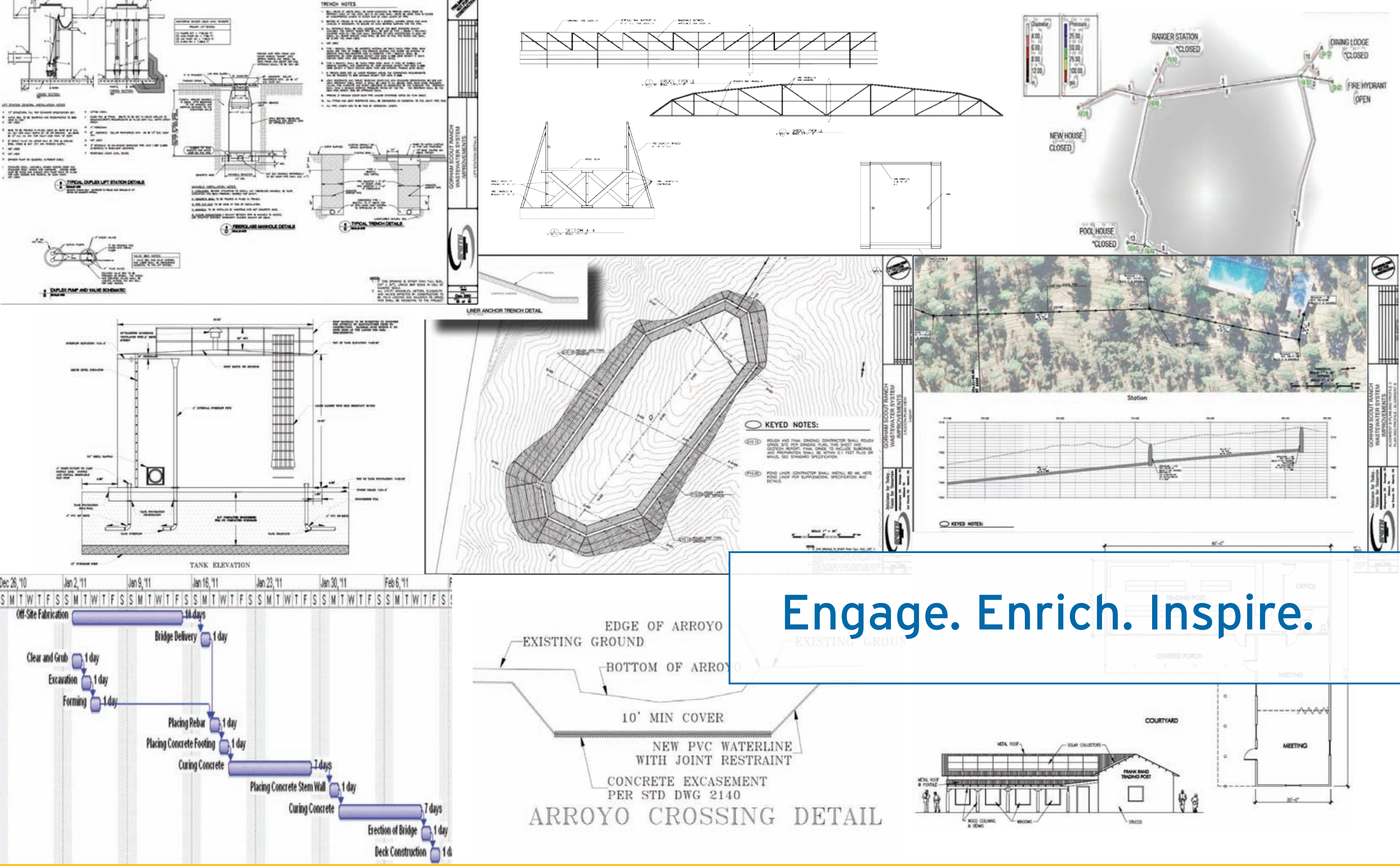


Engage. Enrich. Inspire.

NCEES Engineering Award 2011

Connecting Professional Practice and Education

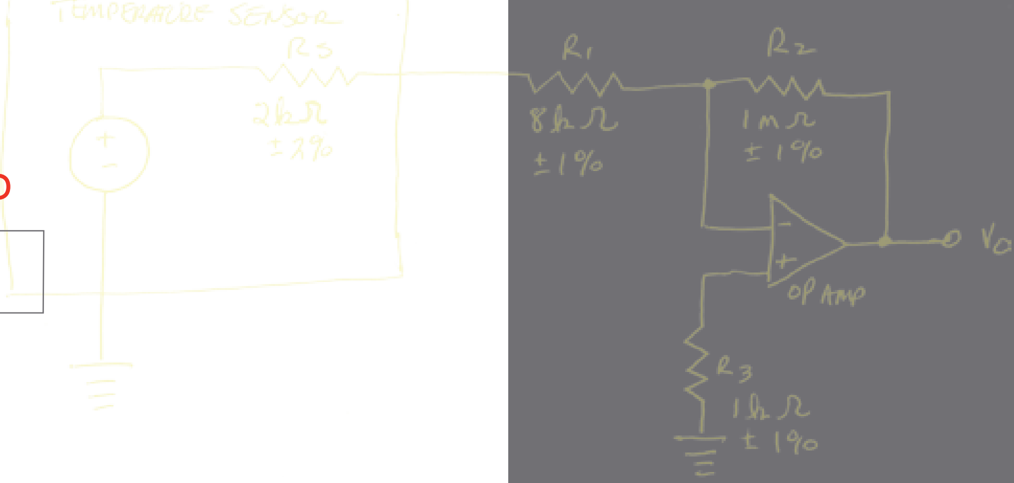
NCEES

advancing licensure for engineers and surveyors

Cover art: Details of display board submitted by the University of New Mexico

2011 NCEES ENGINEERING AWARD

Engage. Enrich. Inspire.



CONTENTS

$25,000 GRAND PRIZE

$7,500 AWARDS


Solar-Powered Microirrigation
Overview
Design Considerations
Final Design
The final design includes a 600W solar array, a 0.5 hp pump, and a switchbox for optional auxiliary generator connection for backup power.
Water Conveyance System Sizing
Solar Array Sizing
Benefit to Public Health, Safety, and Welfare
The construction of the La Nana Bridge benefits their health, safety, and welfare through providing safe passage across the
Knowledge or Skills Gained
The La Nana Bridge offered the unique spe of preliminary, implementation, and post-asse analysis. The real life project provides real wor engineering. Also, the concepts revolving arou community project trained our engineers to be internationally responsible in project managem and professional potential.
I. Soybean Crush Facility
Soybean Crush
Electricity
V. Energy Conversion Facility
Electricity
Heat
Bio Mass Combustion Research Facility
PRIMARY FUEL STORAGE
PRIMARY METERING BIN
DUST COLLECTOR
SECONDARY FUEL STORAGE
SECONDARY METERING BIN
AIR
NATURAL GAS IGNITER
SYNGAS
GASIFIER
ASH/CHAR WASTE
Project Description
Key Personnel
Benefit to Public Health, Safety, and Welfare
1200
Professional Hours
III. Hog Production Facility
Electricity
work on a semester-long design project
10% Project Presentations for Orange County 4-H
Industrial
Client Requirements
Large truck access
Maximized interior vertical clearance
Durable materials
Integrated office space and loading docks
Floor Plans
DESIGN
MARKETABILITY
LOW-ENERGY
Observatory Road Design Project
A Freshman Design Project
Problem Statement

PRESIDENT'S MESSAGE

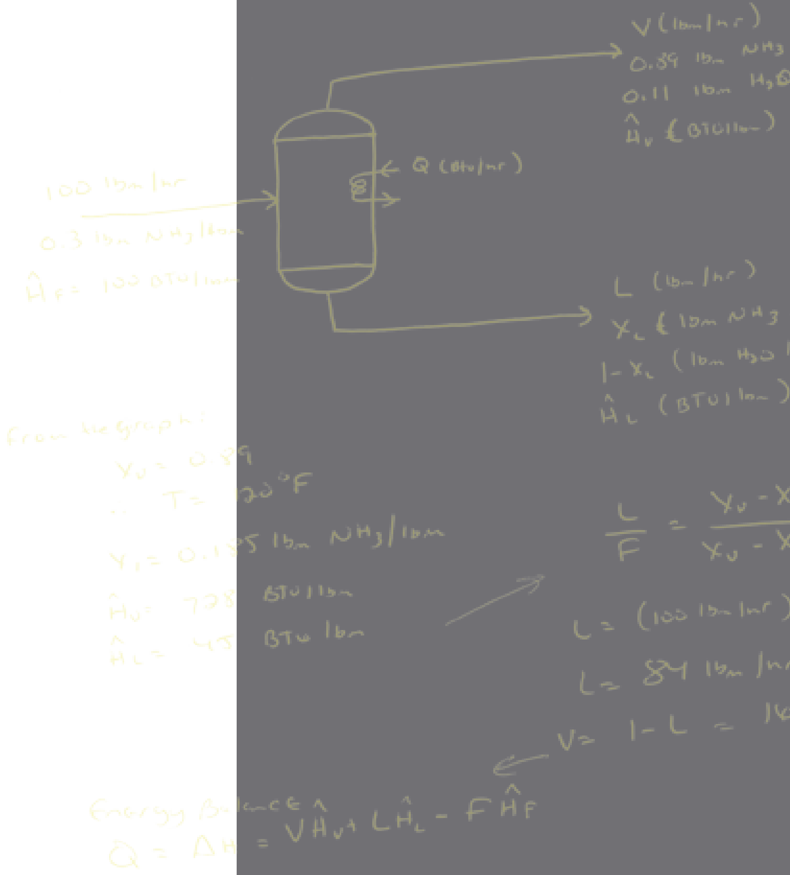
Since 2009, the NCEES Engineering Award has recognized projects that engage students in collaborative activities with professional engineers. A key aim of NCEES is promoting the value of licensure. Working with professional engineers helps students understand how licensure can benefit them personally and, more importantly, how it protects the public.

On behalf of NCEES, I thank all of the students, faculty, and practitioners who took part in this year's projects. We appreciate your efforts to connect professional practice and education. Special thanks also to the members of the jury for giving your time and expertise to support this program.

NCEES has published this book to recognize the 2011 winners. Included in its pages are the abstracts and display boards submitted by the winners, as well as excerpts from their project descriptions, which give their perspectives on how the projects met the award criteria.

We applaud these innovative approaches to inspiring the next generation of professional engineers. We hope they will serve as models for other engineering programs to develop collaborative projects.

Dale A. Jans, P.E.
2011–12 NCEES President




GORHAM
SCOUT RANCH
ED INFRASTRUCTURE IMPROVEME
FOR A YOUTH SCOUT RANCH
CIVIL ENGINEERING / CON
CAPSTONE DESIGN COUR
Ranger station
Dining Hall
Storage Box
Material Laydown Area
Recycling Center
Delivery
10 Kips
Roads
Typical Cross Section

ABOUT THE AWARD

The NCEES Engineering Award was established to promote understanding of the value of licensure and to encourage collaboration between the engineering profession and education.

Academic programs accredited by the Engineering Accreditation Commission of ABET were invited to submit projects that demonstrate a meaningful partnership between professional practice and education. The competition was open to programs from all engineering disciplines.

Projects did not have to offer academic credit to student participants, but they were required to meet other eligibility requirements. The projects had to be in progress or completed by April 1, 2011. If a project had been entered in a previous award cycle, the engineering program was required to explain how the project had been further developed since the previous submission.

The 2011 NCEES Engineering Award jury met in Clemson, South Carolina, on June 7, 2011, to conduct a blind judging of the 26 entries. 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 considered the following criteria in its deliberations:

> Successful collaboration of faculty, students, and licensed professional engineers

> Benefit to public health, safety, and welfare

> Knowledge or skills gained

> Multidiscipline and/or allied profession participation

> Effectiveness of abstract, project description, and display board

The jury selected the University of New Mexico Department of Civil Engineering to receive the $25,000 grand prize. The jury chose five additional winners to each receive $7,500 awards.


34
16
33
1200
Comprehensive Design Course
in Transportation

2011 NCEES ENGINEERING AWARD JURY

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

William Arockiasamy, P.E.
Minnesota Board of Architecture, Engineering, Land Surveying, Landscape Architecture, Geoscience, and Interior Design

Chun Lau, P.E., S.E.
Washington Board of Registration for Professional Engineers and Land Surveyors

Robert Zahl, P.E.
Oklahoma State Board of Licensure for Professional Engineers and Land Surveyors

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

David James, Ph.D., P.E.
Associate Vice Provost for Academic Programs
University of Nevada, Las Vegas

Norma Jean Mattei, Ph.D., P.E.
Interim Dean of Engineering
University of New Orleans

Steven Schreiner, Ph.D., P.E.
Dean, School of Engineering
The College of New Jersey

Patricia Bazrod
Chair, Professional Interest Council V
American Society for Engineering Education

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

Robert Fredell, Ph.D.
Managing Director for Accreditation
ABET

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

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

20
Fire protection and drinking water storage, treatment, and distribution
Wastewater collection and treatment
Project Outcomes: Success

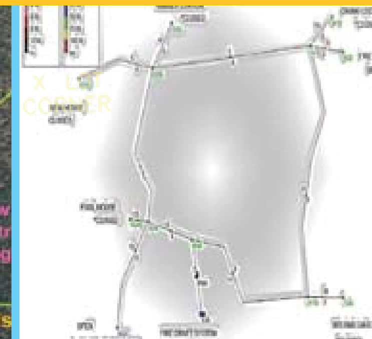
2011 NCEES Engineering Award

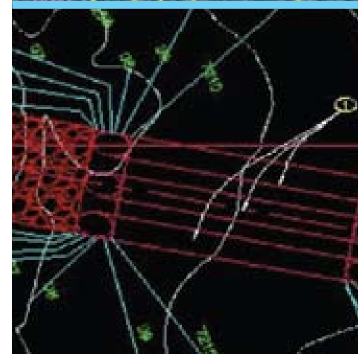
$25,000 GRAND PRIZE WINNER

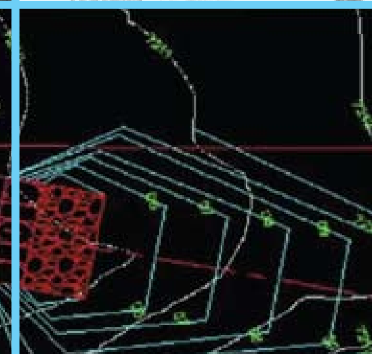
University of New Mexico

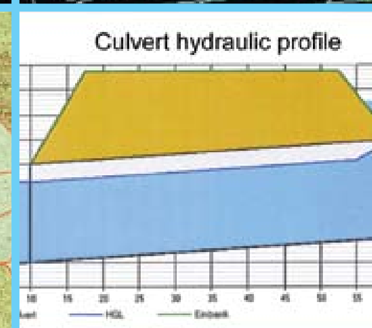
Department of Civil Engineering

Integrated Infrastructure Improvements for a Youth Scout Ranch









$25,000 GRAND PRIZE

PARTICIPANTS

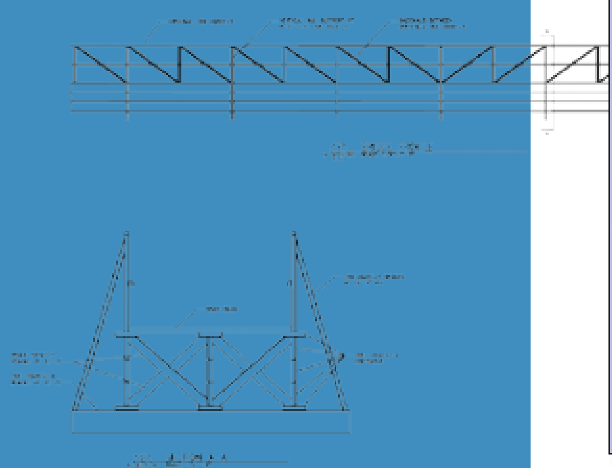
Students
Dominic Abbott
Lorenzo Alvarez
Joshua Baca
Joshua Cosio
Jonathan Ellison
Roberto Gallegos
Steven Gonzales
Gabriel Herrera
Noah Justice
Andrew Kight
Alicia Long
Valerie McCoy
Andre Melancon
Christian Naidu
Isaac Perea
James Platt
Dominic Romano
Emile Saint-Lot
Erica Sanchez
Russell Shoats
Carlos Vigil
Ryan Webb

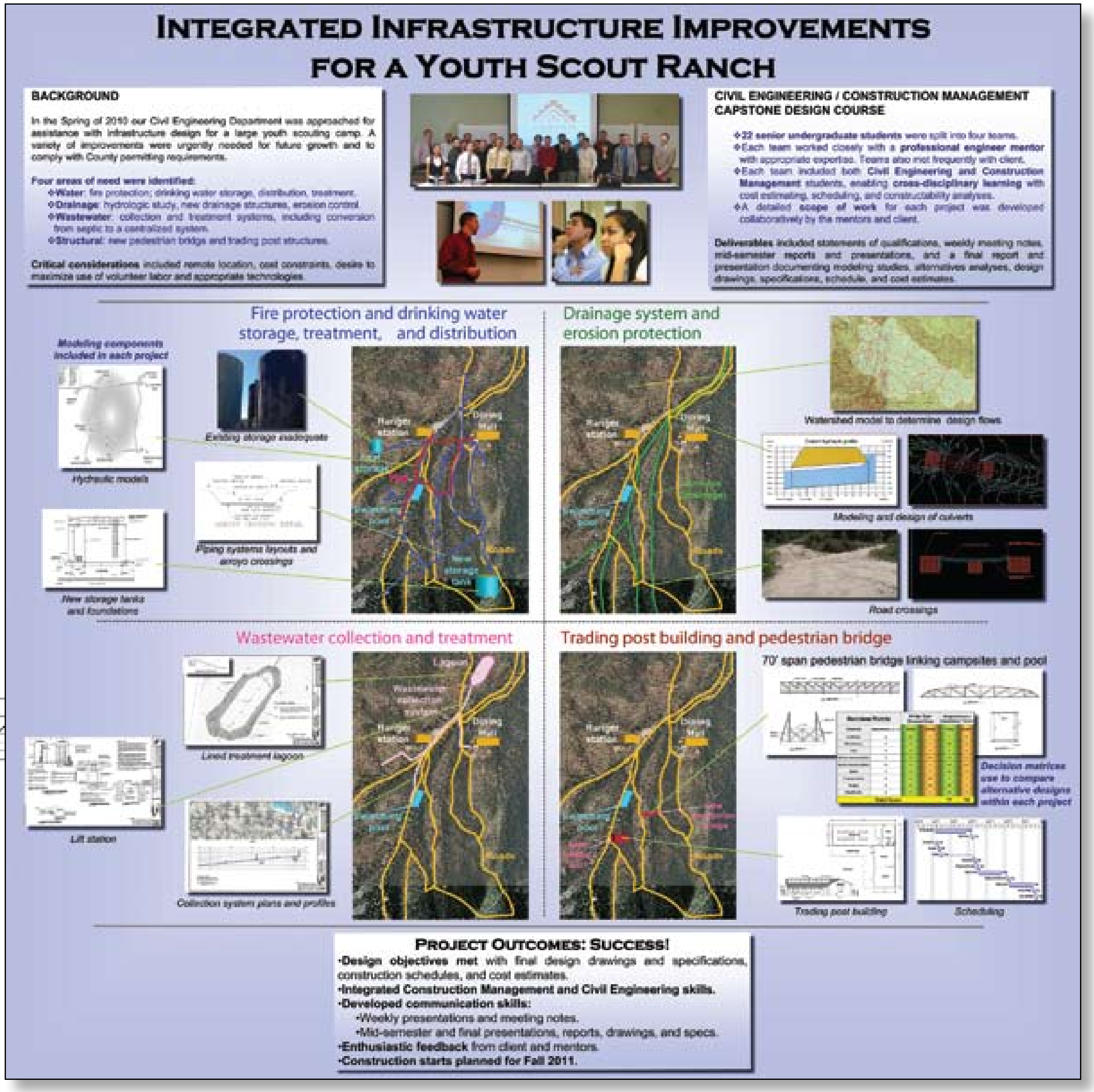
Faculty
Andrew Schuler, Ph.D., P.E.
Kerry Howe, Ph.D., P.E.

Professional Engineers
HDR, Inc.
Ryan Page, P.E.

Smith Engineering Company
Allen Bolinger, P.E.
Pat Conley, P.E.
Jace Ensor, P.E.
Allena Muskett, P.E.

Additional Participants
Boy Scouts of America
Harvey Chace
Scott Johnson
Andrew Mumma
Christopher Shelby

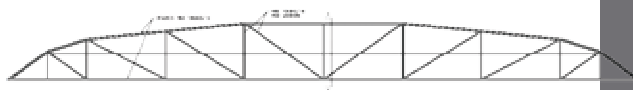




University of New Mexico

Department of Civil Engineering

Integrated Infrastructure Improvements for a Youth Scout Ranch



ABSTRACT

Our civil engineering department was approached by a youth Scouting ranch for infrastructure design assistance in early 2010. A variety of improvements were required for future growth and camper safety. Four areas of need were identified:

> Water: New fire protection, drinking water storage, distribution, and treatment systems

> Drainage: Hydrologic study, drainage structures, erosion control, and emergency access

> Wastewater: New collection and treatment systems

> Structural: New pedestrian bridge and trading post structures

Twenty-two senior undergraduate civil engineering and construction management students were organized into four professional engineer (P.E.) mentor-led teams to address each of these project areas as part of our fall 2010 capstone design course. Each team created a fictitious firm with well-defined roles. Tasks included site assessment (including field measurements and gathering existing data), engineering modeling and calculations, design and comparison of preliminary alternatives using decision analysis tools, preparation of full-size construction drawings and specifications, cost estimation, scheduling, and construction phasing. The teams had to consider site constraints such as rugged terrain, remote location, a need to maximize use of volunteer labor, and limited budgets. Deliverables included statements of qualifications, weekly meeting notes, mid-semester reports and presentations, and final reports and presentations with construction drawings and specifications, cost estimates, and schedules.

The project was highly successful, providing exceptionally strong collaboration between faculty, students, and practicing professional engineers. The student teams worked closely with P.E. mentors, meeting at least weekly and performing much work in their offices. The scopes of work were developed

(continued on next page)

JURY COMMENTS

"The project was very well presented. The client received excellent designs that will benefit generations of Scouts."

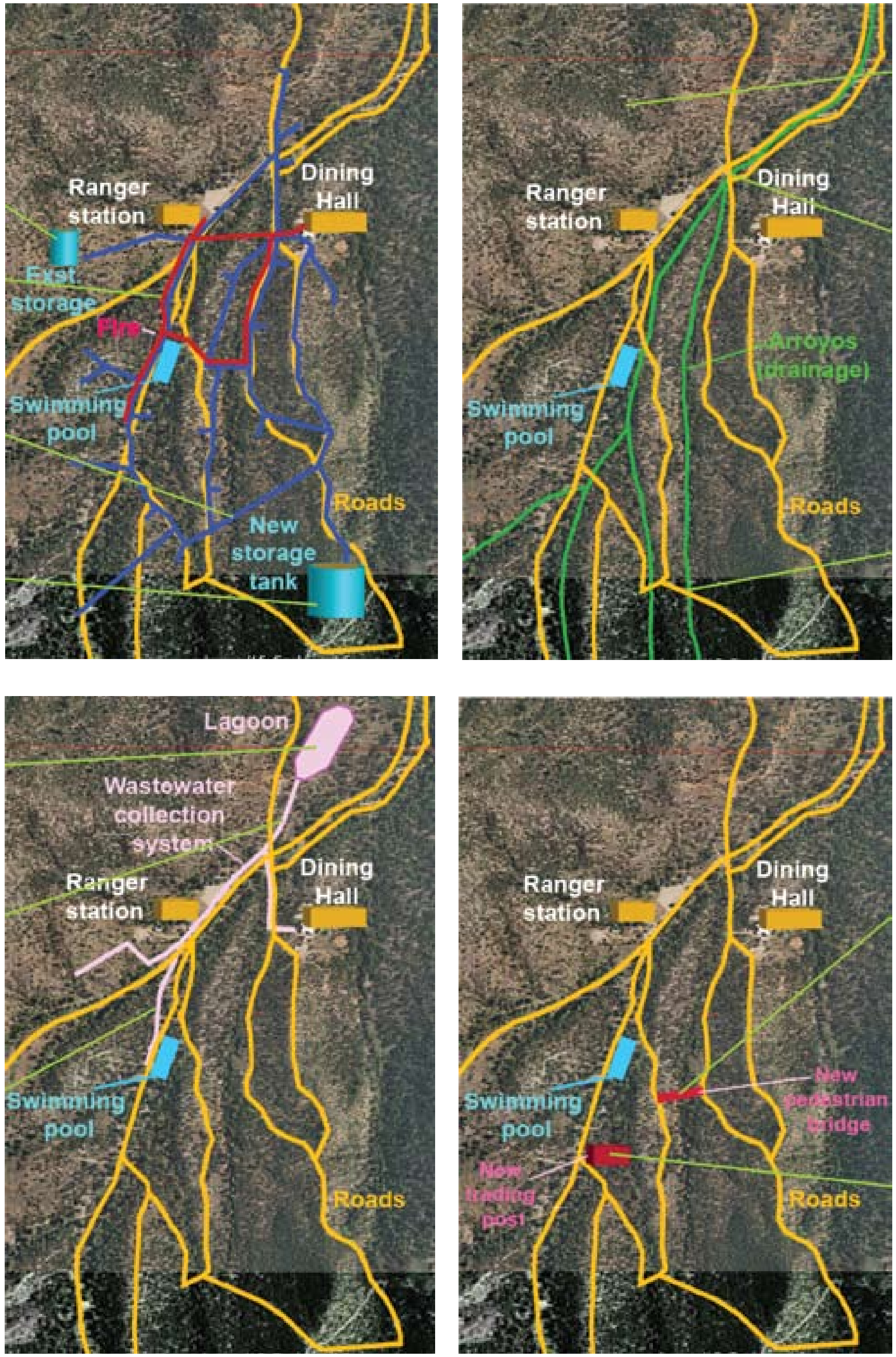
"Excellent opportunity for civil engineering seniors to design a project that could potentially be built as they designed it. The client/student interactions and collaboration with professional mentors at the mentors' offices gave excellent opportunities for students to experience routine working environments."

"This project does a wonderful job of integrating many venues to meet a great need in developing a Scout ranch."

ABSTRACT (continued)

collaboratively by faculty, mentors, and the client. Formal and informal feedback mechanisms were provided for intermediate deliverables and presentations. The projects yielded tangible benefits to public welfare, health, and safety by providing realistic designs for safe drinking water, fire and flood protection, wastewater treatment, emergency road access, and a pedestrian bridge to bypass a steep ravine.

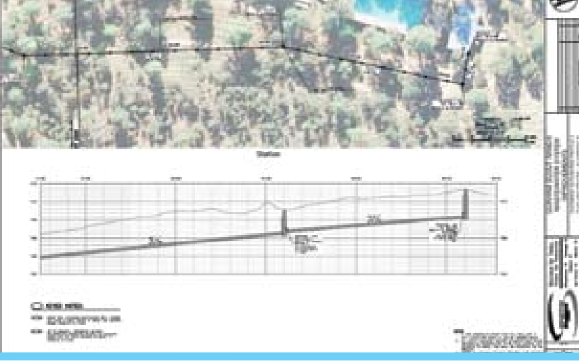
The incorporation of four discrete but related sub-projects at a single site provided a unique opportunity for students to explore specific disciplines within civil engineering deeply, while requiring inter-group coordination. Integration of civil engineering and construction management students on the same teams successfully provided multidiscipline and allied profession participation, with students gaining excellent opportunities to work with the “other sides” of their professions. A variety of knowledge and skills were developed, including extensive presentation and writing skills (with outside professional guidance), gathering of existing data, field investigations, application of modeling skills to real-world problems, permitting applications and communication with government officials, use of decision analysis tools to compare design alternatives and to communicate with clients, incorporation of engineering design with construction management tasks, and development of a full set of design plans and specifications for use on a real project.

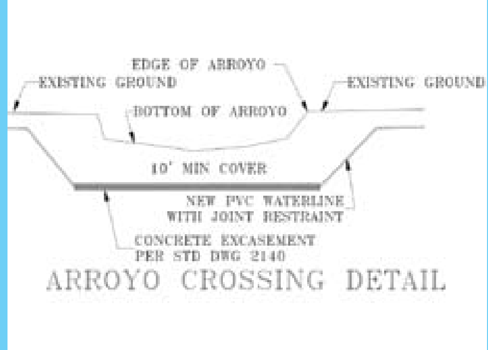


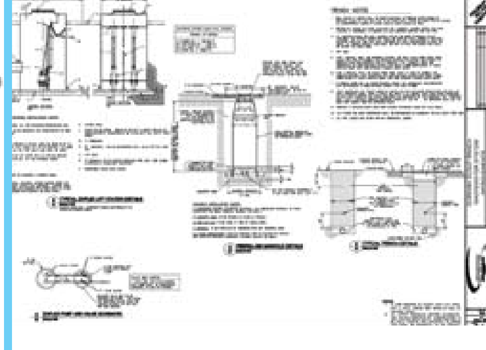
PERSPECTIVES ON

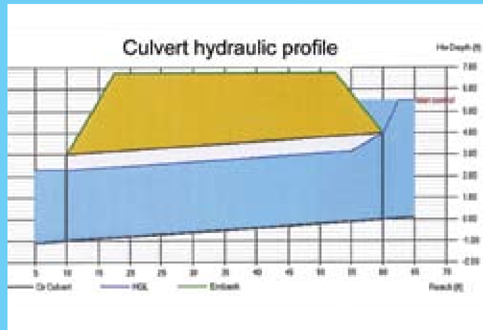
The collaboration of faculty, students, and licensed professional engineers

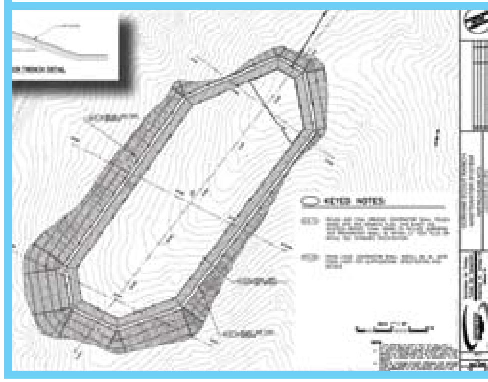
This project provided an excellent example of collaboration between faculty, students, and practicing professional engineers. Our department has a strong history in this regard, with all faculty licensed P.E.s. The Scout ranch project included the primary involvement of four P.E. mentors leading the four project teams, beginning with the collaborative development of the scopes of work by the faculty, mentors, and the client. Additional P.E.s, typically colleagues of the mentors, served as informal advisors for specific project tasks. Close collaboration was ensured in part through weekly meetings between students and mentors, typically in the mentor’s offices, so students also gained a practical understanding of the routine work environment of professional engineers. Student teams also provided weekly update presentations and copies of all meeting notes to the faculty and mentors. A mid-semester progress report provided an opportunity for written feedback from mentors and faculty to the students. A separate mid-semester client presentation was also included to the Scout executive council, which provided further feedback. This collaboration provided 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. In addition, the mentors gained a valuable opportunity to screen new graduates for potential hires; at least one of the students from this project was subsequently hired by their mentor’s firm.

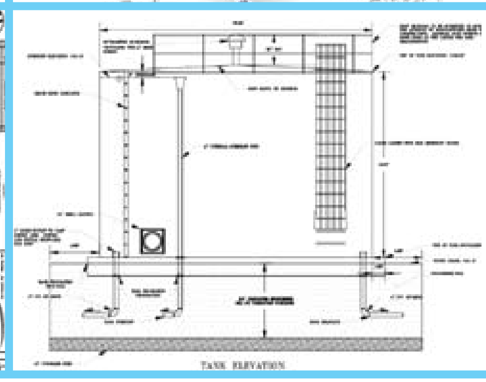






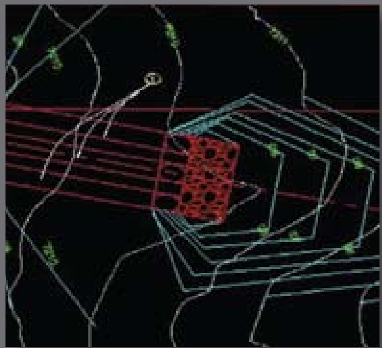






University of New Mexico

Decision Matrix		Bridge Type Element Score		Weighted Score = (Importance * Score)	
Elements	Importance (1-3)	Truss	Girder	Truss	Girder
Aesthetics	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Effectiveness	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Cost	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Offsite Constructability	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Onsite Constructability	1.5	[illegible]	[illegible]	[illegible]	[illegible]
Safety	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Transportation	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Weight	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Wind Profile	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total Score				77	78



The benefit to public health, safety, and welfare

This project provided tangible aid to a non-profit youth Scout ranch dedicated to developing character and skills. As noted, the client initially contacted our department requesting this help, and the student work verified that major deficiencies existed at the site with respect to drinking water, fire protection, drainage and protection of existing structures from erosion, emergency road access during storm events, wastewater upgrades needed for future expansion, a new pedestrian bridge required to improve safety and access to swimming facilities, and a new trading post structure. By providing engineering services free of charge, with the guidance of P.E. mentors, the students were able to provide real benefits to an organization in need. The projects helped to improve safety and protect camper health, while improving opportunities for summer camp experiences for youth. Residing in a Hispanic-serving university, this project also helped prepare under-represented groups for careers in civil engineering.

Multidiscipline or allied profession participation

The integration of civil engineering and construction management students created an excellent opportunity for students with diverse skill sets to interface and create a final project design that included not only a range of engineering skills (e.g., hydraulic, hydrologic, structural, and geotechnical analyses), but also the construction skills required in a real construction project (e.g., cost estimating, scheduling, and construction phasing). In this manner, engineering students solve real-world design problems while learning about practicalities of construction and management. Construction management students, in turn, learn about the challenges and practicalities of engineering design, and all students benefit from working in teams under strict time constraints for production of periodic deliverables under the close mentorship of local engineering and construction professionals. That these programs reside in the same academic department provides a synergy between design and construction that is rare in higher education, although professionals in both fields must frequently work closely together.

POINTS OF VIEW

Andrew Schuler, Ph.D., P.E.
Associate Professor
UNM Department of Civil Engineering
(Professor and project coordinator)

This project was part of a capstone design course. What do real-world projects bring to the course? Our capstone course has used real-world projects for about 20 years; we've found that this provides mentors with background material and well-defined scopes of work that help to take full advantage of their expertise, since they are already familiar with the projects, and it provides students with invaluable exposure to the practicalities of real-world design.

When did the University of New Mexico begin including professional engineers in senior capstone projects? We have included professional engineers as mentors for our capstone course for nearly 20 years.

How has the involvement of professional practitioners grown since this time? We have learned much about the best ways to involve professional practitioners over the years. Keys to success include having regular weekly meetings with the students, including projects that the mentors select and define, and creating well-defined scopes of work appropriate to the mentors' expertise.

How do you decide which projects to work on? We have a list of consultants that enjoy being project mentors, and each semester we solicit them for ideas for projects. We then choose the projects that are likely to be most interesting to the students and are an appropriate blend of different areas of civil engineering.

How did this project prepare students for professional practice? The Gorham Scout Ranch project was particularly beneficial in that it integrated overall improvements for a single site in drinking water, wastewater, drainage, and structural improvements, which required them to communicate across disciplines and to delegate tasks both in their subproject groups and the larger group. The students had to consider significant site and budget constraints, while learning in detail the real needs of the client.

Students from civil engineering and construction management worked together on this project. What did the integration of these two groups bring to the project? Integration of construction management and civil engineering brought an added element of realism to the project: the engineers were responsible for the traditional elements of design, while the construction managers' tasks included scheduling, cost estimates, and safety plans. Working with their counterparts in this way should help to prepare them for real projects when they join the workforce.

What were the biggest challenges on this project? The biggest challenges revolved around organizing the entire class around four subprojects at a single site, which required extra coordination between the student teams, and trying to provide appropriate engineering solutions that fit within the client's budget and site constraints.

What's ahead for the course? We learned from this project that it can work really well to have multiple teams working at a single site—in the future, we would like to build on this semester's approach, possibly even performing more improvements for the Scouts.

What advice do you have for other programs wanting to add similar collaborative projects to their curriculum? The most important thing is to find good mentors and good projects.

How does the University of New Mexico plan to use its $25,000 prize? UNM plans to use the prize to pay for resources to improve the educational experience of their design courses, such as travel to project sites, specialized software, and building models.

Christian Naidu
UNM Class of 2010
(Student participant)

What did you like best about participating in the project? What I liked best was the fact that this was a real-world problem, with budgetary limitations that required an efficient and economical solution. It enabled us to utilize modern tools of the trade to analyze the problem and develop a sound engineering solution.

What did you learn? I learned much about what goes into the various phases of planning and executing a civil engineering project. From project scheduling to using CAD tools to create final shop drawings, everything was a learning process.

How did the participation of professional engineers improve the experience? The professional engineers provided much of what we as students lacked: insight, experience, and the ability to mentor us through challenging phases of the project.

What do you think the engineers learned from working with students on the project? I think the engineers enjoyed the interaction with young, enthusiastic students who had a desire to learn and benefit from the engineers' experience, and also they got an opportunity to give back to the community.

Ryan Page, P.E.
HDR, Inc.
(Project mentor)

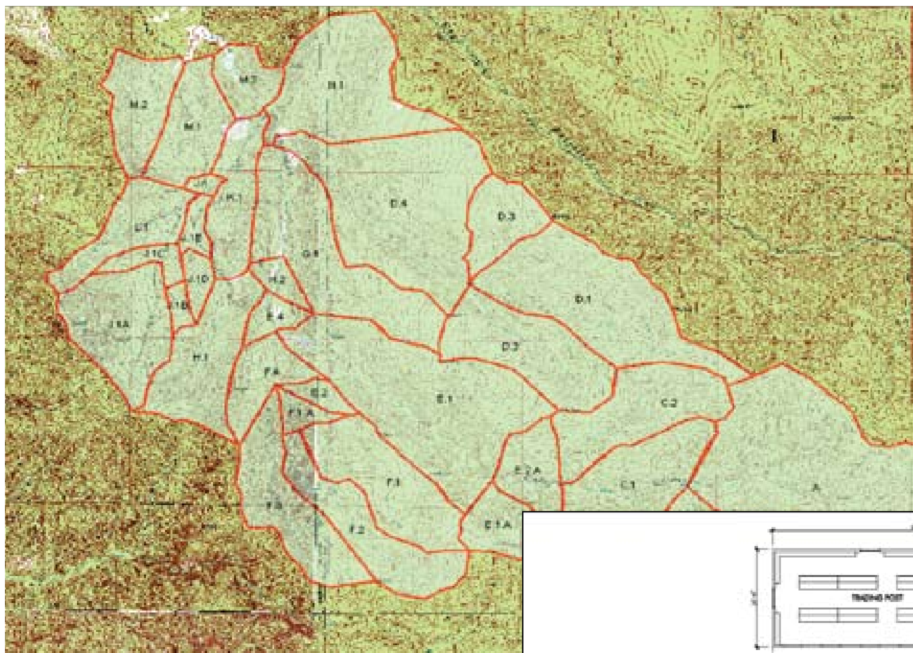
Why did you get involved with the University of New Mexico capstone design course? I got involved with the course because I wanted to help prepare the students for the real-world work environment.

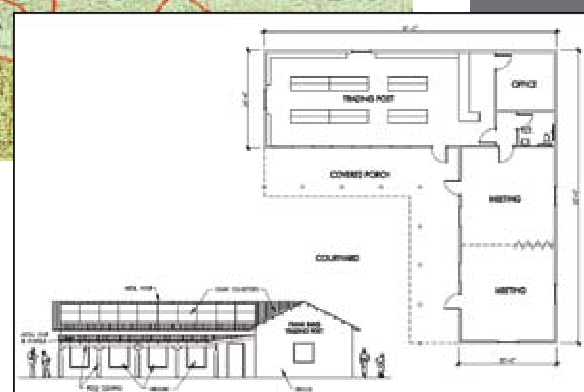
How did you assist the students in the Gorham Youth Scout Ranch project? I assisted the students by giving guidance about how plan sets are put together for structural projects of this nature. I also shared my knowledge of what being a professional engineer is all about.

How did this project prepare students for professional practice? This project prepared the students by giving them the opportunity to experience a project that is exactly the type of project they would be working on once they leave school.

What did the integration of civil engineering and construction management students bring to the project? It created an opportunity for the engineers to get a feel for how things are actually built once they are designed. Knowing how a project will be constructed is valuable information that should be considered during the design phase of the project.

What did you learn from working with the students? I learned that those with the knowledge and experience should take the time to pass it on to the next generation.





What did you want students to take away from working with professional engineers? I hope the students came away with a better understanding about what work will be like once they leave school, which will lessen the learning curve.

University of New Mexico

"I was very impressed with the energy and design skills the student teams applied to the problem. They were very thorough in researching code issues; and they presented several options for dealing with each category of development challenge, including water source planning, wastewater management, storm water management, facility construction, and infrastructure development. They even incorporated 'sweat equity' options into each design solution so that portions of future project costs could be off-set by community volunteer efforts."

Harvey Chace
Associate Director for Maintenance and Planning (Ret.) University of New Mexico Physical Plant Department and volunteer member of the Great Southwest Council of the Boys Scouts of America, Facility Committee


EXIT

2011 NCEES Engineering Award
$7,500 WINNERS

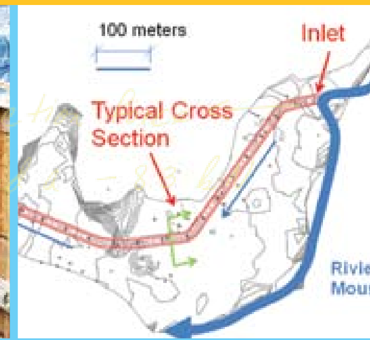
California State University, Los Angeles
Department of Civil Engineering
Connecting Professional Practice and Education through a Civil Engineering Capstone Project: Mud Flow Barrier

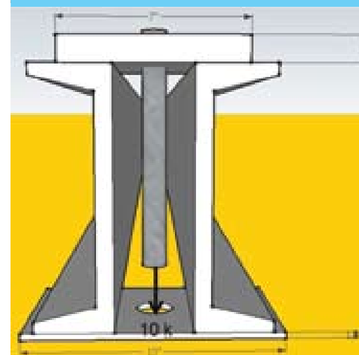
Lawrence Technological University
Department of Civil Engineering
Civil Engineering Capstone Project and Recovery Park

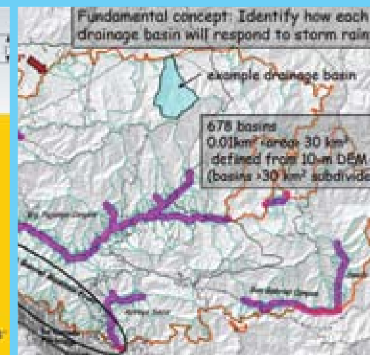
Seattle University
Department of Civil and Environmental Engineering
Flood Control Channel Design for a River in Northwest Haiti

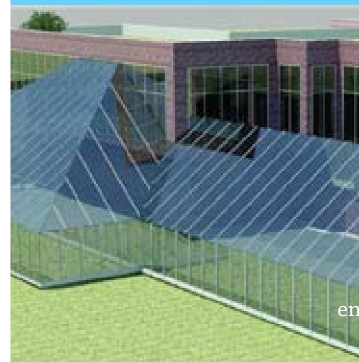
Seattle University
Department of Civil and Environmental Engineering
Structural Design of Dam Sluice Gate Walkway Slabs: Retrofit and Replacement Options

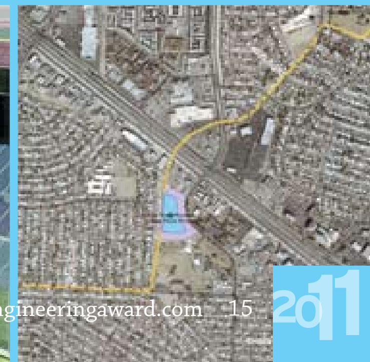
University of Texas at El Paso
Department of Civil Engineering
Development of a Sustainable Infrastructure Management System for a City











$7,500 AWARD

PARTICIPANTS

Students
Ryan Aghakhani
Francisco Alvarado
Veronica Alvarez
Pedro Arechiga
Arthur Asaturyan
San Aung
Victor Ayala-Trujillo
Edgar Bautista
Gabriela Bedolla
Edgar Bermudez
Daniel Delgado
Hung Dinh
Erika Esparza
Saleh Feidi
Azael Hernandez
Richard Huerta
Otto Jacobsen III
Chaodi Ma
Zaw Moe
David Nguyen
Ma Oo
Cesar Orozco
Luis Pedraza
Jessica Perez
Guillermo Petra
Dayana Quijada
Christopher Rauda
Noemi Rodriguez
Israel Rueda
Pranita Shah
Sing Song
Jinkang Tan
Mahnoush Tehrani
Allan Vazquez
Brandon Watkins
Fabiola Wells
Tapan Ukani
Jose Urquizo
Allan Yu

Faculty
Rupa Purasinghe, Ph.D., P.E.
Mark Tufenkjian, Ph.D., P.E.

Adjunct Faculty
Reinard Knur, P.E., G.E.
(Geotechnologies, Inc.)

Howard Lum, P.E., S.E.
(Metropolitan Water District of Southern California)

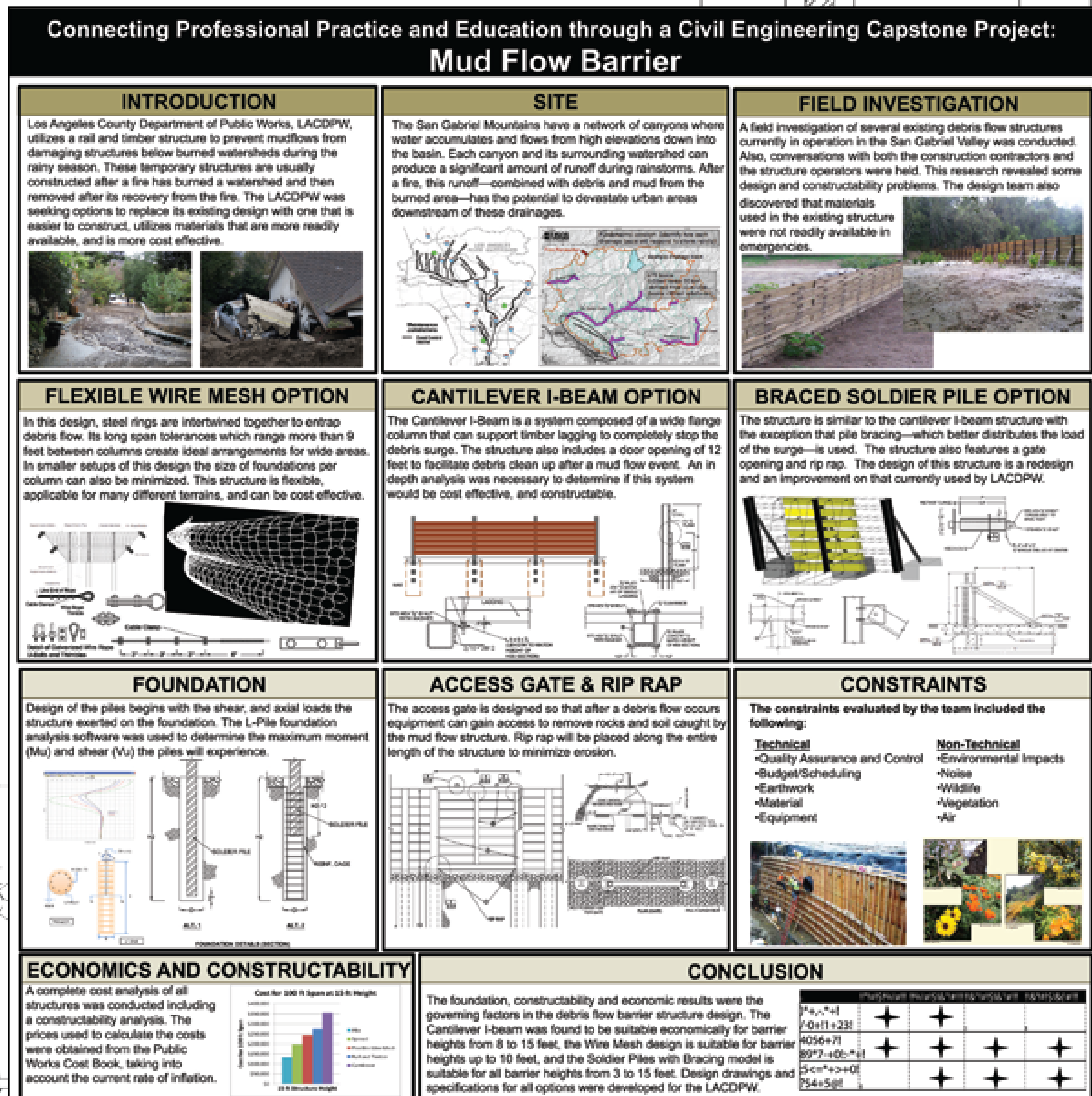
John Shamma, P.E.
(Metropolitan Water District of Southern California)

Professional Engineers
Robert Barsam, P.E., S.E.

CalPortland Cement Co.
Alice Maupin, P.E.

City of Los Angeles
Raymond Chan, P.E., S.E.

Los Angeles County Department of Public Works
Diego Cardena, P.E.
Youssef Chebabi, P.E.
Ben Willardson, P.E., S.E.



California State University, Los Angeles

Department of Civil Engineering

Connecting Professional Practice and Education through a Civil Engineering Capstone Project: Mud Flow Barrier

ABSTRACT

The civil engineering department requires all undergraduates to complete a senior design team project over the course of six months to submerse students into an engineering-firm-type-atmosphere. Facilitators include practicing registered engineers from different disciplines related to the project such as structural, geotechnical, and water resources. 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 ethics.

For the senior design project, the university partners with local agencies to provide the senior design team an opportunity to work on real-world design projects. The idea is to expose the students to a real-life project, the results of which would be implemented by the agency. This year's project was to analyze and provide the participating agency with an alternate design for its standard rail and timber structure utilized for preventing mudflows from damaging structures below burned watersheds. In an effort to reduce construction time and costs, the water resources division requested the analyses of these standard rail and timber structures to determine whether a more cost- and construction-effective barrier can be designed to replace these standard rail and timber structures. This has even become more important as the availability of rail on the open market is limited.

This project required hydrologic and hydraulic analysis to determine the possible flow rates and velocities that can impact the structures. The analysis included a structural and geotechnical analysis to determine dead loads, static pressures, and impact loads on both the structure and the foundation. Once the existing standard was analyzed to determine the factor of safety built into the standard design, alternative designs and/or materials were proposed to reduce cost and construction time. A complete environmental analysis of the project was completed. The project also required evaluation of costs and benefits associated with any developed alternatives.

Over six months, project teams produced a complete technical and non-technical analysis of the project. The analysis included the application of constraints in the final design while holding paramount the safety of the public. Additionally, they prepare a final design technical report including memoranda, computations, drawings, specifications, and cost estimates. 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 students with feedback on the technical merit of the report and presentation.

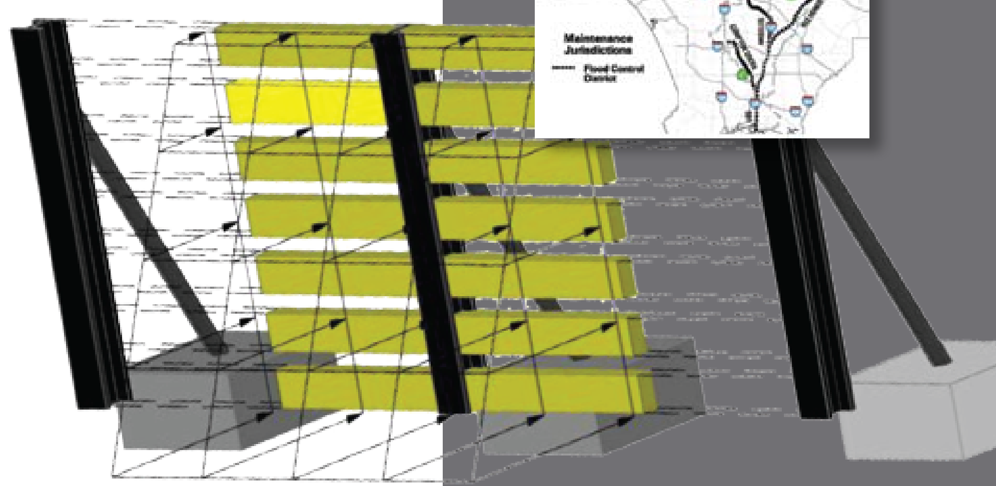
The students and the project were evaluated in a value-engineering-type environment by five professional engineers who scored the students on incorporating realistic constraints such as social, health and safety, economic, sustainability, ethical, environmental, and political. Additionally, the students were evaluated on their techniques and skills for engineering practice.

JURY COMMENTS

"Well-developed alternative solutions that considered cost and constructability. This project significantly benefits public health and welfare."

"The students did an excellent job following the engineering cycle, yielding practical, improved designs."

"The display board provided highly technical and professional details of options for the project."



PERSPECTIVES ON

The collaboration of faculty, students, and licensed professional engineers

Over the six-month duration of the design class, engineering faculty and four practicing registered engineers from three different disciplines worked in collaboration with the students to develop and implement a project plan. The team included one structural engineer responsible for assisting students with utilizing building codes for their analysis and conducting structural analysis using SAP 2000 to analyze impact from mudflow. Students also received great assistance from a geotechnical engineer in understanding the geology needed to support their design. These activities provided the students with leadership opportunities, hands-on engineering experience, and a chance to meet and work with practicing professional engineers.

The 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 including the California Environmental Quality Act (CEQA), and presentation skills. The practical lectures provided the opportunity for the professional engineers to share examples from their personal experience that demonstrated the importance of each topic.

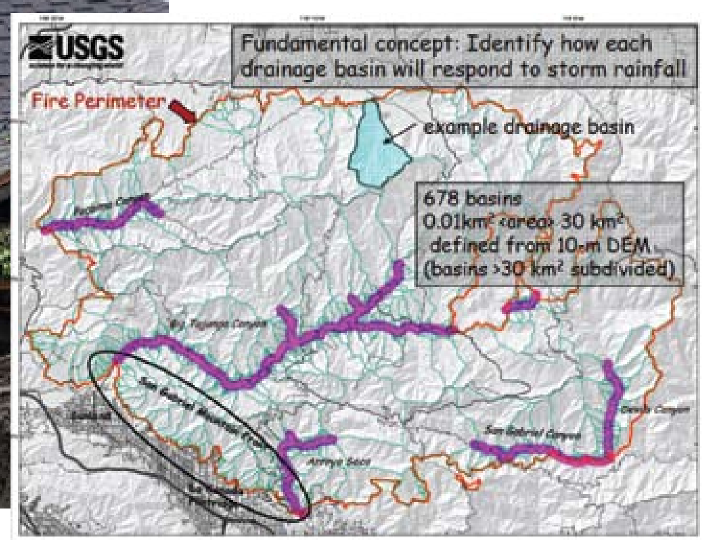
Another requirement for the course was that each student develop a portfolio to be used for job interviews. Registered engineers from the school faculty assisted students in preparing résumés and other documents for the portfolio.

A liaison from the agency, 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 regarding personnel issues and career development. At each stage, the agency reviewed and commented on the tech memos, and the senior design team would adapt the reports as necessary to address these concerns.

Through these many avenues, students gained insight as to the value of experience and professional registration.

The benefit to public health, safety, and welfare

This year's senior design class provided an opportunity for



students to work on a project that directly affects the public's health, safety, and general welfare. The rail and timber barriers that the agency had been using had proven successful in preventing damage from mudflows, but construction and operations and management (O&M) considerations required changes to the design. The agency needed a design that could be installed quickly and easily maintained to ensure its effectiveness after multiple rainfalls.

This project stressed the importance of codes and minimum requirements for design and safety; a flawed design could potentially lead to loss of property or life. In addition, the team analyzed the designs to ensure that they met the requirements of CEQA. In each phase of the project, the health and safety of those that the barriers would be protecting was a major consideration in advancing various designs.

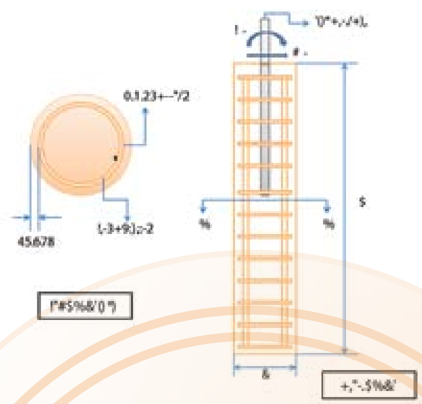
Multidiscipline or allied profession participation

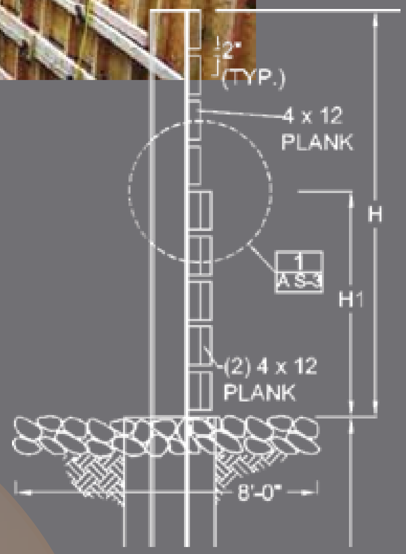
Every instructor in senior design was a professional engineer, encouraging the desirability of licensure. The practitioners have accumulated over 120 years of combined experience among them in environmental, hydraulic, hydrologic, structural, and geotechnical engineering. Design issues from all of these areas arose in the completion of this multidisciplinary project. Instructors brought their experience to the classroom and worked closely with students and guided their paths throughout the entire six months. They introduced students to techniques regarding analysis and design that moved engineering theory into practice.

The knowledge or skills gained

Students obtained knowledge in various fields as part of this design project. In addition to knowledge of traditional debris flow structures, students learned how to design the latest in technology, namely flexible wire mesh structures. Additionally, students were exposed to geological or geotechnical engineering issues and processes in regards to burned watersheds and health and safety implications to this phenomenon. A visit to watershed and multiple mudflow barrier sites gave students insight to the variation in channel dimensions, mudflow impact to barriers, and maintenance process and accessibility issues.

In addition to the knowledge gained in standard engineering practice, the students gained valuable skills in project organization and design, cost estimation, report writing, and presentation/public speaking. Students had to work as a team, both among fellow students and with facilitating engineers, in order to prepare deliverables in a timely manner. Students also gained knowledge of applicable building codes; local seismic, wind, and geological conditions; building materials; and the provisions of CEQA.





$7,500 AWARD

PARTICIPANTS

Students
Kevin Brown
Bryan Dage
Neil Ganshorn
Jessica Howard
Mike Kapetansky
Lindsey Stevens
Erica Walker

Faculty
Lead Advisors
Donald Carpenter, Ph.D., P.E., LEED AP
John Tocco, JD

Technical Advisors
Hiroshan Hettiarachchi, Ph.D., P.E.
Keith Kowalkowski, Ph.D., P.E., S.E.
Luis Mata, Ph.D.
Edmund Yuen, Ph.D., P.E.

Professional Engineers
Subdiscipline Industrial Mentors
Bruce Burt, P.E.
Tom Doran, P.E.
Kevin Foye, P.E.
Theresa Marsik, P.E.
Karen Mondora, P.E.
Jay Ruby, P.E.

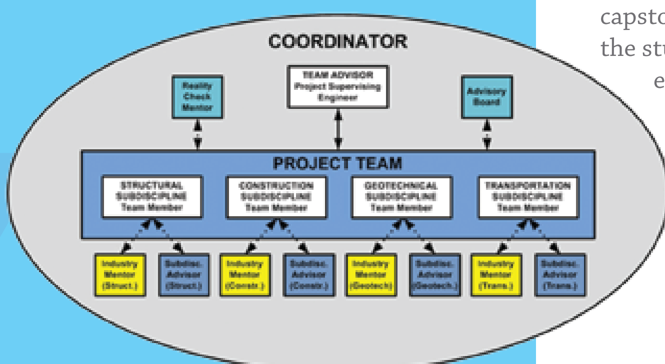
Reality Check Mentors
Robert Kohut, P.E.
Timothy O'Brien, P.E.
Keith Toro, P.E.

Industrial Advisory Board Participants
Richard Anderson, P.E.
George Fadool, P.E.
Dan Fredendall, P.E.
Cheryl Gregory, P.E.
Robert Kohut, P.E.
Andrew Rener, P.E.
William Rohleder Jr., P.E.
Ian Schonsheck, P.E.
Scott Thieme, P.E.
Ben Tiseo, P.E.

Additional Participants
SHAR Recovery Park
Gary Wozniak

University of Detroit Mercy Design Studio
Rocco Castlione
Charles Cross, AIA
Dan Pitera, AIA

Other mentors and advisors include
Dan Kovach
Pat Podges



ABSTRACT

The civil engineering program at the university has a two-semester design and project management capstone experience. The capstone represents the culmination of the students' undergraduate education, providing them an opportunity to integrate and apply various educational components in preparation for their careers as civil engineers. Students are mentored by professional engineers and industry practitioners throughout the sequence while interacting with community organizations.

Students form teams and develop projects of their choice. Their scope of work, based on at least four of the civil engineering subdisciplines, entails generating a conceptual design and project management plan. Deliverables for the capstone include written technical and progress reports, and oral progress and poster presentations.

A major pedagogical aspect of the capstone is the mentor initiative, where the students meet with professional engineers and other construction and design practitioners at various points in the project cycle. For example, teams meet with engineers and design-builders to review the scope and overall viability of their projects.

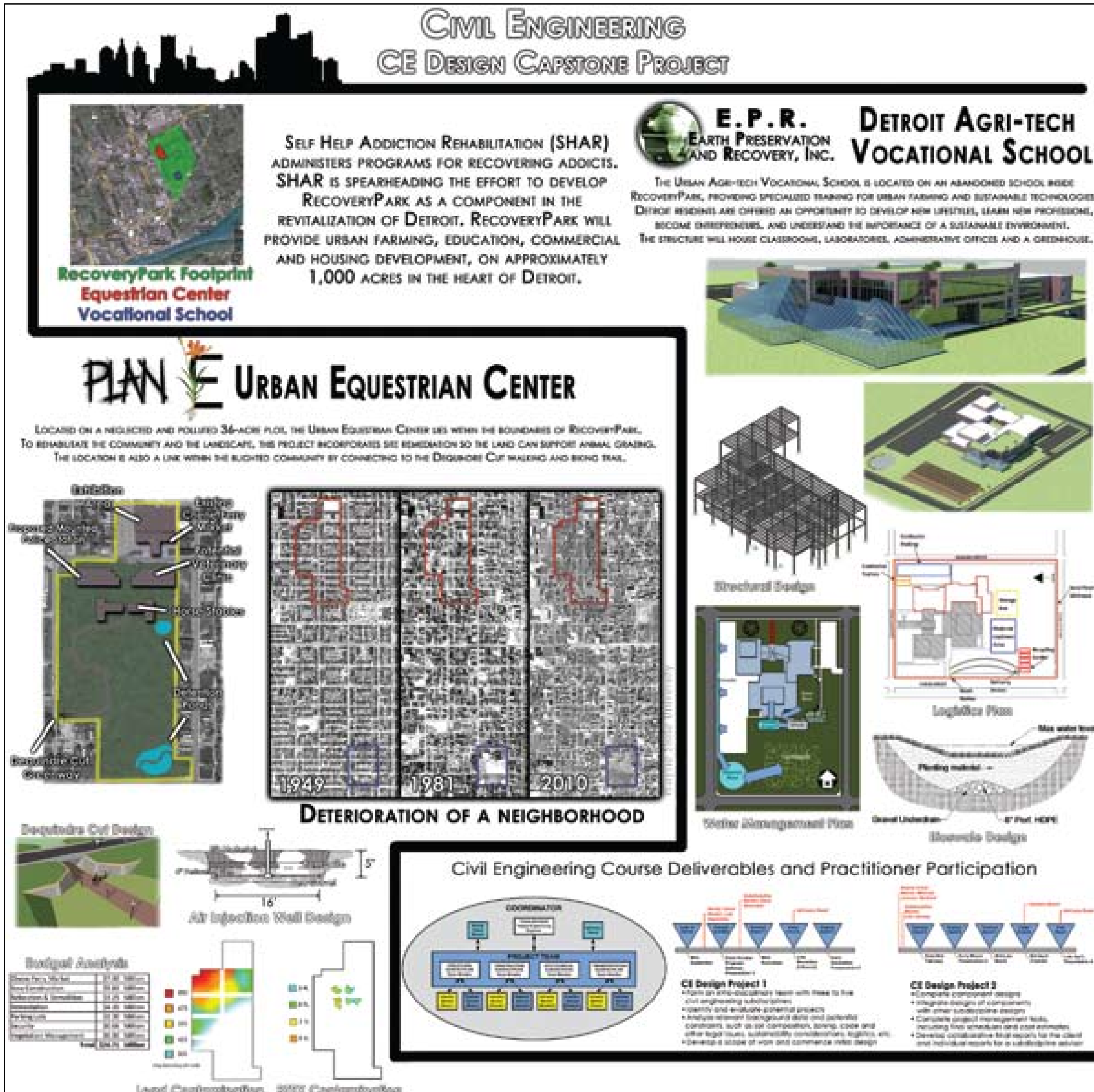
Students participate in subdiscipline-specific sessions where they receive feedback from practitioners on their design and project management approaches. Also, professional engineers evaluate and provide significant feedback to teams in poster presentation sessions.

For the 2010–11 academic year, two of the projects are especially notable for their collaboration with the nonprofit corporation Self Help Addiction Rehabilitation (SHAR; pronounced "share"), located in Detroit, Michigan. Along with administering programs for recovering addicts, SHAR is involved with the development of blighted and depressed property in Detroit now known as Recovery Park. Recovery Park is a major initiative for the revitalization of Detroit. One student capstone team chose an abandoned market to conceptualize an equestrian center for the stabling, training, caring for, and displaying of horses affiliated with the Detroit Police Department. Another team utilized an abandoned Detroit Public School to conceptualize a vocational school for teaching residents urban farming and sustainable living skills. Both student design projects served the Recovery Park community and were utilized by SHAR as part of their fundraising efforts.

Lawrence Technological University

Department of Civil Engineering

Civil Engineering Capstone Project and Recovery Park



JURY COMMENTS

"The project shows a strong tie between engineering design and social renewal and made good use of industry and external mentors and partners."

"This program showed not only the value of engineering skills but also demonstrated the compassionate care of the public good."

"Excellent project addressing a serious issue for many cities. This design solution has the potential for having a national impact."

PERSPECTIVES ON

The collaboration of faculty, students, and licensed professional engineers

Faculty recognized the importance of additional practitioner involvement and determined that while the longstanding advisory board participation in the final oral presentation was highly beneficial, it was also insufficient from the perspective of both the students and the program. Consequently, faculty added several mentoring sessions to the capstone schedule. The mentor initiative includes three types of interactions between practitioners and students:

Reality check mentors: Teams meet with engineers and design-builders to review the scope and overall viability of their projects early in the process. The mentors ask probing questions and encourage critical evaluation by the teams. Faculty believed that as a way to make the interaction more professional, teams should meet the mentors at their place of business. Not only did mentors host teams at their offices, several invited additional employees to participate, making the experience even more realistic and rewarding.

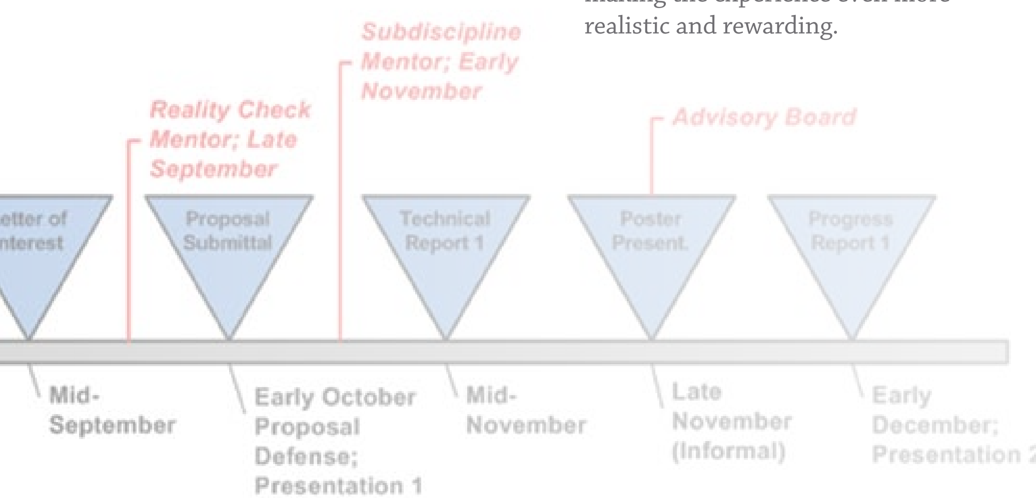
Subdiscipline industry mentors: In subdiscipline-specific sessions with professional engineers, students receive feedback on their design and project management approaches. Mentors also speak to the entire group of students to provide general observations and insights. These sessions occur in both semesters so students can adjust projects based on mentor comments.

Industrial advisory board: The Civil Engineering Industrial Advisory Board members provide feedback on all aspects of the projects during oral and poster presentations. The informal poster session in November serves to educate the advisory board on that year's student projects. Board members thoroughly enjoy sharing their expertise, talking design, discussing construction techniques, etc., with soon-to-be engineers. The formal poster presentation in April occurred at the executive conference facility of one of the board members' companies and included additional student interactions with professionals.

The benefit to public health, safety, and welfare

These capstone projects were an enrichment to an existing regional redevelopment program (Recovery Park) developed to benefit the public health, safety, and welfare of an impoverished and blighted neighborhood in Detroit, Michigan. The student projects were designed within the boundaries of the Recovery Park master plan and included an urban gardening facility (health), mounted police post (safety), vocational school (welfare), farmland (health and welfare), trails (health and welfare), and economic opportunities (health, safety, and welfare). It's difficult to describe how impactful this project would be in the region and how much our students learned about an impoverished community within 15 miles of our campus. The local citizens have no access to fresh, healthy food options (only pre-packaged, highly calorific foods are readily available) and have an unemployment rate of approximately 40 percent. Through their capstone projects, the students put themselves in the place of the residents and learned about the numerous challenges they face in their daily lives.

The design process required students to review and apply all applicable engineering codes and standards and adhere to the ASCE Code of Ethics. The teams also researched regional demographics and familiarized themselves with zoning and planning documents. Possibly the most important point was that the students "listened" to the needs of their "client" through design meetings and public presentations to citizen groups as part of the Recovery Park planning process. The public presentations were above and beyond the requirements of the capstone and undertaken voluntarily by the students. Finally, both teams addressed sustainability issues by researching the USGBC Leadership in Energy and Environmental Design (LEED) process and computing point values for potential LEED certification for the projects.



Multidiscipline or allied profession participation

The capstone instructional team includes 10 faculty, 27 practitioners representing 15 companies, and several guest lecturers who discussed professional skills such as oral communication, writing, sustainable design, and teamwork. As such, the students interacted with a broad range of professionals, including professional engineers, lawyers, urban planners, technical writers, architects, and LEED-accredited professionals.

As an additional component, the teams presented their projects to 25 urban planners from the Netherlands. The planners were touring Detroit as an international case study for urban renewal and were made aware of the projects by the SHAR Foundation. The planners elected to attend the capstone final presentation, and a special session was organized to allow the seven students to spend additional time interacting with the international contingent and answering questions about their designs and experiences. This unexpected opportunity resulted in an exhilarating and rewarding experience. Indeed, the students rose to the occasion and discussed their projects with confidence and intelligence to an unfamiliar group.

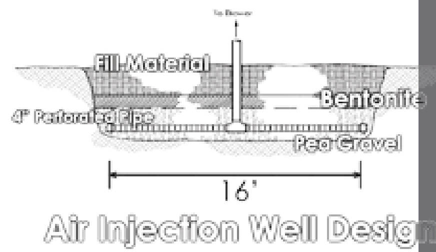
As part of their research, the students interfaced with University of Detroit Mercy Design Studio architects and urban planners who are overseeing the Recovery Park master plan on behalf of SHAR Foundation. While both student projects were unique designs of their own choosing, they did utilize the Recovery Park master plan as a framework for which to locate their projects.

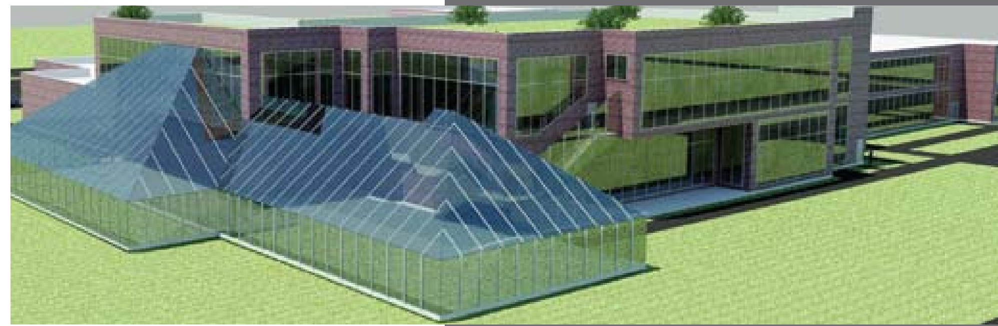
The knowledge or skills gained

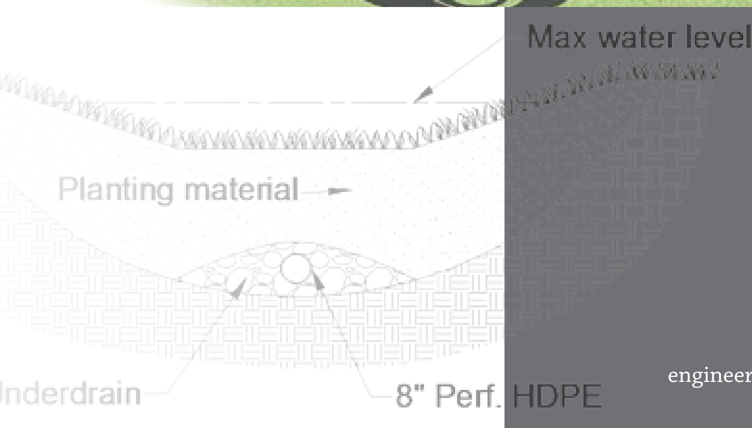
Formal course objectives were written for the two-semester capstone sequence as part of the program assessment and continuous improvement plan. The objectives are consistent with ABET and the American Society of Civil Engineers *Body of Knowledge*, Second Edition (BOK2), which provides the framework for the civil engineering program outcomes.

Additionally, these two teams gained knowledge about an under-serviced population in the Detroit area and how their skills as engineers can be used for the benefit of society. The students also had to interact with a broad range of constituents, including community organizers, urban planners, architects, and the general public. These meetings honed the students' communication skills, especially when communicating technical information to non-engineering audiences, and enriched their capstone design experience.

Finally, each student was assigned a custom laptop loaded with industry-standard software valued at more than $10,000. Students applied state-of-the-art technology specific to their subdiscipline, such as RISA-3D structural design software, Primavera scheduling software, AutoCAD, ArcGIS, the Bentley Water Management suite of software (StormCAD, WaterCAD, Culvert Master, PondPack, Sewer CAD, and Flowmaster), and visualization software for building renderings. As such, students not only learned technical design and project management fundamentals; they also learned to apply industry standard software in their projects.







$7,500 AWARD

PARTICIPANTS

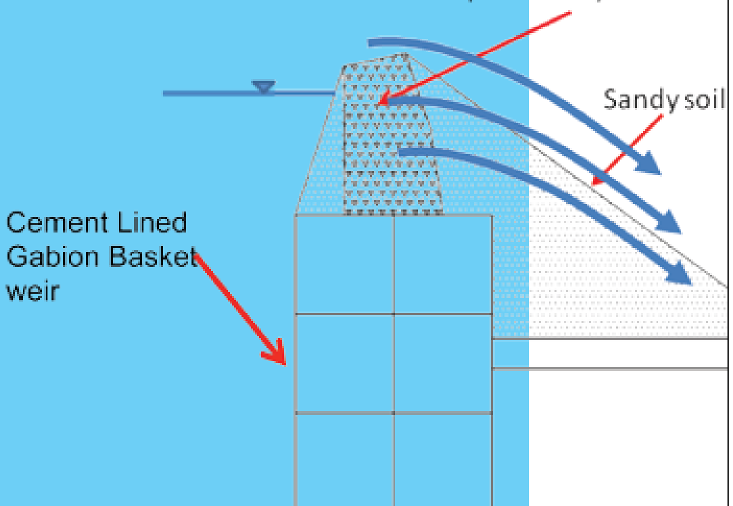
Students
Jenny Graves
Vanessa Mitchell
Devin O'Neill
Adam Stricker

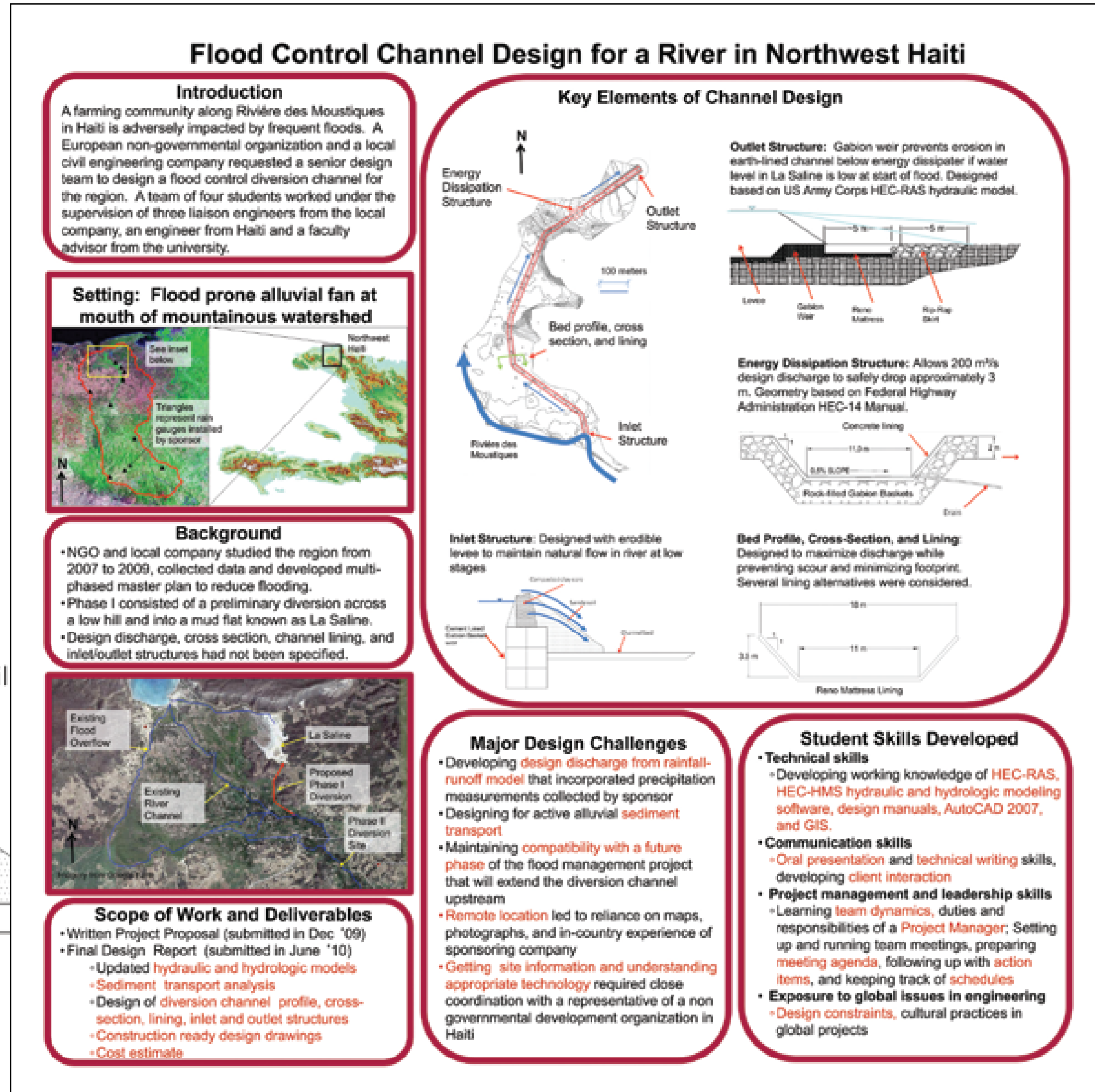
Faculty
Wesley Lauer, Ph.D., P.E.

Professional Engineers
Herrera Environmental
Christina Avolio, P.E.
Michael Spillane, P.E.

Additional Participants
Herrera Environmental
Mark Merkelbach

Liaison in Haiti
Bruce Robinson





Seattle University

Department of Civil and Environmental Engineering

Flood Control Channel Design for a River in Northwest Haiti

ABSTRACT

All engineering students at our university are required to complete a year-long, industry-sponsored senior design project prior to graduation. Last year, a team of four students worked under the supervision of three liaison engineers from a local civil engineering firm and a faculty advisor to design a flood control channel for a river in northwest Haiti. During fall quarter, the students prepared a written proposal outlining the project purpose, a scope and plan of work, a set of project deliverables, a schedule, and a budget. Design work was done in winter and spring quarters and culminated in a report describing hydrologic and hydraulic modeling, engineering design of the channel and its inlet and outlet structures, and construction-ready drawings and calculations. The team made oral presentations to the sponsoring company at the end of fall, outlining the project scope, and in spring quarter, describing their final design, and also met regularly with the liaison engineers over the course of the year.

The project addresses flooding along Rivière des Moustiques, a river in northwest Haiti where recent flooding has adversely affected the agricultural productivity of the region, hurting the livelihood of the community. Prior to our involvement, a European non-governmental organization partnered with a U.S. engineering company to develop a comprehensive floodplain management plan outlining a series of engineering projects needing further design development. The plan included a preliminary design for a diversion channel to route floodwater away from farmland into an uninhabited salt flat.

The company requested the team to finalize the design of the diversion channel. In response, the team updated the existing hydrologic and hydraulic models to determine an appropriate design discharge; designed the geometry, lining, and inlet/outlet structures for the channel; and created a set of construction drawings. Erosion and sediment control played a major role in the design. The inlet structure was designed with an erodible berm overlying concrete-lined gabion baskets to maintain low flow in the existing channel while allowing larger discharges competent for transporting sediment to freely enter the diversion channel. The channel was designed to safely convey the 200 m^3/s design flow with a minimum footprint. A set of energy dissipation structures was included near the outlet to prevent erosion at the mouth of the channel. The channel lining consisted of Reno mattress and gabion baskets with concrete lining in the stilling pool.

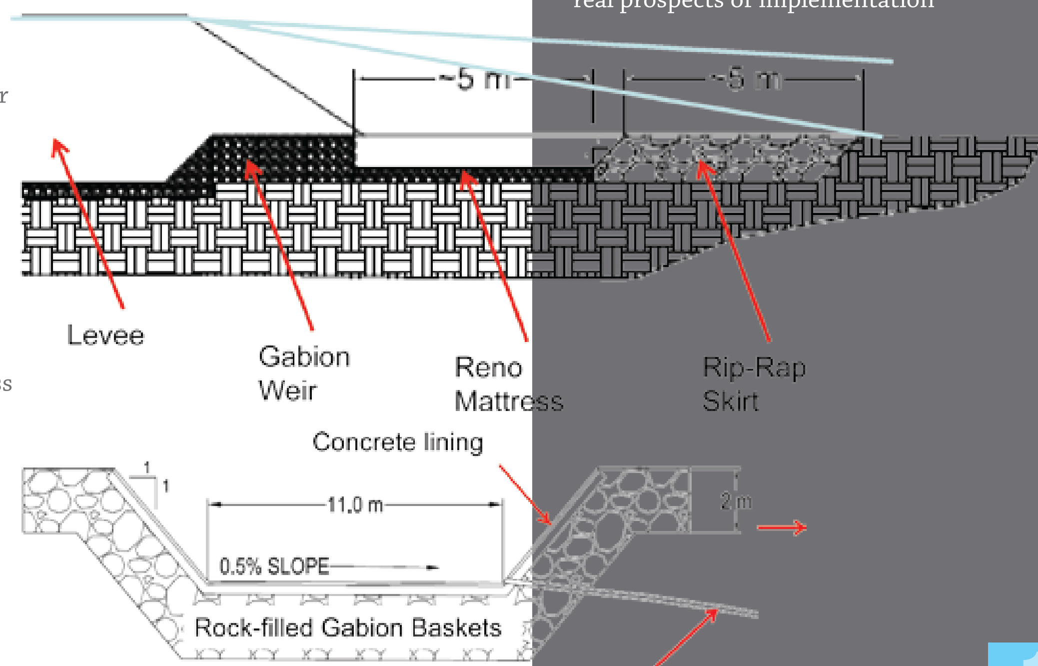
During the year, the student team met with the faculty advisor weekly and with the liaison engineer every second or third week. The team also regularly consulted with a liaison engineer in Haiti regarding the feasibility of design options and the collection of input data (e.g. topographic surveys) necessary for the design. Team members served sequentially as project manager, running team meetings, setting agendas, assigning tasks, and following up on action items. The project strengthened the team's ability to apply their technical knowledge, to work as a team, to communicate effectively, and to practice project management and leadership skills. The project also provided a unique perspective on engineering in the context of international development work.

JURY COMMENTS

"By collaborating effectively with members of the community and with practicing professional engineers, these students have produced a design solution for halting environmental degradation of a municipal water supply system."

"The project has a large beneficial impact on the affected population, with an excellent, well-illustrated technical description and thoroughly developed solution."

"Addresses a real need with a strong technical approach, strong student and professional collaboration, and real prospects of implementation"



The collaboration of faculty, students, and licensed professional engineers
All engineering students are required to successfully complete a team-based, industry-sponsored, year-long capstone project. The team for this project consisted of four students (two women and two men) and was supervised by three practicing civil engineers, of which one was a licensed professional engineer. A civil engineering faculty member, also a licensed professional engineer, served as a faculty advisor.

The students met with their faculty advisor weekly and with their company liaisons every two or three weeks. The company liaisons provided technical assistance when needed and provided feedback on the proposals and reports. The faculty advisor provided technical assistance throughout the project and provided feedback to several drafts of the proposal in fall quarter and the final report in spring quarter.

The benefit to public health, safety, and welfare
Haiti is the only country in the Americas that is listed on the United Nations list of least developed countries. Historically, political corruption has made the distribution of international aid money difficult. The 2010 magnitude 7.0 earthquake has worsened the plight of Haitians and placed an additional burden on already limited resources. While earthquake-related reconstruction is certainly a priority of many aid organizations, there is still a need to address other long-standing problems. Since the funds from the NGO are dedicated to working for the welfare of the farming community, the students were aware that their work would directly benefit the farmers. There is hope that the diversion of sufficient sediment into the existing salt flat could eventually create new arable land.

The diversion channel is about 10 feet deep, posing safety concerns to local residents and livestock, especially when the channel flows full. The students discussed safety precautions appropriate for the project, such as a fence at the top of the levees and bridges across the channel, and recommended that the client in Haiti perform additional analysis in areas where student expertise was insufficient.

Multidiscipline or allied profession participation
The project was supported on the ground in Haiti by a U.S.-based international development organization focused on Haitian development. The students regularly communicated with the Haiti-based representative from the organization, who, while originally trained in the U.S. as an engineer, has focused on development projects for most of his 30-year career. This person provided invaluable advice regarding appropriate construction methods for the area.

Closer to home, our department has an active advisory board consisting of about 10 local civil engineering practitioners. The board meets once a quarter to provide feedback on curriculum, future growth, and other industry-academic issues. The student team made an oral presentation to the board in fall describing their project scope and plan of action. In spring quarter, the team presented their final design and recommendations.

Two licensed civil engineers from the region reviewed the proposal and report and provided feedback to the teams a week prior to the final submission. The team spent the last week of both fall and spring quarters addressing the practitioners' comments before finalizing the proposal and the report, respectively.

It is mandatory for all capstone teams to participate in an annual American Society of Civil Engineers local section presentation competition. These presentations were judged by a panel of four licensed civil engineering practitioners. The format for this competition is a 15-minute oral presentation followed by questions and answers.

The knowledge or skills gained
Students developed the following skills through this project: technical skills, oral and written communication skills, project management and leadership skills, ability to work in a team setting and to interact with clients. They were also exposed to international development and developed skills coordinating work in an international environment.

Technical skills
The students learned how to take a preliminary flood control project to a final design stage ready for construction. Along the process, they became proficient in the following:

> Design and analysis software: U.S. Army Corps of Engineers Hydraulic Engineering Center's River Analysis System (HEC-RAS) and Hydrologic Modeling System (HEC-HMS); HEC-GeoRAS

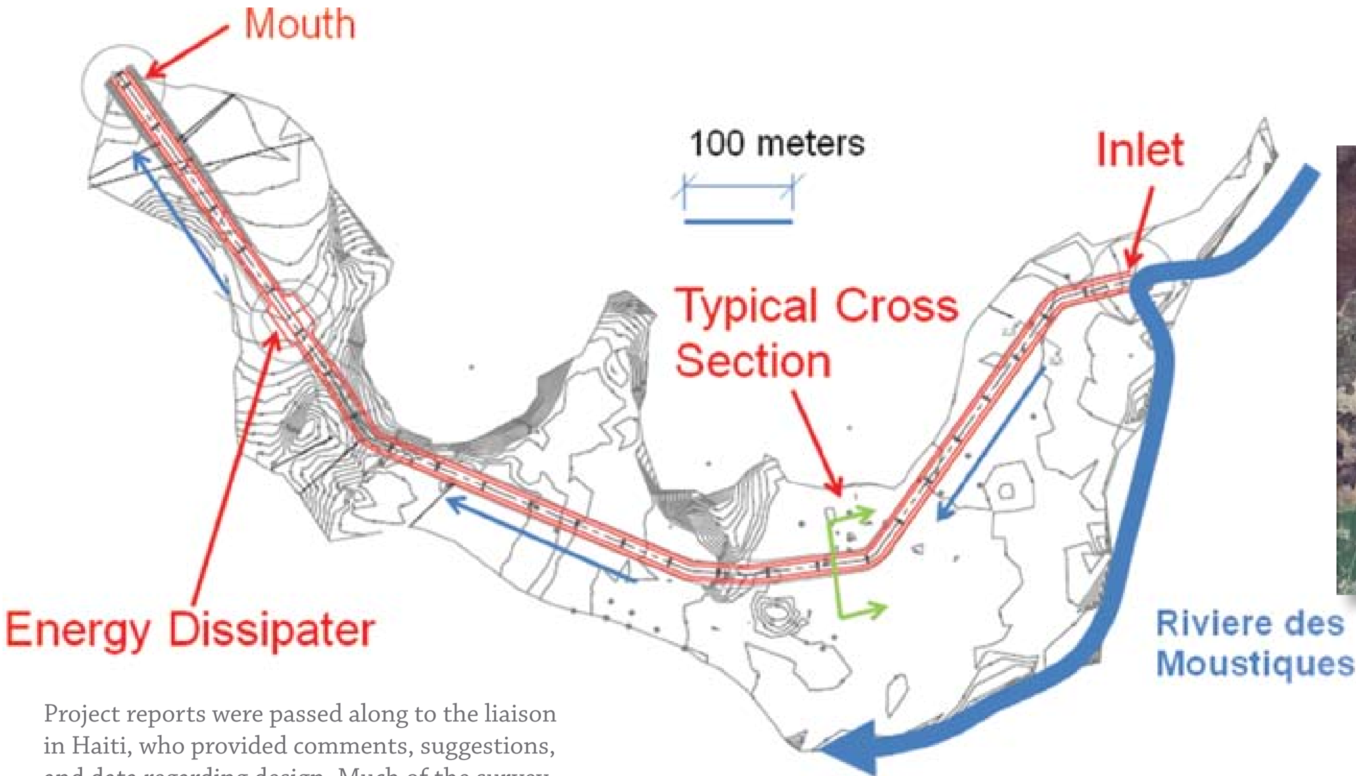
> Design manuals: Federal Highway Administration Hydraulic Engineering Circular 14 (FHWA HEC-14)

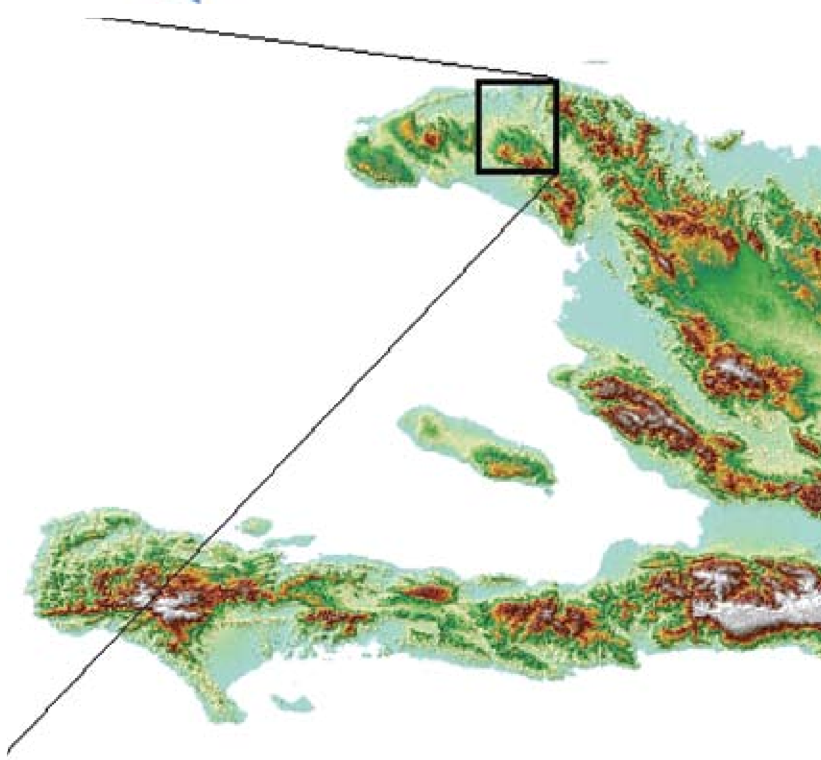
> Mapping and computer-aided drafting: ArcGIS, AutoCAD 2007

> Research: Researching the suppliers for various channel lining materials, locally available construction materials, cultural practices of Haiti, researching regional rainfall data, sediment transport analysis

Communication skills
The students submitted a written proposal to the sponsor at the end of fall quarter, outlining their understanding of the project, scope of work, plan of implementation, and schedule. At the end of spring quarter, they submitted a final report describing the work done, engineering calculations, drawings, and other deliverables requested by the sponsor.

The students were required to make oral presentations to their peers twice a quarter. Each student had to make at least one presentation each quarter. In addition, students presented their proposed work to the company at the end of fall quarter and their final design at the end of spring quarter. The academic year concluded with projects day, a conference-style event where the team presented its work to the entire university community, sponsors of all the senior capstone projects, prospective sponsors, friends, family, and alumni.





Project reports were passed along to the liaison in Haiti, who provided comments, suggestions, and data regarding design. Much of the survey data provided by the liaison was in French, which required that the team proactively ask questions to clarify the meaning of the data.

Project management and leadership skills
Each team member served as the project manager for part of the academic year. The project manager was responsible for setting up the team meetings, developing the meeting agenda, conducting the meetings, assigning tasks to the team members, and following up on action items. He or she was also responsible for contacting the company liaison and the faculty advisor in between team meetings when needed.

Global awareness and issues in engineering
Students learned how design constraints were different in Haiti than in the Unite States. They considered the limitation of equipment and construction materials, inexpensive labor force, language, and cultural differences in their design.

$7,500 AWARD

PARTICIPANTS

Students
Jesse Nofziger
Brian Olmstead
Dylan Parker
Kasi Wells
Ziba Zeyni

Faculty
Katherine Kuder, Ph.D.

Professional Engineers
Seattle City Light
Daniel O'Sullivan, P.E.

Additional Participants
Seattle City Light
David Anderson

ABSTRACT

A local utility company issued a request for proposal to our university's capstone design class for structural improvements to their dam facility. The company identified reinforced concrete service walkways at each of the dam's seven sluice gates as damaged and in need of repair or replacement. The walkways are routinely used by staff for dam maintenance, posing a life-safety issue.

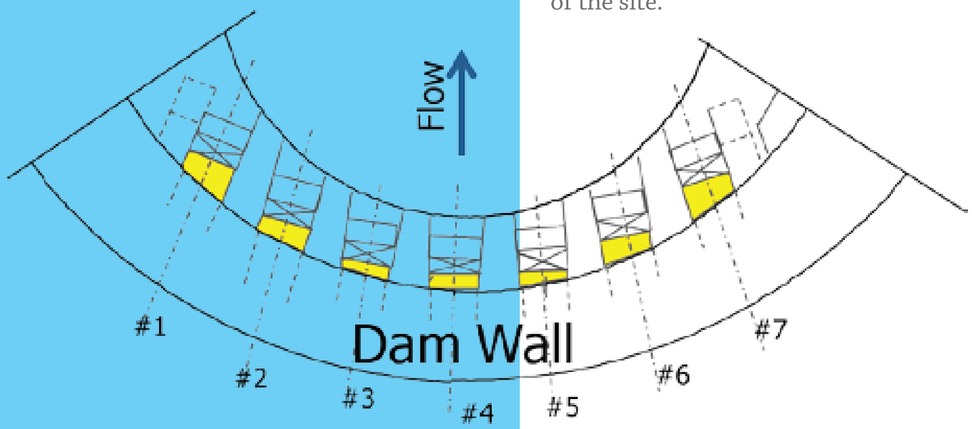
There are a total of seven service walkways, each with varying geometries. The walkways were constructed for maintenance of the sluice gates and most commonly support loads from foot traffic as well as equipment. Each of these walkways is a doubly reinforced concrete slab spanning approximately 20 feet and supported by abutments extending from the main structure between the sluice gates. Excessive slab deflections and cracking were observed during a team visit of the site.

The utility company requested that the student team prepare two design options: (1) steel retrofit and (2) reinforced concrete slab demolition and replacement plan. The structures were to meet the strength and serviceability requirements set forth by the sponsor. The final design was to consider the site-specific challenges of the project, including the remote site location, aggressive climate to which the slabs were exposed, and the limited access to the walkways. Additionally, students were to account for worker safety in the proposed construction process and to prevent debris from falling into the river below.

The steel retrofit involves adding structural members to increase the capacity of the existing slabs. On the upstream side, each member is supported by a bracket bolted to the dam wall. Downstream, the members are supported by two back-to-back channels that rest on the existing slab. The channels transfer loads directly into the supporting abutments. This retrofit is relatively simple to install and costs approximately $56,000.

The full replacement plan requires the installation of a temporary steel bracing system to support demolition and construction. The replacement slabs have an increased depth of 10 inches to meet the specified load requirements. This option provides the requested 50-year service life and costs approximately $213,000. Additionally, the design and construction solution is more complicated to execute, compared to the steel retrofit.

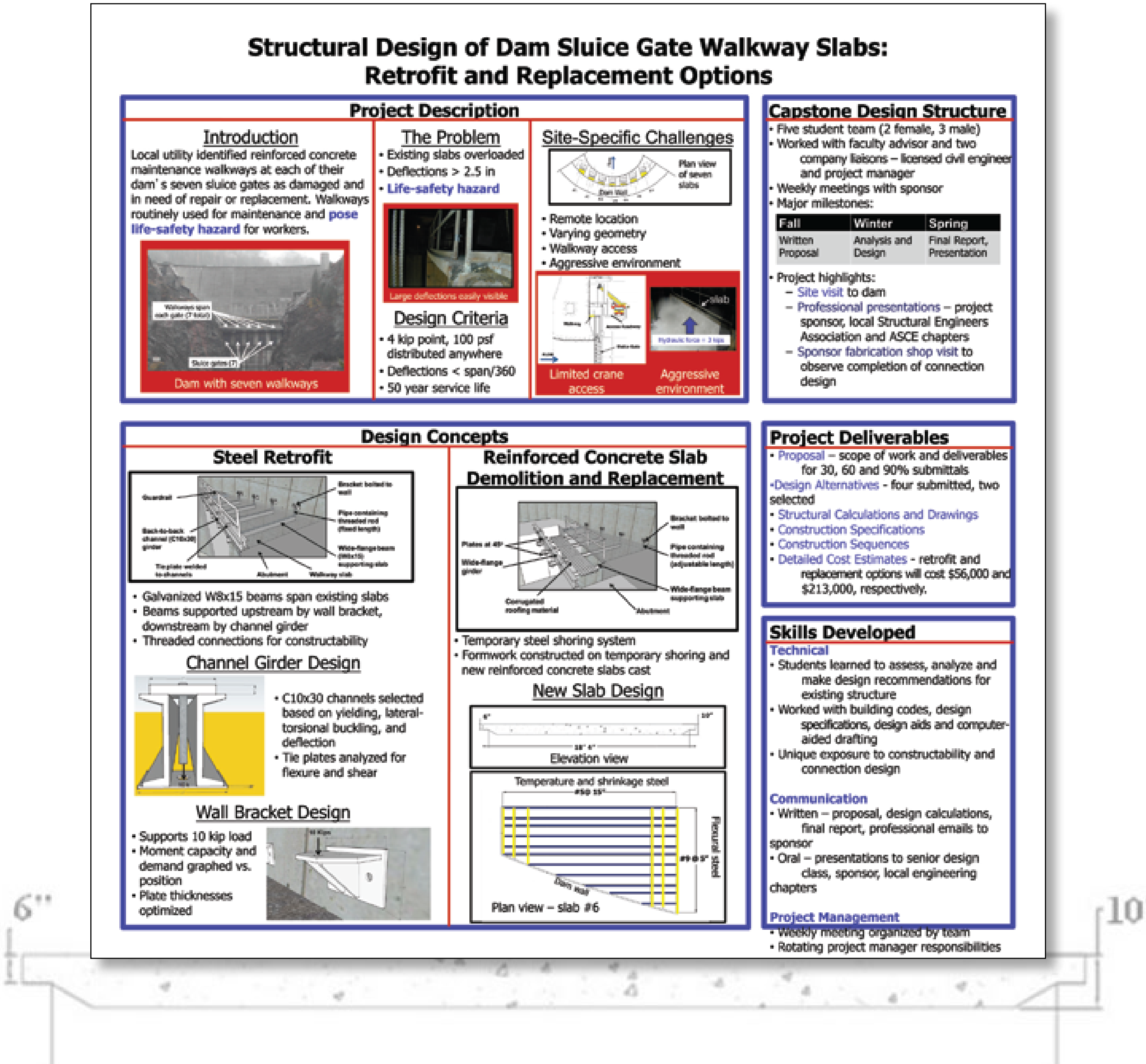
The proposed designs were completed by a five-member senior design team during an academic year. Students met weekly with their faculty advisor and two sponsor-company liaisons, one of whom is a licensed civil engineer and the other a project manager. The team's design calculations were reviewed by the faculty advisor, sponsor liaisons, and two external licensed structural engineers (S.E.s). Project highlights included a site visit; professional presentations to their class, the project sponsor, and outside professional chapters (Structural Engineers Association and American Society of Civil Engineers); and a visit to the sponsor's fabrication shop to discuss connection design. The two final design packages contained structural calculations, engineering drawings, construction specifications, construction sequences, and cost estimates. Throughout the year, students developed important technical, communication, and project management skills to help prepare them for their future careers as practicing engineers.



Seattle University

Department of Civil and Environmental Engineering

Structural Design of Dam Sluice Gate Walkway Slabs: Retrofit and Replacement Options

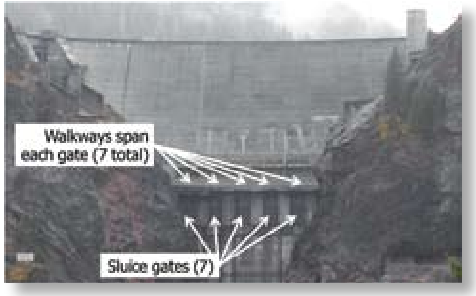


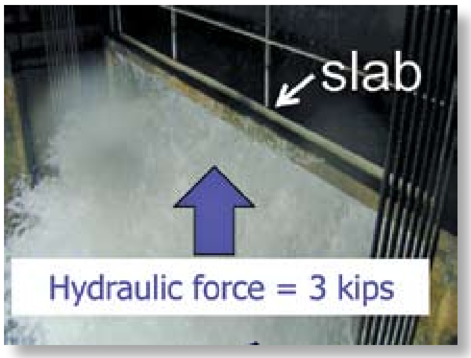
JURY COMMENTS

"The students in this project were challenged with real-life problems of significant complexity. They solved them handily."

"Problem statement, technical issues, and design alternatives were addressed very clearly. Very good multidiscipline collaboration and good use of P.E. mentors."

"An important structural challenge with issues of functionality, constructability, and safety."





The collaboration of faculty, students, and licensed professional engineers

At our institution, senior civil and environmental engineering students are required to complete a year-long, real-world, capstone design project. A team of five students (two female, three male) was assigned to the project, working under the guidance of a faculty advisor and two company sponsor liaisons, one of whom is a licensed civil engineer and the other a project manager.

As part of the capstone course, students completed: (1) a project proposal during the fall quarter, (2) the major analysis and design work during the winter, and (3) a final report and presentation in the spring quarter. To accomplish these tasks, the student team held weekly meeting with their faculty advisor and company liaisons. They also gave two presentations for the sponsor—one in the fall detailing the proposal and one in the spring explaining the final design. These presentations were attended by other licensed civil engineers, project managers, and a licensed structural engineer (S.E.) from the company.

The benefit to public health, safety, and welfare

The project addressed two worker safety concerns and one public health and welfare issue:

Maintenance work on existing slabs: The existing damaged walkway slabs pose a life-safety hazard for dam employees. The sluice gates routinely require maintenance. Much of the equipment involved is very heavy and must be placed on the slabs during cleaning and repair. For example, a single wheel from the sluice gate weighs over one kip. The existing capacity of the slabs (assuming no rebar corrosion) was estimated to be no greater than 10 kips. Given the excessive deflections and cracking observed on the walkways, the capacity may be much less.

Construction for retrofit or replacement options: Construction of the retrofit or replacement option is challenging because there is no access below the slab without the use of complex scaffolding. Construction worker safety was considered in the design by not requiring any person to go below the slabs. This design protects against workers being struck by falling debris.

River preservation: Construction work occurs directly over the river. All designs included methods to prevent any debris from falling into the water and causing contamination.

Multidiscipline or allied profession participation

The project included a number of opportunities for the students to interact with other disciplines and professional engineers:

Conducted a site visit: The visit included a tour of the dam facility in which students interacted with utility operators and workers to learn about the functionality of the deficient walkways. Students took field measurements of the existing slab dimensions and deflections during the tour.

Interacted with practicing engineers: The team gave presentations to the local chapter of the Structural Engineers Association and the local chapter of the American Society of Civil Engineers. The presentation to the Structural Engineers Association occurred in the fall at the beginning of the project and solicited feedback from interested licensed S.E.s. Throughout the year, the students had follow-up meetings with a number of these S.E.s to discuss their design concepts. Additionally, the team's final project report was reviewed by two external S.E.s.

Learned about connection design: The students visited the sponsor's fabrication shop to discuss connection detailing and observe production of one of their final connection designs. They received feedback from the fabricators about how to improve the design and drawings.

The knowledge or skills gained

The senior design experience is unique in that it helps students to develop a variety of important skills needed for practicing engineers.

Technical: The students learned how to assess and analyze an existing structure and then prepare design recommendations to remedy structural deficiencies. This process included using

> Building codes: 2009 *International Building Code*, ASCE 7-05 *Minimum Design Loads for Structures and Other Buildings*

> Design specifications: AISC *Steel Construction Manual* 13th ed., ACI: 318-08 *Building Code Requirements for Structural Concrete and Commentary*

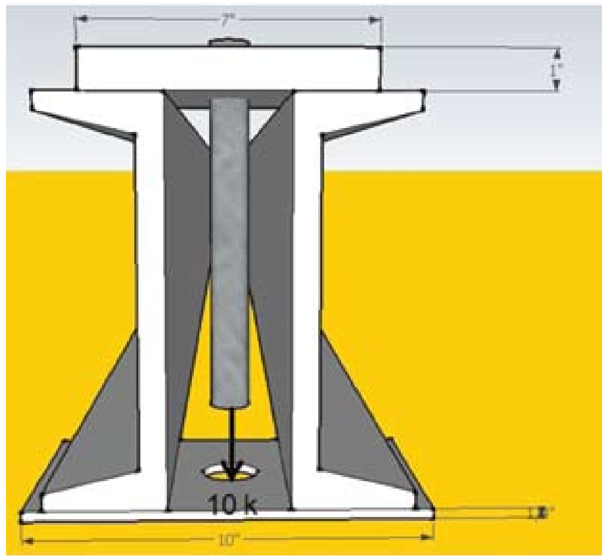
> Design aids: Hilti North America Technical Product Guide 4.2.4, Vulcraft Product Guide

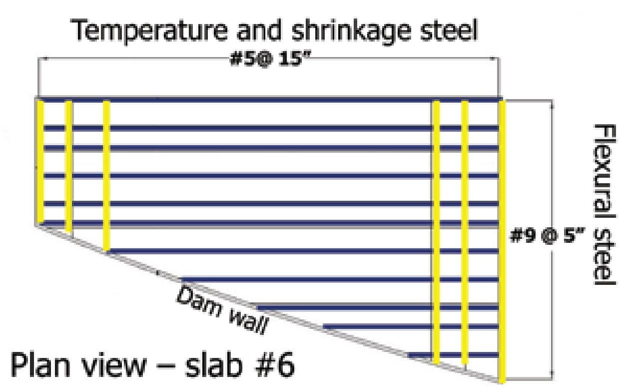
> Computer-aided drafting: AutoCAD 2007

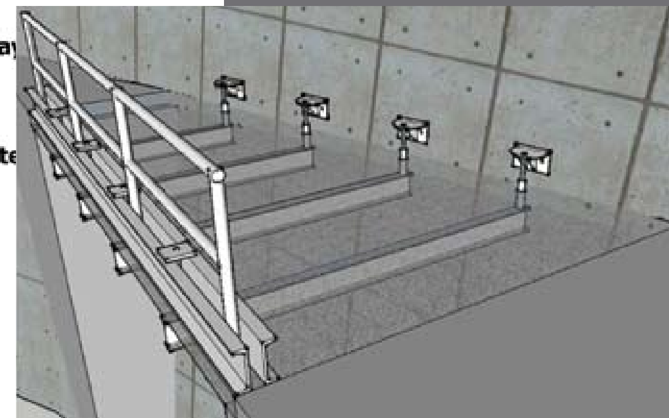
Additionally, the students learned about constructability and detailed connection design, topics not covered in traditional courses. Their final designs addressed site-specific issues and included detailed construction specifications (Construction Specifications Institute) and sequencing.

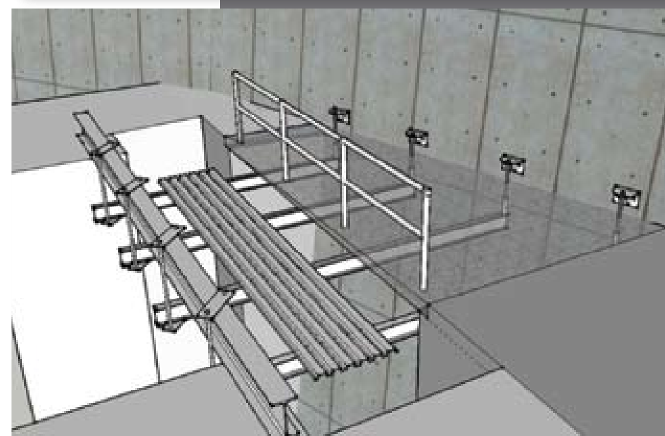
Communication: During the year, students developed both writing and speaking skills. The students submitted a written proposal and a final report for the capstone course. Students provided detailed engineering calculations to the liaison throughout the year and received feedback. The students were also responsible for sending professional e-mails to the project liaisons. The team prepared oral presentations for their senior design course, the project sponsor, and professional engineering societies (Structural Engineers Association and American Society of Civil Engineers).

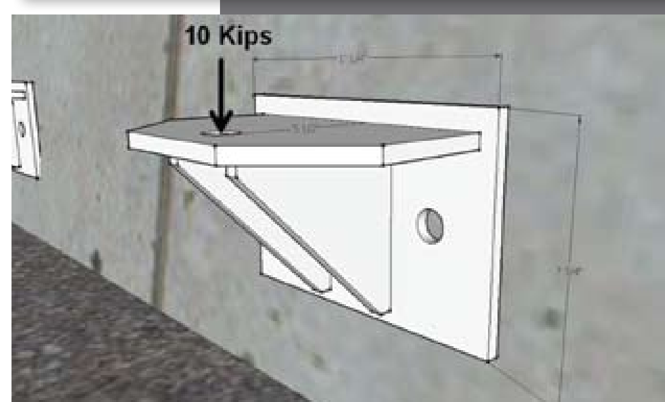
Project management and leadership: The team organized weekly meetings with the faculty advisor and sponsor liaisons. Throughout the year, students took turns serving as the project manager. The project manager was responsible for preparing the agenda, leading meetings, assigning tasks, and tracking overall progress.











$7,500 AWARD

PARTICIPANTS

Students

Undergraduate
Jaime Aranda
Jessica Gutierrez
Karen Jurado
Saul Mejia
Ezri Navarro
Armando Ramirez

Graduate
Gema Camacho
Alejandra Gallegos
Dora Francis
Iraki Ibarra
Mariwyn Light
Luis Quintana
Juan Luis Rios
Gandhar Wazalwar

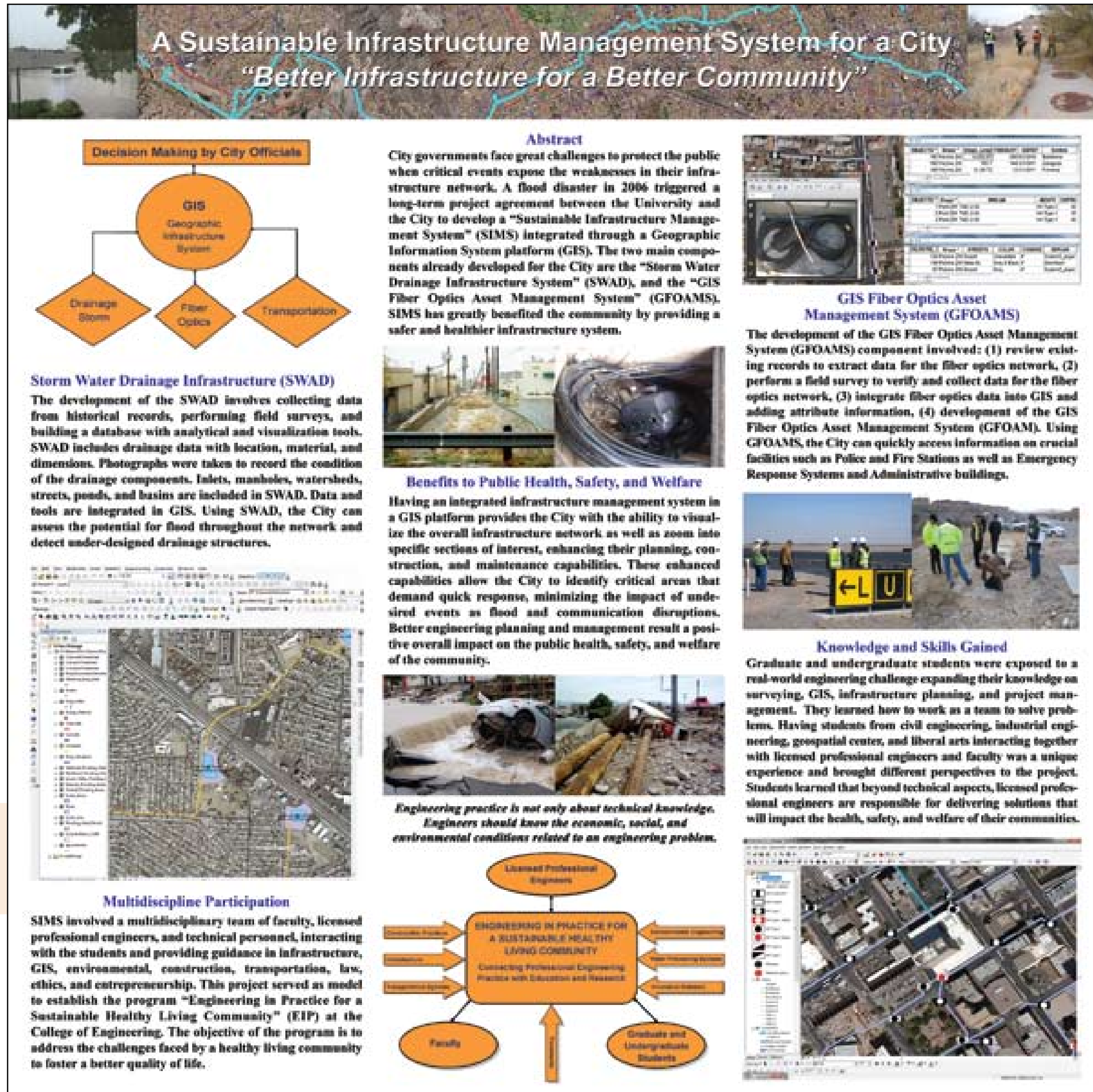
Faculty
Carlos Chang Albitres, Ph.D., P.E.
Raed Aldouri, Ph.D.
Nasir Gharaibeh, Ph.D., P.E.
Soheil Nazarian, Ph.D., P.E.

Professional Engineers
City of El Paso
Johanes Makahaube, P.E.
Samuel Rodriruez, P.E.
Margaret Schroeder, P.E.

Additional Participants
City of El Paso
Lorenzo Alba
Tony Do
Geoffrey Espineli, E.I.T.
Victor Garzon
Alfred Greiner, RCDD, PMP
Jason Himes, E.I.T., RCDD
Alan Lara
Hector Leyva
Hector Mattos
Edward Ozogar
Victor Pereda
Ruben Trujillo

El Paso County
Peter Cooper
Juan Ocasio

El Paso Water Utilities
Marcus Brown



University of Texas at El Paso

Department of Civil Engineering

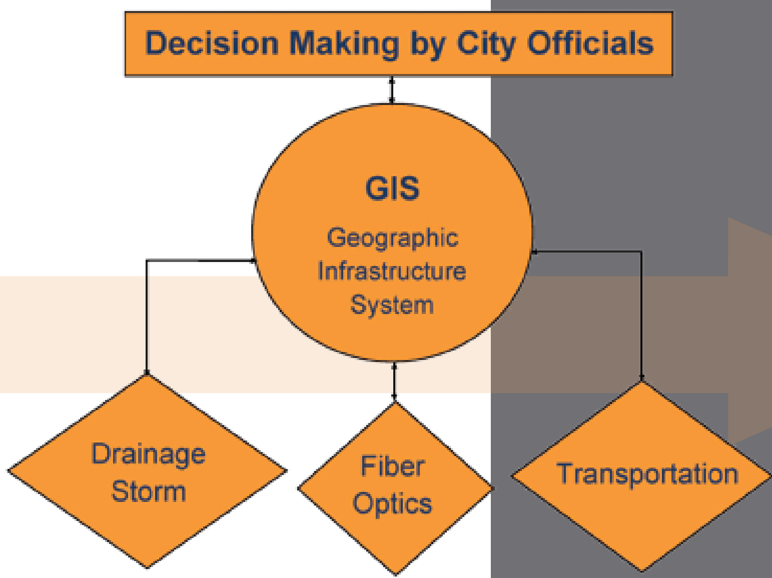
Development of a Sustainable Infrastructure Management System for a City

ABSTRACT

City governments face great challenges to protect the public when critical events expose the weaknesses in their infrastructure network. In 2006, a flood disaster triggered a long-term project agreement between the university and the city to develop a "Sustainable Infrastructure Management System" (SIMS) integrated through a Geographic Information System (GIS). The two main components already developed for the city are the "Storm Water Drainage Infrastructure System" (SWAD) and the "GIS Fiber Optics Asset Management System" (GFOAMS). The integration of a third component to manage the "Transportation Infrastructure System" is currently under discussion. The SIMS project has involved the successful collaboration of faculty, students, licensed professional engineers, and technical personnel. This project served as a model to establish the program "Engineering in Practice for a Sustainable Healthy Living Community" (EIP) at the college of engineering. The objective of the program is to address the current and future challenges faced by a healthy living community with the aim of providing a better quality of life.

SIMS includes practical tools to better manage infrastructure assets, minimizing the impact of undesired events such as flood and communication disruptions. With SIMS, the city is able to visualize the overall infrastructure network as well as zoom into specific sections of interest, enhancing planning, construction, and maintenance capabilities. Maintenance down-times are now reduced by providing maintenance crews with this powerful interactive tool which has demonstrated substantial benefits to safety. Using SWAD, the city can assess the potential for flood throughout the network and detect under-designed drainage structures. Using GFOAMS, the city can quickly access information on crucial facilities such as police and fire stations as well as emergency response systems and administrative buildings. SIMS has allowed the city to develop more reliable maintenance and rehabilitation action plans, providing the community with a healthier and safer infrastructure system.

Graduate and undergraduate students were exposed to a real-world engineering challenge, expanding their knowledge of surveying, hydrology, fiber optics, GIS, infrastructure planning, and project management. They learned how to work as a team, applying critical thinking to identify, formulate, and solve problems, and to effectively communicate solutions. Students worked jointly in a multidisciplinary team composed of licensed professional engineers from public and private sectors and faculty from the departments of civil engineering, industrial engineering, and the geospatial center, receiving guidance in infrastructure, GIS, environmental science, construction, transportation, law, ethics, and entrepreneurship. Seminars were delivered in these disciplines and visits organized to public and private organizations to discuss all aspects related to a sustainable infrastructure system. This exposure gained by the students allowed them to conclude that any changes on infrastructure's performance will impact the health, safety, and welfare of the community, understanding that engineers of the 21st century need to work in multidisciplinary teams to address the technical, economic, social, and environmental conditions faced when solving an engineering problem.



JURY COMMENTS

"Students' learning about 'acknowledging professional responsibility in the practice of engineering' ties into the core of licensure and the responsibilities of being a professional engineer."

"Shows strong collaboration of students, professionals, and city personnel"

"This project has substantial benefits for the municipality and extensively integrates several civil subdisciplines with data acquisition and GIS."

The collaboration of faculty, students, and licensed professional engineers

The project involved the participation of students, faculty, licensed professional engineers, and technical personnel in the development of a sustainable infrastructure management system for the city. A multidisciplinary team was assembled to perform the tasks required in the project. Faculty from the departments of civil engineering, industrial engineering, the Regional Geospatial Center, and licensed professional engineers worked with the students and provided advice in infrastructure, environmental, construction, transportation, law, ethics, and entrepreneurship. Seminars were delivered in these disciplines for a better understanding of what a sustainable infrastructure system means and to increase students' awareness of its impact in the health, safety, and welfare of the community. Students from liberal arts joined engineering students to develop a Web site and promote the project.

Field surveys were conducted by two teams of undergraduate students led by a graduate student and supervised by personnel from the city. Another team of students supervised by faculty members worked in the development of the GIS system components. Students were recruited from surveying (undergraduate), hydrology (undergraduate), senior design (undergraduate), infrastructure management (graduate), and GIS (undergraduate and graduate) courses. Mentoring was provided by licensed professional engineers from the city who guided the students on how to apply concepts learned in class into practice.

In addition to the customized GIS systems developed for the city, the team prepared technical reports and made formal presentations. Theses and journal papers have resulted from the work developed in this project.

SIMS served as model to establish the program "Engineering in Practice for a Sustainable Healthy Living Community" (EIP) at the college of engineering. The objective of the EIP program is to address current and future challenges faced by a healthy living community. Under this program, different problems that affect the community are analyzed to propose practical solutions based on engineering principles. With the aim of providing a better quality of life, the program merges education, research, and professional practice through a synergistic approach in which a multidisciplinary team of graduate and undergraduate students, faculty, and licensed professional engineers work jointly to solve specific infrastructure problems.

Guest speakers are invited to cover potential areas of collaboration, including construction practices, environmental engineering, innovative materials, infrastructure, water processing systems, and transportation systems. Visits to public organizations and private companies are followed to better understand engineering practices. The program currently involves the department of civil engineering, department of industrial engineering, the Geographic Information Systems and Geospatial Applications Center, the city, and a number of other private and public organizations.

The benefit to public health, safety, and welfare

Preserving our infrastructure assets is essential for a sustainable healthy living community. Quality of life is heavily affected by poor infrastructure management. The "Development of a Sustainable Infrastructure Management System for a City" has benefited the community by providing a safer and healthier infrastructure system while minimizing the impact of undesired events such as flood and communication disruptions.

Multidiscipline or allied profession participation

A multidisciplinary engineering team approach was used to successfully address the challenges faced in the project. The project started with the participation of civil engineers in a joint effort with GIS specialists. As the project expanded, industrial engineers and environmental specialists participated in the project. Awareness of the need to respect the environment led to looking at topics such as life cycle assessment, carbon footprint management, design for sustainability, and ethical consumerism. Use of alternative sources of energy for infrastructure systems was discussed by the industrial engineering group, including solar energy, hydrogen, and biodiesel. Students from civil engineering, industrial engineering, and liberal arts played different roles in the project.

Focus groups composed of students, faculty, and licensed professional engineers were assembled in different areas of expertise to discuss all aspects involved in a sustainable infrastructure system for the city. Seminars were delivered by licensed professional engineers to better understand critical areas, including environmental, water processing systems, innovative materials, pavements, transportation systems, infrastructure, and construction practices. Visits were conducted to the city to assess current needs and resources available to address the problems.

The project was aligned with the city's core values that include "Excellence, Integrity, Respect, and Accountability" and its commitment to provide quality customer service to the public.

The knowledge or skills gained

Engineers are problem-solvers by nature; and the development of critical thinking skills to identify, organize, and analyze information becomes crucial when formulating solutions to engineering challenges. In the 21st century, engineers are called on to become leaders in our society, contributing to the creation of a sustainable world that values the quality of life. With this role in mind, the project has provided students the opportunity to develop technical, leadership, teamwork, and communication skills. Undergraduate students were exposed to engineering practices, expanding the lessons learned in class. Graduate students had the opportunity to use all their creativity to come out with practical solutions and develop their communication skills. Specific knowledge and skills gained during the SIMS project can be summarized as follows:

- Practice the principles and methods learned in engineering and management courses including surveying, GIS, infrastructure planning, and project management.

> Operate specialized equipment and software including ArcMap, ArcCatalog, ArcPad, and Trimble Geo XT GPS.

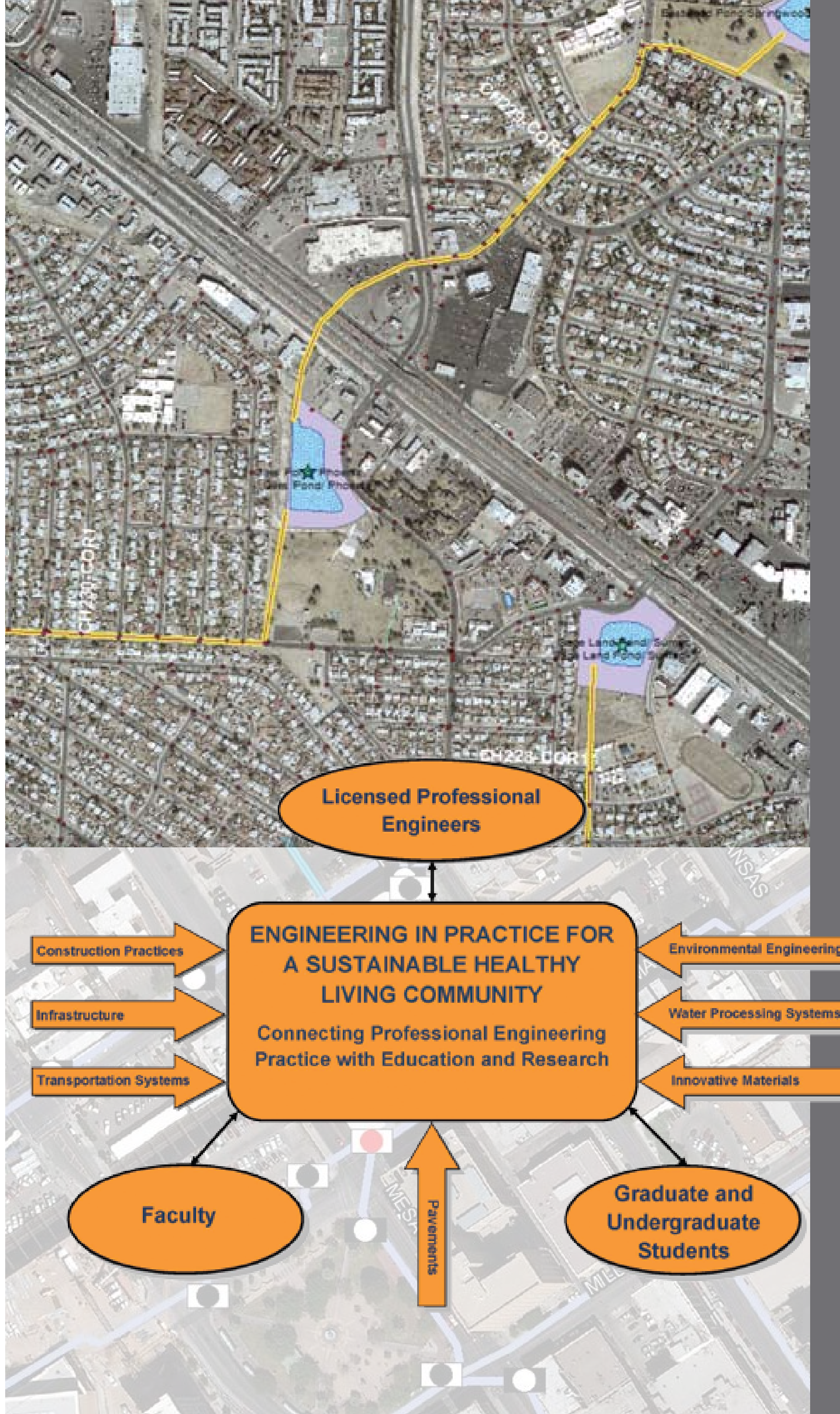
> Interpret "as built plans," realizing that infrastructure evolves over time and plans do not always reflect reality on the field. The dynamic nature of infrastructure implies the need of conducting regular field surveys to update records stored in the system.

> Identify, formulate, and solve critical infrastructure problems, participating in multidisciplinary teams to foster healthy sustainable living communities.

> Be a team player when working on multidisciplinary teams, acknowledging professional responsibility in the practice of engineering and maintaining ethical conduct at work.

> Communicate effectively when presenting potential solutions in oral and written reports.

Students were able to understand that engineering in practice is not only about technical knowledge; engineers must work in multidisciplinary teams to address the economic, social, and environmental conditions faced when solving a problem. Having faculty and students from civil engineering, industrial engineering, geospatial center, and liberal arts interacting with licensed professional engineers was a unique experience and brought different perspectives in benefit of the project. Students ultimately learned that beyond technical aspects, licensed professional engineers are responsible for delivering engineering solutions that will impact the health, safety, and welfare of their communities.



University of Texas at El Paso

2011 PARTICIPANTS

California State University, Los Angeles
Department of Civil Engineering
Connecting Professional Practice and Education through a Civil Engineering Capstone Project: Mud Flow Barrier

California State University, Los Angeles
Department of Civil Engineering
Observatory Road Design Project—A Freshman Design Project

Duke University
Department of Civil and Environmental Engineering
Student-Designed Water Quality Enhancement Projects

Florida A&M University–Florida State University
Department of Civil and Environmental Engineering
ACES: Assignments for Civil Engineering Students, with Focus on "Practice-Profession-Licensure-Service"

Illinois Institute of Technology
Department of Civil, Architectural, and Environmental Engineering
IPRO 357: Zero Community Part 3: The Evanston Project

Lawrence Technological University
Department of Civil Engineering
Civil Engineering Capstone Project and Recovery Park

North Carolina State University
College of Engineering
Re-engineering Rural Community Infrastructure with Student Internships

Oregon Institute of Technology
College of Engineering, Technology, and Management
Cascade Avenue Site Design

Seattle University
Department of Civil and Environmental Engineering
Flood Control Channel Design for a River in Northwest Haiti

Seattle University
Department of Civil and Environmental Engineering
Structural Design of Dam Sluice Gate Walkway Slabs: Retrofit and Replacement Options

Southern Illinois University Carbondale
College of Engineering
La Nana Project

Smith College
Picker Engineering Program
Solar-Powered Microirrigation System and Design Tool

United States Military Academy
Department of Civil and Mechanical Engineering
Civil Engineering Professional Practice Capstone

University of Colorado Boulder
College of Engineering and Applied Science
Engineers Without Borders—Rwanda Team

University of Colorado Denver
Department of Civil Engineering
Alpine, Colorado, Debris Flow Protection Team

University of Dayton
Department of Civil and Environmental Engineering and Engineering Mechanics
Southwest Campus Expansion Project

University of Illinois at Chicago
Department of Chemical Engineering
Industry-Academia Cooperative Chemical Engineering Design Course

University of Iowa
Department of Mechanical and Industrial Engineering
Oakdale Powerplant Biomass Boiler and Gasifier Installation

University of Nebraska–Lincoln
Biological Systems Engineering Department
Integrated Energy and Production System

University of Nebraska–Lincoln
Charles W. Durham School of Architectural Engineering and Construction
Professionally Mentored Interdisciplinary Student Teams Design a Real-World Project

University of New Mexico
Department of Civil Engineering
Integrated Infrastructure Improvements for a Youth Scout Ranch

University of Texas at El Paso
Department of Civil Engineering
Development of a Sustainable Infrastructure Management System for a City

University of Washington
College of Engineering
Drinking Water Project in Piriquina, Bolivia

University of Wisconsin–Madison
College of Engineering
Engineers Without Borders Kenya Project—Design and Implementation of a Small-Scale Pilot Irrigation System

University of Wyoming
Department of Civil and Architectural Engineering
University Design Squad Cooperative Experience

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

PREVIOUS WINNERS

2010

GRAND PRIZE

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

ADDITIONAL AWARDS

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

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

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

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

2012 Call for Submissions

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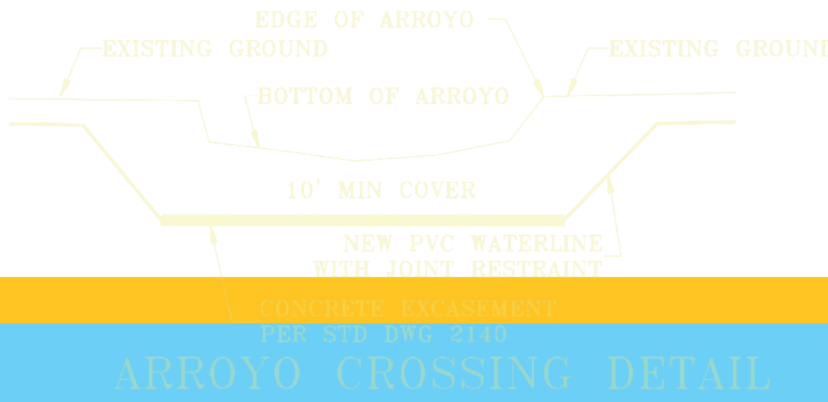

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Clemson, SC 29633 USA
NCEES.ORG