2014 Exhibition of School Planning and Architecture

Energy Positive Portable Classroom

Hawai' i Department of Education

Ewa Beach Elementary

Ewa Beach, Hawaii

Energy Positive Portable Classroom

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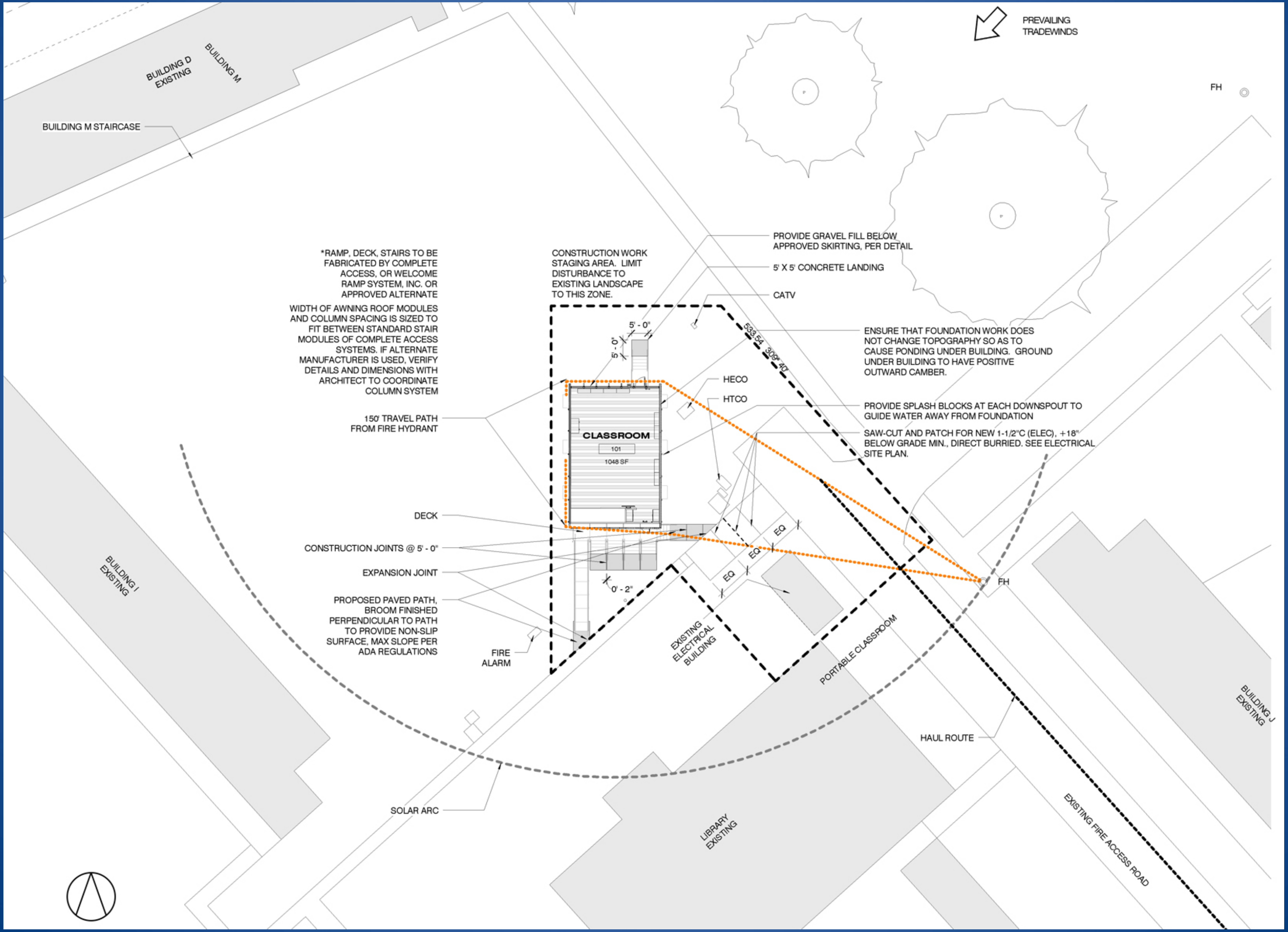


Positive Portable

Community Environment:

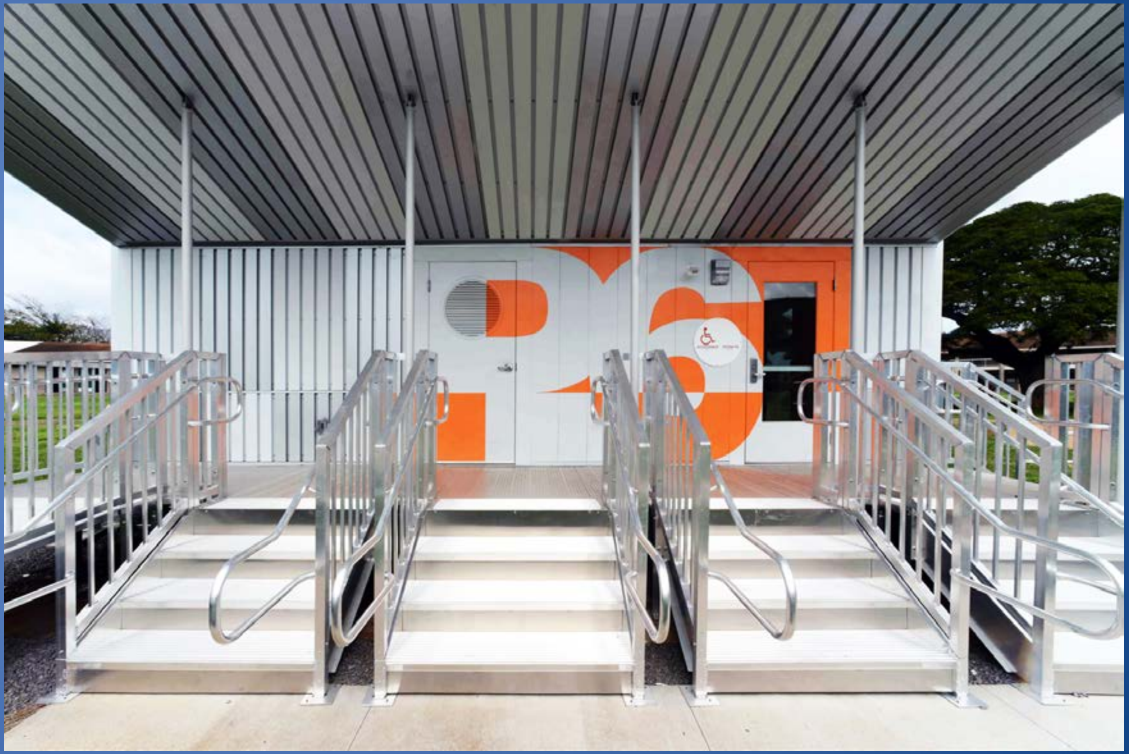
The one room school and its current typological descendant, the ubiquitous portable classroom, are among the most common, mass-produced building types familiar to American children. A Re-invention of this building type will have an enormous impact on the quality of education and environmental stewardship in school districts with rapidly changing demographics, raising education standards and facilities flexibility on the one hand, and revolutionizing quality standards and construction expectations in a large sector of the prefabricated building industry.

The State of Hawaii commissioned a zero-energy, healthy and green alternative to the traditional portable school classroom so common in American public education. One in four Hawaii school children currently studies in energy intensive, poorly built and highly uncomfortable portables. The objective of this winning proposal was the creation of high technology, high-quality, relocatable classrooms that produce extensive reserve energy and other natural resources to share with permanent campus and community buildings.

Prototype for Change

Community Environment Continued:

The classroom is a prototype constructed as a test case for larger deployment across the state of Hawaii. Because Hawaii is a geologically and climatically diverse state with highly varying site conditions and microclimates, the design incorporated systems with extensive flexibility and adaptability built in. For this reason, this prototype design provides a range of optional equipment and systems that will allow the same structure to readily adapt to different sites and to a wide range of classroom functions, from an elementary school classroom in urban Ewa Beach to a science lab classroom in a wet and shaded rural Puna valley.



Due to its broad adaptability and universal message of sustainability, The Energy Positive Portable classroom can engage and empower any community around the world to generate their own energy and structure education around themes of community sustainability.

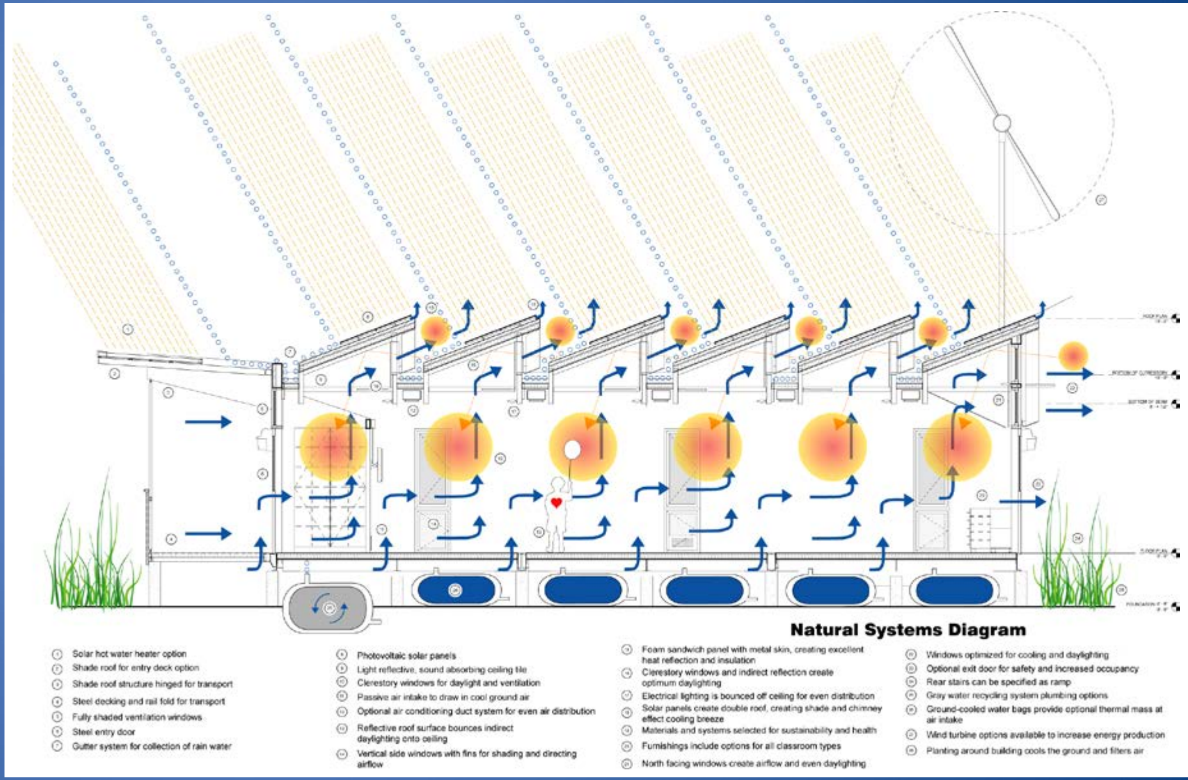
With its unique design and outlook, it has become a structure that not only adds a fresh look to the school campus, but also makes it a landmark to the campus as a meeting point / node.

Sustainable Performance

Learning Environment:

This classroom design addresses performance issues directly impacting the learning experience of its occupants:

1. Thermal Comfort: the portable should remain passively comfortable as much as possible so as to avoid any thermal stress upon its occupants and reduce energy consumption of any optional air conditioning backup system.
2. Daylighting: adequate daylighting at task level has been shown to improve student learning ability substantially, while also reducing energy consumption.
3. Energy conservation and generation: energy conservation via passive cooling design and daylighting coupled with the energy production from renewable sources help offset any consumption of fossil fuel and make the portable an autonomous, self-supporting structure.
4. Indoor air quality via ample air change rate per hour (ACH) provided by natural ventilation assures a healthy air environment for the students.
5. Acoustical Optimization
6. Spatial Flexibility
7. Adaptability to Advancing digital technologies



The classroom includes a live, web-based sustainability information system that enables the building to be used as a learning tool, describing the green features and demonstrating how they are working using live data and interactive displays with weather and building performance data monitored in the building and visualized on the web.

Optimized Comfort
Minimized Cost

Learning Environment Continued:

The Energy Positive Portable Classroom is designed to provide an optimized educational environment for students and teachers while creating a high performance classroom model that advances sustainable design principles as a curricular theme throughout the State's educational system. The design supports the Hawaii Clean Energy Initiative goals of reaching 70% renewable energy supply by 2030, contributing locally generated natural energy to existing buildings in excess of this classroom's usage. This classroom design will maximally conserve as well as collect and generate natural resources, including electrical energy, daylight, wind energy, and rainwater. As well as being strong, efficient and conserving, these qualities are highlighted and exposed throughout the structure, to serve as a learning tool as well as an efficient and healthy learning and teaching environment.

In addition to its advanced technological features, the design includes readily interchangeable and adaptable floor and wall coverings and furnishings to allow multiple types of program and teaching uses. The interior is designed to be quite, comfortable, bright and inspiring.

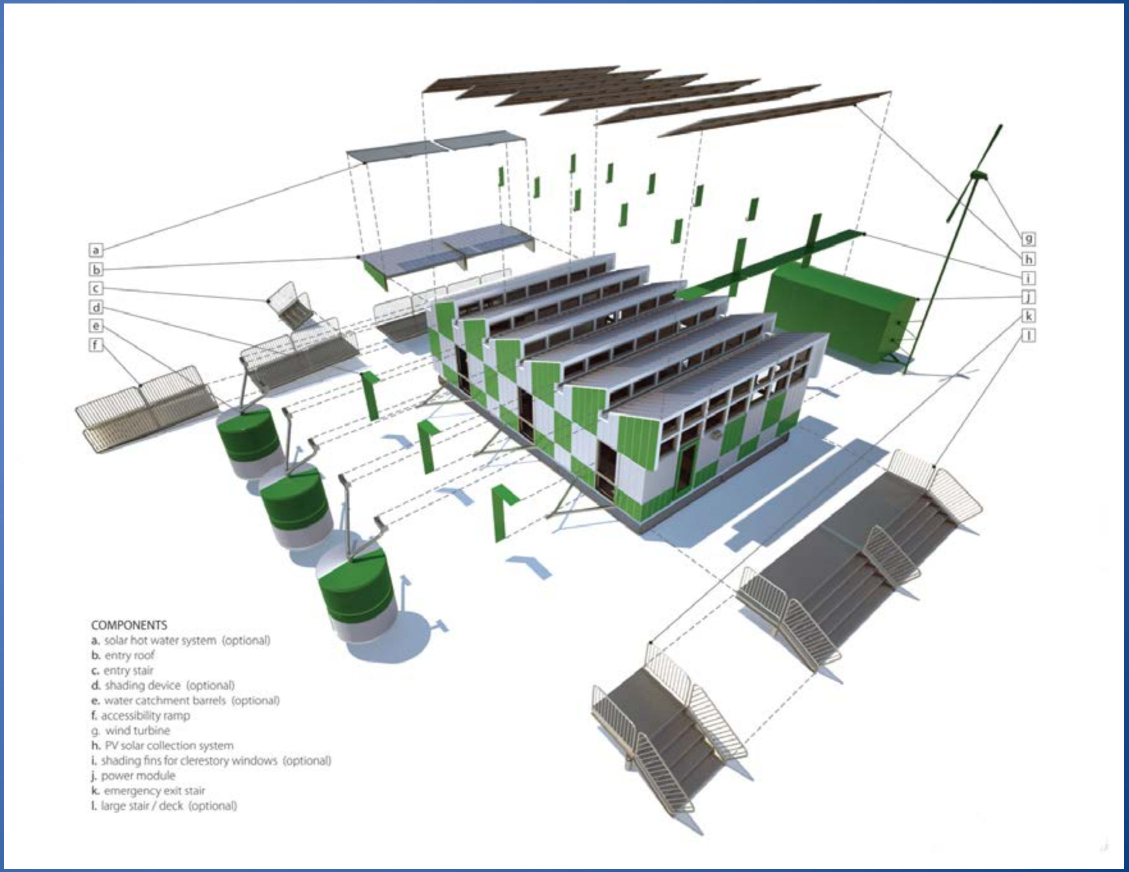
Modular Flexibility

Physical Environment:

The potential for highly varying conditions and microclimates requires extensive flexibility and adaptability built into the system of options available in the portable classroom system. This prototype includes a range of optional equipment and systems that will allow the same structure to readily adapt to different sites and to a wide range of classroom functions, from an elementary school in the desert to a science lab in a wet and shaded valley. Using Building Integrated Modeling software (BIM), accurate site data is used to drive rapid analysis, design, and manufacturing customization for any unique site.

The modular building system is optimized to provide maximum Photovoltaic roof surface orientation, optimized naturally shaded north-facing daylight glazing, and optimally modulated natural flow-through ventilation. These forces are balanced with the additional criteria of manufacturing and transport efficiency, along with functionality for classroom use, low operating costs and ease of maintenance.

The building is prefabricated in either two or three easily transportable modules, reducing initial cost and energy, and facilitating ease of transport and reuse in the future, minimizing waste. The factory-based prefabricator installs all systems, complete and test the portable classroom at its manufacturing facility before the modules are separated, packed and enclosed for land or ocean shipping. The modules are sized for cost efficiency in transport, with practical dimensions for negotiating tight urban streets and difficult rural locations. The modules are built on permanent steel frames, and will not require cranes for delivery and installation. Shipping, delivery and site installation is planned for maximum cost-efficiency.



Adaptable Systems

Physical Environment Continued:

The structure of the building is a hybrid of systems affording maximum benefits from each. Numerous foundation system options allow use in a wide range of site conditions. A steel frame and steel and rigid foam sandwich panel floor and roof system minimize material use, maximize insulation and heat reflection, and deter pests and mold in the cavity-free structure. Walls are framed and sheathed with FSC certified renewable resource wood, insulated with mineral wool for moisture resistance, and sided with 24 gauge steel over a radiation/vapor barrier. The double wall cladding and solar panel-shaded standing seam metal roof create a chimney-effect that shades and cools the building surfaces to greatly reduce heat gain. All glazing is operable and north facing and/or shaded to prevent direct sunlight, and to optimize natural ventilation and comfortable airflow.

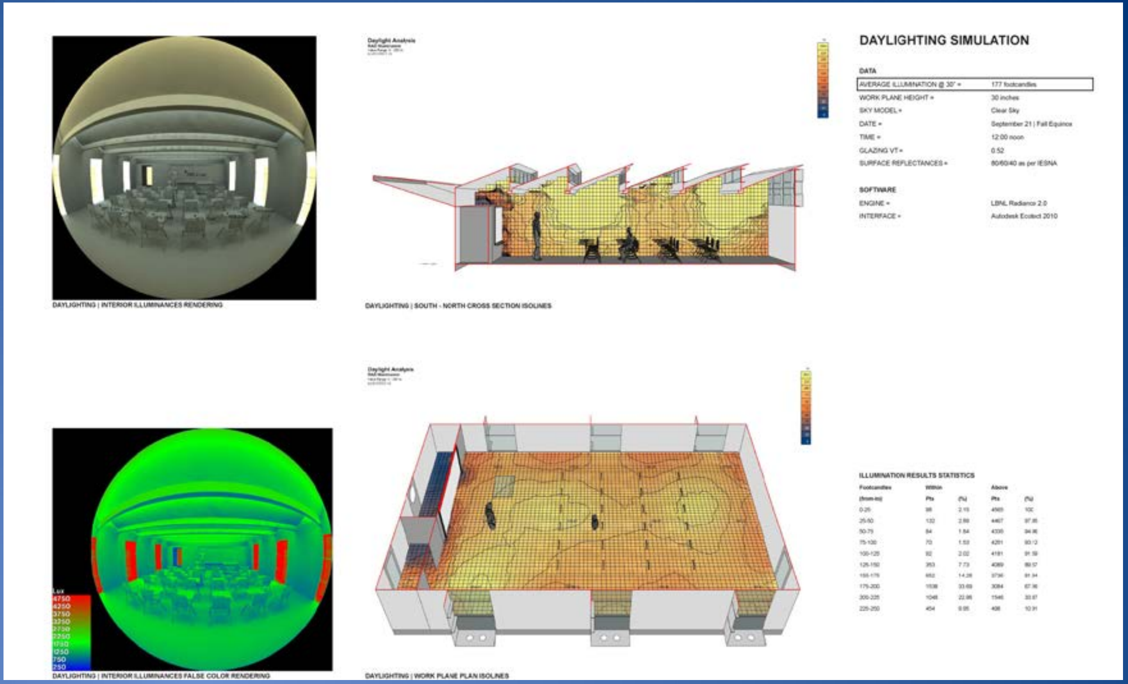
Interior surfaces are low VOC, green products. Exposed beams are FSC certified parallams, with exposed structural steel elements displaying the primary structural components. The interior walls are naturally finished recycled rice straw panels. Ceilings are daylight reflective and sound absorbent high-recycled content acoustical tile. Flooring is natural linoleum tile. The entire classroom perimeter is paneled with a modular system of white board/recycled content tack board, allowing each room to be optimized for different classroom purposes. Interior furnishings are FSC certified, high-recycled content, wheeled modules affording maximum efficiency and adaptability with minimal maintenance.

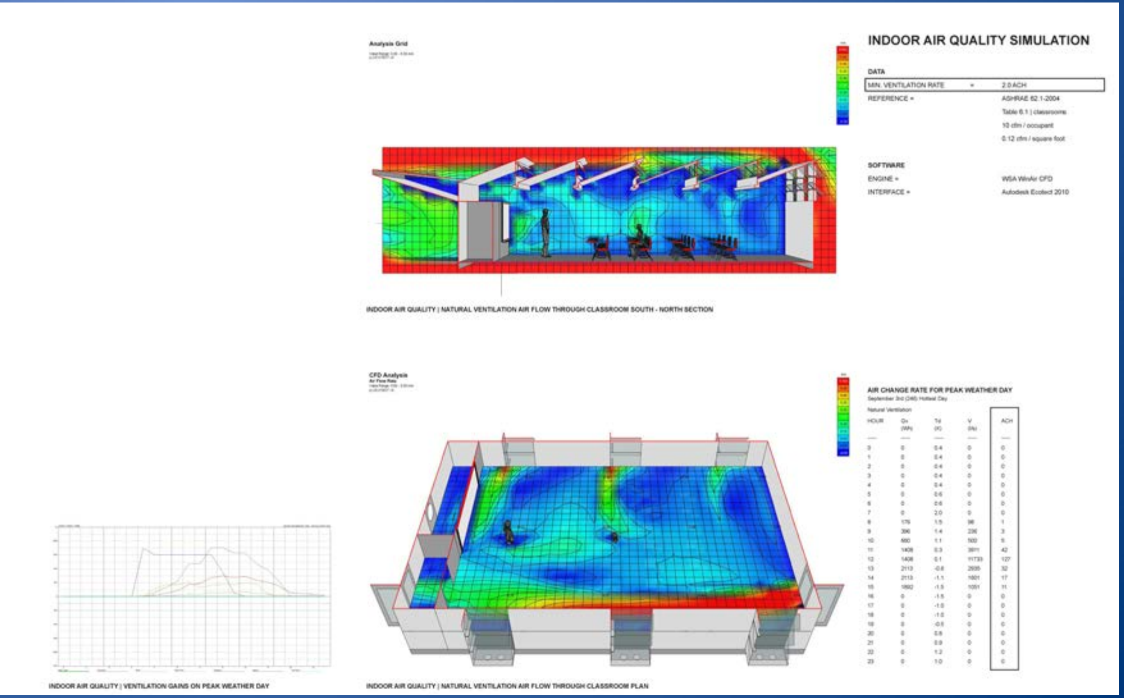
Design Simulation

Planning Process:

Hawaii has a single statewide school district administering all K-12 education in the islands. The State Department of education invited six design-build teams to propose prototype designs with extensive performance analysis predictions and thirty-year life cycle cost analysis. The initial competitive design phase was conducted with several open planning sessions working with DOE officials and school personnel. After submittal of the six designs, DOE officials, facilities staff, teaching teams, and consultant building scientists and engineers carefully studied the proposals and analytical data and cost projections. This project was selected for construction and further testing. During the next phase of design development and construction planning, a larger team of building scientists and specialists in various education and performance disciplines worked closely with the DOE facilities personnel, and with the principal and teacher group selected as the first users of the prototype at a Honolulu elementary school. All design decisions were discussed and vetted among this group throughout the design, construction and site implementation of the first classroom prototype. Once occupied there have been extensive continuing performance analysis and post-occupancy survey studies of the project and its acceptance by students, teachers, administrators, facilities staff and the larger community. All of this ongoing research and analysis will be applied to future implementation of the project as further units are built.

Energy simulation using accurate site data was an important design driver in order to calibrate an ideal classroom environment. The classroom was designed and modeled using Building Integrated Modeling software (BIM) that allowed rapid analysis, design and manufacturing customization for individual site conditions. With the power of this design software, the building form and systems were simulated before construction. Using BIM Modeling and simulation in combination with the advantages of modular prefabrication, the Energy Positive Portable Classroom can be optimized to suit the needs of any unique site.





Learning + Evaluation

Planning Process Continued:

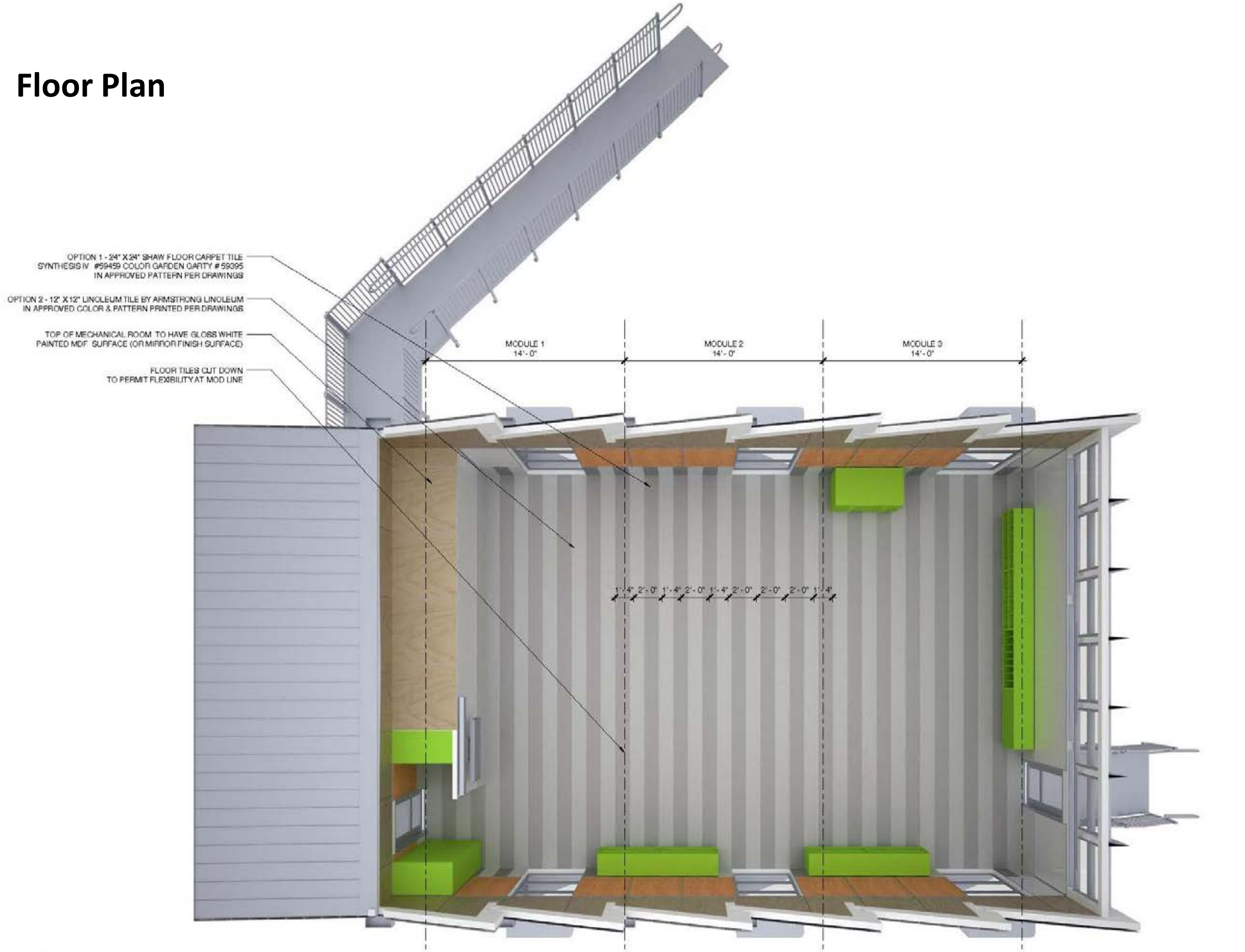
The classroom's sustainability information system enables the high-performance building to be used as a learning tool, describing the green features and demonstrating how they are working using live data and interactive displays. Weather data, energy use, energy production, resource collection, light levels, indoor air-quality and thermal comfort can all be monitored using a full array of recording data and comparative analysis published to the project web site. Current and recorded historical data are collected and available for detailed analysis and assessment.

The team's intense commitment to the environment of Hawaii, its community and schools, along with its commitment to continued involvement in the prototype project and its teaching role in the school system's sustainability curriculum, is intended to assure the long-term success of future school building in the system. The projected need is that the state must build 10,000 new portable classroom units within the next ten years. This prototype has laid the groundwork for this large volume, with a strong testing and evaluation program, and a production system designed to accommodate this level of manufacturing at continuing high-quality levels. While a very small building, this humble portable classroom will have a tremendous impact on the quality of education for more than 25% of all the state's students in the coming years, while setting a high example for sustainable construction and sustainability education throughout the islands, for lasting, long-term impact.

Link to Performance Monitoring Data:

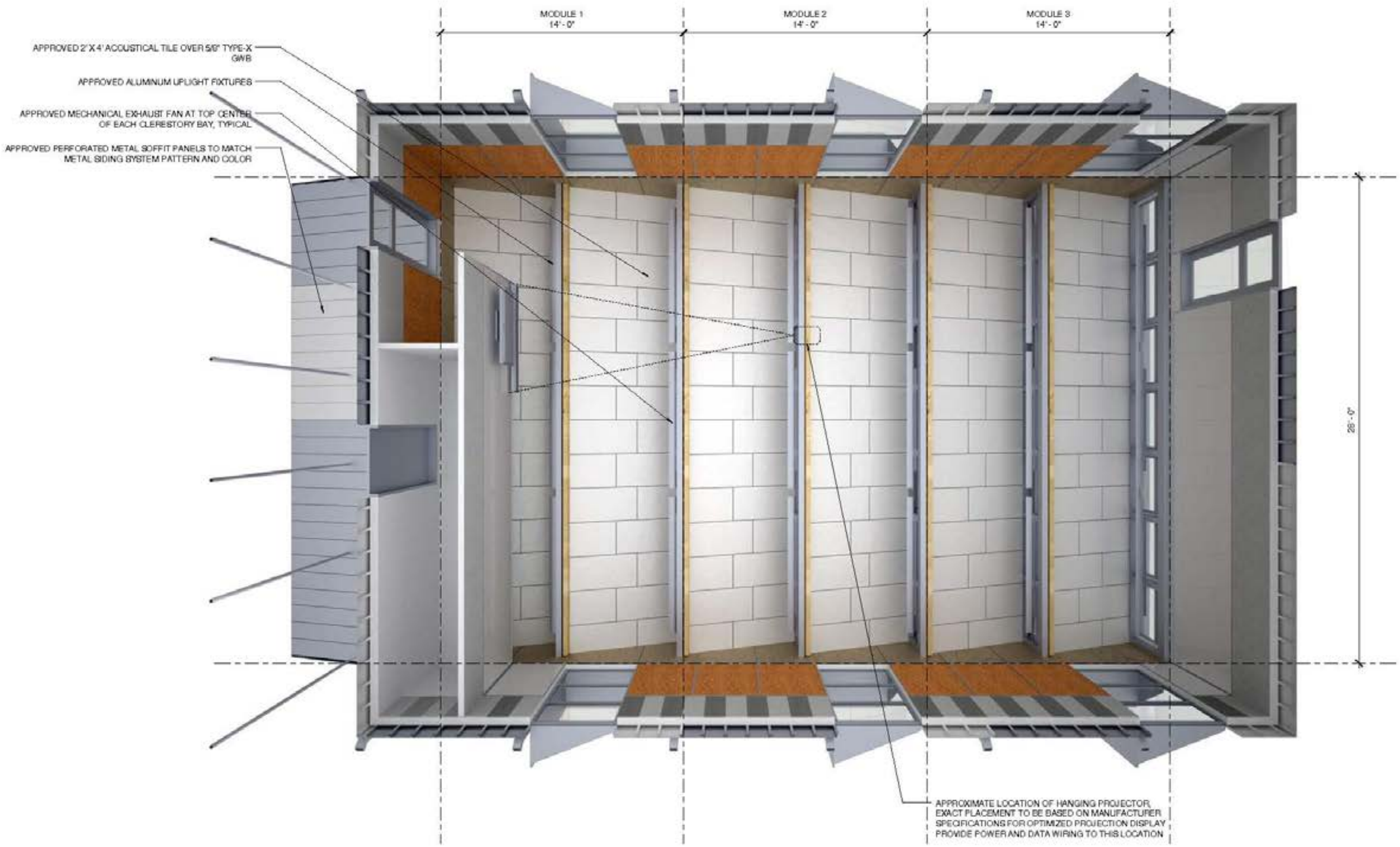
http://login.connectwithwow.net/Powersmiths.wow/KioskPage.aspx?request=GG7k4aH+ZsucpxgC7cKeFDaJwJ8YWz6jmaiuR5QvduvYkVUJAgc4oAVes0u5Vd7NnKc1c6g5C8tS/iMFwvGrSy3nwPD3bhMgdT1iDbJK9pdN2F2OYcvF2A==

Floor Plan



1 DETAIL FLOOR PLAN
NTS

Ceiling Plan



1 RENDERED REFLECTED CEILING PLAN
NTS

Exhibition of School Planning and Architecture Project Data

Submitting Firm :	Anderson Anderson Architecture
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Joint Firm :	Anderson Anderson Hawaii
Project Role	Design Architect
Project Contact	Peter Anderson
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Joint Partner Firm:	Blazer Industries, Inc
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Project Contact	Kendra Cox
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Joint Partner Firm:	Hawaii Modular Space
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Other Firm:	U Hawaii Sea Grant Program / School of Architecture
Project Role	Bioclimatic Design Consultants
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Other Firm:	Symphisis
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Other Firm:	Integrated Design Associates
Project Role	Electrical Engineer, Lighting, Renewable Energy
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Other Firm:	Powersmiths International
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Other Firm:	DL Adams and Associates
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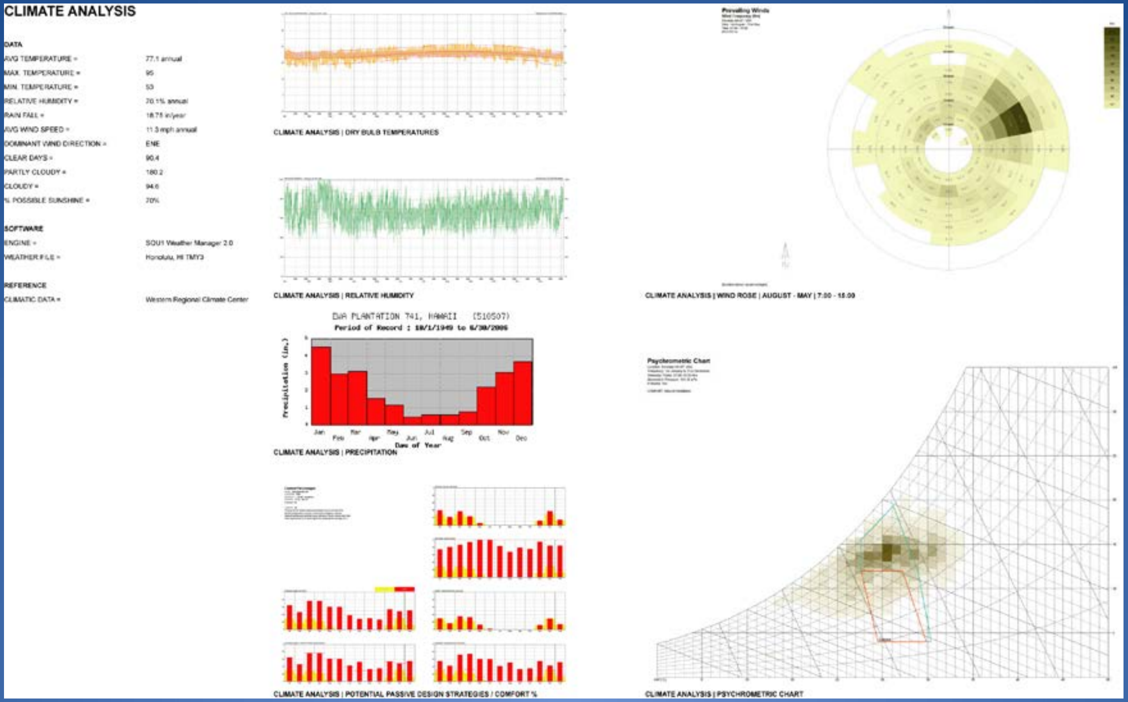
Exhibition of School Planning and Architecture Project Details

Project Name	Energy Positive Portable Classroom
City	Ewa Beach
State	Hawaii
District Name	Leeward District
Supt/President	Kathryn Matayoshi
Occupancy Date	2013
Grades Housed	K-6 + Community
Capacity(Students)	24
Site Size (acres)	.75 Acres
Gross Area (sq. ft.)	1048 SF
Per Occupant(pupil)	43.66 SF
gross/net please indicate	Net
Design and Build?	Yes
If yes, Total Cost:	$496,663
30 Year Lifecycle cost:	$383,698
Includes:	Design / Testing, Construction, Shipping, Installation
If no,	
Site Development:	
Building Construction:	
Fixed Equipment:	
Other:	
Total:	$496,663

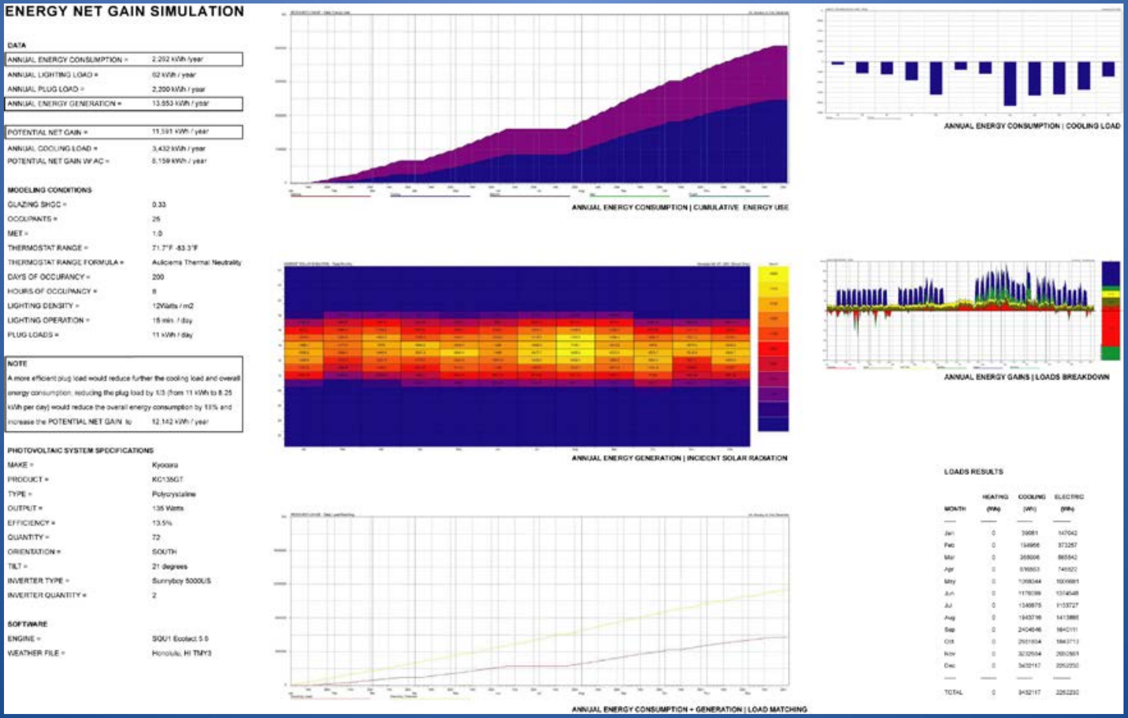
Additional Images

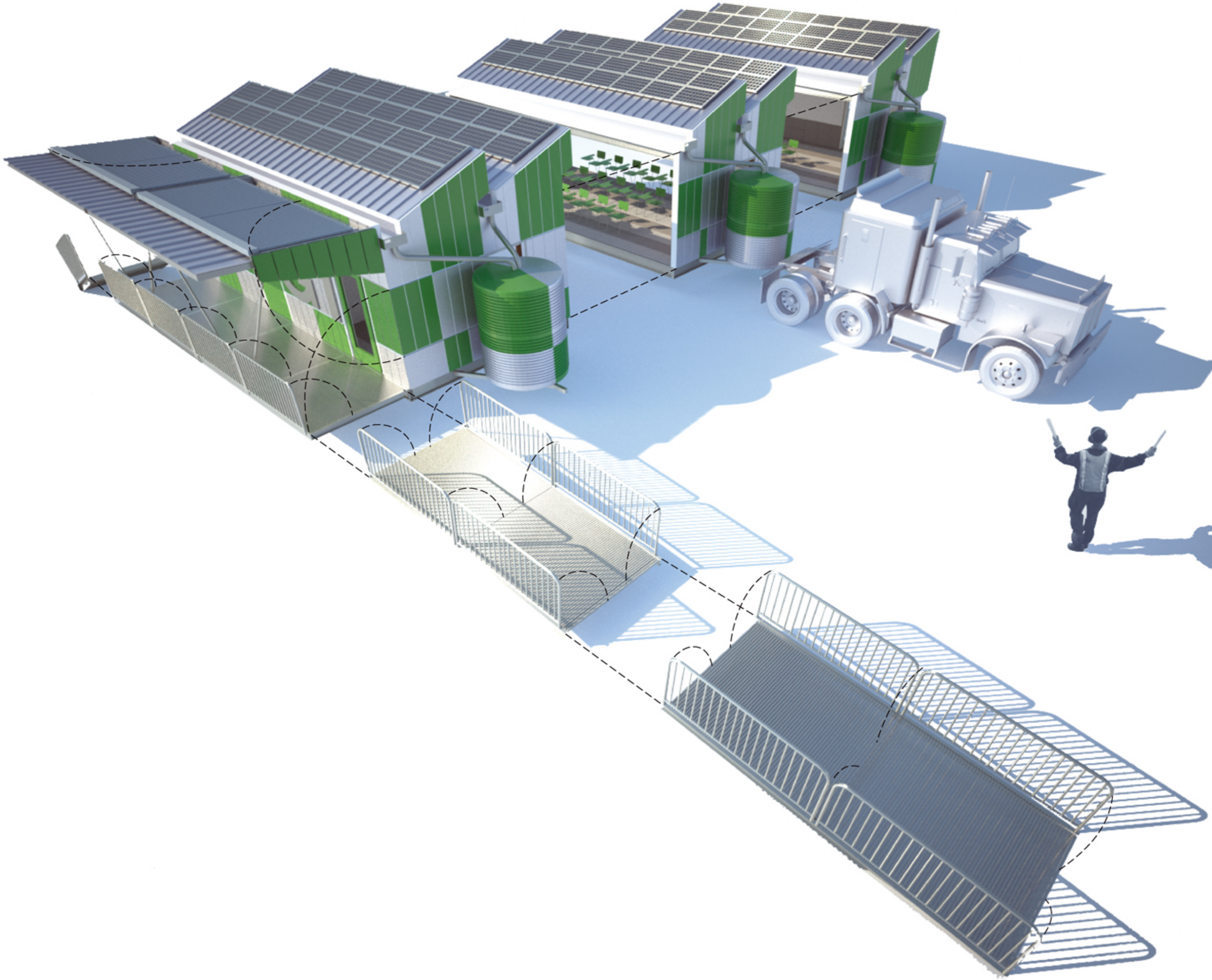
Additional Images

Climate Analysis



Energy Simulation





Modular Installation