Report of Integration of Ethics Across the Curriculum
Civil and Environmental Engineering
Utah State University

Submitted to

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Introduction

This report provides a summary of activities carried out during the 2002-2003 academic year in the Civil and Environmental Engineering (CEE) Department at Utah State University related to preliminary efforts to integrate "ethics across the curriculum" (EAC) concepts into the undergraduate CEE program. These efforts included: 1) presentation of professional ethics/EAC concepts to the CEE faculty at a Fall faculty retreat, 2) integration of EAC concepts and specific ethics problems into a Junior-level environmental engineering science/technical communication course required of all CEE majors, 3) integration of EAC concepts and specific ethics problems into a Junior-level solid and hazardous waste course required of all environmental engineering majors Fall semester, and 4) continuation of ethics issues in a Junior-level design course required of all environmental engineering majors during Spring semester. A summary of each activity is provided below, along with examples of course materials and student/faculty responses as appropriate.

The overall experience of incorporating ethics-related problems into our curriculum has been a positive one for both the students and faculty directly involved in the instruction process. We have not been entirely successful, however, in getting the department to "buy-in" to the program. The goal for the coming academic year is to have one course in the Fall and one course in the Spring semester, outside of the environmental engineering division, incorporate EAC concepts and ethics problems somewhere in the syllabus.

Faculty Retreat Presentation

During the Fall 2002 CEE faculty retreat that is held prior to the start of Fall Semester each year, a short presentation (Appendix A) was given to the CEE faculty describing the EAC 2002 summer seminar. As part of this presentation, a short Professional Ethics quiz was given to the CEE faculty in attendance at this retreat. Twenty-one faculty took the quiz, and their responses are attached to this report as Appendix B. As can be seen from the results

of this evaluation, very few of the faculty were aware of EAC concepts, and most felt that technical material would have to be sacrificed for the ethics material, and that they would have to present large-scale, complex problems if they were to deal with ethics at all. Many of the faculty had not considered discussing professional ethics as an analogy to the engineering design method (Slide 5 of presentation), so it appears that the presentation was enlightening and of value to most of the faculty participants. A challenge was given out to the faculty at the end of the presentation to develop a professional ethics component into one course in each of our five CEE divisions, and to start a "Brown-Bag" lunch meeting once a month to discuss EAC issues with all interested parties within the Department, College and University.

This effort to incorporate Professional Ethics considerations into the CEE curricula has been wholeheartedly supported by the CEE Department Head, Loren Anderson. This support has come in the form of not only financial assistance to allow me to participate in the Summer Workshop, but has also lead to the framing and posting of the ASCE Code of Ethics throughout the teaching labs and classrooms of the CEE Department as a covert statement of the importance of Professional Ethics to the faculty and students in the program. Loren Anderson also encouraged CEE faculty to get involved in incorporating EAC issues into their courses. Only faculty in the Division of Environmental Engineering (DEE), however, generated professional ethics issues into their courses, and these DEE faculty were the only ones involved in EAC discussions throughout the academic year. It is a Department goal to broaden the presentation of professional ethics issues to other divisions within the Department so that CEE students experience professional ethics decision-making throughout their careers here at USU.

EAC Activities at the Course Level

Professional ethics issues were incorporated into four CEE courses within the DEE during the 2002-2003 academic year. These courses included: CEE 3610/CEE3870 a Junior-level environmental engineering science course/technical communication course required of all CEE majors, CEE3780 a Junior-level solid and hazardous waste course required of all environmental engineering majors, and CEE3890 a Junior-level design course required of all environmental

engineering majors. The approach used for integrating professional ethics into these courses, specific examples of professional ethics problems/issues, and student responses to professional ethics material presented in these courses are summarized below.

CEE3610/CEE3870. This course pair is presented in the first semester of the Junior year to all Civil and Environmental Engineering students as an introduction to environmental engineering science, and is used in a writing across the curriculum mode to present technical communication to the CEE students by providing them technical communication instruction and practice in the context of civil and environmental engineering. The two courses are integrated so that technical material presented in CEE3610 is used to generate technical reports and presentations for CEE3870. This course pair was the first to include professional ethics issues in their syllabus, and did so in both the science course and the technical writing course. Appendix C includes handout and exam material generated as part of CEE3610 incorporating professional ethics issues into environmental science and engineering concepts. As with many of our current courses, CEE3610 had included an ethics discussion related to the interaction between man and the environment, but the use of the ASCE Code of Ethics, its emphasis on sustainability, and the ethical responsibility the Code places on all Civil Engineers was a new, positive addition to the course. In the technical writing portion of this course pair, students were first guided through a discussion of professional ethics, and were then encouraged to develop their own codes of ethics for the group work they were to accomplish throughout the semester (for faculty notes on this experience see Appendix D). Samples of these student-generated codes of ethical conduct for their groups are attached as Appendix E. An unexpected outcome of this professional ethics activity was that for the first time in 10 years the instructor did not have to argue with a single group that Civil Engineering projects have an environmental component/impact to them. Through the review and discussion of the ASCE Code, and its emphasis on sustainability and protection of public welfare, they realized the potential environmental impact of every Civil Engineering project they were undertaking. This was a major change from previous semesters when arguments had to be made to individual groups to include environmental impact criteria for alternatives being proposed for Civil

Engineering projects. The instructor was very pleased with the outcome of this integration effort in terms of it increasing their sensitivity to ethical issues, providing them with knowledge of ethical standards of the profession, and beginning to improve their skills at dealing with ethical dilemma. This group based ethics exercise to develop standards of practice within the group setting in this course will be repeated as it was found to be a highly valuable addition to the course both to the students and the faculty. Results of the student's responses to the EAC Course Impact Survey for this course pair are included in Appendix F.

CEE3780. This required course is presented in the Fall semester of the Junior year of the Environmental Engineering major. This course emphasizes the management of solid and hazardous waste, including waste reduction, recycling, waste-to-energy and proper waste disposal. The professional ethics issues that were addressed in this class included: developing an understanding of professional code of ethics as described in the ASCE Code of Ethics, and applying the Sustainability aspect of the ASCE Code to the management and reduction of solid and hazardous waste. The ASCE Code of Ethics was reviewed with the class, and the discussions that were carried out in CEE3610/3870 were supported through clarifying discussions in CEE3780, with particular emphasis on exploring the concept of sustainability. The sustainability concept was brought up in the context of pollution prevention/waste reduction/energy conservation that is an integral aspect of CEE3780. This discussion on sustainability and professional code of conduct was continued through the application of professional practice to a situation that had been published in the May 2002 Civil Engineering magazine regarding requirements for sustainable building practices to be implemented at a Sam's Club store to be built in Madison, Wisconsin. The requirement was contested by the Wal-Mart organization after the building design was completed, but then was considered by Wal-Mart to be bad business practice for setting a publicly known precedent for future Sam's Club stores. This real case was complicated by evidence presented in the article that the Wal-Mart organization was willing to design according to the specified sustainability standard and pay the City of Madison the cost of certification ($75,000), but was not willing to be officially certified because of precedent setting concerns. The question posed for students in

CEE3780 are contained in Appendix G along with background information on the case. The students were asked to play the role of the engineer responsible for meeting the green building design standards, that were then instructed by their employer to meet less “green” (and presumably less sustainable) standards for all future construction projects. The students were asked to consider their professional ethical responsibility versus their responsibility to their employer, to consider ethical responsibilities of managers versus engineers, and to consider alternative strategies for compromises that can be made to solve this problem and make it win-win for all players.

This was an interesting real-life problem as a new Sam’s Club was being built in our community at the time of this class. The students generally responded with a business model in mind, but suggested the need for the design engineering team to quantify corporate benefits of green design practices (energy conservation, material recovery, water conservation, marketing) so that management sees the cost/benefit of these design practices rather than the costs only. These professional ethics activities fit nicely into the content of this environmental engineering topic, and will continue to be an integral part of this course. Results of the student’s responses to the EAC Course Impact Survey for CEE3780 are included in Appendix H.

CEE3890. This course is presented in the Spring semester of the Junior year of the environmental engineering major at USU. It is the first semester in a three semester long series devoted to the development (Semester 1), implementation (Semester 2), and reporting (Semester) of a Senior Design project carried out by groups of undergraduate environmental engineering students. This is the first course in the upper division of the program that devotes a significant amount of class time to the presentation and discussion of topics relevant to the profession of engineering including: professional engineering certification, the engineering design process, engineer/client/constructor relationships, plans and specifications, bidding, cost and time scheduling, proposal development, and professional ethics. It is in this course that the last professional ethics experience was provided to environmental engineering students during the 2002-2003 academic year. Two sets of professional ethics problems were posed to the students, one set dealing with

professional ethics issues that often arise during the design and construction phases of projects (Appendix I), and the other dealing with acceptable professional practice in the bidding of contracts in foreign countries (Appendix J). These case study problems were augmented, as indicated in the first problem set (Appendix I), with guidelines from the National Institute for Engineering Ethics (NIEE) for structuring solutions to ethical problems that develop in professional practice. This structured approach to professional ethics analysis was presented in the first three weeks of the semester, and students were asked to use this structured guideline to answer the ethics problems posed throughout the rest of the semester.

The student's responses to the EAC Course Impact Survey for CEE3890 are included in Appendix K. As indicated in the previous course descriptions, the students found the course increased their awareness of ethics issues, and 75% of them felt that this additional discussion increased their ability to deal with ethical issues even with the previous discussions in three other environmental engineering courses that they completed during the 2002-2003 academic year. Most (6/8) commented on the positive aspects of being exposed to the structured solutions approach from NIEE even though they might have felt that too much professional ethics was discussed in the class (5/8). Despite the fact that only two of 10 class periods were devoted to professional ethics discussions, it appears that some time is needed to let the professional ethics issues we brought up during the academic year sink in. Based on this student feedback, one additional class period in each of the subsequent Senior Design classes will be devoted to professional ethics related to engineering practice issues to reinforce the ideas and require them to practice the NIEE structured solutions approach one more time.

Conclusions

The integration of professional ethics issues into the CEE curriculum has been an interesting and rewarding process for those faculty in the Environmental Engineering Division that have been involved in the process. These faculty have been successful in reaching all of the students in the Department with at least one pair of courses (CEE3610/3870) in which professional ethics provide a significant role in supporting the educational objectives

of the program. It has been possible with the environmental engineering students to continue this introduction to professional ethics issues with additional context based ethics problems and case studies in two required, follow-on courses, one in which the ethics issues are put into a design context. Overall both the students and faculty have found this effort to be a positive one, and future efforts will be directed toward broadening the experiences our civil engineering students have in their follow-on technical elective and senior design offerings.

Appendix A - PowerPoint Presentation Given to Faculty Retreat – Fall Semester 2002, Utah State University

Appendix B - Faculty Professional Ethics Quizzes – Fall Semester 2002
CEE Faculty, Utah State University

Appendix C - EAC Related Materials in CEE3610 – Fall Semester 2002
CEE Department, Utah State University

Appendix D – Discussion of EAC Related Materials in CEE3870 – Fall Semester 2002

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In the 3rd week of class in CEE3870 – Technical Communication for Civil & Environmental Engineers, the instructor handed out the ASCE Code of Ethics. On the back side of the same sheet of paper blanks were provided for a Fundamental Principles section and a Fundamental Cannons section, and the groups were asked to interpret the ASCE Code of Ethics as it pertains to the Group Project that was assigned for the semester. As a class the group went through the ASCE Code of Ethics and discussed how it applied in a professional business setting to make sure they knew the vocabulary. Students gave examples and defined the words they used in the discussion. They were asked if this Code of Ethics applied to them or only applies after they graduate. A number of students expressed the feeling that Code did NOT apply to them as they were still students and are not a professional yet.

They were then given the math example of calculating the optimal spacing for most efficient use of a gas chamber for human exterminations. Students were asked if they felt they were ethical people. (All raised their hand). They were then asked how many would refuse to do an assignment based on their personal ethical belief (None indicated that they would have not done the assignment as it was given to them by a professor, but upon a short reflection they began to question their compliance with this assignment). After a lengthy discussion they began to indicate that they would now think about the assignments given to them in terms of their ethical content rather than just crunching the numbers.

They were then given an example in their field – the design of a guard rail with one design option to design for prevention of death that would yield higher liability, versus a design for death with lower long-term cost and liability. One student commented that there was not an ethical issue here as business is driven only by bottom line cost. Most students disagreed and suggested that these sorts of decisions were not that easy and that they didn’t have any experience in solving an ethical problem in CEE before and that they needed more time to think through a decision on this.

The class went back through the ASCE Code of Ethics to see if it was indeed relevant to the project they were doing in this class. As the class went through the Code and students brought up items that seemed not to fit, other students identified that the Code did apply to one or all of the projects that the groups were working on, i.e., confidentiality of client data did apply to one group with

a member of the group working for the company, etc. The conclusion that the class reached was that the Code, with only slight modification, applied to them right now.

They then easily sat down as groups and rewrote the code to apply to their project. Some were very specific and some were more general depending upon the projects that were being worked on. The completed group codes of ethics were submitted to the instructors for review, and outstanding group codes were selected, framed and mounted around the student study room so that the students were surrounded by their commitments to each other in the form ethical practices of group behavior. These codes remain on display in the Department along with the ASCE Code of Ethics.

Appendix E – Samples of Student Generated Group Professional Codes of Conduct for CEE3610/3870 – Fall Semester 2002
CEE Department, Utah State University

Appendix F - EAC Related Student Course Evaluations in CEE3610/3870 – Fall Semester 2002
CEE Department, Utah State University

Appendix G – Problem Statement and Background Information Used for Sam’s Club Problem CEE3780 – Fall Semester 2002 CEE Department, Utah State University

Sam’s Club Ethics Problem

Please review the attached Sam’s Club developer example problem description provided by Civil Engineering Magazine, May 2002. This problem is a very insightful one in terms of struggles that arise when different standards of practice exist throughout the country. Many examples exist where engineers are asked what they would do when practicing engineering in other countries. This is a great example of this sort of conflict within the US.

You are the Wal-Mart design engineer (a Civil & Environmental Engineer) that headed up the “Green” building design team for Madison’s new Sam’s Club, and are proud of the fact that you were able to meet strict LEED certification standards for this new super-store. You are a bit troubled, however, when the project was put on hold and you were instructed to carry on with business as usual for the 12 other new Sam’s Club projects that will begin next quarter. You remember something your old CEE instructor once told you about the ASCE Code of Professional Practice and begin to ask yourself some questions.

1. What are Wal Mart corporate responsibilities regarding implementation of ‘Green Design’ Certification throughout their corporation if they have done it very successfully for one of their facilities. You might want to go to your corporate web site to see what Wal-Mart says about their corporate environmental ethic.
2. Do you as a design engineer for this project have different responsibilities to promulgate these design ideas throughout the corporate system? Is your responsibility different from the corporate managers in Part 1? What does the code say about these issues?
3. How can these conflicts of responsibilities be resolved if they exist?
4. Was Sam’s Club remiss in “opening this can of worms” and why do you think they did so?
5. How do you feel about Sam’s Club’s approach to “solving” this “problem” with the city? What recourse did they have if any?
6. What will you suggest to upper management as a way of resolving these issues so that Wal-Mart can take the “right” course of action in the future?

Appendix H - EAC Related Student Course Evaluations in CEE3780 – Fall Semester 2002
CEE Department, Utah State University

Appendix I – Problem Statement Used for Design Process Ethics in CEE3890 – Spring Semester 2003 CEE Department, Utah State University

Professional Ethics in Practice

We have spoken a bit about professional ethics in both this class and in CEE3780, and now I would like you to analyze several professional ethics problems based on what you have learned. You should all have information on the Codes of Professional Practice for ASCE, and I would like you to use this Code as a primary reference for you answers. In addition, you should also review information at the web site of the National Institute for Engineering Ethics (www.niee.org) where you will find a range of information on engineering ethics, various Codes of Ethics, educational resources, ethics links, etc. For the next class period, February 11th, please respond to the following ethics problems.

1. Respond to the attached ethics problem "Priming the Town Pump." What would you propose to do to resolve this problem with failing pumps and media questions about the quality of the design project?
2. Please access the NIEE website and go to the "Ethics Case of the Month Club." The current Case of the Month is "Don't Ask, Don't Tell…" which has to do with design requirements for an equilization basin in a wastewater treatment plant. This case is set up to provide you with some suggested solutions to the problem, with the option for you to come up with your own. It also allows you to vote for a given answer. Please consider the answers that are presented, summarize your answer in writing for me, and submit your answer to NIEE through voting for your choice through this web page.

One nice thing about the NIEE web page is that they also provide some guidelines for structuring solutions to ethical problems that develop in your professional life. These guidelines can be found via links on the NIEE Case of the Month Club page titled "Nine basic steps to personal ethical decision making," and "Guidelines for facilitating solutions to ethical dilemmas in professional practice." I would like you to use these guidelines to formulate your answers to these two ethics problems, as they provide a simple, structured approach to addressing ethical dilemma.

ETHICS CASES IN PROFESSIONAL PRACTICE

This Forum article is a continuation of a regular series of columns on engineering ethics. The column has been generated, in part, by an interactive discussion on the Internet.

The focus of the Ethics Case program is to present real situations taken from professional practice in order to stimulate greater attention to ethical issues, and to allow Internet Web site visitors the opportunity to avoid similar pitfalls in their own careers. In addition to providing an opportunity for individuals to read and respond to the case histories, it may also provide a convenient focus for informal brown bag discussions in firms and agencies.

Those interested in this program are encouraged to visit the Web site at the following Internet address:

http://www.engr.washington.edu/epp/Pepl/Ethics
(Use of the capitalized letters as shown is important.)

Results and discussion will also appear in the Forum section of the *Journal of Professional Issues in Engineering Education and Practice*. A more detailed description of this program appeared in the January 1998 issue of this journal.

PRIMING THE TOWN PUMP

Your firm worked long and hard visiting the public works engineer and staff in the city of Elm Grove, some 150 miles from your office, to demonstrate your interest and the firm's capabilities with regard to the design of a new wastewater treatment plant that was expected to be announced in a few months.

You knew of this planned project because your receptionist's brother lives in Elm Grove and is friendly with one of the operators at the present treatment plant. As a result of that lead, you assigned one of your engineers that lives the closest to Elm Grove to attend the monthly city council meetings and spend a little time getting to know who the key players were in the public works arena.

Once the project looked as though it might become a reality, you concentrated on making your qualifications known. You realized that it might be an uphill battle, since there were already two firms in or very close to Elm Grove who had done work on public works design projects for the city over the past five to 10 years. In addition, you found out through your engineer that the public works engineer, Stan Uprite, and his two project managers ran a tight ship and had provided excellent services to the community since the director had been hired some 18 years ago.

As it turned out, your firm was responsive to the SOQ for the project, was short-listed as one of four firms (including the two local firms), submitted a thorough and somewhat innovative proposal highlighting your experience in the selection of customized treatment plant equipment, and was selected for the project.

During design of the project, your project engineer, Florence (Flo) Moore, specified a series of pumps manufactured by an excellent, but little known, company called Excelsior Pumps. When the city's project manager, Dee Taylor, reviewed the specifications for the project, she questioned the cost of the pumps and whether the anticipated maintenance-free warranty would actually hold up under use. As an alternative, she strongly recommended using a standard series of pumps manufactured in the adjoining state by Pumpco, at a purchase price approximately $20,000 below the cost of the Excelsior pump series.

Even though the long-term advantages and life-cycle savings resulting from use of the Excelsior pumps were pointed out and documented from several previous projects completed by your firm, Ms. Taylor still insisted that Pumpco should be the supplier, especially since the initial cost was lower and the city was currently in a belt-tightening mode. Since the issue grew to the point where it had the potential of damaging the relationship between your firm and the city, you finally decided with Flo Moore to specify the Pumpco equipment in the bid documents.

It is now three years after completion of the project and the *Elm Grove Gazette* has just called for you on the telephone and left a message to inform you that the treatment plant pumps have failed again for the third time in 11 months, and to ask what statement you would like to make about the situation. They are especially interested in your comments regarding who was responsible for selection of the pumps.

What do you do?

Appendix J – Problem Statement Used for Gifts to Foreign Officials Ethics in CEE3890 – Spring Semester 2003 CEE Department, Utah State University

Appendix K - EAC Related Student Course Evaluations in CEE3890 – Spring Semester 2002
CEE Department, Utah State University