Example Head Loss Computations

Figure 1 shows two reservoirs connected by a 2 mile long, 2 foot diameter, cast iron pipe. The elevation difference between the two reservoir surfaces is 20 feet. Determine the discharge rate of the reservoir elevations remain unchanged.

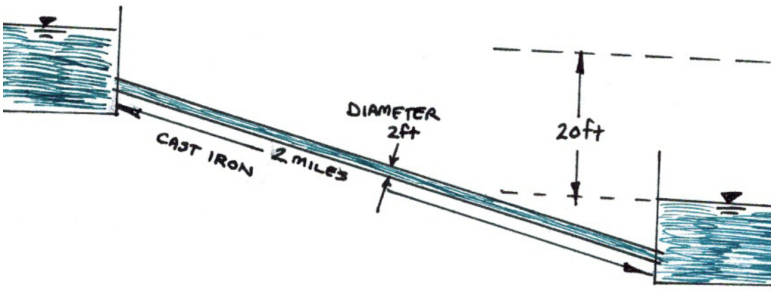

Figure 1: Two reservoirs connected by a cast iron pipe

Solution

Write energy equation for the two reservoirs.

$$\frac{p_A}{\gamma} + \frac{V_A^2}{2g} + z_A + h_p = \frac{p_B}{\gamma} + \frac{V_B^2}{2g} + z_B + h_T + h_L \tag{1}$$

Cancel terms; constant diameter means velocity same at each end; pressure at free surface is zero, no pumps, no turbines – result is

$$z_A = z_B + h_L \tag{2}$$

Apply Darcy-Weisbach equation for head loss

$$z_A - z_B = \frac{8fLQ^2}{\pi^2 g D^5} \tag{3}$$

Substitute numerical values

$$20\ ft = \frac{8f(2 * 5280\ ft)Q^2}{\pi^2(32.2ft/s)(2\ ft)^5} \tag{4}$$

Next program a Reynold's number calculation and use a spreadsheet and goal seek to find Q.

$$Re = \frac{4Q(2\ ft)}{\pi(2\ ft)^2 1.21 \times 10^{-5}\ ft^2/s} \tag{5}$$