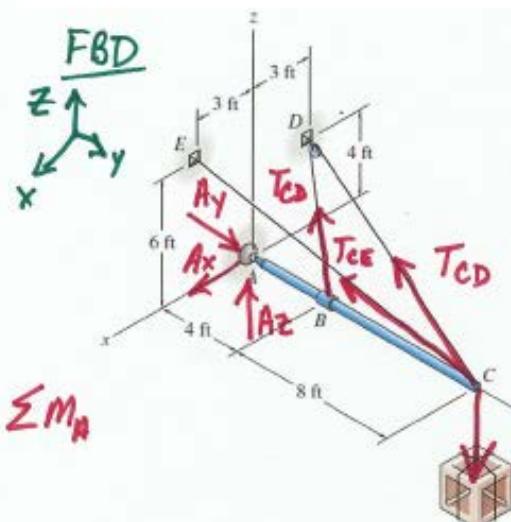


3D Equilibrium II Problem 2

The boom AC is supported by a ball-and-socket joint and the two cables BCD and CE. Cable BDC is continuous and passes over a pulley at D. Calculate the tension in the cables and the reactions at A if the crate has a weight of 80 lbs.



$$\begin{aligned} & A(0,0,0) \quad C(0,12,0) \quad E(3,0,6) \\ & B(0,4,0) \quad D(-3,0,4) \\ & \hat{u}_{BD} = \frac{[-3 -4 4]}{\sqrt{41}} \\ & = [-.469 -.625 .625] \\ & \hat{u}_{CD} = \frac{[-3 -12 4]}{\sqrt{169}} \\ & = [-.231 -.923 .307] \\ & \hat{u}_{CE} = \frac{[3 -12 6]}{\sqrt{109}} \\ & = [2.18 -.873 .436] \end{aligned}$$

Forces moment Reactions	\vec{r}_{AF}	\vec{F}	moments & $\vec{F} \times \vec{F}$
\vec{A}	$[0 0 0]$	$[A_x \quad A_y \quad A_z]$	$[0 \quad 0 \quad 0]$
\vec{F}_{CE}	$[0 12 0]$	$[\sum_{x=0}^{12} 0 \quad -.873 \quad .436] F_{CE}$	$[5.232 \quad 0 \quad -2.616] F_{CE}$
\vec{F}_{BD}	$[0 4 0]$	$[-.469 \quad -.625 \quad .625] F_{BD}$	$[2.5 \quad 0 \quad 1.876] F_{BD}$
\vec{F}_{CD}	$[0 12 0]$	$[-.231 \quad -.923 \quad .307] F_{CD}$	$[3.684 \quad 0 \quad 2.442] F_{CD}$
g_0	$[0 12 0]$	$[0 \quad 0 \quad -80]$	$[-960 \quad 0 \quad 0]$

$$\text{RECOGNIZE } |\vec{F}_{BD}| = |\vec{F}_{CD}|$$

$$\begin{aligned} \Sigma M_x = 0 \Rightarrow 0 + 5.232 F_{CE} + 2.5 F_{BD} + 3.684 F_{CD} - 960 &= 0 \\ 5.232 F_{CE} + 6.104 F_{BD} &= 960 \quad (1) \end{aligned}$$

$$\begin{aligned} \Sigma M_z = 0 \Rightarrow 0 - 2.616 F_{CE} + 1.876 F_{BD} + 2.442 F_{CD} &= 0 \\ -2.616 F_{CE} + 4.640 F_{BD} &= 0 \quad (2) \end{aligned}$$

$$\text{SOLVE } (1+2) \quad |\vec{F}_{BD}| = |\vec{F}_{CD}| = 62.0 \text{ lb}, \quad |\vec{F}_{CE}| = 110 \text{ lb}$$

$$\Sigma F = 0 \Rightarrow \vec{A} = [19.37 \quad 192 \quad -25.0] \text{ lb}$$