SUSTAINABLE (RE)BUILDING SOLUTIONS FOR HAITI

by Martin Hammer and Andy Mueller

Almost two years after the earth shook beneath Haiti's most densely populated region, killing over 200,000 and leaving an estimated 1.4 million homeless, remarkably little rebuilding has occurred. After a largely successful emergency response in the three months following the January 2010 earthquake, donor nations and institutions that pledged over 9 billion dollars have released little of those funds—by many reports reluctant to do so with Haiti's government in transition. However, with its new administration now finding its feet since the April election of President Michel Martelly, that is expected to change.

Of the small amount of the rebuilding that has occurred, or the solutions shown at Haiti's Expo that opened in July, very little is what anyone would call sustainable. Haiti is a nation that before the earthquake suffered extreme deforestation, with as little as 2% of its original forest intact, and virtually all wood for construction imported. The predominant modern building materials of reinforced concrete and concrete block use imported cement and steel. The sand and gravel for these materials is taken from and damages Haiti's riverbeds, or is a weak crushed limestone from quarries that noticeably scar Haiti's mountainsides. Most solutions offered at the Home Expo are prefabricated with materials and labor from outside Haiti, subverting the potential for the reconstruction economy to benefit Haitians themselves, most of whom are in desperate need of employment.

BUILDERS WITHOUT BORDERS AND THE TI KAY PAY

At least one organization is taking a decidedly sustainable approach with the building systems it offers. A small group of architects, engineers and builders from Builders Without Borders (BWB) (www.builderswithoutborders.org) is promoting safe, affordable, sustainable shelter by using in-country materials and labor that strengthens or creates local industries, and with designs that are responsive to Haiti's climate and

culture. In the process of building, BWB trains the local population to build in sustainable ways, empowering them with skills to start their own businesses and build their own shelters.

Builders Without Borders' first project was the construction of a model home in Port-au-Prince. It uses the traditional ti kay (small house) as the basis for its design. The two-room house plus galri (veranda) is the fundamental living unit for rural and sub-urban Haiti. It can be expanded to the rear or either side as the need for space increases. BWB's Ti Kay Pay (Small Straw House) uses baled rice straw, bamboo, steel wire, and earthen plaster for its wall system.

BWB

Earthquake devastation.

STRAW BALE BUILDING HISTORY

Straw bale buildings enjoyed a rebirth in the American southwest in the 1980s, and have since been constructed throughout the U.S., and in over 45 countries in every climate throughout the world. They use an agricultural waste product, baled straw, as building blocks for wall systems that are reinforced in various ways and covered with plaster. Some of the earliest such buildings in the state of Nebraska are over 100 years old. The Ti Kay Pay was derived from a system developed by California engineer Darcey Donovan in 2006 for post-earthquake Pakistan (www.paksbab.org). Architects Martin Hammer and Dan Smith, engineer Henri Mannik, and lead builder Andy Mueller, used their extensive experience with straw bale buildings in the U.S., and adjusted the Pakistan system to the circumstances and available materials in Haiti.

TI KAY PAY

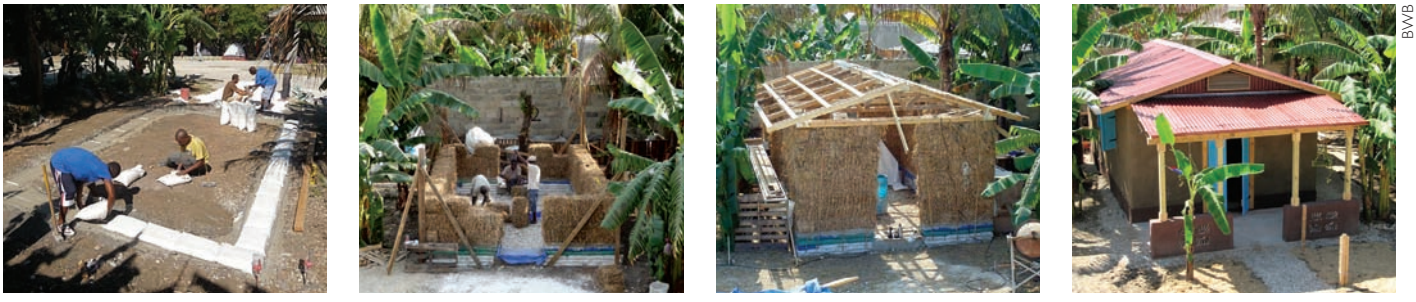
The Ti Kay Pay begins with a rubble trench foundation and courses of gravel bags for the stem wall. The rubble and gravel are produced with a manual rubble crusher using concrete from collapsed buildings, and the gravel bags are sewn from discarded tarps. Although a result of the tragic earthquake, rubble from collapsed buildings and tarps from emergency shelters are now seen as a resource in Haiti.

The foundation stem wall is encased in a layer of mesh-reinforced cement plaster, and the manually-made straw bales are then stacked, and topped with a wooden plate. The bales are reinforced with opposing lengths of bamboo that are through-tied. The corner wall panels use steel wire in an 'X' configuration to resist seismic forces, and polyester packing strap ties the roof structure to the foundation to resist hurricane winds. The roof trusses are made of either wood from deconstructed pallets (another new in-country resource) or construction-grade bamboo, which is being promoted as a way to stabilize Haiti's deforested mountainsides, as well as providing a rapidly renewable building material.

Corrugated steel is used for the roof, which, although imported, is readily available and provides a light, strong, and durable roof. Earthen plasters, using clay-based site soil, crushed rubble, and chopped straw, are used to coat and protect the straw bales and a similar mix is used for the earthen floors. There is a well-established tradition of earthen plasters and floors in Haiti's rural areas, but they are made more durable in BWB's buildings with a glue coat or lime wash.

COOL BUILDINGS AND ASSOCIATED TECHNOLOGIES

The Ti Kay Pay's well-balanced wall system of mass and insulation helps keep the building cool, and its generous door and window openings provide natural ventilation. Its attic is also well ventilated and uses ceiling insulation of straw and clay to shield the interior when the roof becomes warm. The building is complemented with other sustainable systems such as rainwater catchment for potable and non-potable water, and a simple photovoltaic system for lighting. Future buildings will include efficient



BWB

A Ti Kay Pay house rises from its foundation.

cooking stoves, and dehydrating or composting toilets that turn human waste into agricultural fertilizer.

NEXT PROJECTS AND OTHER SUSTAINABLE SYSTEMS

The BWB team will soon embark on designing and overseeing the construction of a school and cafeteria in Port-au-Prince and a rural school on Haiti's south peninsula. In addition to the use of straw bales, other sustainable building systems will be considered. These include minimal wood frame with light straw-clay infill, the use of Haiti's ubiquitous plastic bottles in a mesh-reinforced cement plaster wall, and a wall system using cement blocks made with crushed rubble along with a braced bamboo frame. The latter system is being developed by a team from the Ecological Building Network (www.ecobuildnetwork.org).

Although the 2010 earthquake devastated Haiti beyond what can be imagined or described, it has also created a unique opportunity for this country that has struggled for much of its 200-year history. Haiti now has an opportunity to increase employment and improve its economy, mend its natural environment, and become more self-sufficient by utilizing its own human and material resources. Sustainable principles and methods of rebuilding are vital to achieving those ends, and for setting an example for the rest of the world.

Martin Hammer is an architect in Berkeley, California, and team leader for Builders Without Borders in Haiti. He has also worked in Haiti with the Earthquake Engineering Research Institute and the World Monuments Fund. Martin has been involved with the design, construction, and testing of straw bale buildings since 1995, and helped introduce straw bale building to post-earthquake Pakistan with Pakistan Straw Bale and Appropriate Building.

Andy Mueller is a designer and lead builder for Builders Without Borders in Haiti. He is principal designer and builder for the GreenSpace Collaborative in Massachusetts and is co-founder of Natural Builders Northeast. He has a master's in Landscape Architecture from the University of Massachusetts.