

Civil Engineering Conference and Exposition 2002

ASCE Concurrent Sessions IX
Wednesday, 6 November 2002

Separate Licensing for Structural Engineers

Separate Licensing for Structural Engineers Two-Tier Practice Act

By
John S. Shipp, S.E., F.ASCE

For copy of paper email request to:
JShipp@absconsulting.com

Outline

- Introduction
- General
- Current State License Laws
- NCEES Model Laws and Records Program
- Education
- Examination
- Two-Tier Practice Act

Outline (Continued)

- Continuing Education
- Grandfather Clause
- Summary
- Table 1 - Engineering Practice Act Analysis by State
- Table 2 - Evaluation Criteria
- Attachment A: Definitions
- Attachment B: Education Recommendations

Introduction

- The practice of structural engineering affects the public health, safety and welfare and is subject to regulations in the public interest.
- It is the goal of state licensing laws that only qualified persons be authorized to practice structural engineering.

Introduction (Continued)

- The reality in the practice of structural engineering is that there exists two distinct levels of practice and practitioners.
 - An entry level (i.e., SE-1) for regular low rise structures that can be analyzed by static lateral force procedures.
 - A full competency level (i.e., SE-II) for all structures and analysis procedures including response spectrum and time history dynamic analysis.

Introduction (Continued)

- This discussion is intended to present a proposed licensing law for structural engineers that address the requirements, type of examination and restrictions that apply to these two levels of practice.

Introduction (Continued)

- Recall that a practice act defines the specific type of work that a licensed engineer in that discipline can legally perform, such as the structural design of a building, bridge or other structure, along with the corresponding responsibilities and liabilities.

General

- The requirements in any practice act license are that the applicants demonstrate, **through an examination that is representative of the type of work and method for doing the work for which they are to be licensed**, the acceptable level of ability for that license.

General (Continued)

- Also, prior to sitting for the written examination for a structural engineering license, the applicant must first satisfy minimum education and work experience requirements.

General (Continued)

- This should include graduation from an accredited college or university with a major or specialty in structural engineering, completion of a specified list of courses and minimum number of upper division or graduate college units.

General (Continued)

- Requirements should also include specific work experience under the direct supervision of a licensed structural engineer. Thus, the criteria for evaluation for award of a structural engineering license are education, work experience and examination (**E³**).

General (Continued)

- Some states require that the applicant for a structural engineering license practice have a Civil or Professional Engineering practice act license prior to sitting for the SE examination.
- Table 1 summarizes specific practice and title acts licensed in each state.

Table 1 - Engineering Practice Act Analysis by State (1)

APPROXIMATELY 20% HAVE SE LICENSURE

State	Professional Engineer Practice Act	Civil Engineer Practice Act	Structural Engineer Practice Act	Structural Engineer Title Act	Number of Tiers 1 or 2 ⁽²⁾
Alabama	Yes				
Alaska	Yes				
Arizona	Yes	Yes	Yes		1 ⁽³⁾
Arkansas	Yes				
California		Yes		Yes	2

(1) The applicant must have also passed the NCEES Fundamentals of Engineering examination (formerly called Engineering in Training)

Table 1 - Engineering Practice Act Analysis by State ⁽¹⁾ (Continued)

APPROXIMATELY 80% HAVE NO RECOGNITION OF SE LICENSURE

State	Professional Engineer Practice Act	Civil Engineer Practice Act	Structural Engineer Practice Act	Structural Engineer Title Act	Number of Tiers 1 or 2 ⁽²⁾
New Hampshire	Yes				
New Jersey	Yes				
New Mexico		Yes		Yes	2 ⁽³⁾
New York	Yes				
North Carolina	Yes				

(1) The applicant must have also passed the NCEES Fundamentals of Engineering examination (formerly called Engineering in Training)

General (Continued)

- Attachment A - Definitions, provides a definition of structural engineering and of a structural engineer.

General (Continued)

- Attachment A - Definitions (continued)
 - Structural Engineering - consists of the application of the principals of mathematics, statics, dynamics, and material science, mechanics of materials and structural analysis for the purpose of evaluating the behavior of structures and their foundations under the influence of static and dynamic loads and the design of such structures to safely support these loads while providing serviceability.

General (Continued)

- Attachment A - Definitions (continued)
 - Structural Engineer - an engineer involved in structural engineering including the design, evaluation, alteration, and renovation of structures and the implementation of the design, alteration and renovation during the construction process.

General (Continued)

- Attachment A - Definitions (continued)
 - Structures - any building, bridge, industrial or agricultural facility, hydraulic structures, transmission facilities, infrastructure, or together self-supporting assemblage of elements placed on or attached to a foundation system.

General (Continued)

- The requirement to be a civil engineer prior to application to become a structural engineer has two conflicts that are a result of the increasing complexity of each of the disciplines.

General (Continued)

- **FIRST**, it ties the structural engineering license to the civil engineering license, which was a natural evolution for the original licensing, due to a structural engineering starting as a specialty within civil engineering.
- Our current technological “state of practice” for both the design of structures and more traditional civil projects has specialized the work to the point where the common areas are not as common anymore.

General (Continued)

- Each of these is a separate discipline and requires a specific focus and course of study with different design requirements.

General (Continued)

- These include different codes, guidelines, regulations, and standards that govern the work and standards of practice that govern the responsibilities.
- Engineers who practice civil engineering are not subjected to regulations by the structural engineering codes and should not be expected to be current with their requirements.

General (Continued)

- The **SECOND** conflict is that in many states, including California, the practice act, which includes the authority to perform and be responsible for the work, is with the civil or professional engineering license.
- The title or authority to use the title of Structural Engineer is granted by passing the structural engineering examination after obtaining a civil engineering license.

General (Continued)

- For this discussion the structural engineering license is defined as a practice act not related to or depending upon obtaining a separate civil or any other engineering practice act license.

Current State License Laws

- In Idaho, New Mexico, Washington and Utah, to become licensed as an SE, you must first be licensed as a professional or civil engineer; however, there are no distinction on the type of structure a professional, civil or structural engineer can design.

Current State License Laws (Continued)

- In California, structural engineers are licensed first as civil engineers, then go on to obtain their structural license. Schools, hospitals and various buildings as regulated by cities require an SE license to design (i.e., City of LA requires an SE license to design any building over 160 feet and other cities have similar requirements). Most buildings in California are designed by licensed SEs.

Current State License Laws (Continued)

- In Hawaii and Illinois, an SE license is obtained independently from a civil license. All buildings, bridges and any other structure must be designed by a licensed SE.

Current State License Laws (Continued)

- In Oregon, to become licensed as an SE, you must first be licensed as a professional or civil engineer. Only licensed SE can design “significant structures” which include hazardous facilities and special occupancy structures, essential facilities that have a ground area of more than 4,000 square feet and are more than 20 feet high, structures determined to have irregular features and buildings that are customarily occupied by human beings and are more than 4 stories or 45 feet high.

NCEES Model Law and Records Program

- To solve a variety of difficulties, structural engineers need a uniform, national licensing program that recognizes the structural engineering profession. The Structural Engineering Examination/Recognition Task Force (SEERTF) believes that uniform, national licensing and recognition is possible for structural engineers through appropriate additions to the NCEES Model Law and Records Program.

NCEES Model Law and Records Program

(Continued)

- Among these NCEES Member Boards that do recognize and license structural engineers, there is little consistence in licensing requirements (including relevant examinations and experience); therefore, mobility for structural engineers is difficult. After much discussion, SEERTF has concluded that NCEES is the appropriate organization to address the issue of national licensing for structural engineers.

NCEES Model Law and Records Program

(Continued)

- To continue its work, SEERTF recommends that the 2002-2003 SEERTF be charged with the following:
 - Propose an amendment to the Model Law to include the definition of structural engineer and Model Law Structural Engineer (MLSE), with appropriate qualifications in experience, education, and examination.
 - Recommend modification to the NCEES Records Program that would lead to recognition of MLSE status, facilitating mobility among jurisdictions, as is the case with Model Law Engineer (MLE) status.

Education

- The educational requirements for SE-I should, as a minimum, include graduation with a Bachelor Degree from a recognized engineering program with specific upper division structural engineering classes, see Attachment B.

Attachment B - Education Recommendations

Course	Number of Courses	Hours per Course	Total Hours
Analysis	2	3	6
Matrix Methods	1	3	3
Steel Design	2	3	6
Concrete Design	2	3	6
Timber Behavior and Design	1	3	3
Masonry Behavior and Design	1	3	3
Dynamic Behavior (including seismic)	1	3	3
Foundation Mechanics/Soils	1	3	3
Technical Writing	1	3	3

Attachment B - Education Recommendations

(Continued)

- The American Society of Civil Engineers (ASCE) has a dedicated structural division called Structural Engineering Institute (SEI) of ASCE. ASCE formally acknowledged its commitment to specialization and to strengthening basic education requirements.
- The Board of Directors of ASCE approved a policy statement “supporting the concept of the master’s degree as the first professional degree for the practice of civil engineering at the professional level.”

Education (Continued)

- In addition, a minimum number of professional development units (PDU) or continuing education units (CEU) would be required prior to taking a written examination.
- Also, the applicant must have passed the National Council of Examiners for Engineers and Surveyors (NCEES) Fundamentals of Engineering examination.

Examination

- The examination for a structural engineering license should include testing for knowledge required for the design of new structures or retrofit of existing structures and about specific codes and construction materials including steel, concrete, wood, masonry.

Examination (Continued)

- The examination should also represent the method, standards and practice for doing the work; thus, essay type problems are required to allow the applicants to better demonstrate their knowledge, experience and capability in a similar environment to actual practice.
- **Because of the extensive amount of material to be tested, it may be appropriate to divide the examination into several parts and to allow the parts to be passed separately.**

Examination (Continued)

- The examination for **SE-I** should be 16 hours of rigorous essay problems designed to allow the candidate to demonstrate their knowledge of structural engineering and related criteria as required to perform the structural engineering of those structures defined herein for the SE-I category/area of practice.

Examination (Continued)

- The examination should focus on general analysis, and code criteria/requirements for structural timber, reinforced masonry, structural steel, reinforced concrete, foundation design and seismic design using an equivalent static seismic lateral force procedure for regular structures.

Examination (Continued)

- The examination for **SE-II** should be 16 hours of rigorous essay problems designed to allow the candidate to demonstrate their knowledge of structural engineering and related criteria as required to perform the structural engineering of those structures not covered in the examination for SE-I.

Examination (Continued)

- The examination should have special emphasis on design required for extreme loading including tornado and seismic design and special detailing for ductility as related to advanced structural timber, reinforced masonry, structural steel, reinforced concrete including prestressed concrete, foundation design and advanced computational structural analysis including both spectrum and time history dynamic analysis for complex and irregular structures.

Examination (Continued)

- Note that these examinations are entry level for minimum competency and may not address the higher level of competency that would include complex base isolation, passive dampening, pushover analysis, innovative retrofit systems and nonconventional materials.
- **Also note that current NCEES examinations do not satisfy this criteria.**

Two-Tier Practice Act

- The practice of structural engineering at this time requires both an entry level and a full competence license with a specific level of authority to be adopted by States.
- For this purpose of discussion of the Structural Engineering Practice Act license should have two levels or tiers of authority.

Two-Tier Practice Act (Continued)

- The distinction between the levels would be based on differences in levels of education, experience and examination required to perform more advanced/complex structural engineering.

Two-Tier Practice Act (Continued)

- The entry level or tier, SE-I would limit the licensee to essentially low rise buildings (less than 5 stories), regular structures (as defined in the code), standard or category 1 occupancy and eligible for seismic design using an Equivalent Static Lateral Force (ESLF) procedure; structures that are not highly irregular; or structures that are located in an area of relatively low expected magnitude of seismic strong ground motion.

Two-Tier Practice Act (Continued)

- The full authority level or tier, SE-II, would have no limitations for the design of building or structures.
- Similar definitions are required to be developed for bridges to be assigned to SE-I or SE-II.

Two-Tier Practice Act (Continued)

- Note that for structures in higher seismic areas (i.e., Seismic Design Categories D, E and F per the International Building Code-the IBC) both the level of lateral force and the required connection details are significantly increased.
- A school of thought is that the real litmus test of complexity is the transition from static analysis to dynamic analysis. Seismic design add a new dimension to the practice of structural engineering.

Two-Tier Practice Act (Continued)

- Another way of evaluating levels of practice is by critical loading and critical use. Critical loading could be tornado, hurricane, blast, extreme seismic, etc.
- Critical use could be emergency operations centers, police and fire department facilities, hospitals, schools occupancy over 300 persons, etc. The design of these types of structures should require a SE-II.

Two-Tier Practice Act (Continued)

- Recall that the design concepts required for extreme seismic design are also essential for better building performance and are appropriate for the design of structures subjected to other critical loading and to critical use structures that represent a substantial hazard to human life in the event of a failure and/or are designated as essential facilities.

Two-Tier Practice Act (Continued)

- As an aside it is with interest to note that SEAOC is in the process of preparing a new document, as yet unnamed but affectionately dubbed “**Code Lite.**”
- **Note that 80% of the buildings designed today use only 20% of the seismic design provisions of the code.**
- SEAOC will generate a manual that will streamline the seismic provisions of Volume 2 of the 1997 Uniform Building Code.

Two-Tier Practice Act (Continued)

- The document will be used for the design of buildings not more than three stories or 45 feet in height. The portions of the code relating to taller more complex structures will be omitted. It will include an in-depth commentary.
- This is consistent with entry level or SE-I type of work.

Two-Tier Practice Act (Continued)

- The practice of structural engineering at this time requires both an entry level and a full competence license with a specific level of authority to be adopted by States.
- **For the purpose of discussion the Structural Engineering Practice Act license should have two levels or tiers of authority.**

Two-Tier Practice Act (Continued)

- The distinction between the levels would be based on differences in levels of education, experience and examination required to perform more advanced/complex structural engineering.
- Evaluation criteria is summarized in Table 2.
- **Note Continuing Education is required for initial license(s) and for renewal of license(s).**

Table 2 - Evaluation Criteria

License	Education		Minimum Degree	Required Experience	Written Examination
	Formal	Continuing ⁽²⁾			
SE-I ⁽¹⁾	Upper Division SE Classes	Yes 4-Years	BS Required	4 years after graduation working for SE-1	16 Hr
SE-II	Graduate Level SE Classes	Yes 8-Years	MS Preferred	4 years after receiving SE-I working for SE-II	16 Hr

- (1) The applicant must have also passed the NCEES Fundamentals of Engineering examination (formerly called Engineering in Training)
- (2) Required for initial license(s) and for renewal of license(s).

Two-Tier Practice Act (Continued)

- The basic philosophy of a Two-Tier Practice Act allows structural engineers to select the type of structures they want to include in their practice. The basic philosophy of a One-Tier Practice Act requires all structural engineers to qualify for the full competency level prior to authorization/authority to design any structure.
- **The two-tier system is in fact the actual state of the practice.**

Continuing Education

- Mandatory continuing education is another ingredient to be considered. Several states have licensing laws that require continuing education for renewal of an engineering license.
- Many other states are in the process of evaluating and adopting mandatory provisions for continuing education into their state licensing laws.

Continuing Education (Continued)

- It is apparent that the requirement for mandatory continuing education as a provision for renewal of an engineering license is an appropriate safeguard to assure that the practicing engineer maintains knowledge of the latest technology, codes and standards in order to protect the public health, safety and welfare.

Grandfather Clause

- As with any new engineering licensing level, it is not appropriate, or indeed legal, to restrict licensed engineers from continuing to provide the services they are currently authorized to provide.
- There would need to be a definite period of time during which currently licensed engineers could apply for licensing based on their current licenses and experience.

Grandfather Clause (Continued)

- Engineers who were licensed by a specific date would be authorized to continue to provide the engineering services permitted under the old practice act licensing law
- Thus, only the licensing of future engineers would be affected.

Summary

- In summary, the following recommendations are proposed for a new Two-Tier Practice Act for Structural Engineers' License:
 1. Two-Tier Practice Act for Structural Engineers
 - Not related to civil engineer or any other practice act
 - SE-I with limited authority
 - SE-II with full authority

Summary (Continued)

2. Examinations and work experience requirements to reflect the type of work and method for doing the work for which they will be licensed.
3. Mandatory provisions for continuing education and professional development.
4. Grandfather clause is needed to allow engineers licensed as of a specific date to continue providing the engineering services they are currently permitted to provide.

Approximately 20% have SE licensure

State	Professional Engineer Practice Act	Civil Engineer Practice Act	Structural Engineer Practice Act	Structural Engineer Title Act	Number of Tiers 1 or 2 (2)
Alabama	Yes				
Alaska	Yes				
Arizona	Yes	Yes	Yes		1 (3)
Arkansas	Yes				
California		Yes		Yes	2
Colorado	Yes				
Connecticut	Yes				
Delaware	Yes				
Florida	Yes				
Georgia	Yes				
Hawaii	Yes	Yes	Yes		1
Idaho	Yes			Yes	2 (3)
Illinois	Yes	Yes	Yes		1
Indiana	Yes				
Iowa	Yes				
Kansas	Yes				
Kentucky	Yes				
Louisiana	Yes				
Maine	Yes				
Maryland	Yes				
Massachusetts	Yes				
Michigan	Yes				
Minnesota	Yes				
Mississippi	Yes				
Missouri	Yes				
Montana	Yes				
Nebraska	Yes				
Nevada	Yes		Yes		2

Approximately 80% have no recognition of SE licensure

State	Professional Engineer Practice Act	Civil Engineer Practice Act	Structural Engineer Practice Act	Structural Engineer Title Act	Number of Tiers 1 or 2 (2)
New Hampshire	Yes				
New Jersey	Yes				
New Mexico		Yes		Yes	2 (3)
New York	Yes				
North Carolina	Yes				
North Dakota	Yes				
Ohio	Yes				
Oklahoma	Yes				
Oregon	Yes		Yes		2
Pennsylvania	Yes				
Rhode Island	Yes				
South Carolina	Yes	Yes			
South Dakota	Yes				
Tennessee	Yes				
Texas	Yes				
Utah	Yes	Yes		Yes	2 (3)
Vermont	Yes				
Virginia	Yes				
Washington	Yes	Yes		Yes	1
West Virginia	Yes				
Wisconsin	Yes				
Wyoming	Yes				
District of Columbia	Yes				
Guam	Yes		Yes		2
Northern Mariana	Yes				
Virgin Islands	Yes				
Puerto Rico	Yes				

- Notes: 1. Information in this table is based on the NCEES Structural Examination Telephone Survey and other sources - September 2002
 2. For those states with an SE Practice or Title Act
 3. Structural engineering is recognized, however, there are no restrictions on the type of structure a civil or professional engineer can design.