

Concrete and Building in Haiti

As of October 10, 2014

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Introduction

On Friday, August 22, 2014, I departed San Antonio and headed back to Haiti with a team from Shepherd of the Hills Lutheran Church in San Antonio, Texas. Various members of the team were to be involved in the graduation of the Lutheran Seminary students, make improvements at the Faith Lutheran Orphanage in Gonaives, work with the orphans, teach VBS, survey rolling equipment to determine needed repairs, obtain parts, and locate parts manuals. I was scheduled to teach three 3-hour classes related to producing quality concrete and building disaster (earthquake and hurricane) -resistant housing.



Figure 1. The team from Shepherd of the Hills, except for Sylvia. Clockwise from the left rear. Larry Singletary, Craig Cannon, Paul Miertschin, Herb Nordmeyer, Jim Moritz, Brenda Rosales, Jessica Eggold, Candice Dominguez, Amy Tilt.

The Best-Laid Plans

The original plan had been to fly out very early Saturday morning and arrive in Port-au-Prince at about 3:30 on Saturday afternoon. Due to cancellation

of a flight, we left on Friday evening, were to stay overnight in Ft. Lauderdale, and then fly into Port-au-Prince Saturday, arriving at 8:10 am. As my friend, Bobby Burns, wrote many years ago, “The best laid plans of mice and men oft go asunder.”

Part of the group arrived in Ft. Lauderdale as planned, but three members of the group made it as far as Dallas where they were housed at the airline’s expense. They were to fly to Miami on Saturday morning and then catch a flight to Port-au-Prince, arriving at 2:30 pm.

Six of the fifteen bags we checked ended up sitting at the Ft. Lauderdale airport instead of being loaded onto our plane. They did not arrive until 3:30 pm on Saturday.

The group that was to arrive at 2:30 pm was delayed. Finally at 4:30 pm, we cleared the airport and headed to Gonaives. The trip normally takes us three-and-a-half hours (Google says the trip should take 2 hours and 3 minutes). We ran into a rainstorm along the way and arrived in Gonaives about 9:00 pm. Since there was no electricity, we ate our delayed supper by flashlight.

The Flood

While waiting for the bags and the other team members to arrive, we had lunch and then went to a guest house which Lophane Laurent is building. The guest house is coming along well and is being built to quality standards. Lophane did say that the building inspectors need to see everything during the building process; and as a result, building is much slower than with his normal building. After we had looked over the building, Sylvia (my granddaughter) and I ended up in the back of the lot where we observed the open sewer which flowed past the guest house. As with most open sewers, it was filled with trash and appeared anaerobic. Since there was rain in the area, the water level increased; and children, mostly boys, were like boys everywhere around flowing water. They were playing in the sewage.

When we headed north to Gonaives, there were showers; and before we got halfway there, we experienced a general rain that was heavy. We observed a number of open sewers flowing much higher than normal. About halfway to Gonaives, the sewage was flowing as much as six inches deep over Route 1 in several areas. We observed sewage entering homes near the sewers and people wading in the sewage. Later we learned that three deaths had been reported because of the flooding.

The Comforts of Home

We stayed at the guest house owned by the Lutheran Church of Haiti. The dormitory rooms were air-conditioned. There was a minor problem associated with the air-conditioning. Electricity from the city grid failed on a regular basis.

We had been informed that part of this was a rolling blackout because there was not enough fuel to provide all of the electrical needs. As a backup, we had a generator which would be started when the electricity failed. Periodically the generator was borrowed to use at other church-related functions, and sometimes it would not start. When it would run, for whatever the reason, the generator put out 40 volt electricity most of the time. That was not enough to run the air-conditioners. This resulted in times when we had air-conditioning and electrical lights, times we had electrical lights and no air-conditioning, and times we had neither air-conditioning nor electric lights. In anticipation of the electrical issues, I carried four headlamps with me to Haiti and ended up loaning all of them out.

Concrete Technology Seminars

Our schedule called for me teaching three-hour classes on Tuesday, Wednesday, and Thursday. From previous experience, I knew that there would be changes, but I had adequate lesson materials for the three classes. I did not know whether my students would be new students or whether they would be students who had previously studied with me. I was prepared for both. I arrived in Haiti with approximately 20 pounds of handouts for an estimated 15 students.

On Tuesday, the Lutheran seminary graduation ceremony was held. Since it ran long, my Tuesday class was canceled. When the Wednesday class assembled, I found I had a mixture of new students and old students. The class started with one of my original students asking a question. I answered the question.



Figure 2. Concrete Seminar in Gonaives.

Another of the original students asked for permission to tell about his experience in building. He had shown the information I had provided last year to the owner of the house he was building. The owner decided that the suggestions in my documents would produce a much better house, so he authorized my student to make modifications. That led to a better house and to more work for that student. That student now has a reputation for building quality homes.

Another student indicated he had to take shortcuts; otherwise, his clients would go to other contractors. Before I could comment, the student with the reputation for building quality houses chimed in. The lesson that was available to all of the students was that the decisions you make have a strong impact on your reputation and the expectations of the clients you attract. There is a plethora of

contractors competing for the lowest-quality house construction. Why fight for a place in an overcrowded market when you can build quality and have much less competition?

After that we spent the rest of the class with questions and answers. When a question came up where I had lesson material that would help answer the question, I passed the lesson material out.

Figure 3. Pouring a roof on a 2nd story building.



After four hours of questions and answers, the students decided that I needed a break. They had been promised lunch, and it was not ready, so they talked while I was sent off to take a quick nap.

By the time I finished my lunch, their ride had come, and they departed.

The second day started with more questions and answers. Three hours into the three-hour class, we went on a field trip to see construction defects in the area.

There was a tree growing from the second-floor slab.



Figure 4. A tree has taken root at the second floor slab which extends out from the wall.

There was a support column with eroded concrete.

Figure 5. Support column with eroded concrete. It was holding up outside stairs.



We stumbled upon an electrical connection.

Figure 6. Electrical hookup for a guest house.



Numerous foundations were eroding.

Figure 7.
Numerous
foundations
showed erosion.



Rebar corrosion cracked concrete



Figure 8. Rebar corrosion caused the face
of the column to spall off.

Faulty foundations caused fences to crack.

Figure 9. An inadequate foundation led to this wall cracking.

At each location, we discussed the cause of the problem and possible solutions. As we progressed, they started pointing out problems and leading the discussion.



Towards the end of the field trip we looked at a set of outside stairs which had faulty supports, corroded rebar, and concrete with lots of voids. As I started up the stairs to the second floor, they stopped me and told me it was not safe.

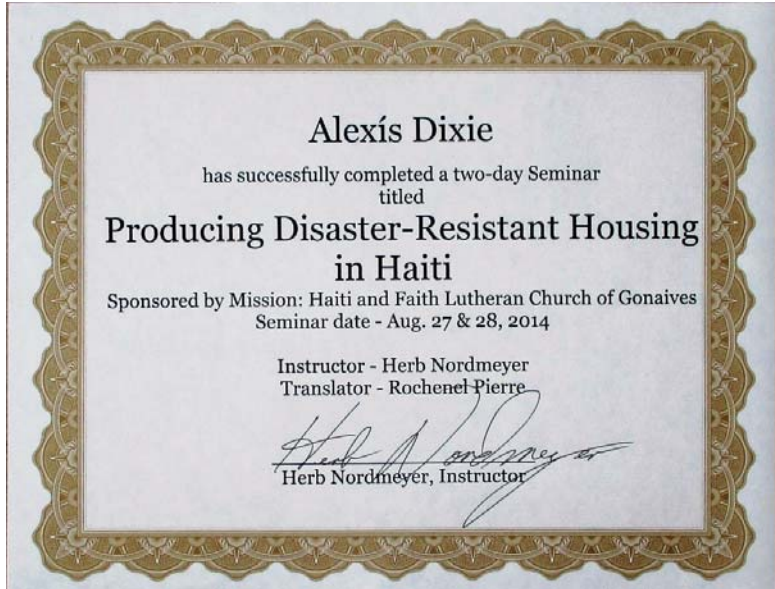


Figure 10. Porous concrete used to form an outside stair.

These are the people who will replace me in teaching construction seminars in Haiti. They will reach many more people than I would ever be able to reach.

Class certificates have been produced and will be delivered on my next trip to Haiti.

Figure 11. Class Certificate



Construction Literature

All of the material I have produced and have available is in English. Many of my students do not speak English and even more do not read English. As a result, they have requested that I prepare the seminar documents in Creole. There is one minor problem: I do not speak or write Creole.

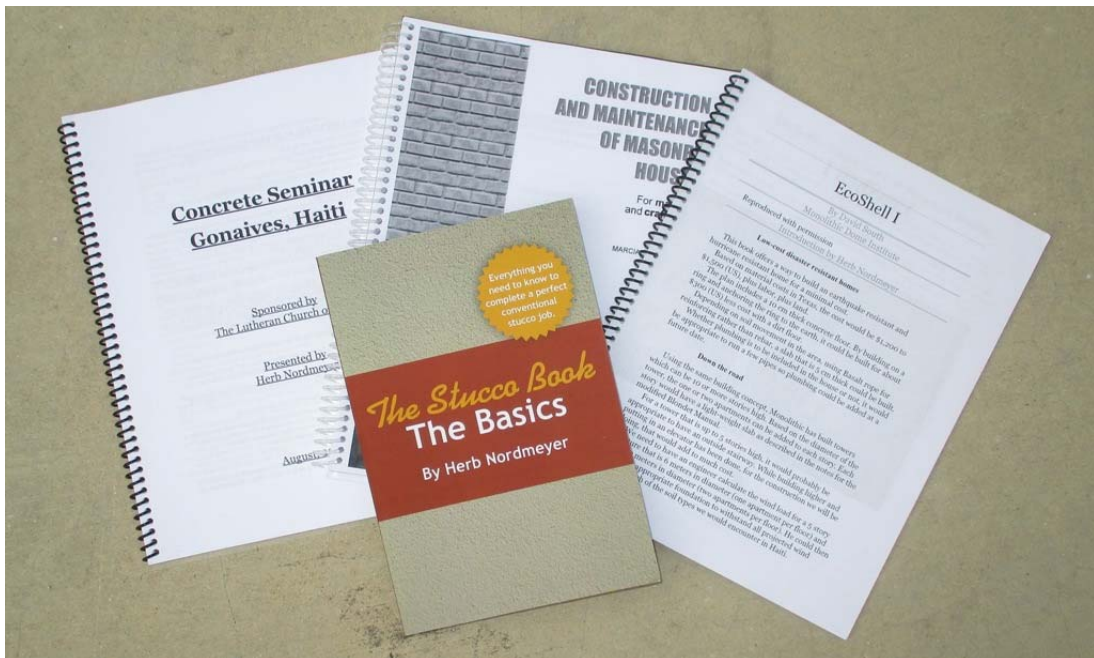


Figure 12 Class literature.

We will be producing two books and at least one booklet. The first book has the working title of **Producing Quality Concrete in Haiti**.

The second book has the working title of **Building Disaster-Resistant Housing in Haiti**. With the second one, we have permission to use the Blondet Report (produced by Romanian engineers for the rebuilding of Peru after the Peruvian Earthquake), in whole or in part, as long as we give credit to the developers of the original document.

The booklet has a working title of **Low-cost, Disaster-Resistant Housing in Haiti**. It is a development of Pastor Benoit challenging me to develop a technique to build disaster-resistant housing for the poorest of the poor in Haiti. He has given me a maximum budget for materials of \$1,000 US per house. Working with David South, President of the Monolithic Dome Institute, we have reduced the cost materials for such a structure to about \$1,200.

Producing Quality Concrete in Haiti

Most of the English text for this book has been written. We need to produce a number of charts, illustrations, and tables. Then all of it needs to be translated into Creole.

Currently it is about 50 pages long. By the time the illustrations, charts, and tables are added, it will be between 80 and 100 pages in length.

Following are some of the steps necessary to produce this book:

- Write the text
- Develop a list of charts, illustrations, and tables
- Contract with someone to produce the charts, illustrations, and tables if it is not something which can be done in-house
- Insert the charts, illustrations, and tables
- Determine printing needs and estimate costs
- Find funding for the project
- Determine whose name(s) will appear on the title page
- Develop the front-matter for the book
- Develop the back-matter for the book
- Have the book translated into Creole
- Have the translated book proofread by a construction professional
- Assign an ISBN
- Develop meta-data and file
- Obtain a Library of Congress number
- Reformat the book and convert to Adobe
- Have the Adobe version of the book proofread by several people
- Determine whether to use POD or Lithography to print the book
- Submit to printer
- File for US Copyright
- Distribute book

Building Disaster-Resistant Housing in Haiti

The Blondet Report consists of text and cartoon characters illustrating the steps for building a disaster-resistant home using confined masonry construction. Converting it into Creole can be done in several ways.

Figure 13. The Blondet Report

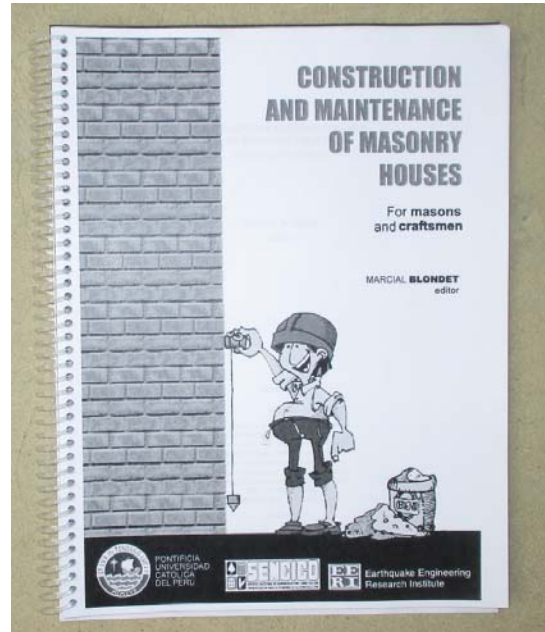
The easiest would be to place the original document, in English, on the right-side page (odd number), and the Creole translation, without the illustrations, on the left-side page (even number). This would have the advantage of being the easiest method to proceed, but the results would not look professional.

A second way would be to separate the original document into the individual components, white-out any text, and insert the Creole text. The document would then be reassembled. This method would look much more professional. We would need someone who is familiar enough with Adobe so the components could be separated out and then put back together.

A third way would be to locate an artist who could redraw the illustrations to make them more Haitian specific and add the Creole text to the illustrations. With the right illustrator, this would produce the most professional looking book.

We also need to write additional sections / chapters for the book. They include, but are not limited to:

- Seismic regions of Haiti
- Constructing a slab on grade
- Building a conventional concrete roof
- Building a lightweight concrete roof
- Manufacturing lightweight hollow tile to replace the hollow clay tile listed in the Blondet Report



Low-cost, Disaster-Resistant Housing in Haiti

Jubilee is one of the poorest slums in Haiti. Some of the people own the plot of ground their hovel is located on, others do not. Pastor Benoit has challenged me to develop housing technology which will allow the construction of

a low-cost house which will be disaster-resistant and for which the materials will cost less than \$1,000.

The water table in this area is high, and the chloride level in the water is high, so conventional rebar cannot be used. The house needs to be such that additions can be added as the owner's economic situation improves. It appears that a 17-foot-diameter EcoShell II from Monolithic Domes using basalt rope instead of steel rebar will function well for this purpose, but the cost would be a little higher than the \$1,000 materials limit.

Basalt rope does not need the cement coverage that steel rebar needs, and it is impervious to chloride corrosion. That will cut costs. Some of the excess cost could be eliminated by eliminating the concrete slab, or by using a 5 cm concrete slab rather than a 10 cm concrete slab. If the stucco is applied carefully, the shell thickness could be reduced to 2.5 cm.

Translating the Books

We know that having the books in Creole will make them much more accessible and acceptable than having them in English. There are several ways we can go about translating the books into Creole, but can we handle it in a manner so the translation work will have a much greater impact on the acceptance of the books and their impact on Haiti? So, rather than just looking at the cost of a project, we are trying to look at the long-term results of the project.



Figure 14. Translator Sophonie Francois with some of the orphans at Faith Lutheran Orphanage in Gonaives.

One of the translators I work with, Sophonie François, is twenty-four years old and wants to go to architectural school in Santo Domingo, Dominican Republic. Her mother has obtained a job in Santo Domingo which includes housing. Moving to Santo Domingo and attending school will eliminate the income Sophonie earns from translating for Mission: Haiti and other groups. We are trying to determine the total cost for her to go to architectural school. The tuition is \$80.00 US per month and the school last for four years.

Sophonie has a heart for helping people, and as an architect, she will be helping many people in Haiti. If she serves as the primary translator and her name is on the cover of the books, it should help her career, and it should make the books more acceptable to the Haitian contractors who will be using them.

Ideally we would set up a fund through Mission: Haiti to collect and disburse funds for her schooling. We are not asking for funding at this time, but if you would be willing to donate to an educational fund, please let me know.

Overhead Water Tank at an Orphanage

While at an orphanage, I was asked to look at an overhead concrete water storage tank. It had been taken out of service because it was leaking. Looking at it from a distance, I noted that three of the four concrete legs were not vertical and that there was no bracing between the legs.

Figure 15. Bottom of overhead water tank.

On the bottom of the tank, I noticed a hairline crack. I used the edge of my hand to hit the cracked area and a piece of concrete came off in my hand. It exposed the rebar which showed signs of deterioration. I then reached up and grabbed the rebar and it crumbled and came off in my hand. A decision was made to remove the water tank.



Figure 16. Corroded rebar from overhead water tank.

Open Sewers in Haiti

I have not been asked to examine the open sewers in Haiti, but with the other work I do in Haiti, I see them every day. Here are some of those observations.

For years the sewers in Haiti have been open ditches. As they erode, they tend to destroy the streets along which they run. To eliminate this erosion, following the earthquake of 2010, many of the open sewers have been concrete-lined. The concrete for them has regularly used relatively large stones and left them exposed. This produces an impressive-looking open sewer, but it leads to some problems.

Some of the stones are deteriorating.

Figure 17.
Deteriorating stone
in sewer.

Around most of the stones, the concrete has shrunk and left an interface crack where anaerobic sewer water can penetrate into the concrete. After fewer than four years, there are



signs that the concrete is degrading. Even though concrete is used for sewer plants around the world, the concrete in Haiti is not holding up.



Figure 18.
Decorative
concrete in an
open sewer

As debris collects in the bottom of the open sewers, men shovel the debris up onto the streets where sooner or later it is picked up and disposed of.

Figure 19.
Cleanings from the
open sewers makes
a "sand pile" to
play in.

Within the past year, a new technique is being used to line the open sewers. Rather than sloped sides, a footing is poured and vertical walls are built with concrete block, and then the concrete block are plastered to protect them. While this system appears to be better, we have already seen deterioration in these sewers.





Figure 20. The new version of the open sewer.

Steps are being taken to cover the open sewers by placing concrete slabs over them. This allows the areas to be used as sidewalks and allows vehicles to drive over the open sewer.

Now a little chemistry lesson - When sewage becomes anaerobic, it produces sulfur dioxide. When sulfur dioxide is in contact with water, it forms sulfurous acid (not as strong as sulfuric acid, but in the same chemical family), When the sulfur dioxide bubbles out of the sewage, if it is in an enclosed sewer, it often dissolves into the water droplets which have condensed on the upper surface of the sewer line. As a result, the concrete above the sewerage deteriorates. Cracks have been observed in several of the slabs that are covering the open sewers. Such cracks will allow the sulfurous acid to reach the rebar and accelerate the deterioration of the rebar.

Next Trip

The plans are not complete, but I intend to head back to Haiti in January with a group from St. Paul Lutheran Church from Destin, Florida.

Figure 21. Sylvia was not in the photo at the beginning of this report. Here she is at the Faith Lutheran Orphanage. One of her duties was to take care of me.

