Civil Engineer Examination
Seismic Principles Test Plan
(Effective for October 2012 Examination)

Definition of Seismic Principles

Seismic Principles is defined as the fundamental principles, tasks and knowledges 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-building structures
- non-structural components, equipment and lifelines

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

I. Seismic Data and Design Criteria (8%)
II. Seismic Characteristics of Engineered Systems (17%)
III. Seismic Forces (35%)
IV. Seismic Analysis Procedures (30%)
V. Seismic Detailing and Construction Quality Control (10%)

Glossary of Seismic Principles Terms

Please note that these abilities are arranged hierarchically from the least complex to the most complex. That is, **recognize** constitutes the least complex ability in the hierarchy and **perform** constitutes the most complex. Each ability presupposes all abilities preceding it in the hierarchy. For example, the ability to **determine** presupposes the abilities to **recognize** and **understand.**

As used in the test plan task statements, the following abilities are defined as:

Recognize	To know or identify seismic principles from past experience or knowledge.
Understand	To recognize and comprehend seismic principles.
Determine	To identify and select after consideration, investigation or calculation seismic forces or systems.
Perform	To execute and complete a task in accordance with seismic principles.

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

I. Seismic Data and Design Criteria (8%)

Tasks required for the development of the project seismic design methodology considering the effects that the seismic environment has on the civil engineering project.

T01. Practice in accordance to laws, codes and standards governing seismic design

K05. Laws regulating civil engineering/limits of practice

K06. Applicable codes for civil engineering construction

T02. Identify design performance goals for a project

K4. Seismic design philosophy of the applicable code

T03. Determine site related coefficients

K1. Geologic seismic hazards and geotechnical data that affect design, including liquefaction

K2. Site related seismic coefficients

K3. Natural period of the structure and the expected period of the seismic ground motion

T04. Determine effects of site characteristics on a structure

K1. Geologic seismic hazards and geotechnical data that affect design, including liquefaction

K2. Site related seismic coefficients

K3. Natural period of the structure and the expected period of the seismic ground motion

T05. Determine seismic design category

K7. Seismic design categories

K8. Building occupancy categories

K9. Seismic importance factors

II. Seismic Characteristics of Engineered Systems (17%)

Tasks required selecting new seismic structural systems, to understand the methods of strengthening existing structural systems and to recognize seismic performance and damage vulnerability of structures.

T06. Select appropriate seismic resisting structural system for a new or existing structure

K10. Different structural systems and their design parameters

K11. Limitations of different structural systems

T07. Identify effects of structural characteristics on seismic design/performance

K12. Requirements for structure having plan irregularities (e.g., torsional response, re-entrant corner, out-of-plane offset)

K13. Requirements for a structure having vertical irregularities (e.g., vertical discontinuities, offsets, soft stories)

K14. Drift and P-Delta to control deflections

K15. Effects of ductility and damping on seismic performance

K16. Effects of redundancy on seismic performance

T08. Evaluate vulnerability of structures with previous poor seismic performance

K17. Anchorage and stability in unreinforced masonry (URM) bearing wall buildings

K18. Buckling or brittle connections in steel-braced frames

K19. Weak connections in precast concrete structures

K20. Punching shear problems in flat slab concrete structures

K21. Diaphragm to wall connection problems in tilt-up and masonry buildings

K22. Welded connection problems in steel moment frames

K23. Post-earthquake safety evaluation

T09. Determine methods for improving seismic performance of existing structures

K24. Methods to improve seismic performance and the effects on the existing structure

K25. Methods and effects of adding stiffness to protect brittle elements

K26. Methods and effects of improving ductility of brittle elements

K27. Methods and effects of strengthening connections in structural elements

III. Seismic Forces (35%)

Tasks required for the determination and distribution of seismic forces.

T10. Determine structural characteristics required to calculate seismic design forces

K28. Mass and stiffness

K29. Methods to determine the structure's fundamental period

K30. Reliability, redundancy and other seismic factors

K32. Choice and application of structural system seismic coefficients

T11. Determine seismic design forces for buildings

K31. Static force procedures and formulas

K33. Choice and application of seismic importance factors

K34. Design base shear

K42. Design lateral force formulas

T12. Perform vertical distribution of seismic forces for buildings

K35. Vertical force distribution

T13. Determine seismic diaphragm forces

K36. Design seismic forces on diaphragms

T14. Determine seismic forces for elements of structures

K37. Design seismic forces on elements of structures

K38. Out-of-plane seismic forces on elements of structures

K39. Use of overstrength factor

T15. Determine seismic forces for non-building structures

K40. Choice and application of non-building structural system seismic coefficients

K43. Design seismic forces on non-building structures

T16. Determine seismic forces for non-structural building components and equipment

K41. Choice and application of non-structural building component seismic coefficients

K44. Design seismic forces on non-structural building components

IV. Seismic Analysis Procedures (30%)

Tasks required for the analysis of engineered structures.

T17. Perform analysis of lateral force resisting systems

K45. Applicable load combinations

K47. Deflection and drift requirements

T18. Perform the distribution of seismic forces to structural elements

K46. Distribution of internal and external forces

K48. Methods used to calculate rigidities of structural elements

K49. Distribution of seismic forces based on rigidity

K50. Diaphragm chord forces, drag forces and diaphragm shear

K53. Methods to distribute shear forces to structural elements

T19. Perform the seismic analysis of diaphragms (e.g., rigid and flexible)

K51. Assumptions controlling the analysis for rigid diaphragms

K52. Methods to determine centers of rigidity and mass

K53. Methods to distribute shear forces to structural elements

K54. Torsional moment requirements in rigid diaphragms

K55. Assumptions controlling the analysis of flexible diaphragms

K56. Sub-diaphragm analysis

V. Seismic Detailing and Construction Quality Control (10%)

Tasks required for the seismic detailing of structural elements and assemblies and for the quality control requirements necessary to assure seismic performance.

T20. Identify the detailing requirements that are critical for seismic performance (e.g., load path, wall anchorage, chord and collector)

K57. Seismic detailing and inherent seismic performance characteristics for steel

K58. Seismic detailing and inherent seismic performance characteristics for concrete

K59. Seismic detailing and inherent seismic performance characteristics for masonry

K60. Seismic detailing and inherent seismic performance characteristics for wood

K61. Deformation compatibility requirements for structural and non-structural elements

K62. Required building separation

K63. Requirements for ties and continuity, collectors or drags

K64. Requirements for anchorage of concrete and masonry walls

T21. Recognize need for construction quality control of the seismic design aspects of the project (e.g., testing, special inspection and observation requirements)

K65. Testing requirements

K66. Special inspection requirements

K67. Structural observation requirements