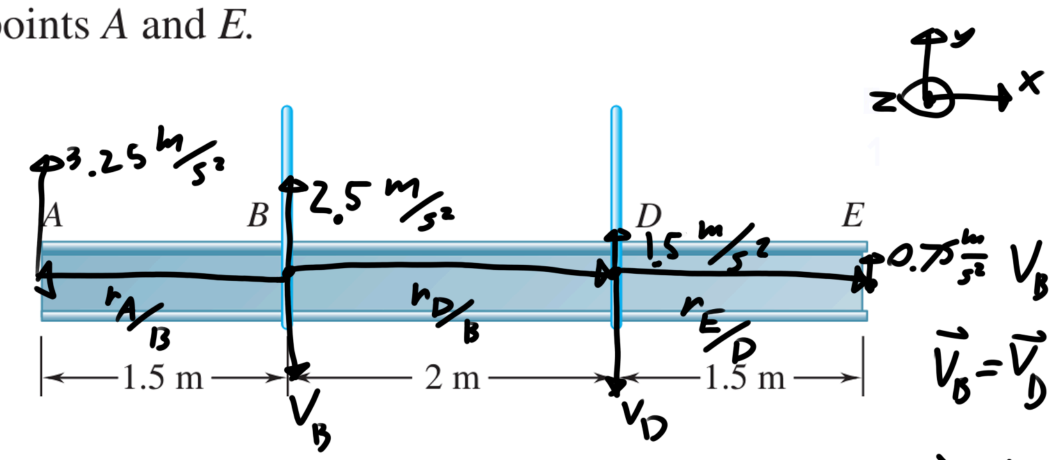
A 5-m steel beam is lowered by means of two cables unwinding at the same speed from overhead cranes. As the beam approaches the ground, the crane operators apply brakes to slow the unwinding motion. At the instant considered, the deceleration of the cable attached at $B$ is 2.5 m/s$^2$, while that of the cable attached at $D$ is 1.5 m/s$^2$. Determine ($a$) the angular acceleration of the beam, ($b$) the acceleration of points $A$ and $E$.




$V_B = V_D$

$\vec{V}_B = \vec{V}_D + \vec{\omega} \times \vec{r}_{D/B}$

$\vec{\omega} = \vec{0}$

$\vec{a}_D = \vec{a}_B + \vec{\alpha} \times \vec{r}_{D/B} - \cancel{\omega^2 \vec{r}_{D/B}} \to 0$

$\vec{r}_{D/B} = 2i$ m

$1.5j = 2.5j + \vec{\alpha} \times 2i$

$1.5j - 2.5j = \vec{\alpha} \times 2i$

$-1j = \alpha k \times 2i$

$= \begin{vmatrix} i & j & k \\ 0 & 0 & \alpha \\ 2 & 0 & 0 \end{vmatrix} \begin{matrix} i & j \\ 0 & 0 \\ 2 & 0 \end{matrix}$

$-1j = 2\alpha j$

$\frac{-1j}{2j} = \boxed{-\frac{1}{2} = \alpha}$

$\alpha k = \boxed{-\frac{1}{2} k \text{ rad/s}^2 = \vec{\alpha}}$

$\vec{a}_A = \vec{a}_B + \vec{\alpha} \times \vec{r}_{A/B} - \cancel{\omega^2 \vec{r}_{A/B}} \to 0$

$\vec{r}_{A/B} = -1.5i$ m

$\vec{a}_A = 2.5j - \frac{1}{2} k \times -1.5i$

$= 2.5j + \begin{vmatrix} i & j & k \\ 0 & 0 & -\frac{1}{2} \\ -1.5 & 0 & 0 \end{vmatrix} \begin{matrix} i & j \\ 0 & 0 \\ -1.5 & 0 \end{matrix}$

$= 2.5j + 0.5 \cdot 1.5j = \boxed{3.25j \text{ m/s}^2}$

$\vec{a}_E = \vec{a}_D + \vec{\alpha} \times \vec{r}_{E/D} - \cancel{\omega^2 \vec{r}_{E/D}} \to 0$

$\vec{r}_{E/D} = 1.5i$ m

$= 1.5j - 0.5k \times 1.5i$

$= 1.5j + \begin{vmatrix} i & j & k \\ 0 & 0 & -0.5 \\ 1.5 & 0 & 0 \end{vmatrix} \begin{matrix} i & j \\ 0 & 0 \\ 1.5 & 0 \end{matrix}$

$= 1.5j + (-0.5)(1.5)j$

$= 1.5j - 0.75j = \boxed{0.75j \text{ m/s}^2}$