20-R-KM-DK-16

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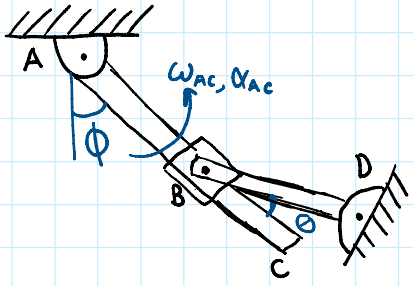
20-R-KM-DK-16 Intermediate Rotating Frame Analysis

Inspiration: 16-140 Hibbeler



Bar AC rotates at ***omega_AC = 2 rad/s*** with an angular acceleration of ***alpha_AC = 1 rad/s^2***. At that instant, it forms a ***phi = 55 degree*** angle with the vertical. If link BD makes a ***theta = 20 degrees*** angle with bar AC and has a length ***r_BD = 0.8 m***, determine the angular velocity and angular acceleration of link BD, as well as the relative acceleration of collar B. The link is connected to a collar which slides along bar AC. The distance to B from A is ***r_AB = 1.1 m***.

$$\vec{v}_B = \vec{v}_A + \vec{\Omega} \times \vec{r}_{B/A} + (v_{B/A})_{xyz}$$
$$= 2\hat{k} \times (1.1\hat{i}) + (v_{B/A})_{xyz}\hat{i}$$

$$v_B = -\omega_{BD}\hat{k} \times (-0.8\cos 20\,\hat{i} - 0.8\sin 20\,\hat{j})$$
$$= 0.8\cos 20\,\omega_{BD}\hat{j} - 0.8\sin 20\,\omega_{BD}\hat{i}$$

$\hat{i}$: $-0.8\sin 20\,\omega_{BD} = (v_{B/A})_{xyz}$

$\hat{j}$: $2.2 = 0.8\cos 20\,\omega_{BD}$

$\omega_{BD} = 2.926488\ldots$ rad/s

$(v_{B/A})_{xyz} = 0.8007345\,15$ m/s

$$\vec{a}_B = \vec{a}_A + \dot{\vec{\Omega}} \times \vec{r}_{B/A} + \vec{\Omega} \times (\vec{\Omega} \times \vec{r}_{B/A}) + 2\vec{\Omega} \times (v_{B/A})_{xyz} + (\vec{a}_{B/A})_{xyz}$$

$$\vec{a}_B = \vec{\alpha}_{BD} \times \vec{r}_{B/D} - \omega_{BD}^2 r_{B/D}$$
$$= \alpha_{BD}\hat{k} \times (-0.8\cos 20\,\hat{i} - 0.8\sin 20\,\hat{j}) - (2.926488)^2(-0.8\cos 20\,\hat{i} - 0.8\sin 20\,\hat{j})$$
$$= -0.8\cos 20\,\alpha_{BD}\hat{j} + 0.8\sin 20\,\alpha_{BD}\hat{i} + 6.438275\hat{i} + 2.34334\hat{j}$$

$\hat{i}$: $6.438275 + 0.8\sin 20\,\alpha_{BD} = 2\hat{k} \times (2\hat{k} \times 1.1\hat{i}) + (a_{B/A})_{xyz}$

$\hat{j}$: $-0.8\cos\alpha_{BD} + 2.341334065 = 2.2 - 3.202939\,66$

$\alpha_{BD} = 4.451296409$ rad/s^2

$(a_{B/A})_{xyz} = 12.0562$ m/s^2