SZÉCHENYI ISTVÁN EGYETEM

ALKALMAZOTT MECHANIKA TANSZÉK

9. MECHANIZMUSOK GYAKORLAT

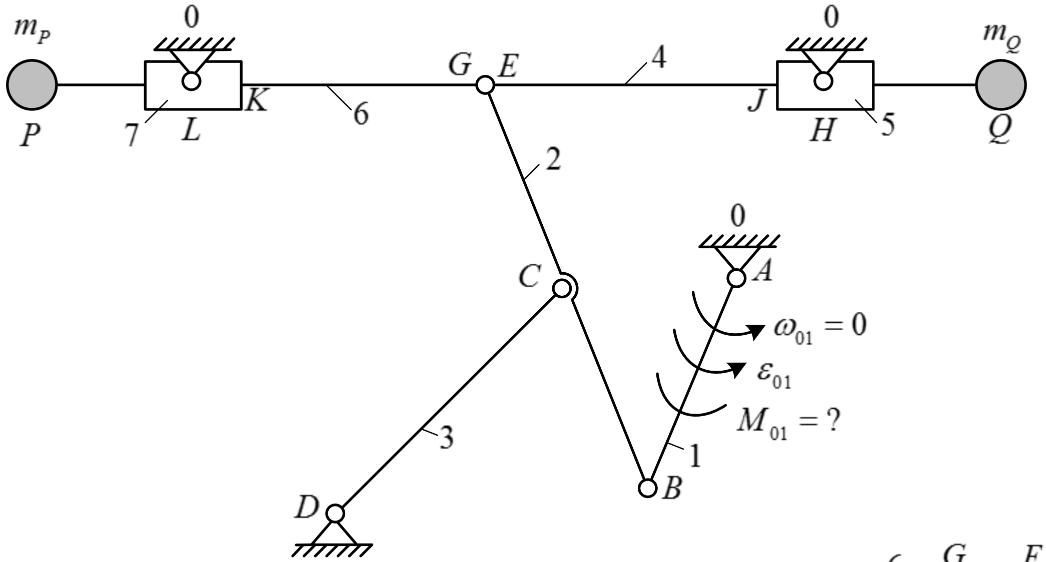
(kidolgozta: Bojtár Gergely egy. Ts; Tarnai Gábor mérnöktanár.)

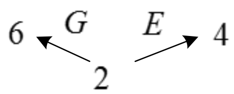
Mechanizmusok erőjátéka, tömegerővel, ill. súrlódással

9.1.

Adott: A mechanizmus méretei, pillanatnyi helyzete, és a meghajtás: $\vec\varepsilon_{01}; \vec\omega_{01}=\vec 0$.

Feladat: gyorsulásábra megrajzolása, és $\vec M_{01}$ meghatározása.





Megoldás:

Szerkezeti képlet: $\overset{\downarrow}{\text{A}}\,\text{BCD} \leftarrow \text{EJH} \leftarrow \text{GKL}$

$$h_g=(1+1+1+1-3)+(1+1+1-3)+(1+1+1-3)=1+0+0=1$$

$$h_k=(1-1)+(0-0)+(0-0)=0+0+0=0 \quad \Rightarrow \quad \text{egyszerű mechanizmus}$$

Gyorsulási állapot:

1. lánc: $\vec a_{AB}+\vec a_{BC}+\vec a_{CD}=\vec 0$ $\omega_{01}=0 \Rightarrow$ minden pont sebessége 0.

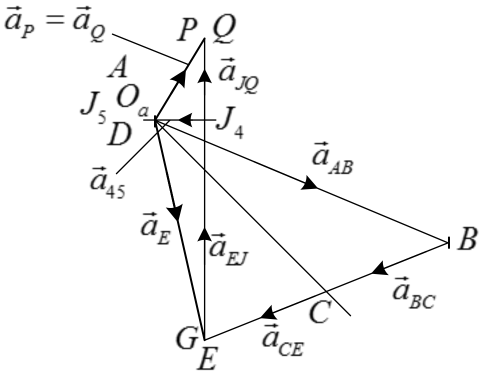
$$\left(\underset{(\vec\varepsilon_{01}\times\vec r_{AB})\perp\vec r_{AB}}{\underline{\underline{\vec b}}_{AB}}+\underset{=\vec 0}{\vec c_{AB}}\right)+\left(\underset{\perp\vec r_{BC}}{\underline{\vec b}_{BC}}+\underset{=\vec 0}{\vec c_{BC}}\right)+\left(\underset{\perp\vec r_{CD}}{\underline{\vec b}_{CD}}+\underset{=\vec 0}{\vec c_{CD}}\right)=\vec 0, \qquad \vec c_{AB}=-\omega_{01}^2\vec r_{AB}=\vec 0=\vec c_{BC}=\vec c_{CD}$$

2. lánc: $\underline{\underline{\vec a}}_E+\underline{\vec a}_{EJ}+\underline{\vec a}_{45}=\vec 0$

$$\varepsilon_{02}=\frac{a_{BC}}{r_{BC}}=\frac{a_{CE}}{r_{CE}} \quad\Rightarrow\quad a_{CE}=\frac{r_{CE}}{r_{BC}}a_{BC} \quad\Rightarrow\quad \underline{\underline{\vec a}}_E$$

$$\underline{\underline{\vec a}}_E+\left(\underline{\vec b}_{EJ}+\underset{\vec 0}{\vec c_{EJ}}\right)+\left(\underline{\vec b}_{45}+\underset{\vec 0}{\vec c_{45}}+\underset{\vec 0}{\vec C_{45}}\right)=\vec 0$$

3. lánc: $\underset{=\vec{a}_E}{\underline{\underline{\vec{a}}}_G} + \underset{=\vec{a}_{EJ}}{\underline{\vec{a}}_{GK}} + \underset{=\vec{a}_{45}}{\underline{\vec{a}}_{67}} = \vec{0}$

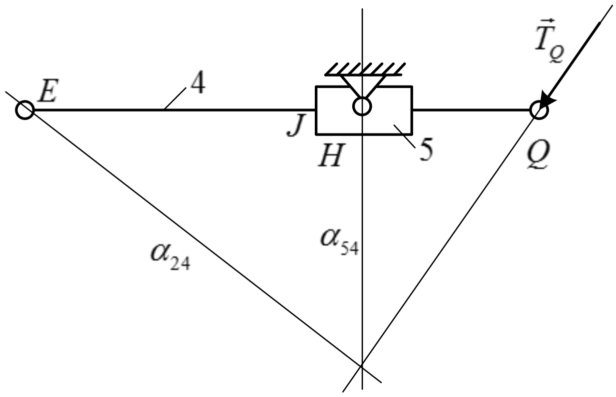


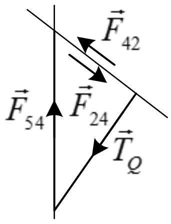
$$\varepsilon_{04} = \frac{a_{EJ}}{r_{EJ}} = \frac{a_{JQ}}{r_{JQ}} \quad \Rightarrow \quad a_{JQ} = \frac{r_{JQ}}{r_{EJ}} a_{EJ}$$

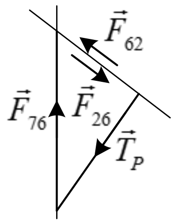
$$\Rightarrow \quad a_{EJ} \uparrow; a_{JQ} \uparrow \quad \Rightarrow \quad \underline{\underline{\vec{a}}}_P = \underline{\underline{\vec{a}}}_Q .$$

<u>Teljes erőjáték</u>: $\vec{T}_Q = -m_Q \vec{a}_Q$, $\vec{T}_P = -m_P \vec{a}_P$ (D' Alambert elv)

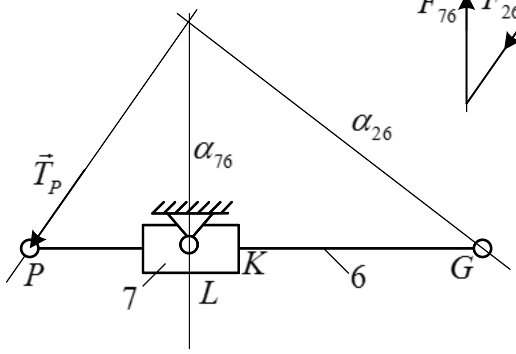
(4) tag: $\vec{F}_{24} + \vec{F}_{54} + \vec{T}_Q = \vec{0}$



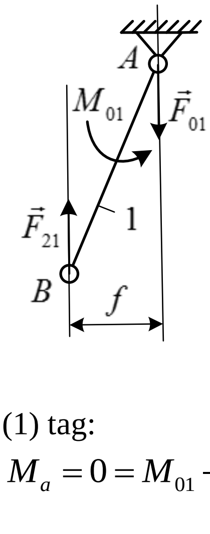


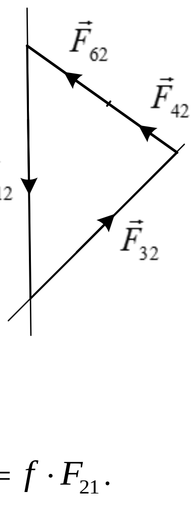


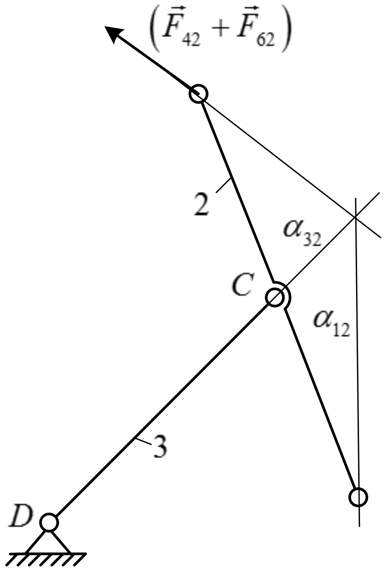
(6) tag: $\vec{F}_{26} + \vec{F}_{76} + \vec{T}_P = \vec{0}$



(2) tag: $\left(\vec{F}_{42} + \vec{F}_{62}\right) + \vec{F}_{32} + \vec{F}_{12} = \vec{0}$







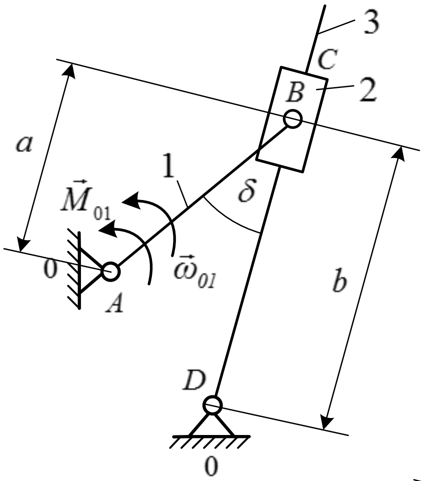
(1) tag: $\vec{F}_2 + \vec{F}_{32} + \vec{F}_{12} = \vec{0}$

$M_a = 0 = M_{01} - f \cdot F_{21} \quad \Rightarrow \quad M_{01} = f \cdot F_{21}.$

9.2.

Adott: A mechanizmus méretei, pillanatnyi helyzete, és a meghajtás: $\vec{M}_{01}, \vec{\omega}_{01}$.

Feladat: $\vec{M}_{03}$ terhelő nyomaték meghatározása: a.) $\mu = 0$, illetve b.) $\mu \neq 0$ esetekben.



Megoldás: a.) $\mu = 0$

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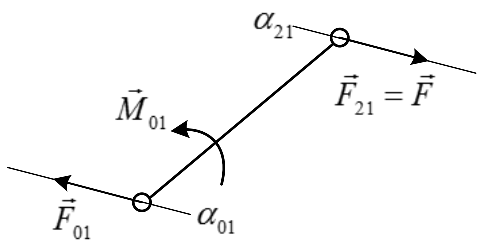
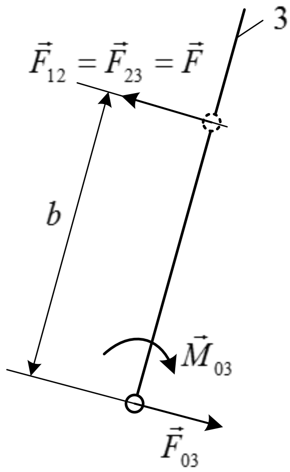
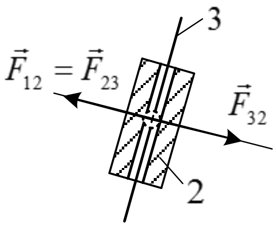
Szerkezeti képlet: A BCD

$h_g = (4-3) = 1$; $h_k = (1-1) = 0$.





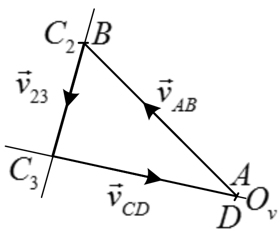


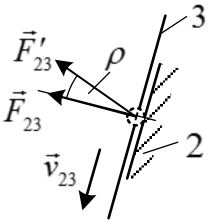
$$\left.\begin{aligned} M_{01} &= aF = r_{AB}\cos\delta \cdot F \\ M_{03} &= bF = r_{CD} \cdot F \end{aligned}\right\} \Rightarrow M_{03} = \frac{b}{a} M_{01} = \frac{r_{CD}}{r_{AB}\cos\delta} M_{01};$$

b.) $\mu \neq 0$

Sebességállapot:

$\underline{\vec{v}}_{AB} + \underline{\vec{v}}_{23} + \underline{\vec{v}}_{CD} = \vec{0}$

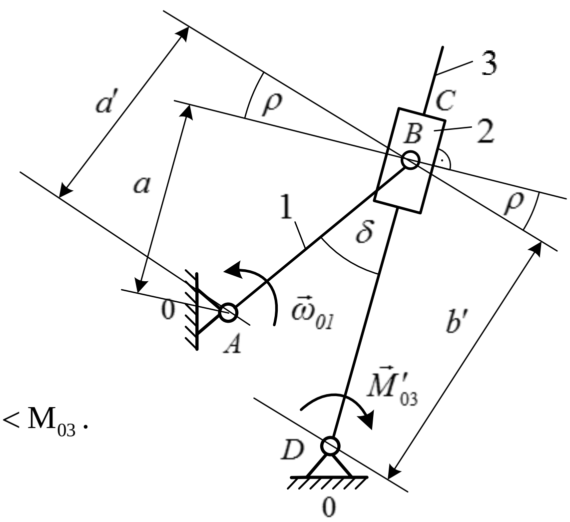




$$\left.\begin{aligned} M_{01} &= a'F' = r_{AB}\cos(\delta-\rho) \cdot F' \\ M'_{03} &= b'F' = r_{CD}\cos\rho \cdot F' \end{aligned}\right\} \Rightarrow$$

,

$$M'_{03} = \frac{b'}{a'} M_{01} = \frac{r_{CD}\cos\rho}{r_{AB}\cos(\delta-\rho)} M_{01}$$



$$\eta = \frac{M'_{03}}{M_{03}} = \frac{\cos\rho\cos\delta}{\cos(\delta-\rho)} = \frac{1}{1+\mu \mathrm{tg}\delta} \Rightarrow M'_{03} < M_{03}.$$