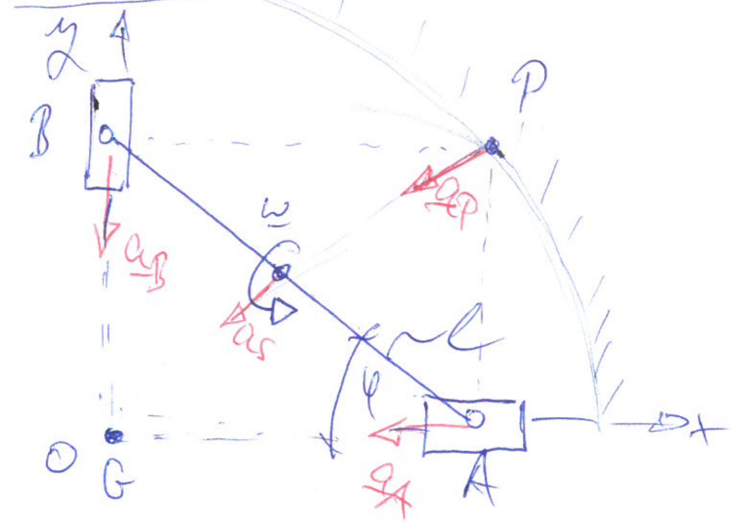
Síkbeli mechanizmusok

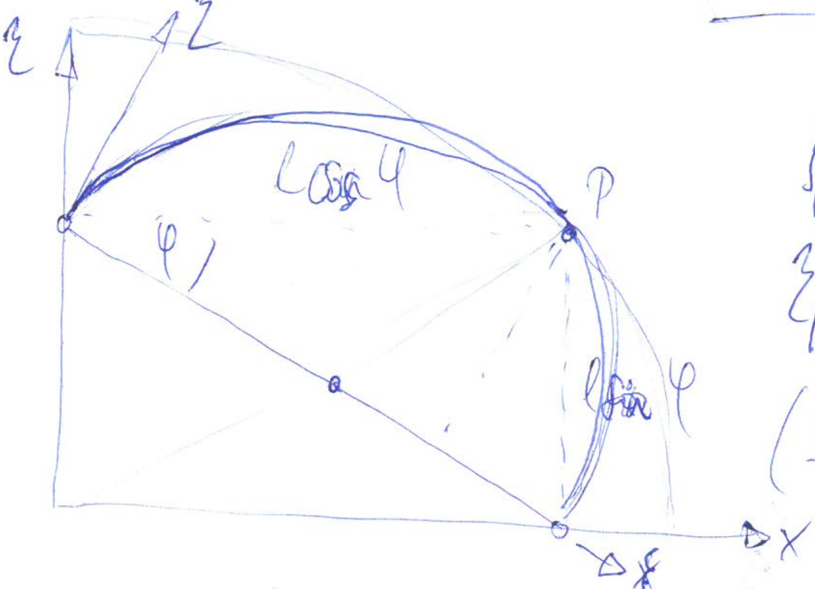


$l = 4\,[m]$, $\varphi = 30°$, $\omega = 0.6\,\left[\frac{rad}{s}\right]$

$\varepsilon = 0\,\left[\frac{rad}{s^2}\right]$

póluspgörbék?, póluspont vándorlási sebesség

$$x_P = l\cos\varphi\,,\quad y_P = l\sin\varphi \Rightarrow \boxed{x_P^2 + y_P^2 = l^2}$$



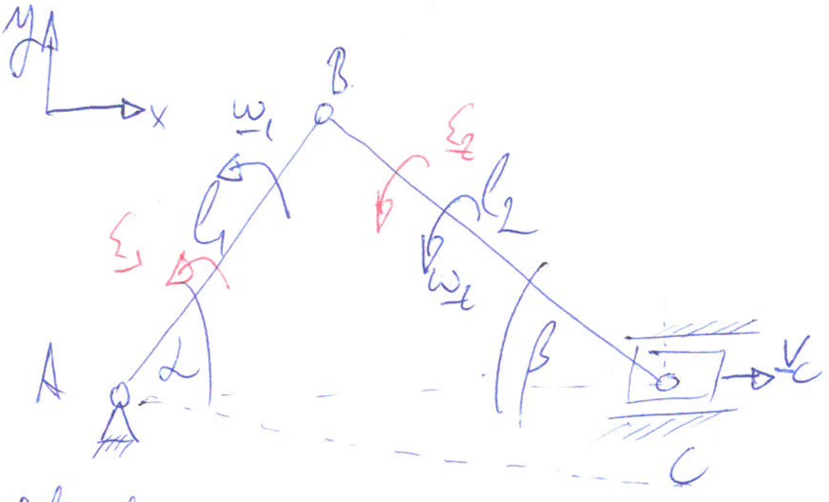
$$\xi_P = l\cos\varphi\cos\varphi = l\,\frac{1+\cos2\varphi}{2}$$

$$\eta_P = l\cos\varphi\sin\varphi = l\,\frac{\sin2\varphi}{2}$$

$$\left(\xi_P - \frac{l}{2}\right)^2 + \eta_P^2 = \left(\frac{l}{2}\right)^2$$

$$\underline{u} = \frac{\underline{\omega} \times \underline{a}_P}{\omega^2}\,,\quad \underline{a}_P = \begin{bmatrix} -1.247 \\ -0.72 \\ 0 \end{bmatrix} \left[\frac{m}{s^2}\right] = \frac{1}{\omega^2}\begin{vmatrix} i & j & k \\ a_{Px} & a_{Py} & 0 \\ 0 & 0 & \omega \end{vmatrix} =$$

$$= \begin{bmatrix} 1.2 \\ -2.078 \\ 0 \end{bmatrix} \left[\frac{m}{s}\right]$$



adott l_1, l_2, v_C = állandó

$\alpha = 60°, \beta = 30°$

$\underline{\omega}_1 = ?, \underline{\omega}_2 = ?$

$\underline{\varepsilon}_1 = ?, \underline{\varepsilon}_2 = ?$

sebesség

$$\left.\begin{aligned} \underline{v}_B &= \underline{v}_A + \underline{\omega}_1 \times \underline{r}_{AB} \\ \underline{v}_B &= \underline{v}_C + \underline{\omega}_2 \times \underline{r}_{CB} \end{aligned}\right\} \quad \underline{v}_C + \underline{\omega}_2 \times \underline{r}_{CB} = \underline{\omega}_1 \times \underline{r}_{AB}$$

$$\begin{bmatrix} v_C \\ 0 \\ 0 \end{bmatrix} + \begin{vmatrix} \underline{i} & \underline{j} & \underline{k} \\ 0 & 0 & \omega_2 \\ -\cos\beta\, l_2 & \sin\beta\, l_2 & 0 \end{vmatrix} = \begin{vmatrix} \underline{i} & \underline{j} & \underline{k} \\ 0 & 0 & \omega_1 \\ \sin\alpha & \cos\alpha & 0 \end{vmatrix} l_1$$

$$\omega_1 = -\frac{\sqrt{3}}{2}\frac{v_C}{l_1}, \quad \omega_2 = \frac{1}{2}\frac{v_C}{l_2}$$

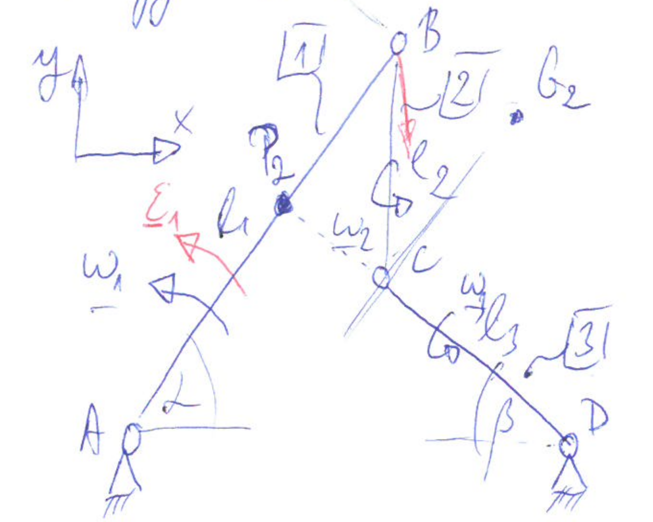
gyorsulás

$$\left.\begin{aligned} \underline{a}_B &= \underbrace{\underline{a}_A}_{=\underline{0}} + \underline{\varepsilon}_1 \times \underline{r}_{AB} + \underbrace{\underline{\omega}_1 \times (\underline{\omega}_1 \times \underline{r}_{AB})}_{-\omega_1^2 \underline{r}_{AB}} \\ \underline{a}_B &= \underbrace{\underline{a}_C}_{=\underline{0}} + \underline{\varepsilon}_1 \times \underline{r}_{CB} - \omega_2^2 \underline{r}_{CB} \end{aligned}\right\}$$

$$\varepsilon_1 = -\frac{v_C^2}{8 l_1 l_2}$$

$$\varepsilon_2 = -\frac{(\sqrt{3}\, l_1 l_2 - 6 l_2) v_C^2}{8 l_1 l_2^2}$$

Négycsuklós mechanizmus



$l_1 = 0.6\,[m]$, $l_2 = 0.3\,[m]$, $l_3 = 0.3\,[m]$

$\omega_1 = 3.5\,[\frac{rad}{s}]$, $\varepsilon_1 = -20\,[\frac{rad}{s^2}]$

$\alpha = 60°$, $\beta = 45°$

I. $\underline{v}_B = ?$, $\underline{v}_C$, $\underline{\omega}_2 = ?$, $\underline{\omega}_3 = ?$, P_2

II. $\underline{a}_B = ?$, $\underline{\varepsilon}_2$, $\underline{a}_C$, $\underline{\varepsilon}_3$, G_2

$$\underline{v}_B = \underbrace{\underline{v}_A}_{\underline{0}} + \underline{\omega}_1 \times \underline{r}_{AB} = \underline{0} + \begin{vmatrix} \underline{i} & \underline{j} & \underline{k} \\ 0 & 0 & \omega_1 \\ l_1\cos\alpha & l_1\sin\alpha & 0 \end{vmatrix} = \begin{bmatrix} -1.819 \\ 1.05 \\ 0 \end{bmatrix} [m/s]$$

$$\left.\begin{aligned} \underline{v}_C &= \underline{v}_B + \underline{\omega}_2 \times \underline{r}_{BC} \\ \underline{v}_C &= \underline{v}_D + \underline{\omega}_3 \times \underline{r}_{DC} \end{aligned}\right\} \Rightarrow \underline{v}_B + \underline{\omega}_2 \times \underline{r}_{BC} = \underline{\omega}_3 \times \underline{r}_{DC}$$

$$\begin{bmatrix} v_{Bx} \\ v_{By} \\ 0 \end{bmatrix} + \begin{vmatrix} \underline{i} & \underline{j} & \underline{k} \\ 0 & 0 & \omega_2 \\ 0 & -l_2 & 0 \end{vmatrix} = \begin{vmatrix} \underline{i} & \underline{j} & \underline{k} \\ 0 & 0 & \omega_3 \\ -\cos\beta\, l_3 & \sin\beta\, l_3 & 0 \end{vmatrix}$$

$$\omega_2 = -\frac{v_{By}}{l_3\cos\beta} = -4.95\,[\frac{rad}{s}], \quad \omega_3 = -\frac{\omega_3 l_3 \sin\beta + v_{Bx}}{l_2} = 5.56\,[\frac{rad}{s}]$$

$$\Downarrow$$

$$\underline{v}_C = \begin{bmatrix} 1.05 \\ 1.05 \\ 0 \end{bmatrix} [m/s]$$

$$\underline{a}_B = \underline{a}_A + \underline{\varepsilon}_1 \times \underline{r}_{AB} - \omega_1^2 \underline{r}_{AB} = \underline{0} + \varepsilon_1 l_1 \begin{vmatrix} i & j & k \\ 0 & 0 & 1 \\ \cos\alpha & \sin\alpha & 0 \end{vmatrix} - \omega_1^2 l_1 \begin{bmatrix} \cos\alpha \\ \sin\alpha \\ 0 \end{bmatrix}$$

$$\underline{a}_B = \begin{bmatrix} 6.717 \\ -12.37 \\ 0 \end{bmatrix} \left[\frac{m}{s^2}\right]$$

$$\left.\begin{aligned} \underline{a}_C &= \underline{a}_B + \underline{\varepsilon}_2 \times \underline{r}_{BC} - \omega_2^2 \underline{r}_{BC} \\ \underline{a}_C &= \underline{a}_D + \underline{\varepsilon}_3 \times \underline{r}_{DC} - \omega_3^2 \underline{r}_{DC} \end{aligned}\right\} \quad \begin{aligned} &\underline{a}_B + \underline{\varepsilon}_2 \times \underline{r}_{BC} - \omega_2^2 \underline{r}_{BC} = \\ &= \underline{a}_D + \underline{\varepsilon}_3 \times \underline{r}_{DC} - \omega_3^2 \underline{r}_{DC} \end{aligned}$$

$$\underline{\varepsilon}_3 = \begin{bmatrix} 0 \\ 0 \\ -95.46 \end{bmatrix} \left[\frac{rad}{s^2}\right], \quad \underline{\varepsilon}_2 = \begin{bmatrix} 0 \\ 0 \\ 62.41 \end{bmatrix} \left[\frac{rad}{s^2}\right]$$

$$\underline{a}_C = \begin{bmatrix} 25.45 \\ 15.05 \\ 0 \end{bmatrix} \left[\frac{m}{s^2}\right]$$

$$\underline{a}_G = \underline{0} = \underline{a}_B + \underline{\varepsilon}_2 \times \underline{r}_{BG} - \omega_2^2 \underline{r}_{BG}, \quad \underline{r}_{BG} = \begin{bmatrix} x_{BG} \\ y_{BG} \\ 0 \end{bmatrix} = \begin{bmatrix} 0.1131 \\ -0.058 \\ 0 \end{bmatrix} [m]$$