

Space Truss (3-d Truss)

6-64

The relevant support reactions are

A_x, A_y

B_y

D_y

Use the whole truss to determine some of the reactions.

$$\sum M_x = 0$$

$$-D_y(\sqrt{6^2 - 3^2}) - 150(6) = 0$$

$$-5.2 D_y = 150(6)$$

$$D_y = -173.1 \text{ lb}$$

$$\sum M_z = 0$$

$$-D_y(3) - B_y(6) = 0$$

$$B_y = -D_y \frac{(3)}{6} = -(-173.1) \frac{3}{6} = 86.53 \text{ lb}$$

$$\sum F_y = 0$$

$$A_y + B_y + D_y = 0$$

$$A_y = -B_y - D_y$$

$$= -86.53 + 173.1 = 86.53 \text{ lb}$$

$$\sum F_x = 0$$

$$A_x = 0$$

Now joint by joint

Joint A:

$$\sum F_x = 0$$

$$-F_{AD} \frac{3}{6} - F_{AB} - F_{AC} \frac{6}{8.48} = 0$$

note that $|AC| = \sqrt{6^2 + 3^2 + 5.2^2} = 8.48 \text{ ft}$

$$+ 0.5 F_{AD} + F_{AB} + 0.71 F_{AC} = 0 \quad (1)$$

$$\sum F_y = 0$$

$$86.53 + F_{AC} \cdot 0.71 = 0$$

$$F_{AC} = \frac{86.53}{0.71} = -122.03 \text{ lb.}$$

(compression)

$$\sum F_z = 0$$

$$F_{AD} \frac{5.2}{6} + F_{AC} \frac{5.2}{8.48} = 0$$

$$F_{AD} = +122.03 \cdot \frac{5.2}{8.48} \cdot \frac{6}{5.2}$$

$$= 86.34 \text{ lb (tension)}$$

from (1)

$$F_{AB} = -(86.34)(0.5) - (-122.03)(0.71)$$
$$= 43.47 \text{ lb (tension)}$$

We take this results to joint D, B or C and continue.

Joint C:

$$\sum F_x = 0$$

$$-F_{CA}(0.71) + F_{CB}(0.71) = 0$$

$$F_{CA} = F_{CB} = -122.03 \text{ lb. (comp)}$$

from previous analysis of Joint A

$$\sum F_y = 0:$$

$$-F_{CA} \cdot \frac{5.2}{8.48} (0.71) - F_{CB}(0.71) - F_{CD} = 0$$

$$F_{CD} = -2(-122.03)(0.71) = 173.2 \text{ lb}$$

(tension)

which makes sense bcos $D_y = -173$

$$\sum F_z = 0:$$

$$-2F_{CA} \cdot \frac{5.2}{8.48} - 150 = 0$$

$$F_{CA} = -122.03 \text{ lb which confirms}$$

our earlier result

Students: complete the analysis for Joints D and C. Note that rounding your numbers may yield slightly different accuracy of final answers. You may also use Method of Sections.