Solutions to Drainage, Stormwater Management, and Irrigation Systems Problems

1. **Problem 1:** A 10-hectare urban area experiences a storm with an intensity of 50 mm/hr. Using a runoff coefficient of 0.7, compute the peak runoff using the Rational Method.

   Solution: The Rational Method calculates peak runoff (Q) using the formula:

   $$Q = 0.0028 \times C \times I \times A$$

   where:

   - C = runoff coefficient = 0.7
   - I = rainfall intensity (mm/hr) = 50 mm/hr
   - A = area (hectares) = 10 hectares

   Substituting the given values:

   $$Q = 0.0028 \times 0.7 \times 50 \times 10 = 0.98\, m^3/s$$

   Video Solution: `https://www.youtube.com/watch?v=AhYI4SqZWOg`

2. **Problem 2:** A rectangular stormwater channel is designed to have a width of 2 m and a depth of 1.2 m. If the flow velocity is 1.8 m/s, determine the discharge.

   Solution: Discharge (Q) is calculated using:

   $$Q = A \times v$$

   where:

   - A = cross-sectional area = width × depth = $2\, m \times 1.2\, m = 2.4\, m^2$
   - v = flow velocity = 1.8 m/s

   Thus:

   $$Q = 2.4 \times 1.8 = 4.32\, m^3/s$$

Video Solution: `https://www.youtube.com/watch?v=R-Vhs_AH8mA`

3. **Problem 3:** A detention basin is designed to capture runoff from a 5-hectare area with a rainfall depth of 80 mm. Determine the total volume of stormwater that needs to be managed.

   Solution: The volume (V) of stormwater is:

$$V = A \times d$$

   where:

   - A = area = 5 hectares = $5 \times 10^4\, m^2$
   - d = rainfall depth = 80 mm = 0.08 m

   Therefore:

$$V = 5 \times 10^4 \times 0.08 = 4{,}000\, m^3$$

   Video Solution: `https://www.youtube.com/watch?v=AhYI4SqZWOg`

4. **Problem 4:** A farmer applies irrigation water at a rate of 25 mm/day over a 2-hectare farm. Compute the total daily irrigation volume required.

   Solution: The daily irrigation volume (V) is:

$$V = A \times d$$

   where:

   - A = area = 2 hectares = $2 \times 10^4\, m^2$
   - d = irrigation depth = 25 mm = 0.025 m

   Thus:

$$V = 2 \times 10^4 \times 0.025 = 500\, m^3$$

   Video Solution: `https://www.youtube.com/watch?v=AhYI4SqZWOg`

5. **Problem 5:** An open drainage channel has a hydraulic radius of 0.5 m, a slope of 0.001, and a Manning's roughness coefficient of 0.015. Compute the flow velocity using Manning's equation.

   Solution: Manning's equation is:

$$v = \frac{1}{n} R^{2/3} S^{1/2}$$

   where:

   - n = Manning's roughness coefficient = 0.015

- R = hydraulic radius = 0.5 m
- S = slope = 0.001

Substituting the values:

$$v = \frac{1}{0.015} \times (0.5)^{2/3} \times (0.001)^{1/2} \approx 1.52\, m/s$$

Video Solution: `https://www.youtube.com/watch?v=R-Vhs_AH8mA`