

6.78 In Fig. P6.78 the connecting pipe is commercial steel 6 cm in diameter. Estimate the flow rate, in m^3/h , if the fluid is water at 20°C . Which way is the flow?

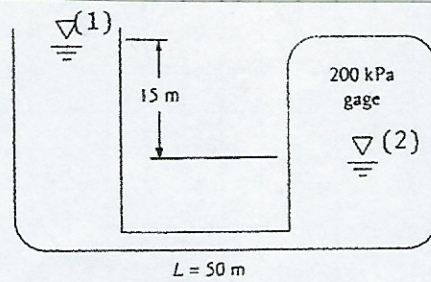


Fig. P6.78

$$\frac{P_1}{\rho} + \frac{V_1^2}{2g} + z_1 + h_p = \frac{P_2}{\rho} + \frac{V_2^2}{2g} + z_2 + h_f + h_f$$

$$z_1 = \frac{P_2}{\rho} + h_f + z_2$$

$$h_f = 15 - \frac{200,000}{998 \times 9.81} = -5.43\text{ m}$$

$f = f(\text{Re}, \epsilon/D)$ ie flow $2 \rightarrow 1$

$$h_f = f \frac{L}{D} \frac{V^2}{2g} = f \frac{50}{0.06} \frac{V^2}{2 \times 9.81} = 5.43$$

$$f V^2 = 0.1278 \quad \frac{\epsilon}{D} = 0.0077$$

$$V = \left(\frac{0.1278}{0.0184} \right)^{1/2} = 2.61 \frac{\text{m}}{\text{s}} \quad f_{\text{fully rough}} = 0.0184$$

$$\text{Re} = \frac{VD}{\nu} = 158,000$$

$$f_{\text{itter}} = 0.0204 \Rightarrow V = 2.5 \frac{\text{m}}{\text{s}}$$

$$\text{etc.} \quad f = 0.0205 \quad V = 2.49 \frac{\text{m}}{\text{s}}$$

$$Q = 25 \text{ m}^3/\text{h}$$