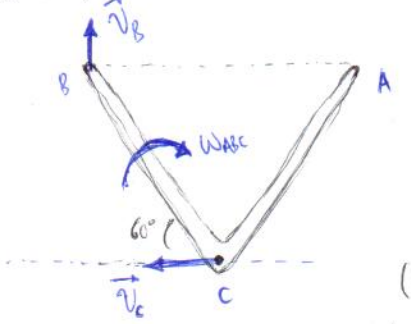
ESP7 – MCR – 2302

① Diagrama cinemático de ABC:



- Ecuación de velocidad relativa → $\vec{v}_B = \vec{v}_C + \vec{\omega}_{ABC} \times \vec{r}_{B/C}$
- Vectores de posición y velocidad

$$\vec{v}_B = (v_B\,\hat{j})\ \text{ft/s}\ ;\quad \vec{v}_C = (-2\,\hat{i})\ \text{ft/s}\ ;\quad \vec{\omega}_{ABC} = (-\omega_{ABC}\,\hat{k})\ \text{rad/s}$$

$$\vec{r}_{B/C} = (-4\cos 60°\,\hat{i} + 4\,\text{sen}\,60°\,\hat{j}) = (-2\,\hat{i} + 3.464\,\hat{j})\ \text{ft/s}$$

- Sustituyendo en la ecuación de velocidad relativa:

$$(v_B\,\hat{j}) = (-2\,\hat{i}) + (-\omega_{ABC}\,\hat{k}) \times (-2\,\hat{i} + 3.464\,\hat{j})$$

$$(v_B\,\hat{j}) = (-2\,\hat{i}) + (2\omega_{ABC}\,\hat{j} + 3.464\,\omega_{ABC}\,\hat{i})$$

- Ecuaciones escalares:

Comp. $\hat{i}$ → $0 = -2 + 3.464\,\omega_{ABC}$ ... (i)

Comp. $\hat{j}$ → $v_B = 2\omega_{ABC}$ ... (ii)

De (i) → $\omega_{ABC} = \frac{2}{3.464} = 0.577$ rad/s

De (ii) → $v_B = 2(0.577) = 1.154$ ft/s

- Calculando $\vec{v}_A$

$$\vec{v}_A = \vec{v}_B + \vec{\omega}_{ABC} \times \vec{r}_{A/B} = (1.154\,\hat{j}) + (-0.577\,\hat{k}) \times (4\,\hat{i}) = (1.154\,\hat{j}) + (-2.308\,\hat{j}) = (-1.154\,\hat{j})\ \text{ft/s}$$

Resultados →

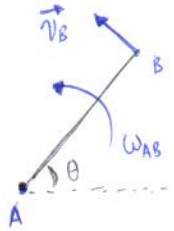
$\omega_{ABC} = 0.577$ rad/s ↻

$\vec{v}_B = 1.154$ ft/s ↑

$\vec{v}_A = 1.154$ ft/s ↓

② - Analizando AB:

$$\vec{v}_B = \vec{\omega}_{AB} \times \vec{r}_{B/A} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 0 & 16.76 \\ 1.5 & 2.598 & 0 \end{vmatrix} = (-43.54\,\hat{i} + 25.14\,\hat{j})\ \text{in/s}$$

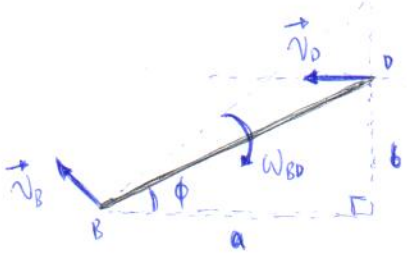


$\omega_{AB} = 160\left(\frac{2\pi}{60}\right) = 16.76$ rad/s

- Analizando BD:

- Ecuación de velocidad relativa → $\vec{v}_D = \vec{v}_B + \vec{\omega}_{BD} \times \vec{r}_{D/B}$
- Vectores de velocidad y posición:

$$\vec{v}_D = (-v_D\,\hat{i})\ \text{in/s} \quad \left| \quad \vec{\omega}_{BD} = (-\omega_{BD}\,\hat{k})\ \text{rad/s} \quad \right| \quad \vec{r}_{D/B} = (9.404\,\hat{i} + 3.402\,\hat{j})\ \text{in}$$



$b = 6 - 2.598 = 3.402$ in

$a = \sqrt{10^2 - b^2} = 9.404$ in

- Sustituyendo en la ecuación de velocidad relativa:

$$(-v_D\,\hat{i}) = (-43.54\,\hat{i} + 25.14\,\hat{j}) + (-\omega_{BD}\,\hat{k}) \times (9.404\,\hat{i} + 3.402\,\hat{j})$$

$$(-v_D\,\hat{i}) = (-43.54\,\hat{i} + 25.14\,\hat{j}) + (-9.404\,\omega_{BD}\,\hat{j} + 3.402\,\omega_{BD}\,\hat{i})$$

$$(-v_D\,\hat{i}) = (-43.54 + 3.402\,\omega_{BD})\,\hat{i} + (25.14 - 9.404\,\omega_{BD})\,\hat{j}$$

- Escribiendo las ecuaciones escalares:

Comp. $\hat{i}$ → $-v_D = -43.54 + 3.402\,\omega_{BD}$ ... (i)

Comp. $\hat{j}$ → $0 = 25.14 - 9.404\,\omega_{BD}$ ... (ii)

De (ii) → $\omega_{BD} = \frac{25.14}{9.404} = 2.673$ rad/s

De (i) → $v_D = 43.54 - 3.402(2.673) = 34.45$ in/s

Resultados !

$\omega_{BD} = 2.673$ rad/s ↻

$\vec{v}_D = 34.45$ in/s ←