

Michigan State University

EDA University Center for Regional Economic Innovation (REI) MSU Center for
Community and Economic Development

Final Report: 30 September 2015

GENERATIVE NZE INFRASTRUCTURE: [SW]LAB NZE PROTOTYPE DETROIT

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FIGURE 1: Illustrative of the Long term vision for DPS/Sampson and the Tireman Neighborhood, including NZE Canopy, improved Public Realm, and Adaptive reuse of the adjacent Biddle School for the Partnership Institute (studio[Ci] 2014)

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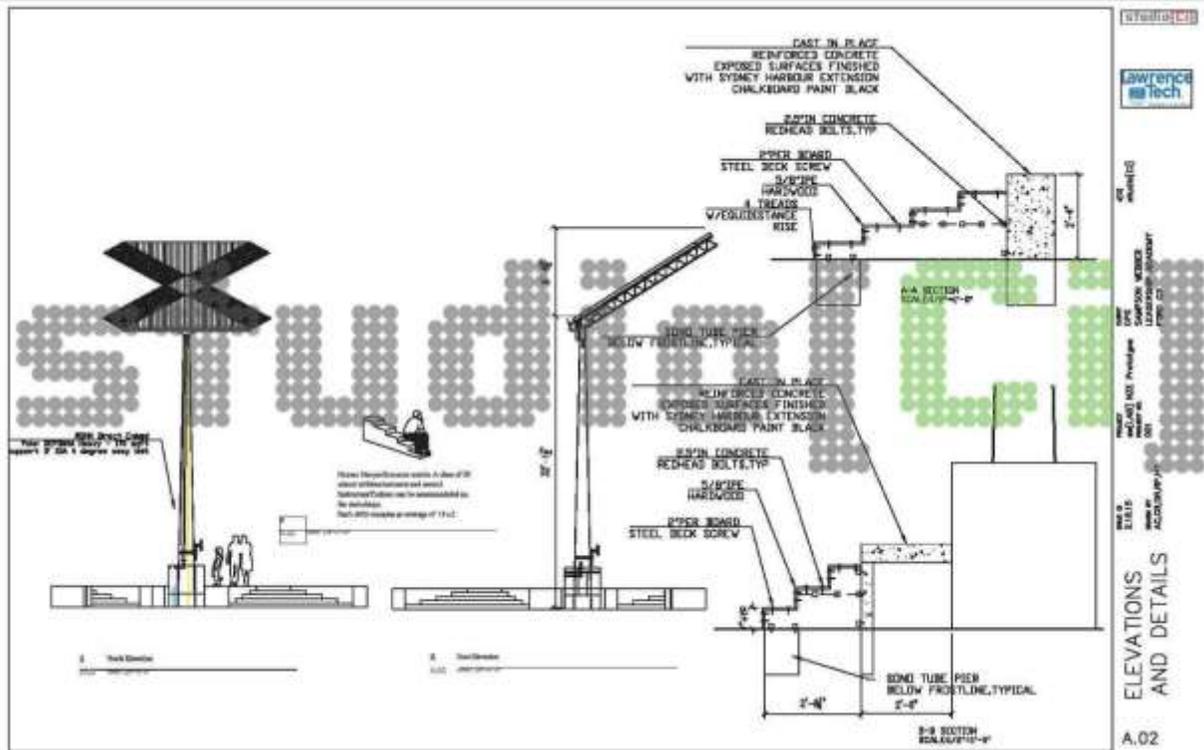


FIGURE 2: Prototype CD set sheet in design development (studio[Ci] 2015)

Project Overview

A transdisciplinary student/faculty team at Lawrence Technological University is partnering with the Detroit Public Schools (DPS), the Mayor’s Office of Neighborhood Services, and Detroit Future City (DFC) to test our design for generative NZE infrastructure at the DPS/Sampson Webber Leadership Academy in the Tireman neighborhood of Detroit (designated *Innovation Ecological* in the DFC Framework). With seed funding through the Michigan State University EDA University Center for Regional Economic Innovation (REI) Program and a Ford C3 grant, we have been able to complete design development and Phase I of installation, and plan to begin building and testing the [sw]LAB NZE prototype to see this important project to fruition.

The goal of this student-led, faculty-guided project is for students to learn about NZE design, the economic transformation of a distressed urban community, and contribute to the installation of a project in Detroit. Student leaders have gained skills regarding community process and engagement in support of revitalizing the Tireman neighborhood of Detroit. The funding from MSU EDA REI allowed our team to support student engagement, community meeting materials and modest support of Phase I of the prototype.



FIGURE 3: DPS/Sampson – LTU Team (LTU eLearning, 2015)

Abstract

Beginning in fall 2013, a transdisciplinary Faculty team led a series of design studios on the conceptual and design development of the [sw]LAB NZE Prototype. Students learned about generative, hybridized NZE architecture and infrastructure; worked on campus and in the Tireman community in the city of Detroit; conducted a process with constituencies associated with the Detroit Public Schools and neighborhood residents and partners; evolved detailed design through testing and alternatives, engaged in “hands on” making of the [sw]LAB NZE Prototype Module; and created details for construction in spring 2016. Our transdisciplinary approach incorporates awareness, education, and training into a project which allows students, teachers, and community members to engage in NZE. We created a replicable model in three steps:

- implemented a NZE lesson plan (successfully demonstrated in fall 2013).
- design development of a NZE Prototype module including photovoltaic and water collection infrastructure. The structure can then be replicated at other DPS schools, reinforcing lesson plans which educate school children and train community members. The module features a layered approach to collecting and storing energy and precipitation, cistern storage and irrigation, and outdoor “learning gardens”.

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- conducted a community engagement process with the School, Community and other partners to insure a collective long term vision and phased implementation.



FIGURE 4: Prototype Site Plan (studio[Ci] 2015)

Partners

Our project is essentially about co-production – bringing the expertise of the academy and the community together, supported by the NGO sector and the public school system, to create a project which enhances student experience (both at the elementary and post-secondary levels) and quality of life for residents. We could not have advanced the project without partners! A team of over three dozen Lawrence Technological University (LTU) students and four professors in both Architecture and Engineering has partnered with the Detroit Public Schools (DPS) to design and build a Net Zero Energy (NZE) structure to be part of an outdoor classroom at the Sampson Webber Leadership Academy (SWLA). The Principal and Lead Teachers played critical roles in the development of the project. In addition to educational partner DPS,

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the sw[LAB] NZE team has collaborated with the Mayor's Office, Department of Neighborhoods District 6, community partners Detroit Future City, Americorp/Youth Energy Squad, and the residents, parents, businesses, and faith-based organizations of the Tireman neighborhood. Perhaps most importantly, the partnership has built close working relationships based on mutual trust, affection, and respect. The professors leading the design project are Associate Professor of Architecture and studio[Ci] Director Constance C. Bodurow, AIA, AICP, CUD; Engineering Professor Donald Carpenter, PhD, PE, LEED AP; Associate Professor of Engineering Robert Fletcher, PhD; and College Professor of Architecture Charles O'Geen. Michigan State University EDA REI provided important process funding, particularly in engaging students. Primary funding to design and install the prototype has been provided by a \$25,000 Ford College Community Challenge (Ford C3) grant with the additional support of the Coleman Foundation, and LTU.



FIGURE 5: One of numerous public/community meetings which allowed students to receive direct feedback (studio[Ci] 2015)

Introduction and Background

The project is the culmination of over seven years of funded research and design in Southwest Detroit by studio[Ci], a transdisciplinary design collaborative founded by Prof. Constance Bodurow at Lawrence Technological University. The team is partnering with the Detroit Public Schools (DPS), the Mayor's Office of Neighborhood Services, and Detroit Future City (DFC) to test our design for generative NZE infrastructure at the DPS/Sampson Webber Leadership Academy in the Tireman neighborhood of Detroit (designated Innovation Ecological in the Detroit Future City Framework). The Team is designing, modeling, and will eventually build and test the [sw]LAB NZE prototype with seed funding from Michigan State University EDA REI, a Ford C3 grant, and other supporting funders.

The goal of our project has always been to create a unique hybridized, generative infrastructure. The NZE Prototype will provide opportunities to advance the scholarship of several design and engineering disciplines, for students to learn about NZE design, and to encourage the economic transformation of a distressed urban community. Students are also being exposed to, and gaining skills regarding, community process and engagement in support of the revitalization of the Tireman neighborhood on the west side of Detroit.



FIGURE 6: NZE Team Room at DPS/Sampson (studio[Ci] 2015)

Approach and Method

Architecture, Urban Design, and Engineering students engaged the project through a transdisciplinary method including curricular, co-curricular, technical, and research assistant roles. In spring 2015, with support from the MSU EDA REI grant, students refined a CAD Construction Documentation Set and physical and digital study models for the Prototype. Students engaged in research of, and compliance with, local, state and federal regulations regarding solar and water harvesting projects. Throughout the process, students interacted with the city, DPS, DFC and other partners and experts to ensure compliance. Students worked under the direction of PI Professor Constance Bodurow, College of Architecture and Design and Co-PI's Professors Donald Carpenter, Civil Engineering and Robert Fletcher, Mechanical Engineering, College of Engineering, and Construction Manager, Professor Charles O'Geen, to design options for a buildable module which will support PV panels and a water harvesting, storage and irrigation systems.



FIGURE 7: The Faculty Team's transdisciplinary teaching and research approach allowed students to engage with diverse faculty and labs (studio[Ci] 2015)

Undergraduate students also collaborated with Graduate Research Assistants from LTU's Master of Mechanical Engineering and Master of Civil Engineering program. All students benefited from this cross college collaboration. In the spirit of transdisciplinarity and hybridized design, students "got their hands dirty" by conducting "making" exercises in LTU's Hydrology and Alternative Energy Labs and then applying what they learned in design development for the NZE prototype. Students were also actively engaged in with the elementary school students (3rd-5th Grades) at DPS/Sampson, under the guidance of the Lead Teachers in our NZE Team Room. The team conducted the bid process with local manufacturers and installers and created and continued to refine cost effective alternatives for photovoltaic and water management systems which can be replicated to form a larger canopy structure in the long term.

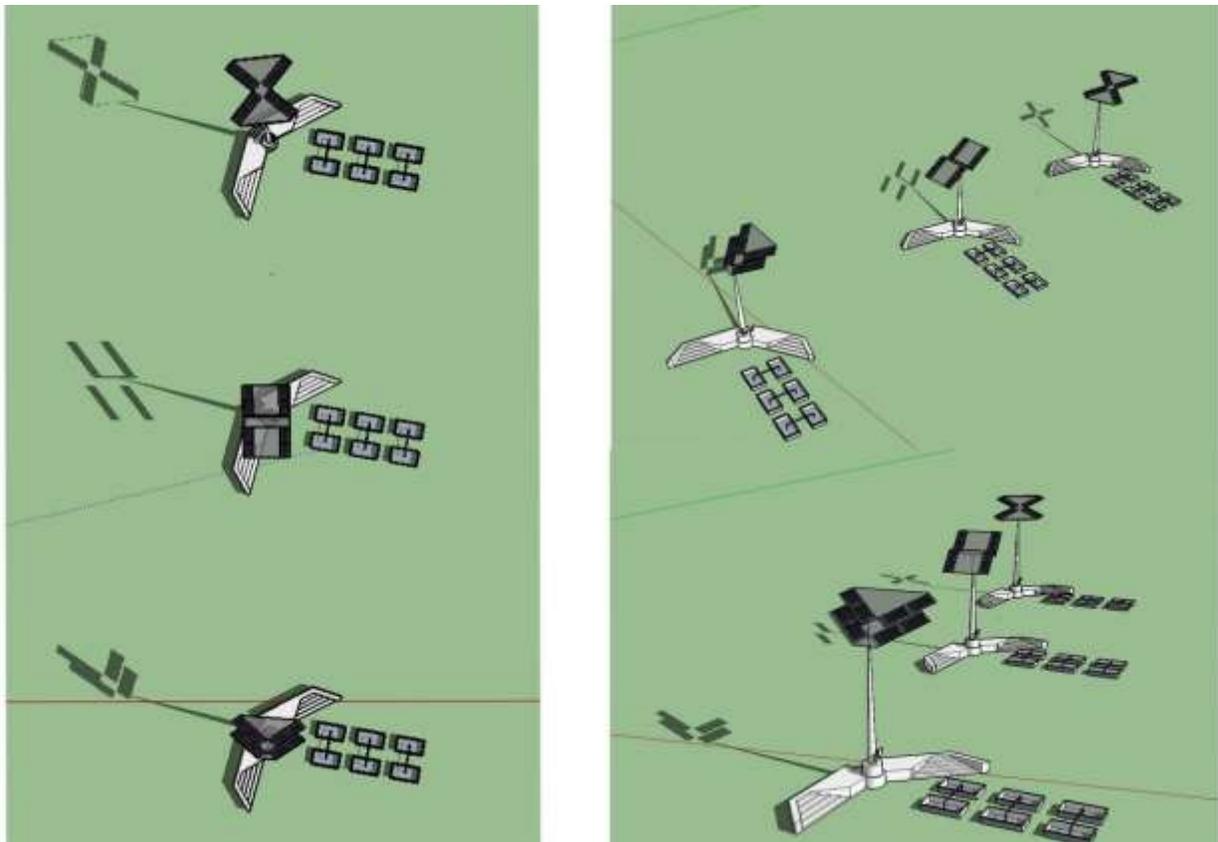


FIGURE 8: Students employed a variety of digital and analogue methods and technologies to design and test options for the Prototype (studio[Ci] 2015)

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The design decision process requires that the prototype achieve aesthetic, performative and equity goals. Staying within a tight budget and making these sort of decisions forced students to be very careful with each design iteration. The transdisciplinary process emphasizes the importance of critical thinking and altering design to respond to dynamic environmental and urban conditions and to achieve diverse performance metrics.

Students also participated in engaging project constituencies and diverse publics. We established a NZE Team Room at DPS/Sampson so that our students could easily interact with elementary school students and their teachers. In an effort to keep the project relevant to the community, the Team held monthly Working Group and Community meetings. During these meetings, students have a leadership role in giving progress reports and documenting input. Students then documented the results of all meetings and created summaries which then inform project specific social media (web, blog, Twitter and Facebook status updates) to keep the University, partners, the general public, and surrounding community informed. These uploads have already generated considerable interest in the community and city and contain images and narrative which illustrate progress on implementing the prototype at the DPS/Sampson Webber Leadership Academy.

Learning: Results and Discussion

The [sw]LAB NZE prototype project design and development is complete as of September 2015. We installed the Phase I Learning Gardens installation in May 2015. Please see a video of the installation on our blog: <https://sciltufordc3.wordpress.com/>



FIGURE 9: *The Team installing Phase I of the Learning Gardens at DPS/Sampson*

During 2015, we were invited to disseminate the project method, process, and results at a variety of academic conferences both locally and nationally, including: Engineering Sustainability at Carnegie Mellon/U Pitt (April); LTU Research Day (April), Structures for Inclusion (SFI) in Detroit (May), and at the Innovate Michigan! Summit at MSU (September).

The full NZE prototype is scheduled to break ground in spring 2016 and finish installation of the prototype in time for the end of the 2015-2016 school year when testing and evaluation will commence. These deadlines required sustained effort by our team during spring-fall 2015, including process with DPS, the community, potential general contractors and other bidders. By the end of the construction period we seek to have a fully functional and replicable solar/water harvesting prototype that will generate energy, training and educational opportunities for the School and Tireman Neighborhood. As important, we also hope to launch a group of design and engineering students who are inspired to explore NZE beyond their insular disciplinary boundaries in the quest for hybridized, and therefore more sustainable, design solutions!

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The [sw]LAB NZE prototype is a “first step” in a much larger vision for the school, the Tireman neighborhood, and the City of Detroit. This prototype project has already led to action and benefit for the community: LTU and DPS have jointly committed to create the “Blue Devil Scholars” program, which identifies fifty 6th grade students at DPS/Sampson each year to pursue a STE[A]M curriculum (continuing through High School) and eventually receiving academic scholarship to attend LTU. For more information, go to: <http://www.ltu.edu/ltu/blue-devil-scholars.asp>



FIGURE 10: Our emphasis and goal is “Active Learning” in NZE and STE[A]M curricula – both in the traditional classroom and in the newly implemented “Outdoor Classroom” - at DPS/Sampson (studio[Ci] 2013, 2015)

Summary and Conclusions

sw[LAB] NZE project is designed to be a replicable prototype for SWLA and other DPS schools to generate renewable energy, conserve and manage water, and reinforce sustainability lesson plans that engage children and train community members through active learning. The vision was created by studio[Ci] @ LTU, and enhanced through co-production with our community partners. The team has co-created curriculum and infrastructure at DPS/Sampson in support of STE[A]M education, including: Lesson plans; Hands-on assignments/indoor and outdoor activities in design, NZE, science and math; A NZE Team Room; Parental Surveys; A community engagement process to insure a collective long term vision and phased implementation; Curriculum, activities, and infrastructure in support of the DPS|Go Green Challenge and DPS|Garden Collaborative programs; Collection Array for Solar Energy and Rainwater, an Outdoor Classroom, and Learning Gardens. As a permanent addition to SWLA's facilities and curriculum, the project will catalyze neighborhood stabilization and restoration.

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The overall, long term vision for the site, school, and neighborhood includes:

- Energy Farms with zones for solar and geothermal energy production and public information “Dash Boards”.
- Stormwater Management through Green Streets, Rain Gardens, and Bioswales (LID best management practices).
- “Year Round” Learning and Community Gardens.
- Community Center and Recreational Amenities.
- A cooperative ownership and management approach creating a new, equitable economic model, revenue, and a generative use model for Detroit’s vacancy.
- A new LTU NZE Partnership Institute for STE[A]M education, research and technology transfer in the adjacent Biddle School.
- A new educational/research entity comprised of DPS, LTU and diverse stakeholders in the neighborhood for the development, manufacture, installation, and maintenance of NZE infrastructure.



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FIGURE 11: The Phased, Long Term Vision for DPS/Sampson, the Site, and the Tireman Neighborhood (studio[Ci] 2014)

Key goals include:

- Achieve Projected Performance: prove that the energy and water collection metrics can be achieved and sustained; prove that the garden beds will thrive through the integrated drip irrigation system.
- Create an “outdoor classroom” that reinforces and supports lesson plans which provide educational opportunities for Pre K-8 school children and training opportunities for community members in NZE and for the knowledge-based economy.
-A successful “test”! This prototype/pilot project will confirm the potential for replicability across the DPS system, the neighborhood, and the City of Detroit.

Through the completion of the project and future monitoring, we hope to learn:

- How to create a neighborhood energy district (micro grid) cooperatively owned and managed by residents;
- More about encouraging a new educational trajectory for Detroit’s children through exposure to NZE and STE[A]M lesson plans;
- Options to engage non-profits like Grid Alternatives to train Detroit residents for jobs in the emergent renewable energy/knowledge based economy;
- Ways to impact the disparity between wealth and poverty in Detroit and move to a more sustainable economic model.

And so much more...

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Acknowledgements:

We wish to thank our funders for their support: Michigan State University – through their EDA University Center for Regional Economic Innovation (REI) Program; The Coleman Foundation - through their Coleman Fellows Program; the LTU Presidential Undergraduate Research Award Program; and Primary Funder for the Prototype: Ford Motor Company Fund - through their Ford Community College Challenge (Ford C3).

Lead Students whose participation was made possible by the MSU EDA REI Grant include: Alin Paul Codreanu and Lu Peng, CoAD and Christopher Bragg, CoE.

Our gratitude and respect to DPS/Sampson Principals: Anthony Houston and Karla Craig; Lead Teachers Ms. LaShon Clay, Ms. Anna Thomas, and Ms. Ellen Hoyer, Librarian and Resident Ms. Tamara Wills and Custodian and Resident Ms. Shelia Allen; and DPS Executive Director Steven Wasko and Director of Sustainability Emile Lauzzana, without whose expertise, energy and enthusiasm this project would not be rewarding, nor possible!

References:

For more information and a brief video on the [sw]LAB NZE project, go to our website:

<http://studio-ci.net/ford-c3-2014/>

For more information on the design process with our project team and the community, go to our project blog: <https://sciltufordc3.wordpress.com/>

For more information on studio[Ci]'s innovative approach to creating Detroit's first NZE Community, go to: http://issuu.com/studioci/docs/studio_ci_vol1

For information on the fall 2013 Transdisciplinary design studio which developed the initial [sw]LAB concept, go to: <https://tuswlab.wordpress.com/>

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