

## Using Professional Mentors for Capstone Design Projects at a Distance

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### Abstract

For over ten years, the University of Hartford's Department of Civil and Environmental Engineering has used professional engineers from the local region as mentors for capstone design projects. The mentor is asked to propose a candidate project, and if the project is selected by a student group, to oversee its technical direction. The mentors become role models for the students, and by allowing students to visit their offices and job sites, give the design teams a glimpse of engineers at work. Past course evaluations by both the students and mentors show a high degree of satisfaction with the experience.

Recently, the department set up a web site that encourages alums to post information about themselves. Most cited recent or current job experience. Some were so interesting, that we thought they would make excellent capstone projects – except that they were not local. With a willing alum, and recognizing that we would have to use several forms of communication, we formulated a project using a mentor-at-a-distance.

The project selected involved the design of a highway bridge located in Chesapeake, Virginia. Parsons, Brinckerhoff, Quade and Douglas, Inc. from Norfolk, Virginia, for whom our mentor worked, was responsible for designing the bridge. They provided site drawings, copies of specifications, and other design materials. Under the guidance of the mentor, the students designed an interior beam and the roadway slab, using AASHTO's (American Association of State Highway and Transportation Officials) 16<sup>th</sup> Edition of the Standard Specifications for Highway Bridges, and VDOT (Virginia Department of Transportation) modifications to AASHTO's standard specifications.

The results of a course assessment questionnaire indicate that engineering, communication and computer skills were enhanced while management skills were not.

### 1. Introduction

The focus of a recent NSF grant awarded the University of Hartford's College of Engineering<sup>1,2</sup>, "Integrating Engineering Design with the Humanities, Social Sciences, Sciences and Mathematics", involved the reshaping of the engineering curriculum through: 1) the integration of contextualized, interdisciplinary design projects throughout the four years of the program; 2) experimental and collaborative learning; 3) partnerships with industry in the creation of "real life" engineering projects for students at all levels; 4) cross-collegiate and cross-disciplinary teams of

faculty and practitioners working together to develop the integration of curricular materials and coordination of assignments. The goal of the grant was to incorporate these objectives into all four years of the undergraduate curriculum, in a coordinated effort to expose students to the design process including all ancillary functions. As a prelude to the grant, the Department of Civil and Environmental Engineering had used, and continues to use, professional engineers from the local region as mentors for capstone design projects<sup>3</sup>. The mentor is asked to propose a candidate project, and if the project is selected by a student group, to oversee its technical direction. The mentors become role models for the students, and by allowing students to visit their offices and job sites, give the design teams a glimpse of engineers at work.

## 2. Discussion

Through faculty contacts in the local area, possible mentors are identified and approached as to their willingness to serve as counselors for capstone senior projects. Mentors are asked to: a) prepare a one page summary of the project including expected outcomes; b) be prepared to spend up to one hour per week during the semester as the project's technical advisor; c) host one meeting of the design team at the mentor's place of work; d) attend one progress report meeting at the university; e) critique the final product. The faculty member in charge of the course: a) organizes the students into teams; b) oversees the selection of projects; c) reviews team proposals including planning of the work and division of labor; d) conducts progress report meetings and keeps the project on schedule; e) assists in the preparation of the written and oral reports; f) assigns the final grade.

Recently, the department set up a web site that encourages alums to post information about themselves<sup>4</sup>. Most cited recent or current job experience. Some were so interesting, that we thought they would make excellent capstone projects – except that they were not local. Having recently been involved in a distance learning exercise, we recognized that under the right conditions, a mentor need not be from the “local” area, but could technically guide a project from a distance. One of the goals that would be sacrificed was the requirement to meet at the mentor's place of work, and for the mentor to come to the University for a progress meeting. It was observed that for the right project, the impact of sacrificing these goals might be minimal. With that in mind, we posted a solicitation on our web site for volunteers to become mentors-at-a-distance. A bridge design project in Virginia proposed by James Long, working for Parsons, Brinckerhoff, Quade and Douglas, Inc. in Norfolk, Virginia, was selected because of the project content and the fact that Jim had family connections in the Greater Hartford area, making a potential campus visit a possibility.

The project description was as follows: “The project is located in the City of Chesapeake in Southeastern Virginia. The purpose of this roadway is to reduce through traffic on the existing Route 168. The current Route 168 is similar to the Berlin Turnpike in Connecticut, a major principal arterial that is divided and currently is a major North/South route through the City of Chesapeake for local residents and vacationers headed to the Outer Banks of North Carolina. Because of increased development along the existing Route 168 corridor and increased traffic headed to the Outer Banks, it is necessary to construct a bypass around the City to move through

traffic from the existing local arterial to a divided limited access highway. Specifically, this bridge will carry an existing local road over the new Route 168 Bypass.”

Project outcomes were listed as: “Design the superstructure for the bridge carrying Route 168 Bypass over Hillcrest Parkway. Specific design tasks will include:

- Vertical and horizontal geometry verifications
- Analysis of structure using AASHTO code
- Reinforced Concrete Design of Cast-In-Place Concrete Slab using Load Factor Design (LFD) as per AASHTO Standard Specifications, and VDOT codes and standards.
- Design Non-Composite Steel Superstructure using LFD as per AASHTO Standard Specifications, and VDOT codes and standards.
- Detailing of Reinforcement for CIP Concrete Slab and Steel Superstructure as per VDOT Standards and Best Industry Practices.
- Limited Plan Preparation showing layout of bridge and final design.
- Checking of all Computations and Plans will be required.

The project began with a conference call, after a package containing site drawings, and pertinent AASHTO and VDOT sections were delivered. The students then spent some time organizing the work and preparing a Gantt chart outlining the work schedule and team assignments.

As the project moved to the performance stage, communications involved weekly conference calls, numerous e-mails, additional project material deliveries, and one face-to-face meeting between the students and the mentor. The students also availed themselves of faculty technical expertise, and the expertise of a local mentor from a different project. In addition to the conference calls, students were required to meet weekly with the faculty member in charge to report and discuss progress.

In the report phase of the project, the faculty member, and a university expert on technical writing reviewed the rough draft of the written report. Although the mentor was unable to attend the oral presentations, other project mentors rated the team on their performance and content. The oral presentations were video taped and a CD produced, and it, and the final report, were forwarded to the mentor for his review.

As a way to measure the efficacy of the endeavor, the students and the mentor completed assessment questionnaires. The 17 question evaluation had possible responses that ranged from 1 point for “Strongly Disagree” to 5 points for “Strongly Agree”. In addition the students could write in answers to two questions - “What were the most valuable aspects of the senior project?” and “What were the least valuable aspects of the senior project?”. If we group question into skill types, Table I shows the results of the evaluation. In general, all scores above 4.0 are considered “strengths”, and those below “weaknesses”

<b>SKILL CLUSTER TYPE</b>	<b>Avg. Score</b>
Engineering Skills	4.4
Communication Skills	4.1
Computer Skills	4.2
Management Skills	3.6

TABLE I

Answers to “What were the most valuable aspects of the senior project?” were:

- Teamwork
- Gathering data
- Work as an engineer
- Real World Experience
- Oral and written presentations
- Increased knowledge of what is to come after graduation

Answers to “What were the least valuable aspects of the senior project?” were:

- Input from professional mentor
- Time was limited
- I would like to have done more with more guidance
- It was hard having a long distance mentor

On the whole, all involved thought the experience was well worth the effort, although some changes will be made when the next mentor-at-a-distance project is pursued. A major change will involve more frequent contact with the mentor early on in the project, to more clearly define what is expected and to clarify technical issues.

### 1. Summary

For over ten years, the University of Hartford’s Department of Civil and Environmental Engineering has used professional engineers from the local region as mentors for capstone design projects. Recently, the opportunity to involve our seniors in a quality capstone project using a mentor-at-a-distance became available. The project involved the design of a highway bridge located in Chesapeake, Virginia. Parsons, Brinckerhoff, Quade and Douglas, Inc. from Norfolk, VA, for whom our mentor worked, were responsible for designing the bridge. They provided site drawings, copies of specifications, and other design materials. Under the guidance of the mentor, the students designed an interior beam and the roadway slab, using AASHTO and VDOT specifications. Communications involved weekly conference calls, numerous e-mails, two FED-EX deliveries, and one face-to-face meeting between the students and the mentor. All involved thought the experience was well worth the effort, although some changes involving more and in-depth communications early on in the project will be made when the next mentor-at-a-distance project is pursued.

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Donald Leone is a Professor of Civil and Environmental Engineering at the University of Hartford. He received his BCE, MCE, and Ph.D. degrees in Civil Engineering from Rensselaer Polytechnic Institute. Professor Leone has been teaching engineering for twenty-five years. He also has ten years of industrial experience as a project engineer at Pratt and Whitney Aircraft, and is a registered professional engineer in Connecticut.

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Jim Long is a Senior Structural Engineer for Parsons, Brinckerhoff, Quade and Douglas in Norfolk, Virginia. He received his BSCE from the University of Hartford, his MSCE from the University of Connecticut and is currently pursuing an MBA at the College of William and Mary. Mr. Long has been designing bridges, waterfront structures and buildings for over eight years and is a registered professional engineer in Connecticut, Virginia and Utah.