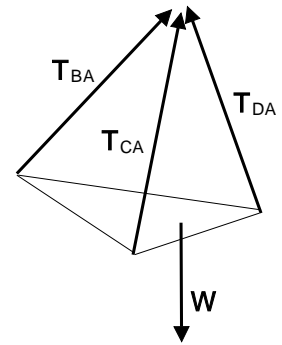


{2.15 }

2.109  $W = 320 \text{ N}$

$\mathbf{W} = - 320 \text{ N } \mathbf{j}$



$$d_{BA} = \sqrt{(6.5 \text{ cm})^2 + (8.0 \text{ cm})^2 + (-2.0 \text{ cm})^2} = 10.5 \text{ cm}$$

$$\lambda_{BA} = \frac{1}{10.5} (6.5 \mathbf{i} + 8.0 \mathbf{j} - 2.0 \mathbf{k})$$

$$= 0.6190 \mathbf{i} + 0.7619 \mathbf{j} - 0.1905 \mathbf{k}$$

$\mathbf{T}_{BA} = T_{BA} \lambda_{BA} = T_{BA} (0.6190 \mathbf{i} + 0.7619 \mathbf{j} - 0.1905 \mathbf{k})$

$$d_{CA} = \sqrt{(-1.0 \text{ cm})^2 + (8.0 \text{ cm})^2 + (-4.0 \text{ cm})^2} = 9.0 \text{ cm}$$

$$\lambda_{CA} = \frac{1}{9.0} (-1.0 \mathbf{i} + 8.0 \mathbf{j} - 4.0 \mathbf{k}) = -0.1111 \mathbf{i} + 0.8889 \mathbf{j} - 0.4444 \mathbf{k}$$

$\mathbf{T}_{CA} = T_{CA} \lambda_{CA} = T_{CA} (-0.1111 \mathbf{i} + 0.8889 \mathbf{j} - 0.4444 \mathbf{k})$

$$d_{DA} = \sqrt{(-1.75 \text{ cm})^2 + (8.0 \text{ cm})^2 + (1.0 \text{ cm})^2} = 8.25 \text{ cm}$$

$$\lambda_{DA} = \frac{1}{8.25} (-1.75 \mathbf{i} + 8.0 \mathbf{j} + 1.0 \mathbf{k}) = -0.2121 \mathbf{i} + 0.9697 \mathbf{j} + 0.1212 \mathbf{k}$$

$\mathbf{T}_{DA} = T_{DA} \lambda_{DA} = T_{DA} (-0.2121 \mathbf{i} + 0.9697 \mathbf{j} + 0.1212 \mathbf{k})$

lumber  $\mathbf{F} = 0 \quad \mathbf{T}_{BA} + \mathbf{T}_{CA} + \mathbf{T}_{DA} + \mathbf{W} = 0$

$F_x = 0 ; 0.6190 T_{BA} - 0.1111 T_{CA} - 0.2121 T_{DA} = 0 \quad \dots$

$F_y = 0 ; 0.7619 T_{BA} + 0.8889 T_{CA} + 0.9697 T_{DA} + (-320 \text{ N}) = 0 \quad \dots$

$F_z = 0 ; -0.1905 T_{BA} - 0.4444 T_{CA} + 0.1212 T_{DA} = 0 \quad \dots$

$$D = \begin{vmatrix} 0.6190 & -0.1111 & -0.2121 \\ 0.7619 & 0.8889 & 0.9697 \\ -0.1905 & -0.4444 & 0.1212 \end{vmatrix} = 0.4001$$

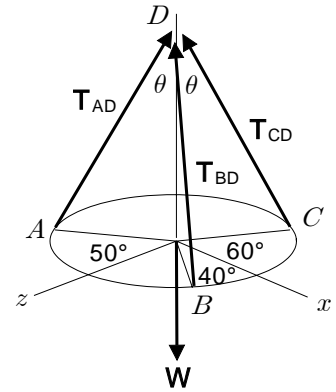
$$T_{BA} = \frac{1}{D} \begin{vmatrix} 0 & -0.1111 & -0.2121 \\ 320 & 0.8889 & 0.9697 \\ 0 & -0.4444 & 0.1212 \end{vmatrix} = \frac{34.4712}{0.4001} = 86.1528$$

$$T_{CA} = \frac{1}{D} \begin{vmatrix} 0.6190 & 0 & -0.2121 \\ 0.7619 & 320 & 0.9697 \\ -0.1905 & 0 & 0.1212 \end{vmatrix} = \frac{11.0777}{0.4001} = 27.6861$$

$$T_{DA} = \frac{1}{D} \begin{vmatrix} 0.6190 & -0.1111 & 0 \\ 0.7619 & 0.8889 & 320 \\ -0.1905 & -0.4444 & 0 \end{vmatrix} = \frac{94.7994}{0.4001} = 236.9290$$

$T_{BA} = 86.2 \text{ N}, \quad T_{CA} = 27.7 \text{ N}, \quad T_{DA} = 237 \text{ N}$

2.117  $W = 62 \text{ N}, \quad \theta = 30^\circ$



$$\begin{aligned} (T_{AD})_y &= T_{AD} \cos\theta, & (T_{AD})_h &= T_{AD} \sin\theta \\ (T_{AD})_x &= (T_{AD})_h \sin 50^\circ = T_{AD} \sin\theta \sin 50^\circ \\ (T_{AD})_z &= -(T_{AD})_h \cos 50^\circ = -T_{AD} \sin\theta \cos 50^\circ \end{aligned}$$

$$\begin{aligned} (T_{BD})_y &= T_{BD} \cos\theta, & (T_{BD})_h &= T_{BD} \sin\theta \\ (T_{BD})_x &= -(T_{BD})_h \cos 40^\circ = -T_{BD} \sin\theta \cos 40^\circ \\ (T_{BD})_z &= -(T_{BD})_h \sin 40^\circ = -T_{BD} \sin\theta \sin 40^\circ \end{aligned}$$

$$\begin{aligned} (T_{CD})_y &= T_{CD} \cos\theta, & (T_{CD})_h &= T_{CD} \sin\theta \\ (T_{CD})_x &= -(T_{CD})_h \cos 60^\circ = -T_{CD} \sin\theta \cos 60^\circ \\ (T_{CD})_z &= (T_{CD})_h \sin 60^\circ = T_{CD} \sin\theta \sin 60^\circ \end{aligned}$$

$$\begin{aligned} F_x = 0 ; & (T_{AD})_x + (T_{BD})_x + (T_{CD})_x = 0 \\ & T_{AD} \sin\theta \sin 50^\circ - T_{BD} \sin\theta \cos 40^\circ - T_{CD} \sin\theta \cos 60^\circ = 0 \\ & T_{AD} \sin 50^\circ - T_{BD} \cos 40^\circ - T_{CD} \cos 60^\circ = 0 \\ & 0.7660 T_{AD} - 0.7660 T_{BD} - 0.5 T_{CD} = 0 \quad \dots \end{aligned}$$

$$\begin{aligned} F_y = 0 ; & (T_{AD})_y + (T_{BD})_y + (T_{CD})_y = 0 \\ & T_{AD} \cos\theta + T_{BD} \cos\theta + T_{CD} \cos\theta - W = 0 \\ & T_{AD} + T_{BD} + T_{CD} = \frac{W}{\cos\theta} = \frac{62 \text{ N}}{\cos 30^\circ} = 71.59 \quad \dots \end{aligned}$$

$$\begin{aligned} F_z = 0 ; & (T_{AD})_z + (T_{BD})_z + (T_{CD})_z = 0 \\ & -T_{AD} \sin\theta \cos 50^\circ - T_{BD} \sin\theta \sin 40^\circ + T_{CD} \sin\theta \sin 60^\circ = 0 \\ & -T_{AD} \cos 50^\circ - T_{BD} \sin 40^\circ + T_{CD} \sin 60^\circ = 0 \\ & -0.6428 T_{AD} - 0.6428 T_{BD} + 0.8660 T_{CD} = 0 \quad \dots \end{aligned}$$

$$D = \begin{vmatrix} 0.7660 & -0.7660 & -0.5 \\ 1 & 1 & 1 \\ -0.6428 & -0.6428 & 0.8660 \end{vmatrix} = 2.3115$$

$$T_{AD} = \frac{1}{D} \begin{vmatrix} 0 & -0.7660 & -0.5 \\ 71.59 & 1 & 1 \\ 0 & -0.6428 & 0.8660 \end{vmatrix} = \frac{70.4987}{2.3115} = 30.4993$$

$$T_{BD} = \frac{1}{D} \begin{vmatrix} 0.7660 & 0 & -0.5 \\ 1 & 71.59 & 1 \\ -0.6428 & 0 & 0.8660 \end{vmatrix} = \frac{24.4806}{2.3115} = 10.5909$$

$$T_{CD} = \frac{1}{D} \begin{vmatrix} 0.7660 & -0.7660 & 0 \\ 1 & 1 & 71.59 \\ -0.6428 & -0.6428 & 0 \end{vmatrix} = \frac{70.4997}{2.3115} = 30.4998$$

$$T_{AD} = 30.5 \text{ N}, \quad T_{BD} = 10.59 \text{ N}, \quad T_{CD} = 30.5 \text{ N}$$