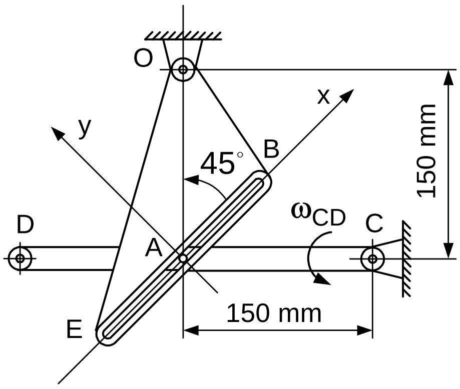

5.34 Kuvan mekanismissa sauva DC pyörii vastapäivään vakiokulmanopeudella $\omega_{CD} = 2\ 1/s$. Määritä kappaleen EBO kulmanopeus $\vec{\omega}$ ja kulmakiihtyvyys $\vec{\alpha}$ mekanismin ollessa kuvan asemassa.

Ratkaisu:

Tappi A liikkuu osan EBO pyörivässä urassa. Käytetään kuvan mukaista kappaleeseen EBO kiinnitettyä xy-koordinaatistoa, jolloin z-akseli on kohti katsojaa. Yksiköt ovat (m,s).

$$\boxed{\vec{v}_A = \vec{v}_O + \vec{\omega} \times \vec{r}_{A/O} + \vec{v}_{rel} = \vec{v}_C + \vec{\omega}_{CD} \times \vec{r}_{A/C}}$$

$$\vec{v}_O = \vec{0} \qquad \vec{\omega} = \omega\vec{k} \qquad \vec{r}_{A/O} = -\frac{0{,}15}{\sqrt{2}}(\vec{i} + \vec{j}) \qquad \vec{v}_{rel} = v_{rel}\,\vec{i}$$

$$\vec{v}_C = \vec{0} \qquad \vec{\omega}_{DC} = 2\vec{k} \qquad \vec{r}_{A/C} = \frac{0{,}15}{\sqrt{2}}(-\vec{i} + \vec{j}) \qquad \Rightarrow$$

$$\vec{0} + \omega\vec{k} \times \frac{0{,}15}{\sqrt{2}}(-\vec{i} - \vec{j}) + v_{rel}\,\vec{i} = \vec{0} + 2\vec{k} \times \frac{0{,}15}{\sqrt{2}}(-\vec{i} + \vec{j})$$

$$\Rightarrow \qquad \frac{0{,}15 \cdot \omega}{\sqrt{2}}(-\vec{j} + \vec{i}) + v_{rel}\,\vec{i} = \frac{0{,}30}{\sqrt{2}}(-\vec{j} - \vec{i})$$

$$\Rightarrow \qquad -\frac{0{,}15\,\omega}{\sqrt{2}} = -\frac{0{,}30}{\sqrt{2}} \qquad \Rightarrow \qquad \omega = 2 \qquad \vec{\omega} = 2\vec{k}\ 1/s$$

$$\Rightarrow \qquad \frac{0{,}15 \cdot 2}{\sqrt{2}} + v_{rel} = -\frac{0{,}30}{\sqrt{2}} \qquad \Rightarrow \qquad v_{rel} = -0{,}30\sqrt{2}\ m/s$$

$$\boxed{\begin{aligned}\vec{a}_A &= \vec{a}_O + \vec{\omega}\times(\vec{\omega}\times\vec{r}_{A/O}) + \vec{\alpha}\times\vec{r}_{A/O} + 2\vec{\omega}\times\vec{v}_{rel} + \vec{a}_{rel}\\ &= \vec{a}_C + \vec{\omega}_{CD}\times(\vec{\omega}_{CD}\times\vec{r}_{A/C}) + \vec{\alpha}_{CD}\times\vec{r}_{A/C}\end{aligned}}$$

$$\vec{a}_O = \vec{0} \qquad \vec{\alpha} = \alpha\vec{k} \qquad \vec{a}_{rel} = a_{rel}\,\vec{i} \qquad \vec{a}_C = \vec{0} \qquad \vec{\alpha}_{CD} = \vec{0} \qquad \Rightarrow$$

$$\vec{0} + 2\vec{k}\times[2\vec{k}\times\frac{0{,}15}{\sqrt{2}}(-\vec{i}-\vec{j})] + \alpha\vec{k}\times\frac{0{,}15}{\sqrt{2}}(-\vec{i}-\vec{j}) + 2\cdot 2\vec{k}\times(-0{,}30\sqrt{2}\,\vec{i}) + a_{rel}\,\vec{i}$$

$$= \vec{0} + 2\vec{k}\times[2\vec{k}\times\frac{0{,}15}{\sqrt{2}}(-\vec{i}+\vec{j})] + \vec{0}$$

$$\Rightarrow \qquad \frac{0{,}60}{\sqrt{2}}(\vec{i}+\vec{j}) + \frac{0{,}15\cdot\alpha}{\sqrt{2}}(-\vec{j}+\vec{i}) - 1{,}20\sqrt{2}\,\vec{j} + a_{rel}\,\vec{i} = \frac{0{,}60}{\sqrt{2}}(\vec{i}-\vec{j})$$

$$\Rightarrow \qquad \frac{0{,}60}{\sqrt{2}} - \frac{0{,}15\,\alpha}{\sqrt{2}} - 1{,}20\sqrt{2} = -\frac{0{,}60}{\sqrt{2}} \qquad \Rightarrow \qquad \alpha = -8 \qquad \vec{\alpha} = -8\vec{k}\ 1/s^2$$

$$\Rightarrow \qquad \frac{0{,}60}{\sqrt{2}} - \frac{0{,}15\cdot 8}{\sqrt{2}} + a_{rel} = \frac{0{,}60}{\sqrt{2}} \qquad \Rightarrow \qquad a_{rel} = 0{,}60\sqrt{2}\,m/s^2$$