Answer Key: Civil Engineering Licensure Exam – Mock Exam (Day 34: Structural Stability and Determinacy)

February 24, 2025

Answer Key

Section A: Multiple Choice Solutions

1. A structure is statically determinate when: **(a) The number of unknown forces equals the number of independent equations of equilibrium.**

2. Determinacy equation for a plane truss: **(a)** $m = 2j - 3$

3. A statically indeterminate beam has: **(a) More unknowns than available equations of equilibrium.**

4. Degree of indeterminacy of a fixed beam with two spans: **(c) 3**

5. A structure is unstable if: **(a) It has insufficient supports or an improper arrangement of supports.**

Section B: Problem-Solving Solutions

1. Truss determinacy check:

$$m = 19, \quad j = 10$$

$$m = 2j - 3 = 2(10) - 3 = 17$$

Since $19 > 17$, the truss is **statically indeterminate**.

2. Beam with an intermediate hinge:

   Simply supported beam has 2 reactions per support, total of 4 reactions.

   A hinge introduces an additional equation of equilibrium.

   $$\text{Degree of determinacy} = 4 - 3 = 1$$

   The beam is **statically determinate**.

3. Frame determinacy check:

   $$m = 4, \quad j = 4, \quad r = 3$$

   Using the equation for frames:

   $$d = m + r - 2j$$

   $$= 4 + 3 - 2(4) = -1$$

   Since $d < 0$, the structure is **unstable**.

4. Continuous beam with three spans:

   $$d = r - 3$$

   $$= (3 \times 3 + 2) - 3 = 6$$

   The beam is **statically indeterminate with a degree of 6**.

5. Planar structure:

   $$m = 13, \quad j = 6, \quad r = 3$$
   $$d = m + r - 2j$$
   $$= 13 + 3 - 2(6) = 4$$

   Since $d > 0$, the structure is **statically indeterminate with a degree of 4**.