

6.62 Water at 20°C is to be pumped through 2000 ft of pipe from reservoir 1 to 2 at a rate of $3 \text{ ft}^3/\text{s}$, as shown in Fig. P6.62. If the pipe is cast iron of diameter 6 in and the pump is 75 percent efficient, what horsepower pump is needed?

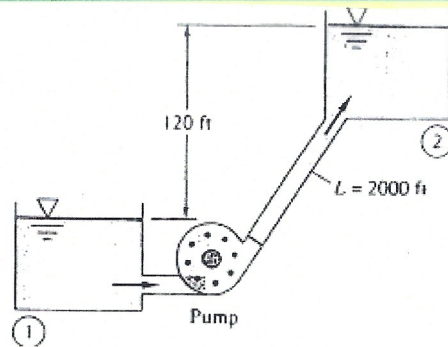


Fig. P6.62

Water 20°C $\rho = 1.94 \text{ slug/ft}^3$ $\mu = 2.09 \times 10^{-5} \text{ slug/ft-s}$
 cast iron $\epsilon = .00085 \text{ ft}$ $\epsilon/D = .0017$ $D = 6/12 = .5 \text{ ft}$

Compute $V = Q/A = 15.3 \text{ ft/s}$
 $Re = \rho V D / \mu = 709,000$
 $f = .0227$

$$p_1 = p_2 = 0$$

$$V_1 = V_2 = 0$$

$$h_L = 0$$

$$\frac{p_1}{\rho} + \frac{\alpha_1 V_1^2}{2g} + z_1 + h_p = \frac{p_2}{\rho} + \frac{\alpha_2 V_2^2}{2g} + z_2 + h_L + h_L$$

$$h_p = \Delta z + f \frac{L}{D} \frac{V^2}{2g}$$

$$= 120 + .0227 \frac{2000}{6/12} \frac{15.3^2}{2 \times 32.2}$$

$$= 120 + 330$$

$$= 450 \text{ ft}$$

$$P = \frac{\rho g Q h_p}{\eta} = \frac{1.94 \times 32.2 \times 3 \times 450}{.75}$$

$$= 112,200 / 550$$

$$= 204 \text{ hp}$$