# Professional Integrity:

**A Primer for Structural Engineering1**

Are you planning to be a Structural Engineer? An Aerospace Engineer?

A Geotechnical Engineer?

How about a Construction Manager or even an Architect?

Regardless of your career plans, the most important characteristic or skill you can offer is your integrity. What IS integrity?

Most people probably think of integrity as a personal thing, an issue of character. For example, someone who thinks “I am a good person” probably would consider themselves to be a person of integrity.

But integrity in the professions is more specific than being a “good person,” because the definition of “good” can vary and your measurement of “good” can differ from someone else’s. For example, some people think they are good because they have never been in trouble or because their intentions or “heart” are good.

Professional integrity, on the other hand, requires us to not only be “good” by our own standards and definitions, but by the standards and definitions of our employer and our profession, as well as perhaps, of society.

Often, a lack in engineering ethics is found to be one of the main causes of an engineering failure. An engineer, as a professional, has a responsibility to their client or employer, to their profession, and to the general public, to perform their duties in as conscientious a manner as possible. Beyond following the law, an ethical engineer is one who avoids conflicts of interest, does not attempt to misrepresent their knowledge so as to accept jobs outside their area of expertise, acts in the best interests of society and the environment, fulfills the terms of their contracts or agreements in a thorough and professional manner, and promotes the education of young engineers within their field ([http://www.matscieng.sunysb.edu/disaster/).](http://www.matscieng.sunysb.edu/disaster/))

Let’s go over a very concrete example taken from an NSF and Bovay Fund sponsored workshop on developing engineering ethics cases (August 14-­‐18, 1995, Texas A&M University, Civil Engineering Case 1: Parking Structure Foundation, <http://ethics.tamu.edu/Portals/3/1995Cases/CivilEngCase/Parking%20Structure%20Foundation.pdf>).

*Mary Johnson has recently passed the PE exam. She works for Spire Engineering as a structural design engineer. For her first project as lead engineer, she designs a parking structure in an area where the soil is poor. She requests a detailed soils report, and the geotechnical engineer recommends continuous footings. Mary designs a reinforced concrete section according to the prevailing ACI standards. The design is reviewed by another of Spire's PE's and Mary proudly stamps and signs her first set of plans.*

*The owner of the structure engages Spire to monitor and inspect the construction process, take concrete samples, etc. Since Mary is the engineer of record, she visits the construction site during the site preparation phase. Although she has heard about the way in which women are sometimes treated by construction workers,*

1 This primer is based on a “Professional Integrity” primer template originally written by Dr. Tricia Bertram Gallant. The template is being used by a number of campus departments to illustrate the connections between academic and professional integrity.

*she was unprepared for what she encountered. The whistling, taunting and general crudeness made her very uncomfortable, but she was determined to follow through.*

*Mary is relatively inexperienced in dealing with contractors. Thus, in the eyes of the superintendent and construction workers, her credibility is suspect. On the first day of pouring concrete, Mary is on site, taking cylinder samples, inspecting the placing of reinforcement, and generally getting a feel for the construction process. She notices a few problems and brings them to the superintendent's attention. He accommodates some of her concerns, but also dismisses others as unnecessary, commenting on her lack of familiarity with day-­‐to-­‐day construction practices. Mary protests and makes additional suggestions. The superintendent takes advantage of her inexperience and ignores her concerns. When she gets back to the office, she talks to some of her more experienced colleagues and they give her some additional advice about construction and contractors.*

*The following day is a warm one, and after about half the concrete pour is completed, the batch plant breaks down and the trucks stop coming. Mary knows from school and the previous evening's discussion that if more than an hour or two passes, the poured concrete will begin to set up and will not bond well with newly poured concrete, forming a "cold joint." She discusses the problem with the superintendent who assures her that the plant will be up soon and tells her not to worry. After an hour and a half has passed, the batch plant is not yet on line. Mary tells the superintendent that the already placed concrete will have to be removed. A protracted discussion ensues in which the superintendent says such a drastic action is unnecessary and that if Mary knew anything about construction, she would understand. He also makes several other derogatory comments about her level of knowledge and competence. He says that he can simply agitate the already poured concrete and produce a structurally sound joint. At that instant, the first concrete truck arrives, and Mary must decide right away.*

*Mary is not sure about the nuances of placing concrete and does not want to risk further abuse from the superintendent and construction workers. Thus she decides to trust the experience of the superintendent and continue the pour. The finished product looks OK, and the rest of the construction is completed without incident.*

*After about two years of service, the parking garage is severely damaged in an earthquake. In the failure some cars are crushed and, unfortunately, three people are permanently crippled. The injured parties and the car owners sue the owner of the parking structure who in turn sues the contractor and Spire Engineering.*

*An evaluation by a forensic engineering firm shows that the proximate cause of the failure was a break that occurred in the footing at the point where the cold joint was. At the trial several people who rent space in the garage testify that a large crack had developed in the foundation about six months after the garage was opened. The owner admits he had an employee fill the crack with driveway patching compound; saying he thought it was just a minor settlement crack, typical of concrete slabs. The owner did not inform anyone else of the patch.*

*The contractor claimed that Spire Engineering, through its agent, Mary, had approved the construction process and that since the superintendent was not a professional engineer, his recommendations should not have legal weight in determining liability. Spire Engineering claimed that the superintendent had engaged in deliberate deception and that the contractor should share liability.*

*There are several items noted in the ASCE code of ethics (*<http://www.asce.org/Ethics/Code-of-Ethics/>*) that are relevant to this case:*

1. *"Engineers shall hold paramount the safety, health and welfare of the public in the performance of their professional duties."*
2. *"Engineers shall perform services only in areas of their competence."*
3. *"Engineers whose professional judgment is overruled under circumstances where the safety, health, and welfare of the public are endangered shall inform their clients of the possible consequences."*
4. *"Engineers who have knowledge or reason to believe that another person or firm may be in violation of any of the provisions of Canon 1 (to hold paramount the safety, health, and welfare of the public) shall present such information to the proper authority in writing and shall cooperate with the proper authority in furnishing such further information or assistance as may be required."*

*Mary seems to have the technical knowledge to handle this case. However, Mary's knowledge about practical construction techniques and ability to deal with the contractor are in question. Mary should not have been subjected to the 'whistling, taunting, and general crudeness'. However, Mary shouldn't allow that to affect the way that she performs her job. Is Mary's preparation at fault? If it is, is this a case of Mary acting outside of her expertise?*

*Mary's foremost obligation is to the public. One might ask if she is acting out of her area of expertise, which would be a direct violation of the ASCE codes. She allows herself to be overruled in this situation, which involves the safety of the public. Is Mary only responsible for technical expertise, suggestions, and consultation, or is Mary on sight to police the contractor and make sure he doesn't cut corners? In this situation Mary has some different options. She could refuse to back down from her recommendation. Mary could notify her employer of the contractor's actions. If it is determined that there is a problem with the 'cold joint', Mary could notify the owner of the structure. If there was any criminal action by the contracting firm then the appropriate government officials could be notified.*

*In hindsight, it appears that Mary was not quite ready to deal with the contractor. If Mary's boss foresaw problems in the relation between Mary and the contractor, he might have chosen to ease her transition by allowing her to go with a supervisor. If Spire sent Mary into a situation that they knew she would not be able to handle, then that might be considered equivalent to practicing outside of your area of expertise, which the ASCE code explicitly forbid.*

*The ASCE Code of Ethics also states:*

*"Engineers shall give proper credit for engineering work to those to whom credit is due, and shall recognize the proprietary interests of others. Whenever possible they shall name the person or persons who may be responsible for designs, inventions, writings or other accomplishments."*

*Mary has an obligation to herself to get credit for her work. If she feels that she is not given credit for her work, she might voice that opinion to her employer. In this situation Mary's opinions were valuable, and she should have been able to voice them. The boss might make the working environment more open, to allow Mary room to express her views.*

*Mary has put her company in a very precarious position. By allowing the contractors to go against her better judgment, she may have incurred liability for the company. She was on sight to make sure that construction would go as expected and she failed to do so.*

When we act in ways that uphold our personal values and beliefs, it could be said that we are exhibiting personal integrity, that is, congruency between our rhetoric (what we say) and our actions (what we do).

The illustration above is a concrete example of the very tricky ethical minefield of professional integrity.

As a professional (i.e., Junior/Senior Structural Engineer, Bridge Engineer, Construction Engineer, Aerospace Engineer, Geotechncial Engineer) you will face complex ethical dilemmas like this on a regular basis and you will be expected to be able to problem solve through them and do “the right thing” and, when you make your choice of action, be willing to be held accountable for whatever consequences come about as a result of your decision.

This type of professional integrity is critically important for all professions, but perhaps for no professions more than those held by university graduates and those that serve society in some way (and, I would argue, ALL professions serve society - look at the financial profession and how that has NOT served society well in the last couple of years).

What does this mean for YOU as an undergraduate? You are a professional‐in‐training.

For example, in SE 1, we are not simply trying to teach you mechanics, materials, analysis, and design concepts, but ways of thinking, acting, and problem‐solving.

So, what you learn in SE 1 and your other engineering classes has DIRECT relation to your future professions ‐ no matter what you are going to be doing. Just some examples of the learning outcomes are:

* 1. An ability to function in multidisciplinary teams
  2. An ability to identify, formulate, and solve engineering problems through critical thinking
  3. An understanding of professional and ethical responsibility
  4. An ability to communicate effectively with written, oral, and visual means
  5. The broad education necessary to understand the impact of engineering solutions in a global and societal context
  6. A recognition of the need for and an ability to engage in life‐long learning
  7. A knowledge of contemporary issues
  8. An ability to use modern engineering techniques, skills, and computing tools necessary for engineering practice

Hopefully this information helps you see how you can engage in SE 1 and your engineering classes as useful learning experiences - they are helping you prepare for your future profession as an Engineer!

Indeed, being a student with integrity is preparation for your future profession. In fact, think of being a student as your profession at this time. Being a student is your job, and just like other jobs or professions, it has tenets for professional integrity. This means that sometimes you will be expected to conduct your work (e.g., your academic assignments, labs, tests) according to standards with which you may disagree.

For example, although you may prefer to have a “cheat sheet” when you take exams, you know that you are not permitted to do so unless designated by the instructor. Thus, sneaking in a “cheat sheet” to an exam would be considered a violation of your professional or academic integrity. Why is this? Well, first it is a matter of fairness. Why should you get to use a cheat sheet if no one else does? This is what we call “an unfair advantage.” Second, it is dishonest. When the instructor is grading your exam, he or she assumes that you completed it without assistance and so, if you had assistance in the form of a “cheat sheet,” it is a dishonest assessment of your individual ability. Third, it is a sign of weak character, of someone who is so focused on the ends (i.e., getting a certain grade) that s/he is willing to do whatever it takes to get there despite the harm s/he is causing to self or others. And frankly, we are hoping to graduate students from UCSD who more often than not, put the means BEFORE the ends!

Because engineering classes promote working together on assignments and projects, one of the major challenges that students have in structural engineering is identifying and understanding the line between collaboration and copying. For example, students may work on a homework assignment together but instead of each student working on all of the problems, they split the assignment and only do partial problems, copying the rest from their peers. Another challenge is when students must do problems that utilize programming like Matlab. Some students may sit at the computer, work on a program together, and then print two identical copies of the solution, or some students may borrow several sections of the script from a friend if they are unsure how to program it themselves. Out in the “real-world”, professional engineers must be able to collaborate in teams and each must carry their own weight on a project. If they get assistance, they acknowledge the contributions of everyone involved – they do not present other peoples’ work as their own. The two main ethical responsibilities as a student that translate to the professional code of ethics is that you do work only in your area of competence, and that you take credit for work only if you did it. If you do not do the assigned schoolwork, you will not become a competent engineer. If you copy from your peers, then it is not your work. Cheating is a habit ‐ a way of getting through. Your habits won’t change just because you graduate.

So, to maintain your professional integrity as a student, we suggest that you approach individual assignments in the following manner:

1. Spend time studying.
2. Attend office hours where you can discuss your misunderstandings or mistakes with your professor or TA so you can improve.
3. Leave a trail of explanation in your work so you (and others) can find errors later. Do not plug everything into a calculator or computer program and expect that the instructor/grader knows where the mistakes were made. For all we know, you just copied the answer from a friend.
4. If you work together on an assignment, make sure each student attempts the problems on their own first and then discuss/collaborate to get to the final solution. You should acknowledge on your assignment the people you worked with.
5. If you work on a computer program together, make sure each of you attempts to write the code separately using your own style (no two codes are ever identical). You can discuss algorithms and processes but do not code it together and print two copies. You should acknowledge on your assignment the people you worked with.
6. If you work in a group on a team project, you can divide responsibilities IF the professor encourages (ask the professor about expectations), but make sure each student is contributing equally. Every member of the team needs to contribute equally and if a particular member slacks off, it needs to be reported so credit can be properly given.
7. Do not use cheat sheets or solutions manuals that were obtained illegally and not provided by the instructor.
8. Report any cases of unethical behavior you observe to your professor or TA.

One final area in the classroom setting in which the subject of professional integrity arises is the issue of attending lectures and receiving credit for doing so. SE 1 will incorporate the use of clickers in order to verify that each student is not only attending class, but also that s/he is taking individual responsibility for learning and understanding the reading assignments and lecture materials that are presented. It is overwhelmingly understood that it is difficult for students to achieve academic success without regularly attending and being engaged in lectures. Falsifying your own attendance and understanding, or those of a friend, (i.e., giving your clicker to a friend so that s/he can click in for you, or vice versa) is wholly against the spirit of good ethical behavior that we want to promote in our students, and it will not be tolerated. It is important that each student

be accountable for each component of his or her own learning, just as Mary, in the example above, is accountable for her actions through all steps in the design, construction, and failure of the parking structure.

Why are we telling you all of this? Do we think that you are dishonest people or cheaters?

No, we believe that the majority of our students are good people who make bad ethical decisions sometimes when they are:

* Pressed for time
* Pressured by family members and other people to “succeed”
* Focused on the grades rather than the learning
* Doing assignments at the last minute
* Too dependent on other people and the internet for the answers, rather than self-­‐reliant and confident in own ability to do the work

So, although we may not have a campus full of “cheaters,” we do seem to have a fairly significant problem on the UCSD campus students who are willing to take the risk for the grade despite the significant costs they may face if caught. We urge you to consider all of the above before you act so that you do not become one of the 600+ students reported for cheating each year. In the end, it is much easier to explain to your engineering school or future employer why you got that C than why you were disciplined for cheating!

For more information about academic integrity at UCSD, please read the material at: [http://academicintegrity.ucsd.edu](http://academicintegrity.ucsd.edu/)

LEARNING AND UNDERSTANDING THE MATERIAL IN THIS PRIMER AND ON THE WEBSITE WILL BE USEFUL FOR YOUR FIRST READING QUIZ!