Answer Key: Civil Engineering Licensure Exam – Mock Quiz (Day 42: Mechanics of Materials)

February 24, 2025

Answer Key

Section A: Multiple Choice Solutions

1. The modulus of rigidity is: **(a) The ratio of shear stress to shear strain**
2. Maximum bending moment in a cantilever beam: **(a) The fixed support**
3. Shear force at the midpoint of a simply supported beam: **(a) Zero**
4. The stress-strain curve of a ductile material: **(a) Elastic and plastic regions**
5. Maximum normal stress in a beam under pure bending: **(a) At the extreme fibers of the section**

Section B: Problem-Solving Solutions

1. Normal stress in a circular rod:

$$\sigma = \frac{F}{A} = \frac{50,000}{\frac{\pi(25)^2}{4}}$$

$$= \frac{50,000}{490.87}$$

$$= 101.9 \text{ MPa}$$

2. Maximum bending moment for a simply supported beam:

$$M_{\max} = \frac{PL}{4} = \frac{30 \times 4}{4}$$

$$= 30 \text{ kN·m}$$

3. Maximum bending moment for a cantilever beam:

$$M_{\max} = \frac{wL^2}{2} = \frac{5 \times 3^2}{2}$$

$$= 22.5 \text{ kN·m}$$

4. Principal stresses using Mohr's Circle:

$$\sigma_{1,2} = \frac{\sigma_x + \sigma_y}{2} \pm \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2}$$

$$= \frac{80 + 40}{2} \pm \sqrt{\left(\frac{80 - 40}{2}\right)^2 + 30^2}$$

$$= 60 \pm \sqrt{400 + 900}$$

$$= 60 \pm \sqrt{1300}$$

$$= 60 \pm 36.06$$

$$\sigma_1 = 96.06 \text{ MPa}, \quad \sigma_2 = 23.94 \text{ MPa}$$

5. Maximum shear stress in a shaft:

$$\tau_{\max} = \frac{Tr}{J} = \frac{2000 \times 50}{6 \times 10^6}$$

$$= \frac{100000}{6 \times 10^6}$$

$$= 16.67 \text{ MPa}$$