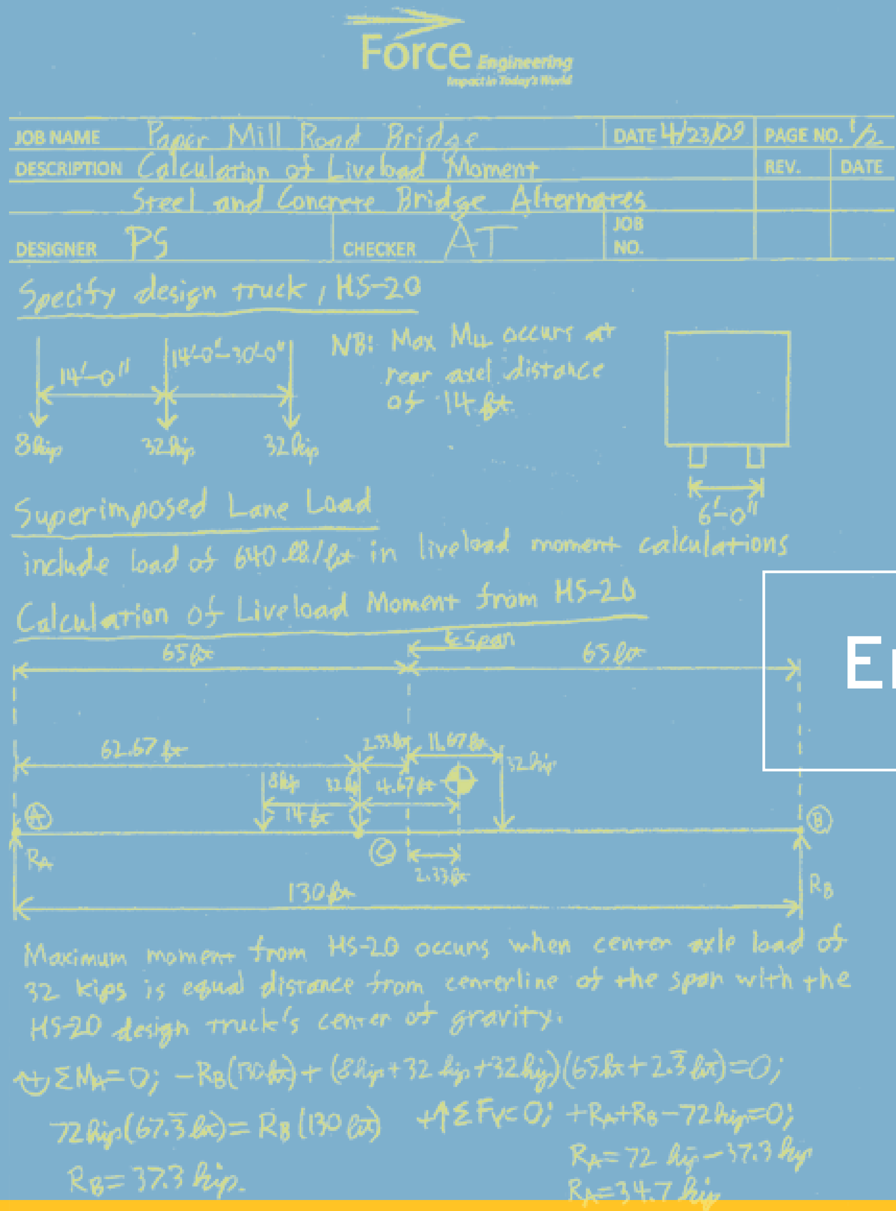

Engage. Enrich. Inspire.

NCEES Engineering Award 2010

Connecting Professional Practice and Education

NCEES

advancing licensure for engineers and surveyors

Cover art: Detail of poster submitted by the University of Delaware

2010 NCEES ENGINEERING AWARD

Engage. Enrich. Inspire.

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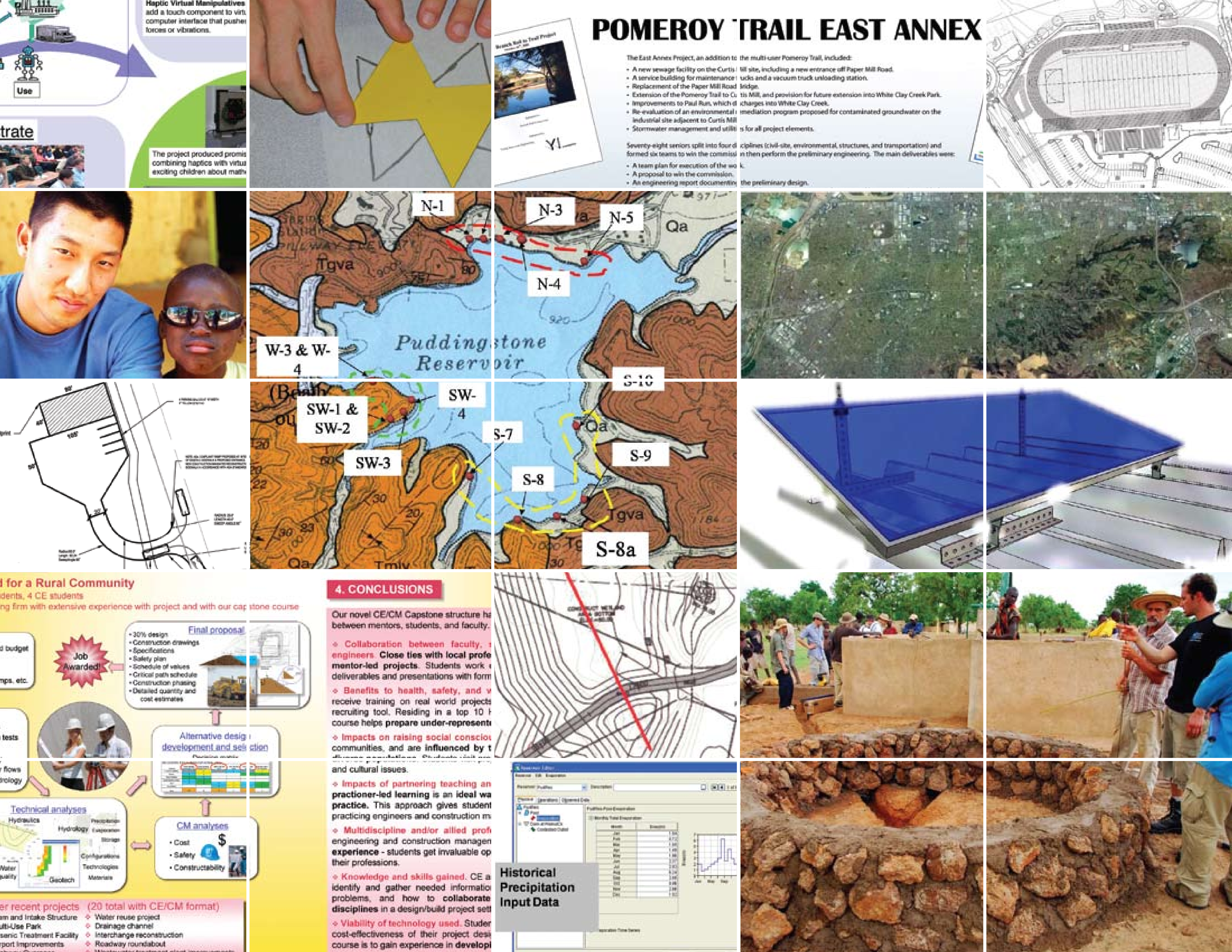

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PRESIDENT'S MESSAGE

The NCEES Engineering Award was launched in 2009 to recognize projects that engage students in collaborative activities with licensed professional engineers. These projects enrich the educational experience by showing students how classroom lessons apply to real-world engineering. By highlighting the responsibilities and privileges of licensure, these collaborations also inspire the next generation of professional engineers to commit to technical competency and ethical practice.

We at NCEES thank all of the students, faculty, and practitioners who participated in this year's projects. We appreciate your efforts to bring together professional practice and education. Special thanks also to the jury members for giving your time and expertise to support this initiative.

NCEES has published this book to recognize the 2010 winners and applaud their innovative approaches to connecting professional practice and education. We also hope that it will encourage others to "Engage. Enrich. Inspire."

David L. Whitman, Ph.D., P.E.
2009–10 NCEES President


NSPE
HOWARD
POMEROY TRAIL EAST ANNEX
WIN THE COMMISSION
DESIGN THE PROJECT
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NCEES ENGINEERING AWARD JURY

Jury members from each of the four NCEES geographical zones were chosen to represent state licensing boards, academia, and professional engineering societies.

George Gibson, P.E., Jury Chair
Oklahoma State Board of Licensure for Professional Engineers and Land Surveyors

Fred Choobineh, Ph.D., P.E.
Nebraska Board of Engineers and Architects

Howard Gibbs, P.E.
District of Columbia Board of Professional Engineering

Patty Mamola, P.E.
Nevada State Board of Professional Engineers and Land Surveyors

John English, Ph.D., P.E.
Dean, Kansas State University College of Engineering

Harvey Palmer, Ph.D., P.E.
Dean, Rochester Institute of Technology College of Engineering

Richard Schoephoerster, Ph.D., P.E.
Dean, University of Texas at El Paso College of Engineering

Bernard Berson, P.E., L.S.
National Society of Professional Engineers

James Plasker, P.E.
ABET

Richard Wright, Ph.D., P.E.
National Academy of Engineering

JUDGING PROCESS

The jury met in Clemson, South Carolina, on March 25, 2010, to conduct a blind judging of the entries, which were submitted by EAC/ABET-accredited engineering programs. Each submission consisted of a display board, abstract, and project description. The jury reviewed the abstracts and project descriptions prior to judging and viewed the display boards at the judging. The jury voted by secret ballot to establish the six award winners and, ultimately, the grand prize winner.

The jury considered the following criteria in its deliberations:

- Successful collaboration of faculty, students, and professional engineers
- Benefit to health, safety, and welfare of the public
- Impact on raising social consciousness
- Impact of partnering teaching and practice
- Multidiscipline and/or allied profession participation
- Knowledge or skills gained
- Viability of technology used
- Effectiveness of abstract and project description
- Effectiveness of display board

$25,000 GRAND PRIZE

PARTICIPANTS

Students

Force Engineering

John Boettger
Kyle Clevenger
Jeffrey Hanna
Dion Hutt
Joshua Morales
Ahwi Quacoe
Robert Schiavone
Peter Seymour
Scott Stables
Jonathan Stephens
Michael Sturgis
Andre Thompson
Jacob Voorhees
Edwin Wong

Quest Engineering

Jacquelyn Allmond
Beatrice Arreola
Meredith Davies
Amy Fitzgerald
Alexander Henderson
Colleen Kane
Anthony Park
Stracy Redis
Marie Rivers
Luigi Rogliano
Skip Sanders
Kevin Schoch
Daniel Sporik

TRW Engineering

Steven D'Ortone
Amanda Duggins
Sarah Finkle
Maria Hatgipetros
Matthew Johnson
Amanda Lusas
Thomas Miner
Eric Ngolle
Gregory Polanin
Timothy Reilly
Kailly Vay
Audrey Yorke
Graham Young

Young Innovators

Jean Baptista
Gregory Baseman
Thomas Boland
Cory Daviau
Stanley Eaton
Bernard Fortunato
Ian Jasperse
Dentin Lehr
Scott Moran
Matthew Parkhurst
Daniel Pomeroy
Samantha Sagett
Owen Smith
Shigemitsu Yoshii

Dimension T Engineering

Trevor Barry
Timothy Burke
Andrew Dubina
Matthew Fiore
Stephanie Karas
Patrick Keenan
Giuseppe Lampugnani
Sharang Malaviya
Charles Mitchell
Joshua Morabito
Jeffrey Rockwell
Emily Seaman
Timothy Senkewicz
Shawn Spencer

SECT Consulting

Ryan Becraft
Thomas Canataro
David Gostomski
Michael Harbison
Blair Jones
Erik Karlkvist
Brian McDevitt
Christine Melvin
TiAwna Moffatt
Jesus Reyes
Kyle Terry
Bryan Walker
Kyle Warren

Faculty

Michael Paul, P.E., AIA (Duffield Associates)
Brandt Butler, Ph.D., P.E. (URS Corporation)
Ronnie Carpenter, P.E. (Carpenter Engineering)
Philip Horsey, P.E., and Ted Januszka, P.E. (Pennoni Associates)
Earl (Rusty) Lee II, Ph.D., P.E.
Paul Imhoff, Ph.D., P.E.

Team Mentors

Ross Bickhart, E.I., and Thomas Coleman II, P.E. (Karins and Associates)
Joseph Challburg, E.I., and Jason Winterling, E.I. (Pennoni Associates)
Sara Henderson (Mid-Atlantic Steel)
Kevin Yezdimer, E.I. (Duffield Associates)

Professional Engineers

Charles Boland, P.E. (Greyhawk)
Jeffrey Bross, P.E. (Duffield Associates)
Robert Chagnon, P.E. (Delaware Association of Professional Engineers)
Mark DeVore, P.E. (State of Delaware)
Vincent Dills, P.E. (Merit Construction Engineers)

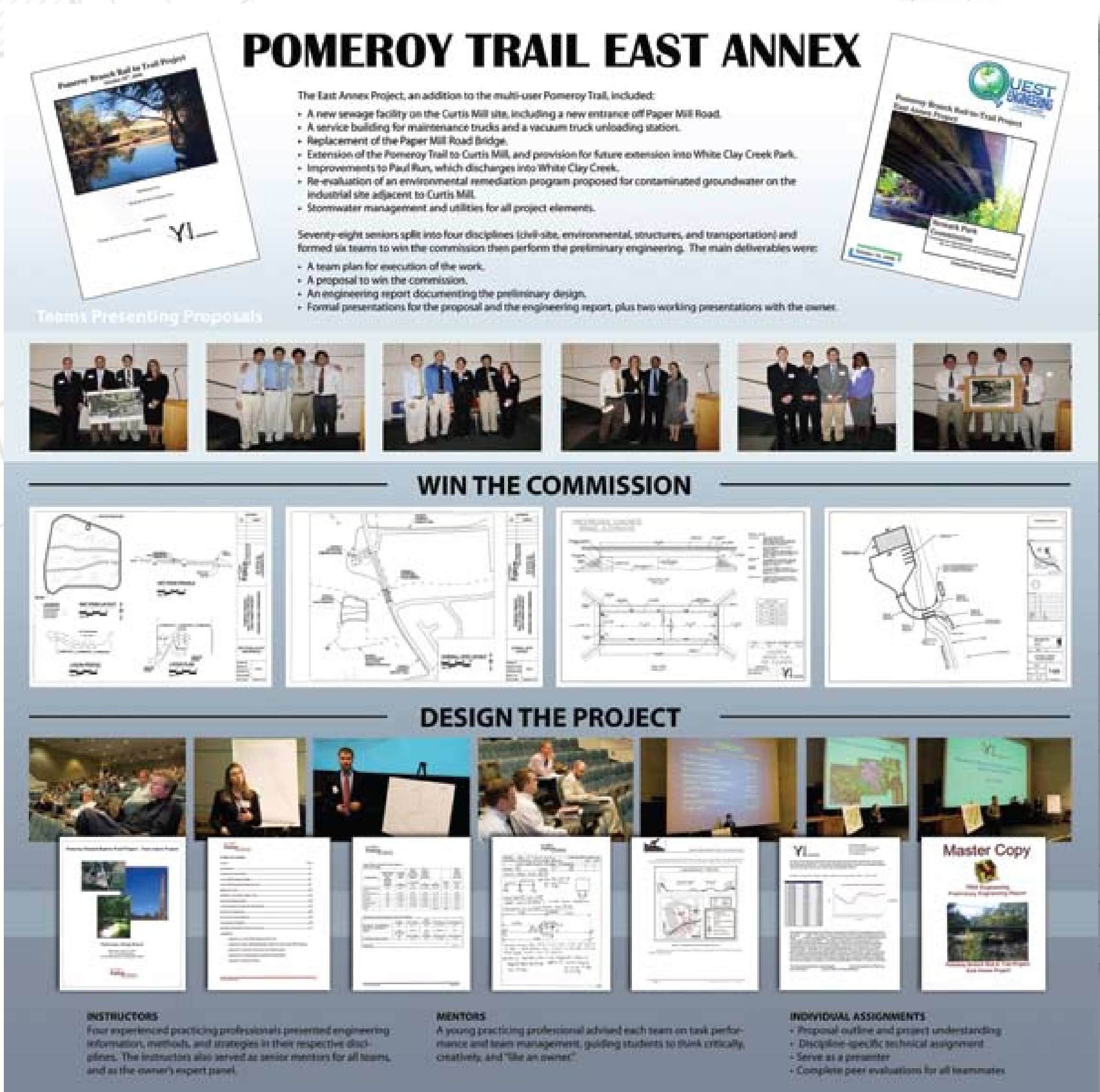
Additional Participants

Peggy Abshagen (Delaware Association of Professional Engineers)
Eugene DiPrinzio, Esq. (Young Conaway Stargatt & Taylor)
Thorpe Moeckel (Wohlsen Construction Company)
Todd Woodward, AIA (SMP Architects)

University of Delaware

Department of Civil and Environmental Engineering

Pomeroy Trail East Annex



JURY COMMENTS

"Excellent integration of 'real-world' experience in an educational setting"

"This submission demonstrated a variety of learning experiences for students that can lead them into a high level of professional, competent, and ethical practice at an early stage in their careers."

"The project involved many facets of engineering but also involved other professions. A great impact on raising social consciousness."

ABSTRACT

As part of a program to expand and enhance a multi-user trail system in and around the city, the Newark Park Commission (NPC) is planning the East Annex Project as an addition to the Pomeroy Trail, which improves the mobility of pedestrians and bicyclists throughout the city and provides an important link to the north campus.

The East Annex Project involves drainage and environmental upgrades, wastewater system improvements, reevaluation of a proposed groundwater remediation program, and infrastructure improvements in a manner that is "context sensitive" and minimizes adverse impacts to the traveling public, natural resources, and existing utilities. The main elements of the project are

- A new sewage and septage facility for the city's system on the Curtis Mill site designed for projected 20-year growth north of the White Clay Creek and including a new entrance off Paper Mill Road
- An unheated service building for the sewage facility that will house three maintenance trucks and a vacuum truck unloading station, in addition to controls and equipment for the pumping station
- Replacement of the two-lane, 130-foot span Paper Mill Road Bridge
- Extension of the Pomeroy Trail to the Curtis Mill site and provision for future extension northward into the White Clay Creek Park
- Improvements to Paul Run, which discharges into White Clay Creek near the trail extension
- Reevaluation of an environmental remediation program proposed for contaminated groundwater on the site of the former Acme Gas Works, adjacent to the Curtis Mill site
- Utilities necessary for all aspects of the project, including modification of existing utilities
- Stormwater management associated with the overall project and all of its elements

Seventy-eight seniors split into four disciplines (civil-site, environmental, structures, or transportation) and formed six teams to win the commission and then perform the preliminary engineering for the complex, multi-discipline project. Four experienced practicing professionals served as discipline instructors. Six younger engineers, all in private practice, served as team mentors. Students produced the following team deliverables, in addition to an individual technical assignment and an individual proposal assignment:

- A team plan for the execution of the work over two semesters
- A proposal to win the commission for the project
- An engineering report documenting the preliminary design of the project
- Formal presentations to the owner's panel of experts for the proposal and the engineering report, plus working presentations in two progress meetings with the owner

PERSPECTIVES ON
(Project description excerpts)

The benefit to the health, safety, and welfare of the public

The students' project was an addition to an actual large public project undertaken specifically to benefit the health, safety, and welfare of the public. Particulars of the students' project were tailored to emphasize these concerns, notably the new sewage facility, the new bridge, the extension of the recreational trail, the creek improvements, and the groundwater remediation. The instructors and several guest lecturers, who also were practicing professionals, including representatives from the state board of professional engineers, addressed the fundamental professional responsibility to public health, safety, and welfare.

The impact on raising social consciousness

Student teams were asked to formulate programs for public outreach, resulting in recommendations for online data collection, door-to-door surveys, and public meetings. One team conducted an ad hoc survey of student transportation preferences.

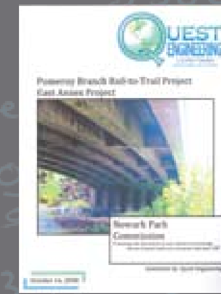
One guest lecturer presented an overview of sustainable design and green building. Most students were keenly interested in this topic, and all teams made an effort to incorporate sustainability into their designs. The sustainability theme was worked into many other aspects of the course. For example, a lecture on cost estimating involved the installation of a packaged groundwater treatment unit powered by photovoltaic energy.

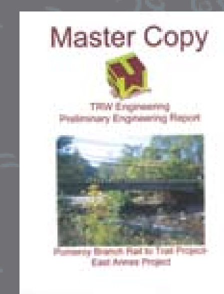
Most importantly, students were continually asked to put themselves in the owner's shoes—to make engineering recommendations and decisions on behalf of the community served.

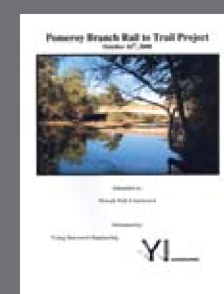
Multidiscipline and allied profession participation

Students chose, gained instruction in, applied, and coordinated the four civil engineering disciplines in their teams' work on the project. The guest lecturer on legal aspects of the project was a prominent real estate attorney. The guest lecturer on sustainable design and green building was a LEED-AP principal architect from a design firm specializing in sustainable projects.

University of Delaware







Michael Paul, P.E., AIA
(Course coordinator)

This project was part of a civil and environmental senior design course. What does using real-world projects bring to the course? When students are asked at the very beginning of the course what they most hope to gain from the course, many write that they hope to get a taste of "real-world" engineering on an actual project. At the end of the course, most of those same seniors confirm that they did gain this experience—with all of its trials and tribulations. From my perspective as the course coordinator, I believe that an important aspect of the course is introducing the many challenges of performing collaborative engineering on an open-ended design.

How do you decide which projects to work on? This, somewhat regretfully, has become our summer chore. We try to find a current or imminent local project that we can adapt to the limitations and requirements of the course and to the skills that senior civil engineering students possess. Since the coordinator and instructors all have active local practices, there is good awareness of what may be available. We are working to develop three or four prototype projects that can be reused serially, with some modest changes each time through.

How did professional engineers and engineer interns work with students on the Pomeroy Trail project? The four discipline instructors provided engineering methods and information that built on what those students should have learned in prerequisite courses. The instructors also served as "senior" mentors for all six student teams, advising on each team's engineering approach and execution and on the team's overall project management and, occasionally, team operation. The young engineers who served as team mentors were advocates for their teams, advising mostly on team organization and management and overall task performance and deliverables development.

How were other professionals involved? Other professionals, who included architects, attorneys, and professional engineers in private practice, public agencies, and construction firms, gave guest lectures on such topics as sustainable design, engineers in construction, presentations, legal aspects of projects and engineering practice, liability and risk, project delivery, and professional registration.

How did this project help students prepare for professional practice? The project and course address professional practice two ways. First, in executing the engineering for preliminary design, the civil and environmental engineering students get what for most of them is their first experience in practicing engineering—on a complex, open-ended, multidiscipline project. Second, many of the whole-group lectures address fundamental issues and responsibilities that underpin professional practice.

What's ahead for the senior design course? Our immediate challenges are developing a new project that is based on a very large, environmentally complex, real project that is being undertaken by the university and retooling the course to be able to accommodate a large jump to 100+ seniors for 2010–11.

Our longer-term challenges are to finish developing our four prototype projects and creating an instructional library for the course so that it can continue indefinitely while easily accommodating inevitable changes in instructors, mentors, guest lecturers, instructional focus, department priorities, and student needs and expectations.

What advice do you have for other programs wanting to incorporate similar collaborative projects into their curriculum? Start planning early and develop the course incrementally. Formulating the project and required deliverables adequately and appropriately takes much time and effort—and the instructors need to be on board to do this. Similarly, organizing the course, including logistics and scheduling, takes much time and effort, since it involves breaking students into balanced teams, lining up and coordinating appropriate guest lecturers, and simply accommodating the inevitable glitches that arise with such a large group of participants.

Instead of trying to create the course and project fully its first year, perhaps start by developing a multidiscipline project that is engineered by student teams. Later, add the professional-issue guest lectures and the assignment to win the commission (by generating a proposal and supporting presentation).

Contact me. I'm happy to share what we've done and help you map out your own course.

How does the University of Delaware plan to use its $25,000 prize? The department chair, Dr. Tripp Shenton, says that the department will use the prize money to support undergraduate activities and to strengthen the senior design experience. Examples of undergraduate activities include support for our student chapters of the American Society of Civil Engineers, Engineers Without Borders, and the Institute of Transportation Engineers; financial support for study abroad and undergraduate research; and financial support for students to attend regional and national meetings and conferences. The senior design experience will be enhanced with new technology and support for field trips or events related to the current project.

POINTS OF VIEW

Brandt Butler, Ph.D., P.E. (Instructor)
Ronnie Carpenter, P.E. (Instructor)
Joseph Challburg, E.I. (Team mentor)
Thomas Coleman II, P.E. (Team mentor)
Philip Horsey, P.E. (Instructor)
Kevin Yezdimer, E.I. (Team mentor)

Why did you get involved with the University of Delaware senior design course?

Butler: I first became involved because a colleague asked me to replace her as an instructor. I have stayed because of the opportunity to work with and mentor young engineers, connect with the current curricula, and identify potential new hires.

Carpenter: I have always enjoyed mentoring current college graduates in the various consulting firms where I have been employed. I particularly enjoy how hungry they are to learn something new. Executing the design project with seniors is a bit different in the sense that you can see a large change in their abilities over the two semesters. Through their course curriculum, they have learned fundamentals, and the format of the senior design course helps them figure out, on their own, how to apply their skill sets.

Challburg: I enjoyed being a part of a great team my senior year (2006–07) and decided to share my experiences with the seniors and also work with the senior design professionals.

How did you assist the student teams in the Pomeroy Trail project?

Coleman: I assisted two teams over the course of the year, mostly by asking questions that forced each team to think like the owner/client. As the year progressed, I would help the teams by sitting in as a substitute owner during practice presentation sessions, giving feedback and asking questions during their trial Q&A that tested their knowledge of the project.

Horsey: The discipline instructors provide course lectures, similar project examples, and design samples for the students' use during the project's year-long course. We also work with the students to assist the teams, shape their project direction, and provide insight to help guide their project design decisions.

Yezdimer: My main role was to assist the team in their own thought process, project development, and approaches to various design elements without providing direct answers.

How did this project help prepare students for professional practice?

Challburg: I believe that this project allowed students to work on a real-world project and perform specific engineering duties within a team atmosphere as they would in an engineering firm.

Butler: Building on the critical thinking and analytical skills learned as undergraduates, the project helped the students tackle new concepts and assignments that they had not studied in prior classes. In addition, they built their written communication skills. The students prepare technical memos for their submittals. The memo format forces students to structure their work in a specific framework that enables a quick overview of the contents and findings, followed by a more detailed discussion and conclusions, much as they would in their professional careers.

Coleman: This project forces students to work together on a scale that is not usually encountered outside of a real work experience. Up until this point, projects have usually been handled by three people at most and have been focused in one aspect of a project, be it a design of a building, wastewater treatment plant, etc.

What did you learn from working with the students?

Carpenter: I learned that these students are free thinkers when it comes to a design process and that they can be active learners when engaged. Since they do not yet know the constraints of design within private practice, they do not have a tendency to recycle ideas. Ultimately, this fosters unique solutions. Consulting firms can certainly take advantage of such a resource.

Horsey: The students' enthusiasm for the project and their team's success each year reenergizes me for my professional work. I am impressed more and more every year.

Coleman: Each year, I am impressed with the increasing level of technical knowledge possessed by students. Some of the programs and Web-based networking tools being used every day by university students would put a lot of businesses' to shame.

What did you want the students to take away from working with professional engineers and engineer interns?

Yezdimer: My goal is to assist the students with becoming more experienced, marketable, and valuable to potential employers.

Butler: I want them to better understand what it means to be a professional. That is, a professional in the execution of their individual work, a professional in fulfilling their responsibilities to their teammates, and a professional in their communication and presentation to clients.

$7,500 AWARD

PARTICIPANTS

Students

All 617 members of the 2006 to 2009 graduating senior classes

Faculty

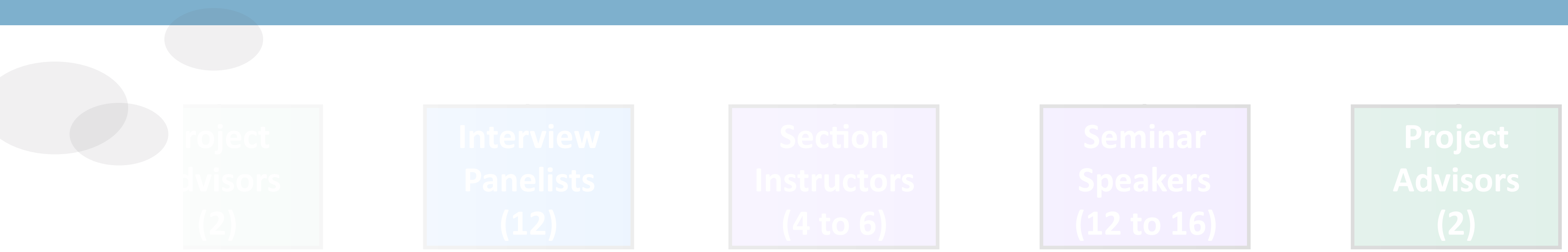
Gregg Fiegel, Ph.D., P.E., G.E.
Jay DeNatale, Ph.D., P.E.
Charles Chadwell, Ph.D., P.E.
Ashraf Rahim, Ph.D., P.E.

Professional Engineers

David Akers, P.E. (California-Nevada Cement Promotion Council)
David Beard, P.E.; Ronald Richman, P.E., EG, GEO; Paul Valadao, P.E.; and Sara Von Schwind, P.E. (California Department of Transportation District 5)
Robert Bein, P.E., and Michael Chesney, P.E. (RBF Consulting)
Jonathan Blanchard, P.E., G.E. (Fugro West)
John Blasius, P.E. (Parsons Corporation)
Bradford Brechwald, P.E., P.L.S.; Craig Campbell, P.E.; and Cheryl Lenhardt, P.E. (Wallace Group)
Michael Cannon, P.E.; John Evans, P.E.; Susan Roberts, P.E., P.L.S.; and Jeffrey Spannbauer, P.E. (Cannon Associates)
Joseph Covello, P.E. (The Covello Group)
Keith Crowe, P.E., P.L.S.
Frank Cunningham, P.E., and Michael Nunley, P.E. (AECOM)
Kevin Devaney, P.E. (Matrix Consulting Engineers)
Diane Dostalek, P.E., P.L.S.
Donald Druse, P.E. (Rick Engineering Company)
Jennifer Epp, P.E. (Central Coast Regional Water Quality Control Board)
John Falkenstien, P.E. (City of El Paso de Robles)
Christine Halley, P.E. (T.J. Cross Engineers)
John Hollenbeck, P.E. (San Luis Obispo County Department of Public Works)
Ken Lindberg, P.E. (Power Engineering Contractors)
Dale Melville, P.E. (Provost & Pritchard Engineering)
Michael Montoya, P.E. (California Polytechnic State University)
Edward Nowatzki, Ph.D., P.E. (NCS Consultants)
James O'Brien, P.E. (American Society of Civil Engineers)
Frank Rollo, P.E., G.E. (Treadwell & Rollo)
John Smith, P.E. (Tartaglia Engineering)
Scott Stokes, P.E. (Above Grade Engineering)
Russell Thompson, P.E. (City of Atascadero)
Lawrence Totten, P.E. (Johnson Western Gunite)
James Van Beveren, P.E., G.E. (Shannon & Wilson)
Robert Vessely, P.E. (Robert Vessely Civil & Structural Engineering)

Additional Participants

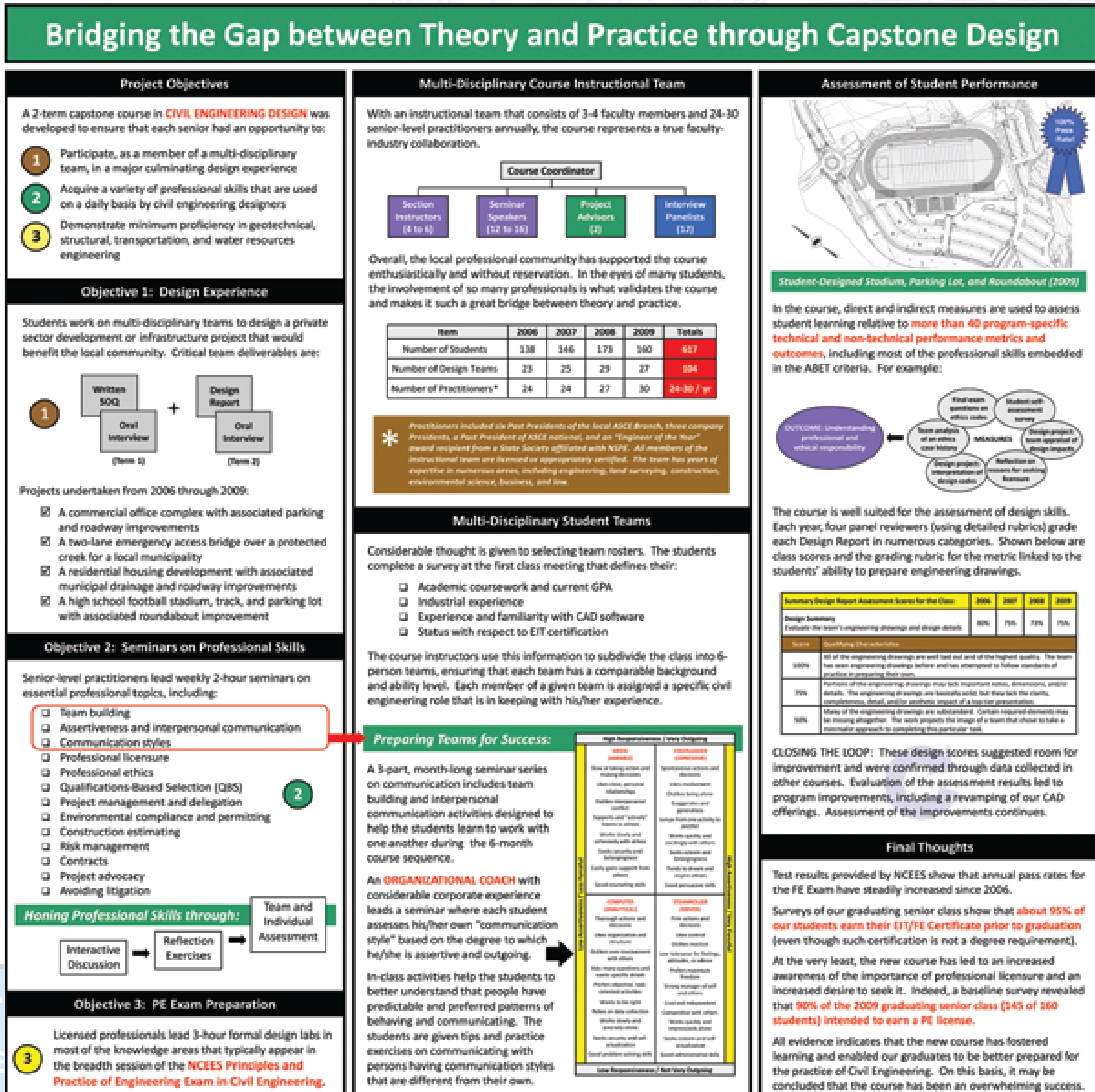
William Boucher (City of Morro Bay)
Chris Clark, JD, AICP (Crawford, Multari, Clark & Moore)
Brad Parker (San Luis Coastal Unified School District)
Ralph Schell and Patty Whelen, JD (Cannon Associates)
Marcy Villa (Organizational Coaching Inc.)



California Polytechnic State University, San Luis Obispo

Civil and Environmental Engineering Department

Bridging the Gap between Theory and Practice through Capstone Design



Bridging the Gap between Theory and Practice through Capstone Design

Project Objectives

A 2-term capstone course in CIVIL ENGINEERING DESIGN was developed to ensure that each senior had an opportunity to:

1. Participate, as a member of a multi-disciplinary team, in a major culminating design experience
2. Acquire a variety of professional skills that are used on a daily basis by civil engineering designers
3. Demonstrate minimum proficiency in geotechnical, structural, transportation, and water resources engineering

Objective 1: Design Experience

Students work on multi-disciplinary teams to design a private sector development or infrastructure project that would benefit the local community. Critical team deliverables are:

1: Written SOQ, Oral Interview (Term 1) + Design Report, Oral Interview (Term 2)

Projects undertaken from 2006 through 2009:

- ☑ A commercial office complex with associated parking and roadway improvements
- ☑ A two-lane emergency access bridge over a protected creek for a local municipality
- ☑ A residential housing development with associated municipal drainage and roadway improvements
- ☑ A high school football stadium, track, and parking lot with associated roundabout improvement

Objective 2: Seminars on Professional Skills

Senior-level practitioners lead weekly 2-hour seminars on essential professional topics, including:

- Team building
- Assertiveness and interpersonal communication
- Communication styles
- Professional licensure
- Professional ethics
- Qualifications-Based Selection (QBS)
- Project management and delegation
- Environmental compliance and permitting
- Construction estimating
- Risk management
- Contracts
- Project advocacy
- Avoiding litigation

Honing Professional Skills through: Interactive Discussion → Reflection Exercises → Team and Individual Assessment

Objective 3: PE Exam Preparation

Licensed professionals lead 3-hour formal design labs in most of the knowledge areas that typically appear in the breadth session of the NCEES Principles and Practice of Engineering Exam in Civil Engineering.

Multi-Disciplinary Course Instructional Team

With an instructional team that consists of 3-4 faculty members and 24-30 senior-level practitioners annually, the course represents a true faculty-industry collaboration.

Course Coordinator: Section Instructors (4 to 6); Seminar Speakers (12 to 16); Project Advisors (2); Interview Panelists (12)

Overall, the local professional community has supported the course enthusiastically and without reservation. In the eyes of many students, the involvement of so many professionals is what validates the course and makes it such a great bridge between theory and practice.

Item	2006	2007	2008	2009	Totals
Number of Students	138	146	173	160	617
Number of Design Teams	23	25	29	27	104
Number of Practitioners*	24	24	27	30	24-30 / yr

* *Practitioners included six Past Presidents of the local ASCE Branch, three company Presidents, a Past President of ASCE national, and an "Engineer of the Year" award recipient from a State Society affiliated with NSPE. All members of the instructional team are licensed or appropriately certified. The team has years of expertise in numerous areas, including engineering, land surveying, construction, environmental science, business, and law.*

Multi-Disciplinary Student Teams

Considerable thought is given to selecting team rosters. The students complete a survey at the first class meeting that defines their:

- Academic coursework and current GPA
- Industrial experience
- Experience and familiarity with CAD software
- Status with respect to EIT certification

The course instructors use this information to subdivide the class into 6-person teams, ensuring that each team has a comparable background and ability level. Each member of a given team is assigned a specific civil engineering role that is in keeping with his/her experience.

Preparing Teams for Success:

A 3-part, month-long seminar series on communication includes team building and interpersonal communication activities designed to help the students learn to work with one another during the 6-month course sequence.

An ORGANIZATIONAL COACH with considerable corporate experience leads a seminar where each student assesses his/her own "communication style" based on the degree to which he/she is assertive and outgoing.

In-class activities help the students to better understand that people have predictable and preferred patterns of behaving and communicating. The students are given tips and practice exercises on communicating with persons having communication styles that are different from their own.

Assessment of Student Performance

Student-Designed Stadium, Parking Lot, and Roundabout (2009)

In the course, direct and indirect measures are used to assess student learning relative to more than 40 program-specific technical and non-technical performance metrics and outcomes, including most of the professional skills embedded in the ABET criteria. For example:

OUTCOME: Understanding professional and ethical responsibility ← MEASURES: Final exam questions on ethics codes; Student self-assessment survey; Design project: team appraisal of design impacts; Reflection on reasons for seeking licensure; Design project: interpretation of design codes; Team analysis of an ethics case history

The course is well suited for the assessment of design skills. Each year, four panel reviewers (using detailed rubrics) grade each Design Report in numerous categories. Shown below are class scores and the grading rubric for the metric linked to the students' ability to prepare engineering drawings.

Summary Design Report Assessment Scores for the Class	2006	2007	2008	2009
Design Summary Evaluate the team's engineering drawings and design details	80%	75%	73%	75%

Score	Qualifying Characteristics
100%	All of the engineering drawings are well laid out and of the highest quality. The team has seen engineering drawings before and has attempted to follow standards of practice in preparing their own.
75%	Portions of the engineering drawings may lack important notes, dimensions, and/or details. The engineering drawings are basically solid, but they lack the clarity, completeness, detail, and/or aesthetic impact of a top-tier presentation.
50%	Many of the engineering drawings are substandard. Certain required elements may be missing altogether. The work projects the image of a team that chose to take a minimalist approach to completing this particular task.

CLOSING THE LOOP: These design scores suggested room for improvement and were confirmed through data collected in other courses. Evaluation of the assessment results led to program improvements, including a revamping of our CAD offerings. Assessment of the improvements continues.

Final Thoughts

Test results provided by NCEES show that annual pass rates for the FE Exam have steadily increased since 2006.

Surveys of our graduating senior class show that about 95% of our students earn their EIT/FE Certificate prior to graduation (even though such certification is not a degree requirement).

At the very least, the new course has led to an increased awareness of the importance of professional licensure and an increased desire to seek it. Indeed, a baseline survey revealed that 90% of the 2009 graduating senior class (145 of 160 students) intended to earn a PE license.

All evidence indicates that the new course has fostered learning and enabled our graduates to be better prepared for the practice of Civil Engineering. On this basis, it may be concluded that the course has been an overwhelming success.

JURY COMMENTS

"This school has an excellent program in place that gives its students a real appreciation for the licensure process."

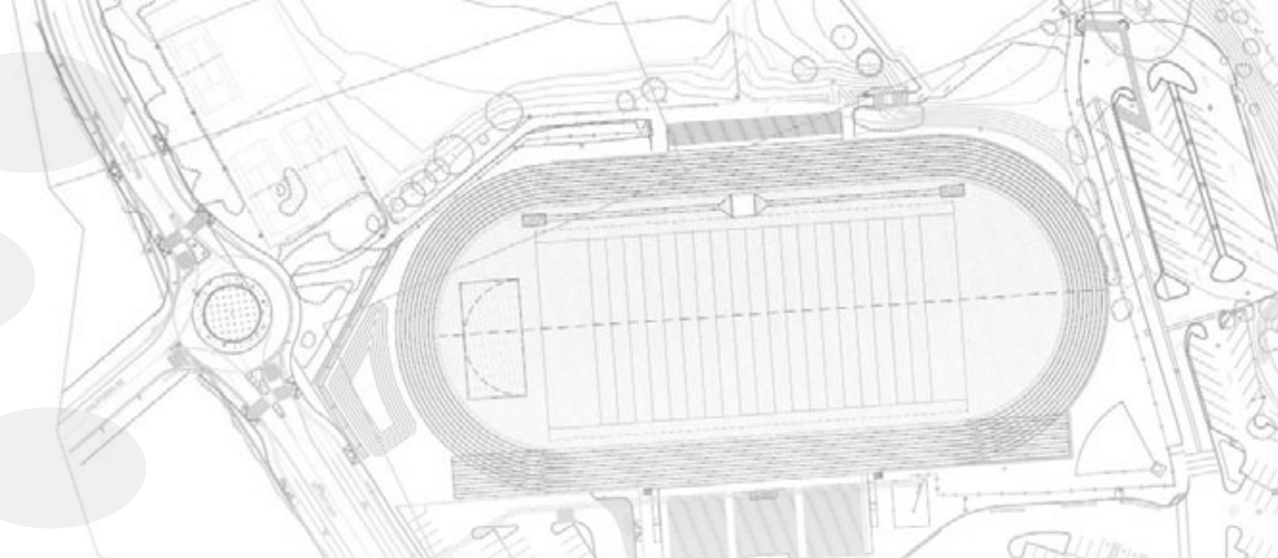
"A high level of involvement of practicing, licensed P.E.s with course content that encompassed not only a broad range of technical elements but also essential nontechnical issues and skills"

"This approach to capstone design could be implemented by all large civil engineering programs."

ABSTRACT

In 2006, the civil engineering capstone design experience at our university changed from an individual study offering to a highly structured, two-term course sequence that includes both lecture and laboratory activities. The entire graduating senior class completes the course sequence at the same time, and each student enrolled receives identical instructions. This change was motivated by a number of concerns shared by the department, its Industrial Advisory Board, and ABET, including: (1) the need for required instruction in a variety of essential nontechnical issues such as communication styles, assertiveness and interpersonal communication, team building, professional licensure, professional ethics, qualifications-based selection (QBS), project management and delegation, environmental compliance and permitting, sustainability, professional liability insurance, risk management, contracts, project advocacy, and avoiding litigation; (2) the need for a truly multidisciplinary capstone design experience that involves a consideration of such influential nontechnical issues as community acceptance, constructability, cost, safety, serviceability, and sustainability; (3) the need for uniformity with respect to both the scope of the senior-level capstone design experience and the assessment of individual student performance; and (4) the need for a class structure that is economical and results in a very high rate of student success.

The new capstone design sequence has five very unique features. First, the instructional team consists of four tenured/tenure-track faculty and over two dozen senior-level practitioners. As such, it is a true university-industry collaboration. Second, all members of the instructional team are licensed professional engineers or appropriately certified non-engineering practitioners. Third, the course is a true hybrid, covering important technical aspects of civil analysis as well as essential non-technical issues and skills that must be understood and mastered to become a successful design professional. Fourth, the organizational structure of the course permits it to be effectively used with a graduating senior class of as many as 180 (and possibly more) students. Finally, the course is a critical component of the civil engineering program's internal assessment process, since the various in-class activities, outside-of-class projects, oral presentations, and examinations permit direct measurement of many different performance metrics and program outcomes.



Item	2006	2007	2008	2009	Totals
Number of Students	138	146	173	160	617
Number of Design Teams	23	25	29	27	104
Number of Practitioners	24	24	27	30	24-30 / yr

High Responsiveness / Very Outgoing

Low Assertiveness / Less Forceful | High Assertiveness / Very Forceful

MEDIC (AMIABLE)	CHEERLEADER (EXPRESSIVE)
Slow at taking action and making decisions	Spontaneous actions and decisions
Likes close, personal relationships	Likes involvement
Dislikes interpersonal conflict	Dislikes being alone
Supports and "actively" listens to others	Exaggerates and generalizes
Works slowly and cohesively with others	Jumps from one activity to another
Seeks security and belongingness	Works quickly and
Easily gains support from others	
Good counseling skills	Good persuasive skills
COMPUTER (ANALYTICAL)	**STEAMROLLER (DRIVER)**
Thorough actions and decisions	Firm actions and decisions
Likes organization and structure	Likes control
Dislikes over-involvement with others	Dislikes inaction
Asks many questions and wants specific details	Low tolerance for feelings, attitudes, or advice
Prefers objective, task-oriented activities	Prefers maximum freedom
Wants to be right	Strong manager of self and others
Relies on data collection	Cool and independent
	Competitive with others

* *Practitioners included six Past Presidents of the local ASCE Branch, three company Presidents, a Past President of ASCE national, and an "Engineer of the Year" award recipient from a State Society affiliated with NSPE. All members of the instructional team are licensed or appropriately certified. The team has years of expertise in numerous areas, including engineering, land surveying, construction, environmental science, business, and law.*

California Polytechnic State University, San Luis Obispo

The impact on raising social consciousness
Civil engineering is truly a people-serving profession, so the primary outside-of-class activity focuses on a specific private development or infrastructure project that would benefit one of the local communities.

This requires the students to familiarize themselves not just with the applicable engineering codes and standards but also with the various planning documents that lay out the municipality's vision for the future. Student statements of qualifications and design reports are expected to address issues such as environmental compliance/permitting and project advocacy in the context of community review, and many of the questions posed during the 50-minute interviews are designed to reveal the students' appreciation for these issues.

Multidiscipline or allied profession participation
With an instructional team that consists of 3–4 faculty and 24–30 practitioners, the course is a true faculty-industry collaboration. The practitioners bring with them years of experience in numerous areas, including engineering, land surveying, construction, environmental science, business, and law.

Overall, the ability of the multidisciplinary instructional team to work together to achieve course outcomes sets a terrific example for the students. Those who participate on the instructional team genuinely enjoy the experience of working with the students and collaborating with other professionals. In the eyes of many of the students enrolled, the enthusiastic involvement of so many design professionals as section instructors, speakers, project advisors, and interview panel members is what validates the course and makes it such a great bridge between theory and practice.

To be sure, a course of this breadth and degree of realism simply would not be possible without the participation of our practitioner partners.

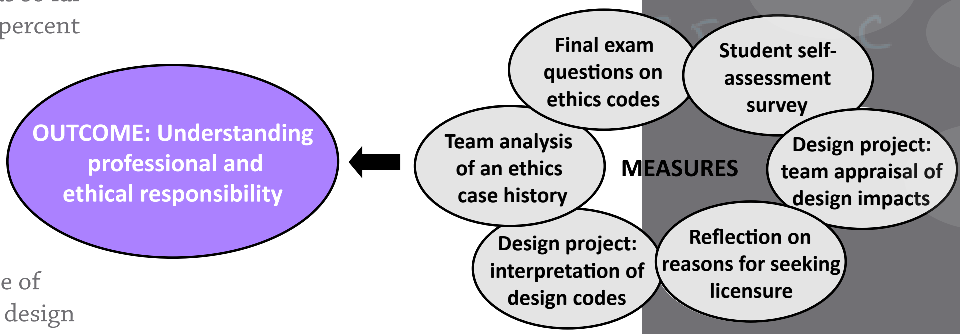
The knowledge or skills gained
Over 600 civil engineering majors have completed the new senior design sequence during the past four years. The new lecture-lab format has corrected the two most nagging administrative issues with the old individual study format: project completion and project grade. The use of a structured delivery method—with common activities, assignments, and assessment standards—has so far led to completion rates of 100 percent and has brought the average grade awarded in the capstone course back in line with the department average for its senior-level electives.

Most of our recent graduates have not yet qualified (by virtue of insufficient post-baccalaureate design experience) to sit for the PE exam, so it's not yet possible to measure the effect this course has had on pass rate. However, test results provided by NCEES show that annual pass rates for the FE exam have steadily increased since 2006.

In addition, surveys of our graduating senior class conducted during the past four years reveal that about 95 percent of our students earn their engineer intern certification prior to graduation (even though such certification is not a degree requirement).

At the very least, the new course has led to an increased awareness of the importance of professional licensure and an increased desire to seek it. Indeed, a baseline survey conducted as part of the 2009 senior design course revealed that 90 percent of this year's graduating senior class (145 of 160 students) intended to earn a P.E. license.

All evidence indicates that the new course has fostered learning and enabled our graduates to be better prepared for the practice of civil engineering. On this basis, it may be concluded that the course has been an overwhelming success.



$7,500 AWARD

PARTICIPANTS

Students

Eddie Adwards
Luz Arteaga
Carineh Babakhan
Roger Baltayan
David Bou
Meisha Chavez
Hamilton Chin
Hein Chu
Thien Chu
Ana Coria
Markows Daus
Rashmikant Dixit
Jahayra Gastelum
Nelson Gines
Lawrence Lopez
Abner Nerio
Edgar Perez
Julio Perez
Shant Saiyan
Alexandre Santini
Roberto Sedano
Tom Siebels
Richie Woo

Faculty

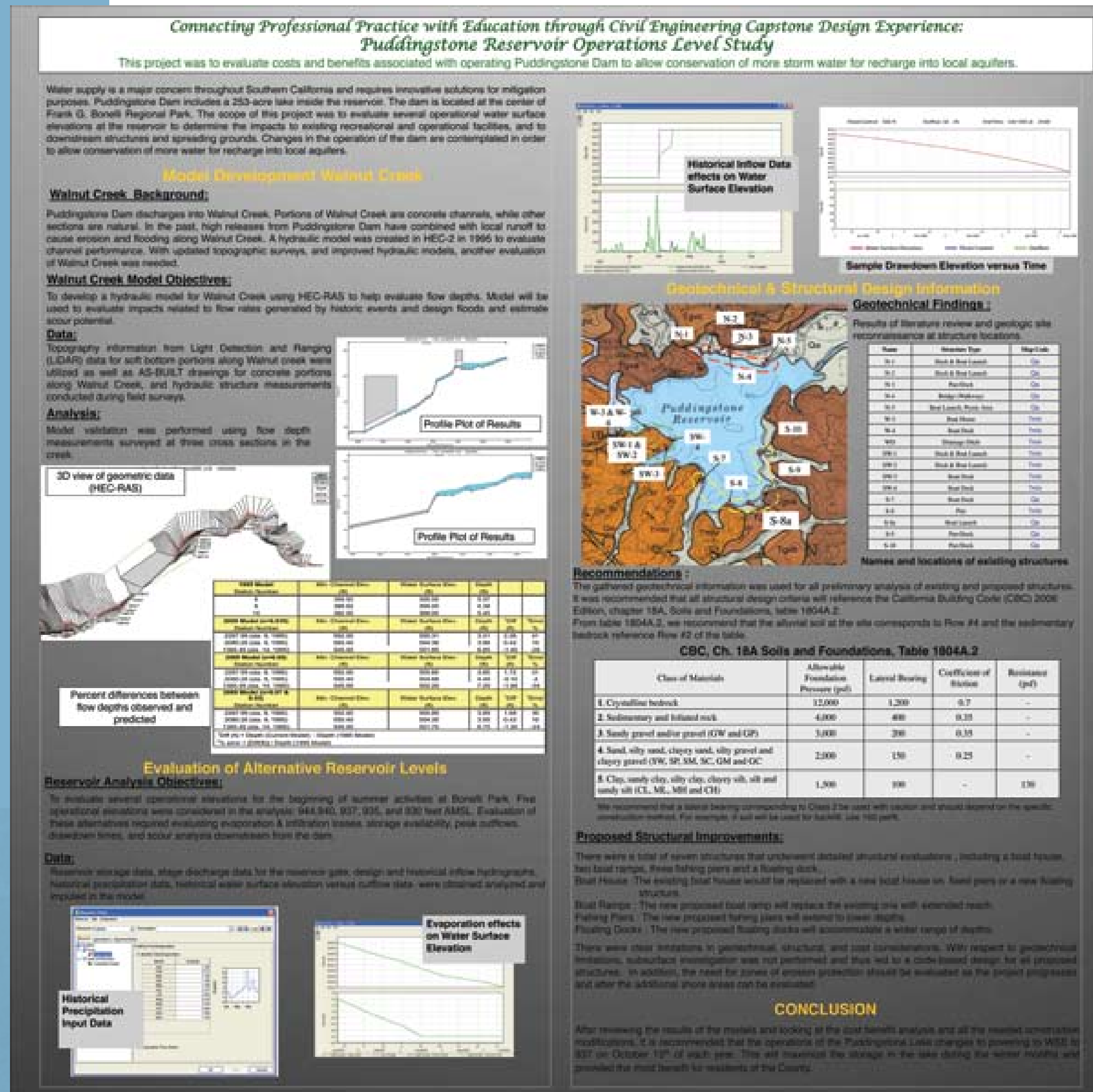
Rupa Purasinghe, Ph.D., P.E.
Humberto Gallegos, P.E.
Victor Langhaar, P.E., G.E.
(Shannon & Wilson)
Harward Lum, P.E., S.E.,
and John Shamma, P.E.
(Metropolitan Water District)
Mark Tufenkjian, Ph.D, P.E.

Professional Engineers

Diego Cardena, P.E.,
and Ben Willardson, P.E.
(Los Angeles County
Department of Public Works)
Robert Barsam, P.E., S.E.
Rod Garcia, P.E.
Hyginus Mmeje, P.E.

Additional Participant

Arif Shahdin



California State University, Los Angeles

Department of Civil Engineering

Connecting Practice and Education through Civil Engineering Capstone Experience: Puddingstone Reservoir Operations Level Study

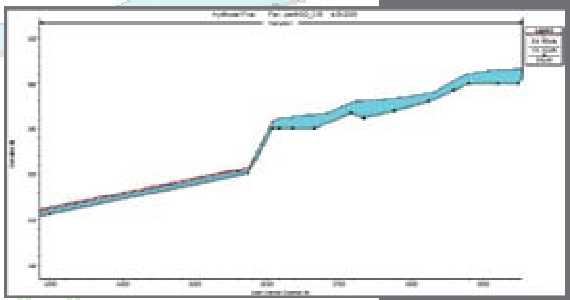
ABSTRACT

The civil engineering department requires all undergraduates to complete a senior design team project over the course of six months. The facilitators include practicing registered engineers from different disciplines related to the project. The project requires integration and synthesis of acquired knowledge as well as the consideration of alternative solutions, methods, and constraints such as economic, environmental, health and safety, social, political, sustainability, constructability, and ethical. The team performs a complete analysis and design including the application of constraints. They then prepare a final design report including memoranda, computations, drawings, specifications, and cost estimates. The written and oral reports are presented to a panel of faculty and representatives from industry. All students are required to participate in the presentation. The panel includes a number of registered engineers who ask follow-up questions and provide the students with feedback on the technical merits of the report as well as the professionalism of the presentation.

For the past couple of years, the university has had the opportunity to partner with local agencies to afford the senior design team an opportunity to work on real-world projects. The facilitators coordinate with representatives of the agency, who are also practicing registered engineers, on the scope of work and timelines for deliverables. The agency reviews the draft submissions and provides comments. The students then address these comments and submit revised reports.

Water supply is a major concern throughout southern California and requires innovative solutions to meet increasing demands due to dwindling supplies. The 2009 project was a partnership with the County Department of Public Works and the County Department of Recreation. Puddingstone Lake is a 253-acre reservoir located at the Frank G. Bonelli Regional Park. The scope of this project was to evaluate several operational water surface elevations at the reservoir to determine the impacts to existing recreational and operational facilities and to downstream structures and spreading grounds. Changes in the operation of the dam were contemplated in order to allow conservation of more water for recharge into local aquifers. The project also required the design of new recreational facilities at the lake, including boat ramps, a boathouse, and other structures. A cost-benefit analysis and evaluation of various constraints were conducted for each of the operational levels. The project was divided into five major tasks, and technical memoranda were written for each task.

Over the six-month duration of the design class, students, with the mentorship of practicing engineers, developed and implemented the project plan. The facilitators also gave technical lectures and assignments in their areas of expertise as well as practical lectures on project organization, cost estimation, report writing, legal issues, and presentation skills. Through these many avenues, students gained insight as to the value of experience and professional registration. The students benefited greatly from the integration of professional practice and education inherent to the senior design project which prepared them for handling real-world projects.

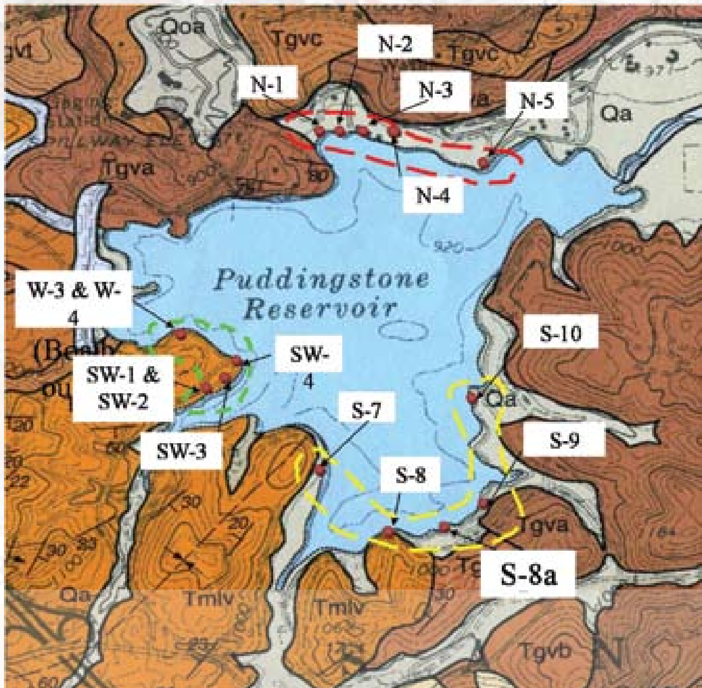


JURY COMMENTS

"Great real-life project. A highlight was the conflicting elements that constrained the design, which forced the student teams to accept compromises/trade-offs to obtain their preferred solution."

"It is great to see engineering students engaged in the design of water systems in areas challenged in water supply."

"This project did an excellent job of demonstrating to students that they should hold paramount the health, safety, and welfare of the public."



PERSPECTIVES ON

(Project description excerpts)

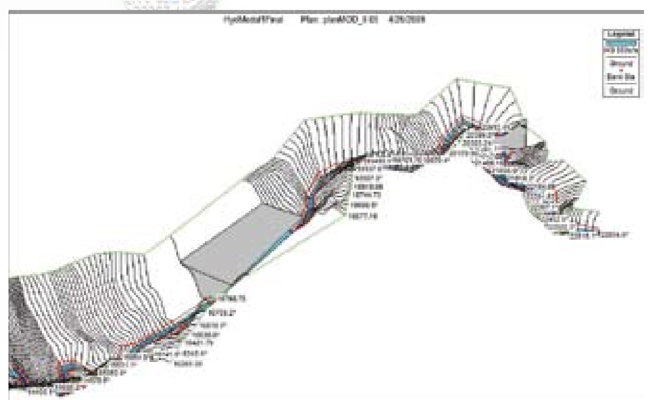
The collaboration of faculty, students, and professional engineers
Engineering faculty and four practicing registered engineers from four different disciplines worked in collaboration with the students to develop and implement a project plan. The team included two hydraulics and hydrology engineers, a structural engineer, and a geotechnical engineer.

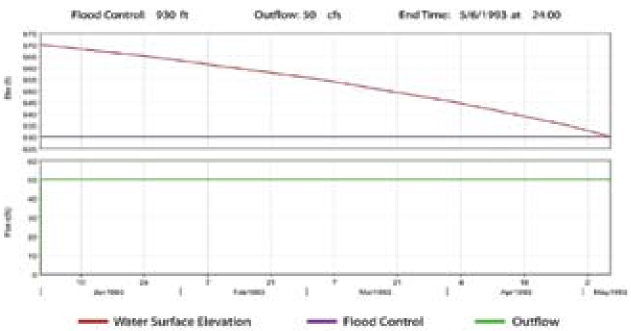
These four facilitating engineers also gave periodic lectures and assignments in their respective areas of expertise. In addition to the technical lectures, faculty provided practical lectures on project design and organization, cost estimation, report writing, legal issues, and presentation skills.

A liaison from the department of public works, also a registered civil engineer, was very involved in the process as well. The liaison visited the school for the initial scope of work presentation and later addressed the class at the DPW office regarding personnel issues and career development. At each stage, DPW reviewed and commented on the tech memos, and the senior design team would adapt the reports as necessary to address these concerns.

The benefit to the health, safety, and welfare of the public
The change in the reservoir operations impacts structures and environments, significantly affecting the health, safety, and welfare of the public. In recognition of the significant aesthetic, environmental, and economic benefits to the community provided by the lake and to protect and enhance the health, safety, and welfare of the public within the County of Los Angeles, this project was planned and executed through a professional, competent, and cost-effective administration of the proposal to modify the elevations of the lake. This was accomplished by taking into account development review, recreational impacts, water supply impacts, public safety impacts using the lake, public safety impacts from flooding, public safety impact to the surrounding community and the airport, and traffic engineering.

Furthermore, field trips to the reservoir and creek under the supervision of the facilitating engineers assisted the students in recognizing the issues firsthand and developing safe habits for fieldwork.





Sample Drawdown Elevation versus Time

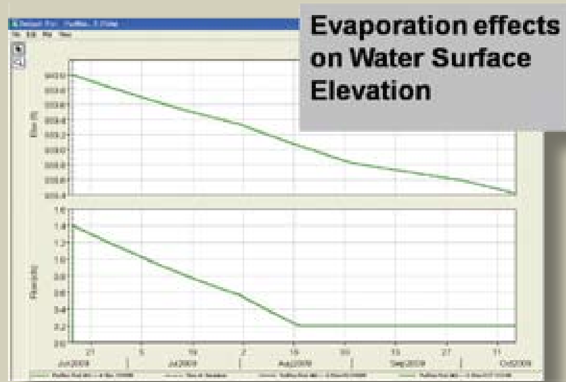
The impact of partnering teaching and professional practice

A partnership between a department of public works, a civil engineering department, and professional practitioners created the opportunity for 23 students to participate in a public project that will be implemented and constructed according to the students' design. The class provided the students with real-life experience in civil engineering and the DPW with design drawings and written specification to immediately advertise a project that has been thoroughly analyzed to meet the public needs.

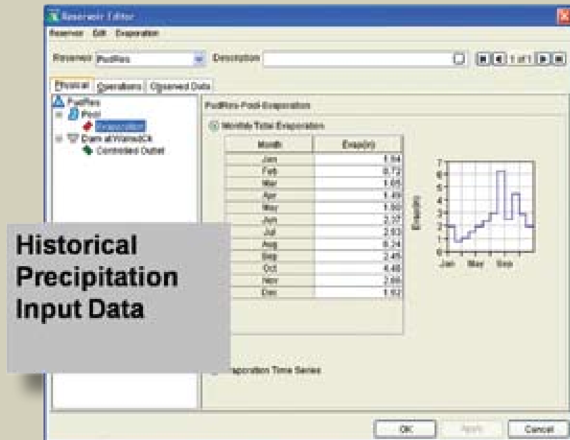
The knowledge or skills gained

In addition to design knowledge for water structures and the application of engineering codes, the students learned how to use the latest technology. Also, they were exposed to drinking water sustainability and health and safety issues. A visit to the reservoir and dam with operational personnel gave the students insight in the operation of a dam, a flood control system, and settling basins.

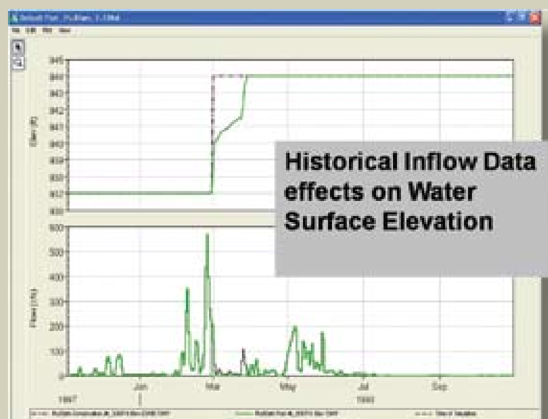
Perhaps of even greater importance were the skills gained in project organization and design, cost estimation, report writing, and public speaking. The students had to work as a team to prepare deliverables in a timely manner. They also gained knowledge of applicable building codes; local seismic, wind, and geological conditions; building materials; and the provisions the of California Environmental Quality Act.



Evaporation effects on Water Surface Elevation



Historical Precipitation Input Data



Historical Inflow Data effects on Water Surface Elevation

California State University, Los Angeles

$7,500 AWARD

PARTICIPANTS

Students

Katelyn Aggas
Tatum Boulware
Christopher Cooper
Justin Coulston
Shawqi Eltarazi
John Furmanski
Andrew Kinard
Joshua Knuckles
Robert Kriener
Mary Maier
Tyler Rowe
Brandon Shropshier
Adam Thompson
Kristen Wallis

Faculty

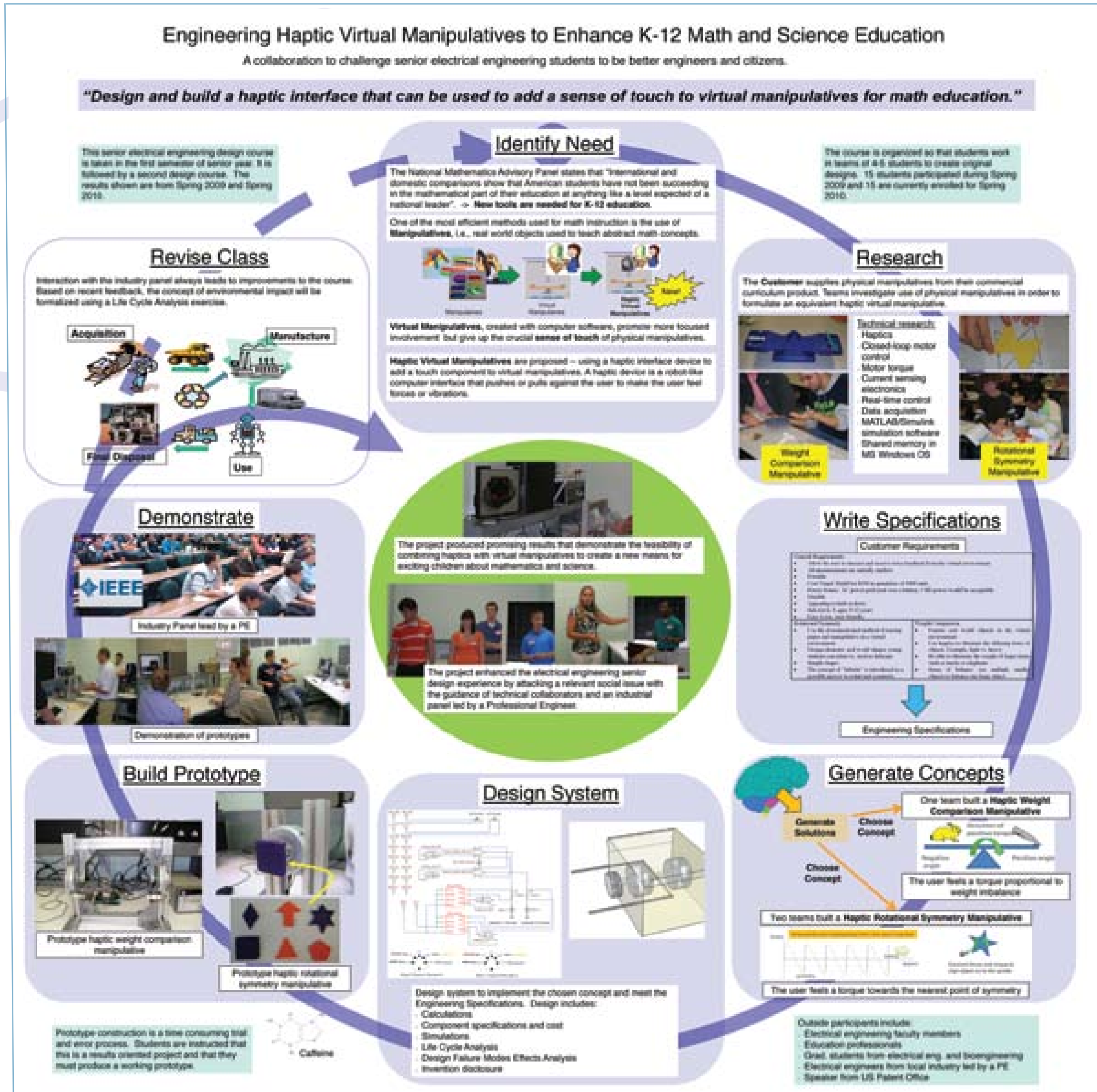
Timothy Burg, Ph.D.
Darren Dawson, Ph.D.
John Gowdy, Ph.D.
Richard Groff, Ph.D.

Professional Engineers

Louis Hapeshis, P.E. (Square D by Schneider Electric)

Additional Participants

Dot Moss (Math Out of the Box)
Ninad Pradhan (Graduate student)
Joseph Singapogu (Graduate student)
Robert Scruggs (Schneider Electric)
Lee Stogner (South Carolina Engineering Cluster)
Mark Stokes (Liquid Controls)
Allen Thomas (Kemet, retired)



Clemson University

Holcombe Department of Electrical and Computer Engineering

Engineering Haptic Virtual Manipulatives to Enhance K–12 Math and Science Education

ABSTRACT

The United States economic and scientific leadership is endangered by low student performance in K–12 mathematics. Experts recommend that new tools are urgently needed to teach topics such as number sense, fractions, algebra, and geometry and measure. One of the most efficient methods currently available for math and science instruction is the use of manipulatives, using real-world objects to teach abstract concepts. Computer software has been used to construct virtual manipulatives; however, these lack the crucial sense of touch of real manipulatives. The recent advent of haptic devices that allow touch-based interaction with the computer suggests a possible solution. A haptic device, essentially a computer-controlled robot that uses electric motors to push or pull against the user, is a unique computer output device that allows the user to actually feel forces or vibrations. A haptic device is proposed to add a touch component to extend virtual manipulatives; that is, creating haptic virtual manipulatives holds the potential to revolutionize the educational field of math and science instruction.

The students in the first semester of the electrical engineering senior design class were tasked to "design and build a haptic interface that can be used to add a sense of touch to virtual manipulatives for math and science education" while being introduced to the larger global implications of the task. Specifically, the engineering students were to design a haptic device (robotic computer interaction device) that could be used in teaching third-grade students rotational symmetry or relative weights of objects. (Note: A commercial designer of manipulatives helped set the requirements for the design using physical manipulatives from the company's curriculum.) The students followed a design process in which each team researched and developed a design, documented their design, built a prototype of their design, demonstrated the prototype to the customer to gain feedback and improve the design, and presented the technical aspects of their work to an industry panel consisting of IEEE members and led by a P.E. The IEEE members evaluated and ranked the designs.

Feedback from the meeting with the industry panel gives the students confidence in their abilities while informing them of their weaknesses. An interactive presentation to the students by members of the industry panel emphasizes the importance of lifelong learning and the role of the IEEE in this endeavor. This discussion also serves as an opportunity for the instructor to gain insight that will allow adaptation of the course to evolving contemporary topics raised by the panel.

This design project links a challenging engineering design problem to a relevant social question: i.e., how to excite kids about math and science in a manner that will facilitate long-term retention of new knowledge. As the engineering students address the technical challenges of building a haptic device, they also address this important educational challenge. The engineering students practice programming, closed-loop control, design principles, MATLAB/Simulink simulation tools, teamwork, oral and written communication, and circuit design in their projects. However, it is only through the interaction with working engineers that these students actually appreciate the necessity of these skills in the next phase of their career. This connection with engineering practice is crucial to overcoming student skepticism about the importance of topics such as safety and environmental concerns and, at the same time, helps the instructor keep the course relevant to the field.

This project produced promising results; it demonstrated the feasibility of combining haptics with virtual manipulatives. The ideas generated in this project will be refined in future semesters of the class and in spin-off research.

JURY COMMENTS

"Goes beyond the abstract and theoretical aspects of electrical engineering education to design and develop devices meeting users' needs"

"Provided an excellent opportunity for students to practically apply engineering knowledge"

"It is great to see electrical engineering design students focused on the promotion of STEM areas for K–12. This prototype could go a long way in steering young people to technical areas."

(Project description excerpts)

The impact on raising social consciousness

This project linked a challenging engineering design problem to a relevant social question: how to excite kids about math and science. Electrical engineering is taught as a rigorous application of math and science to solve specific problems; for example, students have been taught to "solve for the current in a resistor" and told that this will be important in their careers. This design project, however, made the connection that solving for the current in a resistor will allow one to build a device that can help children learn.

The project further facilitated realization of the social implication of enhanced learning; that is, the project allowed the students to understand the strong connection between the work of an electrical engineer and the need and opportunity to increase science and math education for K–12 students. During the semester, the students read excerpts from *Rising Above the Gathering Storm*, developed by the National Academies Committee on Science, Engineering, and Public Policy, which expounds on the need to educate more engineers and scientists in order for the country to remain competitive. The students realized that they themselves are the product of a training system that must be perpetuated, continually improved, and made widely available in order to secure the very best future for our society. The discussions during the design process on application of the technology led to ideas of how the learning devices could be used in rural parts of the state to offset low budgets and reduced infrastructure.

The students completed the class with enhanced technical and communication skills as well as a clear understanding of their role in a global community.

The impact of partnering teaching and professional practice

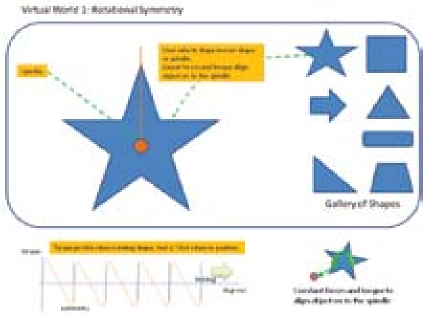
The industry panel, led by a P.E. and primarily made up of electrical engineers, reviewed the design projects and provided essential validation of the students' work. Students are generally suspicious of the course structure in which they must solve an ill-defined, open-ended problem without knowing where the solution can be found. Since the majority of their classroom learning has been well-defined and specific, they initially feel that something is wrong with the design course. When they talk to the experienced engineers and the customer over the course of the semester and during the design presentations, they discover that the design class is actually representative of the real world.

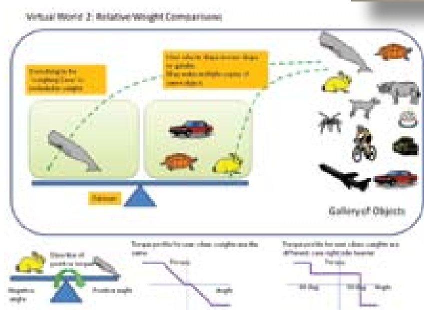
In fact, during the courses leading to the design course, we give the students "dots" of information, and in the senior design class, we teach the students how to connect dots—the credibility and strength of dot-connecting skills relies heavily on the industry panel. The industry panel can provide high impact criticism, often the same criticism that is not heeded when offered by the instructor. Real-world input simply has enormous influence on students,

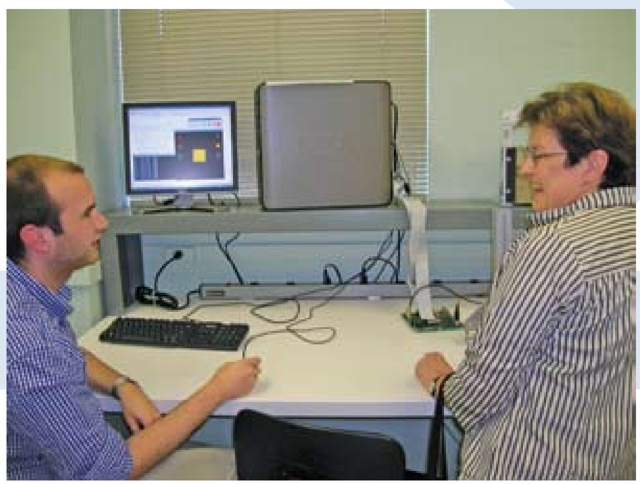
especially regarding issues such as safety, budget, and environmental impact.

The industry panel reinforces to the students the importance of lifelong learning. The panel members give a presentation on the IEEE society and the need to network, attend conferences, take courses, and read literature to stay current after graduation.

Feedback from the industry panel also helps improve the course. Improvements for the current semester include involvement of the practicing engineers earlier in the design process to address specific weaknesses in the Specifications and Safety Analysis components of the presentations. This semester, in response to previous panel input, life cycle analysis will be addressed as a better approach to considering environmental impacts.







$7,500 AWARD

PARTICIPANTS

Students

Approximately 30 students participated in the design phase of the Solar Recharge Project, including the following members of the Burkina Faso travel team:

Kristine Caita
Brennan Keegan
Craig Keenan
Ekaterina Kroupnik
Sarah Ness
Esmaeel Paryavi
Ryan Thomas Payne
Thierry Maalifa Some
Bizhan Zhumagali

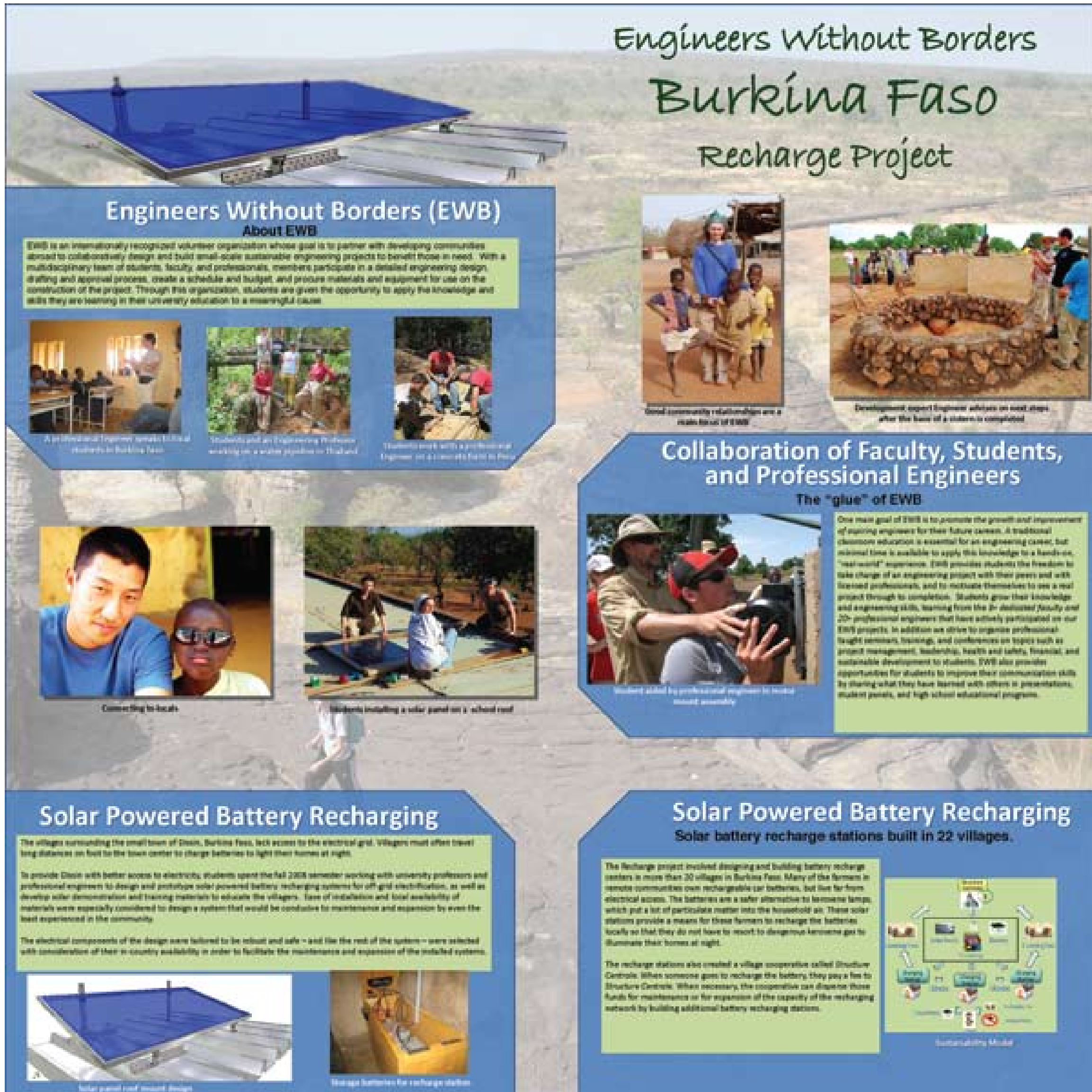
Faculty

Jungho Kim, Ph.D.
Arnaud Trouve, Ph.D.
Kevin Calabro
Peter Chang, Ph.D.
William Fourney, Ph.D.
Deborah Goodings, Ph.D.
David Lovell, Ph.D.
Bryan Quinn

Practitioners

Engineers involved with EWB projects include the following:

William Mellema (Morningstar Corporation)
Betsy Baldwin; Teresa DiGenorva; Robert Geist, P.E.;
Pete Thompson, E.I.T.; and Bitsat Yohannes (Black & Veatch)
Jacques Bloomfield; Keith Brabant; Daniel Engidashet;
and John Sankey, P.E. (Reinforced Earth Company)
Jerry Kashatus (URS Corporation)
Albert McCullough, P.E.
Krista McKim, P.E. (McKim Environmental Consulting)
Lee Meir (Leinc Engineering)
Patrick Murphy (NASA)
Chris Seremet (Catholic Relief Services)
Holger Serrano, P.E. (Montgomery County)
John Williamson, P.E. (Williamson Engineering)
Johannes Zimmerman, P.E.



University of Maryland

Department of Civil and Environmental Engineering

Engineers Without Borders: Solar Recharge Project in Burkina Faso, Africa

ABSTRACT

Engineers Without Borders (EWB) is an internationally recognized volunteer organization whose goal is to partner with developing communities abroad to collaboratively design and build small-scale sustainable engineering projects to benefit those in need.

In 2004, students and faculty from our university's engineering school joined the then-young organization with the establishment of our own chapter. The combined efforts of hundreds of dedicated engineering and non-engineering students, faculty, and professionals have enabled the completion of 14 distinct projects in 7 different communities abroad. We have also expanded our focus to include similar small-scale engineering projects that address the needs of communities surrounding our university.

Today our chapter continues to pursue up to four separate projects at a time—providing over 100 students each year with the invaluable experience of designing solutions to real-world problems under the close guidance of professional engineers and university faculty.

Thus far our chapter of EWB has worked in Ecuador, Brazil, Thailand, Peru, Ethiopia, and Burkina Faso—enabling over 150 students, 20 professional engineers, and 8 faculty from a variety of disciplines to travel to these countries for the implementation of their designs. Many more are able to participate in the vitally important research and design work and the approval process that closely parallels the process a professional engineering team would go through in an engineering design firm.

Unlike taking a course in sustainable development where students may only have time to conceptualize an engineering solution, the students in this program come away from a project having gained exposure to all aspects of a real engineering project. With a multidisciplinary team of students, faculty, and professionals, they participate in a detailed engineering design, drafting and approval process, create a schedule and budget, and procure materials and equipment for use on the construction of the project, then go on to actually build it. Through this organization, students are given the opportunity to apply the knowledge and skills they are learning in their university education to a meaningful cause.

Students dedicate their time without pay or school credit—but with a sense of personal accomplishment and with the understanding that through good work ethic and acute attention to detail, they can collaboratively make a positive difference in the lives of others.

Example EWB Project: Burkina Faso Recharge

Dissin is a small region located in the southwestern part of Burkina Faso, Africa, made up of 24 village communities spread throughout a 15 kilometer radius. An EWB assessment team that traveled to Dissin in 2008 found that the 6,000+ villagers who live outside the town center have significant difficulty accessing electricity.

To address this need for access to electricity, students within EWB, under the guidance of professionals and university faculty, designed and implemented a sustainable off-grid electrification solution in these rural villages of Dissin. A network of 22 solar-powered battery recharging stations was chosen as a way to bring more accessible in-home electrification to the villagers. The student-designed solution enables villagers to manage their own source of energy and reduce their dependence on costly kerosene for dimly lit lanterns.

JURY COMMENTS

"The nature of the project forced students to deal with severe economic, logistical, and 'customer' constraints."

"There is no better training than to take a project from problem definition to completion of construction, and this program does just that."

"The social benefit to the underprivileged beneficiaries of the project is beyond description. The program participants are truly contributing to the health, safety, and welfare of some of the globe's most needy."

PERSPECTIVES ON

(Project description excerpts)

The collaboration of faculty, students, and professional engineers
During the assessment and implementation of the project, students, faculty, and professional engineers worked side-by-side to evaluate and address the needs of the community. During the design and prototyping stage of the project, students took the lead and had the freedom to showcase their own ideas, which were supported by the faculty and professionals working on the project.

The benefit to the health, safety, and welfare of the public
The implementation of the solar-powered battery recharge network has enabled easier access to electricity for the villagers for a variety of uses. The primary benefit is for use in powering lighting at night, which provides a way for villagers to improve their reading and writing skills during non-daylight hours.

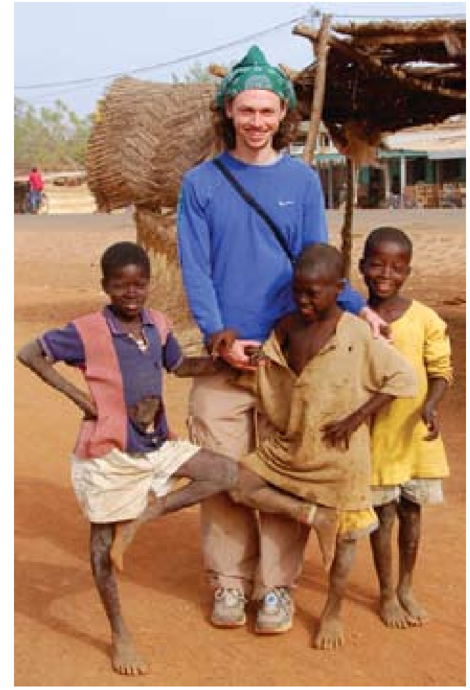
With the implementation of the business plan created, the villagers will keep the profits from the fee charged within Dissin, rather than paying outside sources for this service. The fees collect over time, allowing for funding for further expansion of access to this service to the villagers and increased profits for the village owners. This business model created with the community is aimed at empowering villagers to have more control over their money and to start more small businesses with the same model.

Additionally, electronic communication devices such as phones, radios, and TVs can be used for greater access to the world beyond Dissin.

The impact of raising social consciousness
The students who participated in this project were exposed to the plight of disadvantaged communities. In addition, students saw the need for considering sustainability in engineering designs, especially in remote areas.

Multidiscipline or allied professional participation
Professionals offered technical consulting and help for evaluating engineering designs and worked closely with students in the implementation stage of the project to help them look at all phases of the project from a professional's perspective.

The business students who participated in this project helped the engineering students better understand the development of the business plan for the community. Likewise, the engineering students introduced the business students to the technical design details of the project. This combination of disciplines on one team facilitated learning outside of the students' general focus in their college studies, widening their perspective, and challenged them to look at the project from different angles.



The viability of the technology used
In this project, students gained a better understanding of solar power systems, a design element that is becoming more common in modern building design and construction today. Additionally, students learned how to use modern drawing software to create design drawings of the chosen design solution.

In this age of sustainable and green building, this simply designed solar-powered recharging system, though not as complicated as the sophisticated systems used in the U.S., is useful for the students to understand in both design and construction practice for their future careers.

University of Maryland

$7,500 AWARD

PARTICIPANTS

Students

Approximately 24 students have participated each semester since the combined capstone experience was created in 2007, including the following members of the featured project.

Wastewater Pond for a Rural Community

Civil Engineering
Anthony Cabrera
Rick Grahn
Jacob Hays
John Pavlakos

Construction Management
Diana Davis
Darren Mortensen

Faculty

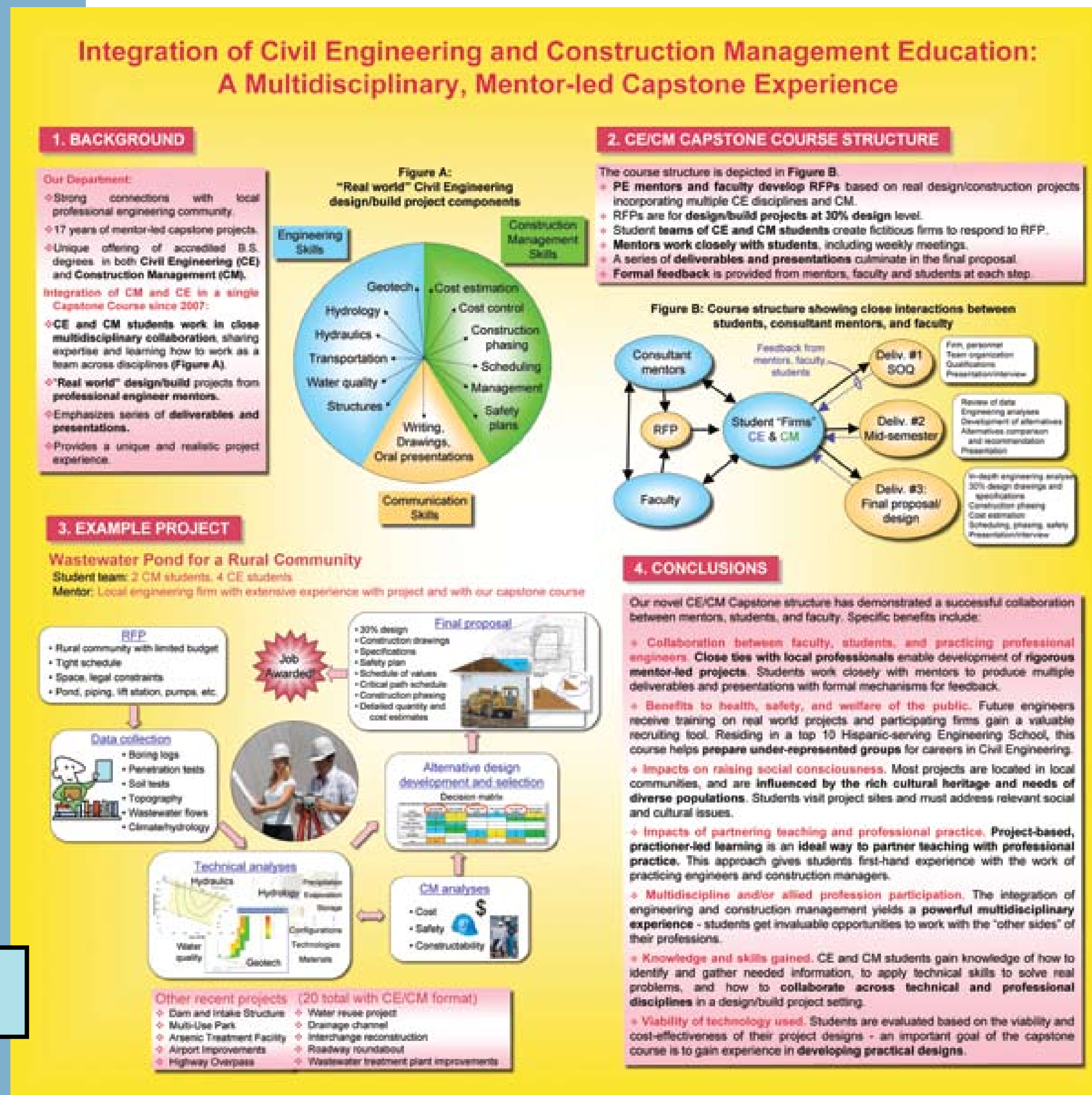
Andrew Schuler, Ph.D., P.E.
Susan Bogus, Ph.D., P.E.
Jerry Hall, Ph.D., P.E.
Kerry Howe, Ph.D., P.E.

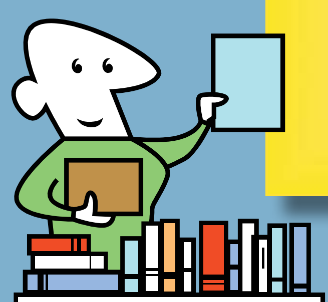
Professional Engineers

Daniel Boivin, P.E.,
and Allen Bolinger, P.E.
(Smith Engineering)

Additional firms providing student mentoring include

Albuquerque Metropolitan Arroyo Flood Control Authority
WHPacific
Boyle Engineering
CDM
CH2M Hill
City of Rio Rancho
Daniel B. Stephens & Associates
Easterling and Associates
HDR
Molzen-Corbin
New Mexico Youth Sports Coalition
Parsons Brinckerhoff
Red Mountain Engineers
Resource Technologies
TransCore
URS Corporation
Wilson & Company Engineers





University of New Mexico

Department of Civil Engineering

Integration of Civil Engineering and Construction Management Education: A Multidisciplinary, Mentor-led Capstone Experience

ABSTRACT

Our department of civil engineering offers accredited degrees in both civil engineering and construction management. We have capitalized on the proximity of these programs, and on close interactions with local professional firms, to create a novel multidisciplinary capstone design course. Student teams comprised of civil engineering and construction management students work closely with professional engineering mentors on 30 percent design and construction plans for real-world projects. The integration of engineering and construction management components provides students with skills important to the engineering/construction workplace, but less common in undergraduate education. Emphasis on project deliverables and presentations, working with mentors in their engineering offices, and structure of the course around responding to a request for proposals help provide students with a realistic project experience.

Example Project: Wastewater Pond for a Rural Community

A recent wastewater pond project consisted of the design and construction of a new wastewater treatment pond as an extension of an existing system for a small rural community with limited financial resources.

The project addressed a fictitious request for proposals (based on real client needs) to expand the capacity of an existing wastewater pond system. The client currently has four wastewater treatment ponds which have reached their design capacity. Failed efforts by a previous firm have delayed design and construction of expanded facilities, leading to schedule constraints for construction. In addition, construction costs were required to remain under $400,000 due to availability of grant funds, and pond volume and depth were constrained to remain outside of the jurisdiction of the state engineer. These realistic, non-engineering criteria illustrate the value to students in using real-world engineering projects.

The design team consisted of six undergraduate students (four civil engineering and two construction management majors), all of whom were in the last semester of their studies. In their second week of classes, the team began weekly meetings at the offices of their mentor consultants, where they began gathering information about the project. Their organizational plan assigned project roles for each technical area and lead personnel for the engineering and construction management components of the project.

After acceptance of their statement of qualifications and shortlisting for a final proposal, the students received their request for proposals and began engineering analyses and development of alternatives. The selected set of design components for further development in the final proposal was a single facultative lagoon with an HDPE liner and a pre-fabricated lift station, which were projected to meet the client's needs.

In-depth analyses for the final design required close collaboration with the project mentors to aid in the gathering of additional information and detailed design.

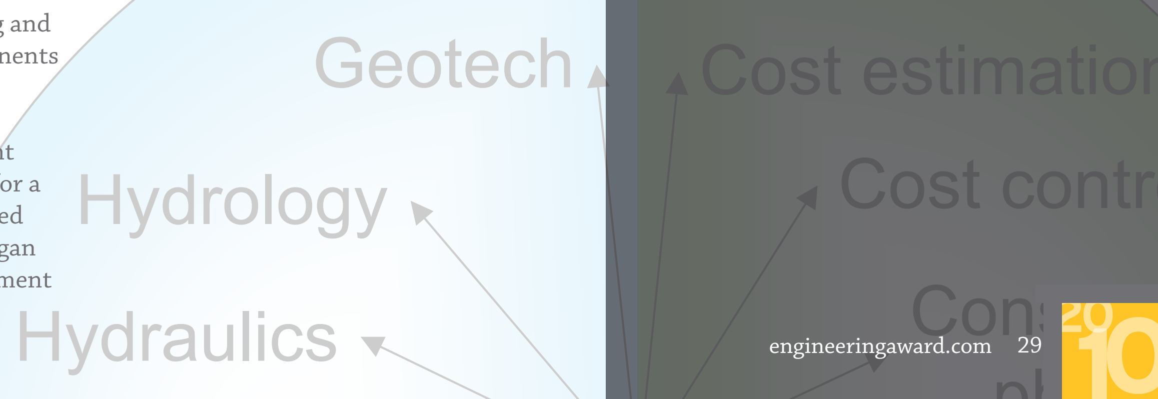
The students' final proposal included a 30 percent design, with construction drawings and specifications, for the facultative pond system, including all associated piping, liner, a lift station, and berm details, and a concrete spillway. These designs and plans were included in a written proposal, and they were presented in a final proposal to faculty, consultants, and fellow students at the end of the semester. At the conclusion of the course, the student team was awarded the project based on an excellent written and oral presentation.

JURY COMMENTS

"This project is a tremendous integration of construction management and civil engineering. Other programs across the country should consider such action."

"The project paired design and construction elements in a way that will produce engineers who will lead the way to more effective projects in the future."

"This program anticipates the growing trend of design-build projects throughout the industry."



PERSPECTIVES ON

(Project description excerpts)

The collaboration of faculty, students, and professional engineers
Our department has been collaborating with professional engineers from local engineering firms and government agencies to teach our senior capstone course since 1993. The regular participation and enthusiasm of local firms are testimony to their support of educating future engineers and benefits of identifying and recruiting the best students. This collaboration provides benefits to students by providing them with opportunities to gain practical experience in working with consultants, as well as learning the responsibilities of being an active member of the engineering community. For the faculty, consultant mentors bring invaluable practical experience to the classroom.

The impact on raising social consciousness
Most projects are located in local communities, which provides students with an increased awareness of their social impact. Student teams typically visit the project site and are made aware of the social and cultural issues surrounding the project by their consultant mentors. These projects are often influenced by the needs and rich cultural heritage of nearby communities, which students must often account for in their proposed designs.

The benefit to the health, safety, and welfare of the public
Future engineers receive training on real-world projects, and participating firms gain a valuable recruiting tool. Residing in a recognized Hispanic-serving engineering school, this course also helps prepare under-represented groups for careers in civil engineering.

The impact of partnering teaching and professional practice
Project-based, practitioner-led learning is an ideal way to partner teaching with professional practice. This approach gives students first-hand experience with the work of practicing engineers and construction managers.

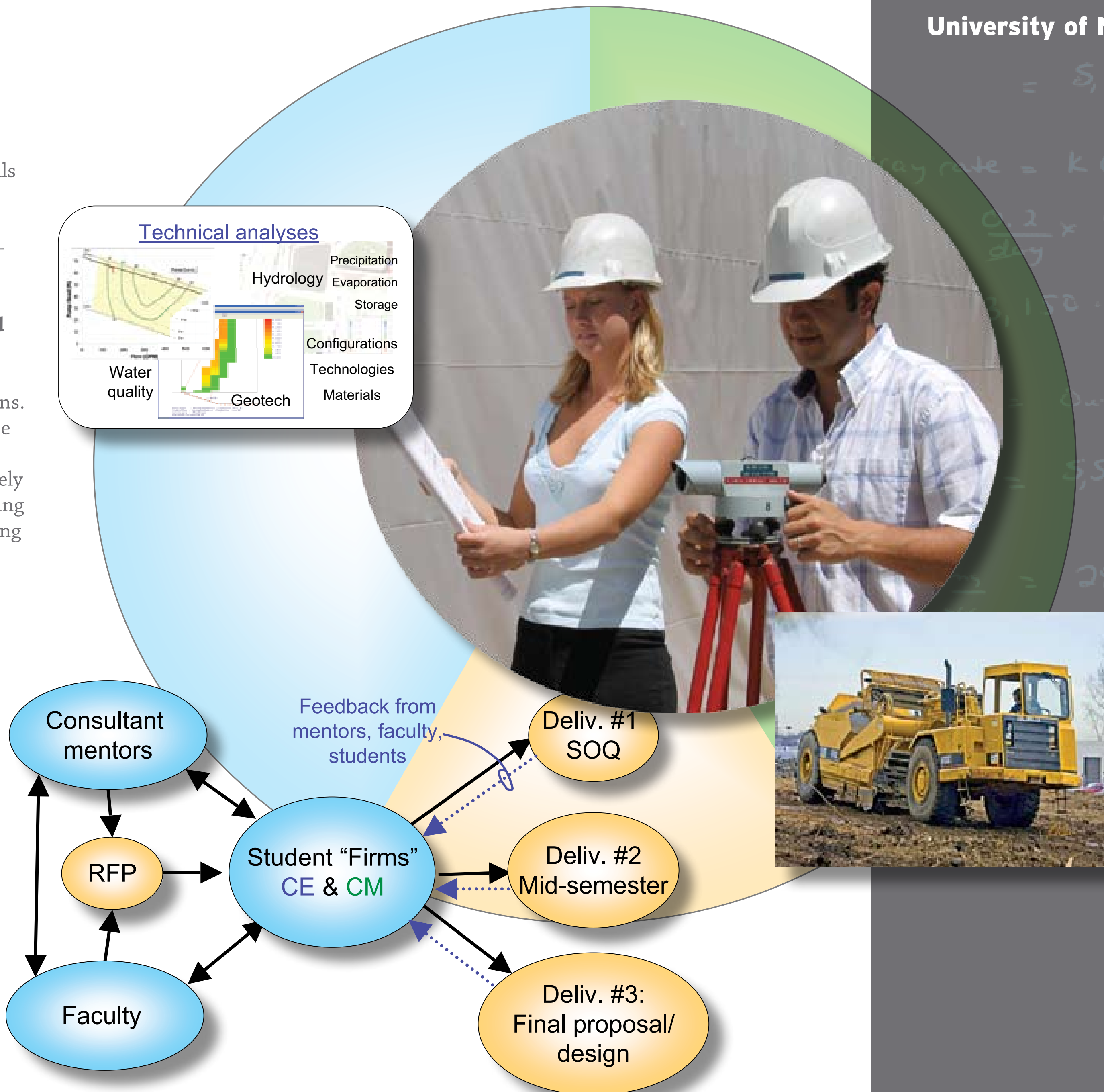
Multidiscipline or allied profession participation
The integration of engineering and construction management yields an important multidisciplinary experience. Students get invaluable opportunities to work with the “other sides” of their professions, which is a common need in many engineering firms but is relatively rare at a meaningful level in undergraduate civil engineering programs.

The knowledge or skills gained
Civil engineering and construction management students gain knowledge of how to identify and gather needed

information, to apply technical skills to solve real problems, and how to collaborate across technical and professional disciplines in a design-build project setting.

The viability of technology used

An important goal of the capstone course is to gain experience in developing realistic, practical designs. Students are evaluated based on the viability and cost-effectiveness of their project designs. Working closely with practitioner mentors, evaluating alternative design comparisons using a decision matrix, and including multiple feedback mechanisms all help ensure that the final designs are viable.



2010 PARTICIPANTS

California Polytechnic State University, San Luis Obispo
Civil and Environmental Engineering Department
Bridging the Gap between Theory and Practice through Capstone Design

California State University, Los Angeles
Department of Civil Engineering
Connecting Practice with Education through Civil Engineering Capstone Experience: Puddingstone Reservoir Operations Level Study

Clemson University
Holcombe Department of Electrical and Computer Engineering
Engineering Haptic Virtual Manipulatives to Enhance K–12 Math and Science Education

Duke University
Department of Civil and Environmental Engineering
Overture Engineering

Southern Illinois University Edwardsville
Department of Civil Engineering
Wastewater Ammonia Gas Mitigation

United States Air Force Academy
Department of Civil and Environmental Engineering
DFCE Apprentice

University of Delaware
Department of Civil and Environmental Engineering
Pomeroy Trail East Annex

University of Maryland
Department of Civil and Environmental Engineering
Engineers Without Borders: Solar Recharge Project in Burkina Faso, Africa

University of Nebraska
Charles W. Durham School of Architectural Engineering and Construction
First Annual Alliance Workshop between Architectural Engineering (AE) and Industry to Promote Learning

University of New Mexico
Department of Civil Engineering
Integration of Civil Engineering and Construction Management Education: A Multidisciplinary, Mentor-led Capstone Experience

University of Tennessee at Chattanooga
College of Engineering and Computer Science
Electric Vehicle Infrastructure

PREVIOUS WINNERS

2009

GRAND PRIZE

Florida A&M University–Florida State University
Department of Civil and Environmental Engineering
Senior Design Capstone Course: Collection of Projects with Featured Everglades Restoration Project

ADDITIONAL AWARDS

Seattle University
Department of Civil and Environmental Engineering
Structural Design Package for the Replacement of a County Bridge

University of Arizona
Department of Civil Engineering and Engineering Mechanics
Practitioner-Led Engineering Experiences

University of Missouri–Kansas City
Department of Civil and Mechanical Engineering
Redcone Civil Design Group: A Practitioner-Centric Capstone Experience

University of Tennessee at Chattanooga
Department of Civil Engineering
Intermodal Transit Center

Virginia Tech
Charles E. Via Jr. Department of Civil and Environmental Engineering
Land Development Design Initiative

HONORABLE MENTION

University of Iowa
Department of Civil and Environmental Engineering
Pilot Program for Expanding Connections between Professional Practice and Education

NCEES
advancing licensure for engineers and surveyors

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