6-79 Bar AB is used to support an 850-lb load as shown in Fig. P6-79. End A of the bar is supported with a ball and socket joint: End B of the bar is supported with two cables. Determine the components of the reaction at support A and the tensions in the two cables.

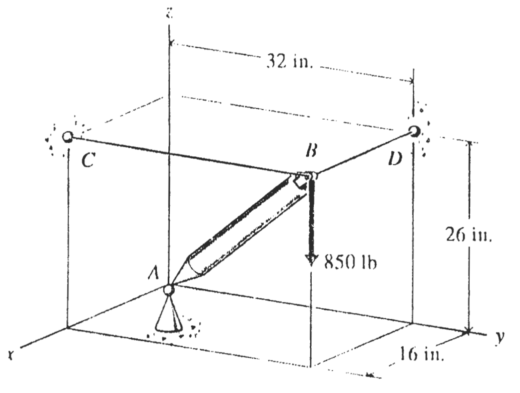
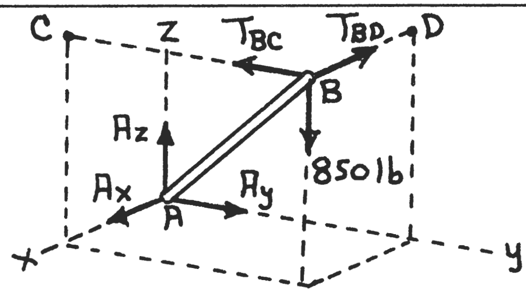


Fig. P6-79

SOLUTION

From a free-body diagram for the bar:



For moment equilibrium:

$$\Sigma \vec{M}_A = (16\,\hat{i} + 26\,\hat{k}) \times (-T_{BC}\,\hat{j}) + (32\,\hat{j} + 26\,\hat{k}) \times (-T_{BD}\,\hat{i}) + (16\,\hat{i} + 32\,\hat{j}) \times (-850\,\hat{k})$$

$$= (26\,T_{BC} - 27{,}200)\,\hat{i} + (-26\,T_{BD} + 13{,}600)\,\hat{j} + (-16\,T_{BC} + 32\,T_{BD})\,\hat{k} = \vec{0}$$

From which:

$T_{BC} = 1046.2 \text{ lb} \cong 1046 \text{ lb}$ $\quad\vec{T}_{BC} = -1046\,\hat{j}$ lb Ans.

$T_{BD} = 523.1 \text{ lb} \cong 523 \text{ lb}$ $\quad\vec{T}_{BD} = -523\,\hat{i}$ lb Ans.

For force equilibrium:

$$\Sigma \vec{F} = \vec{A} + \vec{T}_{BC} + \vec{T}_{BD} + \vec{W}$$

$$= A_x\hat{i} + A_y\hat{j} + A_z\hat{k} - T_{BC}\,\hat{j} - T_{BD}\hat{i} - 850\,\hat{k}$$

$$= (A_x - 523.1)\,\hat{i} + (A_y - 1046.2)\,\hat{j} + (A_z - 850)\,\hat{k} = 0$$

From which:

$A_x = 523.1 \text{ lb} \cong 523 \text{ lb}$

$A_y = 1046.2 \text{ lb} \cong 1046 \text{ lb}$

$A_z = 850 \text{ lb}$ $\quad\vec{A} = 523\,\hat{i} + 1046\,\hat{j} + 950\,\hat{k}$ lb Ans.

6-87* The plate shown in Fig. P6-87 weighs 150 lb and is supported in a horizontal position by two hinges and a cable. The hinges have been properly aligned; therefore, they exert only force reactions on the plate. Assume that the hinge at B resists any force along the axis of the hinges pins. Determine the reactions at supports A and B and the tension in the cable.

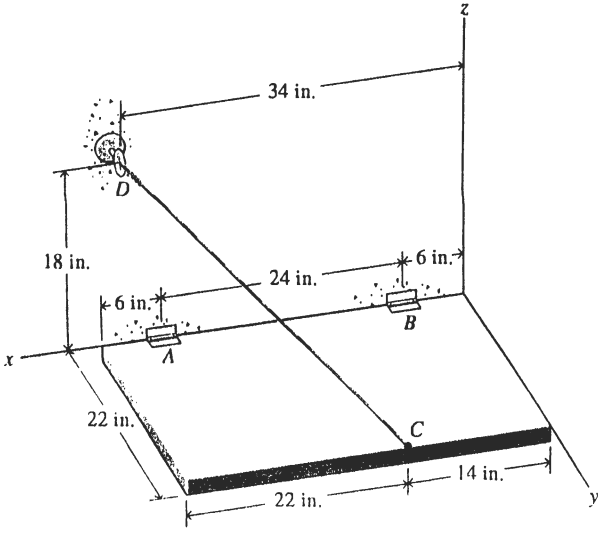


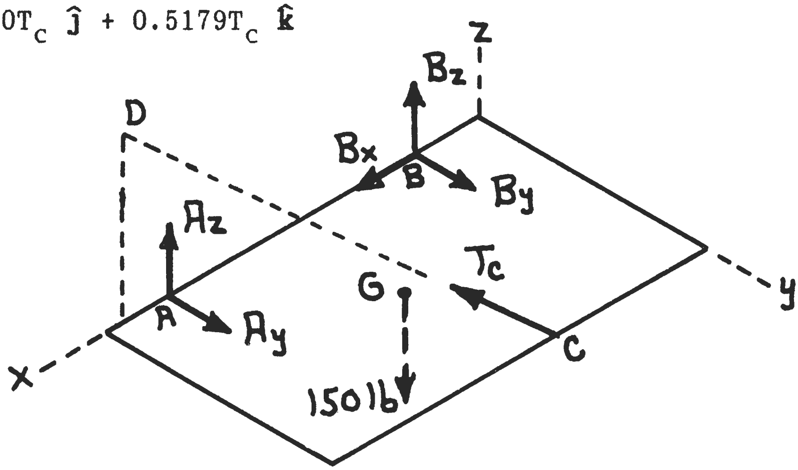
Fig. P6-87

SOLUTION

$$\vec{T}_C = T_C \hat{e}_{D/C} = T_C \left[\frac{20\ \hat{i} - 22\ \hat{j} + 18\ \hat{k}}{\sqrt{(20)^2 + (-22)^2 + (18)^2}} \right]$$

$$= 0.5754 T_C\ \hat{i} - 0.6330 T_C\ \hat{j} + 0.5179 T_C\ \hat{k}$$

From a free-body diagram for the plate:



For moment equilibrium:

$$\Sigma \vec{M}_B = (\vec{r}_{C/B} \times \vec{T}_C) + (\vec{r}_{A/B} \times \vec{A}) + (\vec{r}_{G/B} \times \vec{W})$$

$$= [(8\ \hat{i} + 22\ \hat{j}) \times (0.5754 T_C\ \hat{i} - 0.6330 T_C\ \hat{j} + 0.5179 T_C\ \hat{k})]$$

$$+ [(24\ \hat{i}) \times (A_y\ \hat{j} + A_z\ \hat{k})] + [(12\ \hat{i} + 11\ \hat{j}) \times (-150\ \hat{k})]$$

$$= (11.3938 T_C - 1650)\ \hat{i} + (-4.1432 T_C - 24 A_z + 1800)\ \hat{j}$$

$$+ (-17.7228 T_C + 24 A_y)\ \hat{k} = \vec{0}$$

6-87 (Continued)

Solving yields:

$T_C = 144.82 \text{ lb} \cong 144.8 \text{ lb}$ Ans.

$\vec{T}_C = 144.82(0.5754\ \hat{i} - 0.6330\ \hat{j} + 0.5179\ \hat{k})$

$= 83.33\ \hat{i} - 91.67\ \hat{j} + 75.00\ \hat{k} \text{ lb}$

$A_y = 106.98 \text{ lb}$

$A_z = 50.00 \text{ lb}$

$\vec{A} = 106.98\ \hat{j} + 50.00\ \hat{k} \text{ lb} \cong 107.0\ \hat{j} + 50.0\ \hat{k} \text{ lb}$ Ans.

$A = \sqrt{(106.98)^2 + (50.00)^2} = 118.09 \text{ lb} \cong 118.1 \text{ lb}$

For force equilibrium:

$\Sigma\vec{F} = \vec{A} + \vec{B} + \vec{T}_C + \vec{W} = 106.98\ \hat{j} + 50.00\ \hat{k} + B_x\ \hat{i} + B_y\ \hat{j} + B_z\ \hat{k}$

$+ 83.33\ \hat{i} - 91.67\ \hat{j} + 75.00\ \hat{k} - 150\ \hat{k}$

$= (B_x + 83.33)\ \hat{i} + (B_y + 106.98 - 91.67)\ \hat{j}$

$+ (B_z + 50.00 + 75.00 - 150.00)\ \hat{k} = \vec{0}$

$\vec{B} = B_x\ \hat{i} + B_y\ \hat{j} + B_z\ \hat{k}$

$= -83.33\ \hat{i} - 15.31\ \hat{j} + 25.00\ \hat{k} \text{ lb}$

$\cong -83.3\ \hat{i} - 15.31\ \hat{j} + 25.0\ \hat{k} \text{ lb}$ Ans.

$B = \sqrt{(-83.33)^2 + (-15.31)^2 + (25.00)^2} = 88.34 \text{ lb} \cong 88.3 \text{ lb}$