

Rebuilding Updates

July 2010

It has been said that “poverty predicts quake damage better than the Richter scale”. In more developed countries earthquakes equal to and greater than the 7.0 Haiti earthquake resulted in minimal loss of life as compared with the hundred of thousands who perished in Haiti. This is clearly a result of poor construction practices due in large part to the economic impoverishment of the nation. However, the good news is that it is possible to make drastic improvements to the quality and safety of new construction by implementing a comprehensive plan that does not need to heavily impact the cost of construction.

At Haiti Works! one of our goals is to assure that as new structures are built in Haiti, they are constructed to modern standards that meet internationally recognized codes and are designed to withstand both earthquake and hurricane forces.



Poorly graded sand and aggregate will result in poor quality concrete. Here it is being used to pour thin columns to support the failing damaged concrete structure above.



Block being manufactured with little quality control, poor curing, and inferior raw materials (sand/aggregate). If provided with properly graded and tested raw materials, clean water and education about proper curing and handling, strength of the block can be greatly improved at minimal expense.

As daunting as the task may seem to change the way a whole country builds, the steps can be relatively simple and do not need to be costly:

- Improve the materials used in construction: If better materials are provided to the builders, greatly improved and safer buildings will be the immediate result. For example: Improve the quality of sand and aggregates used in concrete and masonry at their source by working with local quarries to provide proper processing and testing; assure that proper rebar, “durawall” and similar reinforcing materials are available locally by educating suppliers; expand standard materials to include more wood, manufactured wood, composites, and steel through education of suppliers and the builders.



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- Provide quality control and education about proper construction techniques: Working through vocational training organizations, distribution of graphic manuals, free workshops, and by working in concert with suppliers, workers can be taught new techniques. On larger projects legislation should be passed to require building inspections. Private certified firms can be set up to handle the inspections so as not to burden local government.



Here is a photo of “deformed rebar” showing ribs which allow the concrete to grip the steel for structural integrity. Unfortunately much of the rebar used in Haiti is smooth and therefore the concrete fails when the bar breaks away from the concrete. What is the cost of proper rebar? What is the cost of not using the right materials?

- Adopt internationally recognized building codes: Pass legislation to require buildings above a certain size or height meet standard building codes. Utilize building department resources in U.S. or other cities that have adopted Haitian cities, to provide document review on projects. Utilize new private certified testing and inspection companies to enforce code.

- Build within the constraints of economic conditions: 1 and 2 story simple structures are far easier to build to earthquake standards than larger structures which exponentially increase design requirements and expense. Eliminate concrete for horizontal-plane structures for floors and roofs – replace with wood, composite, or steel construction which is far cheaper to build to earthquake standards than concrete.



Photo showing how easily the smooth rebar broke away from the concrete. Well adhered deformed bar would have pieces of concrete sticking to entire length even after such a collapse. Without connection to the concrete, the steel fails to perform its job.

- Create land use codes that prevent construction in unsuitable locations: Steep slopes, the bottoms of storm drainage paths and ravines, and unstable soil areas are simply not good places to build. Comprehensive land use zoning can quickly be implemented to identify unsuitable areas, and as debris is cleared, some areas will need to be put off-limits to new construction. Local governments will have to work at methodically relocating populations remaining in these areas.



This salvaged bar, much of it smooth, will soon be part of the next building. Steps need to be taken to make proper materials readily available.



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At Haiti Works! we are working with both government and private entities in the U.S. and Haiti to pursue these strategies. Your support will assure our success. The lives of so many Haitians depend on the rapid implementation of these reforms. With your support we can literally save thousands of lives.

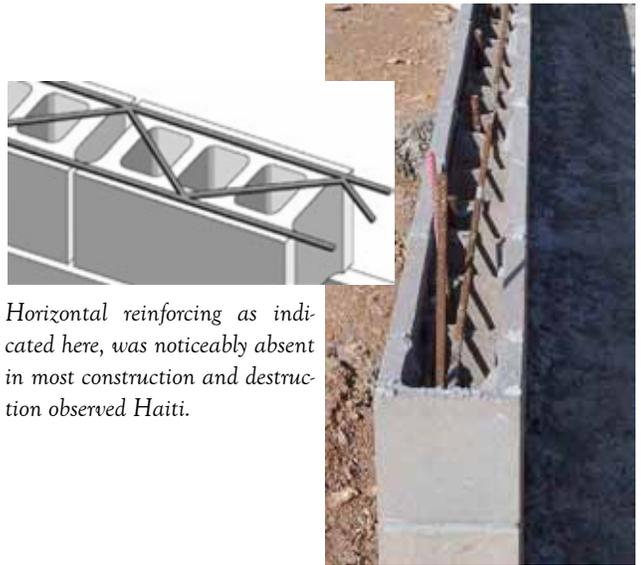
The major causes of destruction in Haiti

To the trained observer who is familiar with modern construction methods and materials the causes for building failures that occurred in the Haiti earthquake area readily apparent: Poor materials, poor construction practices and unsuitable locations for structures. Any one of these by itself could cause catastrophic structural failure, and most buildings have at least 2 of the 3 conditions present.

Sand and the aggregate stone used for mortar and concrete are of poor and inconsistent quality, severely undermining ultimate strength of the finished product. During construction in the tropical heat the mixes are allowed to dry too quickly which results in improper curing and permanent decreased strength. There are many cold joints that



Here is a typical wall construction in Haiti: Widely spaced vertical reinforcing, no horizontal reinforcing and block is left hollow except at the reinforcing. The addition of a proper depth foundation, rebar reinforced bond-beams, truss type horizontal reinforcing in every other course of block, and closely spaced vertical bars in grout-filled cores would make a world of difference in the strength of these walls. This is typical wall construction throughout Haiti whether it is for a security wall, or a building wall supporting roofs and floors above.



Horizontal reinforcing as indicated here, was noticeably absent in most construction and destruction observed Haiti.

occur during construction causing many weak areas where there is a lack of cohesion. Steel reinforcing where present is often inadequate to the extreme – there is almost no horizontal reinforcing, and the reinforcing bar that is used is not properly “deformed” with ridges to aid in the connection to the concrete. The smooth steel rods separate quickly from the concrete when stresses are induced causing failure. In addition to reinforcing rod or bar, it is common practice with modern construction to utilize steel ladder or truss type reinforcing laid horizontally in the masonry joints every other course of block. We did not observe the use of this material anywhere. These are just a few examples of poor materials and practices. Think of the lives that would have been saved if just some of these practices were changed. Imagine if all materials and practices were brought up to current codes and practices. Think of the heartbreak of losing just one family member in such a disaster. Few of us can imagine the magnitude of the loss the Haitians have suffered in this devastating



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New construction being set up for a home with typical widely spaced and inadequate vertical reinforcement.

quite well, and perhaps offered some protection against the hot equatorial sun, this type of construction unfortunately does not readily lend itself to construction which can resist earthquake forces. With some improvements in the raw materials of the masonry and concrete, steel reinforcing, and the practices followed during construction, foundation and wall construction can improved to modern codes without insurmountable difficulty. However when it comes to constructing horizontal planes for floors and roof structures, the level of difficulty in achieving the needed requirements with concrete suddenly makes this form of construction one

earthquake which killed hundreds of thousands of people. We must move quickly to assure that every new structure built in Haiti is built to save lives.

Materials:

In Haiti there has been a heavy reliance on masonry and concrete for their construction. This can be attributed to scarcity of wood from deforestation and easy availability of masonry materials in a country that once manufactured its own cement, and in which sand and aggregate are easily mined.

While the heavy masonry and concrete may have withstood hurricanes

of the most difficult and expensive choices. Wood, steel, and composites even after accounting for importation into the country are by far the more practical, easy to construct and safe means for constructing most structures.



Steep slopes are not conducive to safe construction



Large buildings such as this pancaked structure which was once about 4 stories tall are difficult and expensive to build to meet earthquake standards. It is imperative if such structures are to be built, that they must be required to meet international codes and have strict quality control and inspection standards during construction. Imagine the lives lost in just this one building.



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