Answer Key: Civil Engineering Licensure Exam – Mock Exam (Day 17: Open Channel Flow and Energy Equations)

February 24, 2025

Answer Key

Section A: Multiple Choice Solutions

1. Hydraulic radius definition: **(a) Flow area divided by wetted perimeter**

2. Manning's equation is used to compute: **(a) Flow velocity in open channels**

3. Critical depth is determined by: **(a) Froude number = 1**

4. Subcritical flow occurs when: **(a) Froude number ¡ 1**

5. Specific energy in open channel flow: **(a) Sum of pressure head, velocity head, and datum head**

Section B: Problem-Solving Solutions

1. Flow velocity in a rectangular channel:

$$Q = AV$$

$$10 = (3 \times 1.5)V$$

$$V = \frac{10}{4.5} = 2.22 \text{ m/s}$$

2. Wetted perimeter of trapezoidal channel:

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

$$P = 4 + 2\sqrt{(2^2 + 1) \times 2^2}$$

$$= 4 + 2 \times \sqrt{5 \times 4}$$

$$= 4 + 2 \times \sqrt{20} = 4 + 8.94 = 12.94 \text{ m}$$

3. Critical depth calculation:

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

$$y_c = \left(\frac{8^2}{9.81 \times 2.5^2}\right)^{\frac{1}{3}}$$

$$= \left(\frac{64}{61.31}\right)^{\frac{1}{3}} = (1.04)^{\frac{1}{3}}$$

$$y_c = 1.02 \text{ m}$$

4. Specific energy:

$$E = y + \frac{V^2}{2g}$$

$$= 1.8 + \frac{3^2}{2 \times 9.81}$$

$$= 1.8 + \frac{9}{19.62} = 1.8 + 0.46 = 2.26 \text{ m}$$

5. Froude number:

$$Fr = \frac{V}{\sqrt{gy}}$$

$$A = 5 \times 2 = 10 \text{ m}^2$$

$$V = \frac{20}{10} = 2 \text{ m/s}$$

$$Fr = \frac{2}{\sqrt{9.81 \times 2}}$$

$$= \frac{2}{4.43} = 0.45$$

Since $Fr < 1$, the flow is **subcritical**.