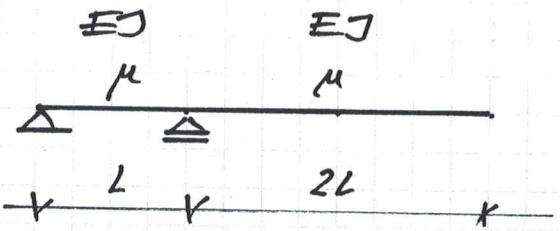
(Given is a frame of weightless bars with concentrated masses. Compute the eigenfrequencies.)



Zadanie 2

Obliczyć pierwszą częstość drgań własnych danej belki.

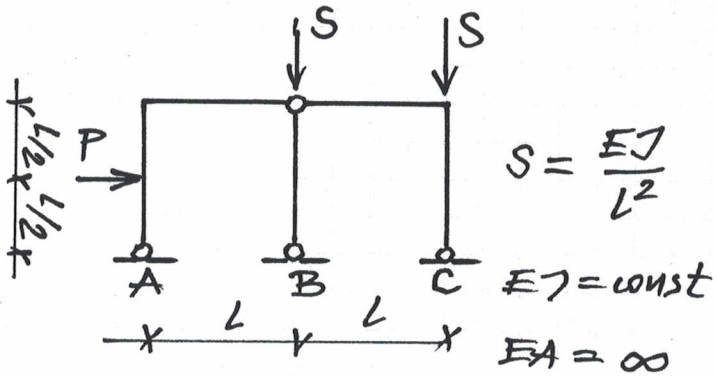
(Compute the first eigenfrequency of the given beam)



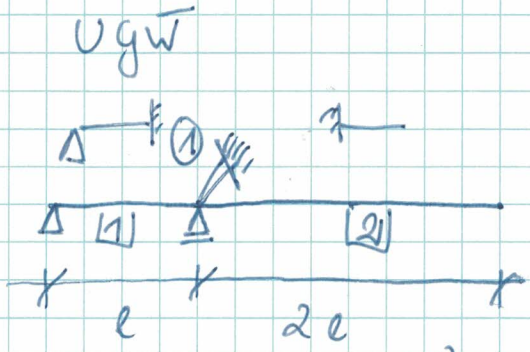
Zadanie 3

Dana jest rama płaska obciążona jak na rysunku. Zapisać równania określające wartość reakcji poziomej w C.

(Given is a plane frame loaded as in the figure. Write down the equations necessary to compute the horizontal reaction at C)



ZADANIE 2



$q_j = [\varphi_1]$

$$\alpha^{(1)} = l \sqrt[4]{\frac{\mu\omega^2}{EJ}} = \alpha$$

$$\alpha^{(2)} = 2l \sqrt[4]{\frac{\mu\omega^2}{EJ}} = 2\alpha$$

r. r. MP $\quad \Phi_1^{(1)} + \Phi_1^{(2)} = 0$

WT

1) $\quad \Phi_1^{(1)} = \frac{EJ}{l}[\alpha'(\alpha)\varphi_1]$

2) $\quad \Phi_1^{(2)} = \frac{EJ}{2l}[\alpha''(2\alpha)\varphi_1]$

$$\frac{EJ}{l}\left[\alpha'(\alpha) + \frac{1}{2}\alpha''(2\alpha)\right]\varphi_1 = 0$$

$$f(\alpha) = \alpha'(\alpha) + \frac{1}{2}\alpha''(2\alpha) = 0$$

$\alpha = 0{,}1 \quad \alpha'(0{,}1) = 3{,}000 \quad \alpha''(0{,}2) = -0{,}001$

$f(0{,}1) = 2{,}999$

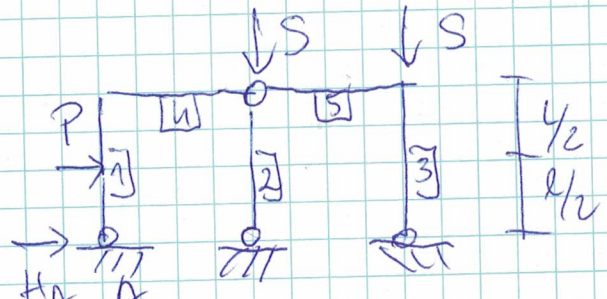
$\alpha = 0{,}7 \quad \alpha'(0{,}7) = 2{,}995 \quad \alpha''(1{,}4) = -1{,}841 \quad f(0{,}7) = 2{,}075$

$\alpha = 0{,}8 \quad \alpha'(0{,}8) = 2{,}992 \quad \alpha''(1{,}6) = -4{,}587 \quad f(0{,}8) = 0{,}703$

$\alpha = 0{,}9 \quad \alpha'(0{,}9) = 2{,}987 \quad \alpha''(1{,}8) = -22{,}622 \quad f(0{,}9) = -8{,}324$

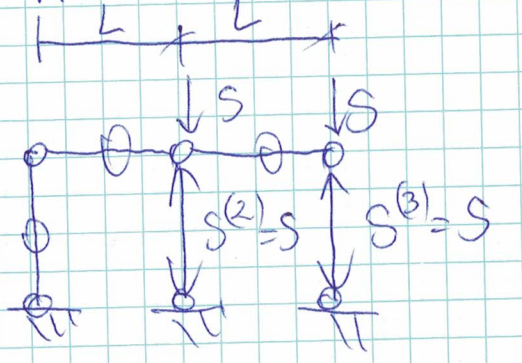
$$\alpha_1 \approx 0{,}8 \qquad \omega_1 = \frac{\alpha_1^2}{l^2}\frac{EJ}{\mu} \cong 0{,}64\,\frac{EJ}{\mu l^2}$$

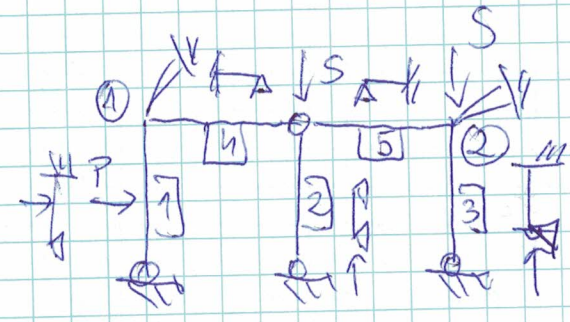
ZAD. 3. EGZAMIN MK2 ST 8.09.2025r.



$S = \frac{EJ}{l^2}$ $EJ = const$ $EA \to \infty$

$H_A = W_A^{(1)}$

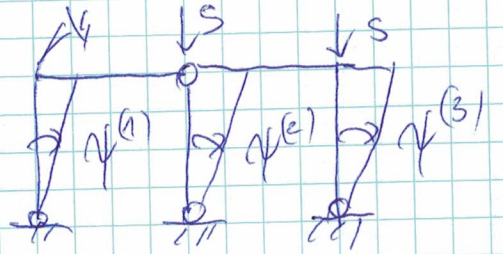




$q = \begin{bmatrix} \varphi_1 \\ \varphi_2 \\ \psi \end{bmatrix}$

$K q = Q$

PLAN PRZEMIESZCZEŃ



$\psi^{(1)} = \psi^{(2)} = \psi^{(3)} = \psi$

$\bar{6} = l\sqrt{\frac{S}{EJ}} = l\sqrt{\frac{\frac{EJ}{l^2}}{EJ}} = 1$

$l^{(1)} = l$	EJ	$S^{(1)} = 0$	$\bar{6}^{(1)} = 0 = 0$	$\psi^{(1)} = \psi$
$l^{(2)} = l$		$S^{(2)} = S$	$\bar{6}^{(2)} = \bar{6} = 1$	$\psi^{(2)} = \psi$
$l^{(3)} = l$		$S^{(3)} = S$	$\bar{6}^{(3)} = \bar{6} = 1$	$\psi^{(3)} = \psi$
$l^{(4)} = l$		$S^{(4)} = 0$	$\bar{6}^{(4)} = 0$	$\psi^{(4)} = 0$
$l^{(5)} = l$		$S^{(5)} = 0$	$\bar{6}^{(5)} = 0$	$\psi^{(5)} = 0$

RÓWNANIA

1) $\sum M_1 = 0 \Rightarrow \phi_1^{(1)} + \phi_1^{(4)} = 0$

2) $\sum M_2 = 0 \Rightarrow \phi_2^{(3)} + \phi_2^{(5)} = 0$

3) $\phi_1^{(1)} \cdot \bar{\psi} + \phi_2^{(3)} \cdot \bar{\psi} + S \cdot l \cdot \psi \cdot \bar{\psi} + S \cdot l \cdot \psi \cdot \bar{\psi} + \bar{L}_2 = 0$

$$\bar{L}_2 = P \cdot \frac{l}{2} \cdot \bar{\psi}$$

$$\frac{EJ}{l^2}$$

3) $-\phi_1^{(1)} - \phi_2^{(3)} - 2S \cdot l\,\psi - \frac{Pl}{2} = 0$

$$\phi_1^{(1)} = \frac{3EJ}{l}(\varphi_1 - \psi) + \frac{3}{16}Pl$$

$$\phi_2^{(3)} = \frac{EJ}{l}\left[\alpha'(1) \cdot (\varphi_2 - \psi)\right]$$

$$\phi_1^{(4)} = \frac{3EJ}{l}\varphi_1$$

$$\phi_2^{(5)} = \frac{3EJ}{l}\varphi_2$$

$$\frac{EJ}{l}\begin{vmatrix} 3+3 & +\textcircled{2} & -3 \\ 0 & \alpha'(1)+3 & -\alpha'(1) \\ -3 & -\alpha'(1) & 3+\alpha'(1)+ \\ & & -2 \end{vmatrix} \begin{bmatrix} \varphi_1 \\ \varphi_2 \\ \psi \end{bmatrix} = \begin{bmatrix} -\frac{3}{16} \\ \\ \frac{3}{16}+\frac{1}{2} \end{bmatrix} Pl$$

$$W_A^{(1)} = -\frac{EJ}{l^2}\left[\right.$$