Problem 1-19

A concrete column has a diameter of 350 mm and a length of 2 m. If the density (mass/volume) of concrete is 2.45 Mg/m^3, determine the weight of the column in pounds.

Solution

This concrete column is assumed to be a cylinder with radius 175 mm = 0.175 m and height 2 m. Multiply the provided density by the volume of the column to get its mass.

$$\begin{aligned} m &= \rho V \\ &= \rho \pi r^2 h \\ &= \left(2.45 \frac{\cancel{\text{Mg}}}{\text{m}^3} \times \frac{10^6 \cancel{\text{g}}}{1 \cancel{\text{Mg}}} \times \frac{1 \text{ kg}}{1000 \cancel{\text{g}}}\right) \pi (0.175 \text{ m})^2 (2 \text{ m}) \\ &\approx 471 \text{ kg} \end{aligned}$$

The weight of the column is

$$W = mg \approx (471 \text{ kg}) \left(9.81 \frac{\text{m}}{\text{s}^2}\right) \approx 4.62 \times 10^3 \text{ N}.$$

Finally, use the conversion factor in Table 1-2 on page 9 to convert it to pounds (or kilopounds).

$$W \approx 4.62 \times 10^3 \cancel{\text{N}} \times \frac{1 \text{ lb}}{4.448 \cancel{\text{N}}} \approx 1.04 \times 10^3 \text{ lb} = 1.04 \text{ kips}$$