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What We Can Learn from Haiti

BY LESLIE JACKSON

When the 7 moment magnitude (M_w) earthquake hit Léogâne, Haiti, about 16 miles west of the capital city, Port au Prince, on January 12, killing hundreds of thousands of people and leaving about 1 million homeless, at least 280,000 buildings collapsed or were severely damaged. On February 27, an 8.8 M_w earthquake rocked Chile. Although it released approximately 500 times more energy, the Chilean earthquake was responsible for only about 500 deaths. What accounts for the difference? The most damaging effect of the earthquake in Haiti was not the ground movement itself, but the collapse of those 280,000 buildings, crushing people, turning a natural disaster into a man-made one. How did so many buildings fail, and what can we learn from this experience to apply to future building practices, in seismic zones and elsewhere, in Haiti and beyond? With the hurricane season approaching and the media having turned their eyes to other news, questions abound as to how to house and rehouse Haitians without making the same devastating mistakes.

Since buildings account for 48% of greenhouse gases, and of that, concrete accounts for 7%, there is more than the threat of natural disaster to plan for in construction and reconstruction. This is an opportunity to not build the same way again—to build in a way that avoids, not just the obvious costs, but also the less visible costs to the environment, the economy, and future generations. Emergency, transitional, and permanent buildings are going up in Haiti, while at the same time, people are doing reconnaissance projects in Haiti's earthquake-hit areas. These projects raise questions, such as What sort of sustainable dwelling—affordable, durable, and appropriate to the climate and culture—is best for rebuilding?

To answer these questions—to figure out how to improve Haiti's built environment while repairing it—many shelter reconnaissance and design programs are now on the ground in Haiti. Here are just a few of them:

A concrete addition to this wood-frame house crushed and buried this man's cousin.

- **Cordaid** – www.cordaid.com. An international development organization with a strong base in the Dutch community. Provides emergency aid internationally and works to eradicate structural poverty.
- **Grassroots United** – www.grassrootsunited.org. Connects relief workers, social groups, and humanitarian organizations to local resources in order to streamline small-scale disaster response operations.
- **Kleiwerks, International** – www.kleiwerks.org. Promotes ecological regeneration and empowers communities through the education of natural building and sustainable technologies.
- **World Bamboo Organization** – www.worldbamboo.net. A global organization for growers, processors, and users of bamboo and bamboo fibers and products.

Timber frame house with stone-and-mortar infill.

Wattle-and-daub house. Building in the vernacular style may be one way to help communities feel validated and have access to development now.

- **Build Change** – www.buildchange.org. Designs safe houses, trains builders and engineers, and empowers homeowners to rebuild better.
- **Architecture for Humanity** – www.architectureforhumanity.org. Promotes architecture and design to seek solutions to global social and humanitarian crises.
- **Habitat for Humanity** – www.habitat.org. Ecumenical Christian organization that builds simple, decent, affordable housing in partnership with people in need.
- **Builders Without Borders** – www.builderswithoutborders.org. An international network of ecological builders working together to help ensure a sustainable future.
- **Article 25** – www.article-25.org. A U.K.-registered charity that designs and delivers buildings and other structures for those in greatest need worldwide.

How the Concrete Buildings Failed

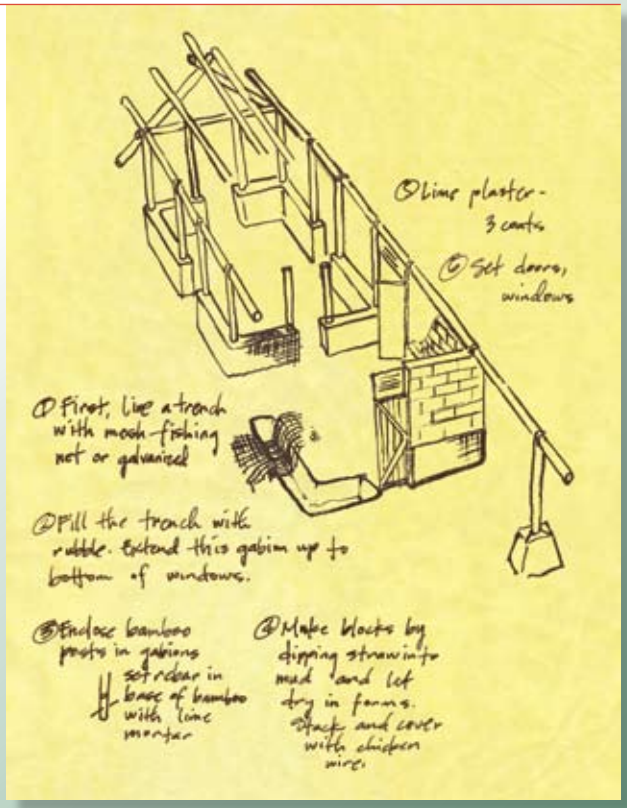
Eduardo Fierro of the Pacific Earthquake Engineering Research Center presents his findings on the collapsed structures in Port-au-Prince, Léogâne, and other surrounding areas in a two-hour video (for a link to the video, see "For more information," p. 52). Fierro's video shows several kinds of weaknesses in several samples of concrete buildings that collapsed. Examples include very little reinforcement, undersized and improperly placed rebar, hoops in strange configurations, and open stirrups—all of which show lack of continuity in the overall structure and failure to build to seismic codes. And some of these buildings, Fierro says, were built with engineers on-site, by construction companies. "Three days after the earthquake, the city was littered with bodies . . . This was not an earthquake disaster," Fierro says. "This was a disaster caused by the construction industry in Haiti. The construction industry that didn't know how to use codes. They didn't have any codes. The people that built these things [who] are building in very bad shape caused this tragedy and the loss of human life . . . We have to design things and construct things and assume that our children, our grandchildren, and our mothers are going to be in this building when the earthquake hits, so we can check all of our numbers and do the proper design to do this."

What's frightening, Fierro says, is that with few other options, Haiti is rebuilding in the same way that caused these failures in the first place, and with rebar salvaged from the rubble using hacksaws. Other critical assessments like Fierro's are being performed before large-scale rebuilding begins. Buildings that didn't fare so badly are being analyzed as well. What kinds of building systems might be more reliable in a culture that tends to build for itself, rather than hiring contractors, architects, and engineers?

Climate-Appropriate Housing: Traditional Meets Modern

Architect Darrel DeBoer points out the economic causes of so much building failure. When a bag of concrete is prohibitively expensive, people tend to amend it with river sand, weakening the mix. Owner-builders still consider concrete the material of choice, even though, with a high rate of illiteracy, many can't read the instructions on the side of the bag. DeBoer suggests a solution that blends the old with the new. The vernacular styles of building in Haiti, such as wattle-and-daub (in which uprights of rot-resistant woods like acacia are driven deep into the ground, horizontal members of wood are woven onto those, and an earthen plaster is applied), may have fared better than poorly built concrete in the earthquake (see photo above). Wattle-and-daub buildings are certainly more comfortable than concrete in the tropical climate, with their breathable earthen plasters, and their thatch roofs, which weigh less than concrete and provide better insulation. They are also far safer. Since the whole structure is held in place by burying the uprights in the ground, it's similar to a pole barn. The floor is a poured mixture of clay,

A Traditional/Modern Approach



Darrel DeBoer is co-author, with Megan Groth, of *Bamboo Building Essentials, the Eleven Basic Principles*. He was named by *Metropolitan Home* magazine in 2001 as one of the 100 most influential designers, and by *Natural Home* as on of the Top Ten Green Architects.

sand, and straw, similar to adobe. If the buildings do collapse in an earthquake, or are blown away by a hurricane, occupants are more likely to survive to rebuild them, using their own skills, with locally available, inexpensive, renewable, economy-feeding materials and labor. The downside is that these buildings need to be maintained. For example, uprights eventually need to be replaced. So when concrete was introduced in the 1920s and was promoted as rot-resistant, easy to maintain, and fashionable, it became very popular. Rot resistant isn't an issue if your family dies inside your house, however.

DeBoer, a strong advocate of bamboo in building, says, "One modern solution, combining the traditional integrity with modern convenience, uses timber—or in this case bamboo—uprights with earthen infill. Used in pure tension and compression, there is no better building material in strength-to-weight ratio. And since bamboo can grow up to 17 times as much biomass as structural softwoods, the area needed to grow a supply of building material is relatively small. It allows builders to be in control of the inputs to their livelihood. Very few materials can make that claim—especially in politically unstable places, where they're dependent upon corrupt supply chains and unstable pricing. The important thing is to plant the right species. (See "A Traditional/Modern Approach.")

Randolph Langenbach, author of *Don't Tear It Down,* a study of the earthquake-resistant vernacular architecture of Kashmir, has studied the patterns of success and failure of various building types all over the world. He observes, "Traditional is modern in those many parts of the globe where pre-modern vernacular buildings of unfired earth, timber, and masonry have remained standing while modern buildings of reinforced concrete and steel have fallen." Langenbach, along with Martin Hammer, Patrick Sparks, Kevin Rowell, and Stephen Kelley, was invited by the World Monuments Fund, Fondation konnaissance et Liberté (FOKAL), and the International Council on Monuments and Sites (ICOMOS) to survey historic buildings in a neighborhood called the Gingerbread District in Port au Prince and make recommendations for their repair to the owners.

The word "gingerbread" comes from the United States. This style is characterized by elaborate ornamentation, high ceilings, and the use of *colombage* wall systems—timber frame with diagonal bracing and infill of masonry or rocks and clay. The old-growth timbers that frame these buildings contributed to their survival in the earthquake. While the group's research was not primarily intended to suggest techniques for future building but to advise on repairing the existing historic buildings, much can be learned about building for these seismic and tropical zones from the relative survival of these structures in the earthquake and from their lasting comfort, such as the natural A/C provided by their high ceilings, broad porches, and the many tall doors and windows.

The Gingerbreads

The historic preservationist and engineer Patrick Sparks, who has a passion for saving old dance halls, judges a structure by attributes other than form or beauty. "Historic preservation in the United States is predicated on a mistaken concept," he says. "It's

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Owners of gingerbread homes provide tents for their workers, whose houses in the city were destroyed.

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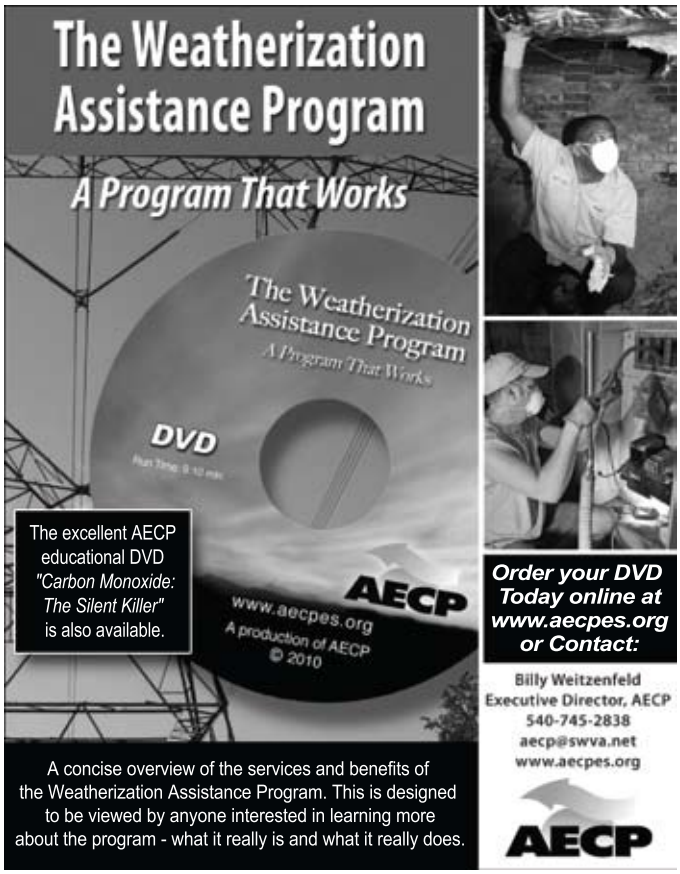
Gingerbread houses are characterized by ornate details, deep porches, and high ceilings.

the decoration, or the artistic aspect, that people pivot on as a decision point for them to say that a building is historic. I'm not any more thrilled by the grand style than I am by the simplest hut. The reason is, the beauty to me is in the simplicity and the performance." Sparks and the team of engineers looked at over 200 gingerbread houses. He says, "They're not all huge houses with turrets and stuff. A lot of them are very simple, like our shotguns on the southern coast of the United States. They are very basic dwellings that anybody could build, and the small ones were probably owner built, so that means a lot to me. I look at the scale of the house. Is it something an individual or two men could build by themselves? What makes a thing endure? A lot of times, it's not the ornamentation. I look for structural survivability and characteristic vulnerabilities. For seismic regions, some of those vulnerabilities can be fixed by making small, incremental improvements, such as putting in a basic, yet durable, floor-to-wall connection. And then, of course, educating people not to put concrete blocks in their walls and not to pour concrete on their floors, which they do when they want tile, which overloads and compromises the building." The group's research revealed one instance in which a concrete ad-



dition to a gingerbread house toppled, crushing the person in it. In another instance, the concrete buildings adjacent to a school crushed 30 people, while the gingerbread still stands.

Sparks says, "Many of the owners and residents at least know what they have, and have an instinctive understanding that their house was made of wood, and that was what made it survive. That was clear—more than one time I was speaking to the residents or the owners—often the women of the house—and they would say to me, 'Oh no, this is a good house; it's made of wood.'"

People, Not Codes, Build Houses

People seem to have adapted to concrete, since it is the only conventional building material in Haiti, but as Sparks says, "Concrete is not and cannot be a vernacular building material, because the part about concrete that makes it structural is not intuitive. There's no chance that reinforced concrete can become a vernacular building system in an owner-builder/dweller-builder society in the developing world because it requires mathematics, and a high level of deduction and analysis, to understand how it's supposed to work and how to do it correctly." One frustration with the many reports on Haiti and other seismically volatile communities is that they conclude that buildings failed because they were not built to code, and that the buildings that didn't fail were built to code. While it's a true pattern, the problem is that analysis does not lead to solutions, nor does it cause a culture of owner-builders to build to a code, especially where no code exists. As Sparks says, "Codes don't build buildings, people do." The lesson learned so far is to ask questions. And the first question is, What can Haiti teach us?

How to Make a Two-Dimensional Image from Two Identical Photographs

In one aerial photograph of an informal settlement, we see flattened dwellings everywhere. One might blame the builders. But Randolph Langenbach shows me how to place two identical aerial photos side by side and then cross my eyes to reveal a third, three-dimensional image magically floating between the two. Suddenly the topography is visible. The landscape is full of very steep ravines, with concrete dwellings stacked and balanced on the hillsides. Poor retaining walls and mudslides were at fault here, not bad home building. Langenbach used this technique to gather more information from the aerial photographs to help in mapping the Gingerbread District, and also to gain useful information that the on-the-ground analyses, combined with the aerials, couldn't have answered fully.

In another example of asking the right questions, Kevin Rowell, of Kleiwerks International, shows an image of a home that stood despite the fact that it was unreinforced masonry

A home in the Gingerbread District of Port-au-Prince.

block with an earthen mortar. The assumption was that the wall was mortared with cement, but on closer examination, it turned out to be mortared with earth, an easy thing to determine. Raising the issue of what is missing helps prevent researchers and rebuilders from jumping to conclusions. Perhaps we have learned from Haiti that the high-tech, industrial way to build is best in high-tech, industrial cultures, and that—based on what's standing—the low-tech, DIY, small-is-beautiful way to build is better in a low-tech, small-is-beautiful culture. For cultures all over the world faced with a housing crisis (including the United States and Canada), lessons abound in the deconstruction of a city from a natural disaster. We have much to learn, and Haiti is a good place to start.

Leslie Jackson *is associate editor for* ***Home Energy.***

>> For more information:

Langenbach, Randolph. *Don't Tear It Down: Preserving the Earthquake-Resistant Vernacular Architecture of Kashmir.* Berkeley, California: Oinfroin Media, 2009.

To learn more about FOKAL, go to www.fokal.org.

To learn more about ICOMOS, go to www.icomos.org.

To learn more about Kleiwerks, International, go to www.kleiwerks.org.

To see the PEER video, go to www.youtube.com/watch?v=F2GDKPIGD58.

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