Concrete & Building in Haiti

Building Homes for Jubilee

Report Concerning the September, 2015 Trip

As of October 23, 2015

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Introduction

Even though I had no intention of going to Haiti during the hottest months of the year, I was there in July and in September. Needless to say, the heat was brutal, and I hereby resolve (at least at the moment) to never go back in July, August, or September.

We planned on erecting two domes, but we ended up getting one erected; and in the process we learned a great deal about working in Haiti.

We loaded a crate with a second shipment of basalt rebar and basalt rope and other things and shipped it to Haiti. Due to my delays in getting the order together and due to some flooding in the Houston area, the crate arrived in Saint Marc, Haiti, on September 17. By now it should have cleared customs, the import duty should have been paid, and it should be in Gonaives.

So far, American Airlines has not given us the "frequent flier miles" the Airform should have earned with their routing it to destinations it should not have gone. The Airform arrived and has been used to build one dome.

Are We Still Teenagers?

On the trip from Port-au-Prince to Gonaives, a van passed us with a casket and funeral flowers on top. On highway curves the casket would slip back and forth, and flowers would break off from the wreaths. Helen and one other person in our vehicle wanted photos of the van and the casket, so Lophane speeded up. The van speeded up. Apparently they thought we were chasing them. We were. For a number of miles we traveled on Route 1 at a pace faster than I had ever traveled on Route 1 before. Photos were taken as we approached Gonaives and then we slowed down. No one has shared the photos with me, so I cannot add a photo of that precarious casket on the van.

Shipping Supplies to Haiti

If we were to finish two domes and if the crew would start building under Lophane's supervision, we were going to need additional supplies, so in July, arrangements were made to ship additional basalt rope, basalt rebar, basalt fiber, primer, wind turbines, and other things to Haiti. Included in the crate were 3 bags of

hydrated lime for whitewashing, a die for cutting threads in 3/4 inch pipe (cheaper to buy 20-foot lengths and cut, than to buy 2-foot threaded lengths), a hammer, and a drill. One roll of the basalt rebar was 12 millimeter while the other rolls were the 6 millimeter stock we had purchased before. The 12 millimeter rebar will be cut into 15-inch lengths and used as shear bracing along the perimeter of each dome. The shipment was delayed from leaving Houston for a week because of flooding. It was shipped on Monarch's mid-September ship and arrived in Saint Marc about the time we were leaving Haiti.

Keeping to a Schedule

In Haiti, we often do not realize reality when we set our plans. For example, on Monday morning, we planned on eating at 8:00 am and leaving the Guest House immediately thereafter. Everything was on schedule until we started to load the generator which was stored in a locked room at the Guest House. It was not there. Lophane got on the phone and found it at Faith Lutheran Church where it was being used on a regular basis. We headed over there and retrieved the generator and made it to Jubilee by about 10:00 am.

Due to the intense heat, we wanted to eat an early breakfast each morning and head out. That way we could get a lot done during the "cool" of the day. After several delays, we found that leaving the Guest House at 7:00 am and then having breakfast brought to us at about 9:00 am when the breakfast for the crew was brought worked out very well. That is, except for the first time, when someone forgot to include our breakfast. Thankfully, I had a box of granola bars in my backpack.

Normally we leave Gonaives on the day before our flight during late morning or early afternoon. This allows us to get most of the way to Port-au-Prince and stay in a motel. We then get up the next morning and leave the motel at 4:00 am to arrive at the airport in time to check in for our flight. Due to protests taking place along Route 1, our security officer told us that we would leave not later than 7:00 am. Apparently his briefing made an impression, since we were on the road by 6:30 am. We drove all the way to Port-au-Prince. Lophane did not even stop so we could have a bathroom break. The only time I have seen Lophane drive faster was when he was chasing a van so Helen could get a photograph of the casket on top of the van.

Erecting the Airform

In June, we tried to attach our Airform to the first slab. We discovered that it was a 30-foot Airform, and we needed a 20-foot Airform. We learned a lot in the process. For our July trip, we should have had a 20-foot Airform, but American Airlines shipped it to Brazil rather than Haiti. It arrived in Port-au-Prince after we left.

We returned in September to erect a 20-foot dome.

Erecting the Airform. Note the proximity to the sewer ditch, the adjacent home, and the community water well.

Since we had drilled and installed 1.25 inch Tapcons in the slab when we tried to install the 30-foot Airform, and since the aggregate in the concrete mix was not ideal, we opted to use 2.25-inch Tapcon anchors.

Attaching the Airform proceeded without many problems. The problems which occurred were related to:

1. Not stretching the Airform tight as it was being attached. As a result, a portion of the back wall was straight rather than curved.

2. Not holding the bit straight as holes were drilled for the Tapcon anchors. As a result, bits broke before they got dull.

3. Not throwing away Tapcon anchors after they had been used with the 30-foot Airform. Even though instructions had been given to dispose of them, someone had carefully saved them. A Tapcon anchor does not have as much holding power after it has been used once.

Attaching the Airform was done from the inside. Each crew member was trained to install the Airform.

After the Airform was attached, we sealed the junction between the slab and the Airform by laying a piece of Glad Wrap on it and holding it in place with sand. That helped seal the system, but there were still leaks, since the slab was not as smooth as we would have liked to have had it.

For a few feet of the perimeter, 1.25-inch Tapcons were used because all of the longer bits had been broken. This is where the used Tapcons were inserted and where a section of the Airform pulled loose as the Airform was coming up to pressure. Using lead anchors, the problem was soon fixed.

We have a Monolithic blower, and we also have a Kodiak 1 Hp Bounce House Blower. Since the second one would move more air, and thus give quicker inflation, we started off using it and never switched to the smaller blower.

We attached the blower to the inflation tube coming from the Airform. It was centered on the front door. Just above the inflation tube is the man-way. It is a larger tube which is just big enough for a person to crawl through to get access to the inside of the Airform.

Stub-outs were installed for water, electricity, and sewage. We hope that at some point in the future they will be able to be used for these purposes. Another purpose is to

The Airform was inflated and brought up to pressure.

connect the manometer to measure the air pressure inside the Airform and to connect the bypass valve to ensure the Airform does not become over-inflated.

With the blower running, we got the pressure up to 5 inches of water. We were shooting for 6 inches, but did not quite make it. With the first of the stucco, we placed a band around the base of the Airform and that helped seal the system. After that we got the pressure up to 5.5 inches of water.

To provide more lateral support in the event of a disaster, every two feet we drilled and inserted a 15-inch-long x 0.5-inch diameter piece of basalt rebar. These were drilled into the concrete at various angles. While probably not needed, a construction adhesive was used to attach the rebar to the slab.

We applied a primer to the Airform to ensure that the first coat of stucco would adhere better. The following morning, we discovered that it was a very effective mosquito trap.

The base for a wind turbine vent was placed on the top of the dome and stuccoed into place.

Originally three doors and no windows were requested. This was changed to two doors and one window. Scott Conover led the group which built the door and window bucks.

Applying the first coat of stucco.

First Coat of Stucco

The two men who were applying the stucco wanted to apply the first coat about 1/8 to 1/4 inch thick and trowel it extremely smooth. No matter how many times I pointed out that we needed the first coat to be about 1.25 cm (0.5 inches) thick, I could not get the message through.

Overnight, with the first coat not being kept moist and with the thin coating, that skim coat cracked. The next morning the crew understood what I had been saying about a thicker coat, and they then applied the appropriate coating of stucco. When the Airform was removed, the cracks in that initial skim coat showed and they added a finishing coat on the inside.

We had planned on using ventilation block around the perimeter of the dome. Since we could not locate any well-made ventilation block (excess clay in the mix would cause the ones we located to disintegrate within a few years), we went with Plan B. So we cut light-wall 2.5-inch PVC pipe at 45 degree angles. Each piece was 3 inches long. We inserted them in the first half-inch coat of stucco. They were placed about every 3 feet around the dome.

We regularly requested that the stucco be wet down to help the curing. While it was regularly done, only small amounts of water were added until Lophane got up on the scaffold and started throwing 5-gallon buckets of water onto the surface.

Wrapping with Basalt Rope

After the first full coat was dry to touch. the dome was wrapped horizontally, vertically, and at about a 45 degree angle with basalt rope. To make the wrapping easier and to do it without having to get on the roof, the rope was passed through a section of 1 inch PVC pipe. That way a person could stand on the ground and accurately place the rope. The pipe used was Schedule 20, and it was more flexible than desired. Schedule 40 would have been better, but it was not available. Even though the instructions called for using 1.6 rolls of rope, 2.5 rolls were used. To hold the basalt rope in place, 4- and 5-inch zip ties were used. Additionally, the window buck was held in place by rope from it to each of the door frames and with rope over the top of the dome.

Vents placed and first coat of stucco wrapped with basalt rope.

By the time the rope was in place and the first coat of stucco had cured, there were cracks showing in the stucco. This was to be expected. The number and extent of the cracks was not anywhere near the number and extent of the cracks in the very thin initial coating.

Second Coat of Stucco

After the basalt rope was in place, a second coat of stucco was applied. It went on a full 0.5 inches thick. Due to the tight quarters where the house is located, it was difficult to get the scaffold in place so the stucco could easily be applied. Above the window an eyebrow was plastered to divert water to each side of the window. The concept is nice, but we need to practice a little more to have an artistically pleasing eyebrow over the window.

We sent two of the crew up on top of the dome to add the turbine neck to the turbine base. Problems developed, in that extra stucco had been added to the turbine base and it needed to be chipped out before the neck could be added. What we did not realize at the time was that the crew had mounted the base upside down. When the third coat of stucco was applied, the neck was fixed permanently into place. This was a case of we needed to practice putting a turbine together on the ground so the

Applying the third coat of stucco.

whole crew could learn the proper way to do it.

Third Coat of Stucco

After curing overnight, the third coat of stucco was applied. While we planned on using 1.5 inches of stucco, we used 2.5 to 3.0 inches over most of the dome. Since there were some problems with the stucco, which are reported in the next section, I was not adverse to having extra stucco on the dome.

Stucco Problems

The first batch of black river sand we received contained about 20% clay, so we refused it. Later a second batch arrived without the excess clay. All of the black river sand contains oversized, so the oversized had to be screened out.

We developed a batch size based on the effective size of the rented mixer. The mix consisted of 1/2 bag of Portland cement, 2 buckets of sand, 0.5 ounces of KelCrete dry powder, and about two ounces of basalt 9 mm fiber. By adding the contents in the right order, the mixer quickly broke up the fiber bundles and provided a well-mixed sticky stucco.

As soon as I turned my back, the owner of the mixer increased the batch size to 1.5 bags of Portland cement. This resulted in the KelCrete not being activated and the fiber bundles not being broken up. When I stood at the mixer, he would generally follow instructions, but would not leave the mixer running long enough to activate the KelCrete fully or to break up the fiber bundles fully. Constantly I heard from him that he was a professional and knew what he was doing. He admitted that he had never used fiber before and had never even heard of KelCrete, but he was a professional and knew what he was doing. Another trait he had, which I have seen in most people who operate small mixers, he loved to fill wheelbarrow full so the wheelbarrow drivers had problems navigating to where the stucco was to be used.

An architect who works for the Haitian government was on the job site. She chewed him out for messing up the mix. He complied with her wishes while she was standing there, but as soon as she stepped away from the mixer, he went back to his old ways.

The church owns a mixer and with the crate which arrived in Haiti in late September, a gasoline motor was included. In the future, we can use one of our own people to do the mixing, and we will have greater control over the mix.

To overcome some of the problems caused by the man running the mixer, since I could not fire him or teach him, I increased the amount of KelCrete and the amount of fiber used.

On the last day we were stuccoing, we finally got through to him and he started mixing so the fiber bundles were broken up and the stucco was a very sticky paste. Before he would dump a batch he would bring a sample to me if I was not right by the mixer, and I would show him the fine fibers in the mix as I approved the batch.

Scaffold Problems

I designed the scaffold to be light-weight and to hold one person on the top of it at a time. This was an error on my part. Since it was light-weight and we were using it on uneven ground, it became more shaky than we anticipated. Also, some of the welds were having problems so we needed to brace each weld. With that done, some of the framing members showed slight bends, so we braced the ladder sections. As we fixed one problem, the next possible point of failure would become evident.

When we had the scaffold working, and two people were on top, and two were part way up the two ladders, the scaffold was overloaded and slowly sagged, bounced off the dome, and then laid down beside the dome we were working on. The people who were on the scaffold were not hurt, and we did another upgrade.

We then decided we needed to start over and design a scaffold system which would work for a 20-foot dome or for a 30-foot dome. After looking at a number of possibilities, we are working with Van Smith who has been building 20- and 30-foot domes in Belize. Before we head back in January, we hope to build a suitable scaffold in Texas and then ship it to Haiti by ship so it will arrive before we arrive.

Removing the Airform

Several people entered the Airform and started removing clamps. Since having a Tapcon anchor on the floor, dropping the Airform on it and then someone stepping on the Airform could puncture the Airform, we decided to ensure that the inside was clean before we started peeling the Airform from the stucco. First the Tapcon anchors and Clamp Angles were removed and placed into buckets. The buckets were passed out through the man-way. The floor was swept, and the sand and gravel, as well as missing Tapcon anchors, were picked up, placed into buckets, and removed. Only after a careful inspection of the floor did we exit the Airform.

Starting at the doors, the Airform was peeled from the lower wall of the dome. After this was done, the Airform was peeled a little higher. This continued until the Airform dropped from the ceiling. It was taken outside, cleaned, and rolled up. Later in the day it was taken to the Guest House for storage.

Finishing the Home

We sent two of the crew up on top of the dome to add the turbine rotor to the turbine neck. After a time, it was determined that the neck was

mounted upside down and some ingenuity had to be used to mount the turbine rotor. When it was mounted, it started spinning. Air was drawn through each of the 2.5-inch diameter vents and flowed along the inside of the dome and exited through the turbine.

Any place there were cracks showing, inside or outside, a coating of stucco was added.

Several people, including Pastor Benoit, wanted us to add the windows and doors. From the start we had maintained that we would build the structure and then the people who were to live in the homes or their friends would install the doors, windows, walls, and sleeping shelves. If the building crew becomes involved in adding them, that would reduce the number of homes we could build.

The lady who was to live in the home wanted us to paint the inside and the outside of the dome. We explained that we recommended a whitewash on the outside because it would make the dome cooler. Lime was being shipped to Haiti for whitewashing, and in January I would teach people how to whitewash. If the outside was painted, we would never be able to whitewash the outside. Currently we can find no sources for hydrated lime in Haiti, so to have hydrated lime, we need to add bags of it to crates we ship to Haiti.

If she wanted to paint the inside, she could. If she wanted to wait, it would be possible to whitewash the inside when we had the lime available in January.

It did not take long for her to get a door installed and move in. She is involved in rebuilding mattresses. That accounts for the mattress springs leaning against the house.

Erecting Dome Number 2

We had planned to erect two domes on this trip. Due to problems with the scaffold, the first one took 8 days to build. This did not give us time to finish a second dome before we left. Lophane would not be available the week following our leaving, so we determined that it would be better not to start the second dome.

Ladies' Organization

One of the groups which came past the building site was an organization of women. They asked Pastor Benoit if I could attend their meeting and answer some questions for 10 or 15 minutes. The meeting was on Thursday, September 10, 2015. Approximately 40 ladies were present. I made a few opening remarks since they had already seen the site and then answered their questions for about an hour. They asked if I could develop a workshop for young men to get them interested in the project and to

show them how the domes were constructed. Of course I could. When I mentioned solar-powered lights, there was a great deal of excitement.

Polar Scaffold

Since returning from Haiti, I have been corresponding with Van Smith, who is designing a polar scaffold from segments of commercially available ladders. I hope to get a scaffold built in Castroville and tested by mid-to-late November and shipped to Florida so it can be on the mid-December ship to Haiti. That way it should be in Gonaives when we arrive in early January, even if it misses the mid-December ship.

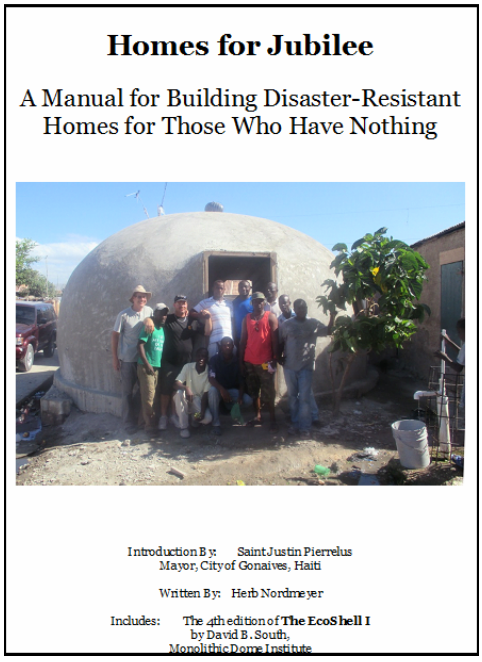
With the system that Van is working on, the polar scaffold could be used for a 20-foot dome, and by adding a few more pieces it could be used for a 30-foot dome.

Progress on *Homes for Jubilee* Book

English Version

The English Version of *Homes for Jubilee* is nearing completion. The main problem had been in formatting the photos so the captions all followed the same formatting. Craig Cannon took care of that. Since then, Judy has gone through the book and noted copy editing problems which have been corrected.

We made a few changes to the book based on what we learned in September. We need the Introduction and the cover, and we will be ready for publication. This mockup is only one of the ideas we are considering.



Haitian Creole Version

We have a few captions and the information which we added to the English Version since returning from Haiti in September, which need to be translated. With that, the Introduction, and the cover, we will be ready for publication of *Kay pou Jubilee*.

Publication of the Two Versions

We anticipate having the books ready for publication before the trip in January, 2016. We will be doing the initial print run using Print on Demand technology.

Pastor Benoit will probably distribute many of the books, since he is constantly talking to groups who are interested in the technology.

Copies of the English Version will be furnished to those who donated a home for Jubilee and those who have made substantial time and technology contributions to the

project. Copies will be furnished to SHLC to distribute for a suggested donation to the project. The amount of the suggested donation has not been determined. Additionally, a copy will be furnished when any new grant application is filed.

The books are being formatted for 8.5 x 11 inches. In talking with the printer, when using Print on Demand method of printing, each copy will cost about $4.50 plus shipping. If we see a demand for printing 2,000 copies at a time, we will switch to lithography, and the cost per copy will be substantially reduced. At the moment, we do not believe that storing 1,500 copies in someone's garage is a good use of our limited funds.

David South with the Monolithic Dome Institute will post a PDF copy of the English Version on his website.

As soon as I get *www.HelpHaitiBuild.com* updated and have a little time, I will post PDF copies of both versions on that site.

David has indicted that he will arrange for translation into Spanish when we finally finish the book.

Plans for January, 2016

During a meeting with David South on October 15, 2015, we discussed a complete revision of the *Homes for Jubilee* book to become an instruction manual for building the Enhanced EcoShell Dome with expanded information concerning concrete and stuccoing. It would be translated into several different languages.

If funding is available for construction, we plan to go for three weeks in January. If adequate infrastructure preparations have been made for building at the Faith Lutheran Church Orphanage (complete the kitchen and install additional latrines), and we plan to construct a 30-foot dome for use as a girls' dormitory. At least one 20-foot dome will be constructed in Jubilee.

If funding is available and if the 30-foot dome is not constructed in January, probably three 20-foot domes will be constructed.

If we do not build the 30-foot dome in January, we will build it during an extended trip later in the year.

Spraying Stucco

I have two MortarSprayers. These are devices which are not unlike hopper guns on steroids. A MortarSprayer costs less than $500 US each and is powered by a large portable air compressor (13.6 cfs at 100 psi). Such an excellent-quality, gasoline-powered air compressor costs about $1,200 US. Using a MortarSprayer will increase the rate at which stucco can be applied to an Airform, will lock the fibers into the stucco to produce a stronger structure, and will allow the stucco to be applied in more even coats. Before we start working on the 30-foot dome for the Girls' Orphanage, I would recommend that we invest in an appropriate air compressor. If that happens, I will ship one of my Mortar Sprayers to Haiti.

Finding Funding

So far, funding has come in as we have needed it; however, we are proceeding at a slow rate. After the Haitian crew is fully trained, and if funds are available, they could be installing a 20-foot dome every two weeks. By splitting the crew into two crews and adding some apprentices, a dome could be completed every week. An Airform, if well cared for, will last for constructing 100 domes. As the rate of construction increases, we will need to add additional Airforms, so if one fails, we do not have a delay while it is replaced, and so a third and fourth crew can be trained and start building.

The original challenge had been to develop technology which would allow disaster-resistant homes to be built for a material cost of $1,000 US. Initial work showed we could do it for about $2,000 US. After we started building slabs and we learned a little more about shipping costs and import duties, the cost went up to $2,800 US.

Besides material costs, we have labor, transportation, etc. Since the crew does not eat on a regular basis, we furnish them two meals a day. Our current best estimate is that each 20-foot dome will cost about $8,000 US. As the crew gets more skilled, and there is less need for supervision, the cost will drop slightly.

If we are building 50 homes per year at a cost of $8,000 US each, we will have a budget of $400,000 US per year. Then there may be infrastructure costs such as roads, utilities, and drainage. That will require some serious fund-raising. By having domes in place, by having the book finished, both in English and in Creole, and by having accurate costs documented, securing those funds will not be easy, but it will be easier. By collecting data on what disaster-resistant homes built with other techniques cost, it should enhance our fundraising efforts.

In June there was an article in an English-language Haitian newspaper that mentioned 23 disaster-resistant homes that had been built for a cost of about $35,000 each. The author of the article indicated that this was very economical.

Most very small non-disaster-resistant homes built in Haiti cost in the neighborhood of $5,000 to $8,000 US.