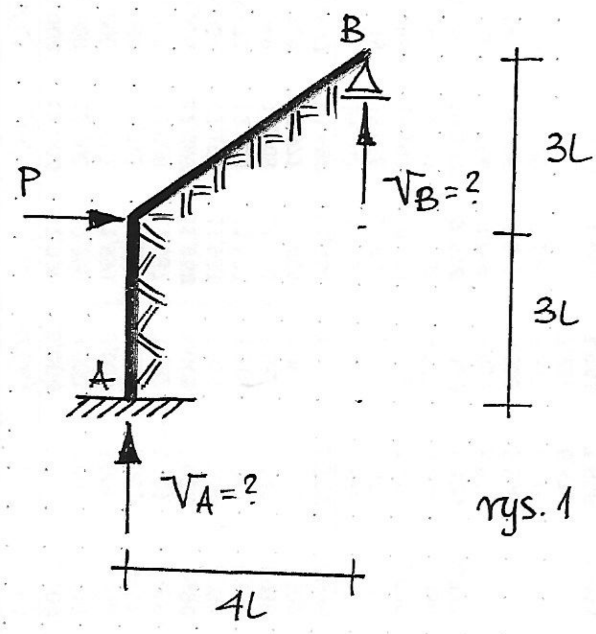
Egzamin z Mechaniki Konstrukcji (MK IPB), 24.06.2017
studia niestacjonarne

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.

$EJ = const., \qquad k = 0{,}0064\dfrac{EJ}{l^4}$

Oblicz reakcję V_A w podporze A oraz reakcję V_B w podporze B w ramie z rys. 1.

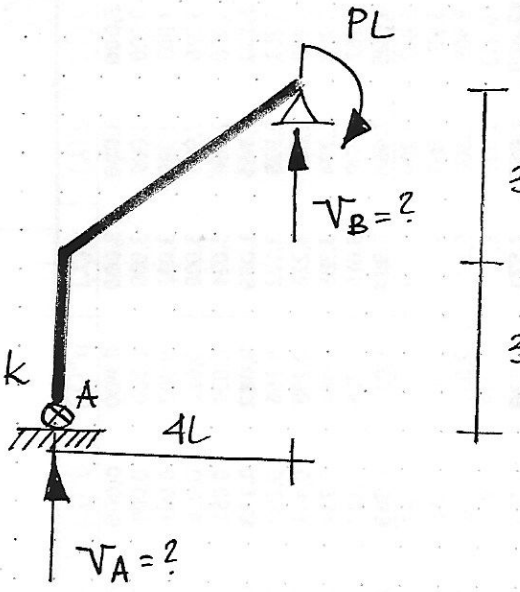


rys. 1

Zadanie 2.

$EJ = const., \qquad k = 4\dfrac{EJ}{l}$

Oblicz reakcję V_A w podporze A oraz reakcję V_B w podporze B w ramie z rys. 2

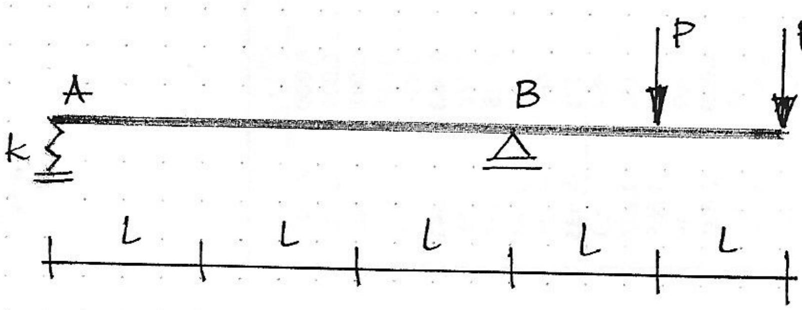


rys. 2

Zadanie 3.

$EJ = const., \qquad k = 10\dfrac{EJ}{l^3}$

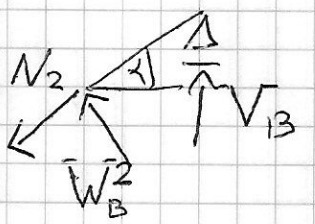
Wyznacz linię ugięcia odcinka A-B belki z rys. 3.



rys. 3

Egzamin z MK3 (IPB$_2$) 24.VI 2017, zadanie 1

Siły w węźle B:

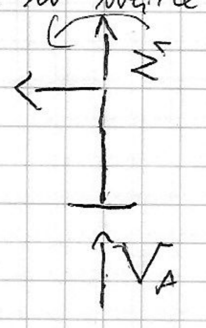


$\sin\alpha = \frac{3}{5}$

$\cos\alpha = \frac{4}{5}$

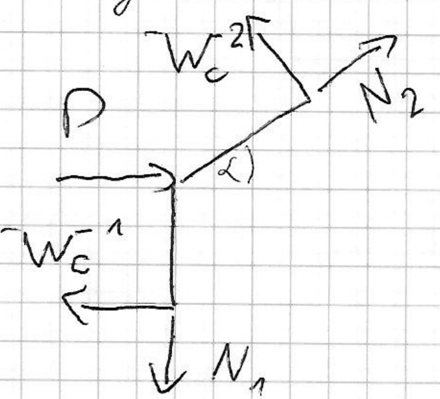
$$V_B = -\frac{\bar{W}_B^2}{\cos\alpha} = -\frac{5}{4}\bar{W}_B^2$$

Siły w węźle A:



$$V_A = -N_1$$

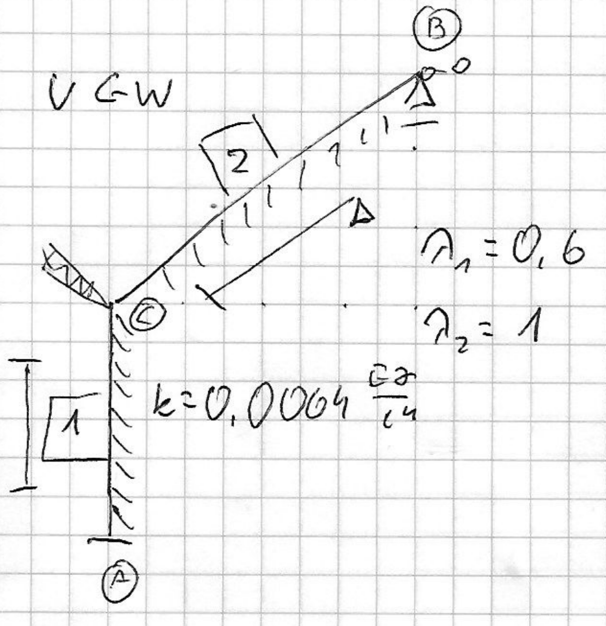
Siły w węźle C:



$$N_1 = \bar{W}_C^2 \cdot \frac{1}{\cos\alpha} + (\bar{W}_C^1 - P)\frac{\sin\alpha}{\cos\alpha}$$

$$V_A = -\frac{5}{4}\bar{W}_C^2 - (\bar{W}_C^1 - P)\frac{3}{4}$$

UGW



$\lambda_1 = 0{,}6$

$\lambda_2 = 1$

RR:

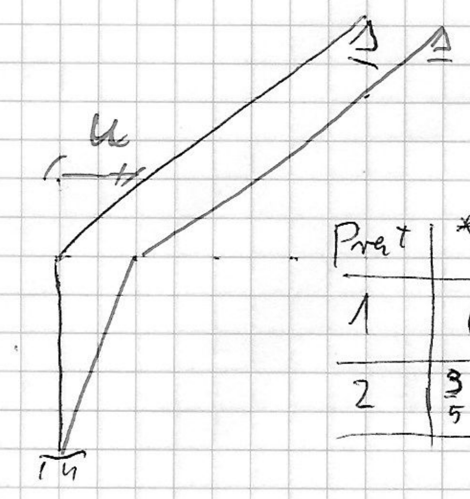
$$\begin{cases} \bar{\Phi}_C^1 + \bar{\Phi}_C^2 = 0 \\ -\left[\bar{W}_C^1 \bar{u} + \bar{W}_C^2 \frac{3}{5}\bar{u} + \bar{W}_B^2 \frac{3}{5}\bar{u}\right] + P\bar{u} = 0 \end{cases}$$

$$\frac{EJ}{l}\begin{bmatrix} 1{,}95 & -0{,}658 \\ -0{,}658 & 0{,}463 \end{bmatrix}\begin{bmatrix} \varphi_C \\ \frac{u}{l} \end{bmatrix} = \begin{bmatrix} 0 \\ 1 \end{bmatrix} Pl$$

$$\varphi_C = 1{,}400\,\frac{Pl^2}{EJ}$$

$$\frac{u}{l} = 4{,}149\,\frac{Pl^2}{EJ}$$

PP



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

$\bar{W}_B^2 = -0{,}130P$

$\bar{W}_C^2 = 0{,}236P$

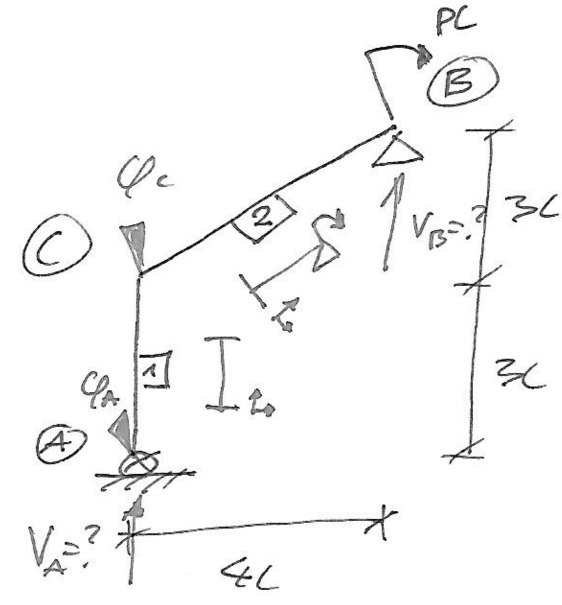
$\bar{W}_C^1 = 0{,}936P$

$\Rightarrow$

$V_B = 0{,}1625P$

$V_A = -0{,}247P$

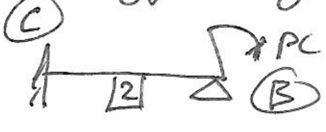
Egzamin MK IPB ustac. 24.06.2017r Zadanie 2



$k = 4\frac{EJ}{L}$, $EJ = const$

$$q = \begin{bmatrix} \varphi_A \\ \varphi_C \end{bmatrix}$$

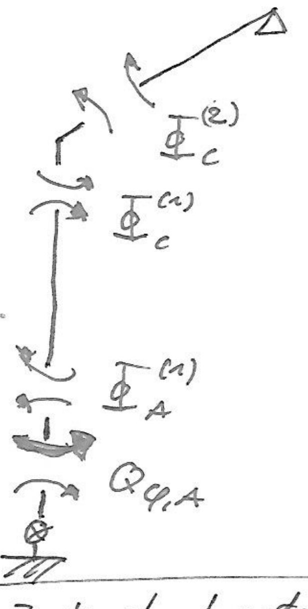
Moment wyjściowy:



$$\Phi_C^{(02)} = +\frac{PL}{2}$$

R.R.M.P.:

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



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

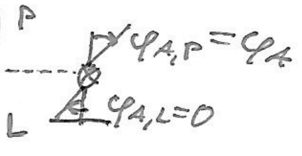
Wzory transformacyjne:

$$\Phi_A^{(1)} = \frac{2EJ}{3L}[2\varphi_A + \varphi_C - 3\cdot 0]$$

$$\Phi_C^{(1)} = \frac{2EJ}{3L}[\varphi_A + 2\varphi_C - 3\cdot 0]$$

$$\Phi_C^{(2)} = \frac{3EJ}{5L}[\varphi_C - 0] + \Phi_C^{(02)}$$

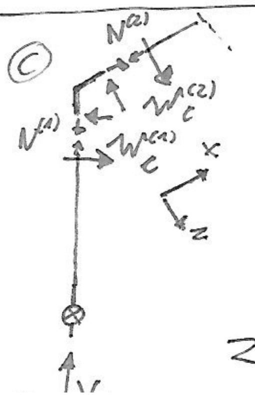
Związek konstytutywny podpory podatnej:



$$\Delta\varphi_A = \varphi_{A,P} - \varphi_{A,L} = \varphi_A$$

$$Q_{\varphi,A} = k\cdot\Delta\varphi_A = \frac{EJ}{L}[4\varphi_A]$$

$$\Rightarrow \frac{EJ}{L}\begin{bmatrix} \frac{16}{3} & \frac{2}{3} \\ \frac{2}{3} & \frac{29}{15} \end{bmatrix}\begin{bmatrix} \varphi_A \\ \varphi_C \end{bmatrix} = \begin{bmatrix} 0 \\ -\frac{PL}{2} \end{bmatrix} \Rightarrow \begin{matrix} \varphi_A = 0.034\frac{PL^2}{EJ} \\ \varphi_C = -0.270\frac{PL^2}{EJ} \end{matrix} \xrightarrow{\text{wz. trans}} \begin{matrix} W_C^{(1)} = 0.158P \\ W_C^{(2)} = 0.268P \end{matrix}$$



Równanie równowagi węzła C na oś z:

$$\Sigma z: \frac{4}{5}N^{(1)} - \frac{3}{5}W_C^{(1)} - W_C^{(2)} = 0$$

$$N^{(1)} = \frac{3}{4}W_C^{(1)} + \frac{5}{4}W_C^{(2)} = 0.453P$$

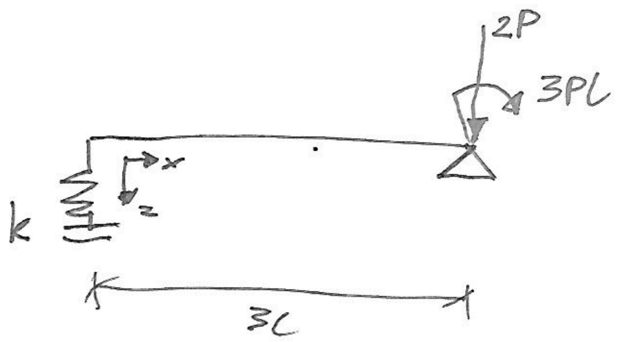
Z równowagi pionowego pręta na pion:

$V_A + N^{(1)} = 0 \Rightarrow \boxed{V_A = -N^{(1)} = -0.453P}$

Z równowagi globalnej na pion: $V_A + V_B = 0 \Rightarrow \boxed{V_B = -V_A = 0.453P}$

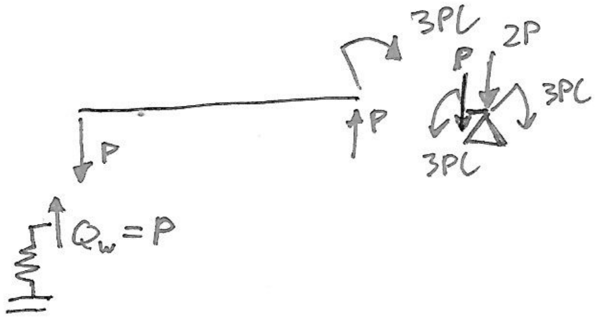
Egzamin MK IPB n.stac. 24.06.17 Zadanie 3

Redukcja wspornika:



$$k = 10\frac{EJ}{L^3}$$

Belka jest statycznie wyznaczalna, więc łatwo dostajemy:



zw. konst. podpory podatnej:

$$Q_w = k\cdot\Delta w \Rightarrow \Delta w = \frac{P}{k}$$

Mamy $\Delta w = 0 - w(0) \Rightarrow w(0) = -\frac{P}{k} = -\frac{1}{10}\frac{PL^3}{EJ}$

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

warunki brzegowe (conajmniej 2 kinematyczne):

$w(0) = -\frac{1}{10}\frac{PL^3}{EJ}$ $\qquad w(3L) = 0$

$M(0) = 0$ $\qquad M(3L) = -3PL$

$$\Rightarrow w(x) = \frac{PL^3}{EJ}\left[\frac{1}{10} - \frac{22}{5}\left(\frac{x}{3L}\right) + \frac{9}{2}\left(\frac{x}{3L}\right)^3\right]$$