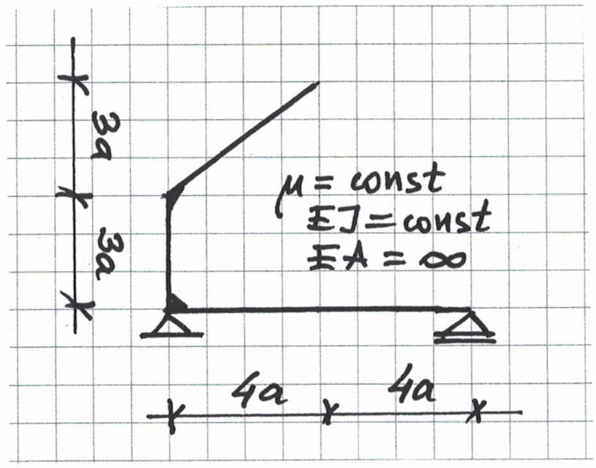
Egzamin z Mechaniki Konstrukcji II, 26 VI 2019 r.
Wydział Inżynierii Lądowej, studia stacjonarne

NAZWISKO imię				
Grupa	Data zaliczenia ćwiczeń		Numer albumu	
Ocena zadania 1	Ocena zadania 2	Ocena zadania 3	Ocena z egzaminu (po egz. ustnym)	Ocena łączna Data

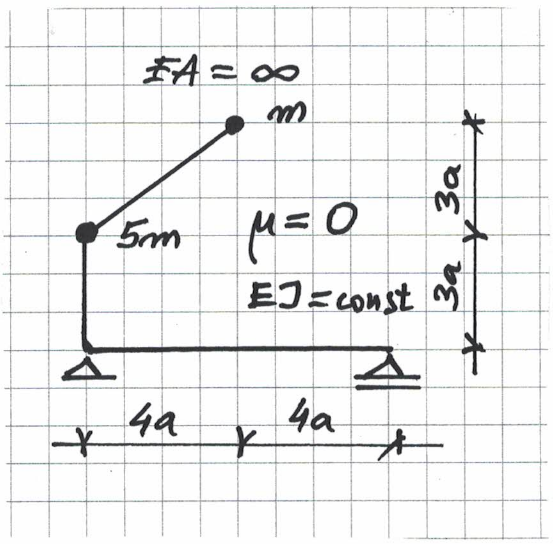
Zadanie 1

Znaleźć równania określające częstości drgań własnych danej ramy płaskiej o ciągłym rozkładzie masy.
(*Write down the equations which determine the eigenfrequencies of the given plane frame of continuous mass distribution.*)



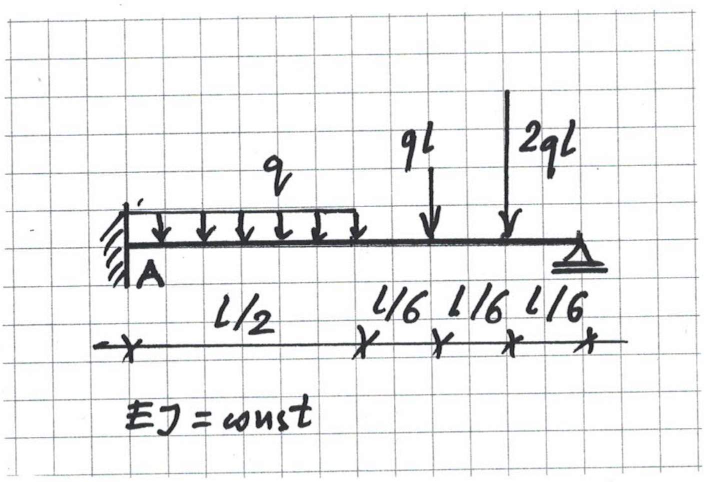
Zadanie 2

Znaleźć równania określające częstości drgań własnych danej ramy płaskiej o punktowym rozkładzie masy.
(*Write down the equations which determine the eigenfrequencies of the given plane frame of discrete mass distribution.*)



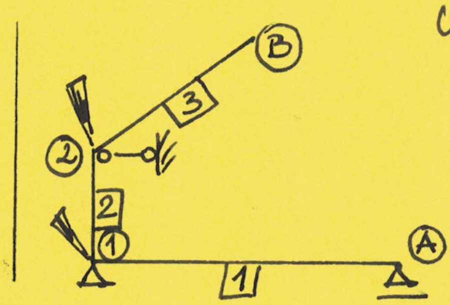
Zadanie 3

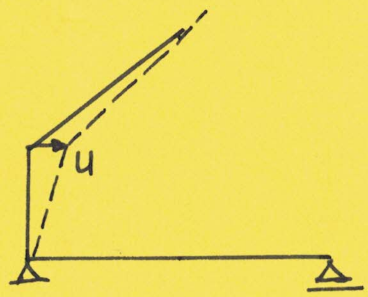
Obliczyć moment zginajacy M_A z wykorzystaniem metody linii wpływu.
(Compute the bending moment M_A *with using the method of influence lines)*



Egzamin MK2, 26.06.2019 zadanie 1

$\omega_i = ?$





	W_i	W_k	u
1	0	0	0
2	0	u	0
3	$\frac{3}{5}u$	0	$\frac{4}{5}u$

$$q = \begin{pmatrix} \varphi_1 \\ \varphi_2 \\ u/l \end{pmatrix}$$

$$\phi_1^1 = \frac{EI}{8l}\left[\alpha'(8\lambda)\varphi_1\right]$$

$$\phi_1^2 = \frac{EI}{3l}\left[\alpha(3\lambda)\varphi_1 + \beta(3\lambda)\varphi_2 - \delta(3\lambda)\frac{u}{3l}\right]$$

$$\phi_2^2 = \frac{EI}{3l}\left[\beta(3\lambda)\varphi_1 + \alpha(3\lambda)\varphi_2 - \theta(3\lambda)\frac{u}{3l}\right]$$

$$\phi_2^3 = \frac{EI}{5l}\left[\alpha''(5\lambda)\varphi_2 + \theta''(5\lambda)\frac{3}{5}u\cdot\frac{1}{5l}\right]$$

$$W_2^2 = -\frac{EI}{(3l)^2}\left[\delta(3\lambda)\varphi_1 + \theta(3\lambda)\varphi_2 - \gamma(3\lambda)\frac{u}{3l}\right]$$

$$W_2^3 = \frac{EI}{(5l)^2}\left[\theta''(5\lambda)\varphi_2 + \gamma''(5\lambda)\frac{3}{5}u\cdot\frac{1}{5l}\right]$$

$$B_{11}^{(3)} = \omega^2\mu\cdot 5l\cdot\frac{4}{5}u = \frac{EI}{l^2}\left(4\lambda^4\frac{u}{l}\right)$$

Równanie równowagi

$$\phi_1^1 + \phi_1^2 = 0$$

$$\phi_2^3 + \phi_2^2 = 0$$

$$W_2^2\bar{u} + W_2^3\cdot\frac{3}{5}\bar{u} - B_{11}^{(3)}\cdot\frac{4}{5}\bar{u} = 0$$

$$\mathbb{K}q = 0$$

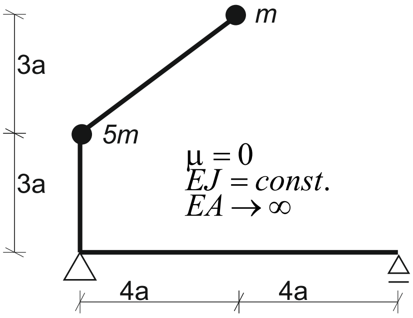
$$\det(\mathbb{K}) = 0 \rightarrow \omega_i$$

$$\mathbb{K} = \begin{pmatrix} \frac{\alpha(3\lambda)}{3} + \frac{\alpha'(8\lambda)}{8} & & \text{Sym} \\ \frac{\beta(3\lambda)}{3} & \frac{\alpha(3\lambda)}{3} + \frac{\alpha''(5\lambda)}{5} & \\ -\frac{\delta(3\lambda)}{9} & -\frac{\theta(3\lambda)}{9} + \frac{3\theta''(5\lambda)}{125} & K_{33} \end{pmatrix}$$

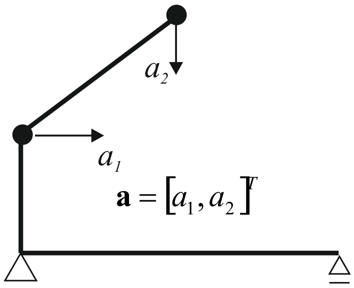
$$K_{33} = \frac{\gamma(3\lambda)}{27} + \frac{9\gamma''(5\lambda)}{3125} - 16\frac{\lambda^4}{5}$$

Rozwiązanie przygotował Jan Perzyński

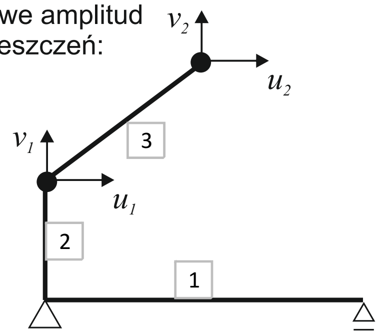
egzMK_2_26.06.2019_zad2



Dyn. stopnie swobody:



Składowe amplitud przemieszczeń:



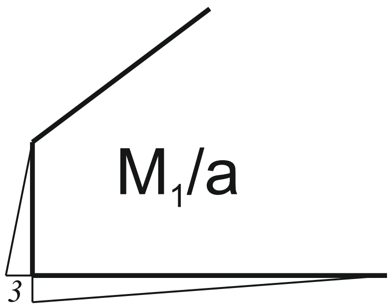
$u_1 = a_1$
$v_1 = 0$

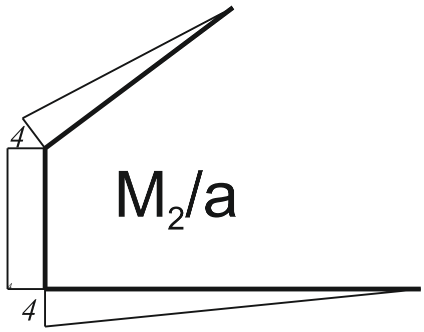
$u_2 = ?$
$v_2 = -a_2$

Oblicz.:

$$-a_2 = 0 - 4a\psi_3 \Rightarrow \psi_3 = \frac{a_2}{4a}$$

$$u_2 = a_1 + 3a\left(\frac{a_2}{4a}\right) = \underline{a_1 + \frac{3}{4}a_2}$$





Macierz mas M:

m	6	3/4
	3/4	1 9/16

Macierz D:

$\left[\frac{a^3}{EJ}\right]\cdot$

33	50
50	117.33

Odp.: $$\underbrace{(\mathbf{I} - \omega^2 \mathbf{DM})}_{\mathbf{A}(\omega)}\mathbf{a} = \mathbf{0}, \quad \mathbf{I} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

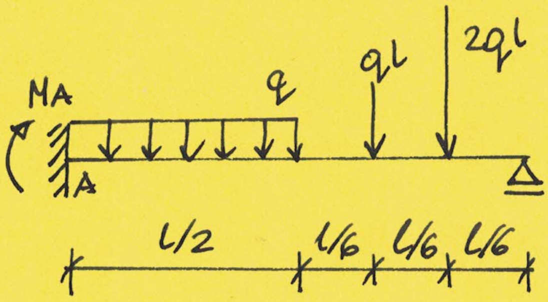
$$\det \mathbf{A}(\omega) = 0 \rightarrow \omega_i$$

Oprac. K. Hetmański.

$M_A = ?$

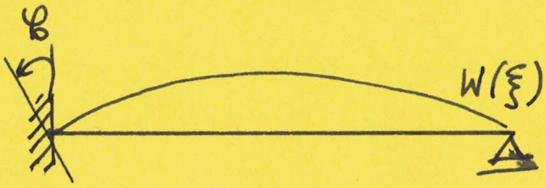
Egzamin MK2, 26.06.2019

Zadanie 3



EJ=const

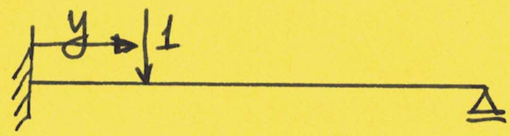
Z twierdzenia Bettiego



$$-M_A \varphi_0 + W(\eta)\cdot 1 = 0$$

$$M_A(\eta) = \frac{1}{\varphi_0} W(\eta)$$

$\eta = \frac{y}{l}$



Linia ugięcia od obciążenia obrotem φ_0

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

$$W(0) = 0$$

$$\varphi(0) = -\varphi_0 \rightarrow \frac{1}{l} W'(0) = -\varphi_0$$

$$M(1) = 0$$

$$W(1) = 0$$

Wtedy

$$W(\xi) = \varphi_0 l \left(-\xi + \frac{3}{2}\xi^2 - \frac{1}{2}\xi^3\right)$$

Czyli linia wpływu $M_A(\eta) = l\left(-\eta + \frac{3}{2}\eta^2 - \frac{1}{2}\eta^3\right)$

Wtedy

$$M_A = \int_0^{1/2} M_A(\eta)\cdot q \, d\eta + M_A\left(\frac{2}{3}\right)\cdot ql + M_A\left(\frac{5}{6}\right)\cdot 2ql = \underline{\underline{0.38ql^2}}$$

Rozwiązanie przygotował: Jan Pełczyński