



AKADEMIA EDUKACYJNO - INŻYNIERSKA

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MATURA STUDIA PRAKTYKA STAŻ PRACA BIZNES PRZEMYSŁ STEAM

KOMPLEKSOWE WSPARCIE EDUKACYJNE ON – LINE NA KAŻDYM ETAPIE KSZTAŁCENIA INŻYNIERSKIEGO

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MECHANIKA I

"UKŁADY STATYCZNIE WYZNACZALNE"

PROJEKT

Oblicz:

– siły w prętach

dla układu brył sztywnych ustroju nośnego przestrzennego.

DANE:

$a, b, c, d, m = OK$

SZUKAM:

$S_1, S_2, S_3 = ?$

$$\begin{aligned}
 m &= 1800 \text{ [kg]} & c &= 14 \text{ [m]} \\
 a &= 14 \text{ [m]} & d &= 14,5 \text{ [m]} \\
 b &= 21 \text{ [m]}
 \end{aligned}$$

$$S_1, S_2, S_3 = ?$$

$$\begin{aligned}
 \text{I)} \quad \sum F_{ix} &= 0 & \text{II)} \quad \sum M_{ix} &= 0 \\
 \text{II)} \quad \sum F_{iy} &= 0 & \text{III)} \quad \sum M_{iy} &= 0 \\
 \text{III)} \quad \sum F_{iz} &= 0 & \text{IV)} \quad \sum M_{iz} &= 0
 \end{aligned}$$

$$G_4 = m \cdot g \rightarrow G_4 = 1800 \cdot 10 = 18000 \text{ [N]} \quad (14 \text{ 415 [N]})$$

$$\begin{aligned}
 \text{I)} \quad \sum F_{ix} &= R_{Ax} + R_{Bx} + R_{Dx} = 0 \\
 \text{II)} \quad \sum F_{iy} &= -R_{Ay} + R_{By} = 0 \\
 \text{III)} \quad \sum F_{iz} &= R_{Dz} - G_4 = 0
 \end{aligned}$$

(6?)

$$\begin{aligned}
 \text{IV)} \quad & \text{---} \\
 \text{V)} \quad & R_{Dx} \cdot d + G_4 \cdot c = 0 \\
 \text{VI)} \quad & -R_{Ax} \cdot a + R_{Dx} \cdot b = 0
 \end{aligned}$$

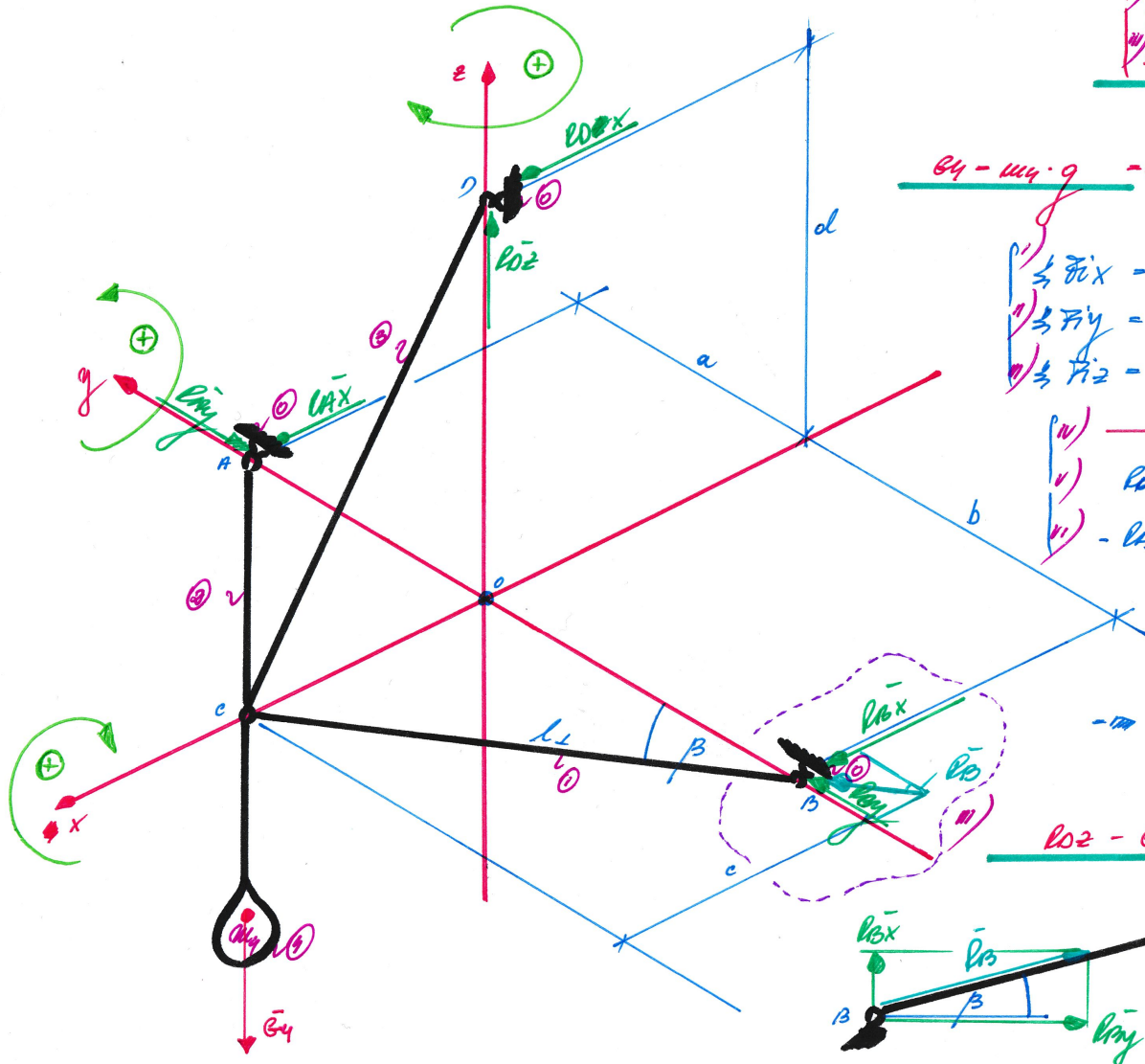
$$\text{V)} \quad R_{Dx} \cdot d + G_4 \cdot c = 0$$

$$\rightarrow R_{Dx} = -\frac{G_4 \cdot c}{d} = -\frac{14 \text{ 415} \cdot 14}{14,5} = -11 \text{ 442 [N]}$$

$$R_{Dz} - G_4 = 0 \rightarrow R_{Dz} = G_4 = 14 \text{ 415 [N]}$$

$$\sin \beta = \frac{c}{L_1} = \frac{R_{Dx}}{R_D} \rightarrow R_{Dx} = \frac{R_D \cdot c}{L_1}$$

$$\cos \beta = \frac{b}{L_1} = \frac{R_{Dy}}{R_D} \rightarrow R_{Dy} = \frac{R_D \cdot b}{L_1}$$



$$l_1^2 = b^2 + c^2$$

$$\Rightarrow l_1 = \sqrt{b^2 + c^2} = \sqrt{(21)^2 + (14)^2} = 25,24 \text{ [m]}$$

$$\begin{array}{l} \text{i)} \\ \text{ii)} \\ \text{iii)} \end{array} \left\{ \begin{array}{l} l_{Ax} + \frac{c}{l_1} l_3 + l_{Dx} = 0 \\ -l_{By} + \frac{b}{l_1} l_3 = 0 \\ -l_{Ax} \cdot a + \frac{b \cdot c}{l_1} l_3 = 0 \end{array} \right. \quad (3?)$$

$$\begin{array}{l} \text{i)} \\ \text{ii)} \end{array} \left\{ \begin{array}{l} l_{Ax} + \frac{c}{l_1} l_3 + l_{Dx} = 0 \\ -l_{Ax} \cdot a + \frac{b \cdot c}{l_1} l_3 = 0 \end{array} \right. \quad /: a$$

$$\left\{ \begin{array}{l} l_{Ax} + \frac{c}{l_1} l_3 + l_{Dx} = 0 \\ -l_{Ax} + \frac{b \cdot c}{a \cdot l_1} l_3 = 0 \end{array} \right. \quad (+)$$

$$\cancel{l_{Ax}} + \frac{c}{l_1} l_3 + l_{Dx} - \cancel{l_{Ax}} + \frac{bc}{a \cdot l_1} l_3 = 0$$

$$l_3 \left(\frac{c}{l_1} + \frac{bc}{a \cdot l_1} \right) = -l_{Dx}$$

$$l_3 = - \frac{l_{Dx}}{\left(\frac{c}{l_1} + \frac{bc}{a \cdot l_1} \right)}$$

$$l_3 = - \frac{(-11\,442)}{\frac{14}{25,24} + \frac{21 \cdot 14}{14 \cdot 25,24}} = \frac{11\,442}{0,55 + 0,83} =$$

$$= \frac{11\,442}{1,38} = 8530,43 \text{ [N]}$$

$$l_{Dx} = \frac{c}{l_1} l_3 = l_{Dx} = \frac{14}{25,24} \cdot 8530,43 = 4431,61 \text{ [N]}$$

$$l_{By} = \frac{b}{l_1} l_3 = l_{By} = \frac{21}{25,24} \cdot 8530,43 = 7084,42 \text{ [N]}$$

$$\text{ii)} \quad -l_{By} + \frac{b}{l_1} l_3 = 0$$

$$\Rightarrow l_{By} = \frac{b}{l_1} l_3$$

$$\Rightarrow l_{By} = \frac{21}{25,24} \cdot 8530,43 = 7084,42 \text{ [N]}$$

$$\text{vi)} \quad -l_{Ax} \cdot a + \frac{bc}{l_1} l_3 = 0$$

$$\Rightarrow l_{Ax} = \frac{b \cdot c}{a \cdot l_1} l_3$$

$$\Rightarrow l_{Ax} = \frac{21 \cdot 14}{14 \cdot 25,24} \cdot 8530,43 = 7084,42 \text{ [N]}$$

$$a) \bar{r}_{AX} = 14084,42 \text{ (N)}$$

$$\bar{r}_{AY} = 14084,42$$

$$b) \bar{r}_{BX} = 4431,61$$

$$\bar{r}_{BY} = 4084,42$$

$$c) \bar{r}_{CX} = -11442$$

$$\bar{r}_{CZ} = 14415$$

$$a) \bar{S}_1 = \bar{r}_A = \bar{r}_{AX} + \bar{r}_{AY}$$

$$\Rightarrow S_1 = r_A = \sqrt{\bar{r}_{AX}^2 + \bar{r}_{AY}^2}$$

$$S_1 = \sqrt{(14084,42)^2 + (14084,42)^2} = 10034,26 \text{ (N)}$$

$$b) \bar{S}_2 = \bar{r}_B = \bar{r}_{BX} + \bar{r}_{BY}$$

$$\Rightarrow S_2 = \sqrt{\bar{r}_{BX}^2 + \bar{r}_{BY}^2}$$

$$S_2 = \sqrt{(4431,61)^2 + (4084,42)^2} = 8530,03 \text{ (N)}$$

$$c) \bar{S}_3 = \bar{r}_C = \bar{r}_{CX} + \bar{r}_{CZ}$$

$$\Rightarrow S_3 = \sqrt{\bar{r}_{CX}^2 + \bar{r}_{CZ}^2}$$

$$S_3 = \sqrt{(11442)^2 + (14415)^2} = 18844,38 \text{ (N)}$$

