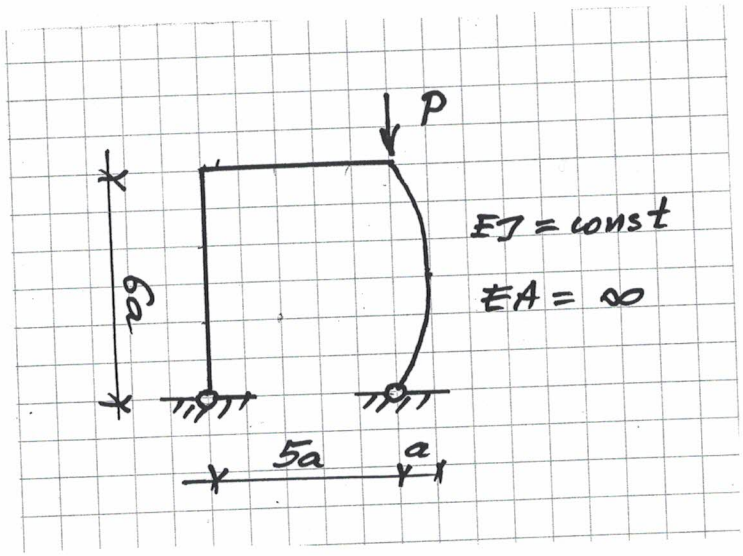
Egzamin pisemny z Mechaniki Konstrukcji I, 3 IX 2024 r.

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

Dany jest ramołuk z łukiem parabolicznym, małowyniosłym obciążony jak na rysunku. Znaleźć wykres momentów zginających.

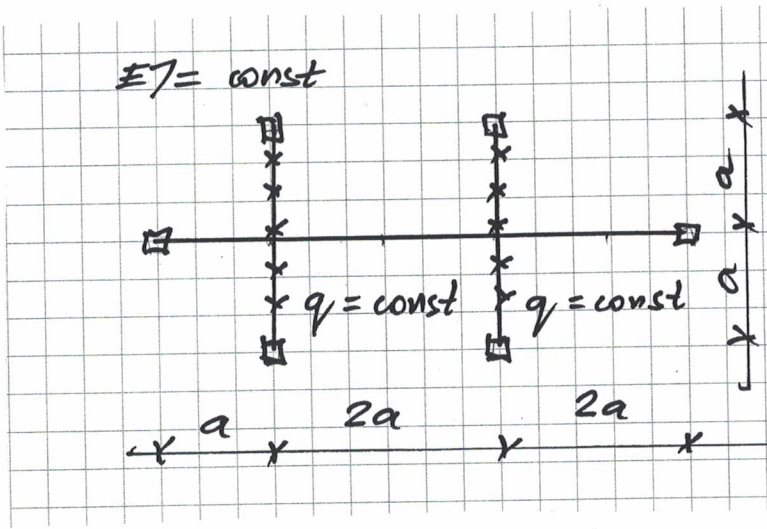
(Given is a frame with a shallow parabolic arch loaded as shown in the figure; find the diagram of the bending moment)



Zadanie 2

Dany jest ruszt przegubowy. Sporządzić wykres momentów zginających

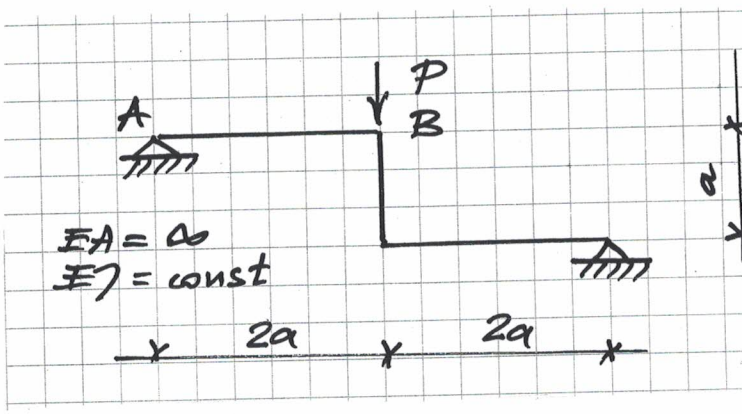
(Given is a system of beams. Construct the diagram of bending moments)



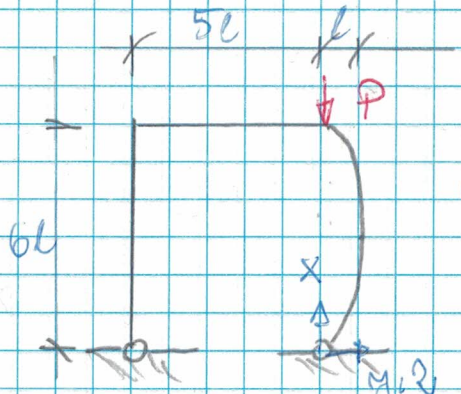
Zadanie 3

Wyprowadzić wzór na ugięcie pręta AB.

(Derive the formula for the deflection of the bar AB.)



Egzamin MK 1 3 IX 2024 ZADANIE 1

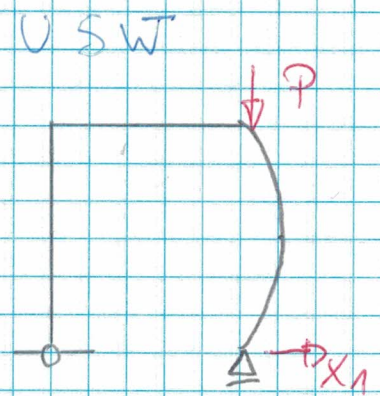


$EJ = const.$

$EA \to \infty$

r-nie osi belki

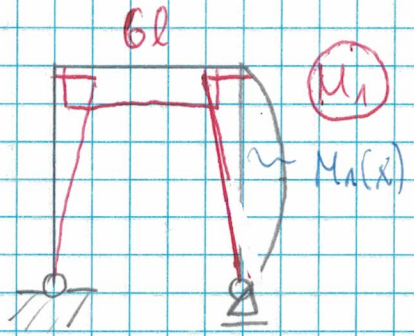
$$y(x) = \frac{1}{9}\frac{x}{\ell}(6\ell - x)$$



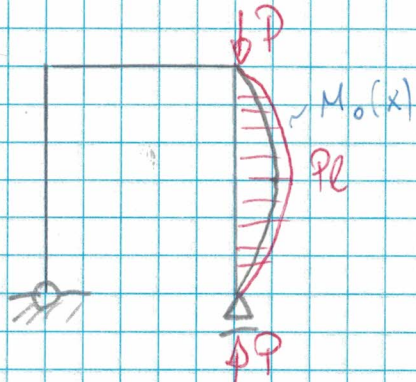
USW

r-nie 2 godowskiego $\quad \delta_{11} X_1 + \delta_{10} = 0$

Stan $X_1 = 1$



Stan „0"



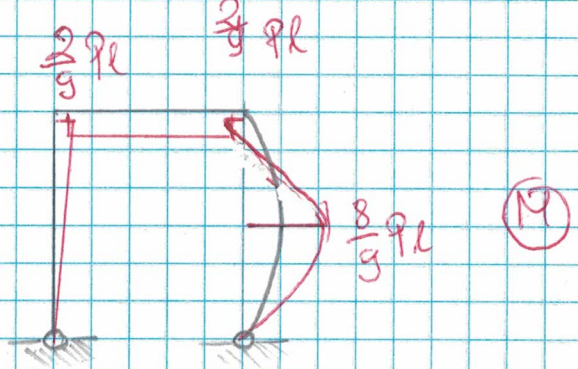
$$M_1(x) = -x$$

$$M_0(x) = P\,y(x)$$

$$\delta_{11} = \frac{1}{EJ}\left[2\cdot\frac{1}{2}\,6\ell\cdot 6\ell\cdot\frac{2}{3}\,6\ell + 6\ell\cdot 5\ell\cdot 6\ell\right] = 324\,\frac{\ell^3}{EJ}$$

$$\delta_{10} = \frac{1}{EJ}\int_0^{6\ell} M_0(x)\,M_1(x)\,dx = -12\,\frac{P\ell^3}{EJ}$$

$$X_1 = -\frac{\delta_{10}}{\delta_{11}} = \frac{1}{27}P$$



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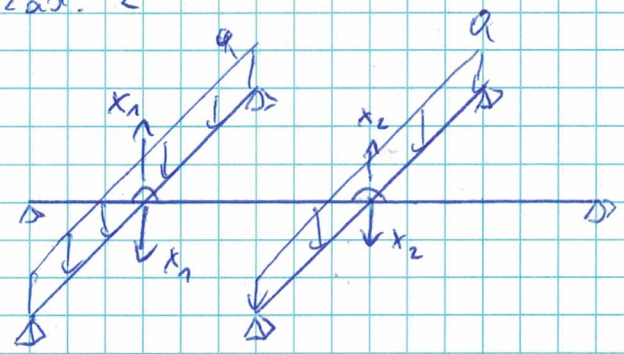
Zad. 2



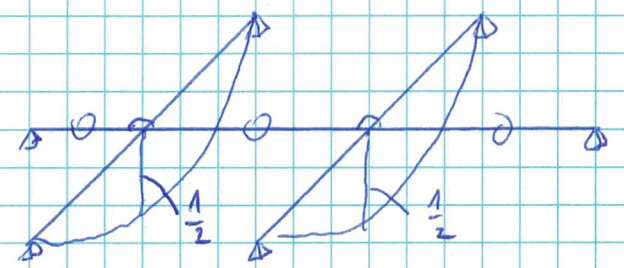
$$\delta_{10} = \delta_{20} = \frac{5}{24}\frac{ql^4}{EJ}$$

$$\delta_{11} = \frac{37}{30}\frac{l^3}{EJ}$$

$$\delta_{22} = \frac{37}{30}\frac{l^3}{EJ}$$

$$\delta_{12} = \frac{4}{5}\frac{l^3}{EJ}$$

$M_0 [ql^2]$

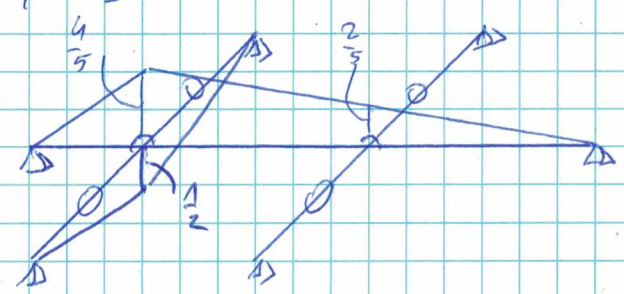


$$\begin{cases} \delta_{11} X_1 + \delta_{12} X_2 + \delta_{10} = 0 \\ \delta_{12} X_1 + \delta_{22} X_2 + \delta_{20} = 0 \end{cases}$$

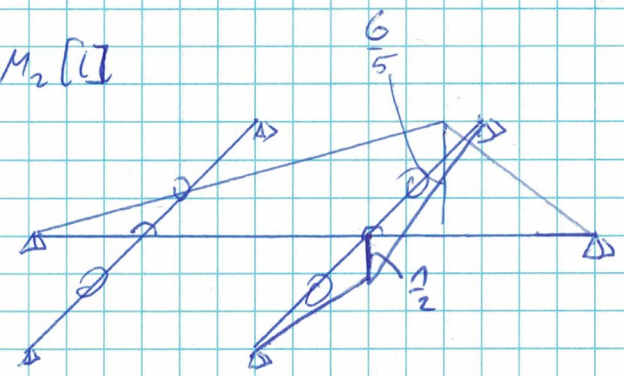
$$X_1 = \ominus \frac{925}{4990} ql \approx \ominus 0,19\, ql$$

$$X_2 = \frac{75}{4990} ql \approx 0,015\, ql$$

$M_1 [l]$

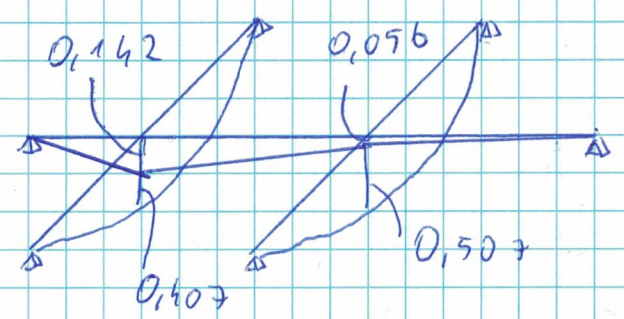


$M_2 [l]$



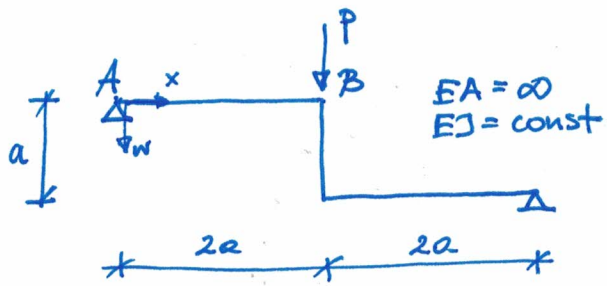
$$M = M_0 + M_1 X_1 + M_2 X_2$$

$M [ql^2]$



Egzamin MK1 3 IX 2024 zadanie 3

Rozwiązanie opracował Jan Perczyński.



Funkcja ugięcia pręta AB

$$W(\xi) = A_0 + A_1\xi + A_2\xi^2 + A_3\xi^3$$

$$\xi = \frac{x}{2a}$$

Warunki brzegowe

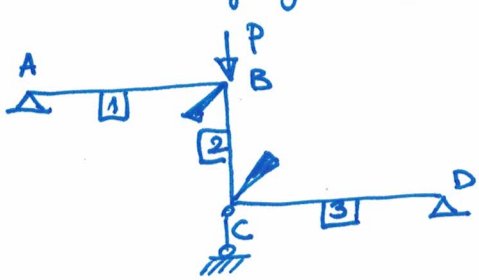
$W(0) = 0$

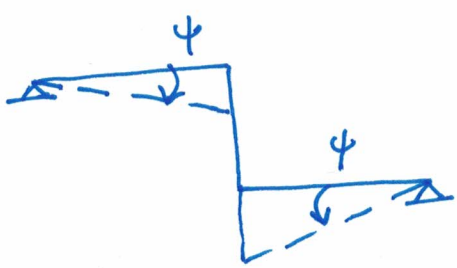
$M(0) = 0$

$w(1) = w_B$

$\varphi(1) = \varphi_B$

Metoda przemieszczeń do wyznaczenia warunków brzegowych w_B i φ_B.





Równania równowagi

$$q = \begin{bmatrix} \varphi_B \\ \varphi_C \\ \psi \end{bmatrix}$$

1) $\phi_B^1 + \phi_B^2 = 0$

2) $\phi_C^2 + \phi_C^3 = 0$

3) $\phi_B^1 \cdot \bar{\psi} + \phi_C^3 \cdot (-\bar{\psi}) + P \cdot \bar{\psi} \cdot 2a = 0$

Wzory transformacyjne

$$\phi_B^1 = \frac{3EJ}{2a}\left[\varphi_B - \psi\right]$$

$$\phi_B^2 = \frac{2EJ}{a}\left[2\varphi_B + \varphi_C\right]$$

$$\phi_C^2 = \frac{2EJ}{a}\left[2\varphi_C + \varphi_B\right]$$

$$\phi_C^3 = \frac{3EJ}{2a}\left[\varphi_C + \psi\right]$$

Układ równań

$$\frac{EJ}{a}\begin{bmatrix} \frac{11}{2} & 2 & -\frac{3}{2} \\ 2 & \frac{11}{2} & \frac{3}{2} \\ -\frac{3}{2} & \frac{3}{2} & 3 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 2Pa \end{bmatrix}$$