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A Study of EAC-ABET Civil Engineering Accreditation Curriculum Requirements and Exemption Provisions of State Licensure Laws and Rules

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Abstract

Engineering licensure is important to the civil engineering profession, and graduates of EAC-ABET accredited programs are expected to identify and explain professional responsibility issues including professional licensure. Accredited civil engineering programs typically introduce students to professional licensure their senior year, a time when students become eligible to take the NCEES Fundamentals of Engineering (FE) Exam. However, many civil engineers never become licensed. One reason may be licensure exemptions. There is no accreditation obligation or legal duty for civil engineering programs to address licensure exemptions in their curriculum.

A study was conducted on the breadth and depth of licensure exemptions. Licensure laws and rules were examined in fifty states, the District of Columbia, and four United States (U.S.) territories. All jurisdictions have exemptions that allow engineers without a license to legally perform specific types of engineering work. Licensure exemptions are vast; forty-nine distinct licensure exemptions were found. Six exemptions are common in more than 50% of the states. The most common exemptions apply to persons who teach engineering courses; work for a licensed engineer; work for a manufacturing company; are employed by state and federal government; work for a public utility; and design and build private dwellings.

The perception that all private and public infrastructure and engineered products are designed by a licensed engineer is not true due to the number of exemptions in the laws and rules in all jurisdictions. Civil engineering programs should include content on engineering licensure laws in their curriculum to enable graduates to understand professional responsibilities and how limitations in licensure laws can affect public safety and an engineer's career path.

Introduction

Forty-nine of fifty state professional engineering licensure laws (referred to as licensure laws in this paper) include language that the purpose of professional engineering (PE) licensure is to protect and enhance the health, safety and welfare of the public [1]. Licensure is especially important to the civil engineering profession [2]. This was true during the development of licensure laws in the early 20th century and is true today. In 2021, sixty-four percent of all engineers who completed the National Council of Examiners for Engineering and Surveying (NCEES) Principles and Practice Exam (PE) took one of the five civil engineering exams rather than an exam in the eighteen other engineering disciplines [3]. Still, not all civil engineers aspire to obtain a PE license.

Knowledge of engineering licensure laws and rules is important to civil engineering programs, faculty, and students. The 2022-2023 Engineering Accreditation Commission of ABET (EAC-ABET) civil engineering program criteria (CEPC) requires programs to have curriculums that prepare graduates to "explain the importance of professional licensure" [4]. EAC-ABET Criterion 5 requires programs to have curriculums to "ensure that students are prepared to enter the practice of engineering," a term defined in all fifty state licensure laws [5]. The third edition of ASCE's Body of Knowledge includes a professional responsibility outcome [6]. Civil engineering graduates are expected to identify and explain professional responsibility issues including professional licensure. Many accredited civil engineering programs introduce professional licensure topics in their senior capstone and senior seminar course, a time when students take the FE exam and are on the pathway to becoming licensed. However, there is no accreditation or ethical obligation for civil engineering programs to provide students with comprehensive licensure instruction. One topic that impacts the number of engineers who eventually become licensed are licensure exemptions.

The United States Supreme Court has made it clear that regulatory licensing is one of state government's strongest powers to use to protect society [7]. State laws are approved by state legislatures and signed into law by the governor. Laws authorize the creation of administrative rules that are written to ensure the practical application of the laws. Rules applicable to professional engineer licensing are typically developed by state licensure boards populated with volunteers appointed by the governor and approved by the legislature.

The majority of graduate engineers are not licensed as professional engineers, and this is not just a recent trend [8]. In 1978, nearly forty years after all states had passed licensure laws, only 30% of the approximate 1 million practicing engineers were licensed professional engineers [9]. It has been reported that every state has one or more exemptions in five categories: (1) engineers working under the supervision of a licensed engineer who takes responsibility for the unlicensed engineer's work; (2) engineers employed by public utilities; (3) engineers employed by the federal government; (4) engineers employed by a state government; and (5) "in-house" engineers employed by a manufacturing or other business firm (known as the "industrial exemption") [8].

Exemptions in state licensure laws have impacted engineering's development as a recognized profession [8]. Since the 19th century, engineering has been closely linked to industrial

companies. Some have argued this harms public health, safety, and welfare. The breadth and depth of these exemptions varies by state and affects everyone living in the United States. Engineering graduates should understand the magnitude of the exemption issue, how it divides the engineering profession, and the affect it has on the public they ultimately serve.

Background

The first professional engineering licensure law was passed by the Wyoming legislature in 1907. The impetus for the law was lobbying efforts by state engineer Clarence Johnston to ensure that only civil engineers and land surveyors would prepare survey maps that were required with irrigation permit applications. Prior to passage of the licensure law, anyone could prepare survey maps, most of which Johnston found to be inaccurate, poor quality, and of little use to his office or the landowner [8]. Louisiana passed a much more comprehensive state licensure law in 1908 that restricted the practice of civil engineering to licensed individuals. The American Society of Civil Engineers (ASCE) initially opposed licensure efforts, preferring the position that civil engineers are best self-regulated [8]. Between 1909 and 1911, ASCE helped defeat licensure laws in Idaho, Pennsylvania, Ohio, and New York. In 1915, Illinois became the third state to enact an engineering licensure law, but it applied only to structural engineers. In 1917, Florida became the first state to enact a licensing law that encompassed all engineering specialties. By 1933, twenty seven states had licensure laws. A series of engineering failures (the St Francis Dam failure in 1928 and the Texas gas distribution line explosion in 1937) motivated other states to pass licensure laws. By 1940, forty three of forty eight states and two territories (Hawaii and Alaska) had licensure laws. By 1950, licensure laws became ubiquitous among states, the District of Columbia, and the territories of Alaska and Hawaii [10].

As the number of licensure laws increased, some engineers and their industries voiced opposition. In 1940, industrial companies initiated efforts to seek licensure exemption for their employees. Rather than opposing state licensure laws, industry focused on exemptions. Their efforts proved very effective. Since that time, the number and type of exemptions have expanded. “Over time, the exemptions have been refined and, in many cases, expanded. Sometimes exemptions are specifically defined in statutes and regulations. In other cases, their scope is a matter of regulatory interpretation, custom, and practice within a jurisdiction” [11].

NCEES was formed in 1920, the same year New York and Virginia became the 12th and 13th states to pass an engineering licensure law. One of the organization’s goals has been to strengthen licensure among states. As such, since 1937, NCEES has supported the elimination of the industrial exemption from licensure laws [9].

NCEES publishes a Model Law and Model Rules for licensing entities to use at their discretion although none currently use it verbatim. The NCEES Model Law contains provisions for only three exemptions: 1) practice of any other legally recognized profession, 2) a temporary licensure for an applicant by comity, and 3) employees and subordinates of a licensed engineer [12]. In 2016, NSPE identified only two states that did not include any exemptions in their licensure laws

other than what are listed in the NCEES Model law. The two states were Arkansas and Oklahoma [13].

The National Society of Professional Engineers (NSPE) was created in 1934 with the goal of uniting the engineering profession and supporting licensure. NSPE currently recommends eliminating all licensure exemptions in Policy Statement 09-173 [14]. "It is the position of the National Society of Professional Engineers (NSPE) that all engineers who are in responsible charge of the practice of engineering, as defined in the NCEES Model Law and Rules, that potentially impacts the public health, safety, and welfare should be required by all jurisdictions to be licensed professional engineers. NSPE recommends eliminating Engineering Licensure exemptions in state licensing laws" [12].

Licensure laws affect all branches of engineering. Support for engineering licensure varies among professional organizations. In 2014, the American Institute of Chemical Engineers (AiChE) expressed its strong support for the industrial exemption, citing the following reasons for its position, "…so many companies operate in several states, while there is a lack of uniformity in licensing laws and regulations among the states" [15]. The American Society of Mechanical Engineers (ASME) Policy Statement 15.2 endorses engineering licensure for its members, but recommends "that any person in responsible charge of the practice of engineering be a legally licensed engineer, except where state statutes allow for exemption" [16]. The American Society of Civil Engineers (ASCE) "advocates licensure as a professional engineer as necessary to protect the health, safety and welfare of the public" [2]. Yet, ASCE also acknowledges and even supports select exemptions in state licensure laws. In Policy 385, ASCE acknowledges that "in some jurisdictions the individuals responsible for review, approval, and design of such documents are not required to be licensed professional engineers and in many cases are exempted by state and federal law" [17]. In Policy 559, ASCE supports alternate credentials, other than licensure, for faculty teaching design courses [18]. This is in contrast to the definition of the "practice of engineering" in the NCEES Model Law [12]. The practice of engineering is very broad and the definition is not uniform among states and professional societies and groups.

In addition to exemptions for industrial groups and manufacturing, there have been federal court decisions that have upheld exemptions for federal employees. The US Constitution's supremacy clause is regarded as preempting state laws. Thus, licensure laws generally do not apply to federal employees working within a state or territory unless the federal government consents to these requirements. However, some organizations including the Army Corp of Engineers and the Naval Facilities Engineering Command, require employees to obtain an engineer's license for higher-level positions in their respective agencies [9].

One of the arguments for the industrial exemption is that large manufacturing companies (or governments) that employ engineers assume product liability. Yet, business controlled industrial exemptions have been a significant factor in major disasters such as the 1986 Challenger disaster, the 2010 BP oil spill in the Gulf of Mexico, and the 2018 Massachusetts gas pipeline explosion in Lawrence, Massachusetts that killed one person and injured 21 others [10].

As a result of the 2018 disaster, Massachusetts eliminated the licensure exemption for engineers performing work for or on behalf of a gas company. One of the recommendations of the National Transportation Safety Board (NTSB) was for all states to "end the PE license exemption for public utility work and require a PE's seal on public utility engineering drawings" [19]. There is much debate about whether exempting engineers from licensure is the correct approach to protect the health, safety, and welfare of the public in these situations.

With the exception of civil engineers, the overall attitude of other engineering disciplines toward licensure is best described as apathy; many engineers either prefer to work for an industrial company under a licensure exemption or work in another sector exempt from state licensure. The purpose of this paper is not to duplicate previous reports that have documented the history behind engineering licensure exemptions or present arguments against licensure exemptions. Rather, the paper is focused on the breadth and depth of exemptions listed in the fifty-five state, territorial, and District of Columbia (DC) licensure laws and the effect this has on engineering education [13], [20].

Research Questions

Knowledge of licensure laws and rules is important to all civil engineers, particularly recent graduates. They need to understand the purpose of licensure laws, the career paths that require a license, and the depth and scope of engineering licensure exemptions. A study was designed to answer the following research questions:

- How many jurisdictions within the United States have licensure exemptions for engineers who perform tasks commonly considered engineering practice?
- Are there patterns in the number and type of exemptions found in licensure laws?
- Do civil engineering graduates practice in areas that are commonly exempt?
- What should undergraduate engineering students know about licensure exemptions?

Research Methods

The study used licensure exemption data from fifty states, four territories, and the District of Columbia. Data was collected from licensure laws and rules in effect in the fifty-five licensure jurisdictions in January 2023. Data was also collected for exemptions in the NCEES Model Law and Rules for comparison purposes. All of these documents are publicly available online. Each is periodically updated on either a regular cycle or on an "as needed" basis.

The exemption data was tabulated and analyzed. In some cases there were common categories from multiple jurisdictions, but many were unique to each individual jurisdiction. In cases where the wording was slightly different, but the intent was the same, the exemption was considered consistent among the jurisdictions. Additional information was collected on whether knowledge of the rules is required in each jurisdiction, another implication for engineering educators.

Results

The results were organized into four groups: States, Territories, District of Columbia, and NCEES. Descriptive statistics were computed for each group and specific exemptions were reviewed that were common or unique to a jurisdiction.

State Results

Every state has exemptions in their engineering licensure law. The number of exemptions ranges from 3 to 26 as shown in Figure 1.

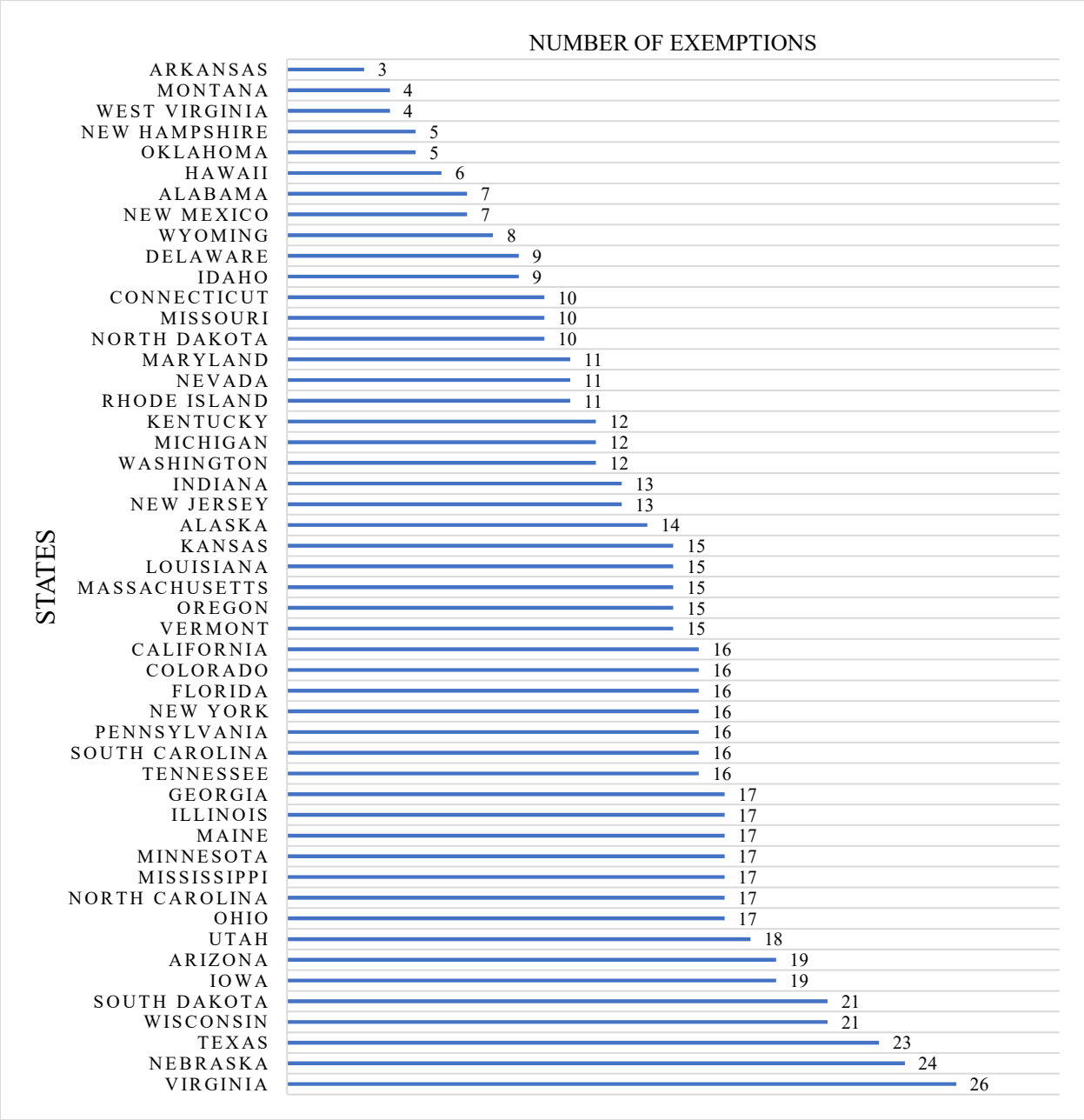

Figure 1 – The number of engineering licensure exemptions found in each state.

The most common number of exemptions are 16 and 17, and the average is 13.7. The number of exemptions per state varies significantly as evidenced by a standard deviation of 5.34 (Table 1).

Table 1 – The descriptive statistics of the number of licensure exemptions per state.

Average	13.7
Minimum	3
Maximum	26
Range	23
Standard Deviation	5.34

There were eleven common exemptions found in at least half of the states. They are listed by order of occurrence in Table 2. Two of the top three apply to engineering instructors at universities. One of the more obvious exemptions pertains to a person who works directly for a professional engineer (a requirement to get licensed in most states) which is an exemption contained in the NCEES Model Law [12]. Various forms of manufacturing exemptions are listed in state statutes. Despite the fact that federal courts have held that federal employees are exempt from state licensure laws, over thirty states list this exemption in their statutes. Employees of utility and communications companies are exempt from licensure in a majority of states. The last exemption category that is common in most states is persons who practice engineering on their legally owned property or on private dwellings.

Table 2 – Licensure exemptions in at least half of the states.

Number of States	Exempt from Licensure – Description
50	Engineering instructors – Teaching principle topics
46	A person who works directly for a professional engineer
39	Engineering instructors – Teaching advanced or design topics
38	A manufacturing engineer
38	A person in the defense, space, or aerospace sectors
36	Airplane manufacturer under FAA authority
34	A person employed by the federal government
32	A person who works for a private utility
31	A person working in interstate communications or for a telephone company
28	A person practicing engineering on their legally owned property
27	A person who designs and/or builds private dwellings

There were 38 exemptions included in less than half of the states (Table 3). The two most common categories are for those with a temporary license and those who operate and maintain heavy equipment. Temporary licenses are listed as an exemption in many states, but these licenses are valid for a short length of time and can only be obtained by an engineer who is licensed in another jurisdiction. A number of exemption categories are similar to the industrial exemption such as military exemptions and exemptions in specific industries such as energy. Numerous exemptions pertain to the design and construction of small buildings that may or may not be occupied, and the design and operation of small water and wastewater treatment plants. The size and importance of a project are commonly used to determine if a license is needed for critical infrastructure such as buildings and treatment plants. State, county, and municipal employees are also commonly exempt from licensure. There are a host of state specific exemptions that pertain to very unique situations, including building golf courses, designing trails, designing signs, serving as an expert witness, performing work as an elected official, and performing real estate inspections.

Table 3 – Licensure exemptions in less than half of the states.

Number of States	Exempt from Licensure – Description
24	A non-resident with a temporary permit, licensed in another jurisdiction
23	A person who operates or maintains heavy equipment
19	Working on a structure on private property not inhabited or used for business
17	Design of agricultural buildings
16	Facility engineers
15	Those who work in research and development
14	Steam, power, refrigeration plant operator
14	Building structures less than 5000 square feet and 3 stories
13	State employees
11	Electric, HVAC, plumbing or mechanical contractors
10	Employee for a municipality
8	County employees – work less than $5000
8	On site waste water treatment system designer/inspector
8	Designing a building expansion less than a specific area (Numerous similar laws)
7	Water or waste water treatment plant work – less than $12,500 total
7	Railroad corporation employees
5	Soil and water conservation work
5	Engineering work during natural disasters or emergency situations
5	Building structures for factory, industry or storage less than 15,000 square feet and 3 stories
5	Military engineering exclusively for the U.S. armed forces
5	Design of a temporary building or shed used for construction purposes
5	Energy exploration
4	Insurance company employees
4	General contractor, material supplier who prepares shop drawings
4	Construction management
3	Service as an expert witness
3	Real estate property inspection
3	Electrical work less than 600 volts and 800 amps
3	Mechanical systems that are standardized – less than 125 psi and less than 300 degrees F.
3	Prepackaged sewer system, less than 100 gpd, not pressurized, less than 50 ft head, main length less than 500 ft.
3	Elected officials practicing engineering in the performance of their duties
2	Design – five to sixteen family dwelling in a government subdivision if reviewed by a building inspector with ICC credentials
2	Services performed by authorized petroleum release businesses
1	Writing environmental permits
1	Signs less than 20 feet high or less than 120 square feet.
1	Non-resident engineers who prepare engineering exams
1	Engineering recreational trails by non-profit organizations
1	Golf course designer

Territory Results

Each territory had at least 3 exemptions, and the number of exemptions ranged from 3 to 9 as shown in Figure 2.

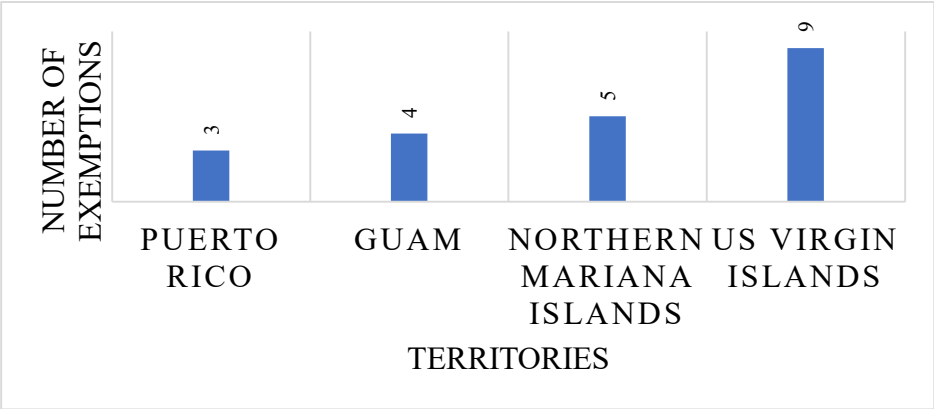

Figure 2 – The number of licensure exemptions found in each territory.

None of the territories had the same number of exemptions, but the totals did not vary significantly. The average was 5.25 and the standard deviation was 2.63 (Table 4).

Table 4 – The descriptive statistics of the number of licensure exemptions per territory.

Average	5.25
Minimum	3
Maximum	9
Range	6
Standard Deviation	2.63

There were six exemptions identified in at least half of the territories, and all but the last two exemptions were common in over half of the states (Table 5). Two of these categories apply to those teaching engineering courses. Another two are for state and federal government employees. One is for those who are licensed in another jurisdiction that have a temporary permit. As with the states, one of the more obvious exemptions is for a person who works directly for a licensed professional engineer (a licensure requirement in most states.)

Table 5 – Licensure exemptions in at least half of the territories

Number of Territories	Exempt from Licensure – Description
4	Engineering instructors – Teaching principles topics
4	A person who works directly for a professional engineer
2	Engineering instructors – Teaching advanced or design topics
2	A person employed by the federal government
2	State employees
2	A non-resident with a temporary permit, licensed in another jurisdiction

Five exemptions were included in only one territory (Table 6). Three of these categories involve practicing engineering on private property. The other two categories involved work performed on a construction site. There were no exemptions unique to a territory that were not included in at least one state. It is important to note that licensure laws and rules in every territory contained fewer exemptions than 80% of the states.

Table 6 – Licensure exemptions in less than half of the territories.

Number of Territories	Exempt from Licensure – Description
1	A person who designs and/or builds private dwellings
1	Structure on private property not inhabited or used for business
1	Design of a temporary building or shed used for construction purposes
1	Construction management
1	A person practicing engineering on their legally owned property

District of Columbia Results

The District of Columbia has its own municipal code that governs licensed engineers within its jurisdiction. There are two exemptions: engineering instructors who teach principle topics and federal employees providing professional services at a federal facility (Table 7).

Table 7 – Licensure exemptions in the District of Columbia

Exempt from Licensure – Description
Engineering instructors – Teaching principles of engineering topics
A person employed by the federal government

NCEES

NCEES maintains a set of model laws and rules. There are three exemptions listed (Table 8). The first is for persons who work directly for a professional engineer, the second is for non-residents with a temporary permit that are licensed in another jurisdiction, and the third is for members of other professions practicing their legally recognized profession.

Table 8 – Licensure exemptions in NCEES Model Laws and Rules

Exempt from Licensure – Description
A person who works directly for a professional engineer
A non-resident with a temporary permit, licensed in another jurisdiction
A person practicing any other legally recognized profession

Overall Statistics

The overall statistics, combining the results from states, territories, and District of Columbia, are shown in Table 9. When compared to the state data, the average number of licensure exemptions decreased by approximately 0.9 while the standard deviation increased by about 0.5. The maximum stayed the same but the minimum and range changed. The territories were within the range of the state data and had little effect overall on the descriptive statistics, but the District of Columbia had the fewest number of exemptions of any jurisdiction. Territories and the District of Columbia had fewer exemptions than most states, but each jurisdiction had at least two exemptions, and those exemptions were shared with at least one other state.

Table 9 – The descriptive statistics of the number of licensure exemptions per jurisdiction

Average	12.8
Minimum	2
Maximum	26
Range	24
Standard Deviation	5.81

Knowledge of Law

Thirty-six of fifty state licensure laws specifically state that engineers are required to have knowledge of the content in their licensure laws. In essence, this is a requirement to understand what types of engineering work requires a license and which types are exempt. The NCEES Model Law also requires knowledge of the licensure laws. Engineers have a responsibility to understand the laws and rules in their jurisdiction in order to know when a license is required for the work they perform.

Discussion of Results

The first research question asked how many jurisdictions within the United States have licensure exemptions for persons who perform engineering tasks commonly considered engineering practice. Every jurisdiction in the study had exemptions in their licensure laws and rules. The District of Columbia had the fewest number of exemptions. No jurisdiction aligned with the NCEES Model Law and Rules. All 54 states and territories had at least 3 licensure exemptions. The average was significantly higher for the states (13.7 exemptions) than territories (5.25 exemptions). Twenty seven state jurisdictions had at least 15 exemptions and no territory had more than 9 exemptions. The number and variety of licensure exemptions in every state jurisdiction produced a high standard deviation.

The second research question asked if there are patterns in the number and type of exemptions commonly found in licensure laws. Six exemption categories were common in more than 50% of the states. This includes those who teach engineering courses (both principle and design topics), work directly for a licensed engineer, are employees of manufacturing companies, work for state or federal governments, work for public utility companies (electric, water, telephone, private utilities), and work for companies that design small structures on private properties.

The third research question asked if civil engineering graduates practice in the areas that are commonly exempt. Exemptions for engineers who work for state and the federal government, work for a private utility company, or design private dwellings apply to civil engineers who perform critical tasks that affect public health, safety, and welfare. Other exemptions, such as working directly for a licensed professional engineer or teaching lower division engineering principle topics, may not directly affect public health, safety, and welfare. As documented by ASCE, many civil engineers select career paths in public agencies, education, industry, and construction [21]. These career paths commonly do not require an engineering license which may be a reason some civil engineering graduates do not become licensed.

The fourth research question asked what undergraduate students should know about engineering exemptions. The study results create a perplexing situation for engineering educators. Accreditation criteria require civil engineering programs to have curriculums that ensure that students can explain the importance of professional licensure and are prepared to enter the practice of engineering, but the content and focus can vary greatly. Civil engineering faculty are ultimately responsible for how content is taught and presented, yet these educators aren't

required to be licensed in most jurisdictions to teach fundamental and design courses. The reality is that most civil engineering programs have both licensed and unlicensed faculty and instructors presenting licensure content to students. It is important for students to understand that unlicensed faculty teaching licensure topics are not violating licensure laws in most states and are typically "practicing engineering" under an exemption. Instruction should be supplemented by guest speakers, advisory board members, project sponsors (capstone or similar classes), and employers who are licensed engineers. They can provide different viewpoints and explain career paths that may or may not require a license.

The study results indicate that licensure laws and rules should be presented to students. In many ways licensure should be coupled with ethics instruction. Ultimately, licensure is intended to protect the health, safety, and welfare of the public. Students must understand this professional responsibility but also the possibility that in some industries, companies rather than individuals, are tasked with protecting the public. Whether this is appropriate or not could be a licensure and ethics discussion question in a senior seminar course. Civil engineering graduates will be faced with licensure issues after graduation and throughout their careers. If students only hear the opinion of one influencer (advisor, professor, internship mentor) during their undergraduate education, they may have a misunderstanding of the ultimate purpose and importance of licensure.

EAC-ABET Criterion 5 requires civil engineering programs to "ensure that students are prepared to enter the practice of engineering." Civil engineering programs are responsible for providing students with information to help them understand the licensure process and the licensure exemption issue. Young engineers must be properly equipped to contemplate their career path and its licensure requirements. Ultimately each engineer is ethically bound to protect the life, health, and safety of the public. Whether that involves an engineering license continues to be up for debate.

Conclusion

The following conclusions were drawn from this study:

1. All 55 jurisdictions (states, territories, and District of Columbia) have engineering licensure exemptions.
2. The average number of exemptions in state jurisdictions is 13.7, and over half of the states have at least 15 exemptions.
3. Territories and the District of Columbia have fewer exemptions on average, but all territories have at least 3 exemptions and every exemption in a territory is shared with other states. The District of Columbia only has two exemptions and they are common to many other jurisdictions, but not the NCEES Model Law and Rules.
4. No jurisdiction has a licensure law that matches the three exemptions found in the NCEES Model Law and Rules.
5. Civil engineers perform tasks in sectors that commonly have exemptions including: teaching upper and lower level engineering courses, designing structures on private

property, working for a licensed engineer, working for industries and manufacturing companies, working for the state and federal government, and working for utility companies. Licensure exemptions in these employment sectors affect the number of civil engineers that eventually get licensed.

6. Civil engineering education should embrace the complexities of licensure laws in their curriculums. It is important to discuss ethical issues associated with licensure's myriad of exemptions and obligation to protect public safety. All licensure viewpoints should be presented to ensure students do not have a skewed perspective for or against licensure.
7. Engineering licensure is much more than the standard three step process that is commonly taught: education, examination, and experience. Examination and experience become irrelevant if engineering jobs only require education and do not require licensure.

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