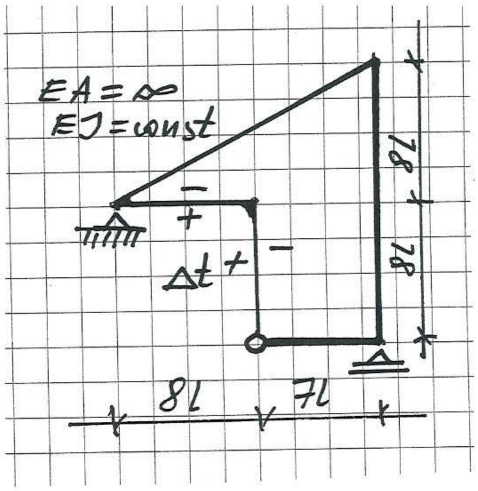
Egzamin pisemny z Mechaniki Konstrukcji I, 26 III 2014 roku.

Imię i NAZWISKO			
Nr albumu			
ocena zadania 1	ocena zadania 2	ocena zadania 3	Ocena egz. pis.
			Ocena końcowa
			Ocena łączna

Zadanie 1

Znaleźć rozkład momentów zginających w danej ramie. Zastosować metodę sił

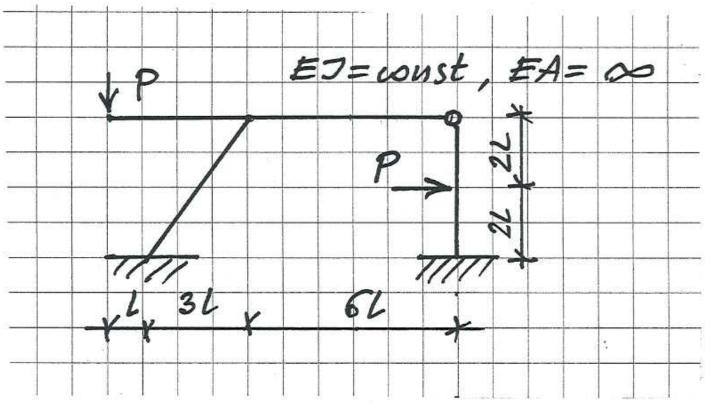
(*Find the diagram of bending moments in the given frame. Make use of the force method*)



Zadanie 2

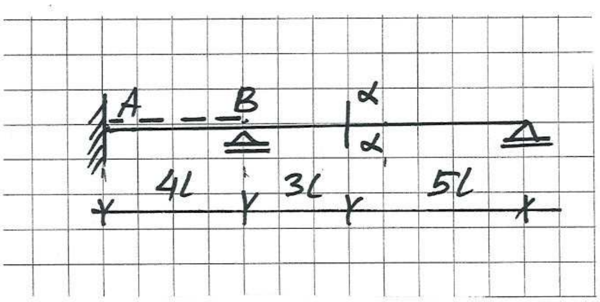
Znaleźć rozkład momentów zginających w danej ramie. Zastosować metodę przemieszczeń

(*Find the diagram of bending moments in the given frame. Make use of the displacement method*)



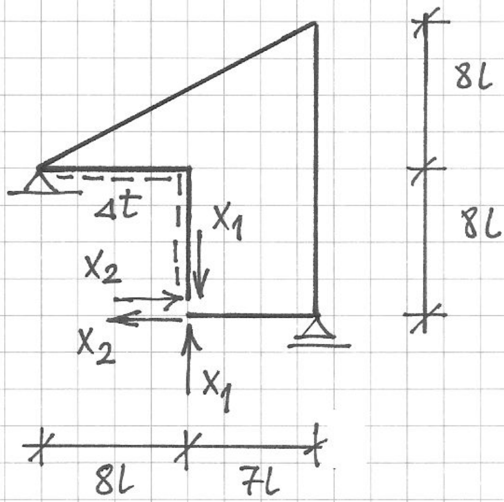
Zadanie 3 Znaleźć linie wpływu momentu zginającego w zaznaczonym przekroju; jazda siły: po AB.

(*Find the influence line of the bending moment at the cross-section indicated, for the unit force position along AB*).

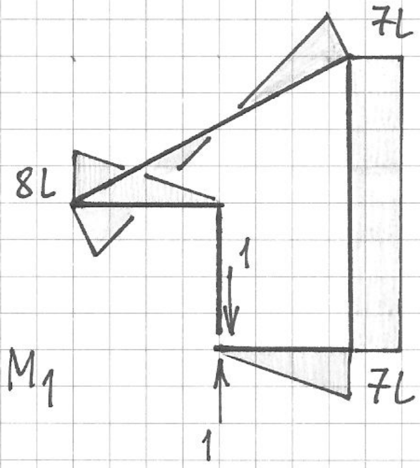


Egzamin MK1, 26 III 2014, zadanie 1

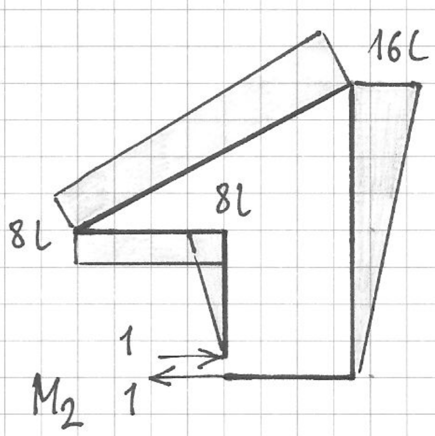
Układ zastępczy:



$X_1 = 1$



$X_2 = 1$



$$\delta_{11} = 1392 \frac{L^3}{EJ}$$

$$\delta_{12} = \delta_{21} = 708 \frac{L^3}{EJ}$$

$$\delta_{22} = 4587 \frac{L^3}{EJ}$$

$$\delta_{10} = -32 \frac{\alpha_t \Delta t}{h} L^2$$

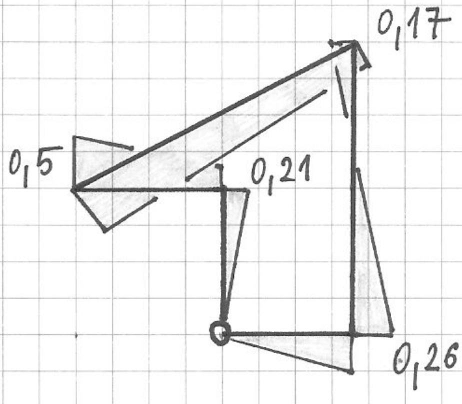
$$\delta_{20} = 96 \frac{\alpha_t \Delta t}{h} L^2$$

$$\delta_{11} X_1 + \delta_{12} X_2 + \delta_{10} = 0$$

$$\delta_{21} X_1 + \delta_{22} X_2 + \delta_{20} = 0$$

$$X_1 = 0{,}0365 \frac{EJ \alpha_t \Delta t}{hL}$$

$$X_2 \; -0{,}0266 \frac{EJ \alpha_t \Delta t}{hL}$$

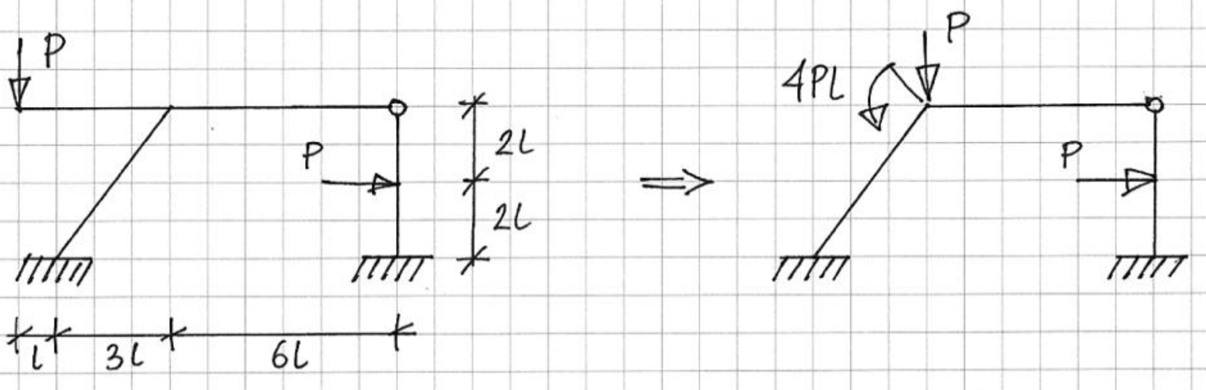


$$\left[\frac{M}{\gamma}\right]$$

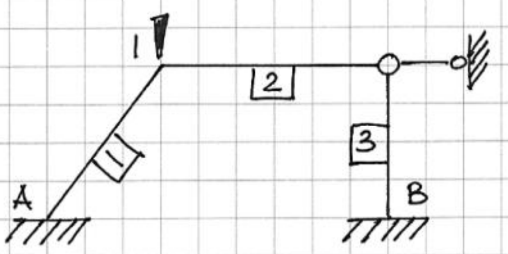
$$\gamma = \frac{EJ \alpha_t \Delta t}{h}$$

EGZAMIN MK 1, 26 III 2014

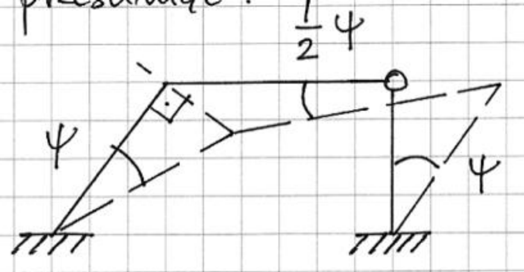
Zadanie 2.



UGW:



plan przesunięć:



$$\underline{q} = [\varphi_1 \quad \psi]^T$$

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

Równania równowagi:

1) $\Phi_1^{(1)} + \Phi_1^{(2)} + 4PL = 0$

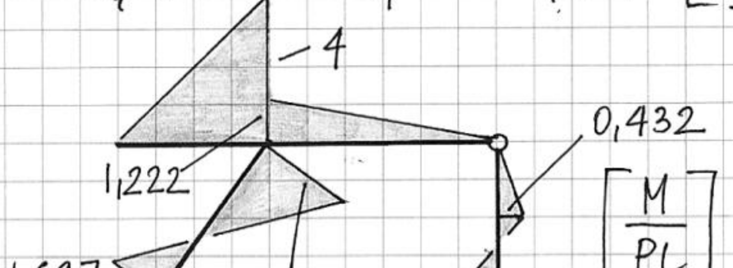
2) $\left[\Phi_A^{(1)} + \Phi_1^{(1)}\right]\cdot\overline{\psi} + \Phi_1^{(2)}\cdot\left(-\frac{1}{2}\overline{\psi}\right) + \Phi_B^{(3)}\cdot\overline{\psi} + \overline{L}_q = 0$

Uwaga: $\overline{L}_q = P\cdot 3L\cdot\overline{\psi} + P\cdot 2L\cdot\overline{\psi}$; $\overset{\circ}{\Phi}{}_B^{(3)} = -\frac{3}{4}PL$

Równania równowagi w postaci macierzowej:

$$\begin{bmatrix} 1{,}3 & -0{,}95 \\ -0{,}95 & 3{,}275 \end{bmatrix}\begin{bmatrix} \varphi_1 \\ \psi \end{bmatrix} - \begin{bmatrix} -4 \\ 4{,}25 \end{bmatrix}\frac{PL^2}{EI} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

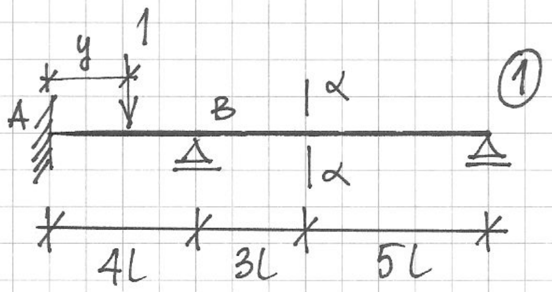
Rozwiązanie: $\varphi_1 = -2{,}701\,\frac{PL^2}{EI}$, $\psi = 0{,}514\,\frac{PL^2}{EI}$

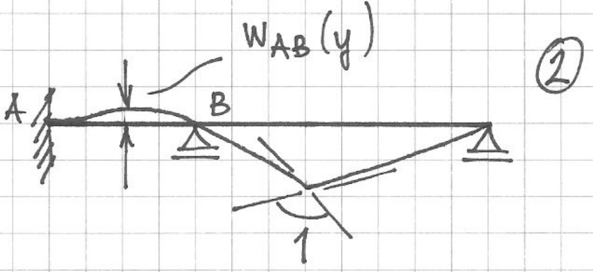


Rozwiązanie opracował:
G. Dzierżanowski

Egzamin MK1, 26 III 2014, zadanie 3

Korzystamy z tw. Bettiego



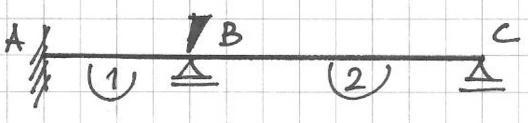


$$1 \cdot w_{AB}(y) - M_\alpha(y) \cdot 1 = 0$$

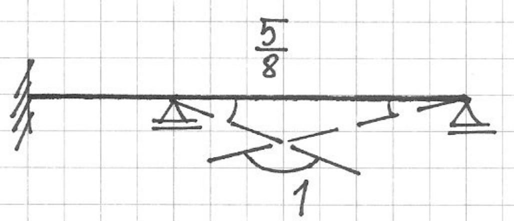
$$M_\alpha(y) \overset{ozn.}{=} \text{lw } M_\alpha$$

$$\text{lw } M_\alpha = w_{AB}(y)$$

Wyznaczamy linię ugięcia belki na odcinku AB stowarzyszoną z $\varphi_\alpha = -1$ w układzie ②.



$$q = [\varphi_B]$$



$$\rightarrow \overset{\circ}{\varphi}_B = -\frac{5}{8} \rightarrow \overset{\circ}{\Phi}{}^{(2)}_B = \frac{3EJ}{8L}\left(-\frac{5}{8}\right)$$

$$\Phi^{(1)}_B + \Phi^{(2)}_B = 0$$

$$\Phi^{(1)}_B = \frac{2EJ}{4L}[2\varphi_B]$$

$$\Phi^{(2)}_B = \frac{3EJ}{8L}[\varphi_B] + \overset{\circ}{\Phi}{}^{(2)}_B$$

$$\rightarrow \varphi_B = \frac{15}{88}$$

$$w_{AB}(y) = L\left(0{,}01\frac{y^3}{L^3} - 0{,}043\frac{y^2}{L^2}\right)$$

$$w_{AB}(y) = C_0 + C_1 y + C_2 y^2 + C_3 y^3$$

warunki brzegowe:

1) $w_{AB}(0) = 0$

2) $\varphi_{AB}(0) = 0 \rightarrow w'_{AB}(0) = 0$

3) $w_{AB}(4L) = 0$

4) $\varphi_{AB}(4L) = \varphi_B \rightarrow w'_{AB}(4L) = \varphi_B$