# Answer Key: Civil Engineering Licensure Exam – Mock Exam (Day 46: Steel Structures – Beams, Columns, and Connections)

February 24, 2025

## Answer Key

**Section A: Multiple Choice Solutions**

1. The primary function of a steel beam: **(a) Resist bending and shear forces**
2. The slenderness ratio is: **(a) The ratio of effective length to the radius of gyration**
3. Failure due to excessive tension in bolts: **(a) Bolt rupture**
4. The plastic section modulus is used to determine: **(a) The plastic moment capacity of the beam**
5. Lateral-torsional buckling occurs when: **(a) The compression flange is not laterally braced**

**Section B: Problem-Solving Solutions**

1. Plastic moment capacity of the steel beam:

$$M_p = Z_p f_y$$

$$= (500 \times 10^3) \times 250$$

$$= 125 \times 10^6 \text{ N·mm} = 125 \text{ kN·m}$$

2. Slenderness ratio of the column:

$$\lambda = \frac{L_{\text{eff}}}{r}$$

$$= \frac{3500}{100}$$

$$= 35$$

3. Shear capacity of bolted connection:

$$V = n \times 2 \times \left(\frac{\pi d^2}{4}\right) \times \tau$$

$$= 4 \times 2 \times \left(\frac{\pi(20)^2}{4}\right) \times 140$$

$$= 4 \times 2 \times (314.16) \times 140$$

$$= 351.9 \text{ kN}$$

4. Maximum bending moment for simply supported beam:

$$M_{\max} = \frac{wL^2}{8}$$

$$= \frac{25 \times 6^2}{8}$$

$$= 112.5 \text{ kN·m}$$

5. Axial stress in the steel column:

$$\sigma = \frac{P}{A}$$

$$= \frac{800 \times 10^3}{400 \times 10^4}$$

$$= 20 \text{ MPa}$$