Civil Engineer Seismic Principles Examination Test Plan

Effective 2022

Definition of Engineering Seismic

Seismic Principles are defined as the fundamental principles, tasks, and knowledge underlying those activities involved in the California practice of seismic design, seismic analysis, or seismic evaluation of new and existing civil engineering projects, such as:

- **Buildings**
- **Non-buildings structures**
- **Non-structural components, equipment, and lifelines**

This area of practice is structured into seven primary content areas:

I. Seismic Data and Seismic Design Criteria (8%)

II. Seismic Characteristics of Engineered System (8%)

III. Seismic Vulnerability and Improvement of Structural Systems (6%)

IV. Seismic Forces: Building Structures (26%)

V. Seismic Forces: Non-Building Structures, Components, and Equipment (14%)

VI. Seismic Analysis Procedures (26%)

VII. Seismic Detailing and Construction Quality Control (12%)

(**NOTE**: As used throughout this test plan, the term **applicable code** refers to the **2022 California Building Code**).

BPELSG Civil Engineering: Seismic Principles (CSP) Test Plan-2022

I. Seismic Data and Seismic Design Criteria — 8%

Professional Activities:

1. Practice in accordance to codes and standards governing seismic design
2. Identify design performance requirements for a project
3. Determine site-related coefficients
4. Determine effects of site characteristics on a structure
5. Determine Seismic Design Category

Test questions on these professional activities may include one or more of the following:

A. Seismic hazards and geotechnical data that affect design, including liquefaction and site classification
B. Site-related seismic coefficients
C. Applicable codes for civil engineering seismic design and construction (e.g., design code philosophy, construction document design data)
D. Seismic Design Categories
E. Risk category based on nature of occupancy

II. Seismic Characteristics of Engineered System — 8%

Professional Activities:

1. Select appropriate seismic force-resisting systems
2. Identify effects of structural characteristics on seismic design/performance
3. Combine lateral force resisting systems

Test questions on these professional activities may include one or more of the following:

A. The different structural systems, their design parameters and limitations
B. Requirements for structures with horizontal irregularities
C. Requirements for structures with vertical irregularities
D. P-Delta effects and drift (e.g., story drift, displacement, deflection)
E. Required building separation and setback
F. Effects of redundancy, ductility and damping on seismic performance

III. Seismic Vulnerability and Improvement of Structural Systems — 6%

Professional Activities:

1. Evaluate vulnerability of structures with previous poor seismic performance
2. Evaluate post-earthquake structural safety
3. Determine methods for improving seismic performance of existing structures

Test questions on these professional activities may include one or more of the following:

A. Anchorage and stability in existing unreinforced masonry (URM) bearing wall buildings
B. Critical connections in precast concrete structures
C. Critical connections and supports in cast-in-place concrete structures (e.g., punching shear)
D. Diaphragm to wall connection failures (e.g., in tilt-up buildings, in masonry buildings)
E. Critical connections in steel braced frame structures (e.g., buckling, brittle)
F. Critical connections in and design characteristics of steel moment frames (e.g., welded, beam to column)
G. Assessment and identification of post-earthquake damage and risk
H. Methods and effects of improving seismic performance on existing structures
I. Methods and effects of improving the performance of brittle elements in structural systems (e.g., increasing ductility, adding stiffness)
J. Methods and effects of strengthening connections in structural elements

IV. Seismic Forces: Building Structures — 26%

Professional Activities:

1. Determine structural characteristics required to calculate seismic design forces
2. Determine seismic design forces for structures
3. Perform vertical distribution of seismic forces for structures
4. Determine seismic diaphragm forces
5. Determine seismic forces for structural elements

Test questions on these professional activities may include one or more of the following:

A. Mass and stiffness
B. Methods to determine the structure's fundamental period
C. Combination of seismic force-resisting systems (e.g., vertical combinations, two-stage analysis, horizontal combinations)
D. Seismic base shear
E. Vertical seismic force distribution
F. Seismic design forces on diaphragms
G. Seismic design forces on structural elements
H. Out-of-plane seismic forces on structural elements
I. Structural wall seismic anchorage forces

V. Seismic Forces: Non-Building Structures, Components, and Equipment — 14%

Professional Activities:

1. Determine seismic forces for non-structural building components and equipment
2. Determine seismic forces for non-building structures

Test questions on these professional activities may include one or more of the following:

A. Mass and stiffness
B. Methods to determine the structure's fundamental period
C. Seismic Design Data and Criteria for nonbuilding structures and nonstructural components
D. Seismic design base shear of nonbuilding structures
E. Rigid nonbuilding structures
F. Seismic Design Force for nonstructural components lateral force formulas

VI. Seismic Analysis Procedures — 26%

Professional Activities:

1. Perform analysis of seismic force resisting systems
2. Perform the distribution of seismic forces to structural elements
3. Perform the seismic analysis of diaphragms (e.g., rigid and flexible)

Test questions on these professional activities may include one or more of the following:

A. Application of seismic load effects in load combinations
B. Seismic forces applied to structural elements within the load path
C. Seismic force distribution to vertical elements of the lateral load resisting system
D. Deflection and drift requirements of diaphragms and structural elements
E. Diaphragm force distribution to structural elements (e.g., chord forces, drag forces, diaphragm unit shear)
F. Requirements for ties and continuity, collectors, and drags
G. Principles used to calculate rigidities of structural elements (e.g., stiffness coefficients, force-deflection relationship, cantilever wall, fixed wall)
H. Distribution of seismic forces based on rigidity
I. Principles and conditions controlling the analysis for diaphragms (e.g., flexible, semi-rigid, rigid)
J. Methods to determine centers of rigidity and mass

K. Torsional moment requirements in diaphragms
L. Subdiaphragm principles and analysis

VII. Seismic Detailing and Construction Quality Control 12%

Professional Activities:

1. Identify the detailing requirements that are critical for seismic performance (e.g., load path, wall anchorage, chord and collector)

2. Recognize need for construction quality control of the seismic design aspects of the project (e.g., testing, special inspection and observation requirements)

Test questions on these professional activities may include one or more of the following:

A. Seismic detailing and inherent seismic performance characteristics for steel
B. Seismic detailing and inherent seismic performance characteristics for concrete
C. Seismic detailing and inherent seismic performance characteristics for masonry
D. Seismic detailing and inherent seismic performance characteristics for wood
E. Deformation compatibility requirements for structural and nonstructural elements
F. Detailing for ties and continuity, collectors, and drags
G. Detailing for anchorage of concrete and masonry walls
H. Seismic special inspection and materials testing requirements
I. Seismic structural observation requirements