Answer Key: Civil Engineering Licensure Exam – Mock Exam (Day 45: Shear, Bond, and Development Length)

February 24, 2025

Answer Key

Section A: Multiple Choice Solutions

1. Shear force in a reinforced concrete beam is resisted by: **(a) Stirrups**
2. Bond stress is: **(a) The shear stress between concrete and reinforcement**
3. The purpose of development length: **(a) Provide sufficient anchorage to prevent bond failure**
4. Maximum shear stress in a beam occurs at: **(a) The neutral axis**
5. Hooks in reinforcing bars are provided to: **(a) Increase bond and anchorage**

Section B: Problem-Solving Solutions

1. Required shear reinforcement:

$$V_u = 120 \times 10^3$$

$$\tau_v = \frac{V_u}{bd} = \frac{120 \times 10^3}{300 \times 450}$$
$$= 0.89 \text{ MPa}$$

The required shear reinforcement is calculated using the appropriate shear formula.

2. Development length:

$$L_d = \frac{f_y d}{4\tau_b}$$
$$= \frac{415 \times 20}{4 \times 1.4}$$
$$= 1482.14 \text{ mm}$$

3. Maximum shear force at the support:

$$V_u = \frac{wL}{2}$$
$$= \frac{20 \times 5}{2} = 50 \text{ kN}$$

4. Required stirrup spacing:

$$S = \frac{A_v f_y d}{V_u}$$
$$= \frac{\pi(10)^2/4 \times 415 \times 450}{80 \times 10^3}$$
$$= 175 \text{ mm}$$

5. Reduced development length for a hooked bar:

$$L'_d = 0.75 \times L_d$$
$$= 0.75 \times 600$$
$$= 450 \text{ mm}$$