INDIAN INSTITUTE OF TECHNOLOGY HYDERABAD

Department of Mechanical and Aersoapce Engineering
Take Home-1

1. Determine the *x*-, *y*- and *z*-components of force **F** which acts on the tetrahedron as shown in Fig. 1. The quantities *a*, *b*, *c* and *F* are known and *M* is the mid-point of edge *AB*.

Fig. 1 Tetrahedron
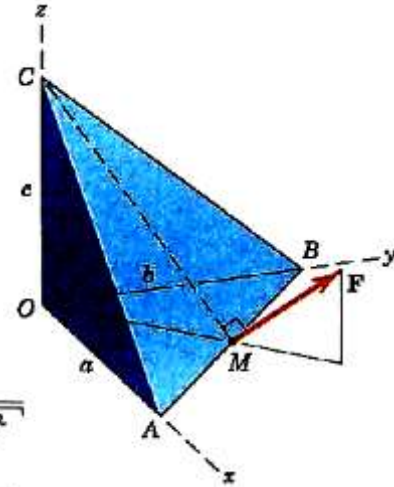
Solution

Finally,

$$F_x = F \frac{2c}{\sqrt{a^2+b^2+4c^2}} \frac{a}{\sqrt{a^2+b^2}} = \frac{2acF}{\sqrt{a^2+b^2}\sqrt{a^2+b^2+4c^2}}$$

$$F_y = F \frac{2c}{\sqrt{a^2+b^2+4c^2}} \frac{b}{\sqrt{a^2+b^2}} = \frac{2bcF}{\sqrt{a^2+b^2}\sqrt{a^2+b^2+4c^2}}$$

$$F_z = F\sqrt{\frac{a^2+b^2}{a^2+b^2+4c^2}}$$

2. The tension in the supporting cable *BC* is 800 N (Fig. 2). Write the force which this cable exerts on the boom *OAB* as a vector **T**. Determine the angles θ_x, θ_y and θ_z which the line of action of **T** forms with the positive *x*-, *y*- and *z*-axes.
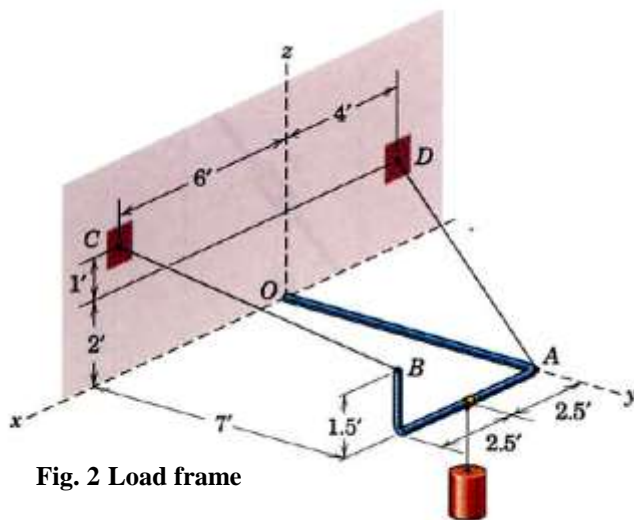
Solution

Fig. 2 Load frame

$$T = T n_{BC}$$

$$T = 800 \left[\frac{+1i - 7j + 1.5k}{\sqrt{1^2 + 7^2 + 1.5^2}} \right]$$

$$= +110.7i - 775j + 166.0k \quad lb$$

$$\cos \theta_x = \frac{+1}{7.23} , \quad \theta_x = 82.0°$$

$$\cos \theta_y = \frac{-7}{7.23} , \quad \theta_y = 165.6°$$

$$\cos \theta_z = \frac{1.5}{7.23} , \quad \theta_z = 78.0°$$

3. The wing of the jet aircraft is subjected to a thrust of $T = 8$ kN from its engine and the resultant lift force $L = 45$ kN (Fig. 3). If the mass of the wing is 21 kN and the mass center is at G, determine the x, y, z components of reaction where the wing is fixed to the fuselage at A.
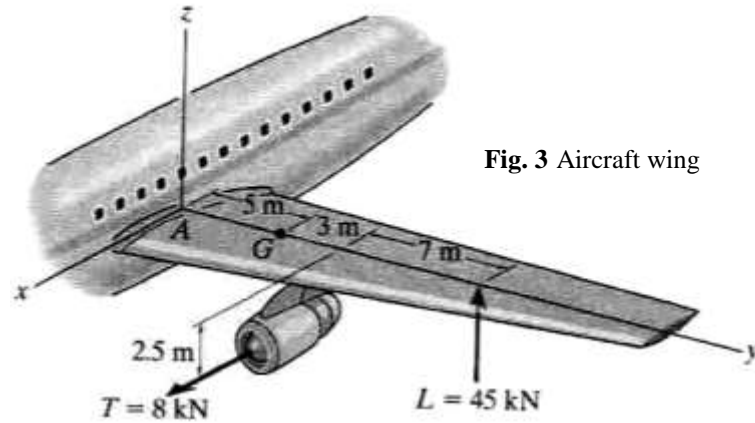
Fig. 3 Aircraft wing

4. The jib crane shown in Fig.4 is subjected to three coplanar forces. Replace this loading by an equivalent resultant force and specify where the resultant's line of action intersects the column AB and boom BC.
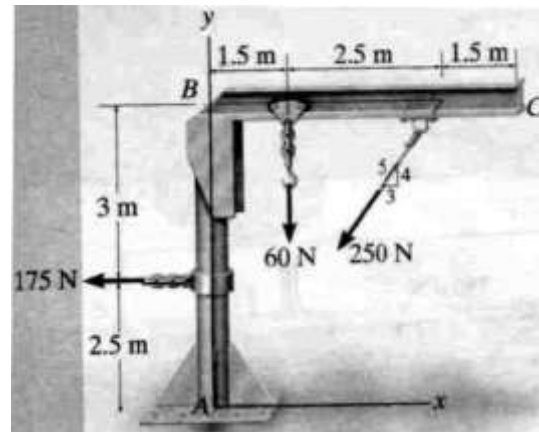
Fig. 4 Jib crane arrangement