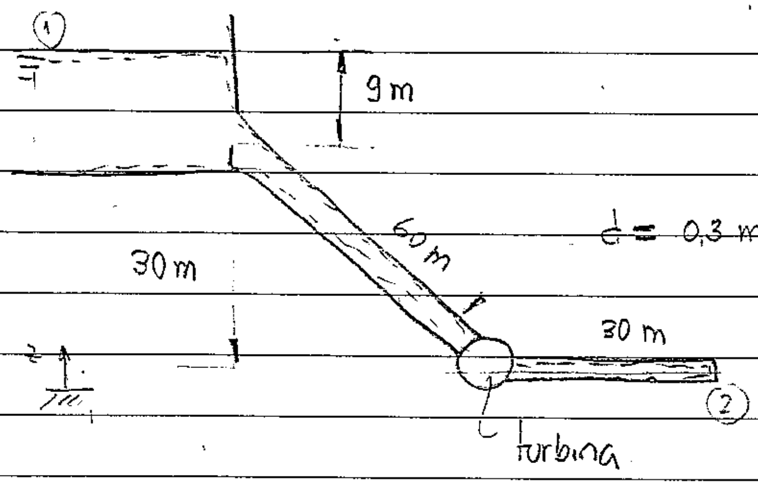
Prob. 8.36 shames Água move a turbina produzindo 75 kW. Qual a vazão?



$d = 0{,}3\ m$ aço $(e = 0.046\ mm)$

$\frac{e}{D} = 1{,}5 \times 10^{-4} = 0{,}00015$

eq da energia:

$$\left(\frac{p_1}{\rho} + \alpha_1 \frac{\bar{V}_1^2}{2} + g z_1\right) - \frac{\dot{W}_{eixo}}{\dot{m}} - \left(\frac{p_2}{\rho} + \alpha_2 \frac{\bar{V}_2^2}{2} + g z_2\right) = h_{lT}$$

$p_1 = p_{atm} = p_2$

$V_1 \approx 0$

$\alpha_2 \approx 1$

$z_2 = 0$

$$\left(\frac{p_{atm}}{\rho} + \alpha_1 \frac{\overbrace{\bar{V}_1^2}^{=0}}{2} + g z_1\right) - \frac{\dot{W}_{TURB}}{\dot{m}} - \left(\frac{p_{atm}}{\rho} + \overbrace{\alpha_2}^{=1} \frac{V_2^2}{2} + \overbrace{g z_2}^{=0}\right) = h_l + \overbrace{h_{lm}}^{=0}$$

$$h_l = f \frac{L}{D} \frac{V_2^2}{2} \qquad \dot{m} = \rho A V$$

$$g z_1 - \frac{\dot{W}_{TURB}}{\dot{m}} - \frac{V^2}{2} = f \frac{L}{D} \frac{V^2}{2}$$

$$g z_1 = \left(\frac{f}{2}\frac{L}{D} + \frac{1}{2}\right) V^2 + \frac{\dot{W}_T}{\rho A V}$$

$$g z_1 \rho A V = \left(\frac{f}{2}\frac{L}{D} + \frac{1}{2}\right) V^3 \rho A + \dot{W}_T$$

$$\left(\frac{f}{2}\frac{L}{D} + \frac{1}{2}\right) V^3 \rho A + \dot{W}_T - g z_1 \rho A V = 0$$

$$\rho A\left[\frac{f}{2}\frac{L}{D}+\frac{1}{2}\right]V^3-gz_1\rho A\,V+\dot{W}_T=0$$

$$(1000)\frac{(\pi)(0.3)^2}{4}\left[f\frac{(60+30)}{(2)(0.3)}+\frac{1}{2}\right]V^3-(9.8)(30+9)(1000)(\pi)\frac{(0.3)^2}{4}V+75\times10^3=0$$

$$(70.69)\left[f(150)+\frac{1}{2}\right]V^3-(2.7\times10^4)V+75\times10^3=0$$

$$\left[(1.06\times10^4)f+(35.35)\right]V^3-(2.7\times10^4)V+75\times10^3=0$$

1) chuta $f=0.02$ obtém $V=3.033\ m/s$

calcula $Re=\frac{\rho VD}{\mu}=\frac{(1000)(3.033)(0.3)}{10^{-3}}=9\times10^5$

do diagrama de Moody para $e/D=0.00015 \rightarrow f=0.014$

2) obtém $V=2.953\ m/s$ $\therefore$ $Re=8.86\times10^5 \rightarrow f=0.014$ ok!

Assim, $V=2.95\ m/s$

$$Q=VA=(2.95)(\pi)\frac{(0.3)^2}{4}=0.21\ m^3/s$$