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PROCEDURES FOR OBTAINING AN ENGINEERING LICENSE IN THE USA AND CANADA

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Abstract: The article focuses on the requirements and procedures for obtaining a professional engineering license in the United States (USA) and in Canada. The rights, privileges and responsibilities from being registered as a professional engineer are also discussed. The paper also provides information on engineering ethics and the liabilities that are associated with engineering projects. The occasional need to be registered simultaneously in more than one state or province are also discussed.

Keywords: Engineering license, professional engineers, licensing procedures

1. Introduction

The practice of the engineering profession is always associated with some liability and risk factors. This problem has been recognized for a long time. In ancient times, people building churches, bridges and other structures, for example, formed professionally managed guilds to guard the secrets of their profession, to limit competition and to secure adequate compensation for their work.

During the Industrial Revolution, many manufacturing companies started to build small steam engines to be used on farms. Many were not properly designed and people suffered injuries due to frequent explosions of the steam-pressure vessels. To protect the public, the United States government, in cooperation with the newly formed association of mechanical engineers, American Society of Mechanical Engineers (ASME), implemented industry safety standards. At the same time, licensing procedures for the engineering profession were initiated. This was the beginning of national professional licensing procedures.

2. Criteria and Procedure for Granting a Professional Engineering License

The procedure for obtaining a state engineering license is controlled and maintained by the individual states in cooperation with engineering associations like ASME. This procedure is not identical in all states, but it is based on the same criteria. An engineering license issued by a state is limited to that state and involves an annual fee that is paid to maintain that license. Agreements between the states, however, allow registered engineers to obtain an engineering license in another state based on an engineering license in the state of residence. Many engineers hold an engineering license in several states if it is required by their work. In the United States, 20% of all engineers maintain a state engineering license and each state has an annual fee for maintaining an engineering license in that state. After the fee is paid, the state issues an official seal with the state emblem and the identification number of the engineering license.

In Canada, the procedure for obtaining an engineering license is very similar. The provincial government issues the engineering license. The criteria and requirements for obtaining an engineering license in the United States and Canada are similar and are as follows. For the purposes of this paper, the requirements of the State of California serve as an example:

1. Graduate from a four-year university engineering program accredited by the Accreditation Board of Engineering Technology (ABET). If the candidate has graduated from a program that is not accredited by ABET (for example, most programs outside of the United States), an evaluation of the program from the perspective of equivalency to an ABET-accredited program is required. This step is required for engineers with foreign credentials.
2. Pass the six-hour Fundamentals of Engineering (FE) examination and receive an Engineer-in-Training (EIT) certification. The FE exam was an 8-hour exam prior to 2014 Some states such as Kansas and New York use the designation of IE (Intern Engineer), but it is essentially the same as EIT.
3. Accumulate six years of engineering experience, typically under the direct supervision of an engineer with a professional engineering (PE) license. In most states, completion of an undergraduate engineering program can be counted as two years of engineering experience. The required engineering experience is then lowered to four years.
4. Pass the eight-hour Principles of Engineering and Practice exam to receive a PE designation.

3. Fundamentals of Engineering Exam (FE)

The Fundamentals of Engineering (FE) exam is offered twice a year (April and October). The exam is administered in two sessions, morning and afternoon, for three to four hours each session. The morning session contains 120 questions that examine the held knowledge from twelve different disciplines [California]. The disciplines are as follows:

- mathematics,
- statistics and probability,
- chemistry,
- computer science,
- ethics and application of ethics in engineering practice,
- engineering economics,
- mechanics (statics and dynamics),
- strength of materials,
- mechanical properties of materials,
- fluid mechanics,
- electricity and magnetism, and
- thermodynamics.

The afternoon session contains 60 questions in the field chosen by the student. The student must select one from seven disciplines listed in Table 1.

Table 1.
Engineering disciplines from which the student can select one for the purpose of the Fundamentals of Engineering (FE) exam

Engineering Discipline	The exam includes questions from the following subject areas.
Civil Engineering	Land surveying, hydraulics, hydrogeology, soil mechanics, foundation building, environmental engineering, transportation, structural analysis, structural design, construction management, strength of materials
General Engineering	Advanced mathematics, probability and statistics, biology, engineering economics, mechanics, strength of materials, fluid mechanics, electricity and magnetism, thermodynamics, thermal science, thermal conductivity
Chemical Engineering	Chemistry, matter-energy conversion, thermodynamics, fluid mechanics, thermal science, thermal conductivity, chemical reactions, designing of manufacturing processes, optimization, economics, computer simulation, control of manufacturing processes, safety, health and environment
Electrical Engineering	Electrical circuits, power, electromagnetism, control systems, communication, signal processing, electronics, digital systems, computer systems
Environmental Engineering	Water resources, water management, sewage management, control of air pollution, solid waste, management of hazardous waste, environmental engineering, management
Industrial Engineering	Engineering economics, probability and statistics, computer modeling, computer calculations, industrial management, management of manufacturing processes, management and upkeep of buildings, logistics, human factor, productivity, ergonomics, dividing of responsibility, quality management

Cont. table 1.

Mechanical Engineering	Designing and analysis of mechanical systems, kinematics, dynamics, vibration control, strength of materials, material processing, measurement and instrumentation, control systems, thermodynamics, energy conversion systems, fluid mechanics, thermal conductivity, thermal science, refrigeration, air conditioning and ventilation

Selection of an engineering discipline for the Fundamentals of Engineering (FE) exam is up to the person who is taking the exam. Most people choose General Engineering. If the candidate chooses General Engineering, the topics in the afternoon session are a continuation of the topics from the morning session. The selection of the engineering discipline for the FE exam applies only to the FE exam and does not prescribe the discipline for the future professional engineering practice (PE) exam.

Statistically, around 65% of all engineers taking the Fundamentals of Engineering (FE) exam satisfactorily pass the exam on their first attempt. An additional 20% pass the FE exam on the second or third try. The FE exam is valid for eight years after passing the exam and can be extended for another eight years. After passing the FE exam and paying the $50 fee, the applicant can receive an Engineer-in-Training (EIT) certificate. The condition for receiving the Engineer-in-Training certificate is a lack of legal violations associated with practicing the engineering profession.

4. Exam from the Principle of Engineering Practice

The exam involving the Principle of Engineering Practice is supposed to assess the theoretical and practical knowledge gained during 4-6 years of engineering practice (under the supervision of a professional engineer). This exam is administered twice a year (April and October), and is eight hours long. The morning session (4 hours) includes forty questions related to the selected engineering discipline. The Principle of Engineering Practice exam is administered separately for each of the engineering disciplines. The afternoon session (4 hours) is focusing on design and problem-solving and it is design specific. Upon successful conclusion, the state issues a professional engineering (PE) certificate and it is aligned with the discipline in which the exam was taken.

There are twenty-five engineering disciplines with corresponding twenty-five corresponding professional engineering licenses (License Lookup, 2018). The disciplines and corresponding licenses are as follows:

AG – Agricultural Engineer,

C – Civil Engineer,

CH – Chemical Engineer,

CO – Consulting Engineer,

CR – Corrosion Engineer,
CS – Control System Engineer,
E – Electrical Engineer,
EG – Certified Engineering Geologist,
FP – Fire Protection Engineer,
GE – Geotechnical Engineer (Soil Engineer),
GEO – Professional Geologist,
GP – Professional Geophysicist,
HG – Certified Hydrogeologist,
I – Industrial Engineer,
L – Land Surveyor,
M – Mechanical Engineer,
MF – Manufacturing Engineer,
MT – Metallurgical Engineer,
NU – Nuclear Engineer,
P – Petroleum Engineer,
PS – Photogrammetrist (Photogrammetric Engineer),
Q – Quality Engineer,
S – Structural Engineer,
SF – Safety Engineer,
TR – Traffic Engineer.

The number of engineers with professional engineer licenses in the United States (Number, 2014) is constantly increasing (Table 2).

Table 2.
The number of engineers with state licenses in the United States between 1940-2015

Year	Number of Engineers with PE State License
1940	67.286
1950	159.759
1960	259.707
1970	374.206
1980	545,000
1990	609.267
2000	669.627
2010	762.280
2015	830,000

The procedure for applying for a PE license is shown in Figure 1 (Engineers, 2018).

The state professional engineering (PE) licenses are issued for 1-2 years and they can be extended for additional years after the applicant pays the US $125 state fee. Many engineers maintain multiple valid PE licenses in different states if a license is required for their work in a different state (License Exam).

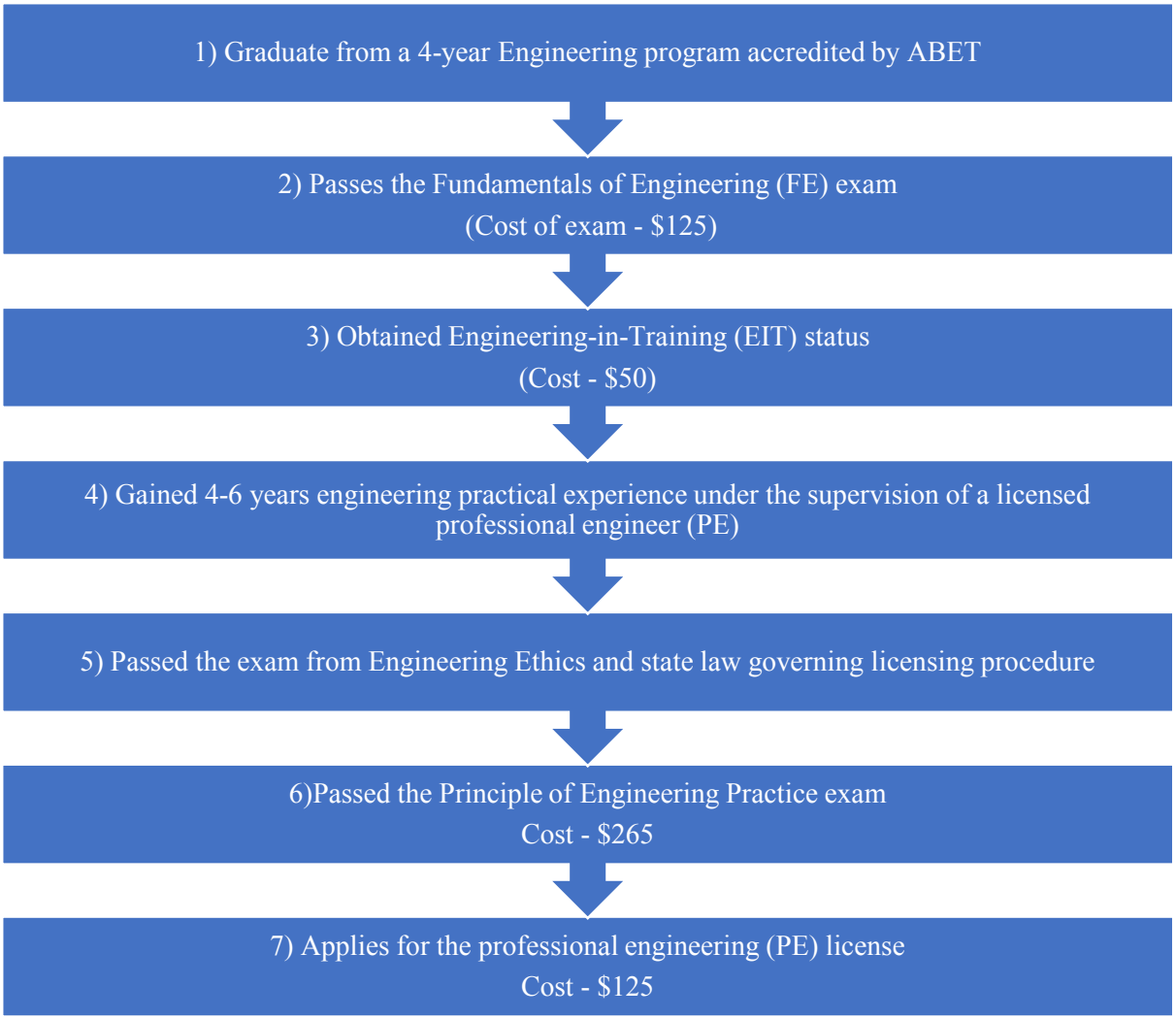

Figure 1. Application procedure for a PE license.

5. Role and Purpose of the State Licensing Procedure

There are many engineering positions which are well paying, but do not require a state engineering license. Those employed in the manufacturing sector or the research and development sector do not require a professional license and registration. Indeed, approximately 80% of engineering that are working in industry do not have a professional engineering license. Engineers with state engineering license(s) are normally employed in public or private organizations that have direct association(s) with public health and safety. Engineers working on public projects overseen by state or federal government agencies need to have a valid state engineering license. A state engineering license can be an asset in finding employment because only 20% of all engineers have a valid state license.

6. Privileges of Engineers Maintaining Valid Professional Engineering (PE) in the United States and Canada

An engineer with a valid professional engineering (PE) license is viewed by state, federal and provincial government agencies as experts in the engineering field where they maintain the license. They are obligated to obey state, federal and/or provincial laws, as well as engineering ethics. Engineering ethics prohibit them from getting involved in projects where they do not have enough knowledge, experience and/or license. A design project completed by a professional engineer with a valid state or provincial license does not require any approval of the project's merit by any state federal, and/or provincial agency or agencies.

It is assumed that the professional engineer who signs off on the design project and puts an official state seal on the design takes full responsibility (legal and financial) for the design portion of the project. The procedure for the project's approval by any government agency or agencies would dilute the liability (legal and financial) of the design portion of the project. Every licensed professional engineer is required to carry liability insurance according to the state law where the project is being done.

If the design project is being done for the mining industry, the appropriate bureau within the Department of Labor overseeing the safety of the mining industry approves the project based on the signature of the licensed professional engineer. In Canada, the Ministry of Labor does not check the merit of the project nor does the Department of Labor in the United States. The licensed professional engineer on the project takes sole responsiblity from the legal and financial perspectives.

A state professional engineering (PE) license is only valid in the state where the license is issued. Therefore, there is often a need to maintain a valid professional engineering license simultaneously in more than one state. Maintaining multiple state licenses can be a costly procedure because each state charges a registration fee to maintain validity. Since only 20% of all engineers in the United States and Canada are registered as professional engineers, the professional fees charged by those professional engineers may be higher. These fees can be based on supply and demand. Most university professors teaching engineering do not maintain a valid state professional engineering license because of the cost factor and lack of need.

7. Conclusion

A state/provincial professional engineering license allows an engineer to handle the design and to oversee the project that directly affects public health and safety. These projects can include bridges, public buildings, public transportation, infrastructure, etc. Normally, these

projects are associated with increased legal and financial liability. Therefore, professional engineers statistically have higher salaries. The average gross yearly salary (2018) was US $99,000. The average yearly salary (2018) for an engineer without a state license is approximately US $94,000. The average yearly salary for an engineer who has passed the Fundamentals of Engineering (FE) exam is approximately US $65,000. The engineering profession in the United States and Canada is considered as one of the most ethical professions. Engineering ethics is incorporated into most engineering curricula. It is also incorporated into the licensing procedure requirements.

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