



# The Professional Engineering



*From humble beginnings in a Western outpost, licensed professional engineers have spent the past 100 years building a reputation for competence, integrity, and service in the public interest.*

**BY DOUG MCGUIRT**

# CENTURY

**E**ngineering licensure had its beginnings in Wyoming when the Wild West was slowly growing tamer. Clarence Johnston, upon accepting the position of state engineer in 1903, was immediately confronted by the unruly nature of engineering and land surveying in this vast, largely undeveloped state where hungry prospectors and developers—including none other than “Buffalo” Bill Cody—were rushing to gain access to state water for irrigation purposes.

To gain access to state water in Clarence Johnston’s Wyoming, the law required the filing of an application, complete with a map outlining the streams, canals, and reservoirs to be used for irrigation. From his bureaucratic position, Johnston soon realized that many untrained and unqualified individuals—lawyers, notaries, and assorted others—were performing the work of engineers and surveyors. This led to inaccurate records and was undoubtedly the source of a great deal of frustration for Johnston and his staff, who were charged with supervising the state’s water distribution. Something, they decided, must be

done in the form of legislation to regulate just who would be able to represent themselves to the public as an “engineer” or “land surveyor.” It was in this manner that Johnston found himself in the unlikely position of founding a licensed profession.

The existence of laws dealing with the practice of engineering goes back to ancient times. In fact, the famous code of the Babylonian ruler Hammurabi (c. 1800 BC) applied the “eye for an eye” policy toward engineering:

“If a builder erect a house for a man and do not make its construction firm, and the house which he built collapse and cause the death of the owner of the house, that builder shall be put to death. If it cause the death of the son of the owner of the house, they shall put to death the son of the builder.”

Of course, Hammurabi’s code, harsh as it was, did not punish unlicensed practitioners—provided their work did not kill anyone. The concept of legislation restricting a profession to licensed professionals can be traced back through historical records to a decree made by King



Roger of Normandy in AD 1140 requiring doctors to present proof of competency before being allowed to practice on the public. Much like today, professional competency was determined by passage of an examination and certification by a group of peers.

In the U.S., the individual states bear the responsibility for regulating the professions, as outlined in the Tenth Amendment of the Constitution and reinforced by the Supreme Court in *Watson v. Maryland* (1910):

“It is too well settled to require discussion at this day that the police power of the States extend to the regulation of certain trades and callings, particularly those which closely concern the public health.”

*Watson v. Maryland* addressed the licensing of physicians, who—along with lawyers and dentists—preceded engineers in organizing themselves as licensed professionals, despite the fact that engineers typically faced more stringent education requirements than most professions.

Prior to licensure, engineers had captivated the imagination of the American public with a number of staggering achievements. In 1869, the final spike was driven in the Transcontinental Railroad, uniting California with the east and putting the

exclamation point on the nation’s westward expansion. On a September evening in 1882, Thomas Edison lit up several blocks of lower Manhattan with the first version of an electric grid. The following year, the Brooklyn Bridge opened to the public. The first decade of the 20th century saw the flight of the Wright brothers and Ford’s Model T. American engineers were changing the world, but questions remained: For one thing, what separates a professional engineer from the untrained and unqualified?

In 1907, the Wyoming Legislature was presented with a bill written by Clarence Johnston and several colleagues. The bill required registration for those who would represent themselves to the public as an engineer or land surveyor and created a state board of examiners for the profession.

Not surprisingly, the proposed legislation met resistance from those who had, up until then, benefited from the lack of standards. Nevertheless, the state legislature approved the bill, and it was signed into law later that year. According to state records, the first person to be licensed in the state was Charles Bellamy, a 52-year-old engineer and mineral surveyor. Some time after the law’s implementation, John-

ston wryly described in a letter to a friend the effects of the law: “A most astonishing change took place within a few months in the character of maps and plans filed with the applications for permits.”

The following year, Louisiana passed an engineering registration law, followed by Florida and Illinois in 1915. Soon after that, Iowa, Colorado, Michigan, Idaho, Nevada, and Oregon passed legislation requiring registration and establishing state boards of examiners for engineering. As more states began to require licensure for professional engineers, a problem quickly emerged: none of the state boards accepted out-of-state licenses. The language of the new laws and the requirements for professional licensure differed greatly from one state to another.

In an attempt to address these issues, the Iowa State Board of Engineering Examiners in 1920 called for the 10 existing state boards to create “an organized and systemized method of procedure to be followed in interstate registration.” The Iowa board also asked the boards to send representatives to discuss the formation of a council representing the state boards. Seven of the 10 state boards responded, and their representatives met in Chicago during

IN 1937, AN EXPLOSION AT A SCHOOL IN NEW LONDON, TEXAS, WAS ATTRIBUTED TO A GAS LEAK CAUSED BY FAULTY ENGINEERING. APPROXIMATELY 300 PEOPLE DIED.



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November of that year to form what would later become the National Council of Examiners for Engineering and Surveying. The purpose of the Council, as expressed in its newly written constitution, was to examine the state laws concerning registration of engineers and provide recommendations for uniformity of practice and reciprocal interstate relations within the profession.

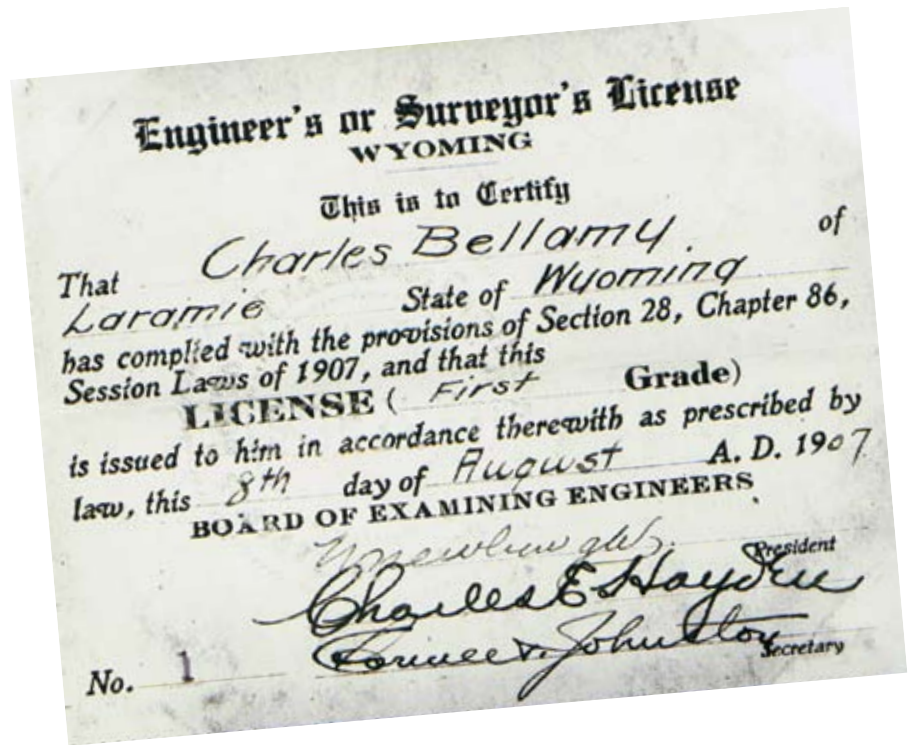
The Council worked throughout the 1920s to coordinate reciprocal relations among the state licensing boards. By 1925, reciprocal cards issued by licensing boards were in use, and licensed engineers possessing a reciprocal card were to be accepted by all member states.

For the profession to continue progressing toward its goals of achieving interstate reciprocity and legal recognition, it was necessary that the remaining states pass licensure laws. David Steinman, P.E.—NSPE founder, NCEES past president, and renowned builder of suspension bridges—summarized the situation in a 1932 speech: “Engineers are pioneers, pathfinders, trailblazers in almost everything they do—with one exception. They have left it to the other professions to be the pioneers and trailblazers in securing professional recognition in the field of organizational and legislative activities for the advancement of the status of a profession.”

Steinman, one of the profession’s strongest advocates in those early years, actively promoted licensure laws as the means by which engineers could best enhance their public stature: “Engineers’ registration laws are, of course, necessary for the safety of the public ... but they are also necessary for the protection of the good name of the profession.”

In 1932, the Council took another step in its mission when it created and ratified its Model Law. In addition to establishing uniform licensing guidelines for the state boards, the Model Law established record-keeping procedures designed to assist engineers needing to work in different states. By this time, 29 states—including Puerto Rico—had passed legislation establishing state boards regulating the engineering profession.

Two years later, Steinman called together representatives of professional engineering organizations in Connecticut, New Jersey, New York, and Pennsylvania. Meeting at



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the Columbia University Club in New York City, the group decided to form a national organization for licensed professional engineers that would be dedicated to the profession’s nontechnical concerns. “The technical problems of civil, mechanical, electrical, mining, and chemical engineers are divergent; but the professional problems are alike,” Steinman wrote in 1935.

The National Society of Professional Engineers would focus on legislative issues, public understanding and recognition for the profession, adequate compensation, ethical practice, and protecting PEs from attempts to restrict their right to practice engineering, among others. In its early years, NSPE adopted the Canons of Ethics for Engineers and Rules of Professional Conduct, founded National Engineers Week, adopted the Engineer’s Creed, published the first salary survey for profes-

sional engineers, and formed the Board of Ethical Review.

For individual members, Steinman wrote, participation in the new Society was the professional engineer’s opportunity “toward making engineering a better and more satisfying profession than he found it.”

While representing different aspects of the profession, both NSPE and NCEES had at their core a dedication to protecting the public. In some cases, states enacted licensure laws only after disasters that were attributed to engineering oversights. California’s state board of examiners was created the year after the 1928 failure of the St. Francis Dam, an event that killed more than 500 people along the Santa Clara River just north of Los Angeles. In 1937, Texas created its state board months after hundreds died in an accident where a school in New London exploded due to a natural gas leak attributed





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## WHAT MAKES A PROFESSIONAL ENGINEER?

According to the U.S. Bureau of Labor Statistics, no fewer than 98 professions fall under the heading “Professional and Related Occupations.” This list includes lawyers, physicians, architects, and engineers. It also includes astronomers, public relations specialists, choreographers, and floral designers.

Despite their many differences, one thing a surgeon has in common with a floral designer is that each is in possession of a large amount of specialized knowledge. The 11th edition of Merriam-Webster’s Collegiate Dictionary agrees with this notion, describing a profession as “a calling requiring specialized knowledge and often long and intensive academic preparation.”

To a person who has completed an engineering degree, this definition makes sense. But, what about a licensed PE? What separates him or her from other practicing engineers? In short, the PE has completed a number of steps that indicate a high level of commitment to professional knowledge and competency, steps that include passing an 8-hour fundamentals exam, completing four years of progressive experience in a particular engineering field, and, finally, passing another 8-hour exam testing the knowledge gained during the candidate’s period of apprenticeship.

Licensure in the U.S. differs from other forms of professional certification in that it is mandated by every state government as a prerequisite for certain activities. Legally, one must be licensed to do any number of things—drive a car, perform surgery, or represent a client in court, for example. For engineers, licensure is required in order to submit plans to a public authority for approval, to work as a consultant, or to be in responsible charge of engineering work. It is a means of ensuring standards of professional competency through a rigorous combination of education, experience, and examination. After meeting these requirements, the PE is entitled to enjoy the prestige and professional advantages that come with the title.

to faulty engineering. These were just two incidents that underscored the vital role the engineering profession plays in protecting the welfare of the public, while at the same time making clear the need for standards regulating the practice.

In 1947, Montana became the last state to enact an engineering licensure law, and by 1950 the entire country, including the District of Columbia, had some form of engineering licensure law in effect. Also in 1950, NSPE adopted a policy encouraging all professional engineers to use the initials “P.E.” after their names.

Despite this legislative achievement, the requirements of one board of examiners rarely matched those of another. Licensure examinations differed greatly from one state to another. Some boards required only an oral examination; others required only written exams. Many exams were written so that items could be answered successfully by those trained in logic but not necessarily in engineering; others required simply the memorization of complicated equations. In all, the exams were found, for the most part, to be deficient in establishing consistent standards for competence.

The state boards decided that the questions should be developed according to a rational method, which would require the test takers to demonstrate the ability to think like engineers. A two-part exam was proposed, the first part of which would last two-and-a-half days and cover such fundamentals as math, applied science, electrical and machine design, and engineering economics, laws, and practice. The second part, to last half a day, required examinees to pass a test covering one of five specialty engineering areas: chemical, civil, electrical, mechanical/industrial, and mining/metallurgical.

Despite some objections that the exam was too rigorous, the state boards eventually approved this examination structure with only a few modifications. Many states were instituting a new category of registration for recent engineering graduates without experience—the Engineer in Training. In recognition of this, the first part of the exam was administered to college seniors and to those interested in initiating the process of obtaining professional licensure; this was the forebear of the Fundamentals of Engineering exam.

Still, it took time for nationwide uniform exams to become reality. In 1955, eight northeast states administered the same EIT exam to 277 engineering seniors; six years later, they administered a uniform professional exam. In 1963, NCEES, after conducting research into the matter of uniform exams, estimated that 3,000 applicants would likely sign up for an EIT exam and that it would cost from \$3 to \$5 to grade each exam.

In May 1965, 30 states administered the first FE exam, which contained 30 questions covering 10 subjects. The next year, a national uniform Principles and Practice of Engineering exam, also known as the PE exam, was made available for the first time. By 1984, all boards of examiners were administering both the FE and PE exams. About the same time, the Council's Records Program—which had been in existence in one form or another since 1932—was reorganized to provide a centralized recordkeeping service located at Council headquarters. Once professional engineers established Council records, their education, experience, and licensure history

were saved in one report that could be transmitted to licensing boards for expedited comity applications. The uniform examinations and the Records Program were making comity across jurisdictions more feasible.

The past few decades have seen the FE and PE exams evolve a great deal. Originally, the FE and PE exams consisted of essay questions. Now, they are made up of multiple-choice questions developed by committees, graded by computers, and psychometrically tested for fairness and relevance. Exam items are written by licensed engineers from academia, consulting, and industry that devote their time and expertise on a volunteer basis. Extensive surveys of professionals across a range of industries are used to determine exam specifications.

The exams have evolved to include many disciplines that did not exist at the time of the first PE exam administration, disciplines that combine new technical knowledge with time-proven engineering methods to create new branches and subspecialties

within the profession. Engineering licensure is now offered in 16 disciplines, with exams in emerging specialties constantly in the works.

Over the last century, the ranks of licensed professional engineers have grown from 1 to nearly 450,000, representing about a third of the nearly 1.5 million engineers working in the U.S., according to the Bureau of Labor Statistics. These professional engineers have brought us the conveniences of modern life, and there is little in the built environment that is not backed by the signature and seal of a PE.

In the next 100 years, professional engineers will continue solving society's technical problems and leading the way on projects as inspiring as the Apollo program and as crucial as clean water supply and distribution. While it is uncertain what those advances will be, professional engineers will, undoubtedly, carry them out with the same high standards and commitment to the public welfare that Clarence Johnston and Wyoming lawmakers set out to establish in 1907. **PE**