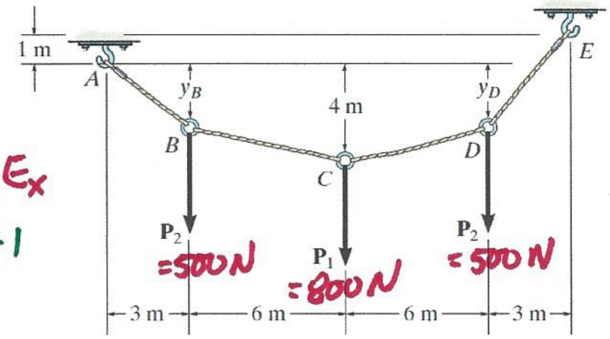
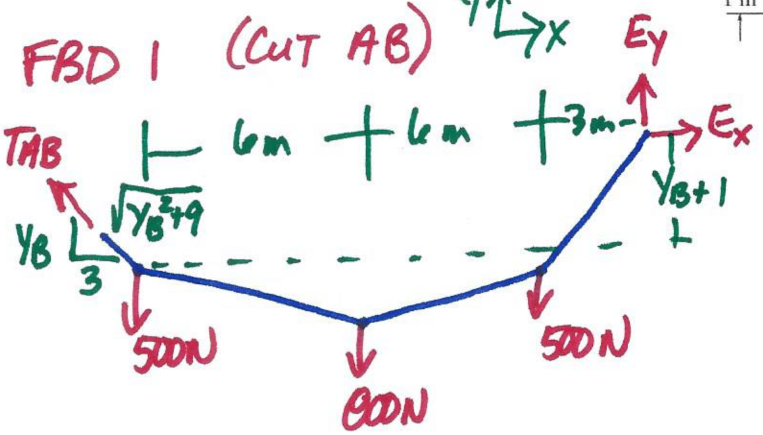
7–94.

The cable supports the three loads shown. Determine the sags y_B and y_D of B and D. Take $P_1 = 800$ N, $P_2 = 500$ N.



FBD 1 (CUT AB)

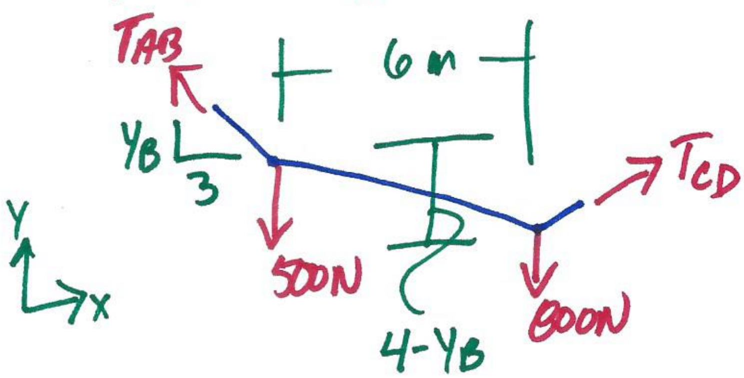


$$\circlearrowleft \Sigma M_E = 0 \qquad -500(15)-800(9)-500(3)+\frac{3}{\sqrt{y_B^2+9}}(y_B+1)T_{AB}$$

$$+\frac{y_B}{\sqrt{y_B^2+9}}(15)T_{AB} = 0$$

$$T_{AB}\left(\frac{18y_B+3}{\sqrt{y_B^2+9}}\right) = 16200 \qquad \text{EQ 1}$$

FBD 2 (CUT AB + CD)



$$\circlearrowleft \Sigma M_C = 0$$

$$-500(6)+\frac{3}{\sqrt{y_B^2+9}}(4-y_B)T_{AB}$$

$$+\frac{y_B}{\sqrt{y_B^2+9}}(6)T_{AB} = 0$$

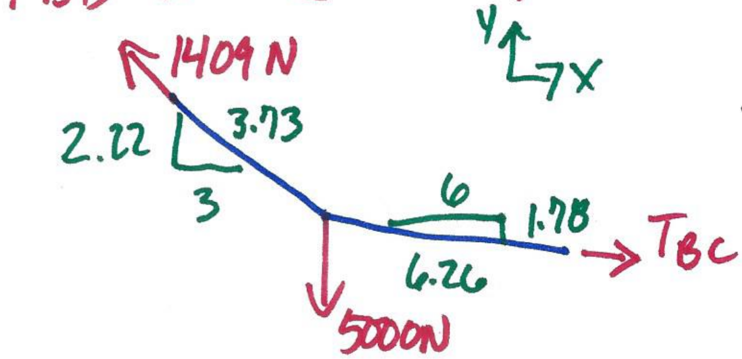
$$T_{AB}\left(\frac{9y_B-12}{\sqrt{y_B^2+9}}\right) = 3000 \qquad \text{EQ2}$$

DIVIDE EQN 1 BY EQN 2

$$y_B = 2.216 \text{ m} = \underline{\underline{2.22 \text{ m}}}$$

SUBSTITUTE INTO EQN 1 $\Rightarrow$ $T_{AB} = 1409$ N

FBD 3 (JOINT B)

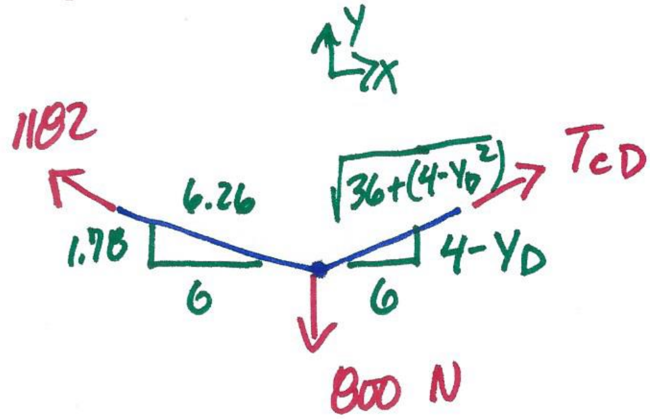


$\rightarrow \Sigma F_x = 0$

$$-\frac{3}{3.73}(1409) + \frac{6}{6.26} T_{BC} = 0$$

$$T_{BC} = 1182 \text{ N}$$

FBD 4 (JOINT C)



$\uparrow \Sigma F_y = 0$

$$\frac{1.78}{6.26}(1182) - 800 + \frac{4-Y_D}{\sqrt{36+(4-Y_D)^2}} T_{CD} = 0$$

$$T_{CD}\left(\frac{4-Y_D}{\sqrt{36+(4-Y_D)^2}}\right) = 1133.33$$

EQN 3

$\rightarrow \Sigma F_x = 0$

$$-\frac{6}{6.26}(1182) + \frac{6}{\sqrt{36+(4-Y_D)^2}} T_{CD} = 0$$

$$T_{CC}\left(\frac{6}{\sqrt{36+(4-Y_D)^2}}\right) = 462.96$$

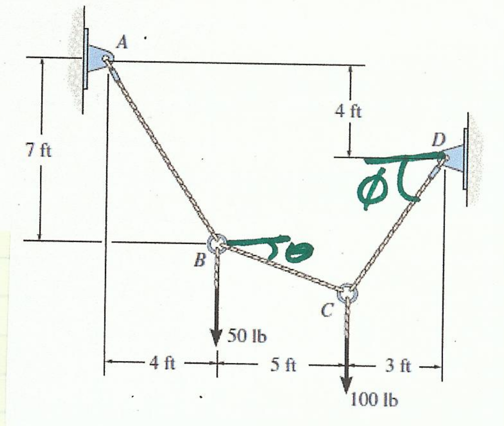
EQN 4

DIVIDE EQN 3 BY EQN 4

$$\frac{4-Y_D}{6} = 0.4085 \qquad Y_D = 1.549 = \underline{1.55 \text{ m}}$$

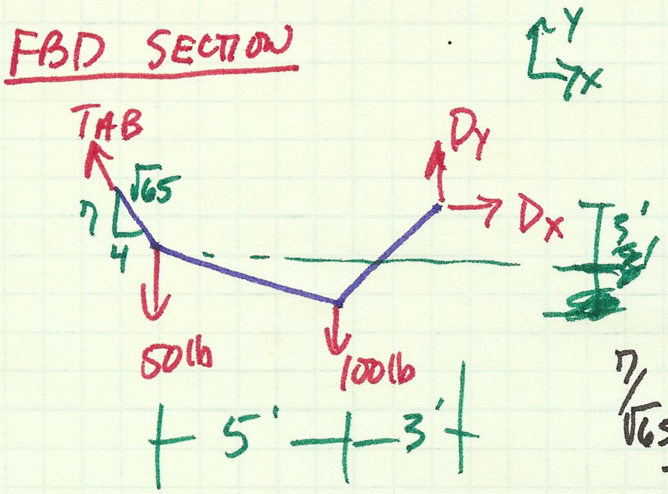
***7–96.**

Determine the tension in each segment of the cable and the cable's total length.



SOLUTION

FBD SECTION



$\circlearrowleft \Sigma M_D = 0$

$$\frac{7}{\sqrt{65}} T_{AB}(8) + \frac{4}{\sqrt{65}} T_{AB}(3) - 50(8) - 100(3) = 0$$

$T_{AB} = 83 \text{ lbs}$

$\rightarrow \Sigma F_x = 0$

$$-\frac{4}{\sqrt{65}}(83) + D_x = 0 \qquad D_x = 41.2 \text{ lbs} \rightarrow$$

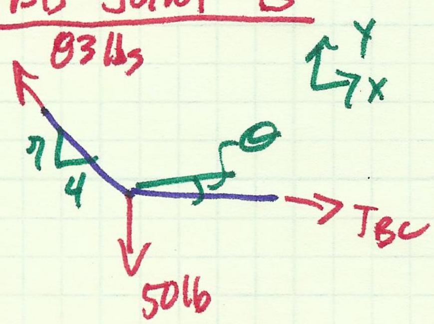
$\uparrow \Sigma F_y = 0$

$$\frac{7}{\sqrt{65}}(83) - 50 - 100 + D_y = 0 \qquad D_y = 77.9 \text{ lbs} \uparrow$$

$$T_{CD} = \sqrt{41.2^2 + 77.9^2} = 88.2 \text{ lbs}$$

$$\phi = \tan^{-1}\frac{77.9}{41.2} = 62.1^\circ$$

FBD JOINT B



$\uparrow \Sigma F_y = 0$

$$-50 + \frac{7}{\sqrt{65}}(83) - T_{BC}\sin\theta = 0 \quad (1)$$

$\rightarrow \Sigma F_x = 0$

$$-\frac{4}{\sqrt{65}}(83) + T_{BC}\cos\theta = 0 \quad (2)$$

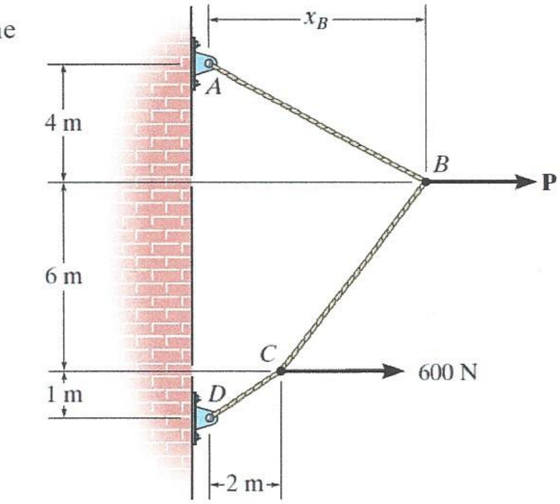
SOLVING (1) + (2)

$T_{BC} = 46.7 \text{ lbs}$, $\theta = 28.1^\circ$

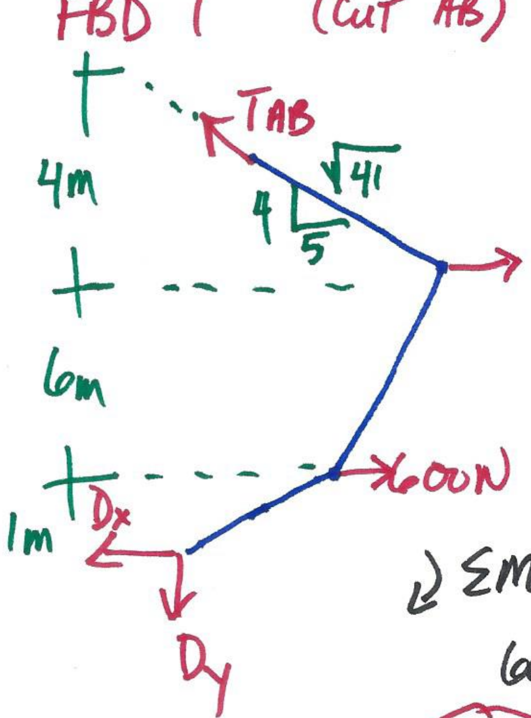
$$l = \sqrt{65} + \frac{5}{\cancel{\sin}\ \cos 28.1^\circ} + \frac{3}{\cos 62.1^\circ} = 20.2'$$

7–98.

The cable supports the loading shown. Determine the magnitude of the horizontal force **P** so that $x_B = 5$ m.



FBD 1 (CUT AB)

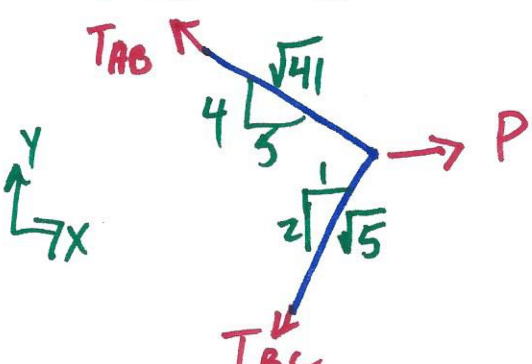


$\circlearrowleft \Sigma M_D = 0$

$$600(1) + 7P - \frac{4}{\sqrt{41}}(5)T_{AB} - \frac{5}{\sqrt{41}}(7)T_{AB} = 0$$

$$\frac{55}{\sqrt{41}} T_{AB} - 7P = 600$$ EQN 1

FBD 2 (JOINT B)



$\uparrow \Sigma F_y = 0$

$$\frac{4}{\sqrt{41}} T_{AB} - \frac{2}{\sqrt{5}} T_{BC} = 0$$

$$T_{BC} = \frac{2\sqrt{5}}{\sqrt{41}} T_{AB}$$

$\rightarrow \Sigma F_x = 0$

$$-\frac{5}{\sqrt{41}} T_{AB} + P - \frac{1}{\sqrt{5}} T_{BC} = 0$$

$$T_{AB} = \frac{\sqrt{41}}{7} P$$ EQN 2

SUBSTITUTE EQN 2 INTO EQN 1

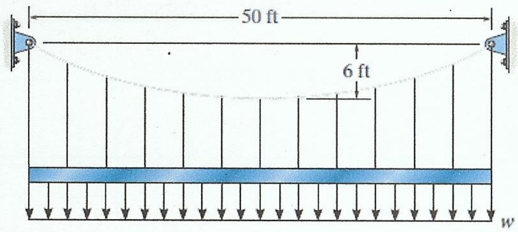
$$\frac{55}{\sqrt{41}}\left(\frac{\sqrt{41}}{7}P\right) - 7P = 600$$

$$\underline{P = 700\text{ N}}$$

7–106.

The cable is subjected to a uniform loading of $w = 250$ lb/ft. Determine the maximum and minimum tension in the cable.

+ THE LENGTH



SOLUTION

$$T_{min} = F_H = \frac{w_0 L^2}{8h} = \frac{250(50)^2}{8(6)} = 13.02 \text{ Kips} = T_{min}$$

$$T_{max} = \frac{w_0 L}{2}\sqrt{1+\left(\frac{L}{4h}\right)^2} = \frac{250(50)}{2}\sqrt{1+\left(\frac{50}{4(6)}\right)^2}$$

$$T_{max} = 14.44 \text{ Kips}$$

$$L_{TOT} = \frac{L}{2}\left(\sqrt{1+\left(\frac{4h}{L}\right)^2} + \frac{L}{4h}\sinh^{-1}\left(\frac{4h}{L}\right)\right)$$

$$= \frac{50}{2}\left(\sqrt{1+\left(\frac{4(6)}{50}\right)^2} + \frac{50}{4(6)}\sinh^{-1}\left(\frac{4(6)}{50}\right)\right)$$

$$= 25(1.109 + 0.9651) = 51.9 \text{ Ft} = L_{TOT}$$