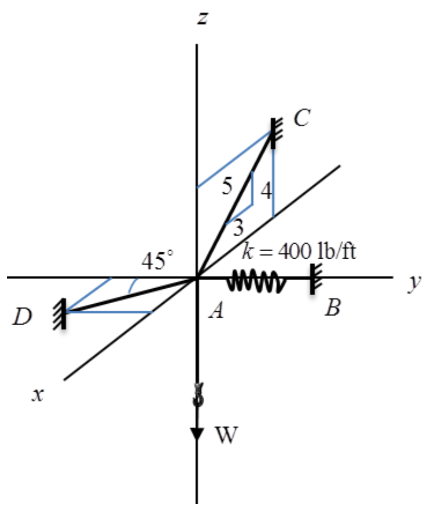
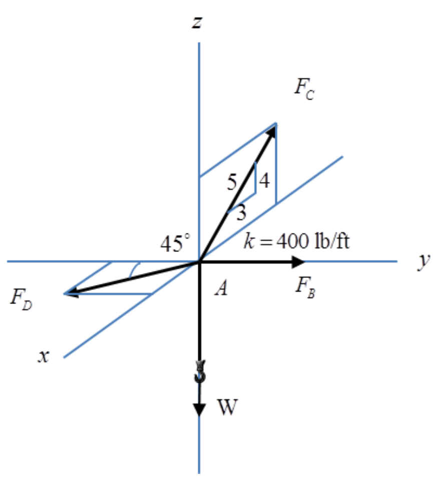
2. A load W follows a normal distribution $N(100,5^2)$ lb and is suspended from the hook. The load is supported by the cable AD lies in the x-y plane and cable AC lies in the x-z plane. The spring has a stiffness $k = 400$ lb/ft. Determine the distribution of the tension in the cables and the distribution of the stretch of the spring for equilibrium.



Solution



Equations of equilibrium

$$\sum F_x = 0;\ F_D \sin 45^\circ - \frac{3}{5} F_C = 0$$

$$\sum F_y = 0;\ -F_D \cos 45^\circ + F_B = 0$$

$$\sum F_Z = 0;\ \frac{4}{5} F_C - W = 0$$

We already know $W \sim N(100, 5^2)$ lb, and then we solve the above equations for the distribution of F_C

$$F_C = \frac{5}{4}W$$

$$\mu_{F_C} = \frac{5}{4}\mu_W = \frac{5}{4}(100) = 125 \text{ lb}$$

$$\sigma_{F_C} = \frac{5}{4}\sigma_W = \frac{5}{4}(5) = 6.25 \text{ lb}$$

So the distribution of the force in cable *AC* is $F_C \sim N(125, 6.25^2)$ lb. **Ans.**

Then the same for F_D, and finally F_B

$$F_D \sim N(106.07, 5.3^2) \text{ lb}$$ **Ans.**

$$F_B \sim N(75, 3.75^2) \text{ lb}$$ **Ans.**

The distribution of the stretch of the spring is therefore

$$F_B = kS_{AB}$$

$$S_{AB} = \frac{F_B}{k}$$

$$\mu_{S_{AB}} = \frac{\mu_{F_B}}{k} = \frac{75}{400} = 0.19 \text{ ft}$$

$$\sigma_{S_{AB}} = \frac{\sigma_{F_B}}{k} = \frac{3.75}{400} = 0.01 \text{ ft}$$

Thus, the distribution of the stretch of the spring is $S_{AB} \sim N(0.19, 0.01^2)$ ft. **Ans.**