INTEGRATING ETHICS INTO THE ENGINEERED CONSTRUCTION CURRICULUM

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ABSTRACT

Construction courses in the Department of Civil and Environmental Engineering at the Pennsylvania State University focus on the subjects of planning, organization, monitoring and control of the construction projects. There is currently a scarcity of information relating to ethical conduct in these courses. Government regulations, environmental permits, and other bureaucratic controls continue to grow. Projects also continue to get larger and more technical, requiring more specialized people, high-tech equipment, and better project control systems. This trend requires that project managers have technical, business, organizational, ethical, and leadership savvy. Many new regulations and specifications (for example, those of OSHA and ACI) require construction engineers to design systems for execution of the construction process. Society demands high standards of construction professional competence and performance. Construction engineers must be aware of social responsibilities and prepare themselves to reflect critically on the moral dilemmas they may confront. In this paper the authors suggest a strategy in which an ethical framework is fundamental to the development of competent construction professionals. By presenting this topic in a holistic and robust way, ethics enhances technical expertise and provides a deeper educational experience for construction engineering students.

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1. INTRODUCTION

Construction courses in the Department of Civil and Environmental Engineering at the Penn State University focus on the subjects of planning, organization, monitoring and control of the construction projects. The emphasis of these courses is on engineering design of the construction process. Students gain the knowledge necessary to apply engineering principles to the analysis of economical approaches to construction project planning, scheduling, monitoring, and control. There is currently a scarcity of information relating to ethical conduct in these courses.

The American Society of Civil Engineers (ASCE) prescribes a body of knowledge defining knowledge, skills, and attitudes outcomes necessary for substantially greater depth and breadth of an individual aspiring to the practice of civil engineering [4]. The 15 outcomes include and begin with the 11 outcomes of the Accreditation Board for Engineering and Technology (ABET) and prescribe more technical depth and additional breadth [1]. Both ASCE and ABET cite an understanding of ethics.

The preamble to the Code of Ethics for Engineers of the National Society of Professional Engineers (NSPE) states in part: "Engineering is an important and learned profession. As members of this profession, engineers are expected to exhibit the highest standards of honesty and integrity [3]. Engineering has a direct and vital impact on the quality of life for all people [13]." The services provided by construction engineers require honesty, impartiality, fairness and equity, and must be dedicated to the protection of the public health, safety, and welfare.

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Engineers must perform under a standard of professional behavior that required adherence to the principles of ethical conduct. One ABET 2000 criterion [1] states that "Engineering programs must demonstrate that their students have an understanding of professional and ethical responsibility."

In this paper the authors suggest a strategy in which an ethical framework is fundamental to the development of competent construction professionals. By presenting this topic in a holistic and robust way, ethics enhances technical expertise and provides a deeper educational experience for construction engineering students.

2. CONCEPTUAL ETHICS MODEL

Fortunately a framework can be developed by recognizing that many laws, regulations, local ordinances, and common law have been enacted to counter unethical behavior. Most design and construction contracts incorporate language requiring all parties to comply with all laws, regulations, etc. [17]. Thus, if an engineer complies with his/her contract, they are in compliance with many ethical standards. Compliance with regulations covering professional registration covers more non-ethical situations.

The authors believe is that ethics cannot be taught; rather what can be taught is a framework for evaluating ethical dilemmas and making decisions. Because ethics instruction covers multiple dimensions, an integrated approach to the framework seems appropriate. In this paper the authors present a model for encouraging the student to compare and combine personal, legal, societal, and professional ethical models into a decision-making framework. The role of Penn State ethics

education is to provide students with at least a minimal theoretical background essential for their understanding of the role that values and ethics play in all decision-making, and an understanding of a decision making framework from which rational, ethically-sound decisions can be made.

Ethics instruction covers two broad topics. There is instruction on the moral aspects of ethics, because there are many situations that are not covered by laws, regulations, or codes of ethics. This theoretical instruction reinforces basic differences between right and wrong, societal values, loyalty, obligations, engineering society codes of conduct, organizational loyalty versus professional obligations, and responsibilities to society. The next component of instruction covers the institutions and systems that regulate and oversee professional conduct. Topics include introduction to construction law and professional liability, risk, the professional standard, and the engineering decision-making process. Instruction is enhanced through real-world case studies and guest lecturers from industry.

There are five basic means of delivering the instructional content described above. These are – 1) a required course in engineering ethics [5], 2) a required course that integrates engineering ethics with the social context of engineering [7], 3) integration of engineering ethics across the curriculum [14], 4) integrated humanities and social science programs that addresses all non-technical ABET 2000 outcomes and 5) integrated engineering related community service projects and lecture series [7].

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The theoretical introduction to ethics is appropriate at the freshman or sophomore level. Once a student has acquired a sense of the construction industry and grounding in ethical theory, it is time to address the subject of applied ethics for construction professionals. Integration of applied ethics in junior and senior level courses in the construction engineering and management program is the main focus of this paper.

The ethical decision making framework includes the following components:

1. Legal System
2. Construction law, professional liability and contracts
3. Societal values and moral behavior
4. Professional practices and employee obligations
5. Construction ethics case studies

The integrated ethics instruction is incorporated into four courses, as shown in Table 1. The first is a sophomore level course teaches morality and a theoretical understanding of right and wrong from a universal viewpoint. A junior-level course provides an introduction to contract law, professional liability, limited societal values, and aspects of professional practice. A senior-level elective course covers more details of professional practice and reinforces the concepts taught in the first two courses by ethical case studies discussion in the classroom. The use of the ethical framework is illustrated to real-world situations. The conceptual model for integration of ethics into construction is shown in Figure 1.

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Table 1. Integration of Ethics in Construction Engineering Curriculum

Level	Credit	Course Title	Dimension of Instruction	Topics
1 – Freshmen or Sophomore		CE 300 Civil Engineering Profession	Right vs. wrong (Morality)	Right and wrong (philosophical viewpoint) Societal values ASCE Code of Ethics
2 – Jr. level Course	3	CE 332 Civil Engineering Management	What you can and cannot do	Legal System Fundamentals of Contracts Fiduciary and commercial arms-length contracts Professional liability Professional registration
3 – Senior Elective	3	CE 432 Construction Estimating, Planning, and Scheduling	Decision making framework	Ethical decision making (hierarchy)
3 – Senior Capstone	3	CE 438 Construction Engineering Capstone Design	Employer obligations and ethical behavior	Ethical decision making (reconciling conflicts)

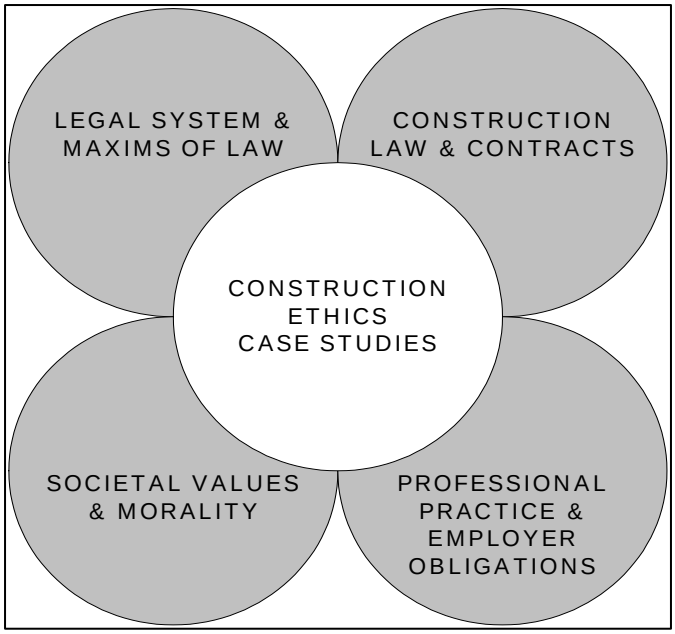

Figure 1. Conceptual Model for Integrating Ethics into Construction Curriculum

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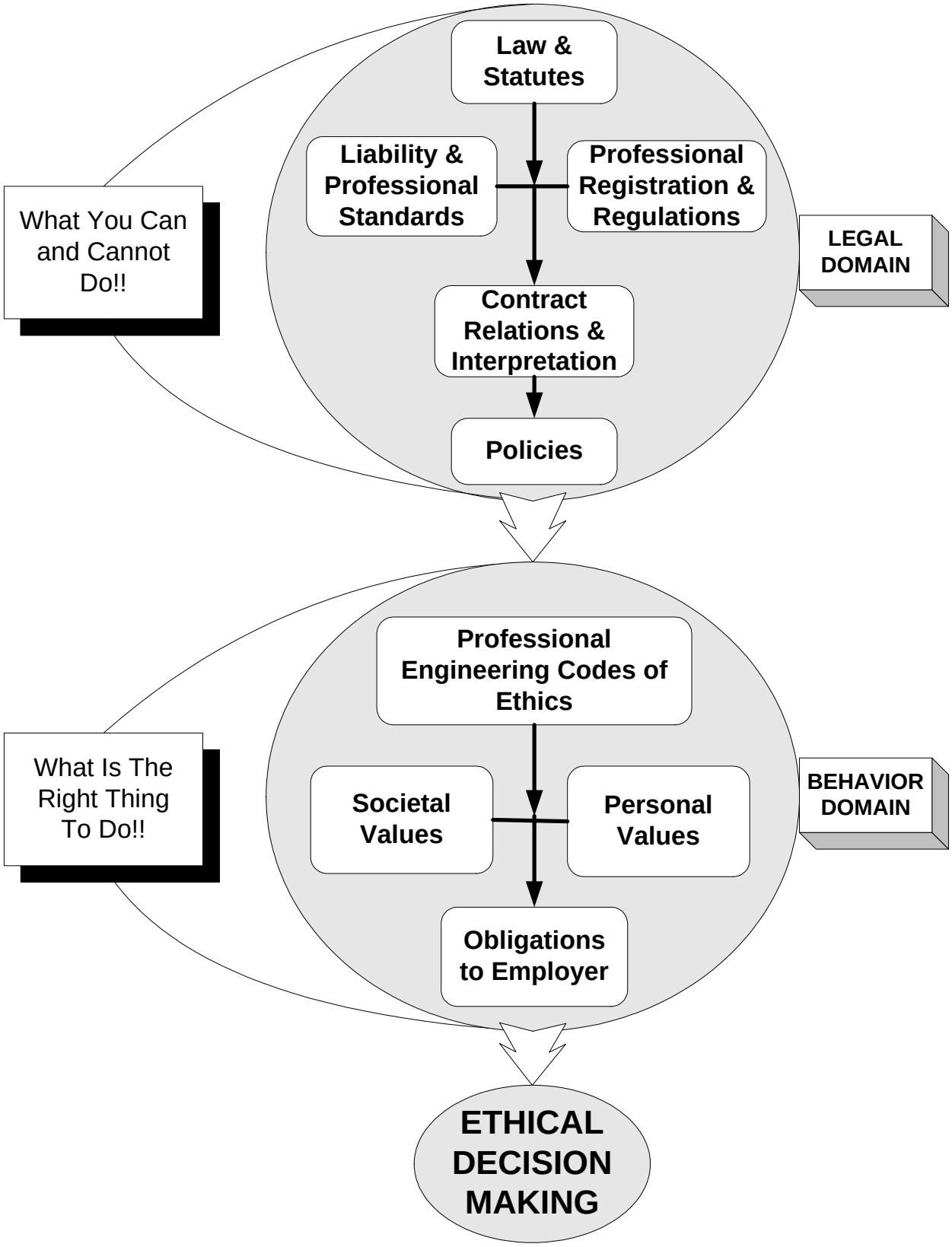

Figure 2. The framework for analysis of case studies and ethical decision making hierarchy

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3. ETHICAL DECISION-MAKING FRAMEWORK

Making ethical decisions requires knowledge of institutions, systems, and norms in two areas or domains, the: legal domain and behavioral domain. There is a loose hierarchy in that the legal domain is applied first. One must always be in compliance with the law; there is no choice. Fortunately, the two domains address different issues, and there is rarely a conflict between the two. The framework for analysis of case studies and ethical decision making hierarchy is shown in Figure 2.

3.1. LEGAL DOMAIN

The legal domain involves statutes, regulations, common law, the contract (design and construction), and policies. There is a decision hierarchy within the legal domain as is illustrated in Figure 2.

3.1.1. Statutes and Regulations

Statutes are laws passed by federal and state legislative bodies. Federal and state agencies formulate regulations to objectify the statute. Regulations have the same legal impact as statutes. One must always adhere to statutes and regulations. Regulations codify many things that professionals can do and cannot do.

Many regulations governing public procurement have been written to make unethical behavior illegal. An example of regulations on ethical behavior is illustrated by the case of U. S. Army Corps of Engineers vs. Swensen [11]. The issues involved bribery collusion, and other reprehensible actions.

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Public construction is controlled by regulation; private procurement is not controlled to the same extent. Where questions arise in private procurement practices, a good starting point is public procurement policy.

3.1.2. Liability and Professional Standards

An individual or company can be found to be grossly negligent and liable where The Professional Standard is not followed. The Professional Standard requires that all professionals act consistently with what other reasonably prudent professionals would do when similarly situated. The case of Watson, Watson, Rutland/Architect, Inc. vs. Montgomery Board of Education [16] discusses The Professional Standard. Thus, when confronted with an ethical dilemma, one should ask, what would other professionals do?

3.1.3. Professional Registration and Regulations

State agencies and Boards control professional registration rules. The rules are codified as regulations, and thus, have the same effect as the law. Gross negligence can lead to the revocation of a professional's PE license. However, there are other actions that regulations prohibit. For instance, a PE cannot practice outside his or her area of expertise. Also, one cannot seal drawings that were not prepared under one's supervision.

3.1.4. Contract Relations and Interpretation

The goal of American law is to give autonomy to contracting parties to pick the parties with whom they wish to deal and the terms on which they deal. Giving autonomy and freedom to contract promotes economic exchanges [15]. The law seeks to protect this goal.

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Contracts require that the parties follow all laws, regulations, and ordinances. If one complies with the contract, then one is in compliance with the law. There are five requirements for a valid contract. These are:

- Competent parties
- Meeting of the minds
- Proper subject matter
- Reasonable certainty of terms
- Considerations

Additionally, in public procurement and in other specific areas, such as real estate transactions, the contract may be required to be in writing. Of particular interest to ethical decision-making is the requirement for proper subject matter. The law will invalidate a contract to do something that is illegal. Thus, it is incumbent on one to know the requirements of codes, regulations, and permits. One cannot contract to do something that is illegal.

Another practice relative to contract formation that interferes with the freedom to contract is the concept of economic duress. Economic duress is illustrated by the case of Rich & Willock, Inc. and Ashton Development, Inc., [12]. In this case coercion was used to force a contractor to accept an unfavorable change proposal.

There are two types of contracts as they relate to construction projects. A contract between a designer and owner is usually viewed as a fiduciary contract and is based on trust and loyalty. A construction contract between a contractor and owner is a commercial arms-length contract. There are some actions one can take under one type that cannot be taken under the other, even though the contract language may appear similar. Much of the sub domain of contractual

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relations is governed by common law. Appellate courts create common law rules when they interpret regulations in areas that are unclear or that are not covered. Common law rules are also developed in relation to the interpretation of design and construction contracts. For example, common law requires good faith and fair dealings between the parties. Active interference or hindering the opportunity for the other party to perform is not tolerated.

One area related to contracts that particularly relates to ethical decision-making is the legal concept of *misrepresentation*. A *misrepresentation* is conveying information as being true or factual when the information is false. The communication of such information can be intentional or innocent, and either form is considered a breach of contract. Withholding of relevant information is also considered a *misrepresentation*. Of special interest herein is the intentional communication of false information and withholding of information.

An intentional *misrepresentation* often conveys that the perpetrator is attempting to induct a lower contractor bid than normally would be made had factually correct information been communicated. Courts tend to deal with intentionally incorrect information and withholding of information quite harshly, where intentional misconduct can be proven. There are instances where the misconduct has been considered fraudulent. The case of City of Salinas v. Souza & McCue Construction Co. [6] is an example of fraudulent conduct.

3.1.5. Policies

Policies are written directives that define how a company, agency, department, etc. will conduct its business affairs. Policies are included in the legal domain, although policies do not carry the

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same legal weight as laws and regulations. However, policies should not be contrary to the law or regulations.

The discussion herein is limited to written policy, as any practice worthy of consideration as policy should also be worthy of being reduced to writing. Unwritten policy is just practice, which may or may not be ethical. For instance, it may be a practice to always pay vendors and subcontractors 30 days late, but it is unlikely that this practice would be written policy. Is the institutional practice of late payments ethical? The answer must be resolved in the behavioral domain.

3.2. BEHAVIORAL DOMAIN

The behavioral domain involves professional code of ethics, professional standards, obligation to employer, societal values, and moral behavior. The study of the acceptable standards of a society is a component of schooling that is essential in helping students to become contributing, responsible and ethically mature persons. The goal is to assist young people in their growth as ethical persons who are able to contribute to the well-being of all individuals and the community. There is no decision hierarchy within the behavioral domain as is illustrated in Figure 2.

3.2.1. Professional Engineering Code of Ethics

Engineering is an important and learned profession. As members of this profession, engineers are expected to exhibit the highest standards of honesty and integrity. Engineering has a direct and vital impact on the quality of life for all people. Accordingly, the services provided by engineers require honesty, impartiality, fairness, and equity, and must be dedicated to the protection of the

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public health, safety, and welfare. Engineers must perform under a standard of professional behavior that requires adherence to the highest principles of ethical conduct [8].

A review of professional codes of ethics exposes students to the existing consensual standards of the construction industry. There is currently a scarcity of information relating to ethical codes for constructional professionals, but the codes of the engineering profession and the American Council of Engineering Consultants will suffice to instill an understanding of the thrust of these standards. Attention may also be given to the opinions of the Board of Ethical Review of the National Society of Professional Engineers, which apply provisions of the code of ethics for Professional Engineers to the ethical problems encountered by engineers. Future civil engineering professionals must demonstrate an understanding of the relationship of engineering to critical contemporary issues. They must demonstrate an appreciation for culture, history, and human behavior, as well as the environment, sustainable design, and public administration. Tomorrow's civil engineers must understand the facility life-cycle process, asset management, as well as appropriate professional codes, standards, and processes that regulate safe design. They must demonstrate knowledge of the ethical and professional responsibility of the civil engineer to improve the quality of life and contribute to the health, safety, and welfare of the population. They must also develop a commitment to practice according to these professional and ethical standards. As indicated in the ASCE policy [5], "practice of civil engineering at the professional level" means "practice as a licensed professional engineer." Civil engineer should demonstrate an understanding of and a commitment to practice according to the seven Fundamental Canons of Ethics and the associated Guidelines to Practice under the Fundamental Canons of Ethics. A thoughtful and careful weighing of alternatives when values conflict is crucial to the responsible

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conduct of engineering. The civil engineer is to hold paramount public safety, health, and welfare.

3.2.2. Societal Values

The students should have an understanding that communities and social organizations are created for the mutual growth and well-being of their members. They should also demonstrate an understanding that there are interactive relationships among individuals, communities and segments of the community. The content of instruction is divided into three parts: Traditional/Historical; Cultural/Ethnic; and Societal/Community.

Traditional/Historical

Many values are reflected historically through traditions represented by things such as religious teachings, or the lives of historical persons. Examining values from this perspective will provide students with a better understanding of how some values have their basis within the historical or traditional part of our society.

Cultural/Ethnic

Values may be derived from membership in a particular cultural or ethnic group. Students study values from the perspectives of various cultural groups in order to contribute to a better understanding of their own community.

Societal/Community

Within this perspective, students will examine values that appear to be accepted by their community and which may lead to greater understanding of societal values.

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3.2.3. Personal Values

All of the foregoing perspectives contribute to the understanding and development of an individual's personal values. These values are taught and reinforced by the home, religious institutions, and other community agencies, including the school. Personal commitment to particular values is a developmental process and results from opportunities to examine, discuss, reflect and act on values within a variety of settings.

3.2.4. Obligation to the Employer

Engineers have an obligation to their profession, their employer, and the public to make known ethical concerns in the workplace. In order to establish a healthy professional working environment, it is vital for the following conditions to exist in the workplace [9]:

- An atmosphere of trust between the employer and the employee
- An empowering environment where employees feel secure in raising and seeking the resolution of sensitive issues
- An absence of fear of employer retribution against employees for raising and seeking resolution of sensitive issues

Employees should raise and seek resolution of issues in a professional manner, and that employers should respond in a way that permits timely and effective resolution of those issues without damaging the reputation of the employee or the employer.

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4. ETHICAL CASE STUDIES

Case studies will be used to demonstrate examples of problems confronted in construction industry. These case studies again highlight issues, and point toward valid resolutions – often without the aid of a code of ethics or any other formula for determining appropriate behavior.

Some of the example case studies to be used in the classroom discussion are listed below.

4.1. Example Case Study 1: *Illegal Construction Worker*

The Sunshine Construction Company was awarded a $9.2 million project to build a middle school for the Ellsinore School District. AIA A201 (1997) [2] was used as the general conditions of the contract. The liquidated damages were $3,000 per calendar day. A time extension was unlikely. The project involved considerable amounts of masonry, so Sunshine solicited bids from various masonry subcontractors. The low bidder was HardRock Masonry. Their bid was 7.8% below the next lowest bid. After it was determined that Sunshine was the lowest bidder, Sunshine home office managers pressured HardRock to reduce their bid even further until they were 10.3% the next lowest bid. From the beginning, work on the job progressed slowly for a variety of reasons to the point that when HardRock began, the project was four weeks behind the schedule. HardRock made good progress, and after several months, the project was about 2 weeks behind schedule.

In discussions with the HardRock foreman, the Sunshine project manager learned that the masonry crews were illegal aliens from Mexico. The foreman indicated that their wages were low (by US standards), and that most craftsmen sent money to their families in Mexico who were very poor. The US wages were their primary means of subsistence. The masons were

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productive, did high quality work, and caused no disciplinary problems on the job. The Sunshine project manager was faced with a problem. If he contacted the Immigration and Naturalization Service (INS) about the illegal Mexicans, they would be deported. The disruption to the project schedule would be significant, and the Sunshine liquidated damages would amount to approximately $10,000. The home office managers would not be happy at all.

Some relevant contract language from AIA A201 [2] is:

Art. 3.3.1

The Contractor shall be solely responsible for and have control over construction means, methods, techniques . . .

Art. 3.4.2

The Contractor shall not permit the employment of unfit persons . . .

Art. 3.7.2

The Contractor shall comply with and give notices required by laws, ordinances, rules, regulations and lawful orders of public authorities . . .

A careful reading of these and other clauses of the general conditions is appropriate.

Ethical Decision –Making

1.What are the negative consequences to Sunshine if project manager contacts INS?

2.What are the negative consequences to Sunshine if project manager does not contact INS?

3.What are the negative consequences to HardRock if project manager contacts INS?

4.What are the negative consequences to masons if project manager contacts INS?

5.What should the project manager do?

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4.2. Example Case Study 2: *Construction Bid Shopping*

Jones Construction Co. was low bidder on a highway improvement project. Their bid was $17,284,317. Their bid included a $724,000 subcontract to Allegheny Construction for the installation of guide rail. After Jones was awarded the contract, they approached Bald Eagle Systems and asked if they would install the guide rail for $675,000. Bald Eagle Systems said yes. Jones then went back to Allegheny Construction, explained that they had a lower bid, and asked Allegheny Construction if they would do the work for $650,000. Allegheny Construction said yes and was subsequently awarded the subcontract.

Ethical Decision –Making

What happens to the difference between Allegheny's first bid of $724,000 and their second bid of $650,000 ($74,000)?

Is it ethical for Jones Constr. Co. to drive down Allegheny Construction's bid in this manner?

5. IMPLEMENTATION

To date the integration of ethics into civil and environmental engineering at the Penn State University has only been partially implemented in the curriculum. Theoretical introduction to ethics have been introduced in a sophomore/junior level classes. The key course module in the senior level construction engineering and project management class will start with lectures covering legal system, construction contracts, societal values, and professional ethical standards, and continued with class discussions of case studies concerning ethical construction practice. For each of the case studies the following seven panel members will actively participate in the construction engineering and project management classroom discussion and the Professor in-charge of the class will act as a moderator for each example case study discussion.

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- Attorney from law firm practicing construction law: For providing legal opinion of the construction business issues.
- Representative from federal, state or local regulatory board: For providing expert ethical opinion on the regulations governing construction practice.
- Representative from Contractor firm: Providing opinion from contractor view point.
- Representative of Owner of the project: For providing ethical issues related with construction project from the owner point of view.
- Representative from Design Firm: Providing ethical issues from the designer prospective.
- Representative from the construction project management consultants: For providing ethical issues from the consultant point of view.
- Professor form the department of Philosophy: For providing the analysis of the legal, contract, societal, and professional ethical standards from philosophical point of view.

6. MEASURING THE OUTCOME

Assessment of the engineering ethics criterion should be carried out using appropriately designed and tested student surveys, faculty surveys, employer surveys, construction professional surveys, and course exams [10]. However, probably the most effective way to demonstrate most of the desired outcomes is through student portfolios that contain samples of student essays analyzing ethical case study issues with which a practicing construction engineer may be faced. These types of essays provide opportunities to demonstrate how a student applies knowledge of different ethical theories to make a decision on what the right thing to do in a given construction engineering decision dilemma.

7. CONCLUSION

The Construction Ethics course is designed to ensure integration of the knowledge of societal values and the development of positive personal values. The goal of teaching societal values is to assist young construction engineers in their growth as ethical persons who are able to contribute to the well-being of all individuals and the community. The primary objective is to develop an understanding of community values. It is also an objective of this course is to develop the ability to recognize consequences of making ethical decisions. Professional ethics can be different from general ethics to the extent that professional ethics must take into account:

- Relations between practicing professionals and their clients,
- Relations between the profession and society in general,
- Relations among professionals,
- Relations between employee and employer, and perhaps most importantly,
- Specialized technical details of the profession.

In this paper we have suggested some techniques for introducing ethical activities into main stream construction engineering and management classes. To be a world-class professional involves a commitment to a higher level of care for those who will be affected by our civil engineering products.

8. ACKNOWLEDGEMENT

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