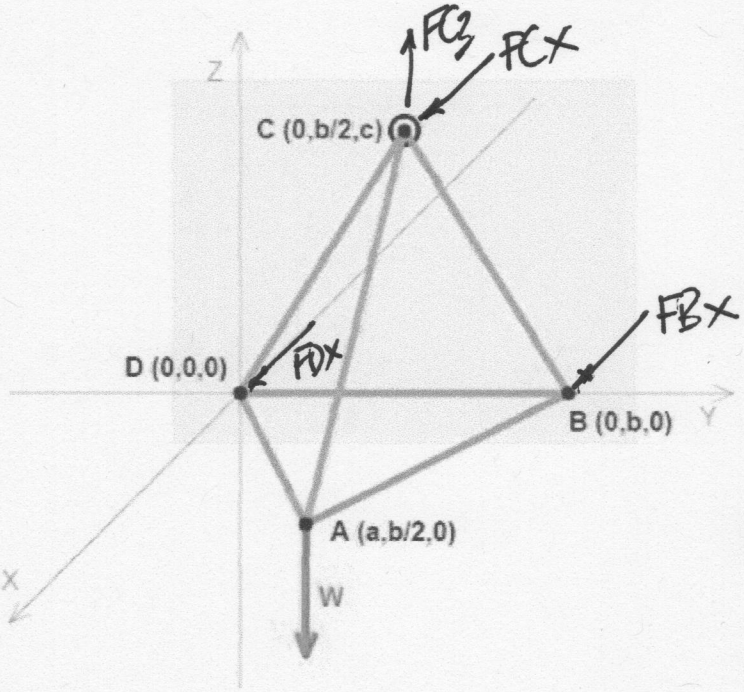
SOLUTION

ip4STATICS Worksheet for U04_3d_P06

A truss-type frame supports weight W at point A. The frame is hung from a ball joint at C. The moment at C is zero. At B and D the frame rests against the wall; forces are normal to the wall and in compresssion. Units are N and m.

Instance variables: weight W in N; lengths a, b and c in m.



NOTE. Force components not shown are 0.

(1) What is the wall force FB(i,j,k) on the frame?

(2) What is the wall force FC(i,j,k) on the frame?

(3) What is the wall force FD(i,j,k) on the frame?

$\Sigma F_x = 0$: (1) $F_{Bx} + F_{Cx} + F_{Dx} = 0$

$\Sigma F_z = 0$: (2) $F_{Cz} = W$

$\Sigma M_y = 0$: (3) $a \cdot W + c \cdot F_{Cx} = 0$

$\Sigma M_z = 0$: (4) $\left(\frac{b}{2}\right) F_{Dx} - \left(\frac{b}{2}\right) F_{Bx} = 0$

Solving for the force components —

$$\boxed{FC_z = W}$$

$$\boxed{FC_x = \left(-\frac{a}{c}\right) \cdot W}$$

From (4), $FD_x = FB_x$.

From (1), $FB_x + \left(-\frac{a}{c}\right)W + FB_x = 0$

So $$\boxed{FB_x = \left(\frac{a}{2c}\right)W}$$

and $$\boxed{FD_x = \left(\frac{a}{2c}\right)W}$$

Assembling components —

$$\begin{cases} \vec{FB} = \left(\frac{a}{2c}\right)W \cdot \vec{i} + 0\vec{j} + 0\vec{k} \\ \vec{FC} = \left(-\frac{a}{c}W\right)\vec{i} + 0\vec{j} + W \cdot \vec{k} \\ \vec{FD} = \left(\frac{a}{2c}\right)W\vec{i} + 0\vec{j} + 0\vec{k} \end{cases}$$