

**NATIONAL COUNCIL OF EXAMINERS FOR ENGINEERING AND SURVEYING**  
**PRINCIPLES AND PRACTICE OF ENGINEERING EXAMINATION**

**STRUCTURAL I**

**EFFECTIVE April 2004–October 2010**

|   | <u>Approximate<br/>Percentage of<br/>Examination</u> |
|---|--|
| <b>I. Analysis of Structures</b>  | <b>31%</b>   |
| A. Loads  | 7%   |
| 1. Dead loads (e.g., weight of the structure, equipment weights, facades)   |  |
| 2. Superimposed and live (e.g., finishes, mechanical equipment, partition loads, live load reductions, pattern, skip, pedestrian) |  |
| 3. Snow (e.g., drifting)  |  |
| 4. Moving (e.g., vehicular, pedestrian, crane)  |  |
| 5. Thermal  |  |
| 6. Shrinkage and creep  |  |
| 7. Impact (e.g., vehicular, crane and elevator)   |  |
| 8. Settlement   |  |
| 9. Ponding  |  |
| 10. Hydraulics (e.g., stream flow, wave action, scour)  |  |
| B. Lateral Forces   | 8%   |
| 1. Wind   |  |
| 2. Seismic  |  |
| 3. Earth retention  |  |
| 4. Hydrostatic  |  |
| C. Lateral Force Distribution   | 11%  |
| 1. Statics (e.g., determinate and indeterminate, location of forces and moments, rigid body diagrams)                             |  |
| 2. Development of a structural system to resist effects of lateral forces   |  |
| 3. Seismic static force analysis procedures   |  |
| 4. Code requirements pertaining to the configuration of a structural system to resist effects of horizontal torsional moments     |  |
| 5. Relative rigidity force distribution analysis (e.g., rotational analysis)  |  |
| 6. Procedures to analyze building with horizontal/plan and vertical irregularities  |  |
| 7. Procedures to analyze diaphragms (e.g., flexible and rigid diaphragms)   |  |
| 8. Code-prescribed static lateral force analysis procedures to determine limitations of story drift                               |  |
| 9. Wind analysis procedures   |  |
| D. Methods  | 5%   |
| 1. Computer-generated structural analysis techniques (e.g., modeling, interpreting and verifying results)                         |  |
| 2. Code coefficients and tables   |  |
| 3. Force diagrams   |  |

4. Simplified analysis methods (e.g., moment distributions, influence lines, portal frame method/cantilever method)
5. Shear and moments diagrams

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| <b>II. Design and Details of Structures</b>                                      | <b>69%</b> |
| A. General Structural Considerations   | 7%         |
| 1. Material properties and standards   |            |
| 2. Load combinations   |            |
| 3. Deflection  |            |
| 4. Camber  |            |
| 5. Vibration   |            |
| 6. Anchorage of a structural system to resist uplift and sliding forces          |            |
| 7. Fatigue (for concrete and steel, AASHTO)                                      |            |
| 8. Strengthening systems to improve existing structural capacity                 |            |
| 9. Specifications, quality controls and coordination with other disciplines      |            |
| B. Steel (AISC/AASHTO, ASD/LFD/LRFD)   | 18%        |
| 1. Tension members   |            |
| 2. Columns   |            |
| 3. Base plates/anchor bolts  |            |
| 4. Beams, plate girders  |            |
| 5. Trusses   |            |
| 6. Beam-columns  |            |
| 7. Connections (e.g., bolted, welded)  |            |
| 8. Ordinary moment frames  |            |
| 9. Special moment resisting frames   |            |
| 10. Bracing  |            |
| 11. Ordinary braced frames   |            |
| 12. Eccentric braced frames  |            |
| 13. Composite steel design   |            |
| C. Concrete (AASHTO/ACI/PCI, Strength Design, LRFD)                              | 16%        |
| 1. Working stress/strength design for bridges                                    |            |
| 2. Flexural members (e.g., beams, joists, bridge decks and slabs)                |            |
| 3. Compression members   |            |
| 4. Two-way slab systems  |            |
| 5. Pre-stressed concrete   |            |
| 6. Shear walls   |            |
| 7. Attachment of elements to concrete (e.g., inserts, attachment plates, dowels) |            |
| 8. Diaphragms  |            |
| 9. Reinforcing bar details   |            |
| 10. Bridge piers   |            |
| 11. Crack control  |            |
| 12. Flexural-compression members   |            |
| D. Wood (NDS/ASD)  | 9%         |
| 1. Sawn beams  |            |
| 2. Glue-laminated beams  |            |
| 3. Columns   |            |

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| 4. Bearing walls   |      |
| 5. Shear walls   |      |
| 6. Plywood diaphragms (e.g., drag struts, chords)  |      |
| 7. Trusses   |      |
| 8. Bolted, nailed, and screwed connections   |      |
| E. Masonry (ACI 530, Working Stress/Strength Design)   | 9%   |
| 1. Reinforced masonry  |      |
| 2. Flexural members  |      |
| 3. Compression members   |      |
| 4. Flexural-compression members  |      |
| 5. Bearing walls   |      |
| 6. Slender walls   |      |
| 7. Shear walls   |      |
| 8. Seismic detailing for shear walls and nonbearing walls  |      |
| 9. Attachment of elements to masonry   |      |
| F. Foundations and Retaining Structures  | 10%  |
| 1. Design coefficients (e.g., active, passive, at rest, bearing, coefficient of friction, cohesion)                              |      |
| 2. Soil profiles in selection of foundation systems (e.g., geotechnical reports, boring logs, settlement, and groundwater table) |      |
| 3. Overturning, sliding, and bearing   |      |
| 4. Spread footings   |      |
| 5. Combined footings/mat foundations   |      |
| 6. Piles (concrete, steel)   |      |
| 7. Drilled shaft/drilled pier/caisson  |      |
| 8. Gravity walls   |      |
| 9. Cantilever walls  |      |
| 10. Basement walls for buildings   |      |
| 11. Effect of loads placed adjacent to foundation  |      |
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| Total  | 100% |

Notes:

1. The examination is developed with problems that will require a variety of approaches and methodologies including design, analysis, and application. Some problems may require knowledge of engineering economics. Approximately 20% of the exam will test bridge knowledge.
2. The knowledge areas specified under 1, 2, 3, ... etc., are examples of kinds of knowledge, but they are not exclusive or exhaustive categories.
3. This examination contains a total of 80 multiple-choice questions. Examinee works all questions.