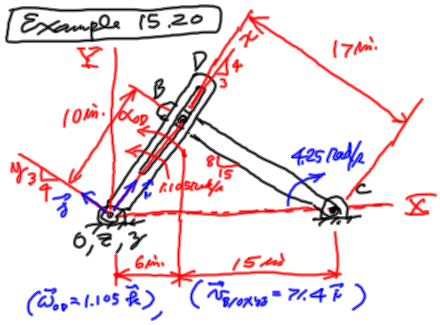
Example 15.20



$\vec{\alpha}_{OD} = ?$, $\vec{a}_{B/OD} = ?$

$\vec{\alpha}_{BC} = 0$, $\vec{\omega}_{BC} = -4.25\vec{k}$

$\vec{a}_B = \cancel{17}(4.25)^2\left(\frac{1}{\cancel{17}}\right)(15\vec{I} - 8\vec{J})$

$\vec{a}_B = 270.94\vec{I} - 144.5\vec{J}$

$\vec{a}_B = \vec{a}_{B/O\,xyz} + \dot{\vec{\Omega}} \times \vec{r}_{B/O} + \vec{\Omega} \times (\vec{\Omega} \times \vec{r}_{B/O}) + 2\vec{\Omega} \times \vec{v}_{B/O\,xyz} + \cancel{\vec{a}_O}$

$\vec{a}_B = a_{B/OD}\vec{i} + \alpha_{OD}\vec{k} \times 10\vec{i} + 1.105\vec{k} \times (1.105\vec{k} \times 10\vec{i}) + 2(1.105\vec{k}) \times 71.4\vec{i} + \vec{0}$

$\vec{a}_B = (a_{B/OD} - 12.2)\vec{i} + (10\alpha_{OD} + 157.79)\vec{j}$

$\vec{i} = \frac{1}{5}(3\vec{I} + 4\vec{J})$ $\qquad$ $\vec{j} = \frac{1}{5}(-4\vec{I} + 3\vec{J})$

$\vec{a}_B = (0.6\,a_{B/OD} - 8\alpha_{OD} - 133.56)\vec{I} + (0.8\,a_{B/OD} + 6\alpha_{OD} + 84.91)\vec{J}$

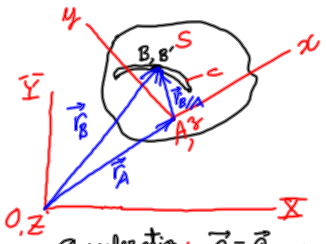
$$\begin{bmatrix} 0.6 & -8 \\ 0.8 & 6 \end{bmatrix} \begin{bmatrix} a_{B/OD} \\ \alpha_{OD} \end{bmatrix} = \begin{bmatrix} 404.5 \\ -229.41 \end{bmatrix}$$

$a_{B/OD} = 59.172$

$\alpha_{OD} = -46.1246$

$\vec{\alpha}_{OD} = 46.1\ \text{rad/s}^2\ \circlearrowleft$ $\qquad$ $\vec{a}_{B/OD} = 59.2\ \text{in./s}^2\ \swarrow 4/3$

Use of rotating reference frame



position vector: $\vec{r}_B = \vec{r}_{B/A} + \vec{r}_A$

velocity: $\vec{v}_B = \vec{v}_{B/A\,xyz} + \vec{\Omega} \times \vec{r}_{B/A} + \vec{v}_A$

$\boxed{\vec{v}_B = \vec{v}_{B/A\,xyz} + \vec{v}_{B'}}$

$\boxed{\vec{v}_{B'} = \vec{\Omega} \times \vec{r}_{B/A} + \vec{v}_A}$

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

$\boxed{\vec{a}_B = \vec{a}_{B/A\,xyz} + \vec{a}_{B'} + 2\vec{\Omega} \times \vec{v}_{B/A\,xyz}}$

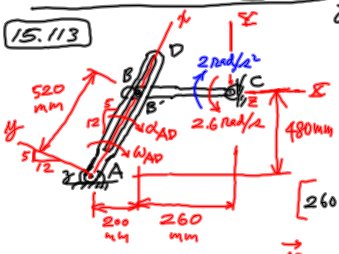
$\boxed{\vec{a}_{B'} = \dot{\vec{\Omega}} \times \vec{r}_{B/A} + \vec{\Omega} \times (\vec{\Omega} \times \vec{r}_{B/A}) + \vec{a}_A}$

$2\vec{\Omega} \times \vec{v}_{B/A\,xyz}$: Coriolis acceleration

$2\vec{\Omega} \times \vec{v}_{B/A\,xyz} = \vec{a}_B - \vec{a}_{B'} - \vec{a}_{B/A\,xyz}$

$= \vec{a}_{B/B'} - \vec{a}_{B/A\,xyz}$

15.113



$\vec{\omega}_{BC} = 2.6$ rad/s ↺, $\vec{\alpha}_{BC} = 2$ rad/s² ↻

$\vec{\alpha}_{AD} = ?$ $\qquad$ $\vec{a}_{B/AD} = ?$

Let Axyz be embedded in member AD

Let B' belonging to AD coincides with B.

$\vec{v}_B = \vec{v}_{B/A\,xyz} + \vec{v}_{B'}$

$[260(2.6)\downarrow] = [v_{B/AD}\ \swarrow 12/5] + [B'A\ 520\omega_{AD}\ \searrow 5/12]$

$\vec{v}_{B/AD} = 624\ \text{mm/s}\ \swarrow 12/5$ $\qquad$ $\vec{\omega}_{AD} = 0.5$ rad/s ↻

$\vec{a}_B = \vec{a}_{B/A\,xyz} + \vec{a}_{B'} + 2\vec{\Omega} \times \vec{v}_{B/A\,xyz}$

$[260(2.6)^2\ \rightarrow\ 260(2)\ \uparrow\ B\ C] = [a_{B/AD}\ \nearrow 12/5] + [520\alpha_{AD}\ \searrow\ 520(0.5)^2\ B'\ A] + [2(-0.5\vec{K}) \times \frac{624}{13}(-5\vec{I} - 12\vec{J})]$

$a_{B/AD} = \square$, $\alpha_{AD} = \square$ $\qquad$ $\boxed{\vec{\alpha}_{AD} = \square}$ $\qquad$ $\boxed{\vec{a}_{B/AD} = \square}$