The Importance of Teaching Ethics

Thomas J. Dobrowski
Purdue North Central

Abstract - In the past decade the American public has been riddled with news of scandal in business. The front page headlines of Enron and Tyco show how a unethical executive can ruin a company and financially ruin the employees. However, while the same can be said for those executives who work in the engineering/technology field, far worse consequences can occur. In July of 2006, apparent sub-standard concrete gave way in the Boston "Big Dig" tunnel project, killing a 38 year old women. In July of 1981, perhaps the most famous engineering/construction disaster in the United States took place, the Hyatt Regency Walkway Collapse. In this case, a change was made to the design (it was disputed who approved the change) to a walkway, and during a dance the ensuing structural failure killed 114 people and injured more than 200. In addition to the loss of life, the ensuing lawsuits bankrupted companies, and several professional licenses were lost.

This paper explores how to discuss the importance of introducing ethics into engineering technology classes. It will also look into way of incorporating these discussions into existing curriculum through the use of examples and case studies. In today's corporate environment, competition is so intense because of pressure to produce, poor decisions are often made. It is through the introduction of ethics, and the possible consequences that poor decisions can lead to, that perhaps educational institutions can help turn the tide and help reverse what seems to be an ever increasing problem.

Introduction

Wikipedia defines ethics as "a major branch of philosophy, is the study of value, or morals and morality. It covers the analysis and employment of concepts such as right, wrong, good, evil, and responsibility[1]. Before the question of how to incorporate ethics into the engineering/technology (or any) classroom is examined, one must ask if it is necessary. A review of recent history suggests that the corporate world in general has had a significant decline in its ethics. The "win at all costs" mentality, coupled with lower profit margins, increased competition, and the need for increased productivity, have led many executives and managers to make poor ethical choices. While engineering/technology educators might often ignore such instances as Enron and Tyco because the poor decisions made were on the business end (not in design or production), it must be remembered that today's graduates might well be running companies in twenty to thirty years. Also, engineering/technology graduates will quite probably be in industries that deal with the public well being. Two famous examples in the construction industry are the Hyatt Regency Walkway collapse, in which a change in the design led to a collapse which killed 114 people and injured more than 200 people. In this case, the designer failed to provide a thorough review of the proposed design change because of time constraints, the contractor failed to wait for a signed and stamped revision, and the owner did not want to pay for additional inspection (even though there had been a structural failure of the roof during construction one year before the walkway collapse). More recently, just last year a large section concrete from Boston's "Big Dig" fell and killed a motorist. The preliminary report indicates sub-standard concrete. In this case, the investigation is centered around

the contractor knowingly using substandard concrete to save money, and the independent testing/inspection firm who approved the concrete.

"Engineering" versus "General" Ethics

Organizations such as the National Society of Professional Engineers (NSPE) and American Society of Professional Engineers (ASCE) have very detailed guidelines pertaining to the ethical practice of engineering. For those in technology (Building Construction), other organizations such as the Associated General Contractors (AGC) also have written guidelines pertaining to ethical behavior (this paper is meant for both engineering and technology educators, therefore the term "engineering" is generic for both engineering and technology). It must be remembered that by the time college educators first meet the students, the students are at least eighteen years old. By this time, the teachings of their parent(s), as well as outside influences and experiences, have already formed the basis for their moral and ethical behavior (do not kill, do not cheat, etc.). It becomes the educators' duty to instill a more "specialized" sense of ethics, while reinforcing the general ethics.

Engineering ethics differs from general ethics in that it is directed towards a specialized area, with specific goals. The NSPE website (http://onlineethics.org/codes/NSPEcode.html) contains the 1,870 word "Code of Ethics for Engineers." The code is broke down into three main categories:

1. Fundamental Canons
2. Rules of Practice
3. Professional Obligations

While the first category (Professional Canons) can be applied to virtually any profession, the latter two are written primarily to those who engage in the practice of engineering. Herein lies the difference in engineering versus general ethics, while engineering ethics certainly contains many facets of what would be considered general ethics, it also emphasizes that there is a higher standard of conduct in the practice of engineering. This is to say that the engineer's should generally act as ethically as the general public would be expected to. However, because much of engineering deals with the health and well being of the general public, there will be times in the practice of engineering when a higher standard of honesty than would normally be expected form the general public, will be necessary.

The Importance of Teaching Ethics

By introducing students to engineering ethics, educators can hope to increase the student's awareness of issues and problems facing the industry. If anything, a "Code of Conduct" as well as using sound judgment when facing a ethical dilemma can be instilled. In industry, there are two ways to cut costs, figure out a new (innovative) method or material of production, or by "cutting corners." There are many times where the line between the two can be somewhat blurred and it is these times that the designer must decide if the changes are in the best interest of the general public or not. Construction is a field that has a relatively poor reputation in the eyes of the general public. In construction, building codes

dictate the rules and regulations for construction. As with many standards, there are sometimes contradictory codes, or gray areas which allow the contractor "wiggle" room. It is here that an ethical dilemma can arise. The contractor can choose to do what is "technically" correct, but not necessarily right, because of a poorly written building code. On the other had they can choose to perform the work in a manner that is consistent with industry standards, but more costly. The point is, there might be times when the engineer is faced with doing something that is acceptable versus doing something that is right. Codes and standards are frequently open to interpretation. There is often a difference between what the standard/code says, and the intended purpose. By teaching the student that is not only important to understand the technical aspect of said standards and codes, but to try to ascertain the intent of the standard. As a retired professor once said, "do not sight in on the tree, and lose sight of the whole forest."

Methods of Implementation

Instilling a sense of ethics into students can be done on many levels. As part of a university wide effort, many institutions have implemented programs dedicated to the elevation of ethical practice. Many college campuses now have Ethics Centers, or departments dedicated to the study of ethics. The implementation of a honor system, or more specifically a honor code is often utilized. While a campus wide program would not address "engineering" ethics specifically, it would provide for laying the groundwork for embedding the concept of ethics. Do honor codes work? A study by Professor Donald L. McCabe of Rutgers University indicates that they do. The following table summarizes a survey of students and illustrates the success of schools who utilize honor codes:

When	Private Campus with Honor Code	Large Public University with Modified Honor Code*	Campuses with No Honor Code
Exams	23%	33%	45%
Written Work	45%	50%	56%

Table 1

* a Modified Honor Code differs from a traditional code in that places more responsibility on the student as in individual.

As can be seen, although a large number of students are still cheating, there is a significant difference between those universities with an honor code versus those who do not have one. Professor McCabe also states that "perhaps equally disturbing is the ease with which many of these students are able to justify or rationalize their cheating. And often they find a convenient way to place the "blame" on others—other students who cheat; faculty who do a poor job in the classroom; *institutions that don't try very hard to address the issue of cheating; and a society that supplies few positive role models when it comes to personal integrity*[2] (emphasis added)." The fact that some student believe that the university

is complacent in their views of cheating further adds to the argument of implementation of some sort of policy. If from the very beginning of their academic careers the concept of ethics is introduced (beyond their existing concepts), an emphasis is placed on ethics throughout their career, the student is more likely to embrace and adhere to the concept.

Introducing ethical analysis within existing classes is a great method of embedding the concept of ethics. Many universities teach classes on ethics as stand alone courses. While this is an excellent idea, to instill a specific (concentrated) idea of ethics, it must be done in the engineering/technology core classes. While at the very least a single professor can implement teachings in their classes, it would obviously be more effective if the entire department injects at least a little discussion of ethics into every class in the program. The continuous "bombardment" from the faculty would show the students the importance of ethics in their chosen field and they would be less likely to forget the lessons learned.

Lectures integrating the class room discussions are supplemented by the addition of analysis of decisions that must be made. A great example would be the aforementioned Hyatt Regency disaster. Following a discussion on the theory of stress/strain or a structural design lecture, the Hyatt case study can be brought up. The student can first see the correct way of designing such a connection. Then, following a review of the case study, see how the failure to follow code and best engineering practices led to a disaster in which the public welfare was not served. It is also such a case which emphasizes the engineer's duty to perform their job to a higher standard than the general public and the potential consequences of failing to do so.

Another great way to teach ethics is to find published or write your own case studies. These should be actual, or at least feasible, problems from industry. Look at a specific area in which to study and make a case study which is relevant to the discussion. The following is an example of a case study that was shown to the author twenty years ago and is still vividly remembered.

You are a recent graduate and have been hired by a consulting engineering firm. While attending a project meeting, the concrete subcontractor submits to the Construction Manager a request to alter the below detail of a retaining wall. The retaining wall (Figure 1) is reinforced concrete with #4 (1/2") reinforcing bar (rebar). The concrete contractor has a sufficient supply of #6 (3/4") rebar left over from a previous project, and would like to substitute the #4 horizontal rebar (at the top of the wall) with the #6 he has in stock, and keep the vertical rebar as shown in the detail. He is also willing to give back a credit to the owner for the unused #4 rebar. The construction manager, who has hired your firm to do the structural engineering (design/build project), is under tremendous pressure to keep costs at a minimum because this was a lump sum project. The construction manager likes the idea of a cost credit and nods in agreement when the concrete contractor states that the additional steel would make the wall stronger (more is better). The footings are already poured and the wall is being framed and the construction manager gives the concrete contractor verbal approval to start placing the larger rebar. At this point, he turns to you as the representative of the structural engineer, to "sign off" on the change. What do you do?

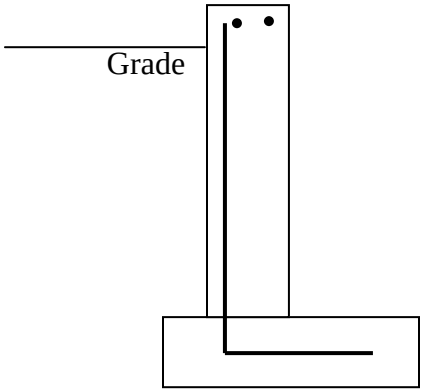

Figure 1

Make this into a class discussion involving analysis of the design change, discussion of proper procedure, and finally applicable sections of a code of ethics. The potential problems with the design change can be analyzed and proven by calculation. In this case, the sketches below show the potential problem. Concrete is stronger in compression than it is in tension, therefore it is often reinforced on the tensile site. The retaining wall below (Figure 2) shows how the wall was meant to deflect (exaggerated). By over-reinforcing the cap of the wall, it stiffens the top sufficiently to resist bending, causing the wall to deflect in the middle (Figure 3) and placing the tension in the wall where there is no reinforcing. The discussion of proper procedure would have to relate to the fact that only the engineer-of-record may sign off on any changes to the contract documents.

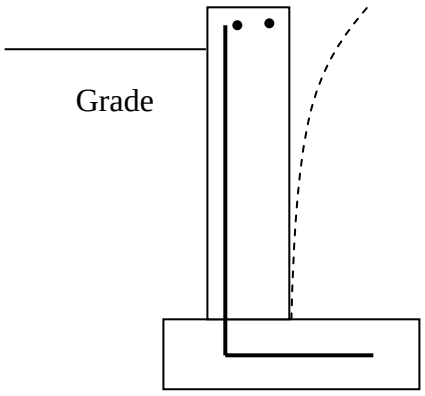

Figure 2

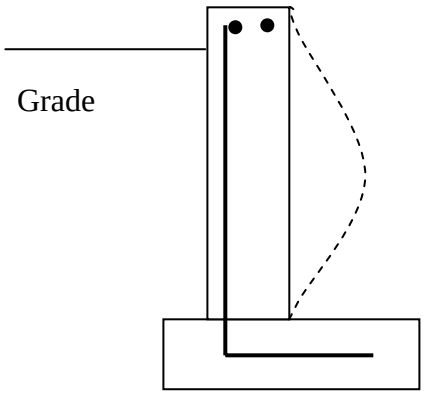

Figure 3

Finally, the ethical dilemma faced by the young engineer. In looking at the NSPE Code of Ethics[3], there are a few items in this case that potentially are in conflict with proper conduct. One such section would be as listed below:

II. Rules of Practice

1. Engineers shall hold paramount the safety, health, and welfare of the public.
    a. If engineers' judgment is overruled under circumstances that endanger life or property, they shall notify their employer or client and such other authority as may be appropriate.

This is an interesting case because the client, in this case, is the party in which is changing the detail. Classroom discussions on case studies like this are extremely beneficial because they not only help the students become active participants in the class, but they also help prepare them for such circumstances that they might actually encounter in their careers. Case studies provide the instructor with fantastic "real world" training and are worthy of inclusion in engineering/technology curriculum because many of today's engineering successes were obtained because of analysis of past failures.

Bibliographic Information

[1] http://en.wikipedia.org/wiki/Ethics
[2] http://www.collegepubs.com/ref/SFX000515.shtml
[3] http://www.nspe.org/ethics/home.asp

Biography

THOMAS DOBROWSKI is a graduate of Purdue University. Mr. Dobrowski has over twenty years of commercial and industrial construction and engineering experience. Prior to joining Purdue North Central two years ago as an Assistant Professor, Mr. Dobrowski spent fifteen years as a Guest Lecturer in the Department of Construction Technology at Purdue Calumet.