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One of Haiti's Few Earthquake Engineers on Rebuilding Better

- Posted by [Alexis Madrigal](#) on January 29, 2010 at 10:00am
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Prescience about a disaster doesn't make dealing with its consequences any easier. Years ago, Pierre Fouché realized that people in his country weren't thinking about building earthquake-resistant buildings. So, he packed his bags for the University of Buffalo's highly respected earthquake engineering school in hopes of bringing that knowledge back with him to Port-au-Prince.

Now, he's struggling to come up with ways to rebuild his country in the wake of last month's earthquake. The quake not only knocked down buildings, but took the lives of the very engineering students and teachers who are so needed now. Haiti Rewired talked with Fouché about local building practices, the future of Port-au-Prince, and what the role of outside organizations like Architecture for Humanity should be.

Haiti Rewired: So, how'd you decide to get into earthquake engineering?

Pierre Fouché: After earning my bachelor in civil engineering at home, I was thinking of getting a higher degree in civil engineering and finding an area of specialization. I understood that there was a need to design against earthquake, but hardly anybody was talking about it. I realized that I could help create the debate about it and eventually become helpful in the process of introducing construction practices that are sound and take into account the vulnerability of our milieu. So, I started to educate myself about how exposed my country was to such disaster.

I soon realized that the country as a whole was very exposed to seismic activity. We have suffered from quakes before and the damages were widespread. For instance, in 1842 my hometown, Cap-Haitien, was completely destroyed. The death toll reached 10,000. In 1751 and 1770 Port-au-Prince was struck; I don't know about the death toll but to all account the damages were extensive. Those were proof enough to me. The same thing could happen again if anything was done. It was even more of a possibility that the construction practices at home were poor. Buildings were spreading all over the place, most barely stable by themselves; they could certainly not withstand the shaking of a strong earthquake.

Since it is common knowledge that the country is vulnerable to other types of natural disasters, instead of just studying earthquake engineering as I was already planning on doing, I thought that it would be better to do research in an area that encompasses more than earthquake resistant design. When in the very first month of my doctoral studies at University at Buffalo my advisor, Dr Michel Bruneau, proposed that I focused my research on multi-hazard engineering, I embraced the idea because I saw its potential for my country and by extension for any other countries exposed to natural and manmade hazards.

HR: Maybe you can talk about some of those construction practices, both the official ones and the informal ones?

PF: There was a lack of regulation and enforcement of the laws about where to build and how to build. The people soon exploited this weakness, and building started to literally sprout out of the ground everywhere, most without proper designing or proper construction details. Everybody wanted to own a place and anybody could build without requesting the help of a qualified builder, an engineer or an architect for that matter. The quality of the built environment was very poor. There was a tendency to use reinforced concrete and masonry in the constructions. The reinforced concrete constructions were lightly reinforced and not detailed to seismic standards. The masonry buildings were not reinforced nor confined.

Since no building code existed or was enforced, architects and engineers would rely mostly on French code (Beton Arme aux Etats Limites, BAEL) or US code such as the American Concrete Institute's to design for reinforced concrete structures which for gravity loading generally.

HR: And by gravity loading, you mean they were just designed to stand up?

PF: Exactly! Most structures were hardly supporting their own weights and the weight of their occupants and contents. So, the best you would get was structures formally designed by architects and engineers for vertical (gravity) loads coming from the weight of the materials used and the occupation of the structures. Informally, this covers the vast majority, the people-poor and rich alike- were building their own houses and there business place without any planning or designing involved. They would select a place, fitted for construction or not, and start building. There would be no site inspection by the authorities or even a construction permit issued by the authorities. Therefore the built environment was the result of large-scale anarchic construction activities.

Another important aspect to consider is that Port-au-Prince was basically the economic and politic center of the country. Whether it is about going to college or finding a job, one stood a better chance by migrating to Port-au-Prince. I am myself originally not from Port-au-Prince, but I had to go the capital in order to get a college education. So getting a place to live was a hard fought battle. As a result, the city started to expand beyond control and areas that were reserved for agriculture or that were not suited for construction would be occupied and built often illegally. Because, of the anarchy reigning in the construction sector, the mountain flanks were soon conquered and shantytowns flourished.



HR: What kinds of materials were used?

PF: In terms of construction materials, the general idea was to use reinforced concrete, load-bearing masonry wall made of concrete blocks, or adobe (mostly in the rural or peripheral areas to a major city). Other in reinforced concrete, steel is rarely used as the primary construction material, it can only be found in some bridges and in a few other structures. In the last 3 decades or so, reinforced concrete became cheaper in the country since it could be produced locally or imported from the Dominican Republic. It became largely the dominant construction material. But the mixing of the concrete and the construction methods used were generally poor with no quality control or the proper detailing. Sadly, those constructions were bound to fail in an event as strong as the quake that rocked the country.

HR: There's a lot of talk putting in a building code, but it seems like the problem isn't the lack of a piece of paper, but the social structures to support the execution of what's on the paper.

PF: According to the law, the office of the mayor in the cities is responsible to deliver construction permits. The process leading to the delivery of a construction permit, at least as spelled out in the law, requires a review of the design, evaluation of whether the type of construction proposed is fit for the location chosen by the owner, and finally inspection of the construction site. However, even when an owner would seek a construction permit to build, there was no guarantee that inspection of the construction site would be done. That is a problem to solve during the reconstruction process.

In terms of enforcement of the law for public works, the Ministry of Public Works and Communication has a unit that is specifically responsible for review and inspection of public construction sites (roads, bridges and other infrastructures).

So legally some structures exist. In the reconstruction process the role of those structures would need to be reassessed and revised. To do so they will need technical knowledge and resources. To be honest, it is going to be a very difficult challenge to train the human resources needed to cope with that task; we have lost so much in terms of qualified resources not only during the quake but way before to immigration. This is going to be a very big limitation in terms of applying the law; there is no use for a law or a code that is not enforced. A great deal of our locally-based human resources is gone, killed in the quake; it is going to take decades before they can be replaced. Maybe, that would be the time for many of our professionals who are living abroad and who have significantly contributed to other economies, in the US and Canada for instance, to turn their eyes to Haiti and help to the best of their capacities.

In the short term, however, what I see to surmount the lack of resources (both financial and human) would be to open the construction market to private and public investors with the means to create affordable housing that have to be designed at least to the minimum standards set in a new code. Also if we agree with them to use the local workforce along with qualified workers they can bring in for the reconstruction process, we can make sure that our future construction workers will have the training needed. But letting the people go back to their old practices cannot be an option.

An earthquake as strong as the one we just experienced is going to kill people in areas poorly constructed. That's a fact! If our leaders can play on that aspect and make our people realize that the need to build differently exists and that it can be both secure and economic, maybe everybody will agree to that and comply to the new standards. But, we cannot maintain the status quo; else, we will be cooking another recipe for disaster. It is simply a matter of time before another earthquake hits the same area. Those are recurrent events. We need to insist on that people who are not following the law are exposing their family to dire consequences; we have to insist on how to effectively deter the people from going back to those dangerous practices.

HR: Are there particular building styles that are unique to Haiti that are particularly good or bad for earthquakes, like the gingerbread house?

PF: The gingerbread houses are very distinctive because of their artistically crafted facades. I don't know how those constructions performed during the quake. One of the advantages they might have is that they are generally lightweight. Another advantage might be that the crisscrossed pattern of the lattices used in their facades is integrated to their gravity load carrying system and may act as braces against the lateral load that came from the earthquake. But those are only speculations, since I haven't actually seen pictures of those building after the quake. I did propose however in an opinion piece published by CNN that the artistic effect that resulted from the latticework be used during the reconstruction because tourists who used to come to the country liked this artistic display.

This could be a way to lure the tourists back in a country that is known for its poverty but not enough, I believe, for its arts. Our economy was not doing well. Now it is completely destroyed. If there is one thing that we can use to generate revenues, that would be tourism and if we want to attract tourists, we need to have something to show. Since this idea had the favor of tourists in the past maybe if we safely integrate those features in the new constructions they might serve revive those types of construction and attract tourists.

HR: What's the role for outside organizations like Architecture for Humanity in the reconstruction?

PF: It can be very important. Right now, the international community is planning to invest a lot of money in the reconstruction process and quite likely most of this money will go through the NGOs. Those NGOs can participate in developing construction projects that can be designed to code. Also, since they are non-profit organizations, they can be even more effective in creating affordable housing options than any other private organizations would be.

HR: Because people tend to build their own houses, are there some sorts of new materials that could make that safer?

PF: In the Caribbean, this is something that is quite frequent. This is what is called "auto-construction". With the help of a construction worker the owner simply builds his/her own house. This can be a problem, when no guidelines exist. This is a very delicate issue, specifically in a poor country like mine. But we can at least set standards and have inspection of the construction sites as it is done in other countries in the Caribbean.

About the materials, I am not personally aware of any type of new proven cost-effective materials that can be used for that purpose, but as a country in a reconstruction process we should not reject any option before it is carefully considered. However, concrete can still be used if mixed and properly reinforced. For instance, it has long been established that confinement of the critical regions in reinforced concrete construction is key to ductile behavior in earthquake events that impose large deformation on structures. By providing the appropriate amount of reinforcement and by following sound practices reinforced concrete can be used safely. Many of those pancake collapses seen in this quake could have been avoided if proper engineering practices were observed.

Finally, though, not as cheap locally as reinforced concrete, we can start looking at steel as a construction material at least for some public structures.

HR: Are you going to head back?

PF: My idea coming here was not to just get the knowledge for myself. It was also about sharing what I'm learning with other engineers back home. If I go home and I am the only one designing against earthquake and other hazards it, it might have a marginal impact, but if other professionals are trained to deal with natural hazards, the built environment would get safer. My goal is to share the knowledge acquired with as many Haitian architects and engineers as possible through teaching, lectures and practical designs projects.

HR: How many other earthquake engineers are there in Haiti? Are there others?

PF: In terms of earthquake engineers living in the country itself, I cannot say for sure. Outside of the countries I know of a few of Haitian descents living in the US and in Canada. One of my professors who is a civil engineer and a geologist used to talk about the likelihood of an earthquake hitting the country. He was trying to raise awareness about the problem, but that was no easy task since in the engineering practice in the country earthquake resistant design isn't common.

HR: What other kinds of human infrastructure are there for reconstruction? How many other engineers are out there to help?

PF: I don't have any exact statistics about that. I do at least know that there were several schools of engineering back home. I can think of seven or eight in Port-au-Prince only. I don't know how many students graduated each year from those schools. From the school that I attended back home, the number was limited, less than 10 a year, I would say.

Many of those schools have collapse. In some, the professors were teaching during the quake, many of them including engineering students have perished. That is going to be another setback during the reconstruction. It takes at least four years to give to a student the skills that he or she needs to become an engineer.

We might need to rely on international cooperation and engineer volunteers, at least during the early years of the reconstruction process to cope with the likely shortage of Haitian engineers we will see during the reconstruction. With so many countries willing to help, this is one types of cooperation the Haitian government could ask for. If other professionals in the domain can come to the country to give presentations and lectures about earthquake resistant design or even participate in the construction projects while transmitting this valuable knowledge to Haitian engineers and architects, this could speed up the reconstruction process and the preparation of our professionals.

Also, for the sake of sound practice and accountability, it should become a requirement that engineers and architects be affiliated to an order and take standard tests that qualify them to go into practice. This can also serve as a basis for legislation that can hold them accountable for what they design. An earthquake might be a natural occurrence, however what about establishing the responsibilities in the disaster that followed?



HR: What kind of changes can be made to the design of cities, not just buildings, to make things better?

PF: We are having a lot of problems with giving the care that their conditions need to the injured. The main reason is the non-existence of lifelines. Lifelines are a set of infrastructures (ports, airports, hospitals, transportation, electric power, water distribution) designed to be both resilient and redundant in a natural disaster and that can be used to support the relief and rescue effort following a major disaster. They have to be fully functional following such event. We need at least that to facilitate access to the victims in future disasters.

Also, I cannot stress that out enough, sound design and construction practices have to be enforced. Furthermore, since the country is exposed to multiple hazards relying on multi-hazard engineered options could be a cost-effective way to go.

HR: Do you think that Port-au-Prince as it was should be rebuilt? Or should people be encouraged to head back out to provincial cities or the country?

PF: I think it has to be rebuilt but it has to be done in a different way. The starting point to the reconstruction of Port-au-Prince, and the modernization of the other cities in the country for that matter, is to have an urban development plan. We need to answer the basic questions of how far can we extend the city, what kind of construction is appropriate, how do we move around the city, who is going to live in it and what will their needs be?

There should be a balanced distribution of the population over the country. There is no doubt about it; however it has to be planned to. The infrastructure has to be developed in the other cities to so as to relieve the demographic pressure on Port-au-Prince. I cannot hide it; overpopulation of PAP was another reason for the death toll. Port-au-Prince was the focal point; everything was concentrated there, as a result everybody wanted to be there.

If the other cities are rebuilt and modernized so as to offer the same or higher standards than a newly built PAP, there will be no need to migrate to PAP. PAP had a third of the population of the country before the quake, the same thing is bound to happen if adequate steps are not taken toward a better occupation of our territory.

HR: Is your family OK?

PF: Everybody is OK. The situation inside the country is not too good and so many people are ending up dying. There is strong fear of another earthquake. The people there are under stress right now and are lacking everything. It's not easy for anybody. You might be a survivor but the stress is high on a daily basis.

Images: 1. University of Buffalo. 2. flickr/GeorgiaP. 3. flickr/UNPhoto

Update 1/29: This post was updated to clarify some statements.

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Comment by [Evan O'Neil](#) on January 29, 2010 at 11:43pm

This interview brings up the key question for long-term reconstruction: How do we avoid "lightning" striking twice in the same place. Perhaps before tackling the vexing problems of urban density, loss of farmland to urbanization, building materials, and informal slum construction techniques there needs to be a country-wide seismic evaluation of the safest building sites.



Comment by [Tami Pettinger](#) on January 29, 2010 at 12:55pm

I was thinking about whether or not Haiti has a junior college system, much like California or Oregon, USA. I have attended classes in construction at the junior college level. Perhaps when things get a little more back to normal someone could set up classes for people who are interested in building, and encourage adhering to building standards in that way. This would be in addition to training engineers and having inspectors. The more people that know how to properly build, the more likely a person trying to build their own home can get some help. Many people probably won't have the resources to hire a professional builder, but this could get the information out to the people who really need it. In addition, when the master plan for the city is done, perhaps some volunteers could design a basic earthquake / hurricane house and offer the plan free for use.

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HaitiRewired: RT @arikia: can't bring myself to close this tab.... <http://bit.ly/aV8vc4> "Alternative Paths to Internet Infrastructure: The Case of Haiti"

HaitiRewired: RT @VRWCTexan NYTimes: Rebuilding Effort in Haiti Turns away From tents <http://s.nyt.com/u/etb> (saying lumber + steel) (via @MelyMello)

HaitiRewired: RT @MSF_USA: An anaesthetist's 10-day mission in #Haiti <http://bit.ly/bwlFDt>

HaitiRewired: Also, @Wired's own Nathan Hodges left today for #Haiti. More reports coming soon.

HaitiRewired: With warnings about violence near food distribution locations, it's worth revisiting Rebecca Solnit: <http://bit.ly/9o0i9H>

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