

## TEAM TEACHING AN ENVIRONMENTAL ENGINEERING FRESHMAN DESIGN COURSE

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### ABSTRACT

A series of fourteen week pilot courses were developed to introduce freshman engineering students to a "realistic engineering" experience through the design analysis of an environmental related problem.

In addition to homework assignments, the students were required to make an oral presentation and to turn in a written report on their solution to the design problem. Student evaluations indicate that the course is well received and is a worthwhile experience.

This type of offering is ideal for interdisciplinary collaboration by faculty. In this pilot study faculty from Department of Civil & Environmental Engineering and the Department of Chemical Engineering, Chemistry, and Environmental Science team-taught the course. These course offerings require very little resource investment and are easily transportable to other institutions.

### INTRODUCTION

During the last five or six years the incorporation of design concepts into the freshman year has gained widespread acceptance in the United States. Spurred forward by the formation of numerous NSF sponsored Educational Coalitions the Freshman Engineering Design programs have become an integral part of the curriculum. The New Jersey Institute of Technology (NJIT), as part of the NSF sponsored Gateway Coalition, a consortium of ten engineering institutions, has instituted such a program and developed numerous discipline and interdisciplinary courses.

The basic intent of these programs is to move the traditional exposure to design concepts from senior year capstone courses into the entire undergraduate curriculum, beginning with entering freshmen. The overall objective is to introduce freshmen to the open-ended nature of design problems, to give students "hand-on" experience, to expose students to teamwork and the solution of problems by a team, and to teach students the importance of both oral and written presentation of their results.

### PROGRAMS

Two different types of courses were developed to introduce freshman to concepts of engineering design. The initial courses were seven weeks in length meeting for three hours per week and discipline based. These were followed by developing fourteen-week,

two to three hour per week interdisciplinary based courses. These were teamed taught offerings by faculty from the Civil & Environmental Engineering Department and the Chemical Engineering, Chemistry, and Environmental Science Department. This paper describes these four freshman engineering pilot courses.

## PILOT COURSES

The case studies involve the siting of some type of infrastructure or facility. The technical backgrounds required to perform the project is given by the faculty in three or four short lectures. These include the introduction of the facility, concept of site selection, and general considerations in social, environmental, political, and economical issues concerning site selection. During the lecture, videotapes about the facility were presented and a field trip was arranged for students to see the facility. The engineering design skills are developed through individual meetings with the various student design teams in a question-response mode. The questions raised by the faculty raise issues that the students might not have considered. In this way the project design is perfected over the length of the semester. The following case studies were developed for this freshman engineering design course:

1. Siting a Municipal Landfill in a Residential Community
2. Siting Selection and Analysis of a Wastewater Treatment Plant Facility

Students were then grouped into teams to site a facility in a residential area. a USGS Quadrangle map and soil survey information (prepared by the Soil Conservation Service, US Department of Agriculture) were provided to each group. Means Building Construction Cost Data was reserved in the library for students to use. Students were asked to prepare a work schedule, which should include the followings: waste/product production estimate for a community with a population of 45,000, footprint determination, preliminary site selection, sites and surrounding area study, research on environmental restrictions, research on political restrictions, economics study, cost analysis, and report preparation. Each team should select at least three sites for their detailed study and conduct a field reconnaissance of the project area.

Professors met individually with each group every week to assess their progress and discuss the problems encountered. Their progress is measured according to their proposed schedule. The students worked in an environment of a guided design. The faculty provided guidance through weekly meetings where the student team reviewed their written and verbal progress reports and plans for completion.

Each team presented a report to the entire class and faculty instructor(s) as well as other department faculty. Other teams could challenge the presenting teams in a professional manner.

Students are encouraged to use computer application programs (word process, spread sheet, presentation) and internet for information searching, computations, final report writing, and oral presentation.

The intent and the design of this course is to have the students understand the engineering design process without getting involved in too much in engineering techniques. The following table shows how the course is designed and what practice is conducted in the class.

Table 1 Course Design

Engineering Design Concepts	Practice
Project planning and scheduling	Responsibility of each member of the team
Restriction	Legislation and regulation at a selected area
Feasibility study	Map and soil information study
Alternative design	At least three sites must be investigated
Determination of the design parameters	Soil, groundwater, topography, etc.
Optimum design and decision making	Site comparison
Social, political, & environmental concerns	Team investigation
Engineering economics	Use of Means cost data

## CONCLUSION

The governing principles upon which these case studies were built include the following basic concepts:

The case study developed is transportable. It is designed to be used appropriately at any engineering school in the country. One must merely select an area in their respective locale for their specific case study.

The case study is appropriate to first or second semester freshman engineering students, but it could easily be adopted to sophomore, junior or senior level students by increasing the outcomes of the exercise.

The case study may be applied to any "appropriate" real site in the vicinity of the engineering college using the study. This allows participating students to have the ability to visit real sites under consideration.

The study is self contained and applicable to any appropriate site near the university utilizing the study. Simple and readily available local information is added by the school using the study.

From the courses offered and the assessment conducted so far, students have shown the ability to learn the basic engineering design concept, such as project planning and scheduling, restriction, feasibility study, alternative design, determination of the design parameters, optimum design and decision making, social, political, & environmental concerns, and engineering economics through these case studies.

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