Engineering Fundamentals Exam

Structural Engineering Standards

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Introduction

Engineering standards are the set of knowledge, abilities, and professional attributes necessary to practice the engineering profession [3-5]. Every Engineering Standard is linked to a number of indicators. These indicators can be viewed as instruments that measure the examinee fulfillment of the corresponding standard. In other words, a Standard is a broad statement about a specific topic, whereas, the Indicators are specific requirements extracted from the Standard and directly linked to the exam question.

Some of these first level standards are drawn from the completion of a Bachelor of Engineering degree from an accredited engineering college. An accredited engineering degree program usually has the breadth of understanding of a wide range of technologies and applications. It also usually has sufficient depth in at least one specific area of practice to develop competence in handling technically complex problems [6].

The knowledge part of the first level standards include, generally, knowledge of science and engineering fundamentals, in-depth technical competence in an engineering discipline, knowledge of theoretical and experimental techniques, knowledge of basic business and project management practices, and broad general knowledge.

The ability part of the first level standards include, generally, the ability to identify, formulate, and solve problems, ability to understand environmental and social issues, ability to deal with ambiguity and complex problems, ability to perform engineering design, and an ability to interpret and visualize data [3-5].

The professional Attributes part of the first level standards are the sets of skills often sought by employers for hiring engineers either fresh graduates or experienced. They are sometimes called “soft” or “general” skills. They include capacity for effective communication [7] with the engineering team and costumers, capacity for effective work within multidisciplinary and multicultural teams, capacity for lifelong learning and professional development, self-drive and motivation, creativity and innovation, leadership, and capacity to maintain a professional image in all circumstances [3-5].

Structural Engineering Standards

The Engineering Standards for the Structural Engineering Discipline are structured around ten core Topics:

1. Mechanics
2. Structural Analysis
3. Design of Reinforced Concrete (RC) Structures
4. Design of Steel Structures
5. Materials

Each Indicator is projected onto three Learning Levels (obtained by combining every two consecutive levels in the revised Bloom's taxonomy into one level)

1. Remembering and Understanding
2. Applying and Analyzing
3. Evaluating and Creating

Standards are coded SE-TJ where:

- SE denotes Structural Engineering
- TJ denotes Topic Number J

Indicators are coded SE-TJ-K (where K denotes the Indicator number).

Example

Topic:	**T1:** Design of Reinforced Concrete (RC) Structures
Standard:	**SE-T1:** Structural Engineers are expected to demonstrate knowledge and skill in Mechanics of components or processes of buildings, bridges and other structural systems.
Indicator:	**SE-T1-01**: Evaluate axial, normal, shear and bending stresses in prismatic bars of rectangular and circular cross sections
Learning Level:	Applying and Analyzing (AA)

Topic T1: Mechanics (10%)

SE-T1: Structural Engineers are expected to demonstrate knowledge and skill in Mechanics of components or processes of buildings, bridges and other structural systems. The following *Indicators* should be addressed in the *Test Questions* on this *Topic Area*:

T1 Indicators

SE-T1-01 Evaluate axial, normal, shear and bending stresses in prismatic bars of rectangular and circular cross sections

SE-T1-02 Compute maximum shear stress and angle of twist in circular sections subjected to torsion (twisting moment)

SE-T1-03 Describe stresses and factor of safety

SE-T1-04 Evaluate stresses and strains under general loading conditions

SE-T1-05 Analyze the stability of columns under different end conditions

T2: Structural Analysis (30%)

SE-T2: Structural Engineers are expected to demonstrate knowledge and skill in analyzing and modeling structural components or processes of buildings, bridges and other structural systems.

T2 Indicators

SE-T2-01 Identify various types of structures, and loads that these structures support

SE-T2-02 Determine various types of loads (dead, live, and wind) according to code provisions

SE-T2-03 Analyze statically determinate structures using equations of equilibrium

SE-T2-04 Evaluate the internal forces in determinate beams, frames, and trusses

SE-T2-05 Draw shear force and bending moment diagrams for beams and frames

SE-T2-06 Draw Influence lines for beams and trusses

SE-T2-07 Evaluate displacements and slopes in beams and frames using numerical and energy methods

SE-T2-08 Use energy methods to calculate displacement and slope for trusses

SE-T2-09 Analyze indeterminate beams and frames using different methods including both classic and numerical methods

SE-T2-10 Evaluate the dynamic characteristic of typical simple structures

SE-T2-11 Use structural analysis software (STAAD, ETABS, SAP)

T3: Design of Reinforced Concrete (RC) Structures (30%)

SE-T3: Structural Engineers are expected to demonstrate knowledge and skill in design of RC components and elements of buildings, bridges and other civil engineering systems.

T3 Indicators

SE-T3-01 Compute design loads within code constraints of safety, serviceability and economy

SE-T3-02 Analyze and design reinforced concrete beams for flexure and shear according to code provisions

SE-T3-03 Design reinforced concrete columns considering biaxial and slenderness effects

SE-T3-04 Analyze and design continuous beams and one way solid and joist slabs satisfying code provisions

SE-T3-05 Design of corbels and deep beams

SE-T3-06 Design two-way slab systems satisfying code requirements

SE-T3-07 Design different types of footings and staircases according to code provisions

SE-T3-08 Recognize the importance of building codes, especially SBC and ACI Codes, in the RC design process

SE-T3-09 Identify the necessity of deflection and crack control in satisfying the serviceability requirements of RC structures

SE-T3-10 Design retaining walls according to the site and structure characteristics

SE-T3-11 Design the various types of shallow foundation

SE-T3-12 Design the various types of hydraulic structures

SE-T3-13 Evaluate the dynamic properties of structures using simple classical methods

SE-T3-14 Recognize the importance of seismic forces in design of buildings and structures according to code provisions

SE-T3-15 Recognize the importance of connections in precast building constructions

T4: Design of Steel Structures (10%)

SE-T4: Structural Engineers are expected to demonstrate knowledge and skill in design of steel components and elements of buildings, bridges and other civil engineering systems.

T4 Indicators

SE-T4-01 Design different steel elements and evaluate their serviceability requirements according to code provisions

SE-T4-02 Evaluate the strength of different steel elements; beams, columns, connections and tension members

SE-T4-03 Recognize the importance of building codes and their role in the design process of steel structures

SE-T4-04 Develop simplified structural models for actual three-dimensional steel buildings

SE-T4-05 Recognize the importance of global and local buckling in design steel members

T5: Materials (20%)

SE-T5: Civil Engineering materials which are used for construction are cement, steel, concrete and its ingredients (aggregates, sand, supplementary cementing materials, etc.).

T5 Indicators

SE-T5-01 Describe engineering properties of constituent materials of concrete (cement, aggregates, etc.)

SE-T5-02 Describe fresh and hardened properties of concrete

SE-T5-03 Describe the mechanical properties of concrete, steel and other structural materials

SE-T5-04 Practice the method of testing and inspection according to standards and specifications and interpretation of test results

SE-T5-05 Analyze testing results of concrete and other construction materials

SE-T5-06 Design concrete mixes to satisfy certain design criteria related to strength, specific performance, and economical constraints

SE-T5-07 Recognize various factors that affect different material strength and durability

SE-T5-08 Apply statistical tools for quality control of concrete

SE-T5-09 Practice mixing, handling, placing and curing of concrete

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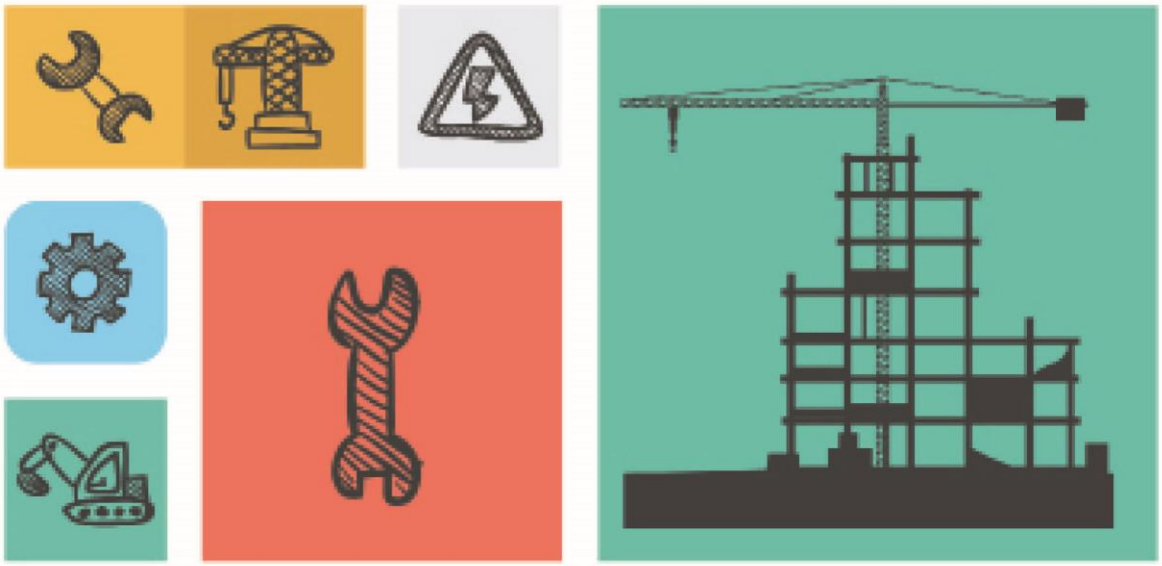

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