White-Paper
on
Licensing of Structural Engineers in Florida

Prepared by
The Structural Licensure Committee of the
Florida Structural Engineers Association, Inc. (FSEA)

VISION: A Safer Florida
Engineers are licensed by the state of Florida to provide for the public safety and welfare. Public safety is paramount in all the duties and tasks performed by structural engineers. It is the vision of the FSEA that its actions shall contribute to the safety and welfare of the residents and visitors of the state of Florida.

MISSION: The Structural Licensure Committee shall determine if structural licensure of structural engineers by the state of Florida would be of benefit to its residents. If so, the Structural Licensure Committee shall advocate for rules and laws to affect such licensure of structural engineers.

EXECUTIVE SUMMARY

The structural capacity and safety of the buildings and structures in which we live and work is so fundamental that it was included in the very first written laws some 3,700 years ago. Since then, laws and building codes have been refined to reflect advances in construction methods, materials and systems. Today's structural systems and their analysis, design and inspection can be exceptionally complex. History has shown that when these complex tasks are performed by unqualified individuals, the safety and welfare of the public is diminished. While total collapses of structures that cause death or injury are rare, nearly every year a significant structural failure occurs and is reported by the news media.

Two states have mandated that all structural engineering be performed by individuals who have been designated by their respective engineering boards as structural engineers. Five additional states and one territory have passed laws or rules that designate certain structures must be designed by a qualified structural engineer. Four states limit the use of the title "structural engineer". A number of other states are in the process of reviewing their laws and the need for structural licensing of structural engineers. The National Council of Examiners in Engineering and Surveying (NCEES) will, as of April 2011, eliminate its entry-level 8-hour examination for structural engineers in favor of a comprehensive 16-hour structural examination.

The state of Florida currently licenses individuals as Professional Engineers upon successful completion of an 8-hour, Principles and Practice examination in the field of engineering of the examinee's choosing. However, once licensed, the engineer may practice in any area of engineering in which he/she has sufficient training and experience - as determined by the licensee. This leads to a 'reactive' environment that subjects the licensee to discipline only after an event has occurred that brings his or her competence into question. For engineers designing structures, the triggering event is often one that has caused injury or death. The alternative is a 'proactive' environment that better prevents unqualified individuals from

practicing structural engineering. This paper discusses the issues regarding structural licensing for structural engineers (SEs) in Florida.

BACKGROUND & HISTORY OF STRUCTURAL ENGINEERING LICENSING IN U.S.

The Code of Hammurabi, written around 1762 BC, includes three laws relating to the strength of structures, including: "*If a builder builds a house for a man and does not make its construction firm, and the house which he has built collapses and causes the death of the owner of the house, that builder shall be put to death*". Over the ensuing 3,700 years, our laws have been refined to reflect our changing attitudes toward the death penalty, and building codes have been revised to reflect the advances in materials, components and methods of design and construction.

Prior to the year 2000, the criterion for the design of buildings and structures in Florida was largely established by local ordinances and laws. Most of those laws and ordinances referred to generally accepted national codes which often contained very few pages dedicated to structural design. The current (2010) Florida Building Code includes over 230 pages related to structural strength, reliability and durability. Each new generation of engineering methods and techniques of analysis brings with it corresponding increases in complexity and sophistication. Prior to the 1960s, structural codes generally specified a safety factor selected by the judgment of the code writers. But with more detailed understanding of how structures react to real conditions, structural codes are now based on probabilistic analysis. While this leads to more efficient use of materials and reduced construction costs, it requires a higher level of understanding, knowledge, training and experience with these complex structural systems.

Structural licensing of structural engineers goes back as far as 1915 in the United States. The state of Illinois was the first to enact a SE licensing act. In November 2000, the three major national structural engineering organizations - the Council of American Structural Engineers (CASE), the National Council of Structural Engineers Associations (NCSEA), and the Structural Engineering Institute (SEI) of the American Society of Civil Engineers (ASCE) - held a national summit on structural licensing of structural engineers. The attendees concluded that the field of structural engineering is changing rapidly, and the structures that SE's design are important and often critical. Therefore, those practicing structural engineering should have appropriate credentials, stay current in the field, and demonstrate sound judgment that comes only with experience. As a result, all three of these organizations have now endorsed structural licensing for structural engineers.

Currently, fifteen states and one territory have some form of SE licensing: Alaska, Arizona, California, Guam, Hawaii, Idaho, Illinois, Louisiana, Massachusetts, Nebraska, Nevada, New Mexico, Oregon, Utah, Vermont and Washington. The requirements vary as to the amount and type of experience required beyond the normal PE license, and the examinations that must be passed to obtain licensure. There are differences in the type of licensure from state to state. They include: full practice restriction, partial practice restriction, partial practice rules, title statutes, and title rules.

The type of structures required to be designed by a SE also varies from state to state. The type of structure ranges from "all" structures to those based upon design criteria factors such as height, area, category of the structure, span (if a bridge) and number of occupants.

EXAMPLES OF SIGNIFICANT STRUCTURAL FAILURES IN FLORIDA

Harbour Cay Condominium, Cocoa Beach, Florida

The Harbour Cay Condominium, a five-story flat-plate reinforced concrete building under construction, collapsed shortly after 3 pm on March 27, 1981, killing 11 workers and injuring another 23. The collapse occurred during placement of the roof slab. *The most probable cause of collapse was a combination of design and construction errors: the design did not consider the possibility of punching shear failure and therefore specified a slab thickness of 8 inches when 11 inches was required; top reinforcing steel in the slab at the column was placed lower than specified further reducing the punching shear resistance. While the slab thickness was less than the building code specified, the slab thickness and reinforcement placement specified in the structural drawings would have provided sufficient punching shear resistance to withstand the construction loads. However, the reinforcement shop drawings called for bar support chairs that placed the reinforcing bars incorrectly.*

Turner Agricultural Center, Arcadia, Florida

Built in 2002 and certified by the Architect of Record that it was designed for 140 MPH winds; the Turner Agricultural Center was used as a hurricane shelter for the Hurricane Charley event of Friday, August 13, 2004. Approximately 1,400 people were housed in the facility as the storm approached. *One of those individuals reported "The mood was cheerful, almost like the gathering before a concert. As the winds started getting stronger, the noise inside got louder. We started noticing a panel of roofing at the far end of the building starting to lift, much like a tarp not tied down tight enough. It started to lift higher and higher, and an announcement came to get to the opposite end of the building. We did so, and shortly thereafter, the far end of the roof started to blow off. Bits of paneling and insulation were swirling around the building. Many people started running out of the building into the storm. Next we heard a wrenching sound and saw that the roof was coming down. We headed down a concrete corridor which dead-ended into a dressing room. We spent the next half-hour or so, standing in a layer of water with 20-30 other people waiting. It was the most terrifying incident of my life."* One FEMA report indicated that clips holding the roof panels to the steel supports failed resulting in portions of the roof blowing off. The project is still in litigation.

Berkman Plaza II Parking Garage, Jacksonville, Florida

Jacksonville-based A.A. Pittman & Sons Concrete Co. had been pouring the top level of a six-story, post-tensioned concrete garage for about four hours when it collapsed at about 6 a.m. on December 6, 2007. *Jacksonville Fire and Rescue Department responders found 60% of the structure collapsed, like a stack of pancakes. According to the state's lead structure specialist on the rescue team, the remaining 40% was standing, but badly damaged. The collapse resulted in the death of one construction worker and injured 23 others. After several investigations by both private and governmental firms, the September issue of Engineering News Record reports "Design deficiencies draw the most fire in the government engineer's report on the December 2007 fatal collapse of a parking garage under construction in Jacksonville, Fla.*" The project is still in litigation.

Sea Base Boy Scout Camp, Islamorada, Florida

On February 2, 1988 this 6,000 square foot dormitory addition collapsed during construction. *The contractor was in the process of placing thin lightweight concrete topping on an elevated concrete plank floor system. The plank system was supported by a new steel beam and column system which located the concrete floor planks over and above, but not connected to, an existing masonry structure.* The entire addition, including architecture, structural, mechanical, electrical and plumbing, was designed by an architect who purported that he was experienced in structural design and had designed more than 300 structures. *Multiple analyses of the structural design revealed numerous substantial defects. In particular, the steel columns were incapable of carrying the self-*

weight of the intended construction, and there was no provision for lateral restraint. The result of this architect's design was a structure doomed to failure. No one was injured by this collapse, but substantial damage and expense was incurred. In hindsight, the timing of this collapse (during construction) was fortuitous when compared to the alternative of construction having been completed, the building occupied and then collapsing causing injury and death.

FLORIDA'S THRESHOLD LAW

Following the collapses, failures, deaths and injuries of the 1970's and 1980's, particularly the Harbour Cay Condominium incident, the Florida legislature recognized that the safety and welfare of the residents of Florida would be improved if certain structures were inspected during construction by certified Special Inspectors. The result was Florida Statute 553.79 which provides that the Board of Architecture and the Board of Engineering certify individuals as Special Inspectors. The "threshold" requiring Special Inspectors is buildings over three stories or 50 feet in height, buildings with an Assembly Occupancy exceeding 5000 square feet or an occupancy of more than 500 persons. Only those individuals with experience in design and construction of buildings of these specific types and sizes of buildings may be licensed as Special Inspectors. The statute's sole provision is to mitigate disparities between the structural design as developed by the Architect or Engineer of Record and the actual construction. It does not address or provide for review of the sufficiency of the Architect's or Engineer's structural design.

NCEES 16-HOUR STRUCTURAL EXAM

The current 16-hour exam for structural engineering went into effect in 2011. This exam consists of two 8-hour components. The Vertical Force component focuses on gravity loads and incidental lateral loads. The Lateral Force component focuses on high wind and earthquake loads. Each component has a breadth module covering a comprehensive range of questions and a depth module focusing on a single area of practice. The breadth module questions are multiple choice. The depth module questions are essay. The depth module choices are buildings or bridges. Depth module choice must be consistent for both components. Each component must be passed to obtain licensure, however, not necessarily in the same two-day period.

The areas to be tested are quite extensive. It is a challenging test that separates those practicing structural engineering occasionally from those practicing it full-time.

REASONS FOR STRUCTURAL LICENSING

1. To protect the health, safety, and welfare of the public. The practice of structural engineering has become an extremely complex profession, and only those fully qualified by appropriate education, experience, examination and licensure should be authorized to design structures.

2. To reduce the number of unqualified engineers who design structures which require complicated analysis. We will never be able to stop the unscrupulous - those who knowingly and willingly practice outside their area of expertise. What we can do is help ensure that those licensed to practice structural engineering have the knowledge and understanding to translate academic theory into practice, and that they do so on a regular basis. We are attempting to guard against those professionals who, though knowledgeable, have not kept up with ever-changing codes,

specifications, and guidelines that govern the practice of structural engineering. Above all else, we are attempting to avoid costly failures and injury.

3. To improve the structural design of more complex structures. As all engineers can attest, the practice of structural engineering has become much more complex. Buildings and bridges are no longer simple structures with regular grids or straightforward spans. More often than not, we are asked to span extreme distances, provide complex load transfers, and appear to defy the laws of physics.

4. To improve structural design in our fast paced, design fee constrained environment. We are faced with the challenges of "less" as well as less time, less budget, and less training. In this day and age of instant connections, fast downloads, and interconnectivity, we are expected to provide results far more rapidly than ever before. In order to meet schedules and save the owner money, project delivery methods have changed from the old standard of design-bid-build to the more time-saving methods of design-build, phased construction, fast-track, and integrated design. Budgets are often tight, and our advanced technology requires that we be ever more diligent in sizing the structural elements and connections. Changes and advances in computer software have allowed structural engineers to go farther than ever before, but we are often faced with the need to "get up to speed" on the latest and greatest systems in a hurry, so that we can include them in our designs.

5. To improve structural performance when subjected to extreme load conditions. Structural engineers are also faced with the added challenge of designing structures with increased expectations of performance. Not only are buildings and bridges supposed to remain standing after being subjected to extreme forces such as hurricanes, earthquakes, and severe storms; often they are required to remain serviceable. Many must protect against disproportionate or progressive collapse and blast effects. Still others must meet extreme limitations on vibration, deflection, and sway in addition to meeting the tight budget, aggressive schedule, and high standards of quality for the project.

6. To improve portability of registrations across various jurisdictions. Revising the licensing laws and regulations for structural engineers in various jurisdictions will bring some added benefits. If requirements for licensing are similar from state to state, it will be easier for engineers to obtain licenses in numerous states so that they can adequately serve their clients. It is not uncommon for engineers to have clients in multiple states, or single clients who have projects across the country. Regulating the practice of structural engineering in all jurisdictions helps reduce confusion for building officials and the public about who is qualified to design structures. It also helps guard against professionals practicing outside their area of expertise, and could aid in reducing discipline cases by state licensing boards.

7. To improve design quality recognized by building officials. This will benefit both the designers and building officials by improving their comfort level knowing they are dealing with structural design professionals.

8. To clarify to the public the importance of structural design which is often taken for granted.

9. To reduce insurance costs to individuals, businesses and government agencies.

MODEL LAW STRUCTURAL ENGINEER/SECB CERTIFICATION VERSUS STRUCTURAL LICENSURE

NCEES added a definition for a Model Law Structural Engineer (MLSE) to its Model Law in 2003 and its Council Records Program in 2005. Separately, the Member Organizations of NCSEA voted in 2003 to establish an independent body, the Structural Engineering Certification Board (SECB), to administer a national board certification program for structural engineers. The MLSE and SECB criteria are intended eventually to serve as the basis for national uniformity in the qualifications required for SE licensure.

SECB is intended to certify PEs and SEs who have comprehensive structural engineering education and experience in structural engineering in the interest of safeguarding the *health*, *safety* and *welfare* of the public. The SECB certificate is not a *license* to practice structural engineering; it is just a name recognition or *roster* designation. The SE *license*, on the other hand, is the privilege given by a jurisdiction to practice the discipline of structural engineering and is granted to individuals who demonstrate minimum competence through *education*, *experience*, and *examination*.

COMPARISON OF LAWS IN OTHER STATES

Sixteen states and one territory currently have specific provisions in place that distinguish structural engineers from professional engineers in other disciplines. However, there is considerable variation among these jurisdictions in the qualifications that are required for SE licensure. There are also important differences in the significance of SE licensure within each jurisdiction. This inhibits the mobility of those who already have the SE license in one state and seek to obtain it in another.

Only Illinois and Hawaii do not require candidates to be PEs in order to be SEs, since they have full practice SE acts. The idea of "separating" SEs from PEs comes from the fact that civil engineering is a broad field that covers many disciplines, including structural, but the depth and complexity required for practicing structural engineering is not addressed in the civil PE exam. This is why a separate exam has been developed to cover with reasonable breath and depth of issues required for an individual to prove their competency as a licensed structural engineer.

PRACTICE RESTRICTIONS AND TITLE RESTRICTIONS

A practice restriction defines the specific type of work that a licensed engineer in a particular discipline can legally perform, along with the corresponding responsibilities and liabilities. The practice restriction can stand alone, which means other professional licensure is not required.

A title restriction defines a general term that a licensed engineer is permitted to use for identifying his or her discipline.

STATES WITH STRUCTURAL TITLE RESTRICTIONS

Alaska	Arizona	Idaho	Louisiana
Massachusetts	Nebraska	Nevada	New Mexico
Vermont			

STATES WITH STRUCTURAL PRACTICE RESTRICTIONS

California*	Illinois	Washington*
Guam*	Nevada*	Utah*
Hawaii	Oregon*	*with some exemptions

TRANSITIONING

Utah has recently passed a structural engineering partial practice restriction which includes a transition clause. This clause was significant in the efforts to secure passage of the legislation. The legislation states that an engineer must meet the requirements for structural engineering licensure by examination "*except that prior to January 1, 2016, an applicant for licensure may submit a signed affidavit in a form prescribed by the division stating that the applicant is currently engaged in the practice of structural engineering."* The legislation demonstrated the desire to "protect the public" by assuring that only those qualified individuals become structural engineers. The legislation also desired to transition those engineers currently practicing in the field of structural engineering by having a liberal enough transition procedure to minimize the impact on those same engineers. Transition clauses were also included in the partial practice restrictions recently passed by the states of Oregon and Washington.

CONCLUSIONS

It is the conclusion of this committee that structural licensure of structural engineers in the state of Florida is beneficial to the public as a whole and to the profession. It is further concluded that Florida is a state with challenging wind loading which requires a higher level of expertise that would be best assured by the enactment of a structural engineering licensure act. The Committee also concludes it is our obligation as structural engineers to "raise the bar" by requiring structural licensure to better protect the public and improve the quality of all structural engineering work.

RECOMMENDATIONS

It is the recommendation of this committee that legislation be prepared and submitted to the state legislative body to implement the enactment of appropriate amendments to the current Florida engineer license law to establish structural licensing for structural engineers. It is further recommended that associative professional associations be enlisted to aide in the success of this endeavor and to gain their insight in relation to and their support of this issue. It is further recommended that such actions be taken as soon as practically possible to better protect the life, safety and welfare of the public in the state of Florida.