

Egzamin z Mechaniki Konstrukcji (MK IPB), 17.06.2017
studia niestacjonarne

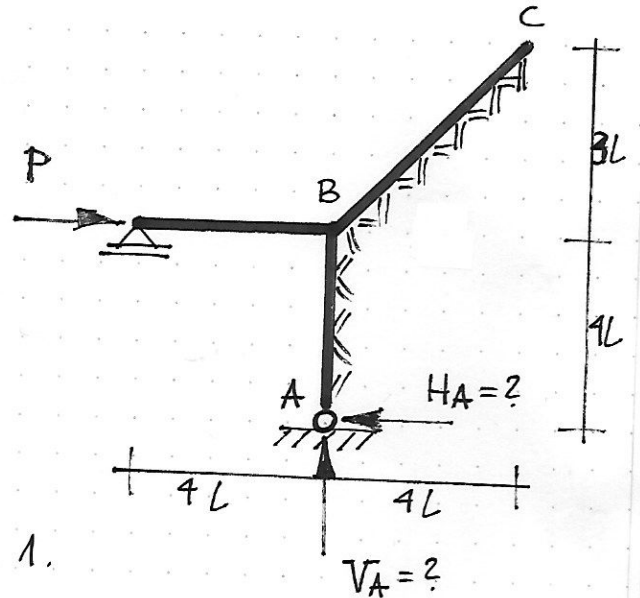
NAZWISKO, Imię				
rok akademicki zaliczenia ćwiczeń		nr albumu	grupa (IPB / BZ)	tryb studiów (ST / NST)
ocena zadania 1	ocena zadania 2	ocena zadania 3	ocena egzaminu	ocena łączna

Zadanie 1.

$$EJ = const., \quad k = 0,0324 \frac{EJ}{l^4}$$

Oblicz reakcje H_A, V_A w podporze A w ramie z rys. 1.

Rama jest podparta sprężystością na odcinkach $A-B$ oraz $B-C$.

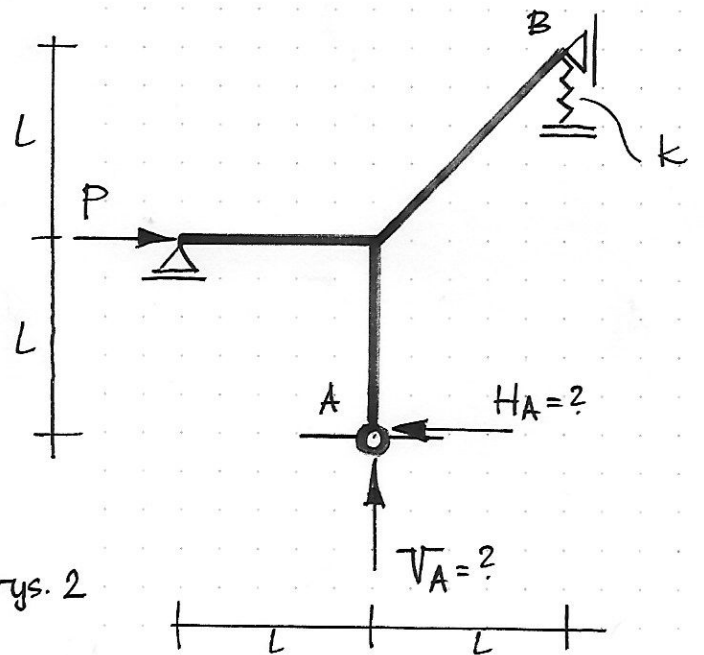


rys. 1.

Zadanie 2.

$$EJ = const., \quad k = 4 \frac{EJ}{l^3}$$

Oblicz reakcje H_A, V_A w podporze A w ramie z rys. 2

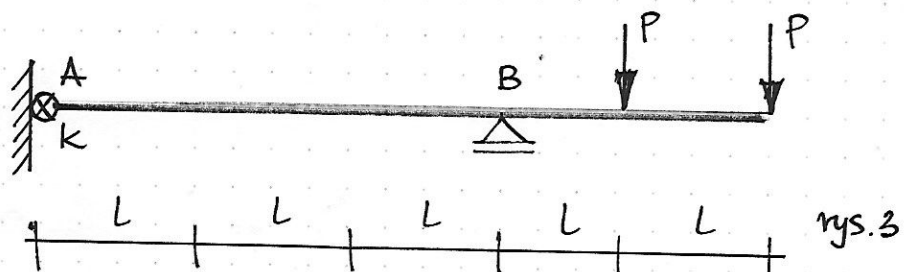


rys. 2

Zadanie 3.

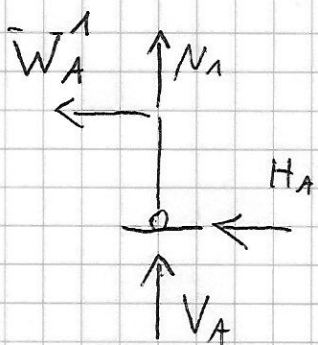
$$EJ = const., \quad k = 10 \frac{EJ}{l}$$

Wyznacz linię ugięcia odcinka $A-B$ belki z rys. 3.



rys. 3

Sily działające w węzle A:

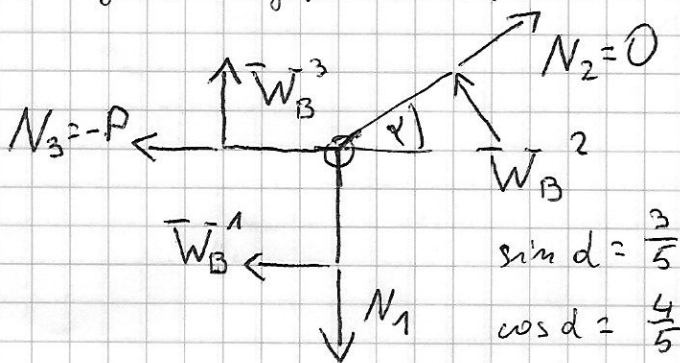


$$V_A = -N_1$$

$$H_A = -W_A^1$$

VGW

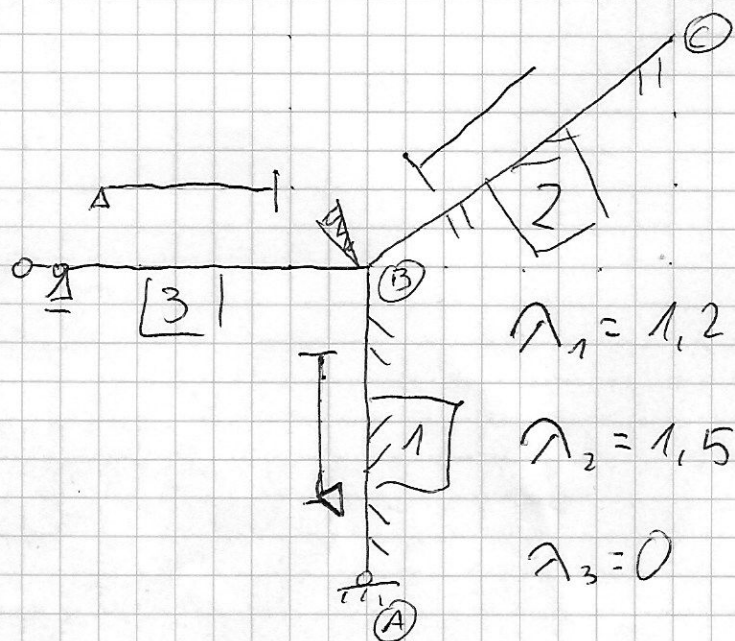
Sily działające w węzle B:



$$N_1 = \bar{W}_B^3 + \bar{W}_B^2 \cdot \cos d$$

$$V_A = -\bar{W}_B^3 - \bar{W}_B^2 \cdot \frac{4}{5}$$

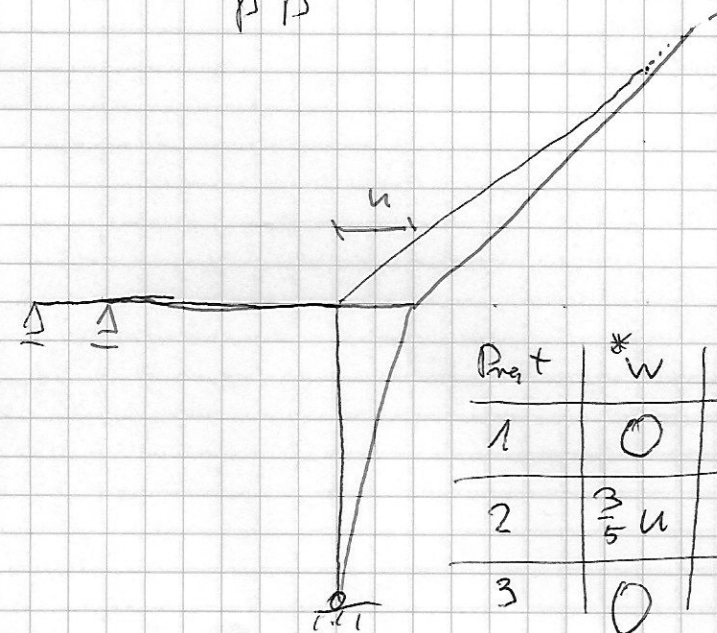
PIP



$$\lambda_1 = 1,2$$

$$\lambda_2 = 1,5$$

$$\lambda_3 = 0$$



Pręt	*w	w*
1	0	u
2	$\frac{3}{5}u$	0
3	0	0

RR:

$$\int \bar{\Phi}_B^1 + \bar{\Phi}_B^2 + \bar{\Phi}_B^3 = 0$$

$$-\left[\bar{W}_B^1 \bar{u} + \bar{W}_B^2 \cdot \frac{3}{5} \bar{u} \right] + P \bar{u} = 0$$

$$\frac{EJ}{l} \begin{bmatrix} 2,073 & -0,123 \\ -0,123 & 0,144 \end{bmatrix} \begin{bmatrix} \varphi_B \\ \frac{u}{l} \end{bmatrix} = \begin{bmatrix} 0 \\ 1 \end{bmatrix} \frac{Pl}{EJ}$$

$$\bar{W}_A^1 = -0,143P$$

$$V_A = -0,4898P$$

$$\bar{W}_B^2 = 0,511P \Rightarrow$$

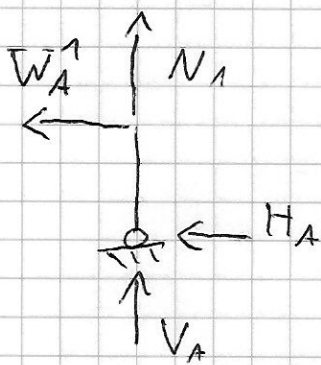
$$H_A = 0,143P$$

$$\bar{W}_B^3 = 0,081P$$

$$\varphi_B = 0,433 \frac{Pl^2}{EJ}$$

$$u = 7,233 \frac{Pl^2}{EJ}$$

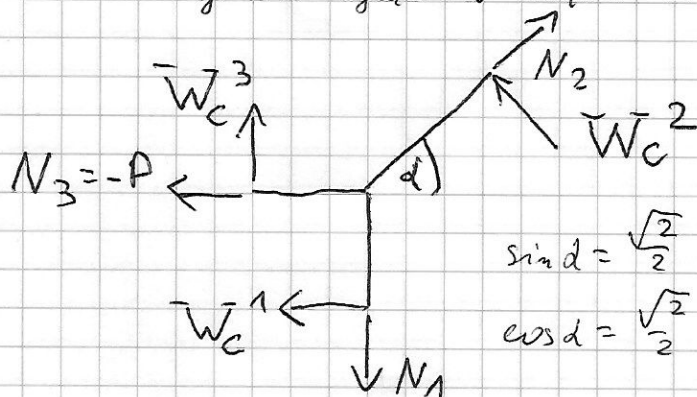
Sily dzialajace w węzle A:



$$V_A = -N_1$$

$$H_A = -W_A^1$$

Sily dzialajace w węzle C:



$$\sin \alpha = \frac{\sqrt{2}}{2}$$

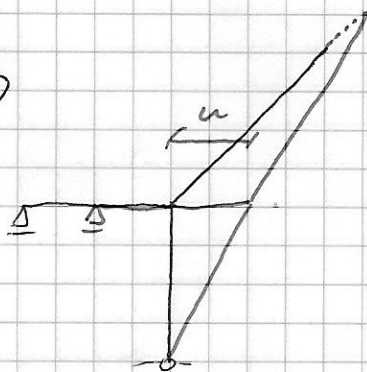
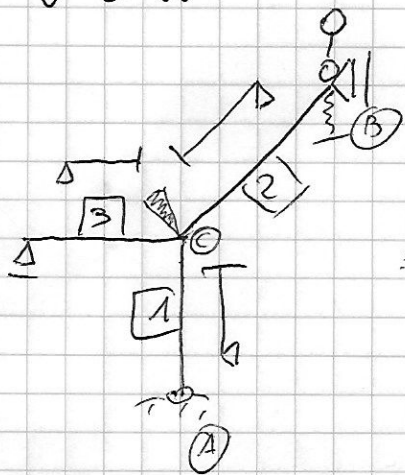
$$\cos \alpha = \frac{\sqrt{2}}{2}$$

$$N_1 = \bar{W}_c^1 + W_c^3 - P + \sqrt{2} W_c^2$$

$$V_A = -\bar{W}_c^1 - \bar{W}_c^3 + P - \sqrt{2} \bar{W}_c^2$$

UGW

PP



Przet	w^*	w^*	
1	0	u	$\Delta W = u$
2	$\frac{\sqrt{2}}{2} u$	$-\frac{\sqrt{2}}{2} u$	$Q_w = ku =$
3	0	0	$= 4 \frac{E\alpha}{l^2} \frac{u}{c}$

RR:

$$\bar{\Phi}_c^1 + \bar{\Phi}_c^2 + \bar{\Phi}_c^3 = 0$$

$$-\left[W_c^1 \bar{u} + \bar{W}_c^2 \frac{\sqrt{2}}{2} \bar{u} + \bar{W}_c^3 \left(-\frac{\sqrt{2}}{2} \bar{u}\right) \right] + P \bar{u} - Q_w \bar{u} = 0$$

$$\frac{E\alpha}{l} \begin{bmatrix} 8,121 & -0,879 \\ -0,879 & 9,121 \end{bmatrix} \begin{bmatrix} u_c \\ \frac{u}{c} \end{bmatrix} = \begin{bmatrix} 0 \\ 1 \end{bmatrix} P l \Rightarrow \begin{cases} u_c = 0,012 \frac{Pl^2}{E\alpha} \\ \frac{u}{c} = 0,110 \frac{Pl^2}{E\alpha} \end{cases}$$

$$\bar{W}_c^1 = 0,296 P$$

$$\bar{W}_A^1 = -0,296 P$$

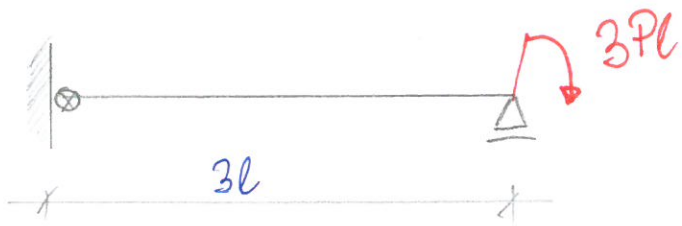
$$H_A = 0,296 P$$

$$\bar{W}_c^2 = 0,184 P$$

$$V_A = 0,407 P$$

$$\bar{W}_c^3 = 0,036 P$$

Schemat zredukowany



Schemat zastępczy



Równanie równowagi

$$\Phi_A^{(1)} + Q_\varphi = 0$$

Wzory transformacyjne i relacja konstytutywna dla węzła

$$\Phi_A^1 = \frac{EY}{3l} [3\varphi_A] + \frac{3Pl}{2}$$

$$Q_\varphi = k \cdot \delta\varphi = k\varphi_A = 10 \frac{EY}{l} \varphi_A$$

$$11 \frac{EY}{l} \varphi_A + \frac{3}{2} Pl = 0 \Rightarrow \varphi_A = -\frac{3}{22} \frac{Pl^2}{EY}$$

linia ugięcia AB

$$w(x) = C_0 + C_1 x + C_2 x^2 + C_3 x^3$$

Warunki brzegowe

$$w(0) = 0$$

$$w(3l) = 0$$

$$\frac{dw}{dx}(0) = \varphi_A$$

$$M(3l) = -EY \frac{d^2 w}{dx^2}(3l) = -3Pl$$

$$w(x) = -\frac{3Pl^2}{22EY} x - \frac{15Pl}{22EY} x^2 + \frac{8P}{33EY} x^3$$