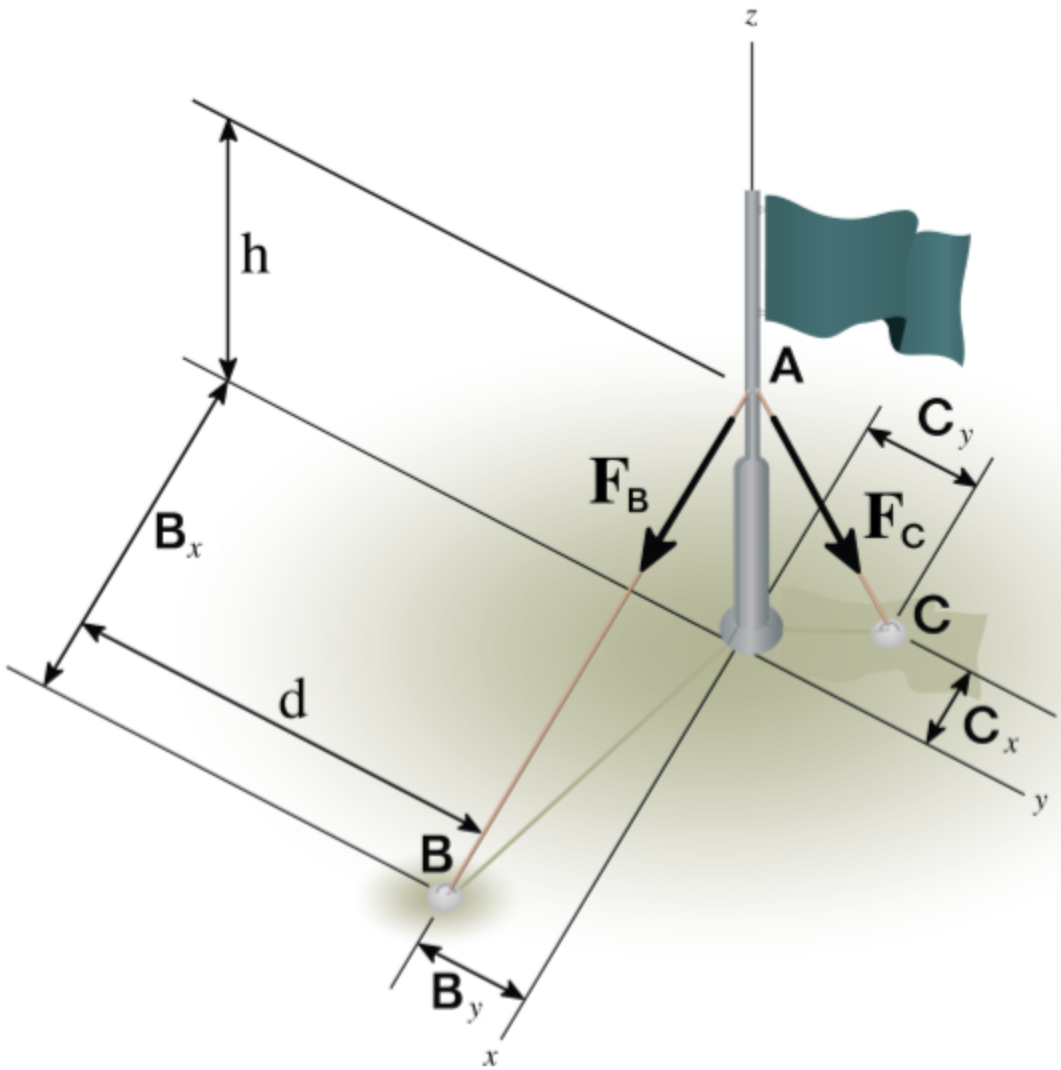
21-5-4-3-GD-001



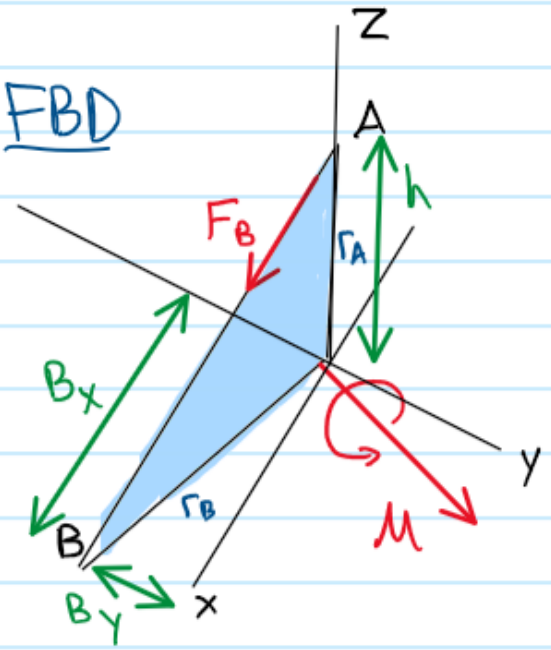
The flagpole shown is normally tied down with 2 ropes, but rope C is slack ($F_C = 0$ N). What is the moment produced by $F_B = \underline{\underline{F_B}}$ N about the base of the pole?

($B_x = \underline{\underline{B_x}}$ m, $B_y = \underline{\underline{B_y}}$ m, and $h = \underline{\underline{h}}$ m)

given F_B, B_x, B_y, h

find M

FBD



either r_A or r_B can be used to solve for the moment

F_B as a Cartesian vector

$$\vec{F}_B = F_B u_{AB} = F_B\left[\frac{B_x}{r_{AB}}\hat{\imath} - \frac{B_y}{r_{AB}}\hat{\jmath} - \frac{h}{r_{AB}}\hat{k}\right] = F_B\left[\frac{(B_x\hat{\imath} - B_y\hat{\jmath} - h\hat{k})}{\sqrt{B_x^2 + B_y^2 + h^2}}\right]$$

$$\vec{F}_B = \underbrace{\frac{F_B B_x}{r_{AB}}}_{F_{Bx}}\hat{\imath} - \underbrace{\frac{F_B B_y}{r_{AB}}}_{F_{By}}\hat{\jmath} - \underbrace{\frac{F_B h}{r_{AB}}}_{F_{Bz}}\hat{k}$$

$$\vec{M} = \vec{r}_A \times \vec{F}_B = \begin{vmatrix} \hat{\imath} & \hat{\jmath} & \hat{k} \\ 0 & 0 & h \\ F_{Bx} & F_{By} & F_{Bz} \end{vmatrix}$$

$$\vec{M} = (0\cdot F_{Bz} - h\cdot F_{By})\hat{\imath} + (h\cdot F_{Bx} - 0\cdot F_{Bz})\hat{\jmath} + (0\cdot F_{By} - 0\cdot F_{Bx})\hat{k}$$

$$\vec{M} = \underbrace{(-h\cdot F_{By})}_{M_x}\hat{\imath} + \underbrace{(h\cdot F_{Bx})}_{M_y}\hat{\jmath} + \underbrace{(0)}_{M_z}\hat{k}\ \text{N·m}$$