

### 3D Equilibrium II Problem 1

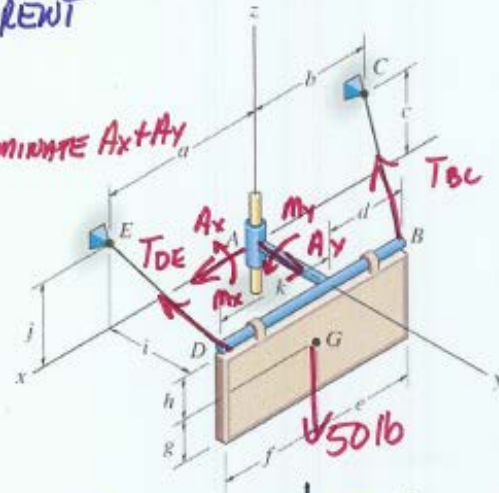
Determine the tensions in the cables and the components of reaction acting on the smooth collar at A necessary to hold the sign of weight  $W = 50$  lb in equilibrium. The center of gravity for the sign is at G.

$$\begin{aligned} a &= 4 \text{ ft} & g &= 1 \text{ ft} \\ b &= 3 \text{ ft} & h &= 1 \text{ ft} \\ c &= 2 \text{ ft} & i &= 2 \text{ ft} \\ d &= 2 \text{ ft} & j &= 2 \text{ ft} \\ e &= 2.5 \text{ ft} & k &= 3 \text{ ft} \\ f &= 2.5 \text{ ft} \end{aligned}$$

$$\vec{u}_{DE} = \frac{[1 \ -2 \ 2]}{\sqrt{1^2 + (-2)^2 + 2^2}} = [0.333 \ -0.667 \ 0.667]$$

$$\vec{u}_{BC} = \frac{[-1 \ -2 \ 2]}{\sqrt{1^2 + (-2)^2 + 2^2}} = [-0.333 \ -0.667 \ 0.667]$$

NON-CURRENT  
6 EQNS  
6 LINKS  
 $\Sigma M_A$  TO ELIMINATE  $A_x + A_y$



FORCES, MOMS REACTIONS	$\vec{r}_{PT \Rightarrow F}$	$\vec{F}$	$\vec{r} \times \vec{F}$ , couples MOMENT REACTIONS
$T_{DE}$	$[4 \ 0 \ 2]$	$[0.333 \ -0.667 \ 0.667] T_{DE}$	$[1.334 \ -2 \ -2.67] T_{DE}$
$T_{BC}$	$[-3 \ 0 \ 2]$	$[-0.333 \ -0.667 \ 0.667] T_{BC}$	$[1.334 \ 1.335 \ 2] T_{BC}$
50 lb	$[0.5 \ 2 \ -1]$	$[0 \ 0 \ -50]$	$[-100 \ 25 \ 0]$
$\vec{M}_A$	_____	_____	$[M_x \ M_y \ 0]$
$\vec{A}$	$[0 \ 0 \ 0]$	$[A_x \ A_y \ 0]$	$[0 \ 0 \ 0]$
		① ② ③	④ ⑤ ⑥

EQUILIBRIUM EQNS

EQNS 3+6

$$\Sigma F_z = 0 = 0.667 T_{DE} + 0.667 T_{BC} - 50 + 0 = 0$$

$$\Sigma M_z = 0 = -2.67 T_{DE} + 2 T_{BC} + 0 + 0 = 0$$

$$T_{BC} = 42.9 \text{ lb}$$

$$T_{DE} = 32.1 \text{ lb}$$

$$\Sigma F_x = 0 = 0.333 T_{DE} - 0.333 T_{BC} + A_x \Rightarrow A_x = 3.6 \text{ lb}$$

$$\Sigma F_y = 0 = -0.667 T_{DE} - 0.667 T_{BC} + A_y \Rightarrow A_y = 50 \text{ lb}$$

$$\Sigma M_x = 0 = 1.334 T_{DE} + 1.334 T_{BC} - 100 + M_x + 0$$

$$M_x = 0$$

$$\Sigma M_y = 0 = -2 T_{DE} + 1.335 T_{BC} + 25 + M_y + 0$$

$$M_y = -17.9 \text{ Ft} \cdot \text{lb}$$

$$\vec{A} = [3.6 \ 50 \ 0] \text{ lb}$$

$$\vec{M}_A = [0 \ -17.9 \ 0] \text{ Ft} \cdot \text{lb}$$