

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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TEORIA MECHANIZMÓW I MANIPULATORÓW

"ANALIZA DYNAMICZNA – ROWNANIA WEKTOROWE"

PROJEKT

Przeprowadź:

- analizę strukturalną
- analizę dynamiczną

dla układu mechanicznego strugarki jarzmowej w zadanym położeniu.

DANE:

$F_1, F_2, M_1, q = OK$

SZUKAM:

$R, M_R = ?$

DL)

DANE:

$|AB| = |DF| = 0{,}30\ [m] = 30\ [cm]$

$|AC| = 0{,}60\ [m] = 60\ [cm]$

$|DH| = |CD| = 1\ [m] = 100\ [cm]$

$h = 0{,}50\ [m] = 50\ [cm]$

$|EG| = |DE| = |CH| = 0{,}50\ [m] = 50\ [cm]$

$|BG| = 0{,}20\ [m] = 20\ [cm]$

$\bar{R} \parallel OX$

$\bar{F}_3 = 100\ [N]$; $\alpha_3 = 20^\circ$

$\bar{F}_5 = 100\ [N]$; $\alpha_5 = 40^\circ$

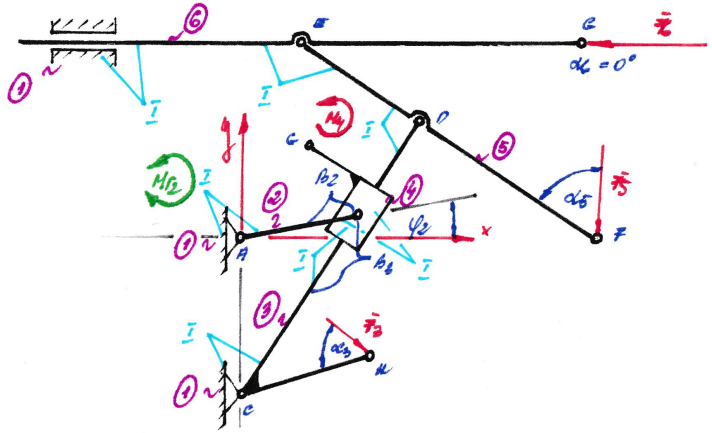
$\bar{F}_6 = 600\ [N]$; $\alpha_6 = 0^\circ$

$M_4 = 10\ [Nm]$; $\varphi_2 = 290^\circ$

SZUKANY:

$\bar{R}$, $M_{r_2} = ?$

1) SCHEMAT STRUKTURALNY ODWZOROWANIA.



2) ANALIZA STRUKTURALNA - RUCHLIWOŚĆ MECHANIZMU.

$$W_\ell = W_T - W_L + W_B$$

$$W_T = 3k - 2p_1 - p_2$$

$k = 5$

$p_1 = 7$

$p_2 = 0$

$$\Rightarrow W_T = 3 \cdot 5 - 2 \cdot 7 = 15 - 14 = \underline{1}$$

$W_L = 0$

$W_B = 0$

$$\Rightarrow W_\ell = W_T = \underline{1}$$

2) Podziałka (miara).

$$\mathcal{H}_L = \frac{\bar{l}}{(\bar{l})}$$

$$\mathcal{H}_v = \frac{\bar{v}}{(\bar{v})}$$

$$\mathcal{H}_a = \frac{\bar{a}}{(\bar{a})}$$

$$\mathcal{H}_F = \frac{\bar{F}}{(\bar{F})}$$

$$\mathcal{H}_L = \frac{|\bar{OS}|}{(|\bar{OS}|)} = \frac{100}{(100)} \Rightarrow (|\bar{OS}|) = \frac{100}{\mathcal{H}_L} = \mathcal{H}_L = 10 =$$

$$= \frac{100}{10} = 10 \text{ [cm]} \Rightarrow (|\bar{OS}|) = 10 \text{ [cm]}$$

4) Analiza otrzymanych - pomiar i obliczenia.

$$(|\bar{AB}|) = \frac{|\bar{AB}|}{\mathcal{H}_L} = \frac{30}{10} = 3,0 \text{ [cm]}$$

$$(|\bar{DF}|) = \frac{|\bar{DF}|}{\mathcal{H}_L} = \frac{30}{10} = 3,0 \text{ [cm]}$$

$$(|\bar{AC}|) = \frac{|\bar{AC}|}{\mathcal{H}_L} = \frac{60}{10} = 6,0 \text{ [cm]}$$

$$(|\bar{DH}|) = \frac{|\bar{DH}|}{\mathcal{H}_L} = \frac{100}{10} = 10,0 \text{ [cm]}$$

$$(|\bar{h}|) = \frac{|\bar{h}|}{\mathcal{H}_L} = \frac{50}{10} = 5,0 \text{ [cm]}$$

$$(|\bar{EG}|) = \frac{|\bar{EG}|}{\mathcal{H}_L} = \frac{60}{10} = 5,0 \text{ [cm]}$$

$$(|\bar{DE}|) = \frac{|\bar{DE}|}{\mathcal{H}_L} = \frac{60}{10} = 5,0 \text{ [cm]}$$

$$(|\bar{CH}|) = \frac{|\bar{CH}|}{\mathcal{H}_L} = \frac{50}{10} = 5,0 \text{ [cm]}$$

$$(|\bar{BG}|) = \frac{|\bar{BG}|}{\mathcal{H}_L} = \frac{20}{10} = 2,0 \text{ [cm]}$$

$\alpha_3 = 20^\circ$; $\varphi_2 = 290^\circ$

$\alpha_5 = 40^\circ$

$\alpha_6 = 0^\circ$

5) ANALIZA DYNAMICZNA - WYZ I WARTOŚCI OD WS.

$$\begin{cases} \sum_i F_{in} = 0 \\ \sum_i M_{in} = 0 \end{cases}$$

$$\begin{cases} F_3 = 100 \quad [N] \\ F_5 = 100 \\ F_6 = 500 \end{cases}$$

$$H_F = \frac{\bar{F}}{(\bar{F})}$$

$$H_F = \frac{\bar{F}_6}{(\bar{F}_6)} = \frac{500}{(\bar{F}_6)} \Rightarrow (\bar{F}_6) = \frac{500}{H_F} = \boxed{H_F = 50}$$

$$= \frac{500}{50} = 10 \Rightarrow (\bar{F}_6) = \underline{10,0} \quad [cm]$$

$$(\bar{F}_3) = \frac{\bar{F}_3}{H_F} = \frac{100}{60} = 2,0 \quad [cm]$$

$$(\bar{F}_5) = \frac{\bar{F}_5}{H_F} = \frac{100}{60} = \underline{2,0} \quad [cm]$$

$$\Rightarrow \begin{cases} (\bar{F}_3) = 2,0 \quad [cm] \\ (\bar{F}_5) = 2,0 \\ (\bar{F}_6) = \underline{10,0} \end{cases}$$

B,S:

$$\begin{cases} \sum_i F_{iB} = 0 \\ \sum_i F_{i5} = 0 \end{cases} \Rightarrow \begin{cases} \bar{R}_{16} + \bar{F}_6 + \bar{R}_{52} = 0 \\ \bar{F}_5 + \bar{R}_{23} + \bar{R}_{54} = 0 \end{cases} \quad \oplus$$

$$\bar{R}_{16} + \bar{F}_6 + \bar{R}_{16} + \bar{F}_5 + \bar{R}_{23} + \bar{R}_{54} = 0$$

$$\bar{R}_{16} + \bar{F}_6 + \bar{F}_5 + \bar{R}_{23}^{\bar{I}} + \bar{R}_{23}^{\bar{II}} = 0$$

$$\sum_i M_{i5}^{(E)} = 0 \Rightarrow F_5 \cdot h_5 - R_{23}^{\bar{I}} \cdot |DE| = 0$$

$$R_{23}^{\bar{I}} = \frac{F_5 \cdot h_5}{|DE|} = \frac{100 \cdot 0,53}{0,5} = \frac{53}{0,5} = \underline{106} \quad [N]$$

$$(R_{23}^{\bar{I}}) = \frac{R_{23}^{\bar{I}}}{H_F} = \frac{106}{60} = \underline{2,12} \quad [cm]$$

$$\bar{R}_{16} + \bar{F}_6 + \bar{F}_5 + \bar{R}_{23}^{\bar{I}} + \bar{R}_{23}^{\bar{II}} = 0$$

$\sum F$:

$$\begin{cases} (\bar{R}_{16}) = 2,25 \quad [cm] \\ (\bar{R}_{23}^{\bar{II}}) = 8,80 \\ (\bar{R}_{23}) = 9,0 \end{cases} ; \quad \boxed{H_F = 60}$$

$$\Rightarrow \begin{cases} \bar{R}_{16} = (\bar{R}_{16}) \cdot H_F = 2,25 \cdot 60 = 112,50 \quad [N] \\ \bar{R}_{23}^{\bar{II}} = (\bar{R}_{23}^{\bar{II}}) \cdot H_F = 8,80 \cdot 60 = 440,0 \\ \bar{R}_{23} = (\bar{R}_{23}) \cdot H_F = 9,0 \cdot 60 = 480,0 \end{cases}$$

5:)

$$\sum_i \bar{F}_{i5} = 0 \rightarrow \bar{F}_5 + \bar{l}_{35} + \bar{l}_{67} = 0$$

VF:)

$(\bar{l}_{67}) = 10,30 \quad [cm] \quad ; \quad \boxed{H_F = 50}$

$\rightarrow \bar{l}_{67} = (\bar{l}_{67}) \cdot H_F = 10,30 \cdot 50 = 515,0 \quad [N]$

3,4:)

$$\sum_i \bar{F}_{i3} = 0 \rightarrow \bar{R}_{53} + \bar{R}_{43} + \bar{F}_3 + \bar{l}_{13} = 0$$

$$\bar{R}_{53} + \bar{R}_{43} + \bar{F}_3 + \bar{l}_{13}^{\bar{t}} + \bar{l}_{13}^{u} = 0$$

$$\left| \begin{array}{l} \sum_i M_{i4}^{(B)} = 0 \\ \sum_i M_{i8}^{(B)} = 0 \end{array} \right. \rightarrow \left| \begin{array}{l} -M_4 + R_{34} \cdot h_4 = 0 \\ -R_{53} \cdot h_{53} - F_3 \cdot h_3 + l_{13}^{\bar{t}} \cdot |BC| - R_{43} \cdot h_4 = 0 \end{array} \right. \quad \oplus$$

$$-M_4 + R_{34} \cdot h_4 - R_{53} \cdot h_{53} - F_3 \cdot h_3 + l_{13}^{\bar{t}} \cdot |BC| - R_{43} \cdot h_4 = 0$$

$$l_{13}^{\bar{t}} = \frac{M_4 + R_{53} \cdot h_{53} + F_3 \cdot h_3}{|BC|} = \frac{10 + 460 \cdot 0,63 + 100 \cdot 0,16}{0,33} =$$

$$= \frac{10 + 283,5 + 16}{0,33} = \frac{309,5}{0,33} = 984,87 \quad [N]$$

$$(\bar{l}_{13}^{\bar{t}}) = \frac{l_{13}^{\bar{t}}}{H_F} = \frac{984,87}{60} = 18,75 \quad [cm]$$

$$\bar{R}_{43} + \bar{R}_{53} + \bar{F}_3 + \bar{l}_{13}^{\bar{t}} + \bar{l}_{13}^{u} = 0$$

VF:)

$$\left| \begin{array}{l} (\bar{R}_{43}) = 25,40 \quad [cm] \\ (\bar{l}_{13}^{u}) = 2,45 \\ (\bar{l}_{13}) = 18,90 \end{array} \right. \quad ; \quad \boxed{H_F = 50}$$

$$\rightarrow \left| \begin{array}{l} R_{43} = (\bar{R}_{43}) \cdot H_F = 25,40 \cdot 50 = 1270 \quad [N] \\ l_{13}^{u} = (\bar{l}_{13}^{u}) \cdot H_F = 2,45 \cdot 50 = 122,60 \\ l_{13} = (\bar{l}_{13}) \cdot H_F = 18,90 \cdot 50 = 945 \end{array} \right.$$

4:)

$$\sum_i M_{i4}^{(B)} = 0 \rightarrow -M_4 + R_{34} \cdot h_4 = 0$$

$\boxed{H_L = 10}$

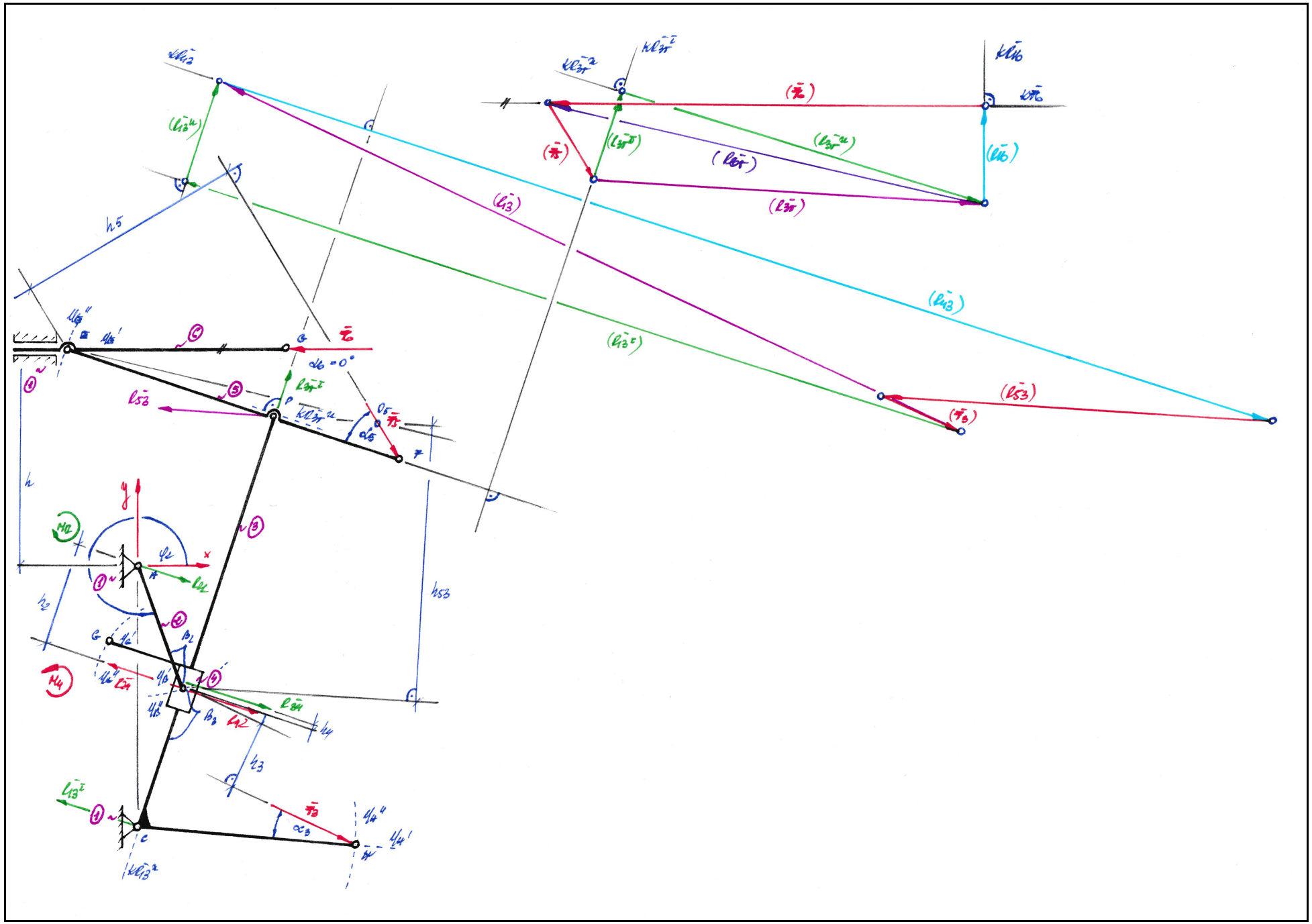
$$h_4 = \frac{M_4}{R_{34}} = \frac{10}{1270} = 0,00787 \quad [m]$$

$$(\bar{h}_4) = \frac{h_4}{H_L} = \frac{0,00787}{10} = 0,000787 \quad [cm]$$

2:)

$$\sum_i M_{i2}^{(A)} = 0 \rightarrow +M_{r2} - R_{42} \cdot h_2 = 0$$

$$M_{r2} = R_{42} \cdot h_2 = 1270 \cdot 0,24 = 304,80 \quad [Nm]$$




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