3.113

3.113 Water flows in a rectangular channel that is 2.0 m wide as shown in Fig. P3.113. The upstream depth is 70 mm. The water surface rises 40 mm as it passes over a portion where the channel bottom rises 10 mm. If viscous effects are negligible, what is the flowrate?

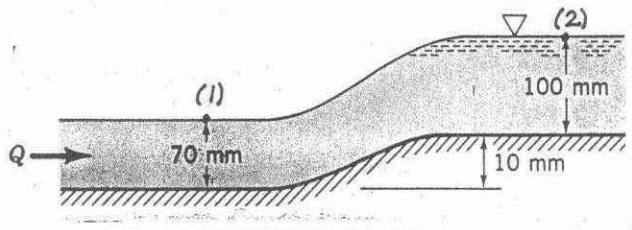

FIGURE P3.113

$$\frac{p_1}{\gamma} + \frac{V_1^2}{2g} + z_1 = \frac{p_2}{\gamma} + \frac{V_2^2}{2g} + z_2 \quad \text{where } p_1 = 0,\ p_2 = 0,\ z_1 = 0.07m, \text{ and } z_2 = (0.01 + 0.10)m = 0.11m \quad (1)$$

Also, $A_1 V_1 = A_2 V_2$

or

$$V_2 = \frac{h_1}{h_2} V_1 = \frac{0.07m}{0.10m} V_1 = 0.7 V_1$$

Thus, Eq. (1) becomes

$$[1 - 0.7^2] V_1^2 = 2\left(9.81 \frac{m}{s^2}\right)(0.11 - 0.07)m \quad \text{or} \quad V_1 = 1.24 \frac{m}{s}$$

Hence,

$$Q = A_1 V_1 = (0.07m)(2.0m)\left(1.24 \frac{m}{s}\right) = \underline{\underline{0.174 \frac{m^3}{s}}}$$