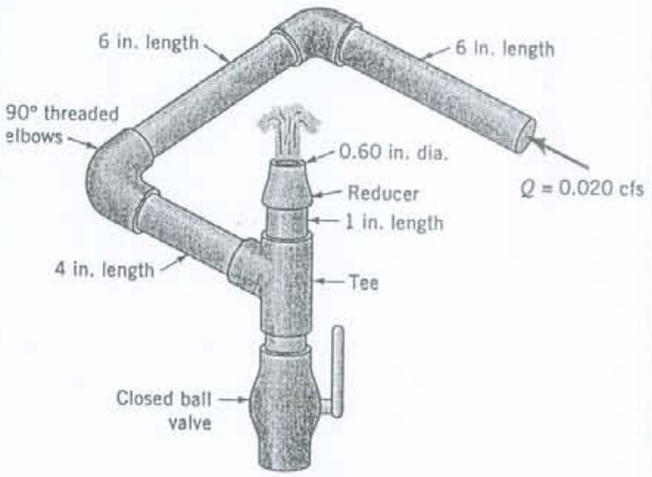
8.70

8.70 Water flows steadily through the 0.75-in. diameter galvanized iron pipe system shown in Video V8.14 and Fig. P8.70 at a rate of 0.020 cfs. Your boss suggests that friction losses in the straight pipe sections are negligible compared to losses in the threaded elbows and fittings of the system. Do you agree or disagree with your boss? Support your answer with appropriate calculations.



■ FIGURE P8.70

Major loss $= f\frac{\ell}{D}\frac{V^2}{2g}$ where

$\ell = (6+6+4+1)\text{in.} = 17\text{in.}$, $D = 0.75\text{in.}$

and

$$V = \frac{Q}{A} = \frac{0.02\ \frac{\text{ft}^3}{\text{s}}}{\frac{\pi}{4}(0.75/12)^2\ \text{ft}^2} = 6.52\ \frac{\text{ft}}{\text{s}}$$

Thus, with

$$\text{Re} = \frac{VD}{\nu} = \frac{6.52\ \frac{\text{ft}}{\text{s}}\left(\frac{0.75}{12}\text{ft}\right)}{1.21\times10^{-5}\ \frac{\text{ft}^2}{\text{s}}} = 3.37\times10^4 \text{ and}$$

$$\frac{\varepsilon}{D} = \frac{0.0005\text{ ft}}{\left(\frac{0.75}{12}\text{ft}\right)} = 8\times10^{-3}$$ (see Table 8.1) we obtain (see Fig. 8.20)

$f = 0.038$ so that $f\frac{\ell}{D}\frac{V^2}{2g} = 0.038\ \frac{17\text{in.}}{0.75\text{in.}}\ \frac{V^2}{2g} = 0.861\ \frac{V^2}{2g}$ (1)

Also,

Minor loss $= \sum K_L \frac{V^2}{2g} = \left[2(1.5) + 2 + 0.15\right]\frac{V^2}{2g} = 5.15\ \frac{V^2}{2g}$ (2)

(2 × 90° elbow, 1 tee, reducer with $\frac{A_2}{A_1} = \left(\frac{0.6\text{in.}}{0.75\text{in.}}\right)^2 = 0.64$ (see Fig. 8.26))

Thus, from Eqs. (1) and (2):

$$\frac{\text{major loss}}{\text{minor loss}} = \frac{0.861\ \frac{V^2}{2g}}{5.15\ \frac{V^2}{2g}} = 0.167 = 16.7\%$$

Probably <u>disagree</u> with boss because pipe friction is about 17% of other losses.