Answer Key: Civil Engineering Licensure Exam – Mock Quiz (Day 21: Hydraulics and Hydrology)

February 24, 2025

Answer Key

Section A: Multiple Choice Solutions

1. Bernoulli equation is based on: **(b) Conservation of energy**
2. Froude number classifies: **(b) Subcritical and supercritical flow**
3. Manning's equation computes: **(b) Open channel flow velocity**
4. Rational Method estimates: **(a) Peak runoff discharge**
5. Unit of hydraulic conductivity in Darcy's law: **(a) m/s**

Section B: Problem-Solving Solutions

1. Pressure at second section using Bernoulli's equation:

$$P_1 + \frac{1}{2}\rho V_1^2 = P_2 + \frac{1}{2}\rho V_2^2$$

$$120 + \frac{1}{2}(1000)(3^2) = P_2 + \frac{1}{2}(1000)(5^2)$$

$$120 + 4500 = P_2 + 12500$$

$$P_2 = 120 - 8000 = 40 \text{ kPa}$$

2. Hydraulic radius of trapezoidal channel:

$$A = (b + md)d = (4 + 2(1.5))(1.5) = (4 + 3)(1.5) = 10.5 \text{ m}^2$$

$$P = b + 2d\sqrt{m^2 + 1} = 4 + 2(1.5)\sqrt{2^2 + 1}$$

$$= 4 + 3(2.236) = 10.7 \text{ m}$$

$$R = \frac{A}{P} = \frac{10.5}{10.7} = 0.98 \text{ m}$$

3. Peak runoff using the Rational Method:

$$Q = CIA$$

$$= 0.75 \times 40 \times 5$$

$$= 150 \text{ m}^3/\text{s}$$

4. Critical depth for a rectangular channel:

$$y_c = \left(\frac{Q^2}{gb^2}\right)^{\frac{1}{3}}$$

$$= \left(\frac{10^2}{9.81 \times 3^2}\right)^{\frac{1}{3}}$$

$$= \left(\frac{100}{88.29}\right)^{\frac{1}{3}}$$

$$y_c = 1.03 \text{ m}$$

5. Darcy velocity in groundwater flow:

$$v = K \times \frac{\Delta h}{L}$$

$$= 8 \times \frac{2}{500} = 0.032 \text{ m/day}$$