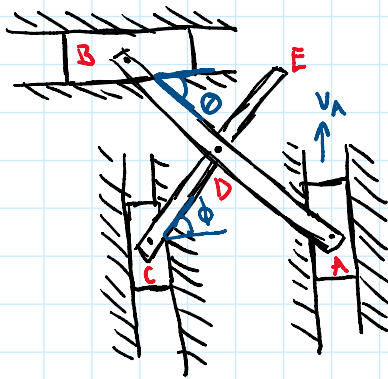


20-R-KM-DK-9 Advanced Velocity (Relative Motion)

Inspiration: 16-72 Hibbeler



The following mechanism has links length $L_{AD} = 0.15 \text{ m}$, $L_{BD} = 0.3 \text{ m}$, $L_{CD} = 0.25 \text{ m}$, and $L_{DE} = 0.2 \text{ m}$. If the slider block A moves upward at a velocity of $v_A = 3.5 \text{ m/s}$, determine the velocities of blocks B and C at the instant shown. The angle between link BD and the horizontal is given as $\theta_{BD} = 35 \text{ degrees}$ while the angle between link CD and the horizontal is $\theta_{CD} = 30 \text{ degrees}$.

$$\vec{v}_B = \vec{v}_A + \vec{v}_{B/A} = 4 \hat{j} + \omega_{AB} \hat{k} \times (-0.45 \cos 35 \hat{i} + 0.45 \sin 35 \hat{j})$$

$$\vec{v}_B = v_B \hat{i}$$

$$\hat{i}: -\omega_{AB} (0.45 \sin 35) = v_B$$

$$\hat{j}: 4 - \omega_{AB} (0.45 \cos 35) = 0 \quad \omega_{AB} = 10.951 \quad \boxed{\vec{v}_B = -2.60093 \hat{i} \text{ m/s}}$$

$$\begin{aligned} \vec{v}_D &= \vec{v}_A + \vec{v}_{D/A} = \vec{v}_A + \omega_{AB} \times (-0.15 \cos 35 \hat{i} + 0.15 \sin 35 \hat{j}) \\ &= 4 \hat{j} + 10.951 \hat{k} \times (-0.15 \cos 35 \hat{i} + 0.15 \sin 35 \hat{j}) \\ &= \frac{8}{3} \hat{j} - 0.93361 \hat{i} \end{aligned}$$

$$\begin{aligned} \vec{v}_C &= \vec{v}_D + \vec{v}_{C/D} = \vec{v}_D + \omega_{CE} \times (-0.25 \cos 30 \hat{i} - 0.25 \sin 30 \hat{j}) \\ &= \frac{8}{3} \hat{j} - 0.93361 \hat{i} + \omega_{CE} \hat{k} \times (-0.25 \cos 30 \hat{i} - 0.25 \sin 30 \hat{j}) \\ &= \frac{8}{3} \hat{j} - 0.93361 \hat{i} - \omega_{CE} (-0.25 \cos 30) \hat{j} + \omega_{CE} (0.25 \sin 30) \hat{i} \\ \vec{v}_C &= v_C \hat{j} \end{aligned}$$

$$\hat{i}: \omega_{CE} (0.25 \sin 30) - 0.93361 = 0$$

$$\omega_{CE} = 7.4688 \text{ rad/s}$$

$$\hat{j}: \frac{8}{3} - \omega_{CE} (0.25 \cos 30) = v_C$$

$$\boxed{\vec{v}_C = 1.0496 \hat{j} \text{ m/s}}$$