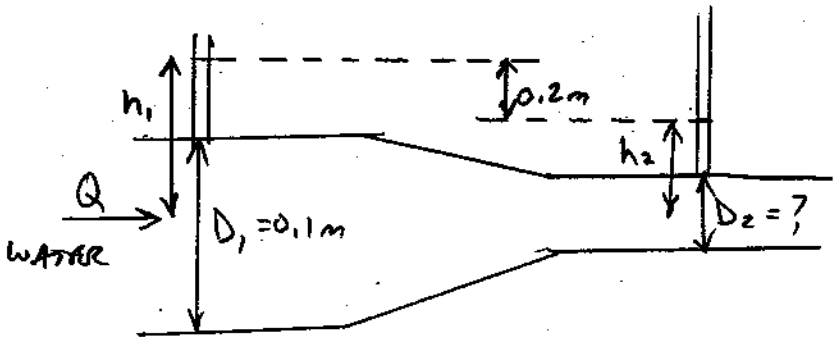
3.19 G: AS SHOWN IN SKETCH

F: $Q = Q(D_2)$



PIEZOMETER TUBES INDICATE

START W/ 2 EQUATIONS — CONTINUITY + BERNOULLI

$\dot{m} = \rho A V \Rightarrow \rho_1 A_1 V_1 = \rho_2 A_2 V_2 \qquad \rho_1 = \rho_2 \therefore \underline{A_1 V_1 = A_2 V_2}$

$A = \frac{\pi D^2}{4} \; ; \; Q = AV$

$* \; V_2 = \left(\frac{\frac{\pi}{4} D_1^2}{\frac{\pi}{4} D_2^2}\right) V_1 = \underline{\left(\frac{0.1}{D_2}\right)^2 V_1}$

$$\frac{P_1}{\gamma} + \frac{V_1^2}{2g} + z_1 = \frac{P_2}{\gamma} + \frac{V_2^2}{2g} + z_2 \quad ; \quad z_1 = z_2$$

$$\frac{P_1 - P_2}{\gamma} = \frac{V_2^2 - V_1^2}{2g}$$

HYDROSTATICS

$P_1 = \gamma h_1$

$P_2 = \gamma h_2$

$P_1 - P_2 = \gamma(h_1 - h_2)$

$* \; P_1 - P_2 = \underline{\gamma 0.2m}$

$$\frac{0.2\gamma}{\gamma} = \frac{\left[\left(\frac{0.1}{D_2}\right)^2 V_1\right]^2 - V_1^2}{2g}$$

$$0.2 = \frac{\left[\left(\frac{0.1}{D_2}\right)^4 - 1\right] V_1^2}{2g}$$

$$V_1 = \sqrt{\frac{(0.2)(2g)}{\left[\left(\frac{0.1}{D_2}\right)^4 - 1\right]}}$$

$$\boxed{Q = A_1 V_1 = \frac{\pi}{4} 0.1^2 \sqrt{\frac{0.2(2g)}{\left[\left(\frac{0.1}{D_2}\right)^4 - 1\right]}} = \frac{0.0156 D_2^2}{\sqrt{0.1^4 - D^4}} \; \frac{m^3}{s}}$$