ip4STATICS Worksheet for U04_3d_P01

A sign, represented by its weight W, hangs from the end of post AO. Wind on the sign causes a force on the post in the Y direction. The post is supported at A by cable AB and at O by a sleeve on a rod lying along the y axis. The sleeve rotates freely about the rod but it cannot slide along the rod. Assume the weight of the post is negligible. The assembly is in equilibrium in the position shown. Units are lbs and ft.

Instance variables: forces W and F in lb; lengths d and h in ft.
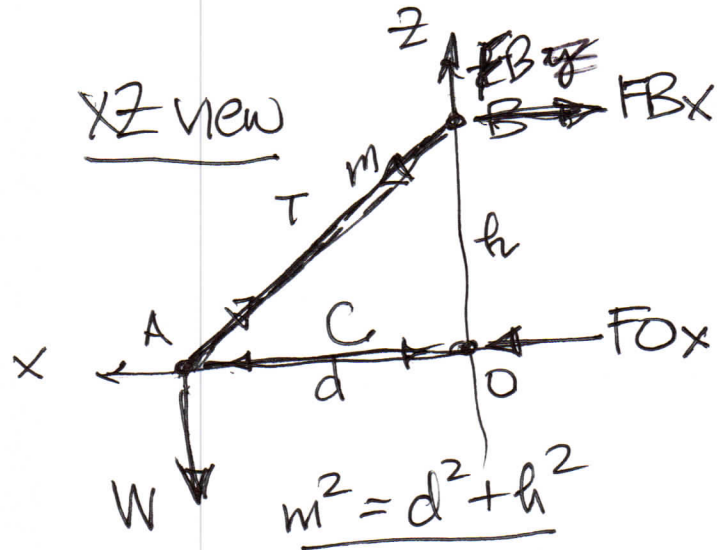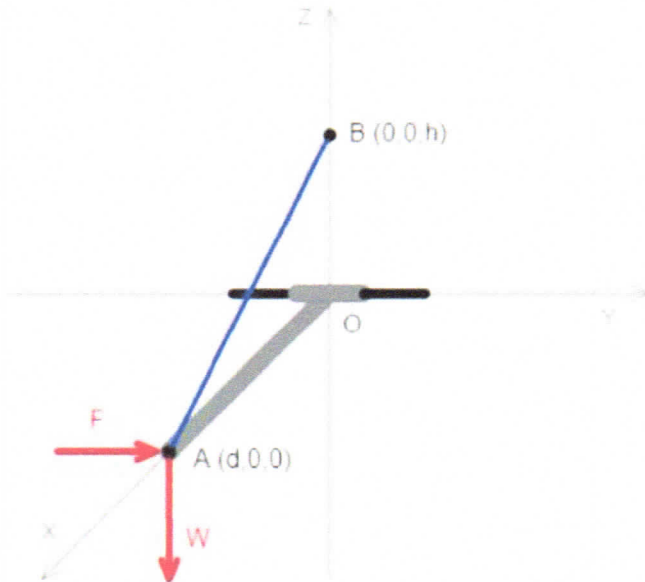
(1) What is the force at O, FO(i,j,k), required for equilibrium?

(2) What is the moment at O, MO(i,j,k), required for equilibrium?

(3) What is the force at B, FB(i,j,k), required for equilibrium?

Step 1. Find tension in cable AB. Use XZ view above.

$$T\left(\frac{h}{m}\right) = W, \quad \text{or} \quad T = \left(\frac{m}{h}\right) * W.$$

Step 2. Find compression in post AO. (XZ view)

$$C = T\left(\frac{d}{m}\right) = \left(\frac{d}{m}\right)\left(\frac{m}{h}\right)W = \left(\frac{d}{h}\right) * W.$$

$$\boxed{FOx = \left(\frac{d}{h}\right) * W} \qquad \boxed{FOz = 0}$$

From the XZ view —

$$FBx = -T\left(\frac{d}{m}\right) = -\left(\frac{m}{h}\right)W\cdot\left(\frac{d}{m}\right) = -\left(\frac{d}{h}\right)W$$

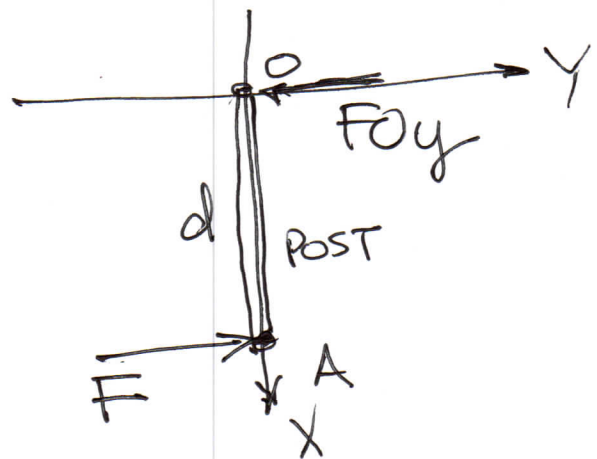$$FBz = T\left(\frac{h}{m}\right) = W\left(\frac{m}{h}\right)\left(\frac{h}{m}\right) = W$$

$$FBy = 0 \quad \text{from cable geometry.}$$

(3) $FB = -\left(\frac{d}{h}\right)W\cdot\bar{i} + W\cdot\bar{j} + 0\,\bar{k}$ ANS,

XY view

$$Foy = -F$$

(1) $FO = \left(\frac{d}{h}\right)W\bar{i} - F\cdot\bar{j} + 0\,\bar{k}$ ANS.

SOLUTION for U04_3d_P01

Moments about O.

$$\boxed{MO_x = 0}$$

$$\boxed{MO_y = d \cdot F}$$ (see XY view)

$$\boxed{MO_z = 0}$$ sleeve rotates aboot
rod (Y axis) freely.

(2) $MO = 0 \cdot \bar{i} + 0 \bar{j} + dF \cdot \bar{k}$