Cultural Constructions: Mock-Ups as a Means of Cultural Engagement

This paper proposes that one can engage students in culturally-relevant, educational, inspirational Design-Build by embracing material and construction conditions that radically differ from our own. Using design research and culturally-informed material mock-ups, students can learn from and design with communities that they may never actually visit.

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DESIGN-BUILD-ENGAGE

There are many benefits of Design-Build which have been recognized in recent literature including: having the capacity to "bridg[e] the gap between theory and practice" as Carpenter states[1] or as an approach to gaining experience in collaborative practice, hands-on learning, linking design and construction and, in some cases, gaining experience working with a community as Wallis discussed.[2] As Gjersten points out in 2012, "Design-Build projects directly address the NAAB criteria of collaboration, project management, leadership, legal responsibilities, ethical and professional judgment, and community and social responsibility."[3] However, what is less commonly found in the recent scholarship on Design-Build is a focus on the learning opportunities through cultural exchange and sensitivity.

The specific focus on the benefits and challenges of Design-Build should expand to include the potential for students to engage cultural conditions of communities in differing cultural contexts through the use of detailed mock-ups. These constructive explorations require students to deeply engage cultural specificity at a level that few students achieve on typical projects. I often see competitions being won for projects in Haiti or East Africa that show proposals that have no identifiable site, people or context, but which have some sculptural, parametrically-derived form. There are Design-Build projects that are transforming these digital explorations into built form. While there are some benefits for the students, there is a missed opportunity of learning from and with the cultural conditions in which they are designing.

In Canizaro's seminal paper on Design-Build in Architectural Education he states that the intention of most Design-Build programs is "to extend students' design skills by making a stronger link with material experimentation and construction."[4] As a Design-Build educator I firmly believe that this link is an essential component of architectural education. However, I believe there is more that can be learned through Design-Build.

Many academic Design-Build programs do projects for and with communities. Canizaro notes that, "[o]utside of construction, the most prevalent characteristic of Design-Build programs is their organization around and intention to provide service to local communities."[5] Tom Dutton from the University of Miami probably gets closest to addressing issues of cultural engagement when he stated that in teaching their students, "[w]e're trying to get them to be better citizens, better community advocates, and to understand the complexity of urban areas."[6] But Canizaro critiques this form of practice as an "ethical commitment to others."[7] He states that Rural Studio, which has a mission to "design, build and serve the poor," does so as part of a commitment to social justice.

Ethics is commonly defined as "moral principles that govern a person's or group's behavior." While architecture schools have a role in teaching ethics, we also need to specifically address issues of cultural exchange within design education. There is potential to provide opportunities for students to gain essential skills of cultural engagement through Design-Build practice. Specifically, students can learn from a culture that they may never visit by building mock-ups of design conditions that are components of projects within another community.

We must help students realize how much we have to learn from the communities with whom we are designing. I assert that most architecture students are not cognisant of how much they can learn about innovation and creativity from people who create buildings in other cultures.

Design-Build is one arena in which we can help students reflectively explore the opportunities and challenges of cultural difference. Through a shared and open dialogue with people from another community regarding their approach to design, construction and habitation, students' perception of design can be challenged. Physically building within conditions that differ from those that they are accustomed to, students can gain cultural sensitivity and an expanded understanding of design.

CULTURAL ENGAGEMENT IN RURAL TANZANIA

In 2008, while teaching at the University of Cincinnati School of Architecture and Interior Design, I began working with a local non-profit entitled Village Life Outreach Project to address the need for a health center in Roche, Tanzania. The non-profit had been working with the rural community since 2004 and the community had identified a permanent health care facility as a primary need. I was contacted by members of Village Life to help lead the project to design and build a health center with the community in Tanzania. I quickly learned that making buildings in rural Tanzania requires an American designer to engage a set of conditions materially, culturally and environmentally that challenge most of our basic assumptions about design and construction.

Following two years of extensive research, interviews and meetings with the local community, Phase 1 of construction began in 2010 with plans of designing and constructing a 2000-sf clinic to serve as administrative and clinic space. The clinic opened on April 1, 2011 and has received multiple awards in the United States but more importantly, is being heavily used and valued by the local community.[8] To retain quality medical professionals at the clinic, there is a need for high quality medical housing for Tanzanian-educated Doctors and Nurses. The next phase of construction is scheduled to begin in November 2014.

The Roche Health Center projects in Tanzania combine faculty-led graduate architecture studios and seminars that engage design research in many ways. This research informs the development of the built projects though the design evolves throughout every step of the construction process. The types of research have varied from interviews, data collection and multi-disciplinary collaborations to extensive mock-ups and large-scale constructions.

Since 2008, I have taught three graduate architecture design studios and have led seminars and independent study projects that have all involved the study of conditions that impact the construction used by the local community in Roche, Tanzania. All studios begin with readings and discussions of the post-colonial history of the region in general and specifically on the influence that the English and Germans had upon the concepts of building and design expression for the community. We explore the limited material options, construction techniques and tools available for villagers as well as the incredible ingenuity embedded within their constructions. In proposing any modification to typical Tanzanian construction we had to fully embrace the lack of electricity, clean water, sanitation infrastructure and motorized transportation.

Some sort of pre-design research is typical in most design studios. With the Tanzania studios, it became evident that the initial research had minimal impact upon their design process until the students began to build mock-ups within the material and construction conditions the community in rural Tanzania. Building mock-ups within their conditions changed everything.

CONSTRUCTION IN RURAL TANZANIA

There are two predominant types of construction in the villages of Northern Tanzania – the indigenous round or square wood, grass, and mud hut that is found in many parts of Africa and a typical single story, rectangular, masonry building with a gabled roof. As designers, we were extremely impressed with the indigenous technology inherent in the thatch-roofed huts. The thatch roof allows air to permeate through while still creating weather enclosure in the roof. It is completely local and natural and has many tremendous benefits as a roof construction. I challenged my students to design a roof that could perform as well within the material conditions and none have met the challenge.

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When we spoke with the villagers about designing with the thatch roofs, their response was resoundingly negative. They felt that these buildings represented their past, while the post-colonial masonry buildings represented the buildings they wanted to produce in the future. Yet the rectangular, masonry buildings they were building were often found with evidence of structural failure. This was the result of several factors – the kiln-dried mud bricks they were using had no significant binder and were not attaining any significant structural strength. Additionally, where they had built concrete beams or columns, there was often incorrectly sized or incorrectly placed reinforcing steel. The construction issues were exacerbated by the fact that the buildings are in an area with significant seismic activity. Many of these buildings were failing or had already become unsafe for occupation.

We soon realized that we needed to work with the villagers to identify approaches to construction that would feel like modern buildings to them (masonry with a solid roof) while utilizing the materials and tools that were widely available. We searched precedents throughout Africa, India, Asia and South America to identify construction assemblies that would be safer and more durable. We discovered several different types of masonry block construction that could be acquired and applied in rural Tanzania using local materials and cultural conditions. The comparison of these different types of block construction involved a series of mock-ups throughout the Roche Health Center studios.

Figure 1: indigenous and masonry buildings in rural Tanzania, *photo by author*

ROCHE HEALTH CENTER DESIGN STUDIOS

I began teaching Roche Health Center studios in the Graduate Architecture program in Fall 2008. In these studios, groups of students explored issues impacting the design and construction of multiple phases of a new health center in Roche, Tanzania. In these studios, we engaged the local culture in every way we could – through interviews, lectures from African faculty, data collection, research and material mock-ups. One student traveled to the region and lived on the ground in Tanzania, leading the design and construction process for the health clinic. Throughout the process, mock-ups were a primary means of research, design exploration and cultural engagement.

Traditional research completed for a design project might include climatic data, demographics, history of the architecture in the area, and socio-cultural conditions. It is less common to study the construction techniques and tools of the place where construction is occurring. If one is building in an industrialized location, this may not be essential. However, anyone who has been involved in academic Design-Build has first hand knowledge about the importance of understanding materials and labor practices for all projects. Engaging students in that materials and labor acquisition process proved to be extremely illuminating.

During initial research with the community we identified several critical issues with existing construction and used mock-ups to explore design proposals using the materials, finishes, patterns and rhythms that are found in the region. We were trying to solve technical problems, but also attempting to do more:

1. *Design for all* by providing a Health Center that addresses the needs of all members of the community.

2. *Design for education* by incorporating teaching and learning into every area of the health center.

3. *Design for reproducibility* by creating buildings using locally available materials and construction techniques.

4. *Design for sustainability* by minimizing energy usage, natural resources and material usage.

5. *Design for permanence* by producing safe, durable, repairable buildings.

6. *Design for the future* by incorporating flexibility and adaptability.

MOCK-UPS

Throughout the design process, we incorporated full-scale mock-ups as a means of testing and developing the design and construction approaches that emerged through our research. To address the structural concerns found in masonry buildings, we utilized mock-ups to test multiple strategies for seismically-resistant masonry blocks as well as other masonry alternatives.

We also identified major acoustical issues as the result of un-insulated metal roofs. We tested combinations of available materials and developed a roof assembly that reduces heat loads and acoustic transfer extensively, thereby allowing users to be able to communicate, even during torrential rains.

In phase 2 we studied the first building and utilized mock-ups to address additional conditions that were identified as needing improvement. Phase 2 mock-ups included alternative wall and roof structure materials, new approaches to columns, roofing alternatives, and privacy filters for apertures.

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Figure 2: masonry construction in Roche, Tanzania, *photo by author, 2008*

Figure 3: masonry construction near Roche, Tanzania, *photo by author, 2008*

Figure 4: Fall 2008 students pressing bricks, *photo by Fall 2008 studio students*

1. ISSB CONSTRUCTION

The structural failure of some of the brick buildings in the region was a significant concern from the outset. When I was on-site in October 2008, we discovered that the kiln-fired bricks they were using were extremely unsafe, inconsistent and structurally unsound. I was told that this was done to reduce cement use in the walls, but the supposed savings in cement achieved by not using cement in the bricks themselves was lost due to the extensive amount of grout that was required to create a consistent wall using the inconsistent bricks. Through conversations with the community, we identified criteria that must be met for the health center wall construction:

1. Wall construction must be appealing to the community.

2. Wall construction must be affordable, accessible and usable by all members of the Roche community.

3. Wall construction must require no electric power (since none is available in the region) and minimal clean water.

4. Any tools or machines needed for construction must be extremely durable and repairable.

5. Wall construction must minimize need for cement (since it is expensive for the villagers).

6. Construction must produce a building wall that is a significant improvement over existing walls in terms of durability, capacity to withstand seismic activity and buildability.

We researched masonry block construction options being used around the world and discovered some options. The only block press found near northern Tanzania was the ISSB Press by Makiga, Inc., which had a headquarters in Nairobi, Kenya. The Interlocking Stabilized Soil Block (ISSB) was recognized by UN Habitat as an ideal building block in rural Uganda.[9] We contacted the manufacturer in Nairobi and began testing mock-ups of a similar brick within the studio. We discovered that the brick was relatively easy to press, required minimal amounts of cement and led to a much more plumb, true and structurally sound wall construction. Through tangible experience with mock-ups, we discovered the specific challenges and potentials of this material. This proved to be a technology that had great potential in the region. The response from the community was extremely positive when it was presented. One leader just said "finally!"

We were able to do mock-ups using a comparable block press during our first design studio as one of several masonry options. In 2012, we received an AIA Ohio Research Grant to purchase an ISSB Press and have it shipped to the University of Cincinnati for in-depth research and mock-ups. We have begun working with the College of Engineering on strength testing and will be doing mock-ups of corner details in upcoming months.

One other viable wall material that we tested was rammed earth. Mock-ups were truly invaluable in this case. Our students noted how energy consuming it was to build a small, rammed earth block. This raised serious concerns about the amount of calories needed and accuracy required for this type of construction. The knowledge gained from the mock-ups was shared with our partners in Tanzania and this choice was discarded in favor of a masonry block press.

2. WALL CONSTRUCTION ALTERNATIVES

The construction of the Roche Health Clinic from March 2010-April 2011 was a successful and informative process. The building was built on budget and on schedule with dozens of the Roche villagers gaining hands-on experience and knowledge in construction skills that enabled them to press ISSB blocks and build with ISSB construction. Many have since gone on to do more construction in the region.

During the construction of the Roche Health Clinic, we identified several conditions where detailing could be improved to simplify the construction. We designed the health clinic using an embedded ISSB condition in which the block is laid before the concrete column is poured. The column is then poured around the ISSB, thereby encapsulating the wall and providing lateral stability for the ISSB wall as well as the column. When the District Officer (a civil engineer by training) for the region brought a team to visit the building, he claimed that it was "the strongest building in Tanzania!"

ISSB construction required more construction management than we had anticipated. Given that we want others to feel comfortable building with the ISSB technology, this proved to be one of the critical challenges to general adoption of the technology. The other critical issue that keeps villagers from using the ISSB bricks is the need for a concrete plinth beam and ring beam.

In a Roche Health Center Design studio in 2011, we analyzed the construction of the health clinic and then chose to reconsider construction from the ground up, taking inspiration from precedents across the globe. One goal was to identify options that would address the impediments to greater adoption of the ISSB construction system by the community at large. The community had identified the cost of cement and complexity of construction as factors that kept them from using the ISSB more consistently.

We identified three wall types (solid, hybrid and screen) and explored their production in several construction technologies. Solid wall construction types included sandbag construction and gabion wall. We looked to reduce cement through the development of an ISSB column. We explored modifications of the existing ISSB blocks to create a corner that was more flexible. We also explored contemporary thatch as a roof alternative that might be accepted by the community. One group of students challenged the use of a wood truss; they built a steel truss to assess its potential.

The results of the mock-ups were mixed. We all agreed that the ideal wall construction would have integral tension members for structural resistance. This would be the only viable way to eradicate the need for concrete columns. But, we always returned to the ISSB because of its availability locally. The steel truss would alleviate some of the labor issues found with the wood truss, but other issues emerged in regards to the challenges of fabrication and maintenance. The corner options have great potential and we intend to explore those further.

During one series of ISSB explorations done with our partners in Tanzania, we had produced a series of inserts to create variations of the typical blocks for corner and joint conditions. While we were struggling with this strategy, one of the ISSB masons, Matthieu, showed us that we could simply carve the blocks with a knife, if we did so immediately after they were pressed.

3. ACOUSTIC IMPROVEMENTS TO ROOF/CEILING

Acoustics is a critical issue in many buildings in impoverished areas of rural Tanzania. In buildings without ceilings, the sound of torrential rain on the metal roof is so

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Figure 5: UC student David Cole's mock-up of concrete corner for ISSB wall, *photo by author*

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deafening that schools have to close until the raining stops. There are two significant rainy seasons in this region and the rains can lead to days without school for buildings that don't have ceilings.

We addressed this by identifying all available materials that could be used for the roof and ceiling construction. We then made a series of mock-ups and compared the sound level directly underneath the roof under comparable rates of rain (from a hose). We used an acoustimeter to measure the levels as we compared different combinations of the materials. Eventually we dropped from 99 decibels directly below the roof to 84 decibels.

This research directly influenced the construction of the health clinic roof. Many visitors have noted that it is much quieter during heavy rains as compared to other local buildings. This layered roof is very effective, but also more expensive. We are working with our Tanzanian partners to find more affordable ways to reduce acoustical transfer in these roofs in the future.

4. SCREENS/FILTERS FOR APERTURES

Malaria is the greatest threat from vector borne disease facing the villagers in the Rorya District of Tanzania. However, many of the buildings in the region don't have screens over the windows. The students in the Fall 2011 studio explored different options for providing mosquito screening and light filtering options using local materials. These proved to be very challenging for the students to build without power tools. In the end, the louvers that we developed for the health clinic, which were built by a local craftsman were considered superior to any of the alternatives that the students produced. They gained tremendous respect for this craftsman through this mock-up process.

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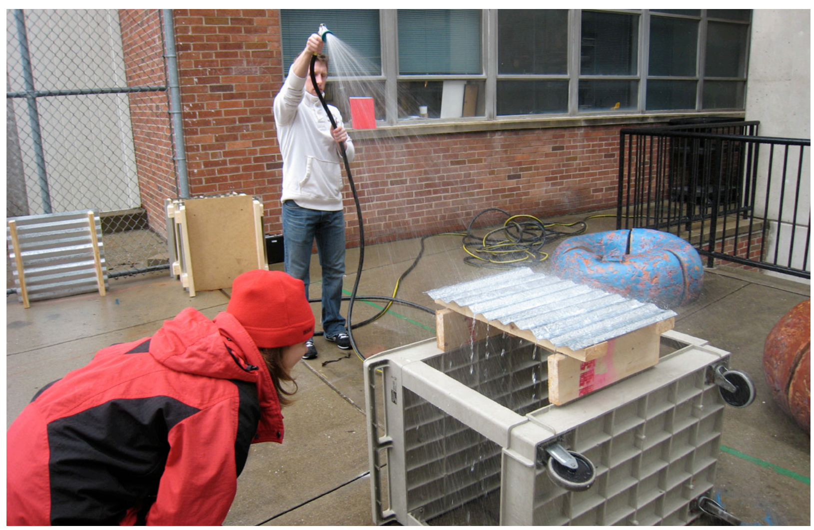

CONCLUSION

The students who have participated in the Roche Health Center studios have had the opportunity to design for and with a community and conditions that are significantly different to the conditions in which they live and work. None of these students had been to Africa prior to taking the studios and few had any knowledge of informal construction techniques. While we were able to lean on critical theoretical readings[10] the research into construction and consequent mock-ups brought students face to face with the opportunities and challenges facing those who would be building the project on-site in Tanzania. Every other type of research kept them at a safe

Figure 6: Tanzanian mason Matthieu demonstrating how ISSB blocks can be modified, *photo by Emily Roush*

Figure 7: Fall 2009 UC students testing acoustics, *photo by author*

distance, but the mock-up enabled them to shift their perspective to one in which they were designing from and within the cultural conditions. Through this process, they gained tremendous respect for what those in rural Tanzania are able to achieve with their given materials and resources.

Students' assumptions about the simplicity or complexity of building a particular element was never accurate and they all found themselves wanting to use power tools for the construction. Being forced to deal with these conditions enabled these students to escape their typical expectations and become intimately familiarized with opportunities and limitations that were different than their own. This evolved into increased consciousness about the opportunities and limitations of the materials and resources within which they typically design.

Even when the mock-ups didn't lead to successful innovations, the learning for the students was significant. Though none of the aperture screen designs will transfer into the actual buildings, the students gained tremendous respect for different ways that builders successfully filter insects while allowing ventilation. Simple things such as mosquito screens gained new consideration in this context. With more time to work with our partners in Tanzania, we hope to be able to collaboratively develop more screening options in the future.

Part of the research process for these studios involves analyzing what is typically designed and built for both functional and cultural reasons. When designing new proposals, the students had to work with the community to develop designs that were culturally-responsive without simply mimicking the existing designs. Rapoport stated that "the traditional and other environments being considered must not be 'copied', but lessons need to be derived through an analysis based on conceptual models from [man-environment relations]."[11] Identifying design expressions that were meaningful and modern, as our Tanzanian partners consistently requested, was extremely challenging. In the end, design required a balance of research, dialogue and intuition. The feedback from the community following the construction of the health clinic was overwhelmingly positive. When interviewed by students of the Clinton School of Public Service in 2011, the Roche community shared great pride in the building, claiming it to be very much "a Roche building."

ENDNOTES

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5. Vincent B. Canizaro (2012), "Design-Build in Architectural Education: Motivations, Practices, Challenges, Successes and Failures," (Archnet-IJAR, Volume 6, Issue 3, November), p.23
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7. Canizaro, p.24
8. This was verified in an assessment completed from June – August 2011 by Spencer Lucker, Masters of Public Service Candidate through the Clinton School of Public Service
9. (2009) document entitled "Interlocking Stabilised Soil Blocks: Appropriate Earth Technologies in Uganda" by UN-Habitat and Good Earth Trust. This document is part of the Human Settlements in Crisis series. http://mirror.unhabitat.org/pmss/getElectronicVersion.aspx?nr=2856&alt=1 (accessed Oct. 1, 2014)
10. Readings on Post-colonialism and cultural difference include: "Development, Cultural Change and Supportive Design" by Amos Rapoport, "Culture and Imperialism", a speech by Edward Said at York University in 1993, Easterly, William; The White Man's Burden: Why the West's Efforts to Aid the Rest Have Done So Much Ill and So Little Good, Moyo, Dambisa and Niall Ferguson; Dead Aid: Why Aid Is Not Working and How There Is a Better Way for Africa, Douglas & McIntyre Ltd, 2010, Polak, Paul; Out of Poverty: What Works When Traditional Approaches Fail, Berrett-Koehler Publishers, 2009 and Schumacher, E. F.; Small Is Beautiful: Economics As If People Mattered. Hartley & Marks Publishers, 2000 (2nd edition).
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