Answer Key: Civil Engineering Licensure Exam – Mock Exam (Day 31: Beams and Frames – Shear and Moment Diagrams)

February 24, 2025

Answer Key

Section A: Multiple Choice Solutions

1. Shear force in a beam: **(b) The sum of vertical forces to the left or right of the section**
2. Maximum bending moment in a simply supported beam: **(b) The midpoint of the beam**
3. Positive bending moment causes: **(b) Compression at the top fibers and tension at the bottom fibers**
4. Shear force diagram for a simply supported beam with UDL: **(a) Triangular**
5. Maximum bending moment occurs where: **(a) The shear force is zero**

Section B: Problem-Solving Solutions

1. Simply supported beam with central point load:

$$R_A = R_B = \frac{10}{2} = 5 \text{ kN}$$

$$M_{\max} = R_A \times 3 = 5 \times 3 = 15 \text{ kN·m}$$

Shear force diagram: Constant values of +5 kN and -5 kN on either side of the load.

Bending moment diagram: Maximum moment of 15 kN·m at midspan.

2. Cantilever beam with UDL:

$$R_A = \sum W = 4 \times 5 = 20 \text{ kN}$$

$$M_A = \frac{wL^2}{2} = \frac{4 \times 5^2}{2} = 50 \text{ kN·m}$$

Shear force diagram: Linear, starting from -20 kN at free end to +20 kN at fixed end.

Bending moment diagram: Parabolic, maximum at fixed end.

3. Simply supported beam with triangular load:

$$R_A = \frac{1}{2} \times 6 \times 8 = 24 \text{ kN}$$

The reactions are computed using moment equilibrium.

4. Beam with moment load:

$$R_A = R_B = 0 \text{ kN (no vertical force applied)}$$

Shear force: Zero throughout.

Bending moment: Constant, -20 kN·m for the entire beam.

5. Propped cantilever beam with UDL:

$$R_A + R_B = 5 \times 6 = 30 \text{ kN}$$

Solving moment equilibrium:

$$R_B \times 6 = \frac{5 \times 6^2}{2} = 90$$

$$R_B = 15 \text{ kN}, \quad R_A = 15 \text{ kN}$$

Shear force diagram: Linear variation.

Bending moment diagram: Parabolic shape.