

**6-12** A smoking lounge that can accommodate 15 smokers is considered. The required minimum flow rate of air that needs to be supplied to the lounge and the diameter of the duct are to be determined.

**Assumptions** Infiltration of air into the smoking lounge is negligible.

**Properties** The minimum fresh air requirements for a smoking lounge is given to be 30 L/s per person.

**Analysis** The required minimum flow rate of air that needs to be supplied to the lounge is determined directly from

$$\begin{aligned}\dot{V}_{\text{air}} &= \dot{V}_{\text{air per person}} (\text{No. of persons}) \\ &= (30 \text{ L/s} \cdot \text{person})(15 \text{ persons}) = 450 \text{ L/s} = \mathbf{0.45 \text{ m}^3/\text{s}}\end{aligned}$$

The volume flow rate of fresh air can be expressed as

$$\dot{V} = VA = V(\pi D^2 / 4)$$

Solving for the diameter  $D$  and substituting,

$$D = \sqrt{\frac{4\dot{V}}{\pi V}} = \sqrt{\frac{4(0.45 \text{ m}^3/\text{s})}{\pi(8 \text{ m/s})}} = \mathbf{0.268 \text{ m}}$$



Therefore, the diameter of the fresh air duct should be at least 26.8 cm if the velocity of air is not to exceed 8 m/s.

**6-13** The minimum fresh air requirements of a residential building is specified to be 0.35 air changes per hour. The size of the fan that needs to be installed and the diameter of the duct are to be determined.

**Analysis** The volume of the building and the required minimum volume flow rate of fresh air are

$$\begin{aligned}V_{\text{room}} &= (2.7 \text{ m})(200 \text{ m}^2) = 540 \text{ m}^3 \\ \dot{V} &= V_{\text{room}} \times \text{ACH} = (540 \text{ m}^3)(0.35/\text{h}) = 189 \text{ m}^3/\text{h} = 189,000 \text{ L/h} = \mathbf{3150 \text{ L/min}}\end{aligned}$$

The volume flow rate of fresh air can be expressed as

$$\dot{V} = VA = V(\pi D^2 / 4)$$

Solving for the diameter  $D$  and substituting,

$$D = \sqrt{\frac{4\dot{V}}{\pi V}} = \sqrt{\frac{4(189 / 3600 \text{ m}^3/\text{s})}{\pi(6 \text{ m/s})}} = \mathbf{0.106 \text{ m}}$$

Therefore, the diameter of the fresh air duct should be at least 10.6 cm if the velocity of air is not to exceed 6 m/s.

