Cable Analysis

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Cable Subjected to Concentrated Analysis

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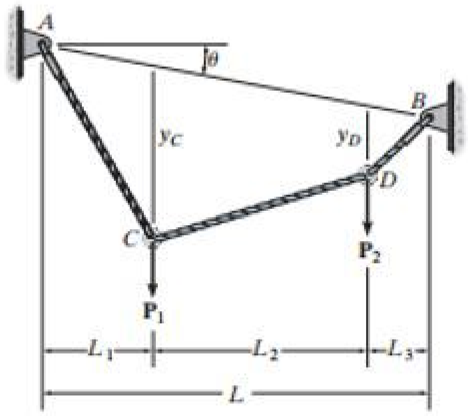
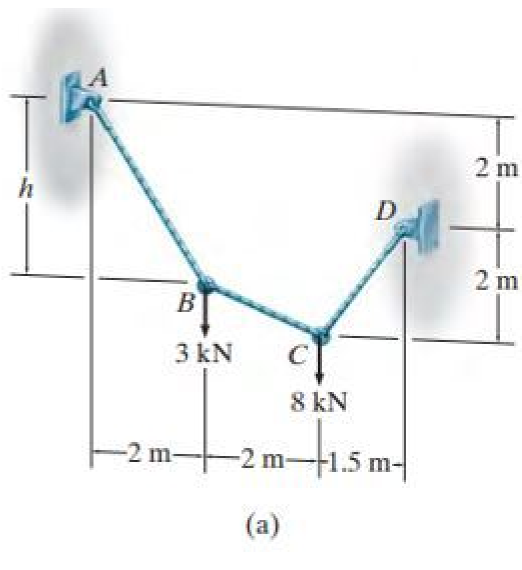
1. Cable Subjected to Concentrated

If the cable is subjected to concentrated loads then the force acting in each cable segment is determined by applying the equations of equilibrium to the free-body diagram of groups of segments of the cable or to the joints where the forces are applied.



Exemple

Determine the tension in each segment of the cable shown in Figure a. Also, what is the dimension h?



(a)

Solution:

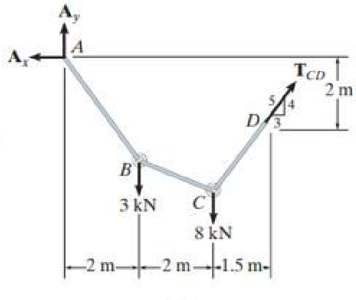
By inspection, there are four unknown external reactions (A_x, A_y, D_x and D_y) and three unknown cable tensions, one in each cable segment. These seven unknowns along with the sag h can be determined from the eight available equilibrium equations ($\sum Fx = 0$, $\sum Fy = 0$) applied to points A through D.

A more direct approach to the solution is to recognize that the slope of cable CD is specified, and so a free-body diagram of the entire cable is shown in Figure b. We can obtain the tension in segment CD as follows:

$$\circlearrowleft + \Sigma M_A = 0;$$

$$T_{CD}(3/5)(2\text{ m}) + T_{CD}(4/5)(5.5\text{ m}) - 3\text{ kN}(2\text{ m}) - 8\text{ kN}(4\text{ m}) = 0$$

$$T_{CD} = 6.79\text{ kN}$$



(b)

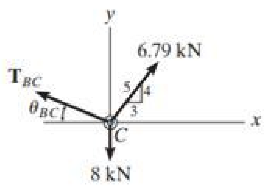
Now we can analyze the equilibrium of points C and B in sequence.

Point C (Figure c):

$$\overset{+}{\rightarrow} \Sigma F_x = 0; \quad 6.79\text{ kN}(3/5) - T_{BC}\cos\theta_{BC} = 0$$

$$+\uparrow \Sigma F_y = 0; \quad 6.79\text{ kN}(4/5) - 8\text{ kN} + T_{BC}\sin\theta_{BC} = 0$$

$$\theta_{BC} = 32.3^\circ \qquad T_{BC} = 4.82\text{ kN}$$



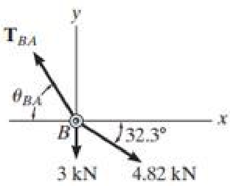
(c)

Point B (Figure d):

$$\overset{+}{\rightarrow} \Sigma F_x = 0; \quad -T_{BA}\cos\theta_{BA} + 4.82\text{ kN}\cos 32.3^\circ = 0$$

$$+\uparrow \Sigma F_y = 0; \quad T_{BA}\sin\theta_{BA} - 4.82\text{ kN}\sin 32.3^\circ - 3\text{ kN} = 0$$

$$\theta_{BA} = 53.8^\circ \qquad T_{BA} = 6.90\text{ kN}$$



(d)

Hence, from Figure a:

$$h = (2\text{ m})\tan 53.8^\circ = 2.74\text{ m}$$