Re_building in Haiti: With and Without Governance

It has been estimated that over 3,000 non-governmental organizations (NGOs) were in operation after the 2010 Earthquake. That led some to refer to Haiti as the "Republic of NGO's". In such a context how should a professor from an American university engage in a rebuilding effort.

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INTRODUCTION

This paper presents three investigations that took place in Léogâne, the town at the epicenter of the 2010 Haitian Earthquake. The assessment of a partially collapsed hospital, developed into the master planning of a 3.5 acres site on which numerous health care needs could be met. To test some of the recommendations of the master plan, a 1,000-sq/ft midwifery training facility was constructed. The third project looked at the broader needs of the community by investigating ways to improve Concrete Masonry Unit (CMU) manufacturing in the town of Léogâne. Each project provided unique learning opportunities for the students involved, while posing the question; what role should outsiders play in addressing problems that are very much rooted in a specific location and cultural context.

BACKGROUND

In June 2010, the Non-Governmental Organization (NGO) Schools for Children of the World (SCW) invited a team of architects and engineers to assess ten schools in the Léogâne Commune. The majority of the schools, like many other buildings in the area, had collapsed or sustained significant damage as a result of the 7.0 magnitude earthquake, which had struck earlier that year on January 12th. During the assessment of the failed buildings there was a great deal of discussion as to what building material would be most appropriate to use in the reconstruction. Some favored the introduction of lighter ductile construction materials while others favored working with the predominant construction method of choice, masonry walls, with concrete columns and beams. The consensus reached favored working with familiar materials, however the need to improve the quality of materials used, and the knowledge of masons working with them was also recognized.

Following the assessment, designs were developed by a number of individuals who had traveled to Léogâne in June. With the experience and knowledge of architects and engineers working outside of Haiti the schools were designed and engineered to resist the seismic and high wind hazards present in Haiti. It took nearly a year for the Haitian Ministry of National Education and Professional Training (MENFP) to approve the first set of drawings, which had been developed ahead of the new Haitian building code, which for the first time recognized the presence of a seismic hazard.

At the time of writing this paper, four years after the earthquake, SCW in partnership with the Spanish Red Cross had completed six schools, with four more still under construction. The Spanish Red Cross had to comply with numerous strict protocols the NGO had developed to ensure the contractors appointed to rebuild the schools were capable of carrying out the work as designed. The extended length of time between design and construction is one of the challenges of working in a developing country. The Ecole National Fond de Boudin, was one of the first schools to be completed in December 2012. The author of this paper was fortunate to see that project through schematic design but became frustrated with what appeared to be protracted delays before work commenced. Out of that frustration the three projects that will be discussed in this paper were developed.

A Community Planning Workshop, hosted by the University of Notre Dame's Haiti Program, held in March of 2011, opened the opportunity to network with Haitians already engaged in capacity building projects both with, and without the support of the international NGO community. During the Planning Workshop the author was introduced to two individuals who had already taken steps to improve services they provided locally. The first was a doctor who was in the process of building a three-story hospital when the earthquake struck. The quake destroyed all but the ground floor of a building under construction for nearly eight years. The second individual was a businessman who attended the planning workshop primarily to inform potential customers that he had invested in new machinery to produce better quality Concrete Masonry Units (CMUs) or blocs as they a known in Haiti. While the Spanish Red Cross sort to find the most capable contractors in the country to complete the projects they were funding, this author, with fewer resources, sort to engage more directly with influential resident of Léogâne with the hope that a more "grass roots" approach to the recovery effort could take hold.

INVESTIGATION 1 – WORKING OUT WHAT WAS BUILT

In 1983 a Haitian organization was established to provide young people the opportunity to gain medical training while serving their local community. Under the direction of Dr Joseph Charles, Conçu pour l'Action Médicale et Éducative par une Jeunesse Organisée (CAMEJO) developed a loyal client base by caring for patients from initial consultation, through diagnosis, treatment, and recovery. Working almost entirely with revenue generated within Haiti, CAMEJO managed to secure sufficient funds to start constructing a 14,000sq/ft hospital on a 3.5-acre site. The earthquake struck when the hospital was only months away from being open to the public. Like many projects in Haiti, and other developing countries, construction takes place when funds become available. This "stop-start" approach to construction leaves a building very vulnerable prior to completion. Metal reinforcement can corrode before being covered with concrete, structural columns and beams are cast with little continuity, and as in the case of the CAMEJO Hospital no shear wall elements had been constructed on the second floor prior to the earthquake. The combination of these inadequacies resulted in the connections between columns and beams on the second floor failing as the roof slab moved laterally during the earthquake. The ground floor of the Hospital remained in tacked. Photographic and video evidence of typical building failures taken on site, and in the town of Léogâne were brought into a studio setting at the University of Illinois where they were studied by students enrolled in a course titled Architectural Design and Exploration:

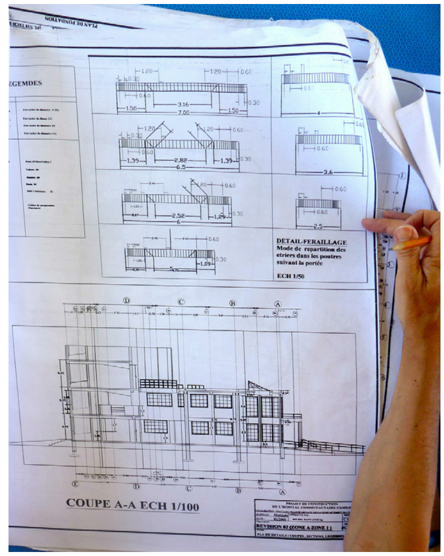

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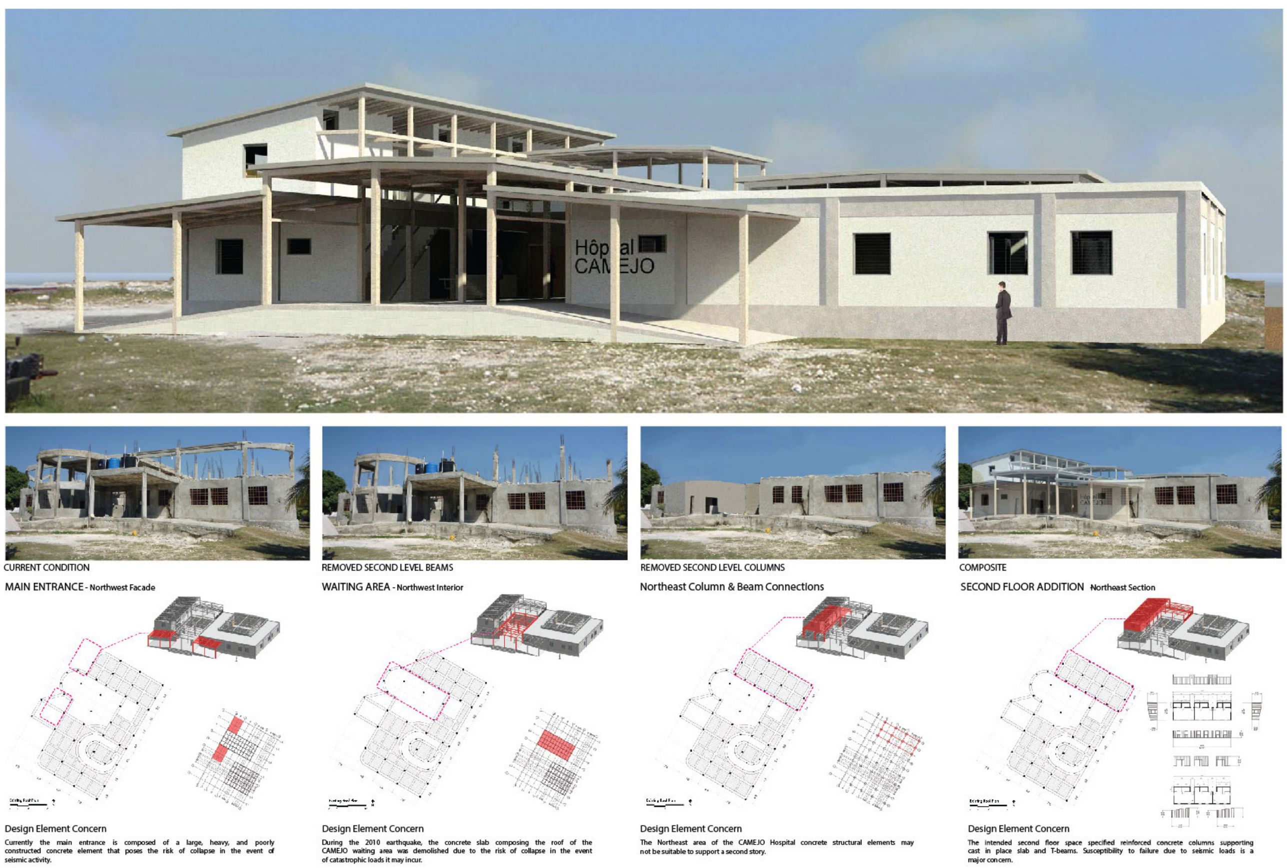
Figure 1 Working Out What Had Been Built

Arch 476. The course was designed to “explore the boundaries of architecture and the built environment” with the intent that the explorations made would lead into built work. From a class of sixteen students, half opted to analyze how and why the CAMEJO Hospital had collapsed, while the other half studied photographs of shops and homes in the town of Léogâne to see if particular building forms or materials used could address the seismic and high wind hazards present in the region.

Following review sessions and input from faculty with a specialization in structural engineering the teams looking at the CAMEJO hospital, including copies of the original construction drawings, split into two camps. One group was so concerned that the original connection details were inadequate to deal with lateral forces, in addition to the poor quality of the construction materials and craft, they opted to re-master plan the entire campus. The second group was more pragmatic; they were fully aware of the time, effort and finances the local community had invested in the hospital. They also believed the organization would prefer to patch up what they had and carry on as best they could. Although far from ideal, this team investigated ways of removing the most dangerous, or redundant elements of the building, such



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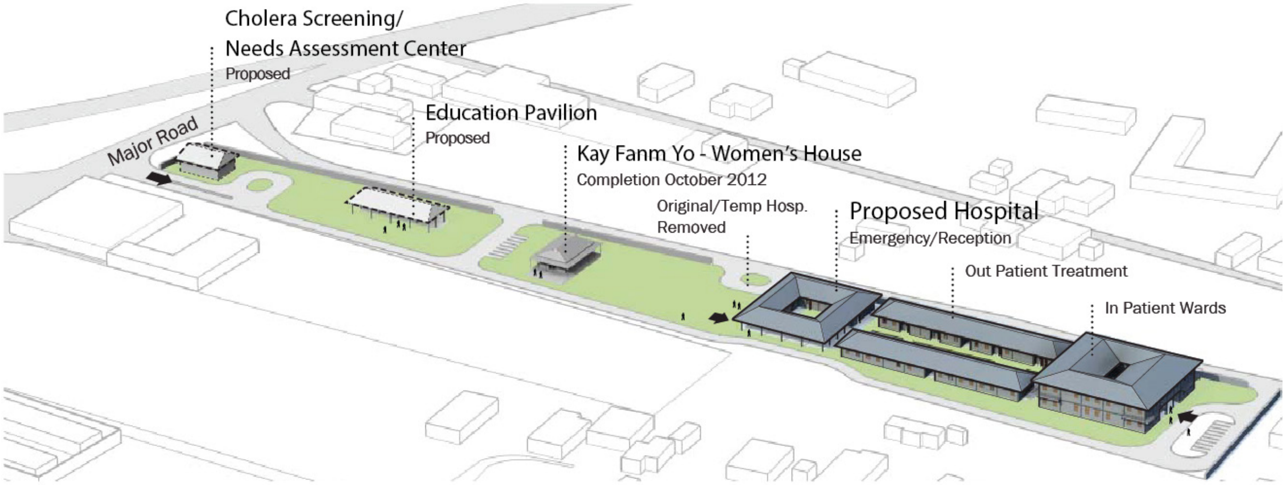
as a ramp to the second floor. Reducing circulation space, and reworking the design of the hospital would allow the creation of more treatment rooms. They developed schematic designs that recommended the removal of the most vulnerable heavy portions of the building, such as an entrance portico, and replace them with lighter ductile steel framed canopies and roofs. The outcome of the studio was an impressive 51-page document that analyzed, to the best abilities of the students, the structural integrity of the portion of the hospital that remained. In addition, two schematic design proposals were developed that illustrated sequential steps that

Figure 2 Presentation Board Created By Senior Students Looking to Repurpose The Partially Collapsed CAMEJO Hospital could be taken to utilize the assets CAMEJO had on their campus.



Proposed Campus Plan

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The focus of the studio was to envision a positive future beyond the immediate situation, in which the same barefoot construction workers who had built the hospital were demolishing portions with sledgehammers. With no enforcement of any regulatory requirements pertaining to structural engineering design, workmanship or raw material quality, the students and studio instructor began to question how could a project like this proceed to the next stage and into construction without those issues being addressed.

INVESTIGATION 2 – MIDWIFERY AND TRAINING

Concurrent with the discussion surrounding what could be done with the main CAMEJO hospital, a proposal was developed to establish midwifery training on the same campus. A loose collaboration was established between two NGOs based in the US and CAMEJO itself. The author of this paper was invited to join the effort and design a structure that acknowledged local building methods, but incorporated improvements that would resist the seismic and high wind hazards present in the region. The 1,000 sq/ft Kay Fanm Yo (Women's House) was an ideal opportunity to understand, at a material level, the challenges contractors face when trying to

Figure 3 Work Comencing On The Kay Fanm Yo (Womes's House) build resilient buildings in Léogâne. The project could also serve as a prototype, and test case for aspects of the master plan developed in the design studio. During the planning stage of the project there was a hope that the model for health care training already practiced at CAMEJO could be transferred into locally based 'on the job' construction training. With so many people injured from the earthquake having received treatment at CAMEJO, a clear connection could be made that "good building practice would serve as the best course of preventative healthcare" . One student from the Arch 476 studio, Shengxi Wu assisted in the preparation of educational material that concisely conveyed the measures required to build a robust building.

Canyons Structural Consulting, based out of Salt Lake City, Utah was appointed as a consultant to ensure the building was designed to a Seismic Category D rating in a location susceptible to 3-second wind gusts of 135 mph. To avoid the complexity of designing and building resilient column and beam connections reinforced masonry was selected as the most appropriate method of construction. A degree rigor was required to set out vertical rebar with the appropriate spacing, and securing CMUs with the required dimension and two cavities was a particular challenge requiring a trip to the capital Port-au-Prince to buy enough blocs to construct the first eight courses of the building. Acquiring sand and aggregates that were of suitable size, angularity and purity was also a challenge, but possible. Vendors locally, or in Port-au-Prince were able to supply everything required to build the Kay Fanm Yo. That said, connectors, treated lumber, and sheet material was imported from the US and sold at nearly twice the cost.

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With funding promised, but not secured, construction began in June 2011. During the first nine-day trip raw materials were sourced, a partner contractor appointed and a foundation dug. At that stage accommodation in Léogâne was very difficult to secure, so no students from Illinois were invited to attend. Four more trips were taken over the course of an eleven-month period. The longest time spent in Haiti was twenty days in May 2012. During that trip a research assistant, and competent carpenter Bill Hodges, joined the effort to complete the structural shell of the facility. An innovative formwork was used to create the critical bond beam at the

Figure 4 Improvement To Craft And Materials in Léogâne

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top of the walls, roof trusses were assembled and the structural shell completed and made weather tight. With that work done the local contractor was left to complete interior finishes.

At the beginning of the Kay Fanm Yo project there were many unknowns, the principle ones being how long would it take to construct the building, and how much it would cost. Estimates were made as to what material and labor costs would be, however neither those wanting the building, nor those who would build it, were willing to enter into any formal contract. The project proceeded based on mutual trust and verbal agreements, very much like many smaller projects in Haiti. Small amounts of money were given to allow the main contractor to purchase material and hire day laborers. Once the materials had been used a detailed itemized bill was submitted and any balance due paid. To complete the structural shell, workers were on site for approximately fifty days. To complete the interior and exterior finishes, the electrical, plumbing and drainage work required another month. If there were no breaks in construction and with the knowledge gained during the process, a similar project could be completed in little over a month and a half. The time lag between the start and conclusion of construction reduced the momentum that was developing to see more construction workers trained to build stronger buildings. Expected funding did not materialize resulting in one of the original US partners withdrawing from the project. These turn of events towards the end of the project were a little disheartening, however those feelings past once the project was officially opened, allowing pregnant women to receive consultations, and birth attendants to receive training.

The project certainly is making an on going positive impact on the community. However to realize the larger vision to see construction workers receive work-place training would require significantly more funds and a longer term commitment. Local instructors would need to receive training the support of local trade organizations established and more construction projects identified and funded.

INVESTIGATION 3 – ADJUSTING FOCUS

In the months that followed the earthquake a number of approaches to construction, new to Haiti, were proposed. A Housing Exposition promoted by the Interim Haiti Reconstruction Commission (IHRC) with backing from the Clinton Foundation and the Inter-American Bank, showcased 60 houses built on land approximately 5 miles north of Port-au-prince in Zoranje. The aim of the Expo was to build a bridge between the entrepreneurial and donor communities to address the tremendous need for housing. Following the Expo a number of house designs were to be

Figure 5 Local Investment in Equipment And Labor replicated in a village of 400 homes “dubbed the ‘exemplar housing settlement’ ” . In Léogâne, there was also openness to the use of new materials soon after the quake. Donations of dimensional lumber and light gauged steel introduced ductile systems of construction, the type of which had not been used since the 1800’s when trees were in plentiful supply on the island. Used in small transitional shelters these materials were later perceived to be cheaper inferior substitutes to concrete masonry units that, up until the earthquake, had served those who could afford them well. Heavy and robust CMU construction is a good choice to resist high wind forces that are experienced on a seasonal basis. However weak connection detailing, and weakness in the blocs themselves are likely to fail catastrophically when subjected to the lateral forces unleashed by a high magnitude earthquake. In Léogâne the chances of such an occurrence is once in every 50 to 100 years. Dimensional lumber and light gauge steel fell out of favor when contracts to sheath stick-framed buildings were not completed. Light gauge structures covered with house wrap offered little security to those wanting a safe place to shelter with whatever remaining possessions they may have had. Long before contracts to supply temporary relief housing were completed, residents of Léogâne, like many in the affected areas, started to build permanent structures with locally produced CMU blocs.

The proprietor of Leomat Construction S.A. was one of the few suppliers of building materials in Léogâne who attended the Community Planning Workshop hosted by University of Notre Dame in 2011. Like many attending the workshop he was very keen to know where was safe to build, and what additional measures could be taken to improve the local building stock. The experience of building the Kay Fanm Yo highlighted the very limited supply of good quality bloc in Léogâne. In addition to variable quality, finding blocs of a suitable size an form for use in reinforced masonry construction was a real challenge. Following the quake Leomat had imported brand new equipment to increase their block production from approximately 2,000 blocs a day to 10,000.

During an initial tour of the Leomat facility encouragement was given to purchase additional molds to allow the production of a bloc measuring approximately 8”x8”x16” with two cavities through which reinforcement bar could pass.

Research was carried out at two additional large scale, and one small scale, manufacturing facility to ascertain wha levels of quality control were in place, and what prices blocs were being sold for and how many blocs were being produced a day. The Haitian Ministry of Public Work, Transportation and Communication released guidelines in September 2010 that recommended all blocs used in construction should have a compressive strength of 10 MPa (1,450 psi) or greater . This recommendation was never mandated or enforce. It was not surprising therefore that initial test results carried out on the blocs tested from the four suppliers in Léogâne came back with troubling results. Of twenty blocs that were tested the average tested compression was 5.96 Mpa, well below the Haitian Governments minimum guideline. Reports from the initial investigation were prepared in French and submitted to the owner of each company. The reports made recommendations of measures that could be taken to improve bloc quality. The recommendations made were as follows:

1. For the first 24 hours of the curing process keep blocs under shade. 2. Spray blocs with water during the initial curing period. 3. Instigate tighter controls over mix ratios. 4. Increase the amount of Portland cement in the ratio of sand, aggregates and cement.

A second round of testing was conducted exclusively at Leomat. The test was carried out the determine if blocs dried in the shade would have better compressive strength than blocs dried in full sunlight. Anecdotal evidence indicated a block dried in the shade could have a compressive strength as high as 11.56 Mpa (1676psi). However results as low as 5.32 MPa were also present in the sample batch. These discrepancies could be an indicate of a number issues:

1. The proportional mixing of aggregates was a more significant factor than whether blocs were dried in the sun or shade. 2. Transferring the freshly formed blocks into a shaded location may have weakened the block before curing had commenced. 3. The samples tested may not have been prepared correctly leading to a more concentrated load being exerted on a smaller portion of the bloc swaying the result.

Despite these less than conclusive results it was encouraging to see that in the year that past between the first set of tests and the second the average block produced by Leomat had improved from 6.38 Mpa (991 psi) to 8.16 Mpa (990.60). This improvement is significant especially when one considers in the time between the first and second tests Leomat invested in two additional high capacity machines and had probably produced over 4,000,000 blocs.

CONCLUSIONS

Conducting research and building in a developing world context rarely, if ever, goes smoothly, and even positive outcomes are tinged with regrets of what could, should, or might have been improved on. The three projects described in this paper are no different. In relation to the main Hospital on the CAMEJO campus the reticence to demolish anything except what was completely failed may have stopped this project moving further forward than where it is currently.

Following the disaster there was a period of time when volunteers were clearing failed buildings at no cost to the owner. The management of CAMEJO did not take up that offer of assistance. With large portions of the hospital fixed with poorly patched repairs there is probably now less likelihood to receive the significant funding required to conduct major structural repairs, develop a new campus, and conduct on the job training.

The construction of the Kay Fanm Yo was far more rewarding, a limited number of student were given the opportunity to understand the principles behind the design and engage in the struggle to build it in a challenging context. The building has been officially opened and women are receiving treatment and midwives are being trained. A return trip, to complete the next phase of the project, the installation of a veranda to provide valuable shade is very likely. It is hoped approval will be granted for more students to be able to participate in such a trip.

Improving the quality of building materials was identified very early in the recovery effort as a way to directly improve the standard of construction across the region. Playing a small part in the improvement of CMU manufacturing in Haiti feels good. The concentration and effort required to build one building may have been a distraction from a larger goal, with greater long-term impact. However, local accountability cannot be dictated from an outsider observing failures and inadequacies. As a professor from the US some knowledge can be transferred to influential individuals, but it is for the local community to set their own agendas and shape their own destiny. Haiti was born with an independent spirit, and that spirit lives on to day, it is what makes it such a fascinating place to conduct a Design-Build project.

ENDNOTES

1. United Nations Report on CAMEJO and overall healthcare in Haiti. *http://www.youtube.com/watch?v=-3mI72JU1Lo*
2. Plant Process Produce - Housing for Haiti. *http://openarchitecturenetwork.org/projects/housing_for_haiti*
3. Questions about the reconstruction's housing projects. *http://haitigrassrootswatch.squarespace.com/haiti-grassroots-watch-engli/2014/1/8/questions-about-the-reconstructions-housing-projects.html*
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5. Haiti disaster 'like no other' by Lisa Miller Jan 17th 2010. *http://www.abc.net.au/news/2010-01-17/haiti-disaster-like-no-other/1211514*
6. CAMEJO Hospital - Léogâne Haiti. *http://vimeo.com/68167974*
7. The Building of the Kay Fanm Yo (Women's House) - Léogâne Haiti. *http://vimeo.com/68167973*
8. Haiti disaster 'like no other' by Lisa Miller Jan 17th 2010. *http://vimeo.com/90688472*