OFF-THE-GRID: THREE DESIGN/BUILD PROJECTS, BUILT OFFSITE, OFF-THE-GRID AND FOR THE PUBLIC

ROCCO CEO
University of Miami

As Design/Build goes getting anything designed and built with students at all, has great pedagogical value. Design/Build bridges the knowledge gap between just drawing or just building, by creating greater understanding and appreciation for both acts. Seeing drawn lines turn into built form and comparing the conceptual gravity of an idea with the tactile weight of materials is intoxicating. With a focus exclusively on projects made for the public realm, this paper reports on the opportunities and challenges offered by building off-site, for the road and off-the-grid. Modular, transportable architecture without cranes, these projects offer lessons on what can be done in the public realm, on limited budgets, tight schedules, and with unconventional production strategies.

Design/Build at University of Miami, in Coral Gables Florida, has existed off and on for a number of years. The students have built affordable housing, installations and small outreach projects that have made a significant impact on the community. Over the past three years, with the help of Jim Adamson of Jersey Devil Design/Build Group, there has been an effort to create a permanent place for Design/Build in the curriculum with a school-wide effort to build financial support and cultivate student interest. What has resulted is a program that focuses on short duration projects for mostly nonprofit clients who can, for the cost of materials, receive design innovation, free labor, and the possibility of a project that builds community relationships while also jump starting ideas that may never have gotten off the ground otherwise. While still in its developmental phase, the UM Design/Build Program is illustrative of the pitfalls and opportunities for a semester long program.[1] The three projects that follow are built examples of how a new generation of graduates are encouraged to take a path in the discipline that is geared toward serving the public.

PROJECT 1: CRANDON PARK SHADE PAVILION/ MOTES ORCHID PAVILION

Project 1, was to create a modest shade structure for Crandon Park, a Miami/Dade County post-war park built in 1947 on Key Biscayne. This simple project evolved into a complex political tug of war that would eventually require the class to design a second project, on a new site, with an entirely different client and program.

The controversy was born out of an unforeseen review process that ultimately deemed the design inconsistent with the new park master plan. The master plan, under review at the time was the subject

Figure 1. Tired students say goodbye to an innovative design for Crandon Park.

of a longstanding lawsuit, of a relative of the park's original patrons. The student's design, judged as inconsistent with the new direction for future development for the park, needed to be redesigned or abandoned. Already halfway through the semester, this presented the studio with a difficult decision - continue with the project and risk not finishing it, or abandon it for another project that could be finished in the time left in the semester.

After much discussion and handwringing the first project was abandoned when we realized that to redesign the project, draw a new set of construction documents AND secure the necessary permits in the time remaining would have meant the project could not have been built. The studio was after all Design/Build not Design/Redesign. No one could have foreseen the circumstances or unintended demise of the first design. Although it felt like failure to not complete the first design we wanted the students to have the experience of building so we opted for the new project. Luckily we had a backup project unfettered by master plans, permits or unforeseen design reviews - an orchid pavilion for Motes Orchids.

Dr. Martin Motes and his wife Mary own a world class nursery for the propagation of epiphytic plants, primarily "Vandas," for research, education and public purchase.

SITE

Their site is a 5 acre nursery in the historic agricultural community in south Miami-Dade County called "Redland." The site gets its name after the red clay and oolitic rock soil that is unique to this region of south Florida. Although Motes' Orchids is primarily a business of propagating and sale orchids its owners also have an interest in better accommodations for the public. The owners wish to have a small pavilion that could be used for the display of Orchids, and a place for the public to sit and have a class on orchid propagation, showed the project was to be as much about the display of orchids as it was about creating a setting to promote the culture of orchid enthusiasts.

Given that less than half of the semester (7 weeks) was left to design, draw, estimate costs, order materials and build the structure, the students had what appeared to be a herculean task ahead of them. Equally arduous was abandoning the ideas of the original project.

The park pavilion, while more than a couple of miles from the university, could have been built off campus. The new project site, too far from the university, could not, and had to be built in modules suitable for travel down the road to be assembled on the site at the semesters end. Students at UM take a full schedule of courses in addition to Design/Build studio and sometimes have classes scheduled 15 minutes apart. Given that our Design/Build program is a one semester endeavor, all projects further than two miles away from the university, had by necessity to be built at the school of architecture to work with student schedules. This constraint has become a defining factor of the program.

The program is simple enough, a long bench with slatted walls and roof to simulate the modeled light conditions needed to protect the orchids and public from the hot Florida sun and heavy rain. With the exception of the pressure treated skids the whole structure is made from rough-sawn, river-recovered cypress.

Given that the structure was nine feet deep and more than 18' long it had by necessity to be built in three sections to be transported down the road. The weight of each of these sections, without the deck and roofing, is nearly 1700 pounds, necessitating unconventional techniques for moving and loading the modules for transport to the site.

BUILDING FOR THE ROAD

Learning the limits of force and resistance students employed hoists and pry bars to move the structure onto a low profile flatbed trailer used to transport the modules to the site. After a great deal of energy was expended, our Model Shop Director Adrian Villaraos suggested a simpler medium of movement, oranges.

Villaraos, a Cuban exile who has an encyclopedic knowledge and facility for making just about anything, often frames lessons in building with a story about Cuba. He said: "When living in Cuba one quickly learns to make-do with what one has on hand," adding "when we needed to move something really heavy and we had no equipment to do the job - we used oranges." So after listening to what sounded like "tall tales" students cut a dozen or so oranges, ate the interior of the oranges

Figure 2. Students using oranges to move a module for transport.

(because it was hot) and put the pulp side down between the wood skids and joists that support the 1700 lb. module. To everyone's amazement, the leftover pulp and fleshy consistency of the skin, stayed together long enough to slide the heavy modules along the skids with very little effort. This tool/technique, underscored the value of ingenuity and resourcefulness for solving a problem on the spot. With the addition of a cable winch hoist, car jack and steel bars, students lowered the modules onto the trailer and ultimately transported all three modules to the site.[2] Today the finished building is well liked and has become the front porch to the nursery.

Figure 3. Finished Orchid Sales-display pavilion.

"The Sales-Display Pavilion built by the UM Design/Build class is a structure perfectly matched to its site and use. The light airy design, providing ample air flow and visual interest reflects the best atmospheric qualities of the greenhouses where the flowers being displayed and sold have been grown. Similarly the choice of materials, predominantly native cypress, mirrors the wooden baskets in which the plants are rooted and the slat roofed growing house where they have been cultivated. The Design build Pavilion combines beauty and functionality in a way particularly felicitously suited to Motes Orchid." -Martin Motes, Owner of Motes Orchids.[3]

PROJECT 2: EARTH LEARNING MOBILE ORGANIC KITCHEN

With the lessons of project one in mind we embarked on our second project one year later. Project 2 appeared to have the makings of an ideal program and scale of project. We were mostly correct.

Mario Yanez, the founder of Earth Learning, a local nonprofit that promotes sustainable agriculture, came to the School of Architecture with the idea to have us design and construct a mobile organic kitchen that could be used in two ways. The first way is as a demonstration kitchen that could be brought to public workshops in the inner city, to teach permaculture and educate the public on healthy ways to prepare locally grown, organic foods. The second way is to be a processing kitchen for local farmers who could; can, dry or process blemished produce unsuitable for the market.

The client also saw this project as empowering ecological learning at a regional scale. It was to travel the county, be off-the-grid, and unlike conventional food-trucks, able to be open completely on one side (for cooking demonstrations and workshops) and would feature innovative energy saving technologies and methods. All total an ideal project for students, and when construction was finished, the owner could simply tow it away – end of project. Or so we thought.

The project required an extensive use of welded steel, a new process for us, and a fairly complex array of systems, two factors that would ultimately add many months to the project. But we are getting ahead of our description here.

The project commenced with requisite site visit and interview by students of the owner and staff, in order to glean the specifics of how the kitchen was to be organized and used. While on site the owner introduced us to our charge - a wasp infested mobile home that would be adaptively reused for the mobile kitchen. Larger and in poorer shape than expected the class gingerly transported the rotting mobile home 25 miles to the campus. Most of it arrived intact. After 2-4 weeks of design and drawing the students presented their project and received approval from the owners to build. Given that the project is for a nonprofit the owner funded the project through a generous grant from the USDA.[4]

The first order of building was to take apart and salvage the trailer, separating and stockpiling anything that could be reused or recycled – giving real meaning to terms such as "life cycle" and "embodied energy."[5] Most of the wood framing, wiring and aluminum siding was recycled. We then began the process of trying to correct a reverse camber in the chassis to have a level foundation from which to weld the new frame – ultimately a fruitless endeavor.

Instruction in welding took place under the direction by our teaching assistant Ralph Provisero, a graduate sculpture student from the Art Department (who incidentally, also taught the instructors). After all were trained the slow process of welding the frame began.

The first lesson learned, is that when working with a new building method and new program give yourself twice as long as you think you need, and then you might be close to staying on schedule. Welding the frame meant only two welders were working at one time slowing overall production on the trailer until the frame was finished. As it turned out the project ultimately went over schedule by one whole semester.

The project did build upon old lessons and provide us with new ones. We knew for instance that the trailer could be no more than 8' wide or 13' tall from the pavement to go down the road without a special permit. We also learned about how to distribute the program to equalize weight at either end of the kitchen, and side to side while keeping the "tongue" weight under 300 lbs. Students learned to choose materials that would keep the overall weight below the maximum for the chassis and tires – a new design parameter generated by the road.

The biggest challenges were in coordinating the installation of the systems and building the drop down doors. The electrical system required 6 solar panels, and a solar hot water collector on the roof. The PV panels powered the LED lights, the freezer compartment and the pumps for the water systems. The cooktop and oven were powered with LP gas from tanks mounted on the front of the trailer. The mechanical compartment for the batteries, inverters, and back-up were located forward because of their weight and accessibility while water tanks were put aft to counterbalance this weight. Given the trailer walls are only 2" thick (1"x1" tubular steel frame with 1" furring and 2" of rigid insulation) students had to locate all electrical and furring with precision.

The seemingly simple design project suddenly became tedious and time consuming. At the semesters end we had completed the frame, floor, windows and doors and some of the exterior metal skin. Time spent figuring out how to remove the reverse camber in the chassis, build the drop down doors, weld the frame and coordinate all the systems made the project drag on leaving most of the interior to be built after the semester was over. While the final cost of $18,000 was perhaps 4 times less than if the owner built this from scratch, the additional hours put into the project made this a long and difficult project that required volunteer hours and a varied work crew to finish the project.

The lessons from this project were clear. Lesson 1: When taking on a new method of building give yourself twice as much time to

Figure 4. Interior of mobile organic kitchen.

do the work as you think you need. Lesson 2: Any project that is systems intensive requires greater coordination and onsite modification for things to go together quickly. Lesson 3: Reusing existing components while saving upfront costs often adds time for recycling, researching compatible parts, refinishing and reconditioning existing parts to finally have functional pieces. These additional time outlays must be computed into the cost of the final piece. The final project is quite well crafted, unique, and made from a substantial amount of salvaged material. Its impact on the community it is intended to serve will show with time.

PROJECT 3: ECO-TENTS FOR EVERGLADES NATIONAL PARK, FLAMINGO

Humbled but not discouraged by the first two projects we sought a public client for project three that would allow for a better fit with our time and scale-of-project constraints. Contacting us on an unrelated matter, Everglades National Park was open to the idea of a project that might benefit us both, and we soon found ourselves touring for potential projects in the mostly vast aquatic wilderness of the Florida Bay.

The national downturn in the economy has forced everyone, including the National Parks, to do more with less. Given a federal mandate to create public/private partnerships, the National Park system was looking to jump start a recent master plan with a demonstration project that could motivate public/private investment in the park.

Designing and building a new prototype for overnight visitors to replace former structures lost to past hurricanes, had the twofold advantage of bringing visitors to the park who may not have otherwise visited, but more importantly allow those overnight visitors to spend more time in the park.

Because the camp site sits at the southern tip of the park, a roundtrip visit from the park entrance to the site takes nearly two hours. Not having overnight accommodations meant many visitors could only spend a small amount of time on the site. Allowing for extended visitor time in the park the Eco-tents will facilitate the building of public support and advocacy for the park's preservation and enhancement - a vital link to its future.

SITE

Established in the 1880s, Flamingo is historically the largest developed area in Everglades National park. The site is at the southernmost tip of the Florida Peninsula and was historically a tiny village of steadfast residents who made charcoal, fished, hunted birds for plumage and sold these commodities to residents of Key West.[6] This remote area was left undisturbed by most of the outside world until 1934 when the United States Congress authorized Harry S. Truman to dedicate it as a National Park in 1947.

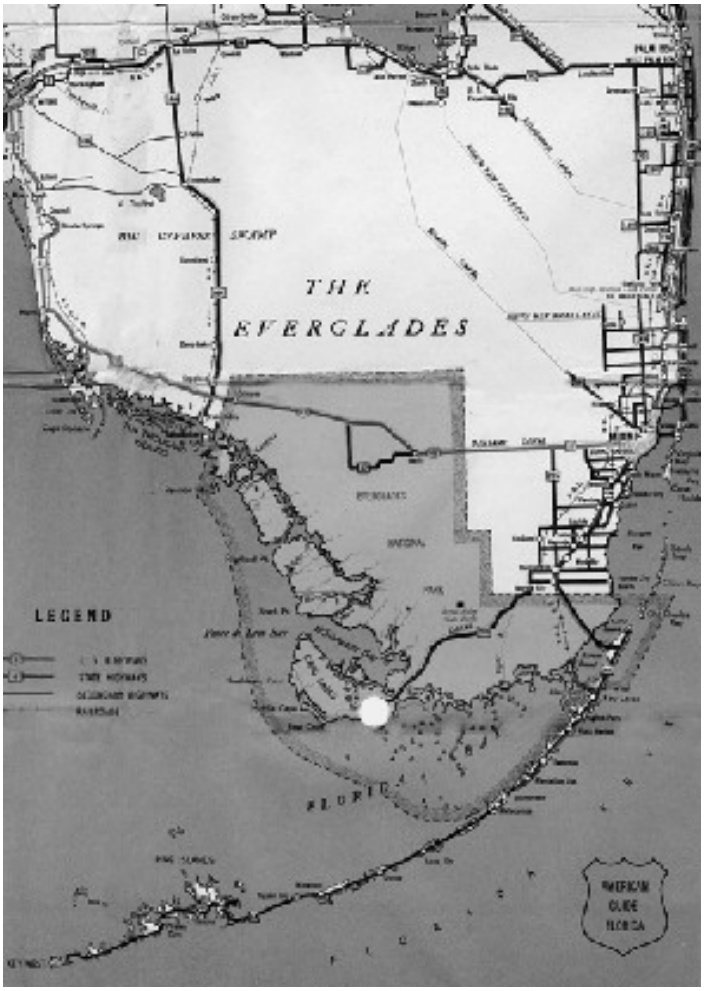

Figure 5. A 1939 map of Florida with Flamingo site indicated at southern tip of state.

Barely above the waterline, Flamingo is a windswept site that provides panoramic views of the Florida Bay, a vast aquatic landscape

where the sky and water are stitched together by hundreds of islands. Also designated a World Heritage Site, and the only place in the United State that is an International Biosphere Reserve, the site is of great ecological importance and the last place on the mainland U.S. to experience a tropical wilderness.

From December through May the weather is ideal, usually around 72 degrees, relatively dry, sunny and buffeted by warm southeastern breezes. The site is frequented by as many as two million visitors a year that come to enjoy kayaking, bird-watching, hiking and camping. The hurricane season starts June 1 and ends November 1. During this uninhabitable period, the site is peppered by daily rain storms leaving standing water that breeds clouds of mosquitos, only to be interrupted by the high winds and tidal surges brought on by cyclical tropical storms and hurricanes.

The project, as defined by our client, is to design and build a prototype for forty Eco-tents at the water's edge and adjacent to the existing campgrounds. Each tent will sleep four people and be built off the ground on a wood platform supporting a fabric tent formed by a pole structure that can be taken down and stored during the off-season. The new Eco-tents were to reflect the aspirations and values of Everglades National Park by being ecologically of low impact, made of green materials and through its construction be illustrative of how one could live simply, and in closer harmony with the land.

The modest scale of the project fit our one semester time frame and the simple focus of a seasonal tent provided a challenge of economy the students relished.

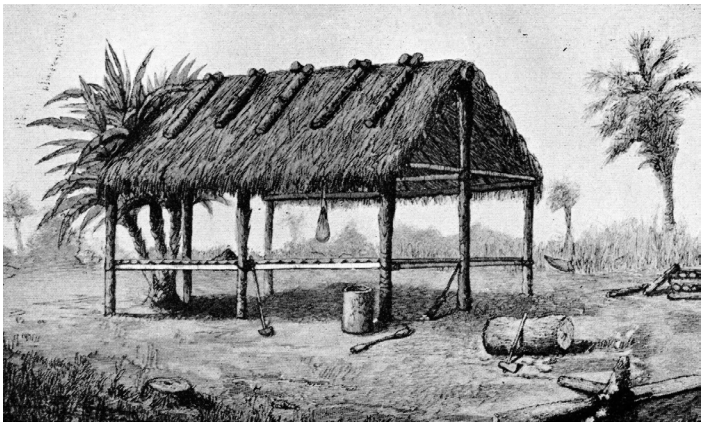

Figure 6. A Seminole dwelling, courtesy of the American Bureau of Ethnology, 1896.

ECO-TENT

The design the students produced is in keeping with the early structures of the Everglades. The pole structure and temporary roof recalls the iconic palm thatched platform structure of the Seminole and Miccosukee Indians who built the earliest vernacular architecture of the region known as a "Chickee." This structure cold be repeated and because it is well suited to the climate, could be erected in a day and if damaged by a storm, quickly re-thatched and occupied.

The Eco-tent's star-like form maximizes the formal properties of one length of wood pole providing both interior structure and outrigger framing with only the wall framing being a different length pole. The modest elevation of the platform, well shaded walls, and shielded screening at the peaks of the walls encourage cross ventilation from every direction. Even the fire rated canvas tent recalls past gator hunters early shacks made from cement soaked fertilizer sacks[7] built as protection from the elements while also lightweight enough to be moved between camps.

The Eco-tents centrally organized Cartesian plan evolved to contrast with the seemingly limitless and disorienting landscape of the Everglades, a place that can quickly erode one's sense of direction.

One of the greatest challenges for the project was the need for modularity and precision. The project was drawn in *AutoCAD,* modeled in *Sketch Up* and built as a physical model at a scale of 1" to 1' with full scale mock-ups of the fittings and poles. These techniques of representation acted as a dry run for erection of the poles and allowed students to see the range of tolerances needed for the project to come together. Spaces in the pole's flitches were built to allow some movement in the poles to compensate for inevitable twisting and bending of the poles whose length exceeds 13 feet. We ultimately found the computer model to be very accurate, not varying more than 1/8," to what was built on site.

Finally the structure had to be made portable so that it could be taken down and put up quickly. We timed ourselves and were able to take down the poles and unbolt supporting knee walls in about 45 minutes. A coordinated crew of four could safely take down the

Figure 7. Framing and platform for Eco-tent with the canvas removed.

tent, poles, and knee walls in little more than 1.5 hours. The goal after disassembly and storage of the poles and walls would be to leave only the platform on site during the hurricane season.

The green materials for the project include bamboo and plastic composite decking (Cali bamboo), that is low maintenance and rot resistant, heat-treated pine, glulam spruce poles, aluminum fittings, stainless steel fasteners; straps, angle braces and saddles. The stainless steel fasteners were donated by *Simpson Strong-tie* who in return for their contribution will monitor the fasteners performance. The largest components of the project are the deck platforms that measure 4.5' wide by 14' long and 1' thick. Built in three sections they can be unbolted for transport to the site and reassembled.

The Eco-tent has been our smoothest project to date and accompanied by solar powered communal restroom facilities is completely off-the-grid, modular, built off-site and completely for the public. As the first prototype will be tested this coming fall we look forward to the 39 that will follow.

GAINS AND LOSSES WHEN UNDERTAKING DESIGN/BUILD PROJECTS

1. Interaction between the public and the academy helps to breakdown inaccurate preconceptions on both sides. Often working to tight budgetary standards and public scrutiny public agencies are often surprised at the level of professionalism and commitment provided by students and the academy – something they did not expect. The academy in return, is buoyed by the public's positive response to their efforts and by having provided real solutions that build community trust and cast schools of architecture as places of critical thinking, research, and problem solving rather than as bastions of higher learning disconnected and self-serving.

2. In the university, service learning, civic engagement, and community outreach are all academic frames for the growing requirement for higher education to remain focused on the community it is preparing its graduates to enter. Design/Build can be an initiation into civic life of the community and helps a student transition to life in the profession or alternatively public service.

3. Leaving behind built work for the public, and accessible to it, is a physical reminder of the importance of the academy in the life and formation of the community. Public projects have the potential to engage more people than building for the private sector.

4. Through the completion of a Design/Build projects students experience the complete cycle of an architectural project through understanding the values and skills of the designer AND the values and concerns of the builder/craftsman, acquiring greater knowledge of and appreciation of both disciplines.

5. There are some downsides to design/build that have to do with "burnout" by both students and faculty. The commitment in time required is often way beyond conventional credit loads for students or teaching loads for faculty. To give students the full design/build experience, including building permitting, many programs by necessity have to be year-long endeavors, and involve reduced curriculum requirements to make the academic and public calendar more compatible. Although the year long experience more closely models practice I believe that a one semester experience also to be a workable model given its fit with the academic calendar, and if taught every other semester, possibly better in preventing student and faculty burnout.

6. The semester long project definitely pushes the aesthetic/value questions of hand-made versus off-the-shelf. One often simultaneously hears the whispers of Ruskin in one ear and Neutra in the other. These two conflicting positions (hand- made pieces versus selecting mass produced components) are often difficult to reconcile. Experience shows that when at all possible listen to Ruskin - production may slow down but students get so much more from the experience. In an increasingly disengaged world, facilitated by technology, Design/Build is invaluable in re-sensitizing students to a tactile process, each other, the public, the discipline, and most importantly - their own hands.

Figure 8. Eco-tents by day (top), and night (bottom).

ENDNOTES

1. See: Wakeford, Katie and Georgia Bizios. *A Mission to Serve: Designing homes, Training Stewards.* 96th Annual ACSA Meeting Proceedings, Washington: ACSA Press, 2008. Under subheadings: "Critique" and "The Importance of Training Stewards," Wake ford and Bezos discuss many of the opportunities, benefits and

challenges of community based outreach projects.

2. An excellent reference for working with blocks, slings and moving heavy objects is the book: Arborist Equipment: a guide to the Tools and Equipment of Tree Maintenance and Removal, by Donald Blair, International Society of Arboriculture, Printed Press, 1999.
3. Ceo, Rocco. *Design/Build Studio, vol. 1.* Coral Gables: University of Miami School of Architecture publication, 2011: 5.
4. Working with not-for-profits frequently requires partnering on grants to fund projects. Tracking material and time costs along the way helps in estimating future in-kind contributions - necessary information for owners applying for grants. The Eco-tent was made possible by a grant to Everglades National Park provided by the South Florida National Parks Trust.
5. Rider, Traci, Stacy Glass, and Jessica McNaughton. *Understanding Green Building Materials.* Edited by Karen Levine. New York: W.W. Norton Company, 2011. This compact book is an excellent "green" primer for Design/Build studios.
6. Everglades National Park. *Flamingo Master Plan and Design Program,* 2010.
7. Simmons, Glen and Laura Ogden. *Gladesman: Gator Hunters, Moonshiners and Skiffers.* Gainesville: University Press of Florida, 1998: 67.