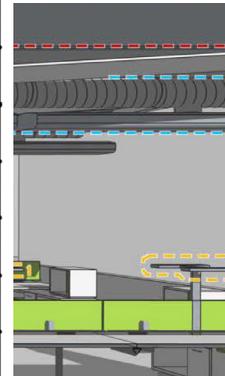
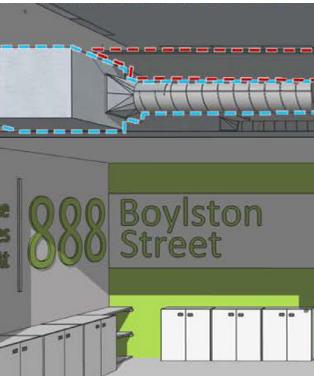


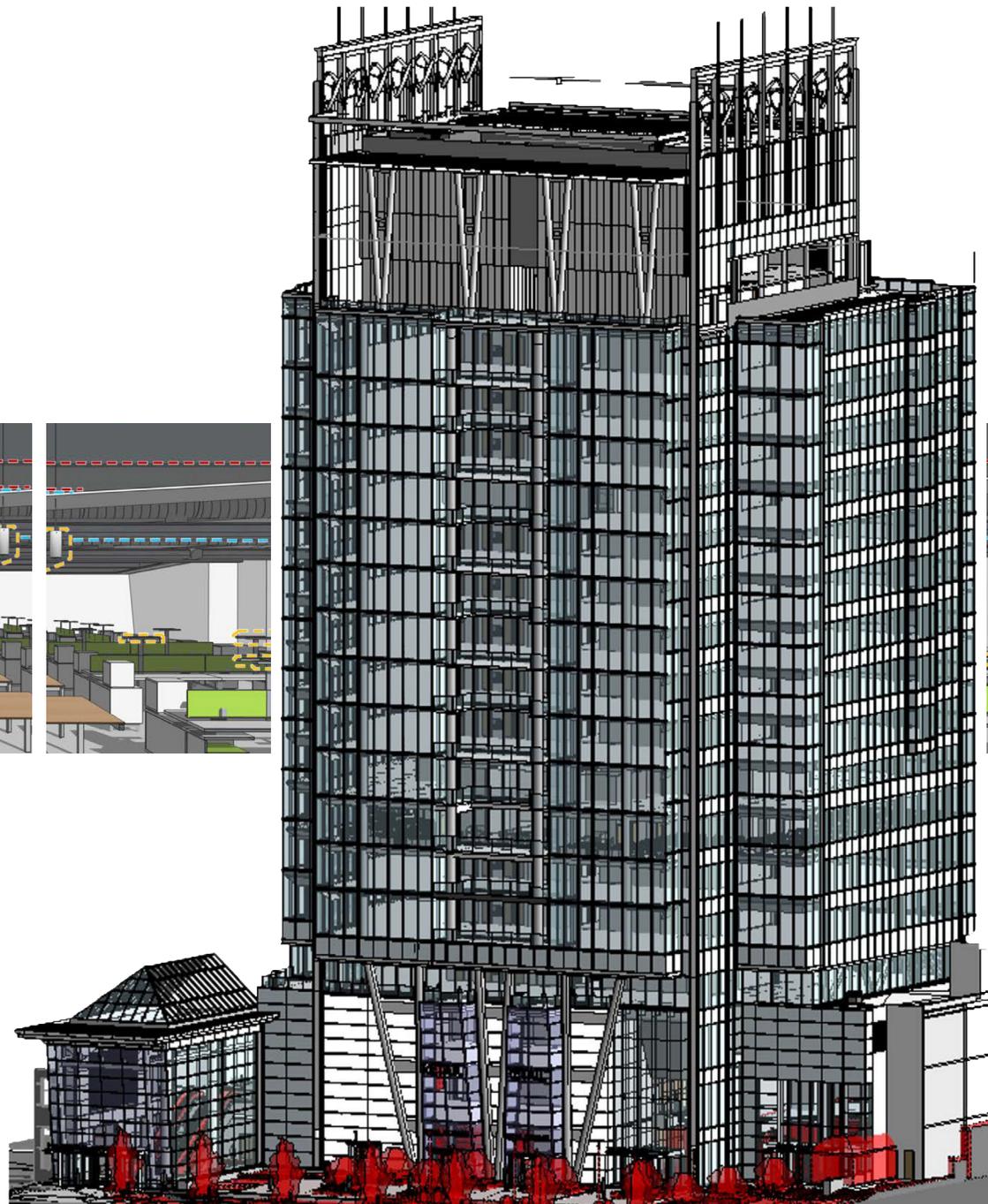


# 2016 NCEES Engineering Award

Connecting Professional  
Practice and Education



Engage. Enrich. Inspire.





**2016** NCEES  
Engineering  
Award

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## President's Message

The NCEES Engineering Award was launched in 2009 to recognize engineering programs bringing students and professional engineers together to work on collaborative projects. Advancing licensure for engineers is a top priority for NCEES, and bringing these two groups together ensures success for everyone. The projects give students the opportunity to take lessons outside of the classroom and apply them to real-world issues in order to increase students' knowledge of engineering principles, and the professional engineers benefit from watching the capabilities and enthusiasm of the students.

Engineering reaches all parts of our lives. These projects show students how working with licensed professional engineers safeguards public health, safety, and welfare. Students not only work with professional engineers but also collaborate with their peers, faculty, other engineering disciplines, and other professions to enrich their experience. These award-winning projects can serve as models for other engineering programs to develop collaborative projects and opportunities for students.

We at NCEES thank the students, faculty, and practitioners who participated in this year's projects. We appreciate and applaud their efforts to connect professional practice and education and to inspire the next generation of professional engineers. We give special thanks to the jury members for giving their time and expertise to support this initiative.

NCEES has published this book to recognize the 2016 winners, and we hope these projects will encourage other engineering programs to develop collaborations with the professional engineering community and continue to engage, enrich, and inspire.

*D. Turner*

Daniel S. Turner, Ph.D., P.E., P.L.S.  
2016-17 NCEES President

# 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, but they were required to meet other eligibility requirements. The projects had to be in progress or completed by March 14, 2016. 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 2016 NCEES Engineering Award jury met in Clemson, South Carolina, on June 7, 2016, to conduct a blind judging of the 21 entries. Each submission consisted of a display board, abstract, and project description. These materials were sent electronically for the jury to review prior to the judging and were also available at the judging.

## The jury considered the following criteria in its deliberations:

- Successful collaboration of faculty, students, and licensed professional engineers
- Protection of public health, safety, and/or welfare
- Multidiscipline and/or allied profession participation
- Knowledge or skills gained
- Effectiveness of display board, abstract, and project description

The jury selected the University of Nebraska–Lincoln Charles W. Durham School of Architectural Engineering and Construction to receive the \$25,000 grand prize. The jury chose five additional winners to each receive \$7,500 awards.





## 2016 NCEES Engineering Award Jury

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

**Michelle Roddenberry, Ph.D., P.E.,** Jury Chair  
Florida Board of Professional Engineers

**Christopher Duhamel, P.E.**  
Rhode Island State Board of Registration  
for Professional Engineers

**Kevin Skibiski, P.E., P.L.S.**  
Missouri Board for Architects, Professional  
Engineers, Professional Land Surveyors,  
and Landscape Architects

**David Whitman, Ph.D., P.E.**  
Wyoming Board of Professional Engineers  
and Professional Land Surveyors

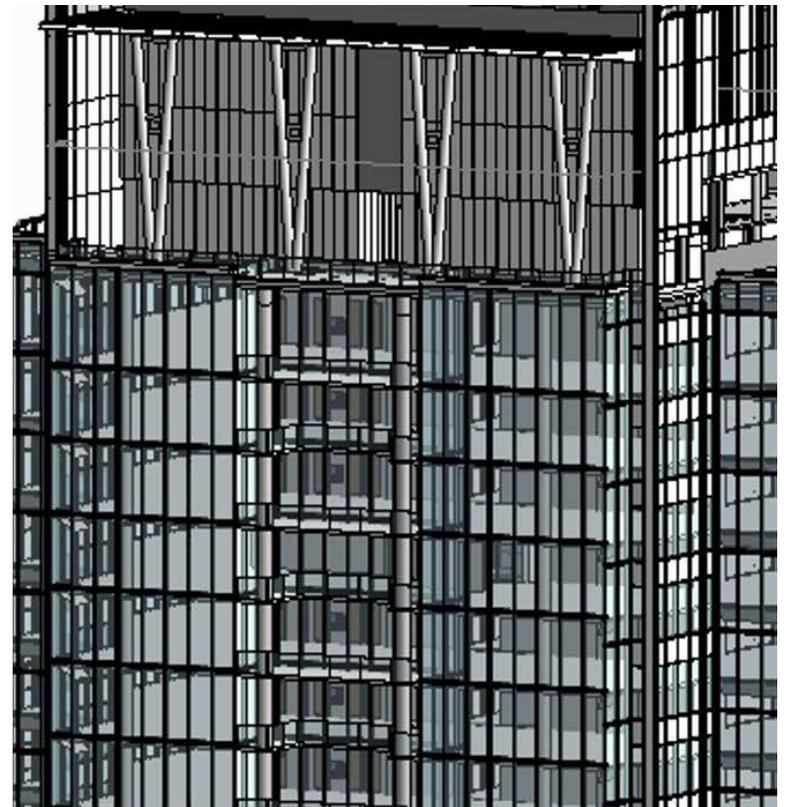
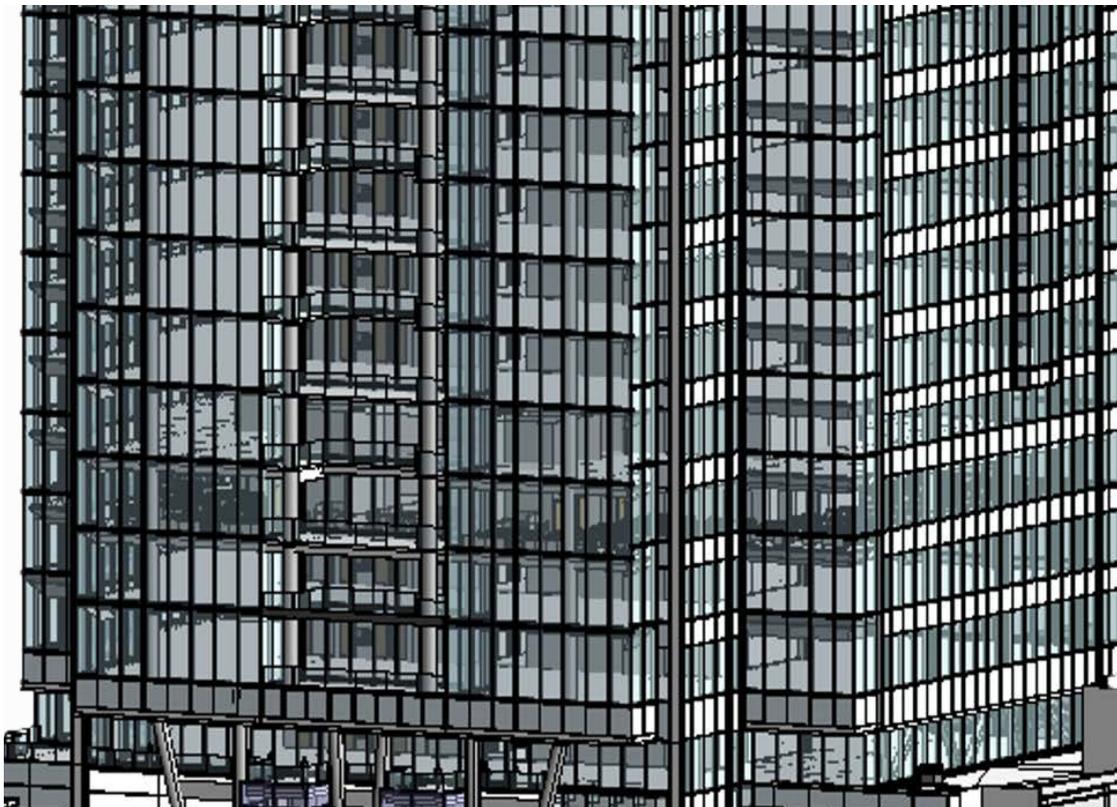
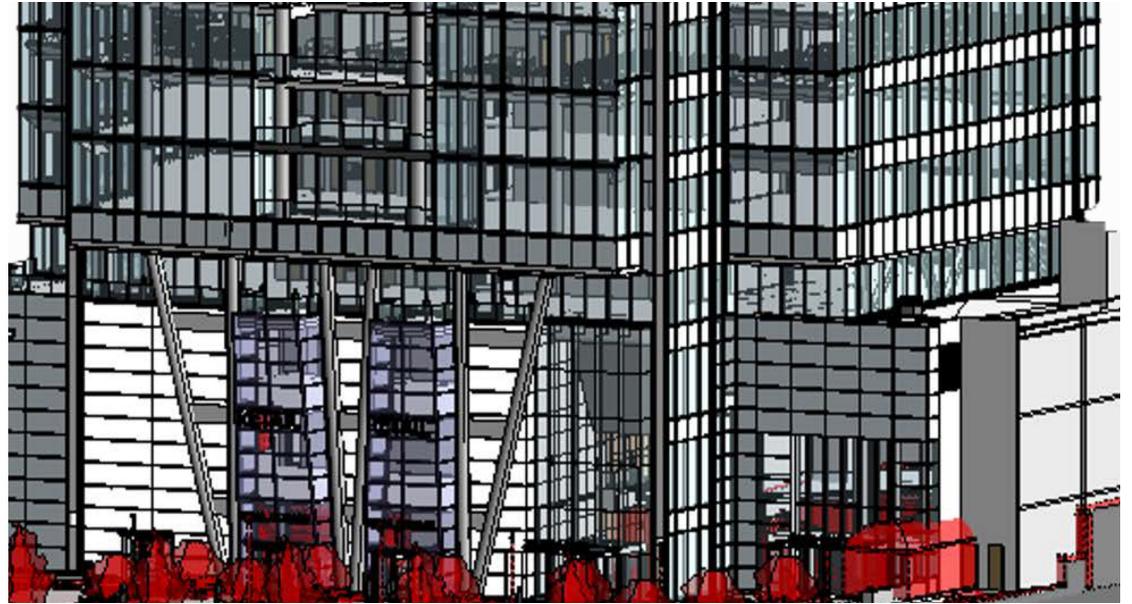
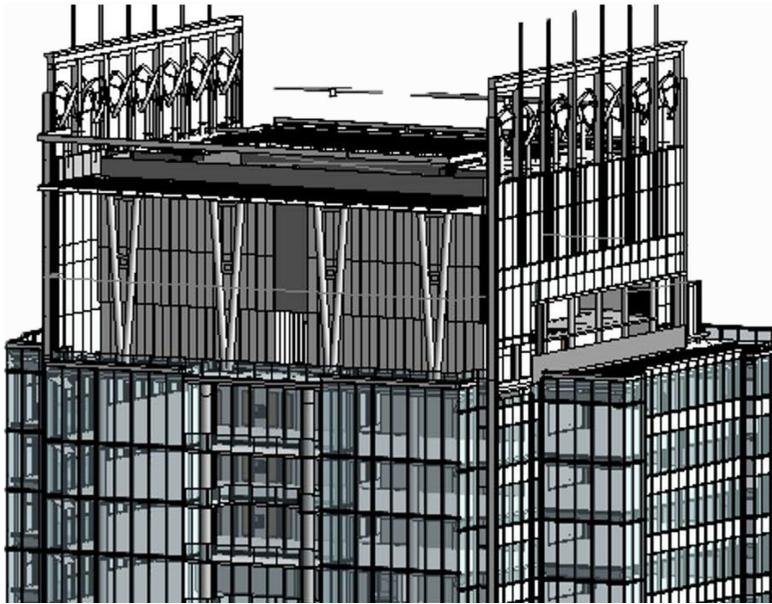
**Ethan Brue, Ph.D., P.E.**  
Dean, Dordt College Engineering Program

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

**Ronald Welch, Ph.D., P.E., COL (Retired)**  
Dean, The Citadel School of Engineering

**Robert Green, P.E., F.NSPE**  
National Society of Professional Engineers

**Michael Smith, D.Eng.**  
DiscoverE Diversity Council

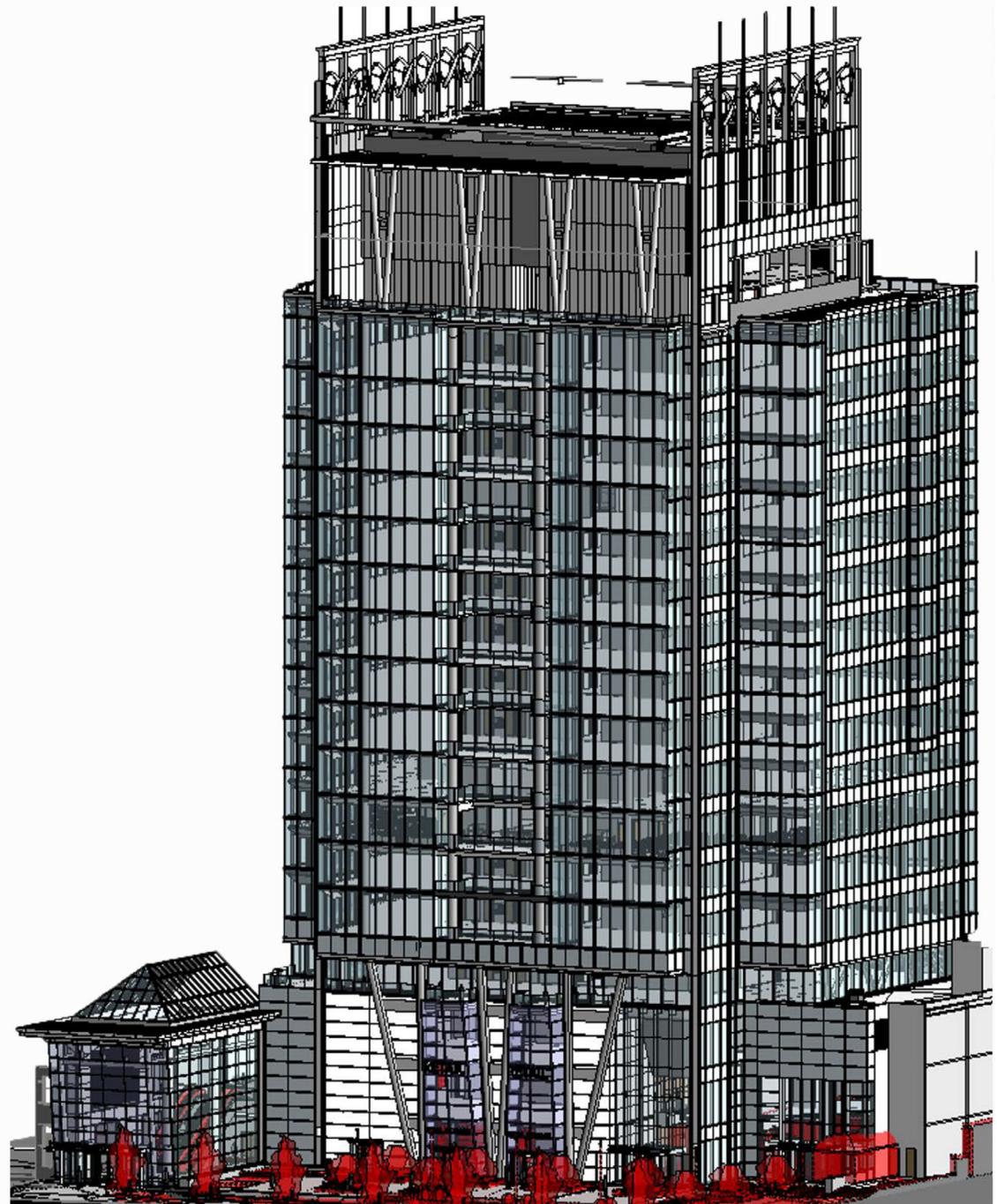


2016 NCEES  
Engineering Award  
**\$25,000 Grand  
Prize Winner**

**University of  
Nebraska–Lincoln**

Charles W. Durham School of  
Architectural Engineering and  
Construction

*888 Boylston Street–  
Interdisciplinary Team Design*





## Abstract

Three separate multidisciplinary teams of six or seven graduate students each were challenged to design a proposed 17-story mixed-use high-rise building located in Boston, Massachusetts. The structure will have 14 stories of offices above three levels of retail and two levels of sub-grade parking. The teams were to meet guidelines, which include energy efficiency 50 percent better than ASHRAE 90.1 energy use baseline, structural design for resiliency against hurricane wind speeds with a 100-year mean recurrence interval (MRI), the ability to provide 48 hours of runtime for critical office tenants in the case of a power outage, and synthesis and safety for the surrounding environment and people. In an effort to further improve building performance, students adopted several design practices defined in ASHRAE 189.1 (Design of High Performance Buildings), resulting in a LEED Platinum building.

The students, preparing to be electrical, structural, mechanical, lighting, and acoustical engineers, worked to create their own interdisciplinary team designs for the complex structure. The primary objective was the development and integration of innovative and original design solutions with a multidisciplinary approach. Further objectives were robust collaboration with over 50 industry professionals that mentored and evaluated the work and the opportunity to gain real-world technical skills, experience, and



knowledge through this collaborative project. These criteria, along with specific goals of the company, led to designs that demonstrate sustainability, resilience to environmental threats, safety, and synthesis with the surrounding built environment.

In order to ensure public safety, the structural teams designed the lateral system to withstand the 100-year MRI for hurricane wind speeds. The mechanical and electrical teams coordinated to develop the fire protection systems. The electrical teams also designed emergency systems to provide safety and standby power. Public health and welfare was partially addressed by designing for occupant

health, productivity, and comfort through indoor air quality control, noise and vibration control, and daylighting. Additionally, the design must connect to the adjacent shopping mall and convention center, and the structure must be designed for a 60-ft long cantilever over the I-90 Massachusetts turnpike without traffic interruptions during construction.

Over the course of two semesters, more than 50 licensed professional engineers and architects from industry, licensed professors from the university, and other allied professionals mentored the students in the myriad aspects of the project. These volunteers were matched with student teams to review progress

and direct students' understanding of the design process and to serve as mentors aiding in practical design and system selection. These professionals met with students on a weekly basis outside of class time. Industry mentors were also tasked to review the building design, narratives, construction documents, and oral presentations of their assigned team. Of the 20 students involved with the project, 13 have taken and passed the Fundamentals of Engineering (FE) exam. The remaining seven have planned to take it by this summer. Further, each will be completing an EAC/ABET-accredited degree, will work under licensed engineers, and plan to pursue licensure for themselves.

**\$25,000**  
Grand  
Prize

## University of Nebraska–Lincoln

Charles W. Durham School of Architectural Engineering and Construction  
*888 Boylston Street–Interdisciplinary Team Design*

### Perspectives On

#### **Protection of public health, safety, and welfare**

The design of 888 Boylston protects the health, safety, and welfare of the public through code compliance, emergency system design, hurricane-resistant structural design, and indoor air quality for the mechanical system design.

For public safety, each structural design team met the 100-year MRI wind speed for lateral system design. A hurricane impact-resistant curtainwall system was also researched and specified. Safety was a primary concern throughout the design of all structural components, including the I-90 braced-frame cantilever truss and column transfer girders.

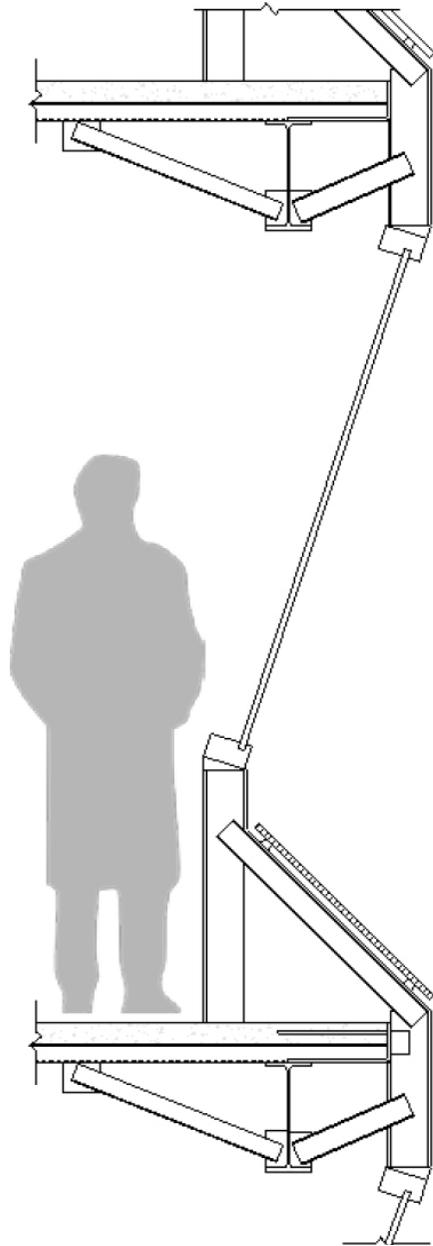
A specialized development, which will serve to enhance aesthetics while providing multiple aspects of protection, were the concrete planters on the plaza. Students designed these to act as bollards to prevent vehicles from driving or accidentally entering pedestrian areas. Not only do the concrete planters protect pedestrian safety, they also increase the blast standoff distance from the building for any vehicle-transported bomb threats.



Public safety is also achieved through the electrical and mechanical system designs. The mechanical designs provide fire protection with automatic sprinklers, fire pumps, smoke control, and pressurization of spaces per IBC 2009 and NFPA requirements. The electrical emergency systems protect lives by providing lighting during emergency and provide legally required standby power. Designs also include security systems, fire alarms,

overcurrent protection, and lightning protection for the building.

Public health and welfare was further addressed by designing for occupant health, productivity, and comfort through mechanical, acoustical, daylighting, and structural floor vibration design. Indoor air quality standards were met for the mechanical system design with proper ventilation and exhaust movement, filter selection,



and humidity control in order to support occupant health and prevent proliferation of airborne pathogens. Daylighting in the office spaces also promotes occupant well-being, while decreasing energy use, which in turn decreases the negative health effects due to energy production. Designs minimize occupant distractions and increase well-being through acoustics and structural vibration control. The office and retail levels meet AISC Design Guide 11 vibration limits for the office and retail areas. Additionally, many design decisions were made to reflect the elegant downtown ambience for building tenants and the community.

#### **Knowledge and skills gained**

The student participants gained real-world skills as a result of this collaborative effort. First, using an actual building design project provided an opportunity to consider synthesis and integration outside of theoretical parameters. It gave the students the opportunity not only to form their own interdisciplinary approach but also to witness and learn from people who have made their life's work on this very basis. By having industry mentors, the students became better prepared to enter the profession with a clear understanding of the skills an engineer must develop and possess.

Further, professionals gave feedback at periodic phase presentations, which challenged the students to accept criticism, learn from it, and continue to fine-tune their projects for a wholly realistic design. Finally, this close relationship illuminated the different opportunities and specializations available to pursue as a career and created potential connections for future employment or collaboration when the students have transitioned into professional engineers. The significant guidance and evaluation of over 50 experienced professionals raised the bar by having the expectation of real, workable solutions to inherent problems in design. The value of professional input was made clear from day one, which made students take this investment in their work very seriously.

#### **Multidiscipline or allied profession participation**

For this engineering capstone project, three student design teams consisting of six or seven mechanical, structural, and electrical option students each, had support and constructive feedback from professional engineers, professional architects, an acoustical consultant, and faculty advisors in architectural engineering. Each team was given a full set of professionals: an architect, several engineers (structural, mechanical, and electrical), and an acoustical consultant. There were 23

non-faculty mentors in all—16 P.E.s or S.E.s, one E.I., five professional architects, and an acoustical consultant.

Additionally, the design teams sought insight from construction contractors, estimators, deep foundation specialists, and construction engineering faculty to discuss construction sequencing, equipment clearances, methods, and cost. Professional engineering mentors shared their experiences and insights on technical design, detailing, and interdisciplinary coordination.

After each design milestone, teams prepared a presentation and narrative showcasing the progress of the entire building design within each discipline. Another set of professionals participated as evaluators providing feedback on presentation and document submissions. This group included 31 P.E.s, S.E.s, E.I.s, and three others, for a total of 34. They graded the presentations and narratives according to competition rubric. Follow-up questions and comments were then discussed with the professionals. This allowed students the opportunity to defend and improve their design. The presentation and discussion process was similar to one that would be found in a professional setting.

**\$25,000**  
Grand  
Prize

## University of Nebraska–Lincoln

Charles W. Durham School of Architectural Engineering and Construction  
888 Boylston Street–Interdisciplinary Team Design

### Points of View

**Clarence Waters, Ph.D., P.E.**  
**Faculty advisor**

#### What value does a real-world project bring to the students?

In addition to allowing students to understand the constraints and requirements of the project stakeholders, working on a real-world project also gives the students the opportunity to work alongside potential future employers and colleagues. These experiences help the students by giving them the valuable resources of both on-the-job training and networking.

#### How do you decide which projects to work on?

Currently, Nebraska Architectural Engineering (AE) Team Design AE 8030-8040 participates in the Architectural Engineering Institute (AEI) student competition. This project is used every year for the course. The project requires the design and integration of mechanical, electrical, and structural systems together and into the building. The project varies from year to year, including everything from a high-rise building in San Francisco to a

vertical farm in Milwaukee, providing new challenges and opportunities for industry involvement. The AEI is the most highly regarded student competition in AE education and is continuing to raise the bar.

#### How did this project prepare students for professional practice?

The majority of Nebraska AE alumni will be designing and specifying the mechanical, electrical, and structural systems for buildings and working on teams of engineers in their careers. Nebraska AE Team Design gives the students these experiences with the mentorship and evaluation from professionals. In working with these industry professionals, the students are also able to learn some tricks and tips of their trade before entering the workforce, which makes them competitive candidates for future employment. It is excellent preparation for professional practice.

#### What was the biggest challenge on this project?

For me, as the course instructor, the biggest challenge is the recruitment and coordination of the over 50 industry professionals that mentor and evaluate the students. The students'

major challenges were designing and specifying the mechanical, electrical, and structural systems for a very significant structure and presenting their work to the professionals that they may work with in the near future. Structurally, a corner of Level 2 of 888 Boylston cantilevers over the Massachusetts turnpike underground tunnel nearly 50 feet. This required the students to design a cantilever truss that would support the many floors above.

#### What advice do you have for other programs wanting to add similar collaborative projects to their curriculum?

Industry relations are critical to the Durham School of Architectural Engineering and Construction, yet mutually beneficial to all stakeholders. Our industry partners mentor and evaluate our students, in addition to partnering on research opportunities. In return, we provide them with an excellent pool of interns and graduates, as well as research to transform and enhance their business practices. I highly encourage all engineering programs to develop these strong, mutually beneficial relationships.

**How does the University of Nebraska-Lincoln plan to use its \$25,000 prize?**

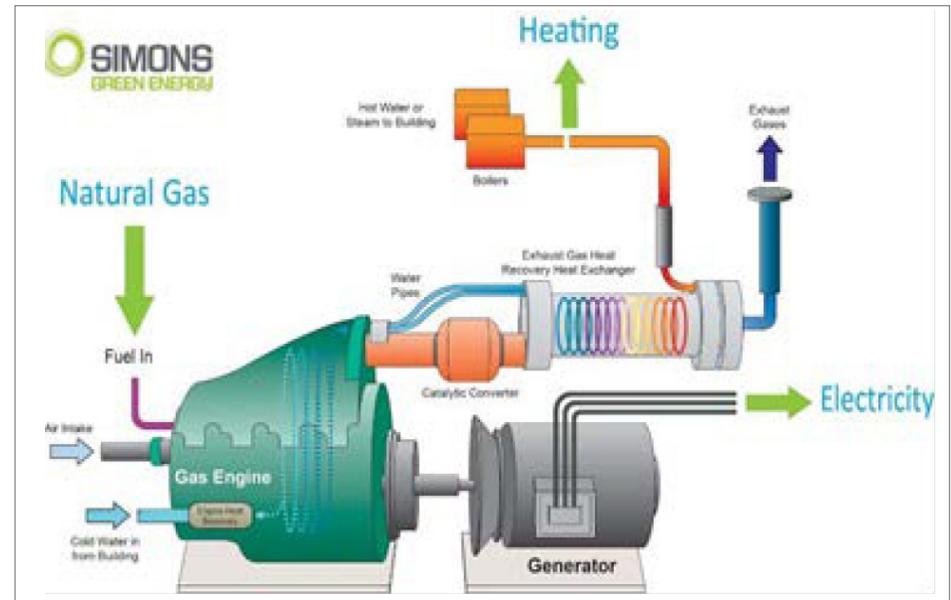
Nebraska AE is very fortunate to be located in Omaha, Nebraska, which is home to a very large and supportive design industry (maybe the highest density of design professionals anywhere). In the AE 8030-8040 Interdisciplinary Team Design Project (our two-semester capstone sequence), we divide the students into teams that include all of the AE options of mechanical/acoustics, electrical/lighting, and structures. Each of these teams are given a full set of professional mentors. At a minimum, there is an electrical, mechanical, and structural engineer, as well as an architect. We have additional engineers and architects that evaluate the student's design presentations and documents. There were over 50 professionals helping with this year's project. We are currently using local engineers and architects to serve as mentors and evaluators, but we have had many companies around the country (including Dallas, Minneapolis, Denver, Detroit, Chicago, and Kansas City) inquire about participating. The \$25,000 award from NCEES will be used to improve the access and quality of our communication technologies, allowing us to connect with mentors and evaluators remotely. This will allow the Durham School of Architectural Engineering and Construction to expand our base of

mentors and evaluators, giving our students the highly valuable skills, tools, and experiences of working with remote professionals, which are very common in today's building design environment. We are considering having our local mentors and evaluators use distance technologies so that all of the students have this experience.

**Nathan Ritta Student**

**What did you like best about participating in this project?**

With a project of this scale, specialization was a must for all student team members. While the entire design process was incredibly collaborative from start to finish, each team had to efficiently allocate tasks between members. As a result, I was able to focus on the things I was most passionate about throughout the entire project, while I also learned to rely on the work of my teammates to carry the project forward. The project presented many complex design problems much bigger than one individual or design discipline could hope to solve alone, and we were constantly required to work together to determine the most effective design solutions. I enjoyed feeling like the expert in the group on certain topics, but I also enjoyed having to come together as a team to collaboratively work through the most important design challenges.



**What did you learn?**

Prior to this project, I was unsure of how specialized I wanted to try to become within my future career in architectural engineering. I knew I had a passion for lighting design, but I also enjoyed power systems design. Working on this project gave me opportunities to flex multiple design muscles, which gave me valuable experience working on all aspects of building electrical systems design. I discovered that, while I do love lighting, I don't want to limit my career opportunities to just those that offer me lighting design experience. Through this project, I learned that there is immense value in becoming as well-rounded as possible in my knowledge of building electrical systems. As

a result, I hope to pursue career opportunities that will not limit me to one facet of design but will allow me to expand my knowledge in all areas of building electrical systems.

**How did the participation of professional engineers improve the experience?**

We (students) would have had no idea where to even begin on this project without the constant input and guidance of the many professional engineers involved. These professionals gave us suggested workflows, helped us to break down and prioritize complex problems, and offered constructive feedback through virtually every step of the design process.

**\$25,000**  
Grand  
Prize

## University of Nebraska–Lincoln

Charles W. Durham School of Architectural Engineering and Construction  
888 Boylston Street–Interdisciplinary Team Design

### Points of View

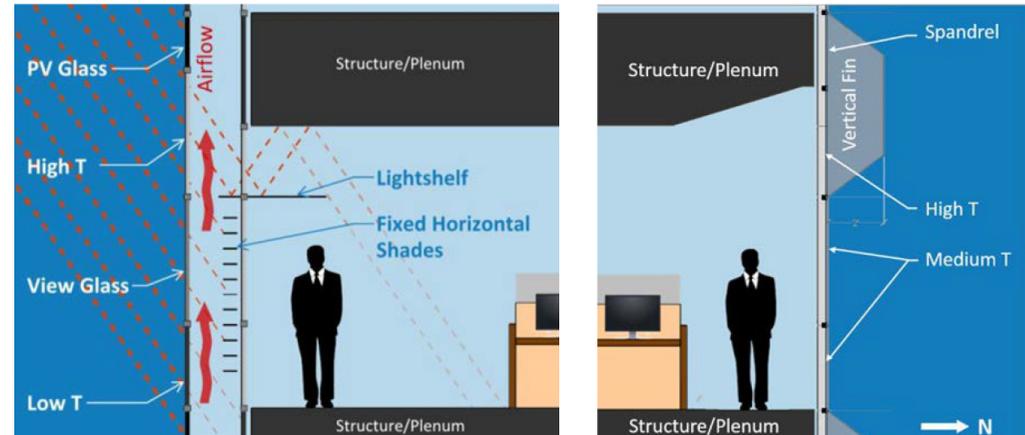
#### What do you think the engineers learned from working with students on this project?

The UNL architectural engineering program is heavily dependent on feedback and guidance from industry professionals, many of whom served as mentors on this design project. Through working with students on this project, these professionals were granted an intimate look at the inner workings of our program, enabling them to identify both strengths and weaknesses of UNL architectural engineering. This knowledge will be invaluable as they continue to advise our AE program in the years to come.

**Aaron Wascher, P.E.**  
**Mentor—mechanical engineer**

#### Why did you get involved with the University of Nebraska–Lincoln’s project?

I am an architectural engineering graduate from Kansas State University. Our profession relies heavily on real-world applications of the knowledge obtained in college. By participating with a project like this, it gives the students experience on how to apply what they’ve learned in multiple classes to a single project.



#### How did you assist the students in the 888 Boylston Street Interdisciplinary–Team Design project?

The professionals working with the students guided them through the process of designing a building. We showed the processes involved with making owner’s requirements, code requirements, and building system requirements work together to create a building.

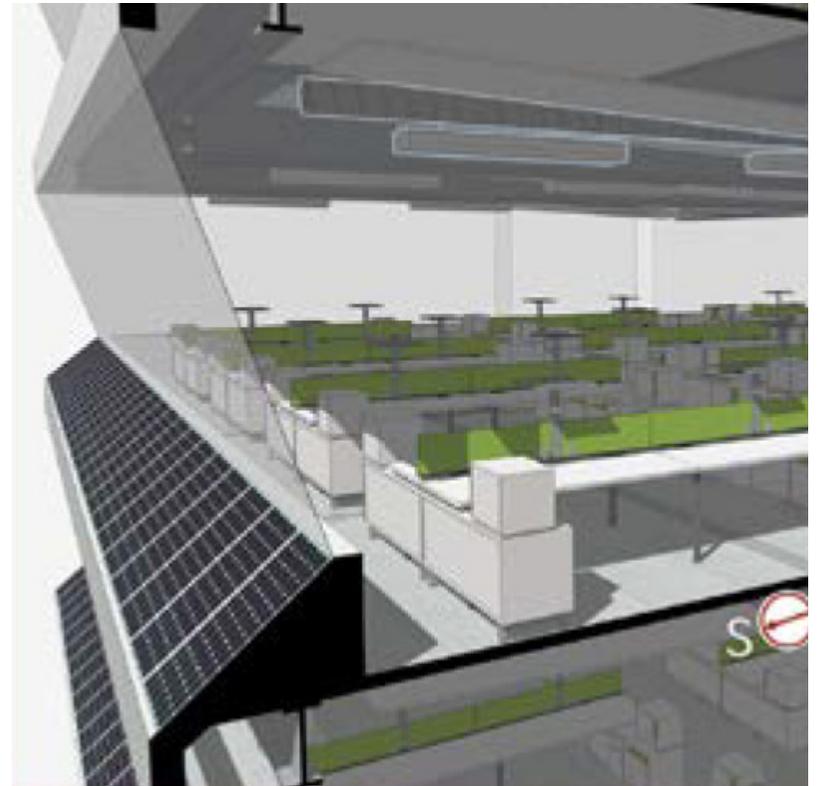
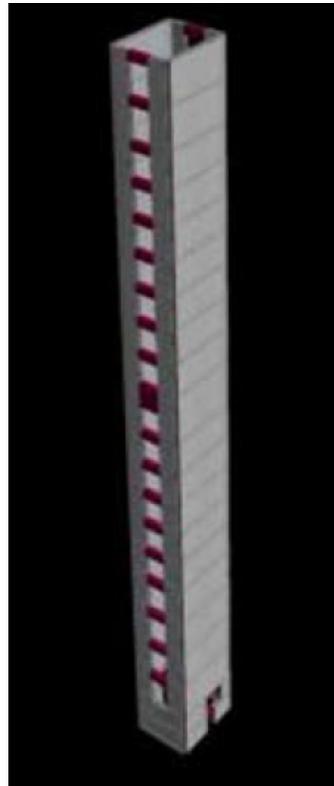
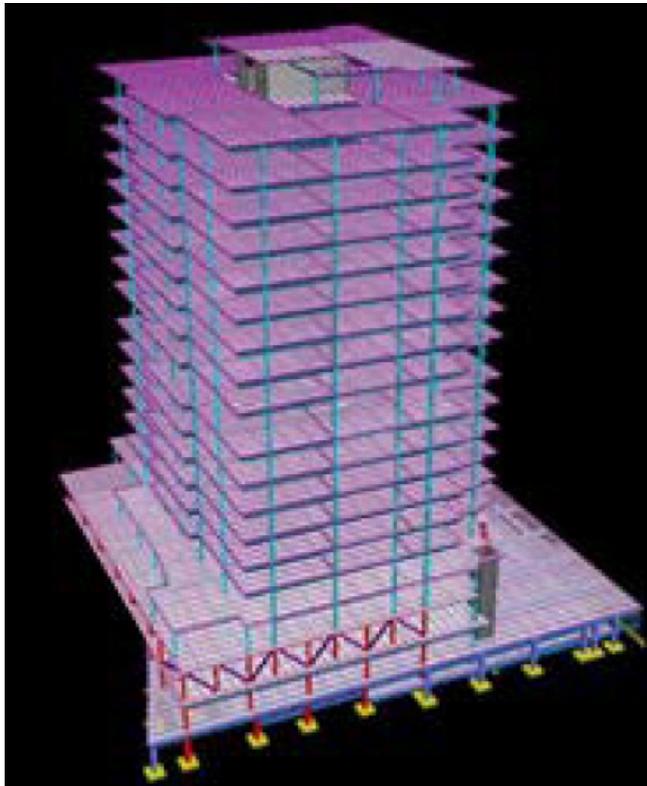
#### What did you learn from working with the students?

I learned about many new systems and products that are available for buildings. They found cutting-edge

designs and decided if they could be applied to the building type. I learned how the next generation is approaching working together by using smart phone apps to coordinate project tasks.

#### What did you want students to take away from working with professional practitioners?

I wanted the students to learn that collaboration with all disciplines will improve the quality of their projects. Building systems are very complex, and being able to work with others and see the situation from another point of view will ultimately produce the best possible project for the owner.





**2016 NCEES  
Engineering  
Award**

**—  
\$7,500  
Winners**

**George Mason University**

Sid and Reva Dewberry Department  
of Civil, Environmental, and  
Infrastructure Engineering

*New Drinking Water and Sewer System for an  
Elementary School for Orphans—Bilwi, Nicaragua*

**George Mason University**

Sid and Reva Dewberry Department  
of Civil, Environmental, and  
Infrastructure Engineering

*Water and Sanitation Project—Children's  
Feeding Center—Puerto Cabezas, Nicaragua*

**Seattle University**

Department of Civil and  
Environmental Engineering

*Design Development of a Cultural Village  
for Migrant Workers*

**Seattle University**

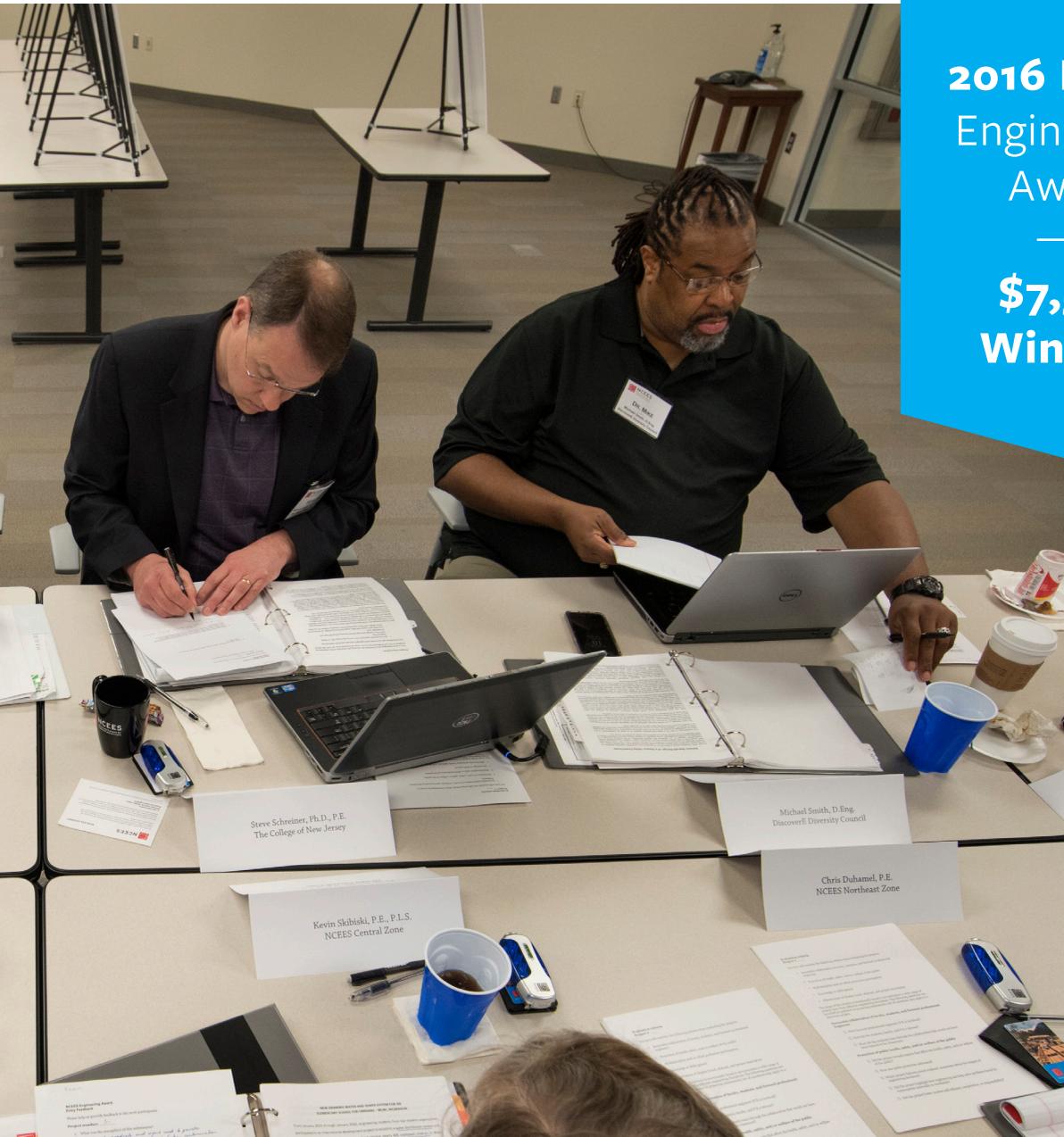
Department of Civil and  
Environmental Engineering

*Design of Habitat-Sensitive Erosion Hazard  
Mitigation Near a Bridge*

**Seattle University**

Department of Electrical  
and Computer Engineering

*Solar Microgrid in Rural Zambia with  
Real-Time Cloud-Based Monitoring*



**\$7,500**  
Award  
Winner

## George Mason University

Sid and Reva Dewberry Department of Civil, Environmental, and Infrastructure Engineering  
*New Drinking Water and Sewer System for an Elementary School for Orphans—Bilwi, Nicaragua*

### Participants

#### Students

Lauren Alger  
Liz Anderson  
Jennifer Arias  
Abigail Armuth  
Rony Avalos  
Dan Bentley  
Oscar Espinoza  
Kumar Karra  
Scott Leary  
Laura Meadows  
Badana Mohamadi  
June Park  
Vaij Raja  
Robert Vallejo  
Zoe Waide  
Whitney Woodcock  
Anne Zheng

#### Faculty

Anthony Battistini, Ph.D.  
Liza Durant, Ph.D.

#### Professional Engineers and Engineer Interns

Matthew Doyle, P.E.  
Maria Angel Londono, E.I.T.  
Mike Morningstar, P.E.  
Basil Mouneimne, E.I.T.  
Ali Nemati, E.I.T.

Sean O'Bannon, P.E.  
Mike Rumsford, P.E.  
Kenex Sevilla, E.I.T.  
Michael Shular, E.I.T.  
Chris Triolo, P.E.

#### Additional Participants

Kristin Amaya  
Amy Mackintosh  
Craig Rice

#### Jury Comments

“This project could be implemented in other places and potentially could have a positive impact on hundreds of people.”

“The collaboration across multidisciplines addressed the basic health needs of a community.”

“The project plan was well developed and focused on a true public health and safety issue.”

### New Drinking Water and Sewer System for an Elementary School for Orphans Bilwi, Nicaragua

**Project Description:**

An elementary school located in Bilwi, Nicaragua contacted our team of 40 student engineers to assist in providing a drinking water system, sewer system, and bathroom facilities for nearly 400 of the school's orphaned children. At the time of the request, the school's only toilet and cesspool were on the verge of overflow, and water being supplied to the school, via a shallow well, was found to be highly contaminated with E-coli, cryptosporidium and trash. The project's scope of work included assessments, planning, detailed design, and construction of a new, reliable water and sewer system. The duration for this project was two years and included over 2,500 engineering labor hours. Approximately \$28,000 dollars was required for materials and travel to fund the mission and was provided by the students who spent two years coordinating fundraising events to raise money. **The student engineers, and the professionals who accompanied them, have been so impacted by this endeavor that, if successful in obtaining the NCEES award, pledge to apply 100% of the earnings towards the construction of our May 2017 Nicaraguan Orphanage Water Project, which is currently being designed.**

**Knowledge and Skills Gained:**

Although it wasn't recognized at the time, some of the most important skills gained were the interactions shared with the professional engineers during this experience. Working side-by-side with professionals in this type of environment while receiving hands-on experience has proven invaluable to the students. Learning the art of compromise to achieve the best value for the client was another lesson learned, as well as persistence and patience. The students, who experienced an unlimited amount of compassion during this trip, also learned what it means to truly make a difference in the lives of those who suffer from extreme poverty, and are now stronger engineers and better human beings because of it.

**Collaboration of Faculty, Students, and Licensed Professional Engineers:**

Since the start of this project in 2014, the students have worked on this project alongside licensed professional engineers, faculty members and staff. Since the inception of the organization, the students have been under the guidance of practicing, licensed professional civil engineers. The students have held biweekly project meetings for over two years where licensed professional engineers and/or engineering interns are in attendance. During the assessment and implementation trips, the students are always accompanied by a professional engineer. The photos to the right show a professional engineer working side-by-side with engineering students.

**Protection of Health, Safety, and/or Welfare of the Public:**

Prior to the implementation trip in 2016, the young school children were drinking contaminated water that contained harmful E-coli and cryptosporidium. After a few days from drinking the dirty water, most children can recover on their own, however, those with compromised immune systems are unable to fight off bacteria. This problem prompted the students to learn how to correctly use laboratory equipment to determine the presence of harmful bacteria. The sample on the top right shows blue dots that indicate there is E-coli and cryptosporidium. The sample on the bottom right represents safe, healthy water that is ready to drink. The school now encourages children to take bottled water home from the school to share with their family members (est. to be 2,000), drastically improving the overall public health of Bilwi.

**Multidiscipline and/or Allied Profession Participation:**

**Environmental Engineering** – Working with a professional environmental engineer, the students designed a water treatment system, an eight stall bathroom facility and septic system. The water system included a 1 micron filter with an ultraviolet disinfection system. The bathroom included eight toilets and four sinks. The septic system was sized to accommodate 300 gpd.

**Structural Engineering** – The students worked closely with a Professional engineer and a University Professor to design multiple structures. The structures included an eight stall CMU block bathroom, a septic tank, a wooden control cabinet, and a 14-foot high concrete water tower.

**3-D Concept And Preliminary Design Phase**

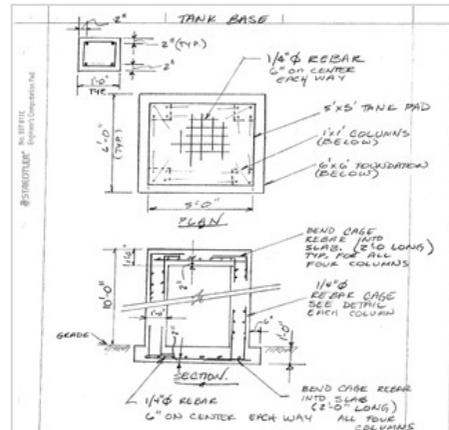
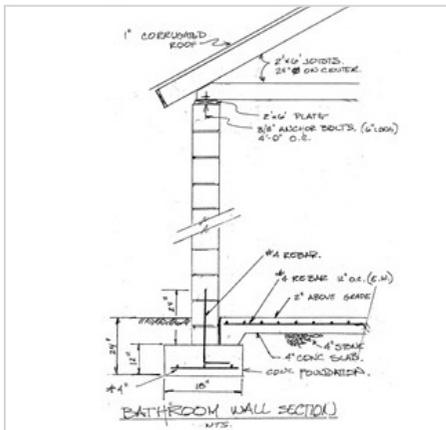
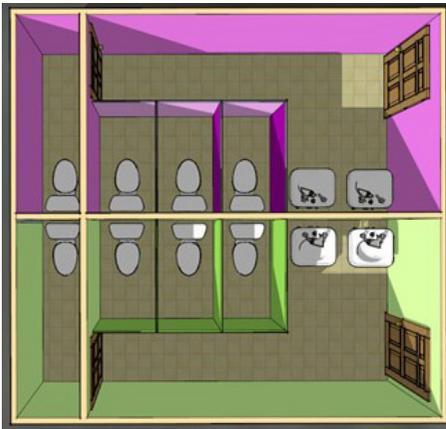
**Detailed Design Phase**

**Construction Phase**

**Electrical and Control Systems Engineering** – The students worked closely with a professional electrical engineer to develop a fully automatic control strategy for the entire water treatment system. They controlled the newly installed well pump by float switches while the UV disinfection unit was triggered by a pump start and the flow for the filters was controlled by a flow regulating valve. Design considerations included head loss, start/stop levels, pressure drops, flow element sizing, response timing, rangeability, accuracy and repeatability. The photo to the left represents an early Process and Instrumentation Diagram (P&ID) of the water system.

**Agricultural and Biological Engineering:** The students collected and analyzed water samples onsite. Samples were taken for turbidity, bacteria, and pH. Water samples were also taken back to the US where the students worked with laboratory technicians at their local water municipality to compare the data against the US EPA's maximum contaminant levels.

**Principles and Practice of Surveying:** During the assessment trip the students collected conventional topographical information of the salient features of the school. During the construction surveying was used to determine lines and grades. Surveying was also used to develop as-built documents for the owner. The photo to the right shows a student behind the level while being mentored by a civil engineering professor. They are laying out the gravity sewer pipe from the new bathroom to the new septic tank.



## Abstract

The lack of potable drinking sources poses the number one priority in global risk based on the impact to society, as announced by the World Economic Forum in January 2015. Regrettably, many less-privileged rural communities are unable to afford adequate sustainable systems to address this complication, negatively impacting the welfare of hundreds of communities worldwide. Our student-directed organization is associated with our university and aims to fundraise, design, and develop stable and innovative engineering systems to alleviate such critical issues revolving around the safety and health of other humans and the natural environment. This document summarizes the contributions and activities of approximately 40 engineering students of multidisciplinary backgrounds, university faculty members, multiple licensed professional engineers, several technical advisors, and various members and leaders of the local community to establish a sustainable water disinfection, water distribution, and septic system at a school of more than 400 orphaned children. Consequently, a project of this magnitude demanded practices of various technical fields, such as surveying, water resources engineering, geotechnical engineering, structural engineering, mechanical and control systems engineering, and electrical engineering.

Findings from an initial assessment trip to the community in January 2015 reported that (a) the current single well being used for the school was a shallow,

exposed hole which posed serious health and safety concerns for the community, (b) the water in use contained numerous contaminants and harmful bacteria and viruses, (c) the community did not have a reliable method of storage and distributing water, and (d) the school's septic tank and bathrooms had failed to provide adequate sanitation. In response to each of the documented problems, the project team proposed (a) the construction of a concrete lid for the well in use to improve the safety of the school children and prevent future contamination, (b) the installation of a chlorine and ultraviolet ray disinfection system, (c) the construction of a sustainable storage and distribution system for the disinfected water, and (d) the drawings and calculations for a new bathroom and septic system. Throughout the course of the project, we, with the collaboration of licensed faculty members and practicing professional engineers, employed a myriad of solutions through significant planning, engineering, constructing, analyzing logistics, and fundraising to propose a new system, which resolves the various risks stemming from the unsafe source of water. With the support of the organization members, the university, and various professionals in multidisciplinary technical industries, the project came to a successful completion in January 2016 with an implementation trip spanning over seven days with over 700 man-hours. The efforts of the team resulted in fulfillment of the school's critical needs and provided opportunities for the engineering students to collaborate with professionals and gain technical field experience.

**\$7,500**  
Award  
Winner

## George Mason University

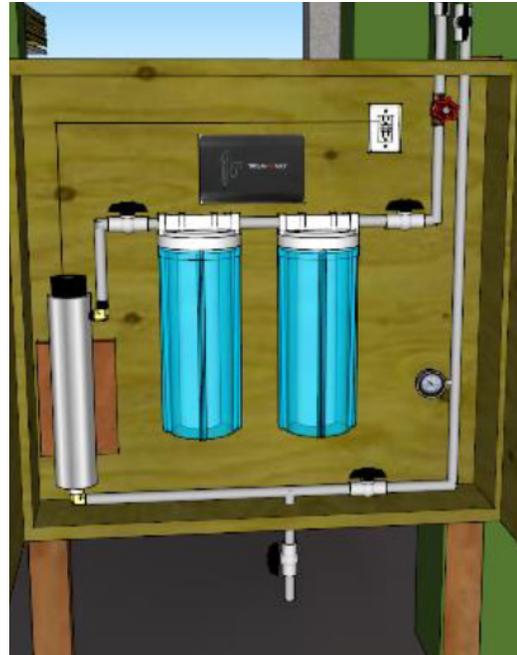
Sid and Reva Dewberry Department of Civil, Environmental, and Infrastructure Engineering  
*New Drinking Water and Sewer System for an Elementary School for Orphans—Bilwi, Nicaragua*

### Perspectives On

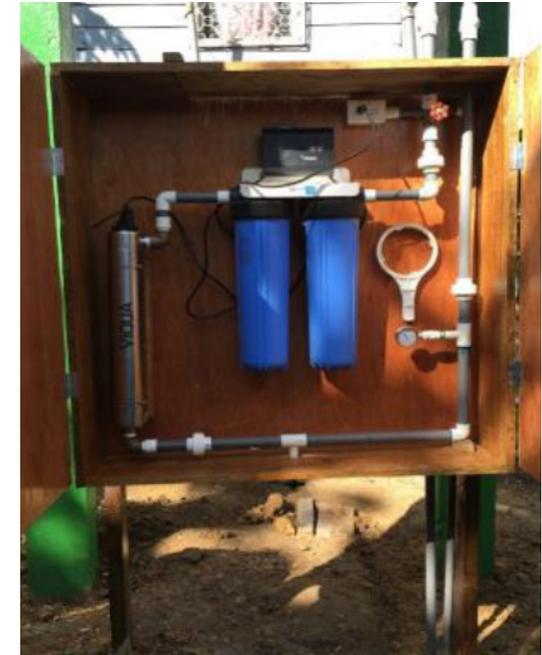
#### **Collaboration of faculty, students, and licensed professional engineers**

Since the first assessment trip in 2015, as many as 40 students and multiple licensed professional engineers and faculty have contributed to this project. Our organization has been under the guidance of a practicing licensed professional in civil engineering since the establishment of the organization in 2010. The students hold weekly project meetings that typically include the attendance of the professional engineers (P.E.s) or engineers in training (E.I.T.s).

Our members conducted extensive research with professional engineers during the assessment trip to further enhance their design for the school. The data consisted of GPS coordinates, water quality tests, soil properties from sample excavation sites, knowledge of local construction practices, associated safety measures, and community survey analysis to understand daily water consumption. Based on the data collected, students and faculty designed the system for future development and water



demand growth. As part of the research and planning process, professional engineers, faculty, and students exhaustively simulated the system and began testing to avoid delays in the field. With forward thinking by the engineers, the project at the elementary school for orphans was completed within seven days.



#### **Knowledge and skills gained**

The knowledge gained through this incredible experience ranges from field experience in engineering to cultural learning for everyone involved. The students improved their understanding of surveying while working alongside professional engineers who taught them beyond



a classroom curriculum. The students also gained knowledge in water resources engineering by understanding the fundamental importance of having the correct design for both water treatment and septic systems.

The significance of relations with the community positively impacted

the students and facilitated the understanding that although a perfect design may be constructed, if it does not meet the community's needs, it is a worthless effort. There was no better feeling than when members of the community thanked our team for their hard work in taking the time to improve their quality of life. The lessons these students learned from

this project and the Bilwi community is something they will carry with them and appreciate for a long time to come; in doing so, they will continue to realize that, as engineers, they have a responsibility to society to never overlook a community's declining public welfare.

**\$7,500**  
Award  
Winner

## George Mason University

Sid and Reva Dewberry Department of Civil, Environmental, and Infrastructure Engineering  
Water and Sanitation Project—Children's Feeding Center—Puerto Cabezas, Nicaragua

### Participants

#### Students

Lauren Alger  
Liz Anderson  
Jennifer Arias  
Abigail Armuth  
Rony Avalos  
Dan Bentley  
Oscar Espinoza  
Kumar Karra  
Scott Leary  
Laura Meadows  
Badana Mohamadi  
June Park  
Vaij Raja  
Robert Vallejo  
Zoe Waide  
Whitney Woodcock  
Anne Zheng

#### Faculty

Anthony Battistini, Ph.D.  
Liza Durant, Ph.D.

#### Professional Engineers and Engineer Interns

Matthew Doyle, P.E.  
Maria Angel Londono, E.I.T.  
Mike Morningstar, P.E.  
Basil Mouneimne, E.I.T.

Ali Nemati, E.I.T.  
Sean O'Bannon, P.E.  
Mike Rumsford, P.E.  
Kenex Sevilla, E.I.T.  
Michael Shular, E.I.T.  
Chris Triolo, P.E.

#### Additional Participants

Kristin Amaya  
Amy Mackintosh  
Craig Rice

#### Jury Comments

"The project provided a significant improvement in public health, safety, and welfare."

"The skills and knowledge gained by the students was evident, as was the public welfare impact of this project on the community."

"The first step to good health is clean water. This project is bringing better health through clean water."

## Water and Sanitation Project – Children's Feeding Center – Puerto Cabezas, Nicaragua

### Project Description:

**THE PROBLEM:**  
The Children's Feeding Center in Puerto Cabezas, Nicaragua, supplies one, nutritious meal to nearly 700 impoverished children daily. Built in 2009, the Feeding Center receives a majority of its food through an organization in Raleigh, North Carolina called Stop-Hunger-Now. Unfortunately, the Feeding Center lacked both a reliable water and sewer system. Prior to our involvement, the center's primary water source originated from a falling well, and ended with wastewater seeping across the ground to the nearest ditch, often where the children played. Our student organization was contacted by a non-governmental organization who requested us to solve the problem. In doing so, we finished on schedule and were under the original cost estimate. The project took 12 months to complete with an investment of nearly \$20,000, obtained by our own fundraising.

**THE SOLUTION:**  
**Answering the Call and Making a Difference:**

- 1,000 (+/-) design labor hours
- 700 construction labor hours
- 0.0 labor hours lost due to injuries
- Re-instated the old well
- Installed a hand washing station
- Installed a new 12-foot high concrete water tower
- Installed a new 300 gallon water tank and piping
- Installed a new 1,000 gallon septic tank system
- Installed a new sanitary drain field
- Installed a new booster pump, bladder tank, and pressure switch to maintain 40 psi
- Reinstated a 0.5 micron water filter
- Trained end-users how to operate and maintain the system

### Protection of Health, Safety, and/or Welfare of the Public:

Having access to clean water opens up a world of opportunities for community growth. Public sanitation and hygiene, combined with a source of clean drinking water, creates lasting community health and sustained human growth and development. As a child, disease from lack of clean water and sanitation carries over into education. A child's education is affected by an increase in truancy, decrease in intellectual potential, and increased attention deficits. With the benefits of clean water, adequate sanitation, and good hygiene, educated individuals grow up to be enterprising adults, who become the owners of businesses, as well as corporate, community and national leaders. From the early years of life, throughout childhood and into adulthood, water is the common beneficial factor determining the quality of life and the possibilities of the future. (Below is only one example of our betterment to the welfare of the public.)

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### Knowledge and Skills Gained:

An engineer's primary focus is often on the math and science aspect of a project, and it can be easy to forget other skills necessary for successful project completion. Some important skills learned for this mission include the following:

**Leadership:** During the entire project we found that we were ultimately in charge of the entire project. We directly affected the lives of others.

**Critical Thinking:** Throughout construction we faced many unknown conditions and several complex problems. We had to identify the most reasonable approach in dealing with difficult situations.

**Visualization:** During the life of the project we had to visualize how complex components came together and ultimately work as a system. The use of 3-D models assisted in visualization (bottom right).

**Clear Communication:** Since we had to interact with many different types of people, we had to communicate effectively in English, Spanish and Miskito.

### Collaboration of Faculty, Students, and Licensed Professional Engineers:

Since the start of this project in 2014, we have had as many as 20 students work on this project alongside licensed professional engineers, faculty and staff. We have been under the guidance of practicing, licensed professional civil engineers since the inception of the organization. The team has been holding bi-weekly project meetings for 12 months with licensed professional engineers and/or engineers in training (EITs) in attendance. During the assessment and implementation trips, the team always had a professional engineer accompanying the students.

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### Principles and Practice of Surveying: A

few weeks before the construction phase, our professionals insisted we learn how to set up the surveyor's level. It became our primary tool in constructing the drain field for the septic system

### Multidiscipline and/or Allied Profession Participation:

**Civil - Structural:** We worked with a professional civil engineer to design and build a 12-foot high concrete water tower. Design calculations included dead and live loads, deflection, beams, columns slab, and footings. MASTAN software was used to develop a force analysis of the structure.

**Electrical Engineering:** A professional electrical engineer was recruited to provide QA/QC on the electrical design and to help re-construct the power system for the entire feeding center. The electrical design included load analysis, pump and pump controls, safety grounding and lighting.

**Civil - Construction:** Prior to the construction, we developed a critical path method construction schedule. We routinely updated cost estimates during the life of the project. A professional was continuously checking our work. Due to optimal construction management, we finished on time and under the budget.

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### Environmental Engineering:

A sanitary engineer from our local Public Works assisted us in determining the best solution for a septic tank system. Multiple alternatives were reviewed and analyzed. The final recommendation was to use two 500 gallon HDPE tanks.

### Control Systems Engineering:

A professional electrical engineer worked closely with us to layout the control strategy. The client wanted the system to be fully automated. Sensor technologies were selected and checked by the professional engineer. The Process and Instrumentation Diagram was our road map for the detailed design.

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### Civil Geotechnical:

Working with a professional civil engineer, we performed a perk-test on the Nicaragua soil to understand the effectiveness of a drain field.

20

## Abstract

The Puerto Cabezas Feeding Center, located along the northeastern shore of Nicaragua, is a nonprofit facility whose primary mission is to provide one nutritious meal per weekday to nearly 700 impoverished children in the community. The feeding center provides for these hungry children, as many parents of the region have various physical and economical restraints making them unable to afford sufficient meals for their families. Unfortunately, the water systems that were in use at the premises were found to be extremely inefficient and to have critical health risks due to a non-operational water and wastewater system. The lack of these systems resulted in large delays during meal preparation and poor wastewater management. The members of the feeding center, already overwhelmed with the dependence of many children for their only source of food, did not have the financial capacity to rehabilitate the established systems to their full potential, which as a result, negatively impacts hundreds of local members of the community.

This report discusses the details of the findings, collaboration, lessons, and results of the assessment and implementation of two systems designed and constructed by a team of engineering students, practicing professional engineers, and university faculty. The project sought to improve the lives of these approximately



700 children and countless adults by increasing efficiency in water distribution and decreasing the risks associated with consumption of bacteria ridden water. The project encompassed various multidisciplinary aspects of engineering, such as structural analysis, electrical engineering, mechanical engineering, and hydraulics, as well as humanitarian factors such as health, safety, and welfare of the public.

An initial field assessment in late 2014 revealed that the feeding center had abandoned its distribution system due to inadequate water pressure and was collecting the needed water



directly from an open hole in the ground. During implementation, a new water distribution system was constructed to address this issue in the kitchen and garden and at various hand-washing stations. The assessment also exposed a collapsed septic tank that resulted in improper disposal of sewage. In response, the team installed a new septic system to allow biological treatment and storage of sludge from the generated waste. The contribution of 40 engineering students of various concentrations and 10 technical advisors and practicing professional engineers made it possible for a large improvement in the protection of public health, safety,

and welfare. Furthermore, working as part of the larger project team created a collaborative experience for students and industry leaders alike. The group was pleased to work with local community leaders and facility managers during the construction of the water distribution and wastewater management system, which came to a rewarding finish in 2015.

**\$7,500**  
Award  
Winner

## George Mason University

Sid and Reva Dewberry Department of Civil, Environmental, and Infrastructure Engineering  
*Water and Sanitation Project—Children's Feeding Center—Puerto Cabezas, Nicaragua*

### Perspectives On

#### **Collaboration of faculty, students, and licensed professional engineers**

Professional civil engineers and professional electrical engineers were involved during the entire project. They mentored the students on how to think through the challenges faced when working abroad. Some of the areas that needed to be focused on were substitution of materials and alternative ways to design when obstructions occur in the field.

Since the students working on the design ranged from freshman to seniors, a primary focus for the faculty and professional engineers was to mentor the students so each could begin discerning which field of engineering he or she is most interested in pursuing. Faculty are able to help the students better their understanding of the engineering curriculum and to demonstrate the importance of learned concepts and equations in real-world projects. Having the students work with professional engineers enables them to take their academic knowledge and be able to express and format

their work in a professional manner. The collaboration of a professional engineer and student demonstrates how they were able to mentor the organization's students throughout the entire project.

Students were separated into various teams, each representing a necessary task within the project: water distribution, structural, wastewater, and electrical systems. The students coordinated with faculty and professional engineers to conduct biweekly meetings. These meetings updated everyone on the status of the project and created a forum to discuss problems and reach proactive solutions.

In the field, students learned how to construct a water distribution system in a hands-on environment with the collaboration of P.E.s. By allowing students to physically construct these components, they are able to identify potential problems before they occur, which will only improve their work as a designer. An engineer's work is only good if constructed properly.



Additionally, students learned the importance of providing a design that is formatted to the needs of the client, the Puerto Cabezas community. With the experience from the professional engineers, students were able to open their minds to not just designing a functional water distribution system as you would for a class assignment, but also to learning to manage all aspects



of the project. For instance, all materials within the system needed to be readily accessible, cheap, and durable so the community can fix the system if any problems arise in the future.

### **Knowledge and skills gained**

To successfully execute this project, students' communication skills were monitored by faculty and professionals. This taught the students to respond in a courteous and professional nature as it would be done in a professional setting. Throughout the design process of the feeding center, our students were continuously improving their presentation skills as memorandums and updates were provided to the organizational member and the university leadership teams. Members of the board, professional engineers, and faculty who are able to attend asked questions as if they were the students' future employer. The emphasis on communication refines the students' skills and prepares them for when they enter the professional world. Every student involved was able to better his or her engineering skills and knowledge by having small group learning sessions with professional engineers. In this manner, they were able to expand their level of thinking and ask questions that were more focused on the engineering practice outside the classroom setting. The process of design was new to many students, and they learned the difference of including feasibility, cost, and clients' needs.

**\$7,500**  
Award  
Winner

# Seattle University

Department of Civil and Environmental Engineering  
*Design Development of a Cultural Village for Migrant Workers*

## Participants

### Students

Mia Bernadino, E.I.T.  
Robert Long, E.I.T.  
Kelsey Rau  
Svyatoslav Rubashka, E.I.T.  
Jordan Sewell, E.I.T.  
Demetria Swendseid  
Hillary Tervet, E.I.T.  
Evan Yamamoto

### Faculty

Nathan Canney, Ph.D., P.E.  
Nirmala Gnanapragasam, Ph.D., P.E.

### Professional Engineers

Jeff Dye, P.E.  
Eric Kelley, P.E., S.E.  
Haritha Venna, P.E.  
Michael Chamberlain, P.E., S.E.

### Additional Participants

Aaron Allen  
Cole Bitzenburg  
Gloria Burton  
James Coan, P.L.S.  
Sara Layrer  
Jose Ortiz  
Bill Singer

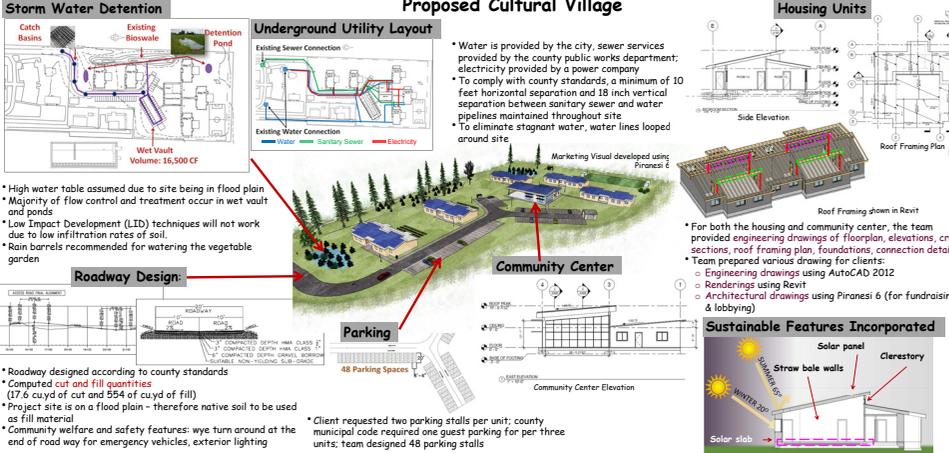
### Jury Comments

“The project addressed a critical need for a migrant class of workers—health and safety.”

“These types of projects help focus our nation’s leaders to require necessary improvements in how we treat our workers.”

“This team tackled an important social issue and did it well.”

## Design Development of a Cultural Village for Migrant Workers

<p><b>Introduction</b> Each year thousands of migrant workers come to our state to work in farms picking fruits and vegetables. The housing provided by farmers for the migrant workers and their families is often dramatically substandard - small single room shacks lacking insulation, heating, and proper ventilation. A non-profit organization (the client) is working with a legal advocacy group to improve the living conditions of these workers. They envision a "cultural village" consisting of improved housing, a community center, garden space and a play area for the children - all owned and operated outside of any single farmer.</p>	<p><b>Condition of Current Migrant Housing</b></p> 	<p><b>Client Needs</b> • Cultural Village to include: • housing to accommodate 20 families, <b>community center</b> for education and outreach, personal and communal <b>vegetable gardens, play area</b> for the children • incorporate <b>sustainable features</b> • Develop 30% <b>civil-site design</b> including: <b>roadway, parking, utilities, grading, drainage plan, and permitting guidelines</b> • Preliminary <b>structural design</b> for housing and community center • Develop <b>marketing materials</b> for fundraising and lobbying and <b>preliminary cost estimate</b> for project</p>
<p><b>Proposed Cultural Village</b></p>  <p><b>Storm Water Detention</b> • High water table assumed due to site being in flood plain • Majority of flow control and treatment occur in wet vault and ponds • Low Impact Development (LID) techniques will not work due to low infiltration rates of soil • Rain barrels recommended for watering the vegetable garden</p> <p><b>Underground Utility Layout</b> • Water is provided by the city, sewer services provided by the county public works department; electricity provided by a power company • To comply with county standards, a minimum of 10 feet horizontal separation and 18 inch vertical separation between sanitary sewer and water pipelines maintained throughout site • To eliminate stagnant water, water lines looped around site</p> <p><b>Roadway Design:</b> • Roadway designed according to county standards • Computed <b>cut and fill quantities</b> (17.6 cu yd of cut and 554 of cu yd of fill) • Project site is on a flood plain - therefore native soil to be used as fill material • Community welfare and safety features: wye turn around at the end of road way for emergency vehicles, exterior lighting</p> <p><b>Housing Units</b> • For both the housing and community center, the team provided engineering drawings of floorplan, elevations, cross sections, roof framing plan, foundations, connection details • Team prepared various drawing for clients: ◦ Engineering drawings using AutoCAD 2012 ◦ Renderings using Revit ◦ Architectural drawings using Piranesi 6 (for fundraising &amp; lobbying)</p> <p><b>Sustainable Features Incorporated</b> • Solar panel • Straw bale walls • Clerestory • Solar slab</p> <p><b>Community Center</b> • Client requested two parking stalls per unit; county municipal code required one guest parking for per three units; team designed 48 parking stalls</p>		
<p><b>Cost Estimation</b></p> <p><b>Civil-Site Development</b> Permits \$9,200 Grading \$1.5 Million Utilities \$2,400 Drainage \$9,400 Wet Vault \$1 Million</p> <p><b>Structural Construction</b> Housing Unit Cost \$290,000 Community Center \$340,000 Solar Panels: Housing Units \$149,000 Community Center \$170,000</p> <p><b>TOTAL COST = \$4.8 Million</b></p>	<p><b>Allied Professional Participation</b></p> <ul style="list-style-type: none"> <li>• Obtained base map from <b>licensed land surveyor</b></li> <li>• Met with <b>architects</b> to discuss design issues</li> <li>• Interacted with <b>legal advocacy group</b> on codes governing migrant housing</li> <li>• A <b>licensed structural engineer</b> advised the team on housing and community center design</li> <li>• Two <b>licensed civil engineers</b> mentored the team on roadway, parking, stormwater design, utility layout &amp; permitting issues.</li> <li>• Interacted with <b>straw bale contractor</b> to learn about construction practices</li> <li>• A <b>community action group</b> and <b>foodbank</b> facilitated a meeting with migrant workers to learn about their experiences and needs</li> <li>• Attended a <b>state legislative session</b> focused on migrant worker housing and code revisions</li> </ul>	<p><b>Knowledge and Skills Gained</b></p> <p><b>Engineering &amp; Technical Skills</b> • Working knowledge of <b>American Society of Civil Engineers standard 7-10 (ASCE 7-10)</b>, <b>2015 International Building Code</b>, <b>City Residential Code</b>, <b>County codes</b>, <b>Stormwater Design Manual</b>, <b>presentation software</b> • Familiarity with <b>Temporary Worker Housing Code</b></p> <p><b>Professional Skills</b> • Oral presentations to class, <b>professional engineers</b> through the department advisory board, <b>clients</b> and to local <b>professional society members</b>. • Developed <b>technical writing</b> skills through <b>proposal, final report, and emails</b>. • Worked with <b>professional engineers, licensed architects</b>, and a broad range of <b>non-engineering partners</b> • <b>Project management and leadership</b> skills: prepared <b>agenda, ran meetings</b>, followed up on <b>action items</b>; prepared <b>client status reports</b>, managed <b>schedules, budgets</b>; learned to <b>work as a team</b>.</p>

## Abstract

Every year, farmers around the U.S. hire hundreds of thousands of migrant workers to manually harvest seasonal fruits and vegetables. In many cases, farmers provide temporary housing for these workers during the picking season. Often times, these houses are stark, offering inhumane living conditions and adversely affecting the safety, health, and welfare of the migrant workers and their families. A local nonprofit organization (NPO) is attempting to provide a new model for migrant worker housing in our region that is independent of the farmers. The NPO hopes to seek funds from state legislature and private foundations to enact this new vision. Working with the NPO, our goal was to develop the engineering design of a “cultural village” that provides housing, a community center, gardens, and a play area for the migrant workers and their families.

Our engineering students are required to complete a team-based, year-long, senior capstone project prior to graduation. In this project, a team of eight students worked under the supervision of three licensed engineers from a local company that served as the project sponsor, and a faculty advisor, also licensed. The eight-person team was subdivided into two teams—one was responsible for the civil-site design and the other

for the structural design of the main buildings on site. In fall quarter, the team submitted a written proposal to the NPO outlining the project scope and approach, deliverables, and schedule. In spring, the work culminated in a final report describing the design methods, engineering drawings, calculations, and recommendations.

The cultural village consists of housing for 20 families: five structures containing two units each. Each unit has four bedrooms to support two families with shared living rooms, bathrooms, and a kitchen. At the center of the cultural village is a community center that consists of a flexible space for community events, laundry, public kitchen, health clinic, and bathrooms. In order to reduce operation costs for the migrant families, the structural team incorporated sustainable features into the buildings, including solar panels, straw bale walls, and passive solar techniques such as clerestories, roof overhangs, and solar slabs for heating. The civil-site team designed the site layout, including roadway alignment and parking stalls per applicable codes, storm water detention ponds, and a wet vault. The team researched required development permits and prepared utility plans for water, sewer, and power. Because of the broad range of stakeholders, the



final design package comprised of AutoCAD engineering drawings, three dimensional renderings using Revit, and architectural visuals using Piranesi 6.

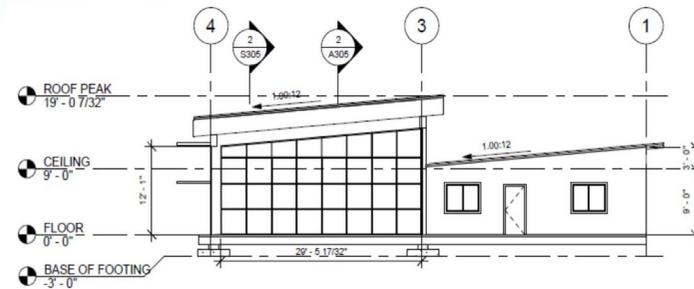
Each team member served as the project manager for part of the year, running meetings, setting agendas, assigning tasks, and following up on action items. The team interacted with two architects, a straw bale contractor, and a legal advocacy group; volunteered in a food bank serving migrant workers; and attended a state legislative session about migrant worker housing. The project strengthened the team’s ability to work together, to communicate effectively with engineering and non-engineering audiences, and to hone professional and leadership skills.

The NPO and the students mutually benefitted from the project. The NPO used the deliverables for lobbying and fundraising. If successful, it plans to implement this model across the state. The students became aware of their social and ethical responsibility towards a marginalized community critical to the American economy.

**\$7,500**  
Award  
Winner

## Seattle University

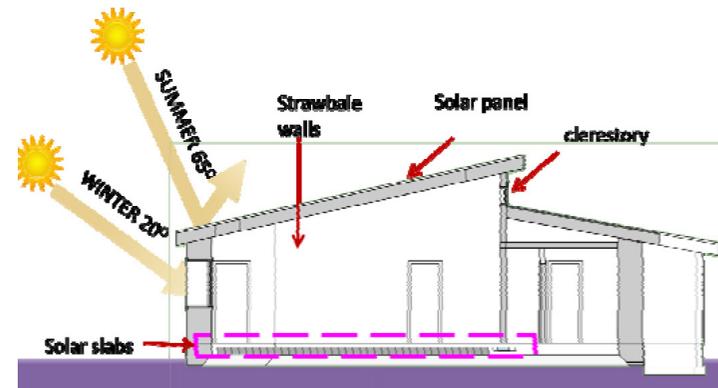
Department of Civil and Environmental Engineering  
*Design Development of a Cultural Village for Migrant Workers*



## Perspectives On

### Multidiscipline or allied profession participation

The team worked with a multitude of allied professionals on this project. The summer prior to the beginning of the academic year, a licensed land surveyor who teaches surveying at a local institution surveyed the property as a student project. They provided the topographic map of the site for the engineering student team to work on. Two architects, one of them licensed, met with the team to discuss the architectural issues and help the team with cost estimates. The team worked with a legal advocacy group to learn the details and deficiencies of the code governing migrant housing. A local community action group and a food bank facilitated the students to work in the field picking produce and at the food bank for a few days in the summer prior to the school year and again in the fall. These experiences helped the team to recognize the struggles of migrant workers and gave them an opportunity to work in a food bank serving the migrants and to hear their concerns of the farmer-provided housing. The team contacted a straw-bale contractor to learn their construction practices. The team attended a legislative session in the state capital where migrant worker housing issues were discussed. This was an enlightening experience for the students to see how legislature



plays a role in the implementation of policies and about the complexity of these types of issues due to the myriad of stakeholders involved.

### Protection of public health, safety, and welfare

Migrant farm workers are the backbone of the U.S. agricultural economy; however, the wellbeing of

this population is largely overlooked and the community stigmatized by political rhetoric. On the other hand, migrant workers continue to come to the U.S. every year because they believe, despite the hardships they endure, that the U.S. provides a better opportunity that is unavailable in their own country. This project helped the team to be aware of

migrant worker issues and how an engineer's skills could be put to good use in improving the lives of this community. The migrant worker's health, safety, and welfare were the foci throughout the project.

**\$7,500**  
Award  
Winner

# Seattle University

Department of Civil and Environmental Engineering  
*Design of Habitat-Sensitive Erosion Hazard Mitigation Near a Bridge*

## Participants

### Students

Kaitlyn Hammond  
Calika Kaley  
Mark Lovrin  
Nicole Nagao  
John Polka  
Ross Starkey  
Matthew Thomas  
Valerie Wu  
Brian Yee

### Faculty

J. Wesley Lauer, Ph.D., P.E.  
Nirmala Gnanapragasam,  
Ph.D., P.E.

### Professional Engineers

Mary Lear, P.E.  
Clint Loper, P.E.  
Mark Ruebel, P.E.

### Additional Participants

Lica Dulan  
Phyllis Meyers  
Richelle Rose

### Jury Comments

“The project helped to stabilize an ongoing erosion problem and improve the habitat for fish and game.”

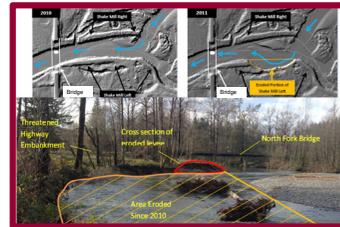
“Dealing with the effects of stream migration is incredibly important to the sustainability of our infrastructure.”

“The students learned important lessons not normally covered in the classroom from the licensed engineers and county liaisons.”

## Design of Habitat-Sensitive Erosion Hazard Mitigation near a Bridge

### Introduction

Large floods in 2011 caused bank erosion to threaten a bridge in a rural part of our county. Designing a solution to this problem that addressed erosion hazards, ecological needs, and community safety was the focus of a multi-year student project. Work involved two civil engineering senior capstone teams, two non-engineering students (biology and environmental studies), regular supervision by three engineers and several ecologists and planners at the county, input from engineers and drafters at a local consulting firm with experience in the regional river management, and a faculty advisor.

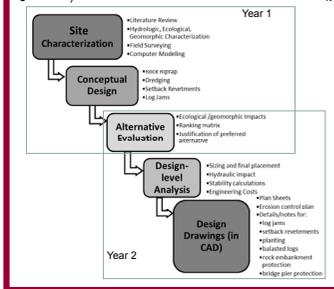


### Background

Erosion in 2010/2011 led to scour on the north abutment of the bridge. Further erosion of the bend would likely lead to change in flow direction through the bridge, potentially causing damaging scour near the bridge piers and could threaten the entire roadway embankment along the south bridge approach. Long-term sustainability and ecological impact are heavily-weighted considerations for the county flood management division and were emphasized on this project.

### Scope of Work and Deliverables

- Written Proposals (submitted in Dec '13 and Dec '14)
- Final Design Reports (submitted in June '14 and June '15) Year 1 and 2 tasks and deliverables were:



### Key Elements of Project



**Site Characterization** included bathymetric mapping, hydraulic modeling, air photo analysis and ecological assessment. Flood and erosion hazards were used to map overall risk to infrastructure.



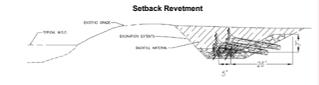
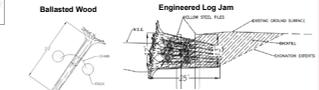
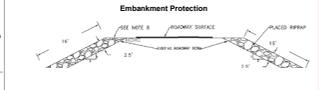
**Conceptual Designs/Alternatives Evaluation**  
Teams developed a range of plans to minimize erosion using setback revetments, engineered log jams, rock embankment protection, and excavation, and evaluated with respect to effectiveness, cost, and ecological appropriateness.

Alternative	Cost	Time	Ecology	Stability	Overall
Option 1	Low	Fast	High	High	High
Option 2	Medium	Medium	Medium	Medium	Medium
Option 3	High	Slow	Low	Low	Low

**Design-level Analysis:** Teams worked with county engineering liaisons to identify design standards and perform stability calculations. The chart illustrates some computations performed on a single project element.



**Design Review:** Draft drawings were reviewed by three licensed engineers at the county who also provided training on review protocol.



**Drawings:** Both teams developed CAD drawings. In year 1, these focused on conceptual design. In year 2, drawings were taken to a typical 30% design level that can be used for initial review by regulatory agencies.

### Major Design Challenges

- Developing **hydraulic model** for simulating velocities and shear stresses for use in design
- Designing for ecological appropriateness, which emphasized allowing for **geomorphic change** and required input from non-engineering team members.
- Developing system for evaluating the wide range of conceptual alternatives. This required the input from county planners and ecologists.
- **Evaluating continued change** that occurred at the site between year 1 and year 2.
- **Identifying design standards** for the relatively new low-impact technologies employed on the project.

### Student Skills Developed

- **Technical skills**
  - Developing working knowledge of **HEC-RAS, design manuals, AutoCAD, and GIS.**
- **Communication skills**
  - **Oral presentation and technical writing skills, developing client interaction**
- **Project management and leadership skills**
  - Learning **team dynamics, duties and responsibilities of a Project Manager**; Setting up and running team meetings, preparing **meeting agenda**, following up with **action items**, keeping track of **schedules, value of file organization and project archiving.**
- **Collaboration with allied professions**
  - Ability to incorporate **multidisciplinary criteria** regarding ecology, transportation, hazard management in decision making

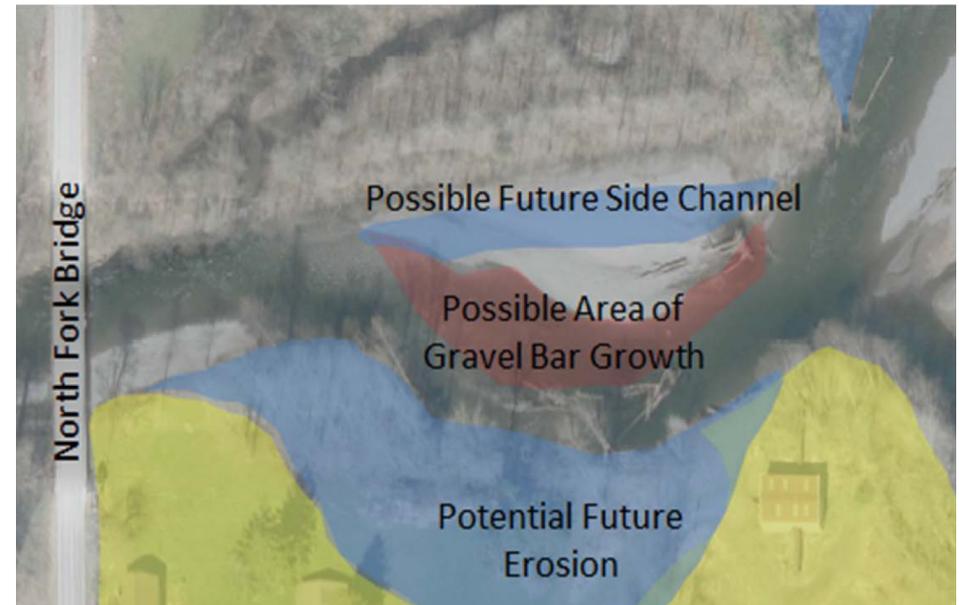
## Abstract

Our university regularly supports teams of three to five students on year-long capstone design projects. Recently, we supported two teams of civil engineering students who worked in collaboration with a local county flood management division to design erosion mitigation for a bridge. In addition to a host of traditional engineering analyses related to river hydraulics, slope stability, erosion protection, grading, and cost, the project required detailed assessment of geomorphic and ecological conditions. This would not have been possible in a single year, so the project was organized in two phases. The first occurred during the 2013–14 academic year and focused on background analysis and conceptual design. The second occurred during 2014–15 and focused on detailed design analysis and design drawings. Continuity between project phases was maintained by a) working with the same team of engineers and scientists at the county both years, b) having a single faculty advisor supervise the project for its duration, and c) including a single biology/ environmental studies student as a biological consultant during both years.

The project was motivated by progressive erosion of a river bend that threatened an important bridge in a rural part of the county. The site is located in a natural area, much of

which is designated county parkland. Simply rebuilding the failing banks and lining with rock riprap was not a preferred alternative due to potentially significant impact on habitat and ongoing maintenance costs. Maintaining habitat quality for resident populations of trout and for terrestrial mammals such as elk was a priority for the county. The county was also interested in developing projects for which acquisition of environmental permits would be straightforward.

The project required regular (i.e., at least monthly) interaction between multiple departments at the county, as well as input from a consulting firm with experience in the area. Several members of the sponsoring team are licensed as professional engineers, and others have advanced training in ecology and environmental planning. Because of the rather specialized nature of the work, students from both teams (as well as non-engineering students) attended regional and national conferences on river restoration or water management where they interacted with professional engineers and restoration scientists. The team developing the design drawings regularly met with design engineers and drafters at county and at the consulting firm that had studied the reach.



The main tasks performed in 2013–14 included background analyses related to hydrology, geomorphology, habitat, and hazards; hydraulic modeling; and conceptual design. The design alternatives included traditional rock riprap based bank protection, construction of engineered log structures to divert flow away from the eroding bank, and buried rock/ log structures that would be set back from the existing bank but that would stop erosion once it progressed into these structures. The 2014–15 team performed additional hydraulic modeling necessary for developing design velocities and depths and detailed development of the preferred alternative, which included buried

rock/log structures, construction of an engineered log structure in the channel, and rock armoring of the roadway embankment. Calculations were performed to assess performance of these project elements in range of failure modes. Design drawings were produced in AutoCAD representing project plan, cross-section, and profile; project details; and a full temporary erosion and sediment control plan for use during project construction.

**\$7,500**  
Award  
Winner

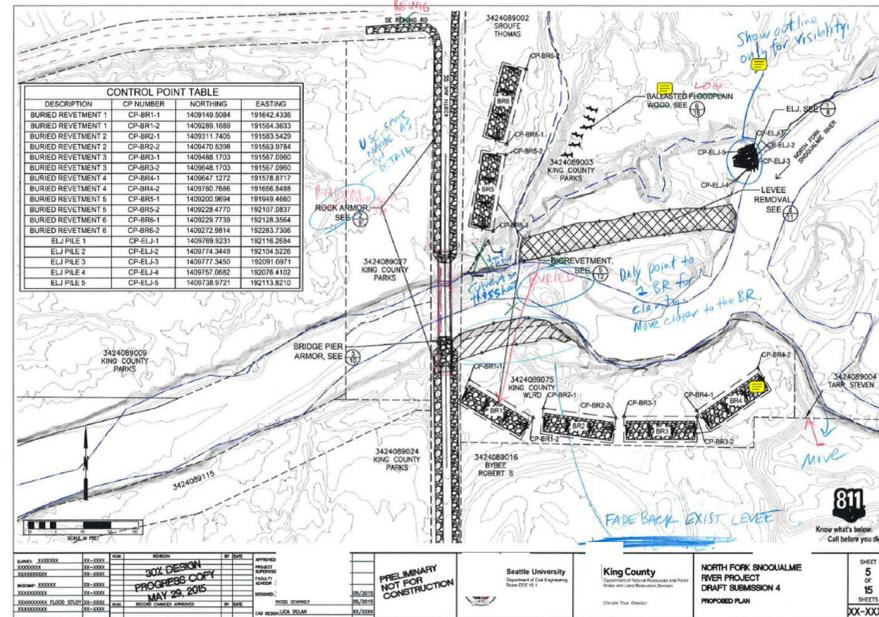
## Seattle University

Department of Civil and Environmental Engineering  
*Design of Habitat-Sensitive Erosion Hazard Mitigation Near a Bridge*

### Perspectives On

#### Collaboration of faculty, students, and licensed professional engineers

During their senior year, students at our program are divided into teams of four or five students and assigned a project that is supported by an external organization such as an engineering consulting firm or municipal engineering agency. Teams prepare a written proposal during fall and a final report at the end of the academic year for the client. Teams are advised by a faculty member and are supervised by a faculty instructor who organizes capstone project milestones and provides day-to-day continuity for the entire capstone class. In this project, both faculty members were licensed professional engineers. The design team was supported by two liaison organizations—the county flood management division and an engineering consulting firm that had developed management plans near the study reach. Three of the county liaisons, who met regularly with the team, are licensed engineers, and others on the county team have advanced degrees in ecology and land use planning bringing a unique

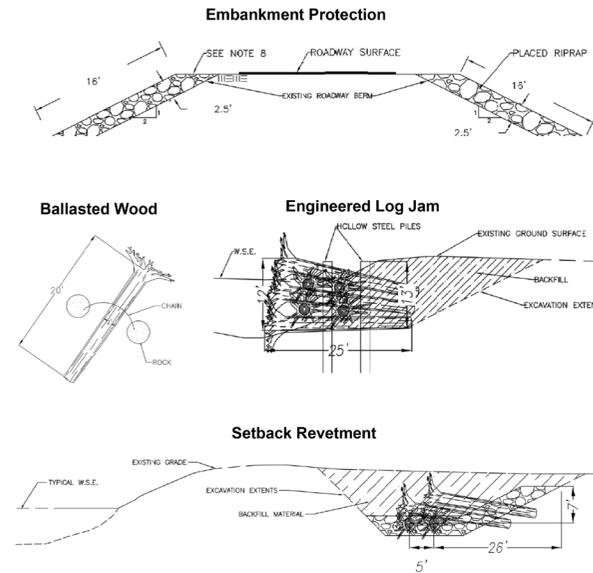
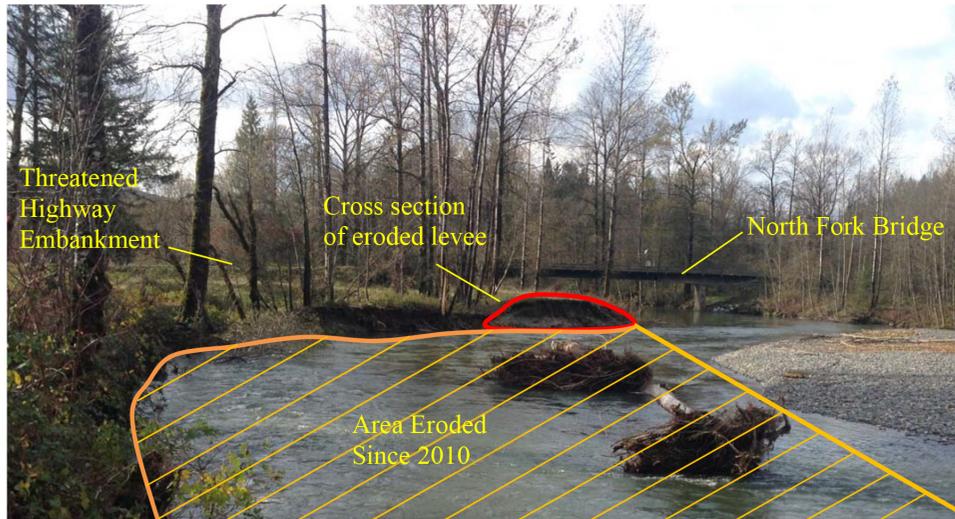


interdisciplinary element to the project. Meetings with the county occurred regularly during both years (i.e., at least once/month).

#### Multidiscipline or allied profession participation

Students in both years collaborated with multiple departments at the county. These included county roads crews, who installed emergency rock protection at one of the bridge

abutments during the first year; county transportation engineers, who attended student presentations and clarified transportation department priorities; county surveying crews, who the teams directed regarding locations for cross-section surveys and identification of benchmarks; county drafters, who provided the teams with site topography and helped set up AutoCAD templates in standard County format; and with



county ecologists and planners, who worked closely with the non-engineering team members on their site assessment work.

Students also benefitted from input from a range of professionals outside the county. In the fall quarter of both years, several practicing engineers from multiple engineering disciplines provided lectures and workshops to the class on project planning, project scheduling, project management, team work, and making effective presentations. In the spring quarter, project reports were reviewed by several external engineering reviewers.

A local consulting firm that had developed reach-scale management plans for the river system also met with team members and provided advice regarding drawings and engineered log jam design.

We encourage our students to enter their projects in regional and national student design competitions. Consequently, the year two team entered their project in a national undergraduate design competition sponsored by a water resources engineering organization and was selected to attend the associated conference to present their project.

They won the competition, and by competing, benefitted from feedback from nationally recognized engineers. The biology/environmental studies student, who served the role of “consulting” ecologist, presented her work at a regional professional meeting on river restoration. Three of the year two team members also attended this conference, where they received specialized training on river morphology. The regional conference draws professionals with engineering and ecological backgrounds and thus also supported the interdisciplinary nature of the project.

**\$7,500**  
Award  
Winner

# Seattle University

Department of Electrical and Computer Engineering  
*Solar Microgrid in Rural Zambia with Real-Time Cloud-Based Monitoring*

## Participants

### Students

George Goldsmith  
Sergey Russo  
Alexandra Keiko Schleicher  
Natalie Swope

### Faculty

Steve Szablya, P.E.

### Professional Engineers

Patrick Cummings, P.E. (USA)  
Henry Louie, Ph.D., P.E. (Zambia)  
Matt Salmon, P.E. (USA)

### Additional Participants

Matthieu Bach  
Michael Dauenhauer  
Peter Dauenhauer  
Antoine Desclos le Peley  
Jay Heitman  
Jenna Isakson  
Byron Lynch  
Likonge Makai  
Reynard Pieterse  
Michael Swope

## Jury Comments

“The project fills a need in a remote area of the world for an isolated rural village.”

“Innovative project that allows for continued monitoring of the problem addressed in the project”

“Electricity is vital to improve society. When it is too expensive to provide through normal means, engineers find a solution.”



### PROJECT DESCRIPTION

Undergraduate engineering students designed a 2.5kW solar-powered microgrid with integrated Data Acquisition System (DAS) for implementation in Chalokwa, Zambia. The DAS is the innovative feature of the microgrid. The self-contained DAS is easy to install, autonomously self-calibrates and automatically connects the microgrid to the Internet. Engineers can remotely review diagnostic data from the microgrid on a web-based interactive on-line dashboard. This is important because microgrids in developing countries are prone to premature failure due to overuse, economic issues, mis-operation or lack of maintenance. Access to real-time diagnostic information allows engineers to identify incipient failure modes and recommend preventative corrective action, thereby prolonging the lifespan of the microgrid and the life-changing electricity it provides.

The students designed the microgrid system and DAS, and documented their technical specifications. The students worked on the two designs in parallel. The microgrid system was designed based on the needs of the local village, budget constraints and the geography of the site. The DAS design consisted of four parts: hardware design, software design, alert/relay capability and documentation for planned distribution in other locations in Zambia, Cameroon and the Philippines. The DAS is production ready, complete with installation guide and instruction manual.

## SOLAR MICROGRID IN RURAL ZAMBIA WITH REAL-TIME CLOUD-BASED MONITORING

*Providing a remote Data Acquisition System that connects to the Internet*



### COLLABORATION

The students collaborated with an international team of multi-disciplinary professionals. Their faculty advisor is a P.E. in electrical engineering. The students met with their advisor weekly and with a group of professionals every other week. A practicing electrical engineer in France mentored the students on software aspects of the DAS, and a faculty member and licensed professional engineer in Zambia advised the students on the contextual aspects. The final design was reviewed by another electrical engineer practicing in Zambia.

Although the project is largely related to electrical and computer engineering, energy development projects are inherently cross-disciplinary. Two civil & environmental P.E.s and one mechanical engineer provided the mentoring needed to design key features of the microgrid and DAS. An accountant helped with budget and tracking expenses. Two licensed electricians and an experienced mechanic provided practical insights to the final layout of the DAS.

This international effort was a success thanks to the participation of so many passionate professionals in four countries. They put in the time and energy to mentor the students by sharing their expertise and guiding them in the use of industry standards. Over the course of the project the students developed working knowledge in technical documentation, writing contracts, dynamic project requirements and engineering processes; in addition to experience facing international challenges including local codes, culture practices and sustainable business development.

**Why is this significant?** The Data Acquisition System allows engineers to monitor the health of the microgrid anywhere in the world. This significantly improves the sustainability and reliability of remote microgrids in developing countries because potential failures can be avoided, leading to longer service life and higher reliability. The system is autonomous and self-calibrating and can be used on any remote microgrid in the world. The system has gained the attention of the industry and to date there have been requests for over 20 DAS units for existing and future remote microgrid installations.

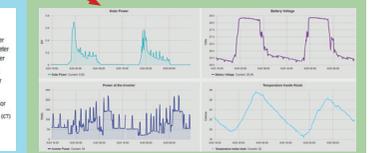
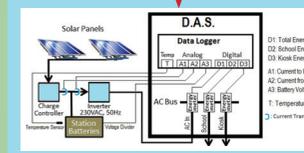
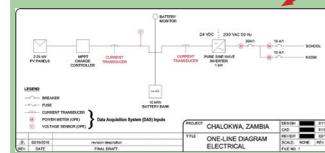
### DESIGNING THE MICROGRID



### BUILDING THE DAS

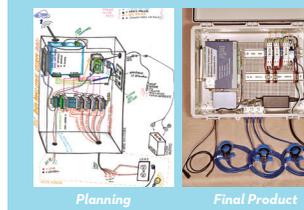


### PROGRAMMING THE CLOUD SERVER & DASHBOARD



### KNOWLEDGE AND SKILLS GAINED

- Applied electrical power engineering, controls engineering, computer engineering and software engineering.
- Applied international and local electrical codes.
- Gained insight about the challenges and opportunities to provide sustainable and reliable access to electricity.
- Used state-of-the-art computer tools to design the microgrid.
- Learned about international business acumen for project implementation.
- Acquired skills to prepare a business proposal for project implementation.
- Wrote the specifications for manufacturers to produce custom parts.
- Experienced the entire product delivery cycle including specification, iterative design, proto-typing, assembly and final production.
- Learned the importance of international teamwork and good verbal and written communication.



### BENEFITS TO PUBLIC HEALTH, SAFETY AND WELFARE

- The microgrid uses sustainable energy to significantly reduce poverty and improves the outlook for human development, safety, and welfare in the following ways:
  - Electricity service to the Chalokwa Primary School improves the educational outlook for the children.
  - Household lighting provides security, allows children to study longer, and extends productive hours into the evening for adults.
  - Local electricity access eliminates need to travel long distances to recharge mobile phones, saving time, effort, and expense.
  - Refrigeration services preserve fish, allowing local fishermen to sell their catch at distant markets for a higher price.
  - Because there is little local technical expertise, the DAS is a critical tool for engineers to remotely monitor the on-going operation of the microgrid, improving the outlook for sustainable operation, and providing remote monitoring for energy projects around the world.

## Abstract

Undergraduate engineering students designed a 2.25kW solar-powered microgrid with integrated data acquisition system (DAS) for implementation in Chalokwa, Zambia. The DAS is the innovative feature of the microgrid. The self-contained DAS is easy to install, autonomously self-calibrates, and automatically connects the microgrid to the Internet through a cloud server. Engineers can remotely review diagnostic data from the microgrid on a web-based interactive online dashboard. This is important because microgrids in developing countries are prone to premature failure due to overuse, economic issues, misoperation, or lack of maintenance. Access to real-time diagnostic information allows engineers to identify incipient failure modes and recommend preventative corrective action, thereby prolonging the lifespan of the microgrid and the life-changing electricity it provides.

The students designed the microgrid system and DAS and documented their technical specifications. The students worked on the two designs in parallel. The microgrid system was designed based on the needs of the local village, budget constraints, and the geography of the site. The DAS design consisted of four parts: hardware design, software design, alert/relay capability, and documentation for planned distribution in other locations in Zambia, Cameroon, and the

Philippines. The DAS is production ready, complete with installation guide and instruction manual. The DAS has gained the attention of the industry. To date, requests have been made for over 20 units for existing and future microgrid installations.

Presently, the people of Chalokwa, Zambia, have no access to the electrical grid. The microgrid improves the outlook for human development, safety, and welfare in several ways. A primary school will have electricity service for the first time, improving the educational outlook for the children. Indoor household lighting allows children to study longer and adults to extend productive hours into later in the evening. Outdoor lighting improves security and reduces encounters with dangerous wildlife. Villagers will no longer be forced to travel several kilometers to the nearest electrified town to recharge their mobile phones, saving time, effort, and expense. Refrigeration services powered from the microgrid will let the local fishermen preserve their catch, allowing them to be sold at distant markets for a higher price. Because there is little local technical expertise, the DAS is critical in monitoring the ongoing operation of the microgrid, improving the outlook for its sustainable operation. In short, this project benefits public safety, welfare, and the developmental outlook for the entire Chalokwa community.



The project was led by four electrical engineering undergraduate students under the mentorship of a university faculty member and dedicated liaison engineers in France and Zambia. The large scope of this project and complex nature of development projects in general made it necessary to have an international, multidisciplinary, and collaborative team. The broader team consisted of engineers from various disciplines, licensed professional engineers (P.E.s) in the United States and Zambia, allied professionals (licensed electricians, machinists, and carpenters), and an accountant.

The knowledge gained by the students reflected the multidisciplinary nature of the project. The students learned how to design off-grid solar-powered systems. They designed the innovative

DAS hardware and software. They gained insights on the influence that social, economic, and geographic factors can have on the sustainability of microgrid projects in developing countries. More specifically, the knowledge gained included designing to meet international and local codes, collaborating with technical and business experts, planning for longterm sustainability, and learning the importance of community involvement and education. The students also learned how to collect and analyze site information from community surveys. The students participated in field testing, construction, and deployment. The DAS has been field tested and is operational, yielding the expected results.

**\$7,500**  
Award  
Winner

## Seattle University

Department of Electrical and Computer Engineering  
*Solar Microgrid in Rural Zambia with Real-Time Cloud-Based Monitoring*



### Perspectives On

#### **Collaboration of faculty, students, and licensed professional engineers**

The students collaborated with an international team of multidisciplinary professionals. Their faculty advisor is a P.E. in electrical engineering. The students met with their advisor weekly and with a group of professionals every other week. A practicing electrical engineer in France mentored the students on software aspects of the DAS. A faculty member who has a

Ph.D. in electrical engineering and is a licensed professional engineer in Zambia advised the students on the contextual aspects.

Although the project is largely related to electrical and computer engineering, energy development projects are inherently cross-disciplinary. Two civil and environmental P.E.s and one mechanical engineer assisted with the design of the microgrid and DAS. An accountant helped with the budget

and tracking expenses. Two licensed electricians and an experienced mechanic provided practical insights to the final layout of the DAS.

This international effort was a success thanks to the participation of so many passionate professionals in three countries. They put in the time and energy to mentor the students by sharing their expertise and guiding them in the use of industry standards. Over the course of the project,



the students developed working knowledge in technical documentation, writing contracts, dynamic project requirements, and engineering processes. They also experienced international challenges, including local codes, culture practices, and sustainable business development.

**Knowledge and skills gained**

The knowledge students gained was broad. Students gained appreciation for the diverse skills that energy development projects require. The students learned and applied elements of electrical power engineering, computer engineering, and software

engineering. They experienced the design process from specification through iterative design, prototype construction, and final production.

The four students learned the importance of team work and good oral and written communication, as

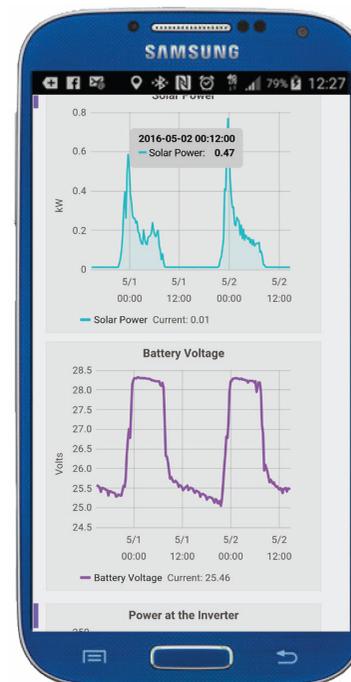
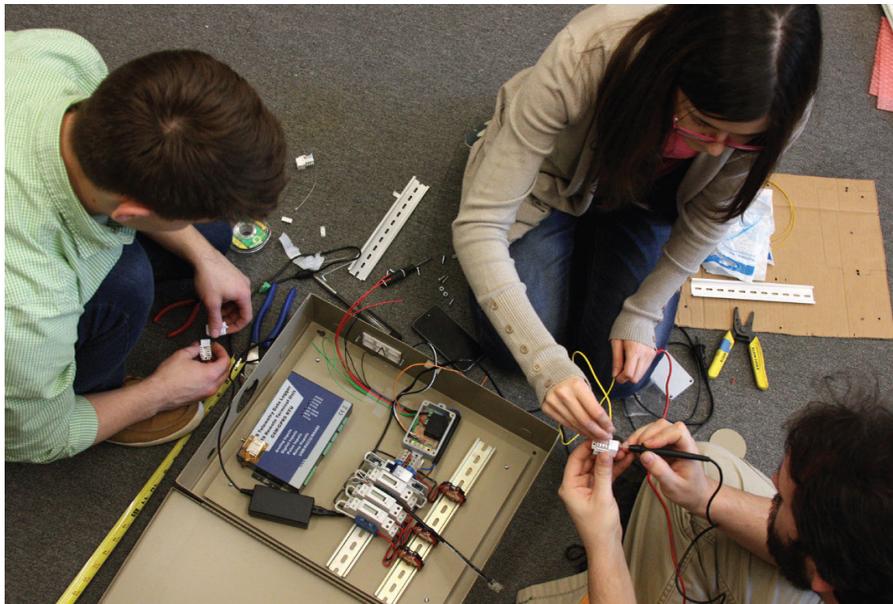
they interacted with professionals across the globe. They were exposed to the interaction between engineers and the public they serve—in this case the community of Chalokwa.

This project was not just a technical or academic problem. There were





aspects of the Chalokwa community and culture that needed to be captured and incorporated into its design. This required patience and active listening. It required students to value the needs and real desires of the locals. The context of this project challenged the students to step away from their lives and experience what life is like without access to electricity.



The students learned that post-implementation plans are just as important as pre-implementation design. The data collected from the DAS will be monitored to improve the technical outlook of the kiosk for years to come.

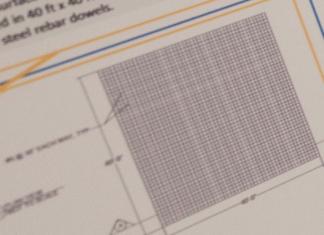
Clean energy solutions are the future of humanity. The knowledge gained from this project will allow students to apply their sustainable design approaches into their own communities. The world is a global village and in order to satisfy its energy demands, without depleting the environment of its natural resources, renewable energy approaches need to be adopted.

s and associated

Option 3	Option 4
Supported RC Slab (800 psf)	Pile Supported RC Slab (800 psf)
RC Raft	Pile Supported RC Slab (500 psf)
Level Stockpile	Geotextile
\$30.4 M	\$42.9 M

Client's preferred option

16" thick concrete raft is to be installed after removing the existing drivable surface and excavating 12" of native soil. The rafts would be installed in 40 ft x 40 ft sections; these would be connected with steel rebar dowels.



### Knowledge and Skills Gained

Participants developed skills to work on a multidisciplinary project encompassing geotechnical, structural, water, and environmental issues. Knowledge of various design guidelines: ASCE 7-10, Seismic Load for Building and Retrofit of Existing Structures, American Concrete Institute Manual 7-2 Foundation and Water Design Manual (SAP-Structural Analysis Program (SAP-HEC-RAS), Computer information from a local

## Engineers Without Borders Dominican Republic 2009-2014

### Program Background

In 2009, the Engineers Without Borders (EWB) chapter began a structural and sanitation program in the Dominican Republic in conjunction with the Batey Relief Alliance in the communities of Batey Cinco Casas and Batey Santa Rosa. Both communities are located in the Monte Plata Province seen highlighted in Figure 1.

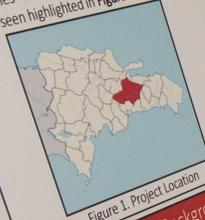


Figure 1. Project Location

### Community Background

In the 1960's, the Dominican sugar cane industry went through reforms and had to downsized. As a result, there was a large loss of employment, and many people today live in poverty. The Batey Relief Alliance (BRA), EWB's partner in the Dominican Republic, is a non-profit, non-political, humanitarian relief entity that works in the Dominican Republic, Latin America, and the Caribbean. Many Dominican communities in existence today are located at the site of the old Bateys or sugar cane plantations. Batey Cinco Casas and Batey Santa Rosa, the two communities with whom EWB has worked, are two such communities.

### Program Scope

- The entire program consisted of the design and construction of the following projects:
- (a) a roof to enclose a medical facility located in Batey Cinco Casas
  - (b) a septic tank system for a medical facility located in Batey Cinco Casas
  - (c) a series of latrines for the community of Batey Santa Rosa

### Projects

#### Hurricane-Resistant Roof - Batey Cinco Casas Medical Clinic



Figure 2. Open roof clinic

Figure 3. Roof rendering

Figure 4. Completed Roof

#### Septic System - Batey Cinco Casas Medical Clinic



Figure 5. Septic system rendering

Figure 6. Septic system installed

Figure 7. Septic system rendering

Figure 8. Septic system installed

Figure 9. Septic system rendering

Figure 10. Septic system installed

Figure 11. Septic system rendering

Figure 12. Septic system installed

Figure 13. Septic system rendering

Figure 14. Septic system installed

Figure 15. Septic system rendering

Figure 16. Septic system installed

Figure 17. Septic system rendering

Figure 18. Septic system installed

Figure 19. Septic system rendering

Figure 20. Septic system installed

Figure 21. Septic system rendering

Figure 22. Septic system installed

Figure 23. Septic system rendering

Figure 24. Septic system installed

Figure 25. Septic system rendering

Figure 26. Septic system installed

Figure 27. Septic system rendering

Figure 28. Septic system installed

Figure 29. Septic system rendering

Figure 30. Septic system installed

### Seismic Retrofit Design of a Historic Utility Powerhouse

Project Description

Structural Collaboration with Faculty, Licensed Engineers, and Master Technicians

Structural Deflection

Proposed Repairs

Interdisciplinary Collaboration

Skills Learned

Program Scope

Knowledge and Skills Gained

Community Background

Program Background

Project Location

Project Description

Structural Collaboration with Faculty, Licensed Engineers, and Master Technicians

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Project Location

Project Description

Structural Collaboration with Faculty, Licensed Engineers, and Master Technicians

Structural Deflection

Proposed Repairs

Interdisciplinary Collaboration

- Full Scale engineering project practice
- Research through monitoring
  - Adherence to codes
  - CAD and Solid Works design practice
- Construction Skills
- On-site communication
  - Basic use with building materials and tools
- Communication/Teaching Skills
- Familiarity with team professor
  - Website maintenance
  - Writing skills
- Interdisciplinary Collaboration
- The program increases student interaction with engineering and business disciplines
  - Civil Engineering
  - Structural
  - Environmental/Geotechnical
  - Mechanical/Electrical
  - Chemical/Industrial/Manufacturing
  - Surveying
  - Construction Management

**George Mason University**

Sid and Reva Dewberry Department of Civil, Environmental, and Infrastructure Engineering  
*New Drinking Water and Sewer System for an Elementary School for Orphans—Bilwi, Nicaragua*

**George Mason University**

Sid and Reva Dewberry Department of Civil, Environmental, and Infrastructure Engineering  
*Water and Sanitation Project—Children’s Feeding Center—Puerto Cabezas, Nicaragua*

**Mississippi State University**

Department of Industrial and Systems Engineering  
*Piston Assembly Simulation*

**Old Dominion University**

Department of Civil and Environmental Engineering  
*Engineering Systems and Research Building Addition*

**Polytechnic University of Puerto Rico**

Electrical and Computer Engineering and Computer Science Department  
*Thermal Energy Reduction*

**Portland State University**

Department of Civil and Environmental Engineering  
*Landscaping Yard Stormwater Treatment Design*

**Portland State University**

Department of Civil and Environmental Engineering  
*Living Cully Plaza Ecoroof*

**Rose-Hulman Institute of Technology**

Department of Civil Engineering  
*Infrastructure Improvements for Two Communities in the Dominican Republic*

**Seattle University**

Department of Civil and Environmental Engineering  
*Design Development of a Cultural Village for Migrant Workers*

**Seattle University**

Department of Civil and Environmental Engineering  
*Design of Habitat-Sensitive Erosion Hazard Mitigation Near a Bridge*

**Seattle University**

Department of Civil and Environmental Engineering  
*Liquefaction Mitigation Design Options for a Utility Service Center*

**Seattle University**

Department of Civil and Environmental Engineering  
*Seismic Retrofit Design of a Historic Utility Powerhouse*

**Seattle University**

Department of Electrical and Computer Engineering  
*Solar Microgrid in Rural Zambia with Real-Time Cloud-Based Monitoring*

**State University of New York**

Department of Environmental Resources Engineering  
*Setting Pole Dam Evaluation, Tupper Lake, New York*

**University of Arkansas at Little Rock**

Department of Construction Management and Civil and Construction Engineering  
*Three-Story Medical Office Building—Multidisciplinary Study*

**University at Buffalo**

Department of Civil, Structural, and Environmental Engineering  
*Changing the World One Engineer at a Time*

**University of California, San Diego**

Department of Electrical and Computer Engineering  
*Global TIES—Baja del Sol*

**University of Evansville**

Department of Mechanical and Civil Engineering  
*MCDC Green Infrastructure Project*

**University of Kansas**

Department of Civil, Environmental, and Architectural Engineering  
*Design-Build Suspension Footbridge*

**University of Nebraska–Lincoln**

Charles W. Durham School of Architectural Engineering and Construction  
*888 Boylston Street—Interdisciplinary Team Design*

**Virginia Military Institute**

Department of Civil and Environmental Engineering  
*Implementation of Sustainable Drinking Water Infrastructure and “Pipe-In-Bottle” Solar Showers/Eco-Latrines in Pampoyo, Bolivia*



## Previous Winners

### 2015

#### Grand Prize

##### **Marquette University**

Department of Civil, Construction,  
and Environmental Engineering  
*Sechum Vehicle Bridge*

#### Additional Awards

##### **The Citadel**

Department of Civil and Environmental Engineering  
*Multidisciplinary Evaluation and Rehabilitation Design  
of Sacred Heart Catholic Church*

##### **George Mason University**

Sid and Reva Dewberry Department of Civil,  
Environmental, and Infrastructure Engineering  
*Water Supply, Distribution and Storage  
Sabana Grande, Nicaragua*

##### **Seattle University**

Department of Civil and Environmental Engineering  
*Seismic Analysis and Retrofit Design of a Historic  
Substation Control Building*

##### **University of Arkansas at Little Rock**

Department of Construction Management  
and Civil and Construction Engineering  
*American Red Cross of Greater Arkansas  
Seismic Retrofit Feasibility Study*

##### **University of Nebraska-Lincoln**

Charles W. Durham School of Architectural  
Engineering and Construction  
*Multidisciplinary Vertical Farm Design*

## 2014

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### Grand Prize

#### Seattle University

Department of Electrical and Computer Engineering  
*Microgrid System for a Wind and Solar Farm Located in Rural Kenya*

### Additional Awards

#### The Citadel

Department of Civil and Environmental Engineering  
*Wave Dissipation System*

#### North Carolina State University

UNC/NCSU Joint Department of  
Biomedical Engineering  
*Creating a Better Way to Locate Vasculature  
for Intravenous Therapy*

#### Seattle University

Department of Civil and Environmental Engineering  
*Historic Landmark Incline Lift Structural Evaluation  
and Retrofit*

#### University of Evansville

College of Engineering and Computer Science  
*Fairfield Reservoir and Dam*

#### University of Notre Dame

Department of Civil and Environmental Engineering  
and Earth Sciences  
*Innovative Housing Solutions for Post-Quake Haiti*

## 2013

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### Grand Prize

#### Cleveland State University

Civil and Environmental Engineering Department  
*Design, Funding, and Construction of the August Pine  
Ridge School/Hurricane Shelter in Belize*

### Additional Awards

#### Northern Arizona University

Department of Civil Engineering, Construction  
Management, and Environmental Engineering  
*Paper Pulp Sludge Characteristics and Applications*

#### Seattle University

Department of Civil and Environmental Engineering  
*Design Options for a Creek Crossing for a Utility Company*

#### Seattle University

Department of Civil and Environmental Engineering  
*Structural Evaluation and Retrofit of a Warehouse*

#### University of Nevada, Reno

Department of Civil and Environmental Engineering  
*Capstone Design Project—SouthEast Connector*

#### University of Texas at El Paso

Department of Civil Engineering  
*Multidisciplinary Design of a Sustainable,  
Environmentally Friendly, and Affordable House*

## 2012

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### Grand Prize

#### Florida Atlantic University

Department of Civil, Environmental,  
and Geomatics Engineering  
*Dania Beach Nanofiltration Plant Expansion*

### Additional Awards

#### Oklahoma State University

School of Civil and Environmental Engineering  
*Roadway and Water Feature Design at the Botanic Garden*

#### Seattle University

Department of Civil and Environmental Engineering  
*Design of an Orphanage, Learning and Community  
Center in Ethiopia*

#### Seattle University

Department of Civil and Environmental Engineering  
*Historic Dam Guard Rail and Vehicle Barrier Retrofit  
for Public Safety*

#### University of Texas at El Paso

Department of Civil Engineering  
*Multidisciplinary SMART Design of Fire Station 513*

#### Valparaiso University

College of Engineering  
*Maji for Masaera—Rehabilitation of a Man-Made  
Irrigation Canal*

# Previous Winners

## 2011

### Grand Prize

#### University of New Mexico

Department of Civil Engineering  
*Integrated Infrastructure Improvements for a Youth Scout Ranch*

### Additional Awards

#### 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 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*



## 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 Multi-disciplinary,  
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 Polytechnic Institute and State University**

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

## 2009

### **Honorable Mention**

#### **University of Iowa**

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



## EDUCATION

# 2017 NCEES Engineering Education Award Call for Submissions

Enter by May 1, 2017.  
Find out how at [ncees.org/award](http://ncees.org/award).

A project that brings together licensed professional engineers and students can teach real-world lessons about professional practice and help students discover what the engineering profession is really all about.

And it's got something else to offer—national recognition for your engineering program.

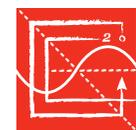
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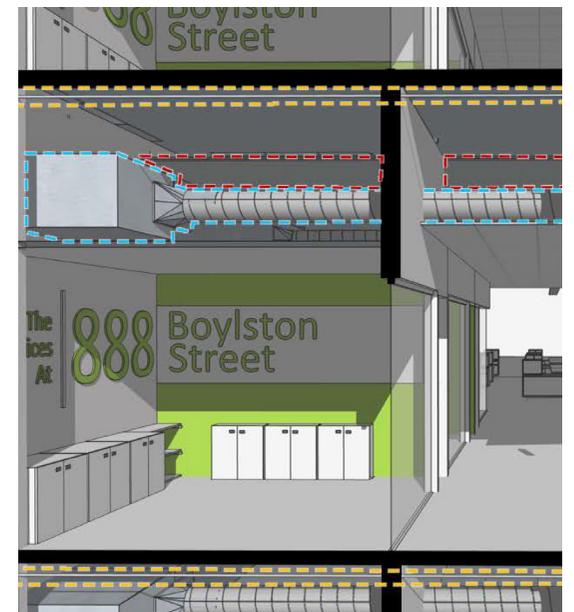
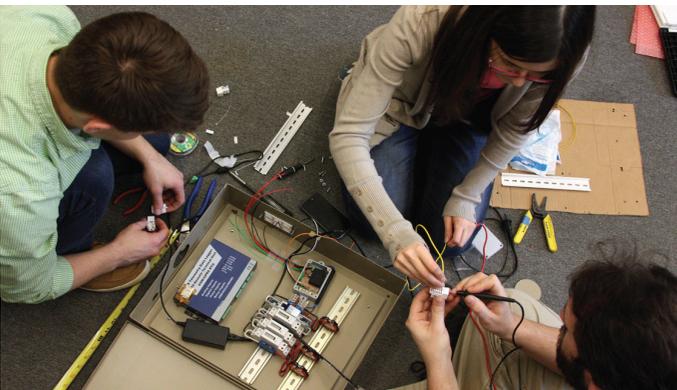
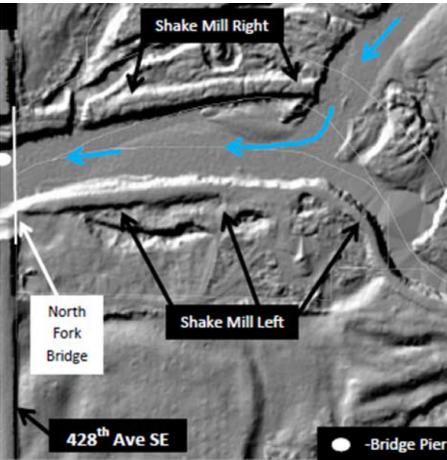
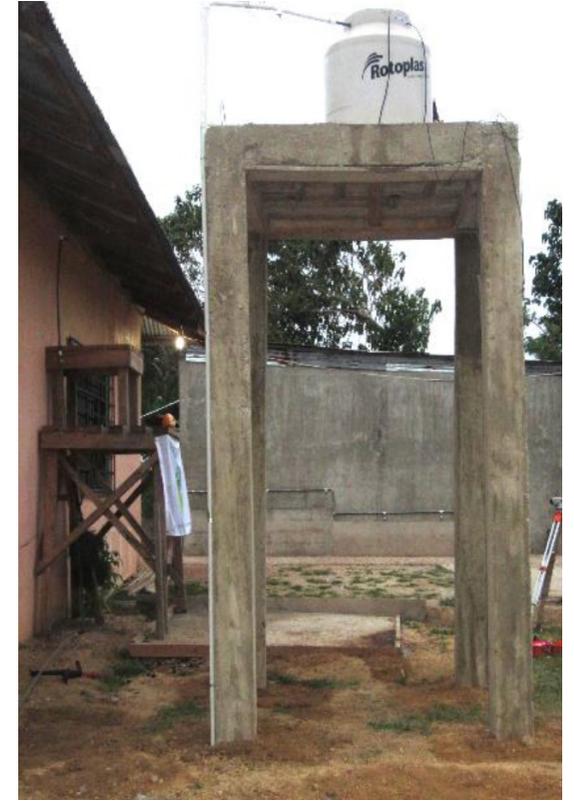
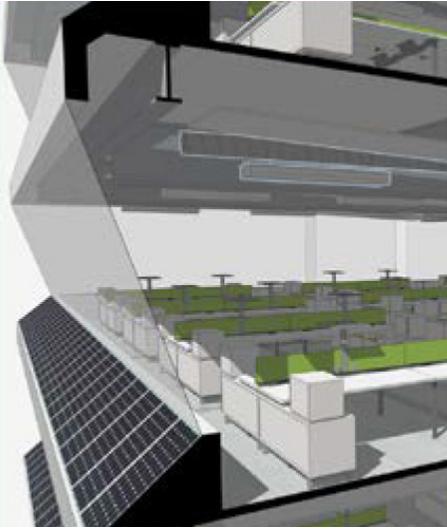
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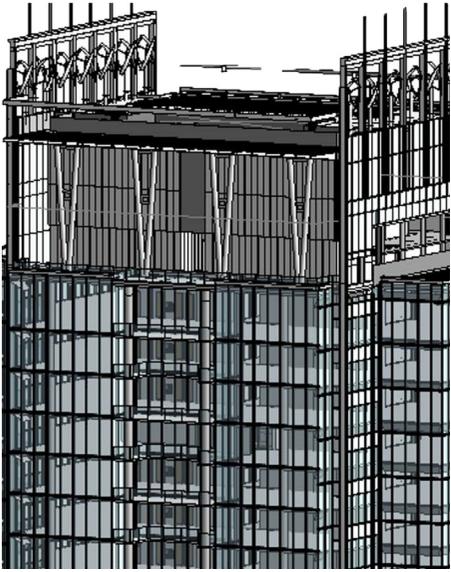


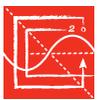
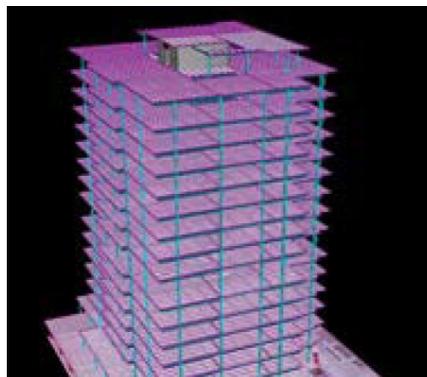
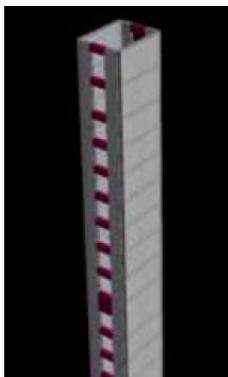
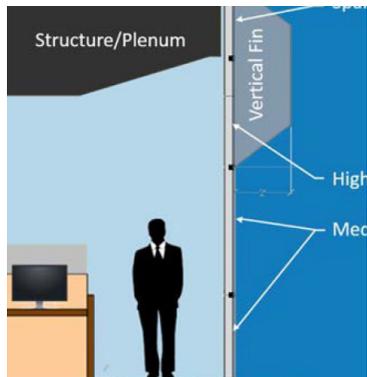
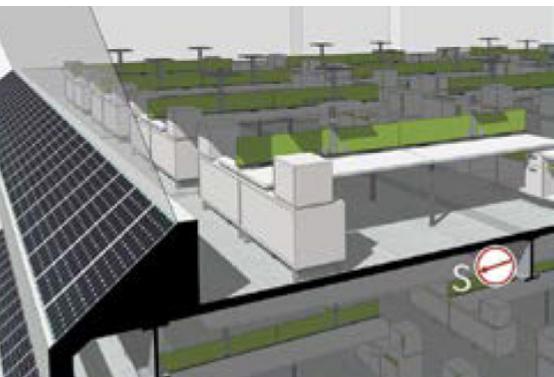
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