Licensure

Why Additional Credentialing is Necessary for Some Structures

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Structural engineering licensure is a hotly debated topic within the structural engineering profession. One question that is often raised is "What structures (often referred to as *Designated Structures*) should structural engineers be required to design?" This article discusses:

- What is a *Designated Structure*?
- What is NOT a *Designated Structure*?
- Why require a structural engineering (S.E.) license to design *Designated Structures*?

What is a *Designated Structure*?

The Structural Engineering Licensure Coalition (SELC) includes all major organizations specifically representing structural engineers throughout the United States and is dedicated to a common position in support of structural engineering licensure nationwide. SELC is comprised of the Structural Engineering Institute (SEI), the National Council of Structural Engineers Associations (NCSEA), the Structural Engineering Certification Board (SECB), and the Council of Structural Engineers (CASE). The SELC states in its Position Statement:

> *"SELC advocates that jurisdictions require S.E. licensure for anyone who provides structural engineering services for designated structures."*

Structural engineering licensing laws, where they exist, vary from state to state. A few states identify the discipline of the individual engineer in the state's roster of engineers. This practice is usually referred to as a *roster designation*. Some structural engineering licensing laws take the form of a *title act*. A title act only restricts who may use the title of Structural Engineer but places no restrictions on the practice of structural engineering. Other structural engineering laws take the form of a *practice act*. A practice act both restricts who may use the title of Structural Engineer and defines what areas of engineering practice that may only be performed by a licensed structural engineer. Some states have what is termed a *full practice act*, which requires all structures to be designed by a structural engineer (S.E.). A few states have what is termed a *partial practice act*. Designated Structures are defined in a partial practice act, which requires a licensed S.E. to design the Designated Structure. The status of structural engineering licensure in the United States is shown in the *Table*.

The definition of a Designated Structure also varies in the nine partial practice states and territories listed in the *Table*. Some states and territories use the term *Significant Structures* instead of *Designated Structures* in their licensing laws. Depending on the state or territory, *Designated Structures* may include:

- Schools
- Hospitals
- Essential facilities
- Hazardous facilities
- Structures ≥ 45 feet, 4 to 5 stories
- Bridges

While not obvious, the groupings of Designated Structures shown above do follow a pattern. The Designated Structures contained in these partial practice acts generally fall into the following categories:

- Buildings and other structures representing a substantial hazard to human life (ASCE 7/IBC Risk Categories III and IV). These structures typically are designed for greater loads and have design and detailing restrictions placed on them due to their significant number of occupants (for example, tall buildings), occupants who need assistance in an emergency (for example, school, some healthcare facilities, and the like), or that store explosive or toxic materials.
- Buildings and other structures designated as essential facilities (ASCE 7/IBC Risk Category IV). These structures typically are designed for greater loads, have design and detailing restrictions placed on them, and functionality requirements placed on them because these structures must operate after a design event (for example, hospital, police station, fire station, and the like).
- Buildings and other structures requiring special consideration. Structures falling in this category represents local opinion on the importance of a particular type of structure. For example, a building with fewer occupants than those typically found in Risk Category III may be identified as a Designated Structure.

What is *Not* a Designated Structure?

The quick answer to this question is "all other structures not mentioned above." The structures listed above as Designated Structures represent a relatively small percentage of all structures built. Having said this, the movement by the structural engineering profession to enact partial structural engineering practice acts in all remaining states have made some in the civil engineering profession concerned. Specifically, geotechnical engineers raised a concern that *Geo-Structures* would be grouped within Designated Structures by some states. Examples of Geo-Structures are:

- Temporary and permanent earth-retaining systems

Table of current status of structural licensure.

Full Practice States	Partial Practice States	Title Restriction	Roster Designation
Hawaii	Alaska	Idaho	Arizona
Illinois	California (other legislation*)	Louisiana	Connecticut
	Nevada	Nebraska	Massachusetts
	Oregon		New Mexico
	Utah		Rhode Island
	Washington		Texas
	Guam		Vermont
	Northern Mariana Islands		
	Oklahoma		

*California officially only has a *title act*. The 1933 Field Act requires that schools be designed by a licensed structural engineer. The 1972 Alquist Act requires that hospitals be designed by a licensed structural engineer.

  - o Conventional gravity walls
  - o Modular gravity walls
  - o Mechanically Stabilized Earth (MSE) walls
  - o Non-gravity cantilever walls
  - o Soil nail walls
  - o Landslide stabilization systems (using any of those systems described previously)
  - o "Support of Excavation" systems (permanent or temporary)
- Shallow and deep foundations
  - o Drilled shafts
  - o Piles, micropiles, tie-downs
  - o Ground improvement
  - o Rigid inclusions
- Underpinning of structures affected by excavations
- Shafts and tunnels
- Dikes (not used as secondary containment), dams and levees, and soil and rock slopes

To address the concerns of geotechnical engineers, a joint task committee of the Geo-Institute (GI) and SEI was formed in 2015 to develop a recommended consensus position statement on the design of specialty geotechnical structures as it relates to S.E. licensure. This consensus document, known as the Oak Brook Accords, was developed and approved by the Board of Governors of both institutes on February 16, 2016. The joint task committee recommended:

- Because the design of both temporary and permanent Geo-Structures may involve structural engineers, geotechnical engineers, civil engineers, or any combination thereof, **Geo-Structures should not be subject to designated thresholds contemplated for S.E. licensure, even when these Geo-Structures support a Designated Structure**.
- In all cases, an appropriately qualified and licensed professional engineer shall be in responsible charge of the work.

The use of the term "appropriately qualified" was meant to convey that geo-structures must be designed by engineers (structural, geotechnical, or civil) who have the background, training, knowledge, and experience appropriate for the particular geo-structure.

Why Require Licensure to Design Designated Structures?

There is only one answer to this question: ***To protect the health, safety, and welfare of the public***.

While the professional engineer (P.E.) laws in all states are intended to protect the health, safety, and welfare of the public, their reliance on self-evaluation of competency dramatically weakens the existing licensing laws. Self-evaluation of competency often leads engineers to do things that they are truly not qualified to do in response to a weak economy or when traditional markets dry up. A STRUCTURE article from March 2011 by Jon A. Schmidt, P.E, SECB, titled *Incompetent and Unaware of It* discusses the problem of self-evaluation of competency.

So, what do structural engineering practice acts protect the public from? A structural engineering practice act that requires a licensed structural engineer to design Designated Structures protects the public from:

- Inexperienced professionals
- Unqualified professionals
- Professionals not familiar with new and more complex codes
- Decrease in engineering education requirements
- Inadequate or non-existent structural plan reviews
- Advanced design software used by less-qualified/less-experienced engineers
- Professionals not familiar with new and more complex building materials
- Professionals not familiar with designing for extreme events

The following are actual examples of some of the problems described previously.

Example 1 – Unqualified professionals. A retired aeronautical engineer designs a school building (Risk Category III structure) in a region of high snowfall. The engineer has no experience in masonry design. He cuts and pastes masonry details from another engineer's project that used a 14-foot-high wall. Unfortunately, the new project uses 28-foot high walls. Snow load causes the masonry walls to bow and crack and doors to jam, resulting in the closing and later condemnation of the school.

Example 2 – Professionals not familiar with new and more complex codes/ Professionals not familiar with designing for extreme events. The Royal Palm Hotel in Guam (Case Study by R. O. Hamburger at **www.selicensure.org**) was damaged in a seismic event. Structural design was performed by a licensed civil engineer. The civil engineer of record for the project also served as the special inspector of record. At the time of the project, licensing laws on Guam provided for both a

civil license and structural title. At the time of the collapse, the civil engineer of record did not possess the structural title authority. A review of the design showed that the analytical model used to design the structure had numerous errors, including several columns that were rotated 90 degrees from their actual orientation. Additional confinement hoops required around column splices were not specified on the drawings. Masonry infill walls used in the construction of the hotel created short-column conditions throughout the structure. Code-required strong-column weak-beam criteria were not complied with in the design of the hotel. It was also determined that the contractor did not follow the structural details on the drawings. Special inspection reports, signed by the engineer of record, indicated that the improperly constructed joints had been inspected by the engineer and that he approved of the placement of reinforcing steel. Further, correspondence and notes on drawings indicate that because the seismic design forces for the structure were less than the wind forces, compliance with the detailing requirements for special moment frames was not essential. It was clear from the investigation that the civil engineer of record did not have a proper understanding of the seismic design and detailing requirements in the building code.

Example 3 – Advanced design software used by less-qualified / less-experienced engineers. A pedestrian bridge at NRG Stadium in Houston, Texas (*SEAoT Newsletter*, Winter 2010), required significant modifications shortly after construction was completed. The pedestrian bridge was required to be a pass-through (Pony) truss bridge. While installing lights on the trusses, the electrical contractor noticed that the trusses swayed back and forth several inches. An investigation of the problem revealed the rigid connections of the truss' vertical members to the bottom chord, required for a pass-through truss to be stable, were not provided. The original design of the truss used two-dimensional analysis software. The design engineer missed the fact that the two-dimensional analysis software assumed that the truss was braced out-of-plane. The design engineer was also not familiar with the design procedures required for a "Pony" truss. Columns were added to the midspan of the pedestrian bridge, and the upper chords of the trusses were braced to correct the design error.

Conclusion

The above examples demonstrate that structural engineering is not a part-time profession. A licensed S.E., as opposed to a licensed P.E., is required to design Designated Structures to protect the public. The structural engineering licensing process demonstrates that individuals who are allowed to practice structural engineering are knowledgeable in the use of all structural materials and current structural codes, and experienced in structural design. While there are licensed professional engineers experienced in structural design, there are many who are not. A professional engineering license (P.E.), by itself, does not demonstrate the competency of the individual to perform structural engineering. Another step is required to demonstrate that competency. A structural engineering license combined with a structural engineering practice act is an effective method to ensure that only those individuals with knowledge in the use of all structural materials, current structural codes, and experience in structural design are allowed to design Designated Structures.▪

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