

P7.41 Repeat Prob. 7.20 with the sole change that the pitot probe is now **10 mm** from the wall (5 times higher). Show that the flow there cannot possibly be laminar, and use smooth-wall turbulent-flow theory to estimate the position x of the probe, in m.

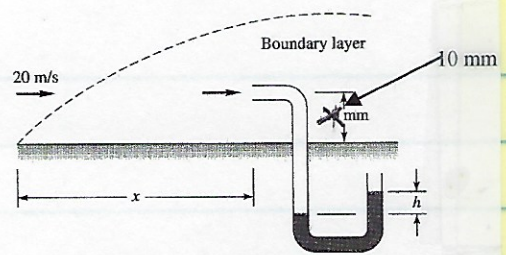


Fig. P7.20

If laminar largest $Re_x = 3E6$

$$\rho = 1.2 \text{ kg/m}^3$$

$$\mu = 1.8 E-5 \text{ kg/m}\cdot\text{s}$$

$$= \frac{1.2 (20) x}{1.8 E-5}$$

$$\text{ie } x = 2.25 \text{ m}$$

$$\delta = \frac{5x}{Re_x^{1/2}} = \frac{5 \times 2.25}{(3E6)^{1/2}} = 6.5 \text{ mm}$$

$$P7.20 : h = 16 \text{ mm}$$

$$SG = .827$$

$$\rho_s = 129 \text{ Pa}$$

$$u = 14.7 \text{ m/s}$$

$$u/v = .734$$

< 10 mm

∴ turbulent

$$\text{at } y = 10 \text{ mm } .734 = \left(\frac{y}{\delta}\right)^{1/7} = \left(\frac{10}{\delta}\right)^{1/7} \Rightarrow \delta = 87 \text{ mm}$$

$$Re_x = \frac{u x}{\nu}$$

$$\delta/x = \frac{.16}{Re_x^{1/7}} \Rightarrow x = 5.15 \text{ m}$$