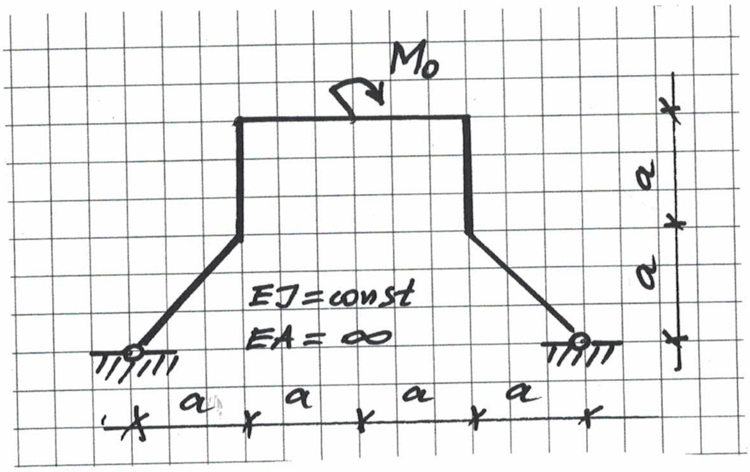
Egzamin pisemny z Mechaniki Konstrukcji I, 12 II 2020 r.

NAZWISKO imię				
Grupa	Data zaliczenia ćwiczeń		Numer albumu	
Ocena zadania 1	Ocena zadania 2	Ocena zadania 3	Ocena z egzaminu	Ocena łączna Data

Zadanie 1

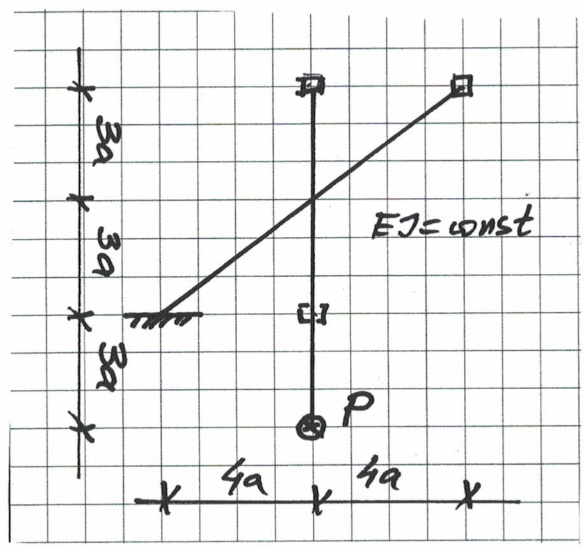
Dana jest rama płaska obciążona jak na rysunku; zapisać układ równań metody przemieszczeń. *(For the given frame write down the equations of the displacement method.)*



Zadanie 2

Dany jest ruszt przegubowy, obciążony jak na rysunku. Sporządzić wykres momentów zginających.

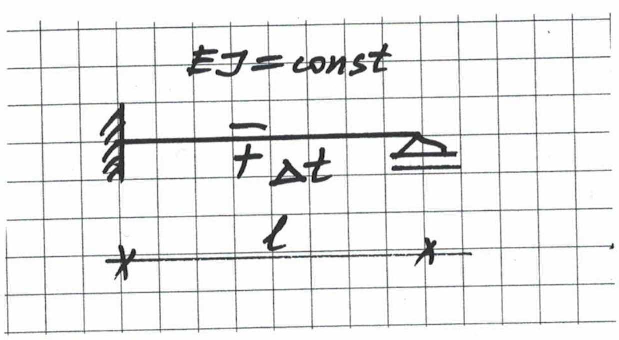
(There is given a system of beams, loaded as shown in the figure. Find the diagram of the bending moments).



Zadanie 3

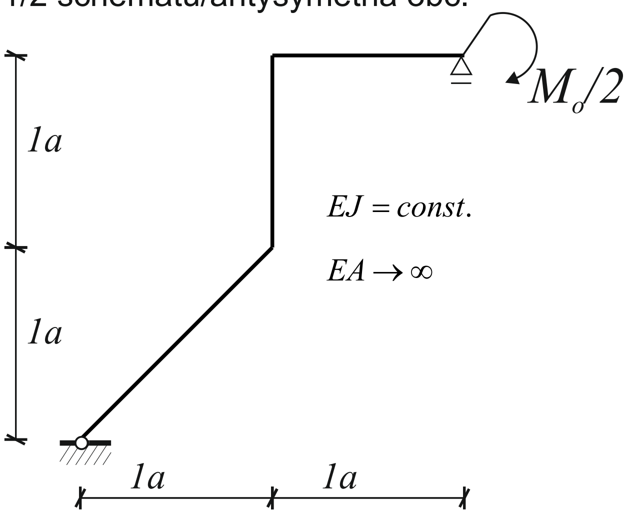
Znaleźć linię ugięcia danej belki.

(Construct the deflection line of the given beam).

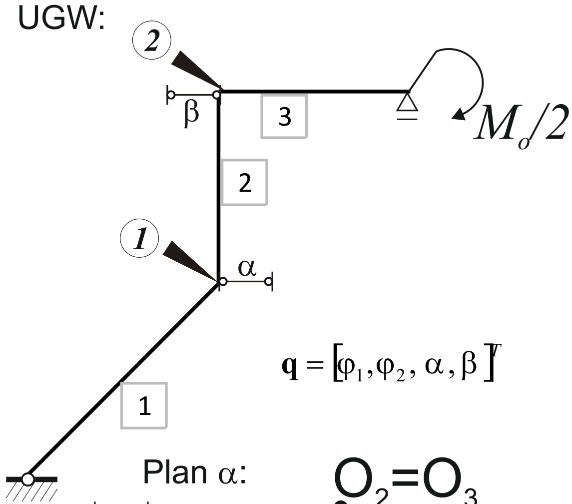


zad.1/egz.MK_1/12.02.2020

1/2 schematu/antysymetria obc.

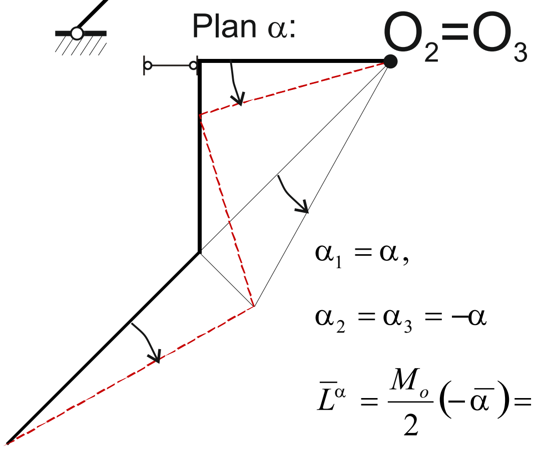


UGW:



$\mathbf{q} = [\varphi_1, \varphi_2, \alpha, \beta]^T$

Plan α:



$\alpha_1 = \alpha,$

$\alpha_2 = \alpha_3 = -\alpha$

$\overline{L}^{\alpha} = \frac{M_o}{2}(-\overline{\alpha}) = -\frac{1}{2}M_o\overline{\alpha}$

$\psi_1 = \alpha,$

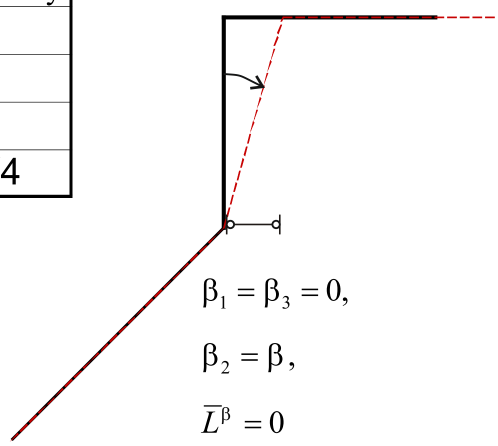
$\psi_2 = -\alpha + \beta$

$\psi_3 = -\alpha$

Wzory transformacyjne:

	φ_1	φ_2	α	β	Moment wyjściowy
Φ_1^1=EJ/a[	2.12132		-2.12132]		
Φ_1^2=EJ/a[	4	2	6	-6]	
Φ_2^2=EJ/a[	2	4	6	-6]	
Φ_2^3=EJ/a[		3	3]		+$M_o/4$

Plan β:



$\beta_1 = \beta_3 = 0,$

$\beta_2 = \beta,$

$\overline{L}^{\beta} = 0$

Równania równowagi:

1./ $\overline{\varphi}_1 = -1, \overline{\varphi}_2 = \overline{\alpha} = \overline{\beta} = 0:$

$\Phi_1^1 + \Phi_1^2 = 0,$

2./ $\overline{\varphi}_2 = -1, \overline{\varphi}_1 = \overline{\alpha} = \overline{\beta} = 0:$

$\Phi_2^2 + \Phi_2^3 = 0,$

3./ $\overline{\alpha} = -1, \overline{\varphi}_1 = \overline{\varphi}_2 = \overline{\beta} = 0:$

$\Phi_1^1(-1) + [\Phi_1^2 + \Phi_2^2] + \Phi_2^3 + \frac{1}{2}M_o = 0,$

4./ $\overline{\beta} = -1, \overline{\varphi}_1 = \overline{\varphi}_2 \overline{\alpha} = 0:$

$[\Phi_1^2 + \Phi_2^2](-1) = 0.$

Odp:

EJ/a

6.121320343	2	3.878679657	-6
2	7	9	-6
3.878679657	9	17.12132034	-12
-6	-6	-12	12

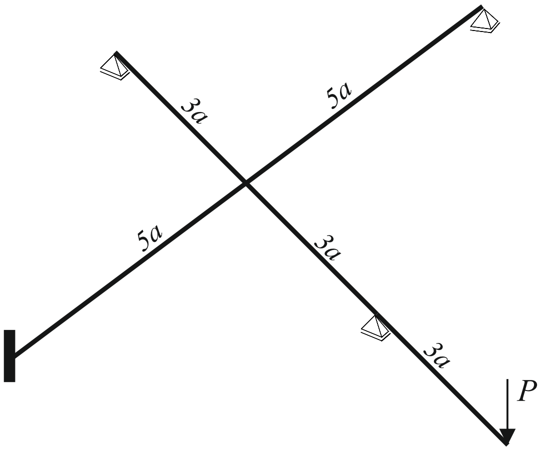
q=

-0.25
-0.75

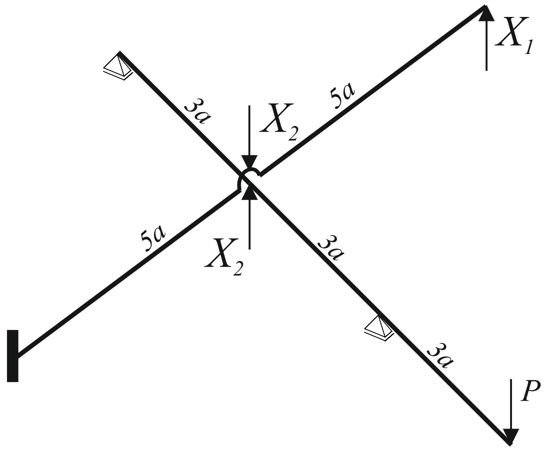
M_o

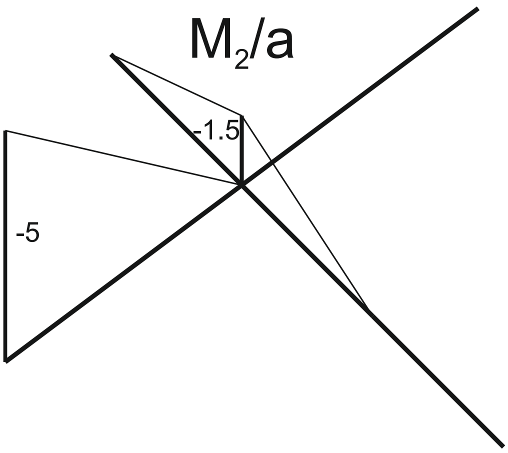
oprac. K.Hetmański

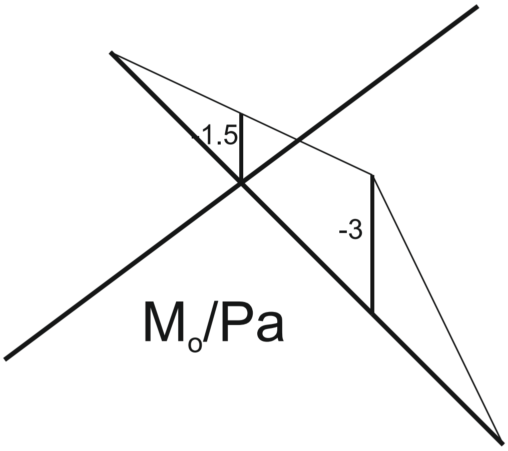
zad.2/egz.MK_1/12.02.2020

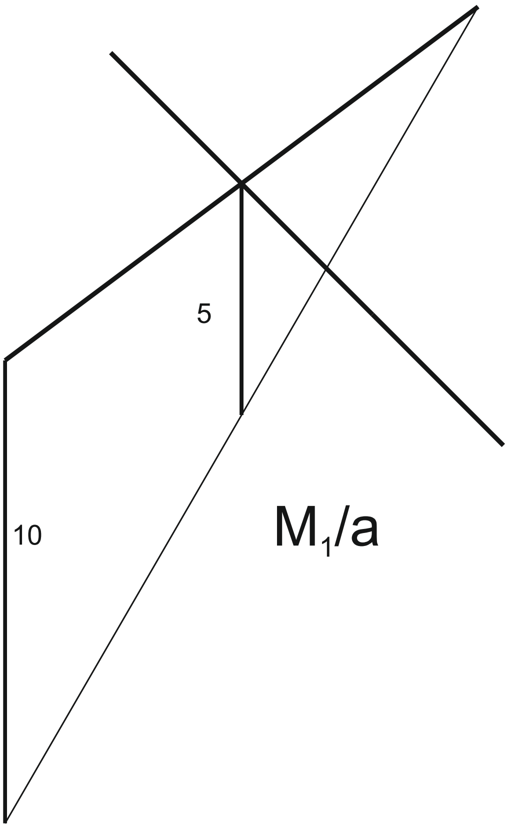


Schemat zastępczy:







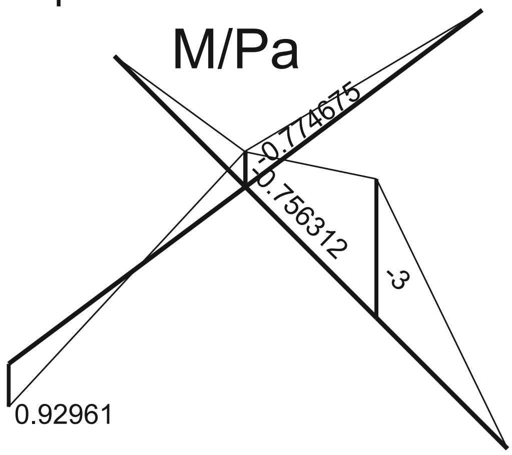


UR: $\frac{a^3}{EJ}$ $\frac{Pa^3}{EJ}$

333 1/3	-104 1/6	X_1			=	0
-104 1/6	46 1/6	X_2	+	6.750		0

X_1=	**-0.1549**	P
X_2 =	**-0.4958**	

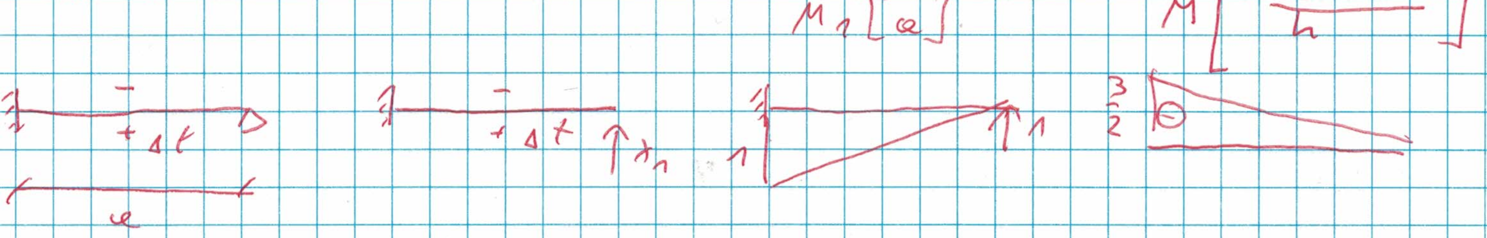
Odp:



oprac. K.Hetmański

MK 1 12. II 2020

Zad. 3



$$\delta_{11} = \frac{1}{3}\frac{a^3}{EJ} \qquad \delta_{10} = \frac{1}{2}\frac{a^2 \Delta t \alpha_t}{h} \qquad X_1 = -\frac{3}{2}\frac{EJ \Delta t \alpha_t}{a h}$$

$$M(x) = \frac{3}{2}\frac{EJ \Delta t \alpha_t}{a h}(x - a)$$

$$\kappa(x) = \frac{M(x)}{EJ} + \frac{\Delta t \alpha_t}{h} = \frac{3}{2}\frac{\Delta t \alpha_t}{a h}(x - a) + \frac{\Delta t \alpha_t}{h}$$

$$\kappa(x) = -\frac{d^2 w(x)}{dx^2} \qquad w(x) = -\iint \kappa(x)\, dx\, dx$$

$$w(x) = \frac{3}{2}\frac{\Delta t \alpha_t}{a h}\left(a\frac{x^2}{2} - \frac{x^3}{6}\right) - \frac{\Delta t \alpha_t}{h}\frac{x^2}{2} + C_1 x + C_2$$

$$w(0) = 0 \Rightarrow C_2 = 0 \qquad \varphi(0) = 0 \Rightarrow C_1 = 0$$

$$w(x) = \frac{3}{2}\frac{\Delta t \alpha_t}{a h}\left(a\frac{x^2}{2} - \frac{x^3}{6}\right) - \frac{\Delta t \alpha_t}{h}\frac{x^2}{2} =$$

$$= -\frac{1}{4}\frac{\Delta t \alpha_t}{a h}\left(a x^2 - x^3\right)$$