Civil Engineering Licensure Exam – Mock Exam (Day 43: Design Philosophies – Allowable Stress and Ultimate Strength)

February 24, 2025

Instructions

- Time Limit: 60 Minutes
- Coverage: Design Philosophies – Allowable Stress and Ultimate Strength
- Total Questions: 10 (Multiple Choice & Problem-Solving)
- Show complete solutions for problem-solving questions.

Section A: Multiple Choice Questions (MCQs)

Choose the best answer.

1. The Allowable Stress Design (ASD) method ensures:
   (a) The structure remains within the elastic limit under service loads
   (b) The structure can sustain ultimate failure loads
   (c) The maximum strain before rupture
   (d) That the material will yield before failure
2. The Load and Resistance Factor Design (LRFD) accounts for:
   (a) Safety factors applied to both loads and resistances
   (b) Only dead loads and live loads
   (c) Only the yield strength of the material

(d) The modulus of elasticity only

3. The factor of safety in allowable stress design is defined as:

   (a) The ratio of ultimate strength to allowable stress

   (b) The ratio of applied stress to yield stress

   (c) The ratio of load to deformation

   (d) The sum of all loads divided by resistance

4. Ultimate strength design (USD) ensures:

   (a) The structure can sustain extreme loads before failure

   (b) The structure remains within the elastic range

   (c) The structure has no residual stress

   (d) The structure has maximum stiffness

5. A key difference between ASD and LRFD is:

   (a) ASD uses a single factor of safety, while LRFD applies load and resistance factors

   (b) ASD accounts for ultimate loads, while LRFD considers service loads

   (c) LRFD uses only one load factor for all loads

   (d) ASD provides a lower factor of safety than LRFD

Section B: Problem-Solving

1. A steel beam is designed using ASD. The allowable bending stress is 160 MPa, and the actual bending stress is 120 MPa. Determine the factor of safety.

2. A reinforced concrete beam is designed using LRFD. The factored moment is 250 kN·m, and the nominal moment capacity is 300 kN·m. Determine the strength reduction factor.

3. A structural steel column is subjected to a service load of 500 kN. If the factor of safety in ASD is 1.67, determine the required ultimate strength of the column.

4. A beam carries a dead load of 40 kN and a live load of 30 kN. Using LRFD with load factors of 1.2 for dead load and 1.6 for live load, determine the factored load.

5. A structural steel tension member has a yield strength of 250 MPa. If the safety factor for ASD is 1.67, determine the allowable stress for the member.