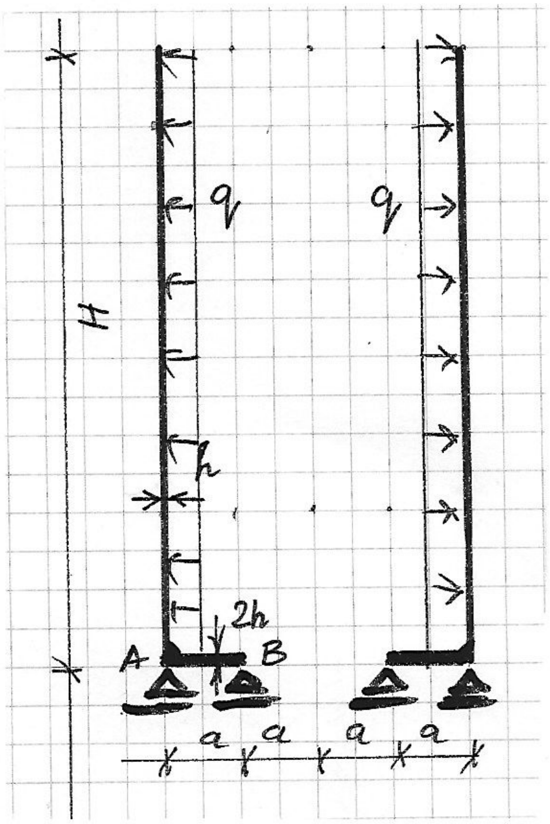
EGZAMIN MK (MK3) KB studia mgr stacj. dnia 31 I 2017 r.

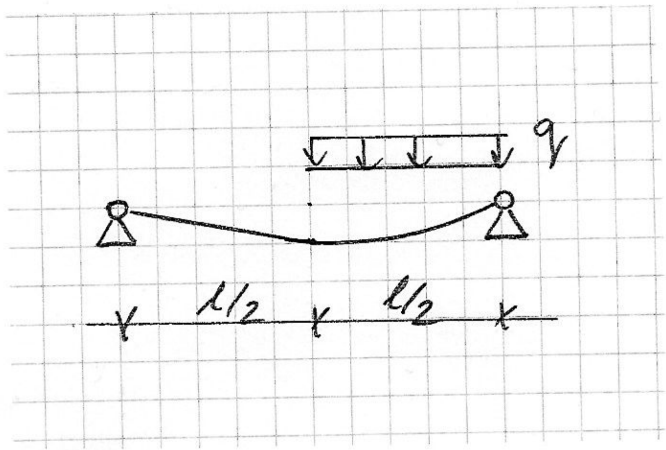
<table>
<tr><td colspan="3">NAZWISKO Imię</td></tr>
<tr><td colspan="2">Nr albumu</td><td>Ocena z ćwiczeń projektowych</td></tr>
<tr><td rowspan="2">ocena
zadania 1</td><td rowspan="2">ocena
zadania 2</td><td>Ocena z egzaminu po ustnym</td></tr>
<tr><td>Ocena łączna, data, podpis</td></tr>
</table>

Zadanie 1.
Dany jest wysoki zbiornik walcowy z dnem pierścieniowym, obciążony jak na rysunku. Znaleźc przemieszczenia promieniowe u_A, u_B.
Dane: *a, h=a/10, q, H, E*=30GPa, współczynnik Poissona =0.2.

(The given cylindrical vessel with the annular bottom plate is loaded as in the figure. Compute radial displacements u_A, u_B.. Data: a, h=a/10, q,H, E=30GPa, Poisson's ratio=0.2)

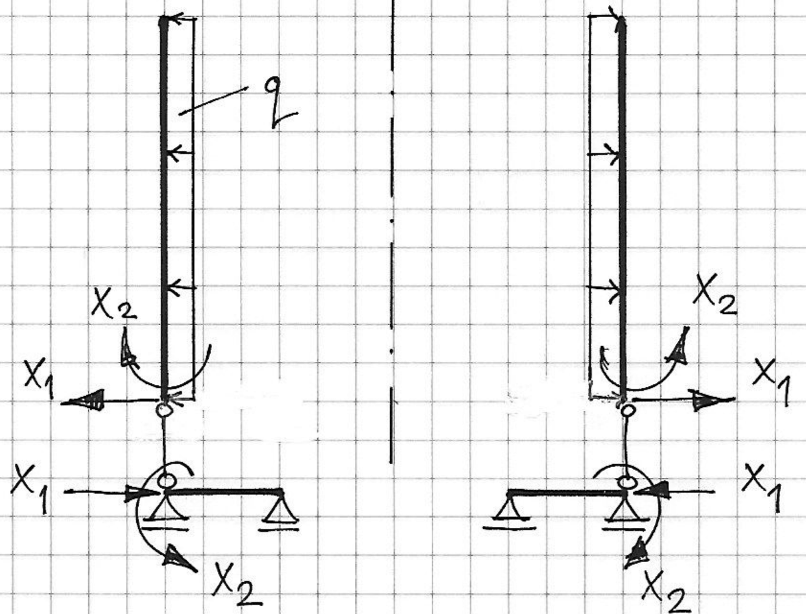


Zadanie 2.
Dane jest cięgno nierozciągliwe obciążone jak na rysunku. Obliczyć rzędną krzywej zwisu w środku cięgna.
Dane L_0= 1.05 *l*.
(The given inextensible cable is loaded as in the figure. Compute the ordinate of the sag function at the middle point of the cable. Given: L_0= 1.05 l.)



Zadanie 1 / Problem # 1

Schemat zastępczy / Primary structure



płyta / plate: $h_1 = 2h$

$$C_1 = \frac{Eh_1}{1-\nu^2} = 6{,}25 \cdot 10^6 a$$

$$D_1 = \frac{Eh_1^3}{12(1-\nu^2)} = 20833\ a^3$$

walec / cylinder: $h_2 = h$

$R = 2a$

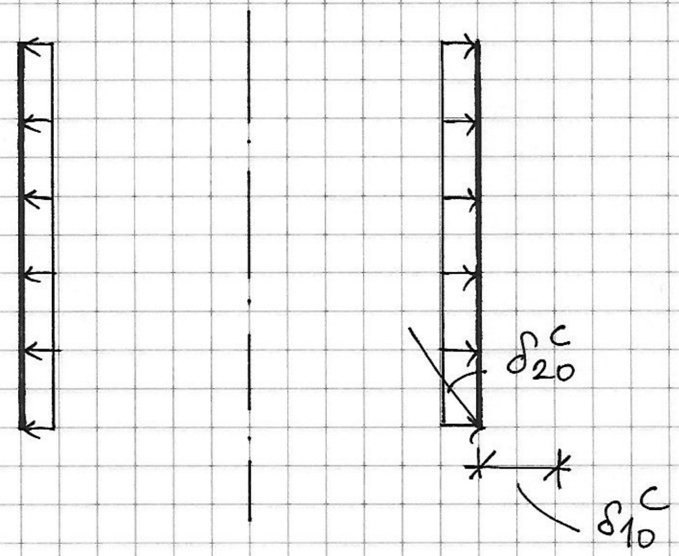
$$C_2 = \frac{Eh_2}{1-\nu^2} = 3{,}125 \cdot 10^6 a$$

$$D_2 = \frac{Eh_2^3}{12(1-\nu^2)} = 2604\ a^3$$

$$\lambda = 5{,}83 \leftarrow \lambda^4 = \frac{Eh_2R^2}{4D_2} = 1152$$

WALEC / CYLINDER

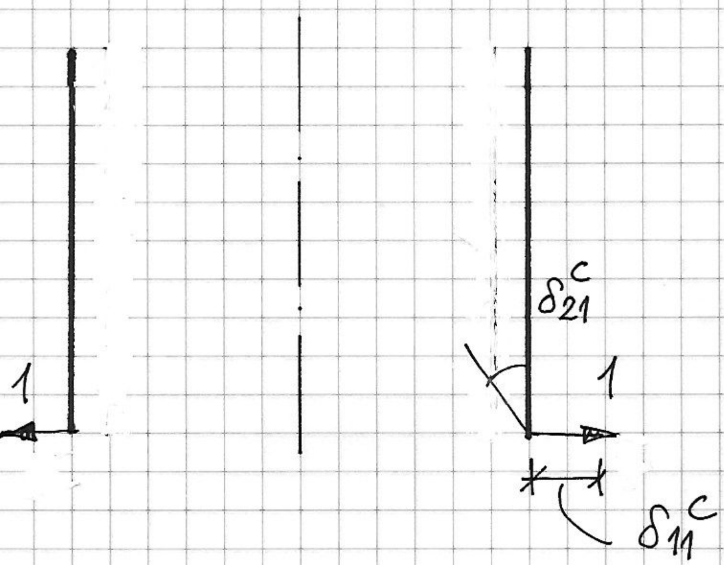
Stan "0" (bezzgięciowy) / The "0"-th state (non-bending)



$$\delta_{10}^c = \frac{qR^2}{Eh_2} = 0{,}00000133 qa$$

$$\delta_{20}^c = 0$$

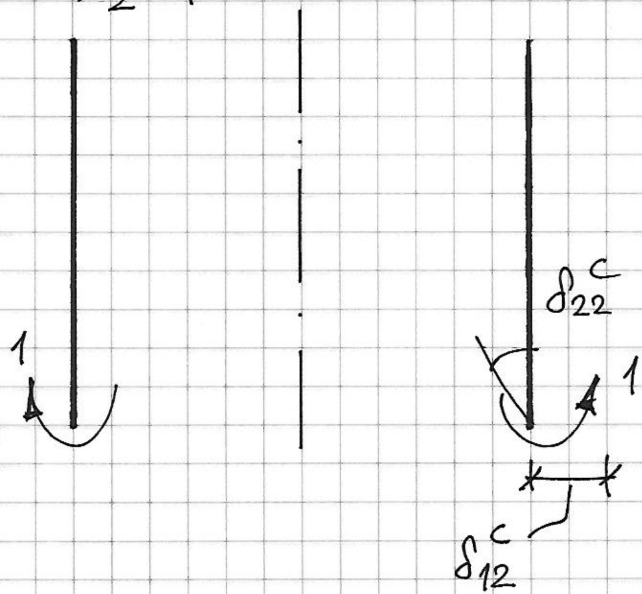
$X_1 = 1$



$$\delta_{11}^{c} = \frac{2R\lambda}{Eh_2} = 0{,}00000777$$

$$\delta_{21}^{c} = \frac{2\lambda^2}{Eh_2} = 0{,}0000226 \cdot \frac{1}{a}$$

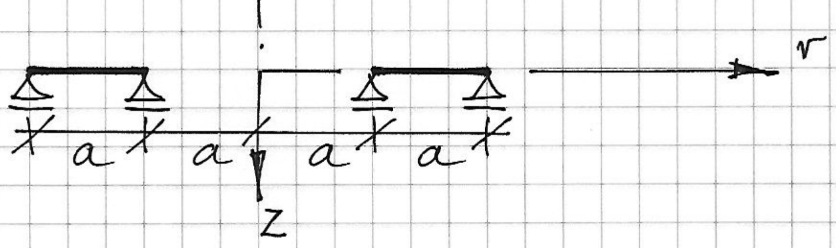
$X_2 = 1$



$$\delta_{12}^{c} = \delta_{21}^{c}$$

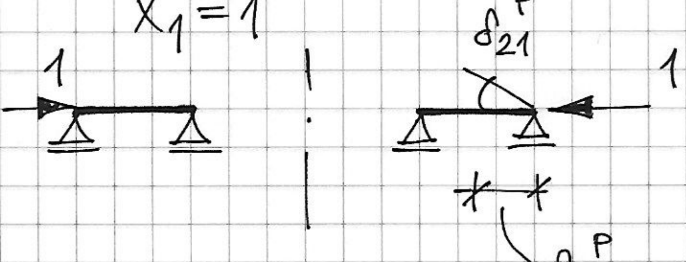
$$\delta_{22}^{c} = \frac{4\lambda^3}{ERh_2} = 0{,}000132 \ \frac{1}{a^2}$$

PŁYTA / PLATE



$$\varrho = \frac{r}{2a}$$

$X_1 = 1$

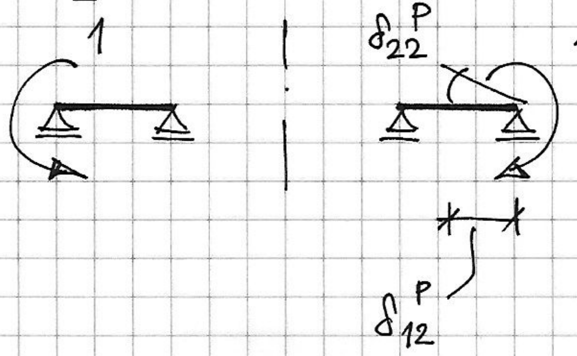


$$\delta_{11}^{p} = \frac{2a}{4a^2 - a^2} \cdot \frac{1}{Eh_1}\left[(1-\nu)\cdot 4a^2 + (1+\nu)a^2\right]$$

$$= 4{,}889 \cdot 10^{-7}$$

$$\delta_{21}^{p} = 0$$

$X_2 = 1$



$$\delta_{12}^{P} = \delta_{21}^{P}$$

δ_{22}^{P} – pomijamy wyznaczenie
we skip the calculations

WYZNACZENIE X_1, X_2 / SOLVING FOR X_1, X_2

$$\left.\begin{aligned} \delta_{11} X_1 + \delta_{12} X_2 + \delta_{10} = 0 \\ \delta_{21} X_1 + \delta_{22} X_2 + \delta_{20} = 0 \end{aligned}\right| \longrightarrow X_1, X_2$$

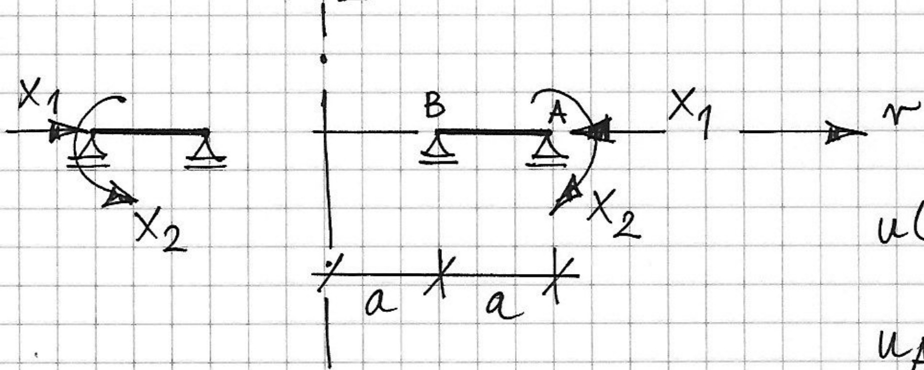
$$\delta_{11} = \delta_{11}^{C} + \delta_{11}^{P}$$

δ_{12}, δ_{21}, δ_{21}, δ_{20}, δ_{10} – podobnie / similarly

---

WYZNACZENIE u_A, u_B / CALCULATIONS OF u_A, u_B

Niech X_1, X_2 – znane / Assume that X_1, X_2 are known.



$$u(r) = A_1 r + A_2 \cdot \frac{1}{r}$$

$$u_A = u(2a)$$

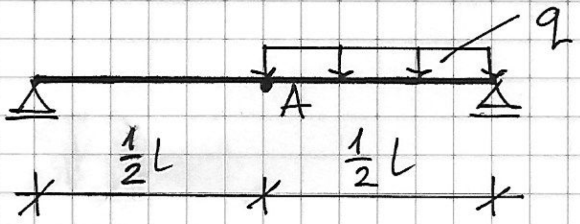
$$u_B = u(a)$$

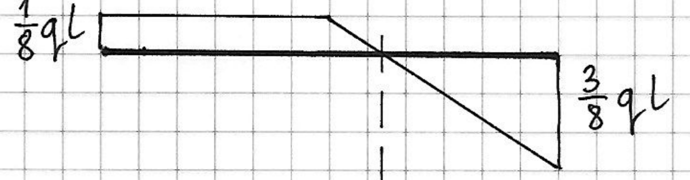
$$N_2(r) = C_1\left[(1+\nu) A_1 + (1-\nu)\frac{A_2}{r^2}\right]$$

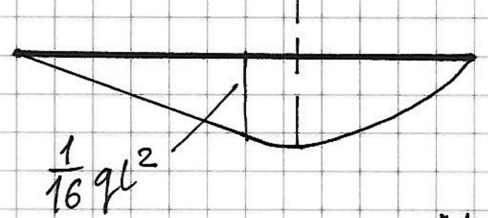
$$\left.\begin{aligned} N_2(a) = 0 \\ N_2(2a) = -X_1 \end{aligned}\right| \longrightarrow A_1, A_2$$

Zadanie 2 / Problem #2

Belka zastępcza / Equivalent beam







$$z_A = \frac{M_A}{H} = \frac{1}{16}ql^2 \cdot \frac{1}{0{,}507\,ql} = 0{,}123\,l$$

$$H = Q\sqrt{\frac{\lambda_0}{2(1-\lambda_0)}}$$

$$\lambda_0 = \frac{L}{L_0} = 0{,}952$$

$$Q^2 = \int_0^1 T(\xi)\,d\xi = \frac{1}{8}ql \cdot \frac{1}{2} \cdot \frac{1}{8}ql + \frac{1}{2} \cdot \frac{1}{8}ql \cdot \frac{1}{2}\left(\frac{2}{3} \cdot \frac{1}{8}ql - \frac{1}{3} \cdot \frac{3}{8}ql\right)$$
$$+ \frac{1}{2} \cdot \frac{3}{8}ql \cdot \frac{1}{2} \cdot \left(\frac{2}{3} \cdot \frac{3}{8}ql - \frac{1}{3} \cdot \frac{1}{8}ql\right) = \frac{5}{192}q^2l^2$$

$$Q = 0{,}161\,ql$$

$$H = 0{,}507\,ql$$