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Professional Ethics for Engineers

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Professional Ethics for Engineers

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A Short History of Engineering Ethics

One definition of ***Ethics*** is:

> *The rules or standards governing the conduct of a person or the conduct of the members of a profession.*

Prior to 1900, professional societies generally subscribed to the belief that ethics was a matter of an engineer's personal responsibility and not appropriate for a written code. The American Society of Civil Engineers (ASCE), for example, stated in 1877 "*that it is inexpedient for the Society to instruct its members as to their duties in private professional matters*."

The earliest codes of ethical conduct for engineers were developed in the early 1900's. The American Institute of Electrical Engineers (now "the IEEE"), published ethical codes in 1912. These contained no explicit reference to the public or to the environment. The loyalty was to the employer. The AIEE code stated: "The engineer should consider the protection of a client's or employer's interests his first professional obligation, and therefore avoid every act contrary to this duty." Likewise, the original Code of Ethics published by the ASCE in 1914 focused mainly on engineers' relationships with their clients and their peers, and did not address responsibilities to the public.

Throughout the early to middle part of the 20th century, professional societies began to recognize the need for Codes of Conduct to address responsibility to the public. On October 28, 1946, the Board of Directors of the National Society of Professional Engineers (NSPE) adopted a "Canon of Ethics for Engineers" that was prepared by the Engineers' Council for Professional Development (ECPD), which is now the Accreditation Board for Engineering and Technology (ABET). Among the provisions of this code was:

> *"As the keystone of professional conduct is integrity, the engineer will discharge his duties with fidelity to the public, his employers and clients, and with fairness and impartiality to all. It is his duty to interest himself in public welfare, and to be ready to apply his special knowledge for the benefit of mankind."*

Today, dozens of professional engineering societies have published codes of ethics, which have evolved since the early days to include responsibilities to both the public and the environment, as well as responsibilities to an engineer's employer. Most of these codes of conduct follow the ECPD/ABET model and are quite similar to each other. A good example is the Fundamental Canons of the Code of Ethics for Engineers published by the NSPE (refer to Page 2).

Note the subject of Fundamental Canon #1 – "Hold paramount the safety, health, and welfare of the public". The "safety, health, and welfare" of the *public* is front and center in the NSPE Code of Ethics, which demonstrates how much the priorities have shifted since the early 1900's. Protecting the interest of one's employer is relegated to Fundamental Canon #4 in the current NSPE Code of Ethics.

Fundamental Canons of the NSPE Code of Ethics for Engineers

1. ***Hold paramount the safety, health, and welfare of the public.***
2. ***Perform services only in areas of their competence.***
3. ***Issue public statements only in an objective and truthful manner.***
4. ***Act for each employer or client as faithful agents or trustees.***
5. ***Avoid deceptive acts.***
6. ***Conduct themselves honorably, responsibly, ethically, and lawfully so as to enhance the honor, reputation, and usefulness of the profession.***

Why is it Important to Study and Practice Engineering Ethics?

We reviewed one definition of Ethics earlier in the course. A second definition of ***Ethics*** is:

> *Motivation based on ideas of right and wrong.*

There is a moral component to *Ethics*. Engineers should be motivated to "do the right thing". Seems obvious, doesn't it? Of course, you want to do the right thing. So, why do you need to study E*thics*?

Why Study Engineering Ethics?

We need to go back to the first definition of Ethics: *The rules or standards governing the conduct of a person or the conduct of the members of a profession.*
It is important to study engineering ethics so that you will understand the standards governing what is acceptable behavior in the practice of engineering.

The standards governing acceptable behavior for engineers have been developed in the form of Codes of Conduct adopted by professional organizations, such as NSPE. These standards represent the collective experience of many learned professionals who have studied Ethics and have adapted the Codes of Conduct based on observing the impacts of engineers' actions over

many years.. Many of these standards are intuitive. For example, NSPE Fundamental Canon #5 states "Avoid deceptive acts". It is pretty widely accepted in all walks of life that deception is unethical.

But, other topics covered by the Codes of Conduct may not be so intuitive. For example, the NSPE Code of Ethics for Engineers prohibits the acceptance of free engineering designs from equipment suppliers for specifying their product. On the surface, this arrangement looks like it might be a "win-win situation". You get help with the engineering and the vendor gets his foot in the door. But, the free engineering design provided to you by the vendor is a form of compensation that creates a conflict of interest. Conflicts of interest will be covered at the end of this course.

Why Practice Engineering Ethics?

OK, you know that it's important to study engineering ethics to learn what is considered to be appropriate behavior for professional engineers. Once you know what the rules are, why is it important to follow them?

Setting aside the issues of right and wrong for a moment - which is incentive enough for most of us to practice ethics – there are other reasons why it is important for you to act ethically in your professional practice. Below are some of the consequences that can result from unethical behavior:

- Personal injury and damage to property due to your engineering designs, which can result in litigation against you
- Disciplinary action by your state licensing board and any professional societies with whom you are a member
- Embarrassment to you, your employer and the engineering profession
- Loss of income due to termination by your employer or being ostracized within your local engineering community as a result of your actions

It is important to note that all of the state engineering boards have enacted laws and rules for engineers. Like the professional societies, the state licensing boards' rules of professional conduct follow many components of the ECPD/ABET model, which remains the *de facto* standard across the U.S.

The Most Common Ethics Violations

Covering every state licensing board's requirements is not feasible in this short course. In fact, just covering every point in the NSPE Code of Ethics would take an entire course in itself (you can take just such a course on PDHengineer.com titled ***Code of Ethics for Engineers***). The focus of this course, ***Professional Ethics for Engineers***, is the most common ethics violations and what you can do to ensure that you don't find yourself on the wrong side of a Board disciplinary hearing.

A survey of recent disciplinary actions imposed by the Texas Board of Professional Engineers and the Florida Board of Professional Engineers, two of the nation's largest licensing jurisdictions, indicates that the following are the most common violations of the Boards' Laws and Rules:

- Advertising and/or practicing engineering without a license.
- Sealing plans or documents for which the engineer lacked competence in the subject matter or the engineer had no direct control or supervision of the preparation of the plan or document.
- Sealing plans or documents which indicates gross negligence or a lack of care and diligence (i.e. not conforming to applicable codes and standards)

The violations listed above, which are covered under Fundamental Canons #1 and #2 of the NSPE Code of Ethics for Engineers, are illegal in Texas and Florida, as well as all other U.S. licensing jurisdictions.

Advertising and/or Practicing Engineering without a License

If you are a professional engineer, you may think there's no way you can possibly run afoul of Rule of Practice #1e (a subset of Fundamental Canon #1) of the NSPE Code of Ethics, which states:

> *Engineers shall not aid or abet the unlawful practice of engineering by a person or firm.*

Unlicensed practice of engineering is one of the most common violations prosecuted by U.S. state engineering licensing boards. An individual who has never been licensed as an engineer (and in some cases has no engineering training whatsoever) will advertise that his company performs "Engineering Services" in the local edition of the Yellow Pages. Or an individual with an expired PE registration will continue to perform "Engineering Services" after the effective date that his PE registration expires. If you are registered as a professional engineer and your registration is current, then Rule of Practice #1e doesn't apply to you. Right?

There are instances where a registered professional engineer in good standing can unintentionally violate Rule of Practice #1e of the NSPE Code of Ethics and subject himself to disciplinary action by one of the state licensing boards. Case Study #1 is one example:

Case Study #1

Mr. John Brown works for the ABC Consulting Company in their Norman, OK office. He is a registered professional engineer in his home state of Oklahoma. Mr. Brown's primary job responsibility is the preparation of environmental impact reports for the proposed construction projects initiated by the municipalities in the state of Oklahoma.

Mr. Brown receives a call from ABC's Houston, TX office. The engineer in the Houston office that is responsible for preparing environmental impact reports has just resigned. The Houston office has a contract to prepare an environmental impact report for a construction project that is planned by the Houston Independent School District (HISD).

Mr. Brown travels to Houston to gather the data needed to prepare the report. He then travels back to his office in Norman, OK and finishes preparing the report. At the bottom of the report, he signs his name "John R. Brown, P.E." and he faxes the report to ABC's Houston office for submittal to the HISD.

Although the names and some details have been changed, Case Study #1 is based on a real-world scenario that occurred in the state of Texas. Although the engineer was registered in another state, he was not registered in the state of Texas at the time that the report was prepared. Since the report was submitted to a public entity in Texas for a Texas property, the Texas Board of Professional Engineers determined that the use of the "P.E." designation after his name in the Texas report represented an unlawful representation that Mr. Brown was licensed in Texas as a professional engineer and he was disciplined by the Board.

Plan Stamping

Plan stamping is an illegal action whereby a professional engineer places his or her registration seal on drawings, designs, reports, and/or specifications that he or she did not author or for which he or she did not have personal professional knowledge and direct supervisory control and responsibility.

Rule of Practice #2b in the NSPE's Code of Ethics for Engineers states the following:

> *Engineers shall not affix their signatures to any plans or documents dealing with subject matter in which they lack competence, nor to any plan or document not prepared under their direction and control.*

There are two primary ways in which engineers get in trouble with Rule of Practice #2b:

1) Sealing documents for engineering work in areas for which the engineer lacks competence.
2) Sealing documents for engineering work in areas where the engineer is competent, but the engineer did not supervise the work (plan stamping).

Plan stamping and practicing outside of one's area of competence are pervasive problems in the engineering professional. These activities are illegal in all states and they are amongst the most common violations resulting in disciplinary action by the state licensing boards.

1) The Engineer Lacks Competence

An engineer must perform services only within areas of his/her competence. Without guidance, this is an area where even a well-intentioned engineer can mistakenly violate the NSPE Code of Ethics, as well as his state licensing board's laws and rules.

A good example is when an engineer supervises a multi-discipline project. It is difficult for an engineer to gain the knowledge and experience to be considered competent in all aspects of the design, particularly for complex projects or projects with a broad scope.

How does the NSPE Code of Ethics address this? Rule of Practice #2c states:

> *Engineers may accept assignments and assume responsibility for coordination of an entire project and sign and seal the engineering documents for the entire project, provided that each technical segment is signed and sealed only by the qualified engineers who prepared the segment.*

2) The Engineer Did Not Supervise the Work

A similar issue arises when an engineer supervises the activities of junior engineers or contractors on a project. State engineering licensing boards stipulate that the engineer can only sign and seal plans under which he/she had "responsible charge". To what extent must the engineer be engaged in the design effort to have had "responsible charge"?

The Florida Board of Professional Engineers provides excellent insight into this issue on their website:

> ***Q.*** *Occasionally I have been asked by a contractor or other professional to sign and seal plans they did. I understand I can only sign and seal plans over which I have had responsible charge but what is meant by "responsible charge"?*
>
> ***A.*** An engineer who signs and seals engineering documents in responsible charge must be capable of answering questions relevant to the engineering decisions made during the engineer's work on the project, in sufficient detail as to leave little doubt as to the engineer's proficiency for the work performed. It is not necessary to defend decisions as in an adversarial situation, but only to demonstrate that the engineer in responsible charge made them and possessed sufficient knowledge of the project to make them. Examples of questions the engineer must be able to answer include the criteria for design, methods of analysis, selection of materials and systems, economics of alternate solutions, and environmental considerations.

Gross Negligence / Lack of Care and Diligence

Unlike practicing outside of one's area of competence, the engineer guilty of gross negligence or demonstrating a "lack of care and diligence" is quite often competent in the area of practice. He's just lazy or sloppy, or both.

The result of gross negligence by engineers can be catastrophic. A study conducted at the Swiss federal Institute of technology in Zurich analyzed 800 cases of structural failure in which 504 people were killed, 592 people injured, and millions of dollars of damage incurred. When engineers were at fault, the researchers classified the causes of failure as shown in Table 1 below:

Table 1- Causes of Structural Failure

Insufficient knowledge	36%
Underestimation of influence	16%
Ignorance, carelessness, negligence	14%
Forgetfulness, error	13%
Relying upon others without sufficient control	9%
Objectively unknown situation	7%
Imprecise definition of responsibilities	1%
Choice of bad quality	1%
Other	3%

Source: Swiss Federal Institute of Technology in Zurich

What can be done to reduce engineering errors caused by gross negligence and a lack of care and diligence? You can start by staying abreast of the codes and standards that are pertinent to your area of practice through continuing education. You should always check your work before publishing a report or issuing a drawing. And never allow a project deadline to compromise the quality of the product that you produce.

But what about other engineers? What can you do to help reduce errors by your colleagues?

1. <u>Report gross negligence</u>

Rule of Practice #1a in the NSPE Code of Ethics states:

> *If engineers' judgment is overruled under circumstances that endanger life or property, they shall notify their employer or client or such other authority as may be appropriate.*

The case study below published by Texas Tech University's Murdough Center for Ethics in Engineering illustrates the type of real-world dilemma that an engineer could face.

Case Study #2

The XYZ Corporation has been advised by a State Pollution Control Authority that it has 60 days to apply for a permit to discharge manufacturing wastes into a receiving body of water. XYZ is also advised of the minimum standard that must be met.

In an effort to convince the authority that the receiving body of water after receiving the manufacturing wastes will still meet established environmental standards, the corporation employs Engineer Doe to perform consulting engineering services and submit a detailed report.

After completion of his studies but before completion of any written report, Doe concludes that the discharge from the plant will lower the quality of the receiving body of water below established standards. He further concludes that corrective action will be very costly. Doe verbally advises the XYZ Corporation of his findings. Subsequently, the corporation terminates the contract with Doe with full payment for services performed, and instructs Doe not to render a written report to the corporation.

Thereafter, Doe learns that the authority has called a public hearing and that the XYZ Corporation has presented the data to support its view that the present discharge meets minimum standards.

What would you do if you were in Engineer Doe's position? You could easily just not issue a report on your findings. After all, you've been paid in full for your work. Before making your decision, go to the previous page and review NSPE Code of Ethics Rule of Practice #1a.

To review the full discussion of this Case Study, visit the website of the Texas Tech University's Murdough Center for Ethics in Engineering at http://www.niee.org/.

2. Be candid in your evaluation of peers

The problem with negligence is that it can be difficult, if not impossible, to detect in the engineering licensing process. A bright, but lazy individual might breeze through college and then become complacent on the job. This individual may have no trouble passing the Fundamentals and Principles and Practice exams. But, negligence is often a result of poor work ethic, not lack of intelligence.

Fortunately, the PE licensure application process typically requires the applicant to obtain references from professional engineers. If you are asked to write a reference letter or complete a reference form for a PE applicant, be candid in your evaluation.

3. Lead by Example

You can influence your colleagues, particularly younger engineers, by always being careful and diligent in your work. When tasked with reviewing a junior engineer's work, point out any

errors. And take the opportunity to reinforce the importance of checking one's work to catch mistakes and ensure compliance with applicable codes and standards.

Avoiding Conflicts of Interest

Relative to plan stamping, gross negligence and unlicensed practice, engineers are rarely disciplined by the state engineering boards for engaging in code of conduct violations related to conflicts of interest. However, the fact that few cases are prosecuted does not mean that conflicts of interest are not a cause for concern in the engineering profession.

Rule of Practice #4a of the NSPE Code of Ethics states that engineers shall disclose all known and "potential" conflicts of interest that could "appear to influence" their judgment or the quality of their services. It is not enough to merely avoid a conflict of interest. The engineer must avoid even the "perception" of a conflict of interest.

Case Study #3

Mr. Smith is a professional engineer employed by AB Pump Company. Mr. Smith has lunch with Mr. Jones, representing YZ Seal Corporation. The men discuss YZ's product line at some length during lunch. Over dessert, the men begin discussing football and learn that they are both huge fans of the Green Bay Packers professional football team.

Mr. Jones calls Mr. Smith a couple of days later and invites him to watch the Packers game Sunday in YZ's corporate suite. Mr. Smith accepts the invitation and attends the game. The men spend the afternoon watching their beloved Packers. The subject of business never even comes up in the conversation.

As they exit the suite after the game, Mr. Williams, a salesman employed by EF Seal Corporation, spots the two men. Mr. Williams knows both men, but chooses not to approach them. A couple of weeks later, Mr. Smith sends out a request for quotation to both YZ Seal Corporation and EF Seal Corporation to supply several hundred thousand dollars worth of pump seals. Both companies submit quotations and are evaluated in accordance with AB's normal bid evaluation process. Mr. Smith is responsible for performing the technical bid evaluation, but is not involved in the final purchase decision.

YZ Seal Corporation is awarded the contract based on technical merit and lowest cycle costs. The next day, John Smith is called into the office of AB Pump Company's president. The company president is concerned about a phone call that he received from Mr. Williams, representing EF Seal Corporation, who is alleging that an inappropriate relationship may exist between Mr. Smith and Mr. Jones of YZ Seal Corporation.

Case Study #3 illustrates how easily a perceived conflict of interest can lead to problems for the parties involved.

Did Mr. Smith have a conflict of interest?
"A person has a conflict of interest if:

a) he is in a relationship with another requiring him to exercise judgment in that other's service, and
b) he has an interest tending to interfere with the proper exercise of judgment in that relationship." (Davis, 1982)

Note that judgment is critical to have a conflict of interest. If a decision is made according to a set of rules, then there is no conflict of interest even though there may be competing claims on the part of the person making the decision.

In the case of Mr. Smith, there was no conflict of interest because the purchase decision was made using an established set of rules. Mr. Smith's attendance at the ball game did not influence his evaluation of the pump seal bids. In fact, Mr. Smith did not even make the final purchase decision regarding the pump seals.

Did Mr. Smith have an apparent conflict of interest?

An apparent conflict of interest is also called a perceived conflict of interest. In this situation, a third party perceives that the decision-maker's ability to make a proper judgment is subject to influences that will bias his judgment.

Mr. Smith had an apparent conflict of interest. Mr. Williams, not knowing all the facts, concluded that:

a) Mr. Smith had a personal relationship with Mr. Bill Jones, and
b) Mr. Smith was in a position to influence the award of the pump seal bids, and
c) Mr. Smith's relationship with Mr. Jones biased the bidding process in favor of the YZ Seal Corporation.

However, the facts are:

a) Mr. Smith only recently met Mr. Jones. There was no long-standing personal relationship that might tend to influence Mr. Smith's judgment.
b) Mr. Smith was in a position to influence the award of the pump seals only to a limited extent by potentially favoring YZ seals in the technical portion of the bid evaluation. However, Mr. Smith was not in a position to make the final purchase decision.
c) Mr. Smith's relationship with Mr. Jones did not bias the bidding process. A pre-established set of corporate policies were followed in the bid evaluation and award process.

A Final Word

I'll leave you with a quote from the Ethics Case Studies published by the Texas A&M Departments of Philosophy and Mechanical Engineering:

> *"The public has provided engineers, through the tax base, with the means for obtaining education, and through legislation, with the means for licensing and regulating themselves. In return, engineers have a responsibility for protecting the safety and well-being of the public in all of their design efforts. This is part of an implicit social contract all engineers agree to when they accept admission to an engineering college."*

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