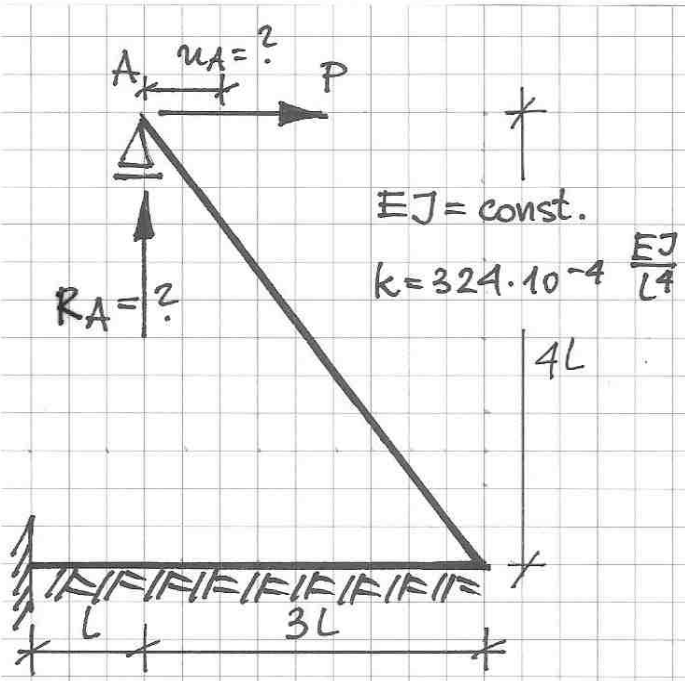
Egzamin z Mechaniki Konstrukcji, 23.06.2015
Exam on the Mechanics of Structures

NAZWISKO, Imię LAST NAME, First Name				
ocena zadania 1	ocena zadania 2	ocena zadania 3	ocena egzaminu	ocena łączna

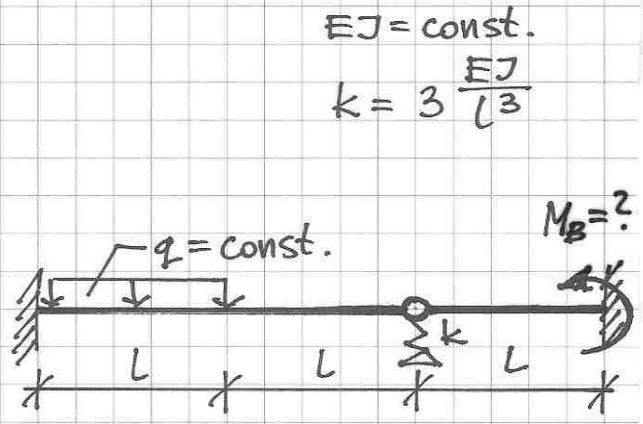
Zadanie 1 (Rys. 1) **Problem #1 (Fig. 1)**
Oblicz reakcję R_A.
Calculate the reaction R_A.

Zadanie 2 (Rys. 1) **Problem #2 (Fig. 1)**
Oblicz poziome przemieszczenie u_A .
Calculate the horizontal displacement u_A .

Zadanie 3 (Rys. 2) **Problem #3 (Fig. 2)**
Oblicz wartość momentu M_B korzystając z tw. Bettiego.
Calculate the moment M_B by the Betti Theorem.



Rys. 1 Fig. 1

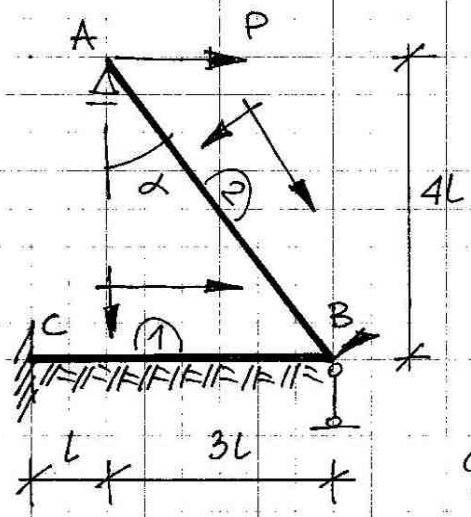


Rys. 2 Fig. 2

λ	C(λ)	S(λ)	T(λ)	R(λ)	M(λ)	N(λ)	C'(λ)	T'(λ)	R'(λ)
0,0	**4,000**	**2,000**	**6,000**	**6,000**	**12,000**	**12,000**	**3,000**	**3,000**	**3,000**
0,1	4,000	2,000	6,000	6,000	12,000	12,000	3,000	3,000	3,000
0,2	4,000	2,000	6,000	6,000	12,002	11,999	3,000	3,001	3,000
0,3	4,000	2,000	6,002	5,999	12,012	11,996	3,001	3,003	2,999
0,4	4,001	1,999	6,005	5,997	12,038	11,987	3,002	3,009	2,996
0,5	**4,002**	**1,998**	**6,013**	**5,992**	**12,093**	**11,968**	**3,005**	**3,021**	**2,990**
0,6	4,005	1,996	6,027	5,984	12,192	11,933	3,010	3,044	2,980
0,7	4,009	1,993	6,050	5,970	12,356	11,877	3,018	3,082	2,962
0,8	4,016	1,988	6,086	5,949	12,608	11,790	3,031	3,140	2,936
0,9	4,025	1,981	6,137	5,919	12,972	11,665	3,050	3,223	2,898
1,0	**4,038**	**1,972**	**6,208**	**5,877**	**13,480**	**11,491**	**3,075**	**3,338**	**2,846**
1,1	4,055	1,959	6,304	5,821	14,163	11,258	3,109	3,492	2,776
1,2	4,078	1,942	6,429	5,748	15,056	10,956	3,153	3,692	2,687
1,3	4,107	1,920	6,589	5,656	16,197	10,573	3,209	3,944	2,575
1,4	4,143	1,894	6,787	5,541	17,624	10,100	3,277	4,254	2,438
1,5	**4,186**	**1,862**	**7,030**	**5,402**	**19,377**	**9,526**	**3,359**	**4,629**	**2,275**
1,6	4,239	1,823	7,323	5,235	21,498	8,844	3,455	5,071	2,086
1,7	4,301	1,778	7,670	5,041	24,026	8,049	3,566	5,586	1,871
1,8	4,373	1,726	8,075	4,818	27,000	7,136	3,693	6,174	1,632
1,9	4,456	1,666	8,541	4,564	30,459	6,106	3,833	6,835	1,370
2,0	**4,550**	**1,600**	**9,073**	**4,280**	**34,438**	**4,962**	**3,988**	**7,568**	**1,091**

Egzamin z MK3 (IPB) 23.06.2015 Zadanie 1

Zadanie 2

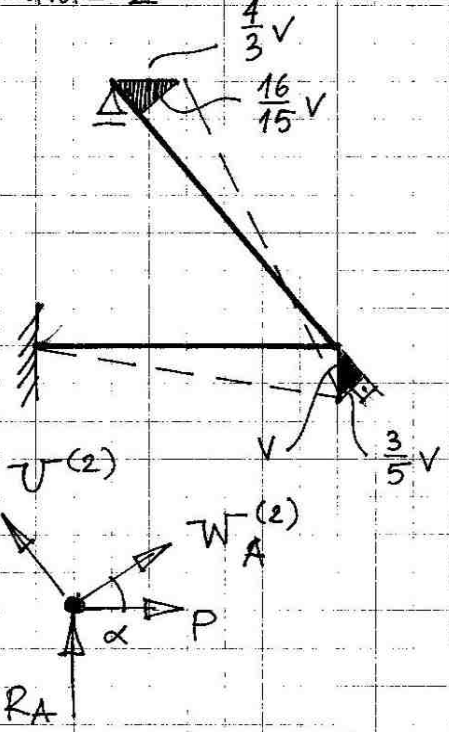


$EJ = const.$

$k = 324 \cdot 10^{-4} \frac{EJ}{L^4}$

$\lambda^4 = \frac{kL^4}{4EJ}$

$q = [\varphi_B \quad \frac{V}{L}]^T$



Warunek równowagi w punkcie A:

Equilibrium condition at point A:

$R_A \cdot \sin\alpha + W_A^{(2)} + P\cos\alpha = 0$

$R_A = -\frac{1}{\sin\alpha} W_A^{(2)} - P \cdot \frac{1}{tg\alpha}$

$\sin\alpha = \frac{3}{5} \qquad tg\alpha = \frac{3}{4}$

$\lambda = 0{,}3 \qquad \lambda^{(1)} = 1{,}2$

$$\begin{cases} \Phi_B^{(1)} + \Phi_B^{(2)} = 0 \\ W_B^{(1)} \cdot \overline{V} + W_A^{(2)} \cdot (-\frac{16}{15}\overline{V}) + W_B^{(2)} \cdot \frac{3}{5}\overline{V} = P \cdot \frac{4}{3}\overline{V} \end{cases}$$

$\Phi_B^{(1)} = \frac{EJ}{4L}\left[C(1,2)\varphi_B - T(1,2)\frac{V}{4L}\right]$

$\Phi_B^{(2)} = \frac{3EJ}{5L}\left[\varphi_B - \frac{V}{3L}\right]$

$W_B^{(1)} = -\frac{EJ}{16L^2}\left[T(1,2)\varphi_B - M(1,2)\frac{V}{4L}\right]$

$W_A^{(2)} = \frac{3EJ}{25L^2}\left[\varphi_B - \frac{V}{3L}\right] \qquad W_B^{(2)} = -\frac{3EJ}{25L^2}\left[\varphi_B - \frac{V}{3L}\right]$

$$\begin{cases} 1{,}62\,\varphi_B - 0{,}602\,\frac{V}{L} = 0 \\ -0{,}602\,\varphi_B + 0{,}302\,\frac{V}{L} = 1{,}333\,\frac{PL^2}{EJ} \end{cases} \rightarrow \quad \varphi_B = 6{,}329\,\frac{PL^2}{EJ}$$

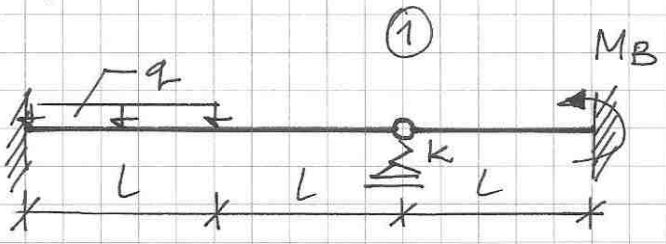
$$\frac{V}{L} = 17{,}033\,\frac{PL^2}{EJ}$$

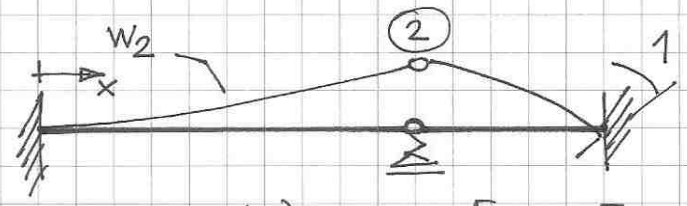
$u_A = \frac{4}{3}V = 22{,}711\,\frac{PL^3}{EJ}$

$R_A = -1{,}4636\,P$

opracował: G. Dzierżanowski

Egzamin z MK3 (IPB) 23.06.2015 Zadanie 3





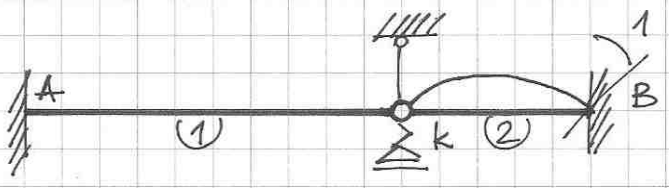
$W_2 = W_2(x)$, $x \in [0, 2L]$

Z tw. Bettiego:
By the Betti Theorem:

$$-M_B \cdot 1 + \int_0^L q\, W_2(x)\, dx = 0$$

$$M_B = q \int_0^L W_2(x)\, dx$$

gdzie $W_2 = W_2(x)$, $x \in [0, 2L]$ jest linią ugięcia stowarzyszoną z obrotem = 1 w punkcie B.
where $W_2 = W_2(x)$, $x \in [0, 2L]$ denotes the deflection line related to the rotation angle = 1 at point B.

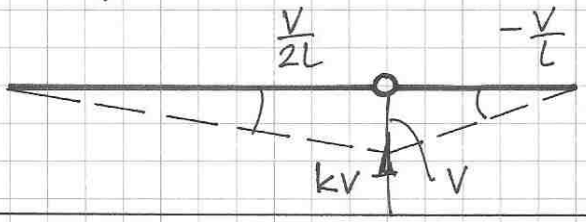


$EJ = const.$

$k = 3\frac{EJ}{L^3}$ $\qquad \tau = \frac{kL^3}{EJ} = 3$

$\overset{\circ}{\Phi}{}^{(2)}_B = \frac{3EJ}{L} \cdot 1$

$q = \left[\frac{V}{L}\right]$



$$\Phi^{(1)}_A \cdot \frac{\bar{V}}{2L} + \Phi^{(2)}_B \cdot \left(-\frac{\bar{V}}{L}\right) - kv \cdot \bar{v} = 0$$

$$\Phi^{(1)}_A = \frac{3EJ}{2L}\left[-\frac{V}{2L}\right]$$

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

$$\frac{EJ}{L}\left\{\left[\frac{3}{8} + 3 + \tau\right]\frac{V}{L}\right\} + 3\frac{EJ}{L} = 0$$

$$\frac{V}{L} = -\frac{24}{51}$$

$W_2(x) = C_0 + C_1 x + C_2 x^2 + C_3 x^3$

$W_2(0) = 0$
$W_2'(0) = 0$
$W_2(2L) = -\frac{24}{51} \cdot L$
$W_2''(2L) = 0$

$\rightarrow$ $C_0 = 0$ $\quad C_1 = 0$ $\quad C_2 = -0{,}176\,\frac{1}{L}$
$C_3 = 0{,}029\,\frac{1}{L}$

$$W_2(x) = L \cdot \left(\frac{1}{34}\frac{x^3}{L^3} - \frac{3}{17}\frac{x^2}{L^2}\right)$$

$$M_B = -0{,}051\, qL^2$$

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