

Sustainability Challenge Grant Final Report

Date Submitted: 01.31.17

Project Title: Point of Departure: Place Making and Identity Via Integrated, Didactic & Sustainable Transit Shelters

Report Submitted by: Martin Summers & Michael Wilson

Reporting Period: Fourth Quarter (October 2016-January 2017)

Budget Information: \$49,991 Total

PoD Account Balance (07/14/16): +\$4,034.05

Summary

During 2016, the College of Design (CoD) & The Center for Applied Energy Research (CAER) continued along a path to design and construct critically placed high-performance transit shelters—plugging into campus transportation to physically manifest the University of Kentucky’s sustainability and transportation agendas. Our designs seek to integrate sustainable site strategies, context specificity, high-performance architectural skins, sustainable materials, photovoltaic systems, storm water management, and high-efficiency lighting and infographic displays to reimagine what a shelter can be.

During initial efforts in 2015, we analyzed the campus and integrated our analysis with the master plans, designed new graphics for the system, designed four site-specific shelters, constructed a solar mock-up, started a publication and presented this work to stakeholders and President Capilouto. The dialogue with UK Administration began earlier than imagined and are now in position to deliver our first constructed shelter. Through 2016 we continued to develop the design and coordination with our consultants having a few setbacks along the way. While there is a budget for construction, it will not be enough to ensure all opportunities for sustainability in the design are realized. This grant helped to catalyze the integration of sustainability and educational aspects within the design as it transitions toward real world implementation, leveraging the impact of campus research to engage students in a dialogue about sustainability, alternate transportation, the value of design, and the possibilities of collaborative research at UK. The grant also provided the space for an intensive investigation into a multitude of issues related to designing a small scale project with large ambitions, which has led to several presentations and publications.

Objectives

Planned

Design and Delivery of construction documents for the first of several, sustainably driven, site-specific shelters. Transforming research into a capital project. UK wants to begin by developing a single shelter for construction - summer 2016. The site adjacent to the Pharmacy Building on South Limestone was chosen based on prioritization with PTS and the master plan goals.

High Quality presentation materials will be presented in campus wide exhibitions in spring 2016.

Achieved

First shelter designed and takes into account larger conceptual aspirations of the design team to link shelter to site and to address “Enhanced User Experience Through Communication and Technology,” as highlighted in the Draft Transportation Master Plan. This was enthusiastically received and put into the Draft Transportation Master Plan as, “To Be Built.” The electrical system designed and coordinated with the structure to maximize power production and energy efficiency utilizing state of the art technologies including energy efficient displays and lighting, inductive charging stations, thin film photovoltaic cells, micro-inverters, and multi-power point tracking technology.

Methods

To get to construction, we assembled a team of expert consultants to work with students and faculty. We value their knowledge and expertise at the cutting edge of sustainable design/construction and want to deliver that to the campus. The team and the design have the ability to drive the discussion of sustainable thinking beyond a single transit shelter, leaving a lasting impact on broader campus and infrastructure design decisions. Along the way we anticipate collaborating with civil engineering students/faculty in site surveys, sustainability students/faculty, and computer science students/faculty to help with the interfaces.

Our team of students, faculty, stakeholders, professionals and national/international consultants, progressed the design from concept to design development. We worked through a series of meetings seeking out the most innovative, integrated, sustainably driven solution within the project budget set by the university and capital projects. We produced presentation materials for exhibits and effective communication of concepts that have already been published and exhibited in several venues, and we continue to develop documents for the construction of the first shelter. As the project develops, we anticipate building mock-ups to test construction concepts and details.

The architecture students in the College of Design, led by Assistant Professor Summers developed the overall design and managed the team of consultants with assistance from Eric Zabilka at Omni Architects. The two students participated in the Spring of 2015, and brought a deep knowledge from initial concept to current solution. Their continuity provided internal project sustainability and smoothly transitioned us into the next phases that started Fall 2015 and ran through the end of summer of 2016.

Regarding the design and specification of the electric/photovoltaic power system, an interactive approach was used to collaboratively solve the problem. A student from Electrical Engineering participating in independent study in spring 2016 engaging with Schneider Electric, the College of Design team, and the various consultants to aid in the specification process. Michael Wilson from the CAER coordinated this effort. Recent graduates who formed the electrical engineering team (Spring 2015) formed the Schneider Electric team in combination with their supervisors, providing team continuity. Their solar mock-up was funded by part of this grant last year and is still collecting useful data. Unfortunately, their time became limited and we had to seek out another electrical engineer.

Through a series of design meetings, consultants were engaged in problem seeking conversations to identify the issues, best practices, and potentials for innovative and integrated design solutions. From these meetings the architectural team developed a design for the site and coordinated with the EE team to deliver an integrated solution. The design was evaluated by the larger team through reviews that assess the solution against the goals developed in our regular team meetings. These meetings were also held with campus and city stakeholders to integrate their input. When appropriate, we will engage local contractors and engineers with our consultants to increase local knowledge of cutting edge sustainable thinking and to identify those who may be able to construct the project.

We continue toward the goal of construction and hope to start the next phase of the project where capital money is released for construction. We used the money from the grant to support the team during this important development period where ideas become reality and the campus becomes an immersive learning opportunity. Our team will follow the projects construction and address issues that arise, typical with any construction project. This time period will be critical as decisions will be made that affect the result in real-time and therefore those involved must be knowledgeable of the entire project and intent.

Outcomes

Transforming research into a capital project is an enormous challenge filled with unexpected victories and stumbling blocks. The site adjacent to the Pharmacy Building on South Limestone was chosen based on prioritization with Parking and Transportation (PTS) and the Transportation Master Plan (TMP) goals. The project has been shown in a public forum for the Draft Transportation Master Plan on October 8 and 9 (2015) as a project that “Will Be Built!” Overall these were tremendous victories considering the initial concept of the project to where we are today. As the project progresses, we will have to coordinate with Capitol Projects closely as there are several projects on the boards in this area of campus that will need to be considered as we address the changing status of site access over time.

The most important lesson we have learned through this process is the power of ideas! This project began simply but in its evolutions and future forecasting, we were able to build a constituent group on campus that helped to support and push for the projects implementation. With this support it has allowed the team to focus on the work itself knowing that the administration and campus stakeholders were already on board with the direction of the design and the broader goals at stake. This has been a refreshing realization in what was initially anticipated as being the most difficult hurdle. In fact, we were discussing construction at a point so early in the projects development that the team had to slow down the pace a little in order to do the work.

It is also critical for a project like this to have continuity of faculty, project management, financial support and student continuity and commitment. The students who have been with the project throughout have a project that will stand out among their peers when shown in their portfolio's as it closely reflects the trajectory of their future professional careers and experiences, and is already garnering recognition through exhibits and publications. This blurring of academia and professional practice is a particularly useful model within an academic context as it has the power to push the profession toward better design and toward a more responsible questioning of goals. The difficulty is

carving out the time for faculty to dedicate to the work among the myriad of other responsibilities necessary within the position.

Number of students and number of community participants

Owen Duross and Thompson Bury are graduate students from the School of Architecture who were supported to work on this project. They (guided by Mr. Summers) developed the site strategy and design of the shelter in its campus context. They worked from abstract concept to material solutions that engaged all aspects of architectural practice, developing the shelter, its material considerations, performative geometry that was coordinated with structural engineers, electrical engineers and with campus authorities. They designed the shelter from initial research and overall Master Plan to the final form, patterns of the pavers, lighting layout, fixture selection, landscape design and furniture solutions while taking into account the complex nature of social dynamics within a public transit shelter - attempting to design for an “Enhanced User Experience.”

Ben Ragusa was a senior undergraduate electrical engineering student. He led the day to day research efforts working with CAER engineers, Electrical Engineering consultants, and the College of Design team to iteratively develop the electrical system. This effort successfully resulted in the design of multiple electrical systems and schematics using a variety of technologies, providing cost benefit analyses to inform technological and project decisions. Additionally, Mr. Ragusa developed a prototype display system using a raspberry pi controller to display real time power generation of the photovoltaic system, real time load measurements of the electrical system (lights, screen, controls, etc.), as well as interface with the Parking and Transportation Services website providing accurate locations of buses and routes. The ability to add messaging, such as from a social media feed or advertising thanking sponsors was also included in the prototype. These studies provided a baseline to work from that would be advanced graphically and statistically in the final project.

One of the benefits of having a high-performance transit center equipped with an electrical system was the added amenities that would be provided to riders and pedestrians alike. LED lights were selected and their power consumption quantified, designed to provide additional safety as well as indication of arriving buses. An indoor/outdoor rated 42” LED display (SunBrite Outdoor Digital Signage) was identified to serve as a potential display screen and could be controlled by a simple microcontroller such as Raspberry PI. An inductive charging platform (PowerSquare) was selected to be able to provide charging stations for multiple electrical devices such as phones and tablets.

Multiple Lexington area electrical companies served as community partners for this project including Schneider Electric, Shroul Tate Wilson Mechanical and Electrical Engineers, and NPM services.

Living laboratory

This project was designed to use the University of Kentucky campus as a living laboratory, harnessing the creative and technical abilities of UK students to develop forward looking solutions to real world problems. Students, staff, and faculty involved on the project team interfaced with campus stakeholders to gain guidance and information regarding feasibility studies and design considerations.

Site evaluations were performed with regard to adjacent architectural language, physical parameters, and infrastructure concerns. Additionally, multiple local and international companies were introduced to the effort and encouraged to participate in the ongoing experiment that is the University of Kentucky campus.

New collaborations?

MiaSole. Manufacturer of thin film solar technology with 20 year power guarantee.

BFMJ Structural Engineers

Ben Ragusa has now gone on to industry working for Lockheed-Martin but could prove a valuable collaborator moving forward.

Shrout Tate Wilson and Schneider Electric could prove to be valuable collaborators and project participants moving forward.

Published or planned scholarly products

Exhibited (Peer Reviewed and Invited)

- Disruptive Continuity Exhibition – CEL Gallery – St Louis, Missouri – Opening February 27, 2017
- 2016 Korea Institute for Youth Facility and Environment (*KIYFE*) *International Invitation Exhibition* – Nov 20 through 25 - Munjeong Samsung Raemian Gallery – Seoul, South Korea
- 2016 UK Sustainability Forum Challenge Grant Projects Exhibition - Boone Center, University of Kentucky – Lexington, Kentucky – December 1, 2016
- 2015 UK Sustainability Forum Challenge Grant Projects Exhibition - Boone Center, University of Kentucky – Lexington, Kentucky – December 1, 2015
- 2015 “NCARB Regional Board Meeting,” 2nd Floor Gallery, Pence Hall – Lexington, Kentucky – November 12, 2015

Presentations (Peer Reviewed)

- Summers, M. (February 27, 2017) – “Disruptive Continuity [Exploration in-Form]” – Disruptive Continuity Exhibition Gallery Talk – CEL Gallery – St Louis, Missouri
- Summers, M. (November 3, 2016) – “Disruptive Continuity [Exploration in-Form]” – Texas Society of Architects 77th Annual Convention and Design Expo as part of the 2016 TxA Emerging Design + Technology sessions - San Antonio, Texas - November 3, 2016
- Summers, M. (September 16, 2016) – “Disruptive Continuity – Explorations in Digital Form via Iterative Process” – 2016 AIA KY/AIA IN Convention: Craft-Distilling Design – Lexington, Kentucky

Publications (Peer Reviewed)

- Summers, M.– “Point of Departure” - SCI-Arc “Off Ramp 12: Tolerance” (<http://sciarc-offramp.info/tolerance/point-of-departure>) (January 20, 2017)
SCI-Arc is one of the most influential architecture schools in the world and they publish Off Ramp as an academic journal about contemporary architectural discourse.
- Bieg, K. - “2016 TxA Emerging Design + Technology Conference Proceedings” - UT Austin - (Publication Date TBD, 2017)

- Summers, M. - Exhibition Book – “2016 International Architectural Exhibition for Youth Facility” - Korea Institute for Youth Facility and Environment (KIYFE) – “Point of Departure” - (January 2017)

Reflection

Former project participants from Schneider Electric faded away as real life considerations got in the way. Moving forward, there needs to be some tangible reward to get meaningful involvement from professionals in the research areas. Due to the relatively small amount of monies available in this research program, and the focus on student engagement, incentives other than financial (such as education credit, recognition by the university, etc) should be investigated to increase industry participation. While other consultants have donated their time to the project and consider this an opportunity for R&D or to be part of a project they see as exceptional, it is difficult to keep them engaged in a significant way as with Schneider Electric above. That has meant a series of stops and starts.

The Electrical Engineering department proved difficult to work with in 2016, with little interest or effort from expected contributors. Despite multiple requests, they would not support independent study or senior design project even though the past two projects were award winning among their peers. Luckily, Dr. Holloway helped identify a very competent undergraduate researcher to help complete the tasks required.

One significant setback in the process was the difficulty to translate the design from our design software to production software necessary to develop construction documents. A good portion of the summer was spent refining the design and then testing software plug-in's and workflows to manage the translation of complex geometry from one software to another. Along the way we discovered that our small team was at the professional cutting edge, when questions were posted to user group boards online and the responses were, “if you figure it out, let us know as we are all looking for a solution to that issue.” While this was not helpful, it did let us know that our team was truly working in a contemporary, professional context. While we were able to identify a process via two different programs, it came at the very end of the summer when the student's commitment to the project ended and classes began again.

Budget Analysis

Currently the CoD has a remaining balance in the project account for approximately \$4,034.05 and in the project budget we show an estimated \$5,000 additional that remains in UK Sustainability Grant account that we have not yet requested. (I don't have the latest verified number from our business office at the date of this submission, the number is based on the prior submittal minus the expenses for software purchase in the last quarter.) This leaves a total of \$9,034.05 to be used if consultants have expenses, if we need supplies for any presentations or if we need money to produce material a mock-up. A possible secondary use of this funding if the above become unnecessary would be to use the remainder for summer employment of one student or faculty time to work toward completion of the construction documents and/or a book for the entire project. This publication would advance the dissemination of the research to a broader audience and when the structure is completed, that documentation could be included.

Visuals

2-5 captioned images



Figure 1: View Southwest across South Limestone | Shelter becomes a beacon in the context where sensors detect occupation and alters the lighting, making one aware of how their body affect the immediate environment.

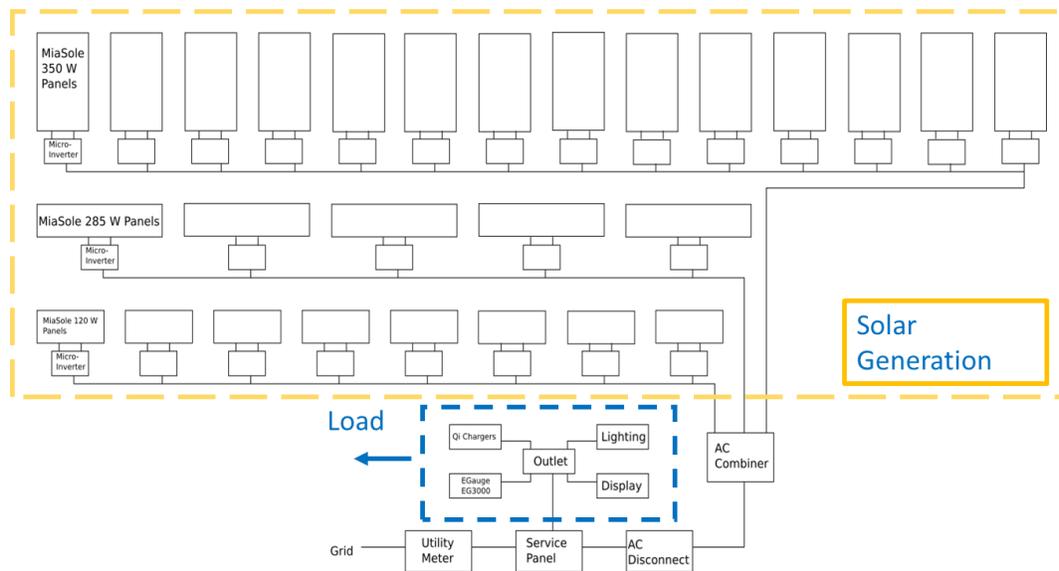


Figure 2: Electrical Schematic of final design prototype for the pharmacy location

Solar Bus Shelter Display

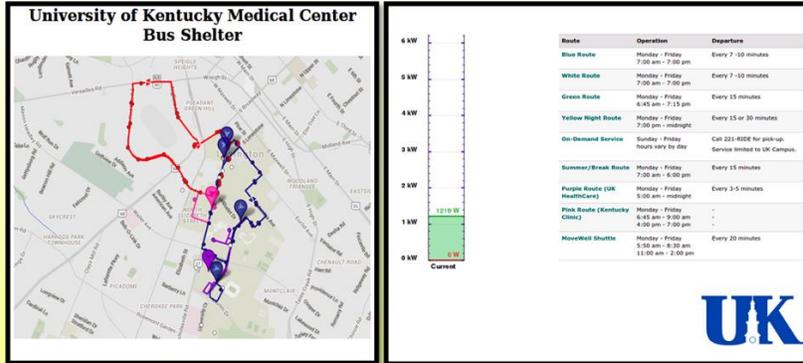


Figure 3: screenshot of prototype display system using real time information from P&TS and energy monitors.



Figure 4: Idealized final screen content and graphics.

If your project will not be complete prior to the report deadline, you will need to submit a progress-to-date project report and an extension request by January 31, 2017. The extension request must contain the following;

- Justification explaining why more time is necessary
- Time-table for completing the project (maximum extension is through May 15, 2017)
- Budget indicating remaining funds at present and how they will be spent during extension