

8.30

8.30 Water flows through a 6-in.-diameter horizontal pipe at a rate of 2.0 cfs and a pressure drop of 4.2 psi per 100 ft of pipe. Determine the friction factor.

For a horizontal pipe $\Delta p = f \frac{L}{D} \frac{1}{2} \rho V^2$,
 where $V = \frac{Q}{A} = \frac{2.0 \frac{\text{ft}^3}{\text{s}}}{\frac{\pi}{4} (6 \text{ ft})^2} = 10.2 \frac{\text{ft}}{\text{s}}$

Thus,

$$f = \frac{2D\Delta p}{\rho L V^2} = \frac{2 \left(\frac{6}{12} \text{ ft} \right) (4.2 \times 144 \frac{\text{lb}}{\text{ft}^2})}{(1.94 \frac{\text{slugs}}{\text{ft}^3}) (100 \text{ ft}) (10.2 \frac{\text{ft}}{\text{s}})^2} = \underline{\underline{0.0300}}$$

8.31

8.31 Water flows in a cast-iron pipe of 200-mm diameter at a rate of 0.10 m³/s. Determine the friction factor for this flow.

For a $D = 0.200 \text{ m}$ cast iron pipe, $\frac{\epsilon}{D} = \frac{0.26 \text{ mm}}{200 \text{ mm}} = 1.3 \times 10^{-3}$ (Table 8.1)

Also,

$$Re = \frac{VD}{\nu}, \text{ where } V = \frac{Q}{A} = \frac{0.10 \frac{\text{m}^3}{\text{s}}}{\frac{\pi}{4} (0.2 \text{ m})^2} = 3.18 \frac{\text{m}}{\text{s}}$$

Hence,

$$Re = \frac{(3.18 \frac{\text{m}}{\text{s}})(0.2 \text{ m})}{1.12 \times 10^{-6} \frac{\text{m}^2}{\text{s}}} = 5.68 \times 10^5, \text{ so from Fig. 8.20 we obtain}$$

$$f = \underline{\underline{0.0215}}$$