

# Builders Without Borders

## Sustainable Rebuilding Solutions for Haiti

### Ti Kay Pay - Small Straw House The First Strawbale Building in Haiti

Builders Without Borders' first building project in Haiti has begun. Team leader, architect Martin Hammer, and lead builder Andy Mueller are in Port-au-Prince constructing the first strawbale building in Haiti. Why straw? It can create one of the most seismically-resistant building systems on the planet. This fits with BWB's mission to develop and promote safe, affordable, sustainable & culturally-appropriate shelter in places of need.

As with all BWB projects, this work in Haiti includes training and active involvement of people in the communities where the work occurs. This collaboration allows the development of appropriate solutions that are received and owned by the local population. Already, Haitians Jean Louis Elie and Annio Baptiste have become integral members of the Ti Kay Pay construction team, and Jean Louis plans to build his own strawbale home after the first one is complete.

In a recent team interview by CBC Radio-Canada, after only five days of working on the Ti Ka Pay, Jean Louis remarked - "When people see the construction, then they really accept it. Because it's ours. The straw is ours. We make it, we live in it, it's no problem." And he continued, in response to a question about whether it took an earthquake to change people's ideas about how to build in Haiti - "If we had this kind of house, less people would have died."



Jean Louis Elie interviewed by  
CBC Radio-Canada

### Using Local Materials and Developing Local Industries

The Ti Kay Pay was designed to use as many in-country and local materials as possible, to build on existing labor and skill resources, and to encourage the creation of local industry. From the foundation to the roof, material and building system choices were made with these goals in mind.



Crushing rubble into usable aggregate

One enormous material resource that is largely untapped in Haiti is the rubble resulting from the collapsed buildings in the earthquake. The Ti Kay Pay design uses crushed rubble in the foundation and in the stem wall in gravel bags. The same crushed rubble is also screened for fine aggregate in the plasters. BWB and one of its partners, the Ecological Building Network, have purchased a manually

operated rubble crusher to generate that material. Alternately, the gravel bags can be filled with the crushed limestone that is commonly used as an aggregate in concrete. This material makes a weak concrete, but works exceptionally well as fill in the gravel bag system.

The gravel bags are made from the ubiquitous tarps that are found throughout the earthquake affected region. Cut and sewn to the needed size by a local seamstress, damaged and otherwise unusable tarps can be turned into building material instead of becoming part of the waste stream.



Tarps into gravel bags

Straw bales are central to the Ti Kay Pay construction system. Rice straw is plentiful in Haiti, as rice is commonly grown in the broad Artibonite Valley northwest of Port-au-Prince, as well as near Les Cayes on the south peninsula. At least 80% of rice straw in Haiti goes to waste, usually burned after harvest, polluting the air in the process. Two and sometimes three rice crops are grown annually, making straw a rapidly renewable resource in Haiti. BWB's Ti Kay Pay uses manually baled straw for its wall system, reinforced with bamboo and covered with interior clay and exterior lime plasters. Clay is readily found throughout Haiti and a tradition of clay plaster exists, and efforts are being made to revive Haiti's lime kilns.



Straw being burned in the Artibonite Valley



Straw bale being tied off in a steel compression mould.



Noel and Arol exhibit the first batch of straw bales manufactured in Haiti



Pallet or bamboo trusses provide the roof structure, covered with commonly available and durable sheets of corrugated steel. Wood from pallets, left from the vast number of post-earthquake aid shipments, has become a new in-country resource for Haiti. Bamboo has long been native to Haiti, and a number of bamboo plantations existed before the earthquake. However, it is now widely seen that strong and fast-growing bamboo has been underutilized as a construction material in Haiti over recent decades. A campaign is underway to increase bamboo plantings and develop a bamboo industry, especially with species such as *Guadua* that are particularly effective as a structural material. Bamboo also has tremendous potential to help with Haiti's staggering condition of deforestation. Kevin Rowell of Kleiwerks International, with his extensive experience worldwide with bamboo construction, is a special consultant regarding this and other natural building materials used in the project.



**Above:** Disassembling pallets  
**Below:** Kevin Rowell conducts a bamboo workshop

### Cool Houses

Although the thermal insulation commonly associated with strawbale buildings is generally not needed to keep buildings warm in Haiti, the system's excellent balance of mass and insulation moderate temperature and keep the interior space cool. A light mix of straw and clay is used as insulation above the ceiling to shield the interior space from the heat of the sun as it warms the roof during the day. The attic space is generously ventilated, and louvered transoms above doors and windows provide cross ventilation throughout the day.

### Culturally Appropriate and Flexible Design

BWB's Ti Kay Pay is a culturally appropriate design derived from the Haitian Ti Kay, the common two-room plus galri (veranda) house, which is the fundamental rural and sub-urban living unit in Haiti. The BWB team has developed an understanding of Haitian vernacular building traditions with research and field observations and input from its Haitian team member and architect Regine Laroche, as well as with the research of architect and University of San Francisco professor Chris Andrews.

The galri is especially important to the design, since much of Haitian daily living occurs outside. It provides an outdoor space protected from sun and rain and serves as a transition from the more public yard or street to the private interior rooms.



The Ti Kay Pay design with front Galri  
 (drawing by Tammy Ng and Dan Smith)

The Ti Kay Pay design also lends itself to expansion. A third room in the back can be easily added, extending the shotgun floor plan. Rooms or porches with shed roofs on one or both sides can be added as well. Window locations in the design can instead accommodate doors and vice versa as the site or needs of the owner demands.

The design is a blend of traditional and modern in its form and appearance, including the plaster finishes associated with the modern concrete and block buildings Haitians have come to prefer, but with a light roof that so many Haitians are returning to after countless concrete roofs collapsed in the earthquake.

The system of strawbale construction developed for the Ti Kay Pay can also be applied to other house designs, or other building types as well. It is particularly suitable for use in small schools or clinics. Larger scale buildings, including two story buildings, could employ many of the systems developed for the Ti Kay Pay with proper engineering.

### **Safe Buildings for Secure Lives**

The Ti Kay Pay has been engineered to withstand earthquake forces exceeding Haiti's January 2010 earthquake, as well as 145 mph winds from hurricanes that annually threaten Haiti. Mesh reinforced plasters encase the gravel bag foundation, vertical lengths of bamboo stiffen the walls, and steel wire tension ties diagonally brace the corner wall panels, all to resist earthquake and wind forces. Large uplift forces under the roof from hurricane winds are countered with the weight of the building itself, by strapping the roof down to the foundation. Martin Hammer, project engineer Henri Mannik and architect Dan Smith, have used their 40 years of combined experience designing strawbale buildings in seismically active California to ensure the safety of these buildings. They have drawn heavily on numerous laboratory and university testing programs over the last 15 years.



The Ti Kay Pay unplastered, showing mesh over gravel bags, bamboo stiffeners over straw bales, and diagonal wire bracing

(drawing by Tammy Ng and Dan Smith)

### **Affordability**

The cost of these buildings is extremely important, and is being carefully monitored. The more affordable and the more they can compete with conventional methods of building, the more they will be utilized. Ways to simplify the building system and make its construction more efficient are constantly being explored to reduce cost, but without sacrificing safety or durability, and in fact making the building more so.

## **Associated Building Systems**

While the foundation, wall and roof systems are carefully considered and make up the building itself, associated systems are addressed as well, including:

- Rainwater catchment to above or below ground cistern
- Direct current photovoltaic system for lighting and other low-demand electrical needs
- Dehydrating or composting toilet systems, turning human waste into agricultural fertilizer
- Efficient cooking systems, such as rocket stoves or solar ovens will be promoted

## **Partnerships and Funding**

The BWB team continues to explore and develop partnerships with other organizations and consider future projects and trainings. This includes a school project for the organization Sionfonds, teacher housing in the village of Archaie, a partnership with Architecture for Humanity for small school projects, and a strawbale housing village in the Artibonite Valley where 70% of Haiti's rice crop is grown. Funding for the construction of these projects is expected to come largely from the project recipients, but BWB will provide training, organization, technical expertise, tool support, and in some cases may share construction costs. A baling mould and farm jack alone cost \$500 USD, and more are needed to increase bale production.

## **Donations**

Please consider donations to support the beginning phases of this important work that will create local industries and employment, provide an inspired model of sustainable reconstruction, and that we expect in time will sustain itself. Donations now will make you a part of constructing the first strawbale building in Haiti. This building is truly a historic structure, honoring Haitian culture and its vernacular building traditions and fusing those with strawbale construction's own rich history by adapting it to the Haitian environment. Consider making the donation in honor or memory of a loved one, or as a meaningful holiday gift for a family member or friend. All donations are tax deductible as Builders Without Borders is a project of Networks Productions Inc. a registered 501(c)3 non-profit organization.



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