①

Determine the force in each cable needed to support the 500-lb load.

$D(0, 12ft, 8ft)$

$B(-2ft, 0, 0)$

$C(0, 6ft, 0)$

$A(2ft, 0, 0)$

$F_W = (-500)\hat{K}\,{}^{lb}$
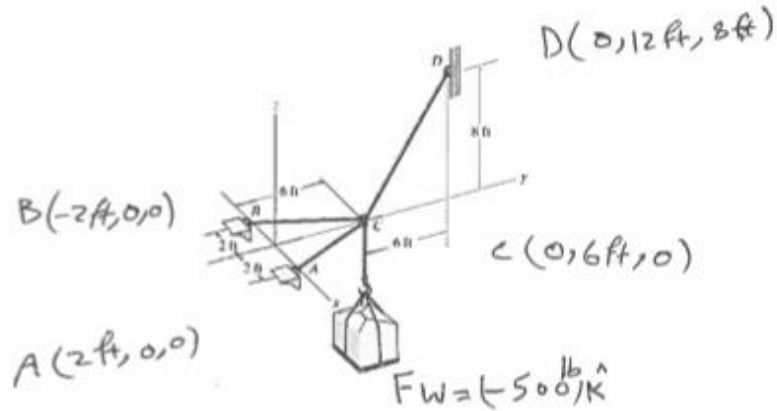
Show all work using a neat presentation
Show an accurate FBD

AC $\hat{u}A = \dfrac{(2ft-0)\hat{\imath} + (0-6ft)\hat{\jmath} + (0-0)\hat{K}}{\sqrt{(2ft)^2 + (-6ft)^2 + 0^2}}$

$= \dfrac{2\hat{\imath} - 6\hat{\jmath}}{\sqrt{4+36}} = \dfrac{2\hat{\imath} - 6\hat{\jmath}}{\sqrt{40}} = \dfrac{2\hat{\imath} - 6\hat{\jmath}}{2\sqrt{10}}$

$\hat{u}A = \dfrac{1}{\sqrt{10}}\hat{\imath} - \dfrac{3}{\sqrt{10}}\hat{\jmath}$

B-C $\hat{u}B = \dfrac{(-2ft-0)\hat{\imath} + (0-6ft)\hat{\jmath} + (0-0)\hat{K}}{\sqrt{(-2ft)^2 + (-6ft)^2 + 0^2}}$

$= \dfrac{-2\hat{\imath} - 6\hat{\jmath}}{\sqrt{40}}$

$\hat{u}B = -\dfrac{1}{\sqrt{10}}\hat{\imath} - \dfrac{3}{\sqrt{10}}\hat{\jmath}$

②

$D-C$ $\hat{u}_D = \dfrac{(0-0)\hat{\imath} + (12ft-6ft)\hat{\jmath} + (8ft-0)\hat{k}}{\sqrt{(0)^2 + (6ft)^2 + (8ft)^2}}$

$\qquad\qquad = \dfrac{6\hat{\jmath} + 8\hat{k}}{\sqrt{100}}$

$\hat{u}_D = \dfrac{3}{5}\hat{\jmath} + \dfrac{4}{5}\hat{k}$

$\vec{F}_W = -(500\,lb)\hat{k}$

$\vec{F}_A = F_A\,\hat{u}_A \qquad \vec{F}_B = F_B\,\hat{u}_B \qquad \vec{F}_D = F_D\,\hat{u}_D$

$\vec{F}_A + \vec{F}_B + \vec{F}_D + \vec{F}_W = \vec{0}$

$F_A\left(\dfrac{1}{\sqrt{10}}\hat{\imath} - \dfrac{3}{\sqrt{10}}\hat{\jmath}\right) + F_B\left(-\dfrac{1}{\sqrt{10}}\hat{\imath} - \dfrac{3}{\sqrt{10}}\hat{\jmath}\right) + F_D\left(\dfrac{3}{5}\hat{\jmath} + \dfrac{4}{5}\hat{k}\right) - (500\,lb)\hat{k}$

$\hat{\imath} = \dfrac{1}{\sqrt{10}}F_A - \dfrac{1}{\sqrt{10}}F_B = 0 \implies F_A = F_B$

$\hat{\jmath} = -\dfrac{3}{\sqrt{10}}F_A - \dfrac{3}{\sqrt{10}}F_B + \dfrac{3}{5}F_D = 0$

$\hat{k} = \dfrac{4}{5}F_D - 500\,lb = 0$

③ Solve for F_A, F_B

$$\hat{\imath} = \frac{1}{\sqrt{10}} F_A - \frac{1}{\sqrt{10}} F_B = 0 \quad \Rightarrow F_A = F_B$$

$$\hat{\jmath} = -\frac{3}{\sqrt{10}} F_A - \frac{3}{\sqrt{10}} F_B + \frac{3}{5} F_D = 0$$

$$-\frac{3}{\sqrt{10}} (F_A + F_B) = \frac{3}{5} F_D$$

$$\frac{\sqrt{10}}{3} \times \frac{3}{\sqrt{10}} (F_A + F_B) = \frac{3}{5} F_D \times \frac{\sqrt{10}}{3}$$

$$F_A + F_B = \frac{\sqrt{10}}{5} F_D$$

$$F_A = \frac{\sqrt{10}}{5} F_D - F_B$$

$$k = \frac{4}{5} F_D - 500 \, lb = 0$$

$$\frac{4}{5} F_D = 500$$

$$\frac{5}{4} \times \frac{4}{5} F_D = \overset{125}{500} \times \frac{5}{4}$$

$$F_D = 625 \, lb$$

④

$F_D = 625 lb$

$\Sigma + F_A = \dfrac{\sqrt{10}}{5} F_D - F_B$

$F_A = \dfrac{\sqrt{10}}{5} \cdot 625 - F_B$

$F_A + F_B = 125\sqrt{10}$

$F_A \quad = \quad F_B$

$F_A = \dfrac{125\sqrt{10}}{2}$

$F_A = 197-64 \simeq 198 \, lb$

$F_B = \qquad\qquad 198 \, lb$

$F_D = \qquad\qquad 625 \, lb$