

# **Social and Cultural Aspects of Constructions with Bamboo**

**Martha Garcia-Saenz**

Purdue University North Central, Westville, Indiana, USA, mgarcia@pnc.edu

## **ABSTRACT**

For a long period of time, corn was the food for the poor until new uses like ethanol raised prices to the point that many poor people could not afford its price, increasing the existing gap between poor and rich. In a similar way, bamboo has been considered the poor man's timber due to the easy and cheap way to get it for food or for construction material for housing. Due to the actual tendency and a growing demand for eco-friendly products in the construction industry, bamboo is gradually emerging as a "green gold" for growers and builders. This document explores the rapid changes in use of bamboo and the reasons why the poor man's timber is becoming the rich "green gold" supported by the environment's global tendency toward green construction. Seeing what happened with the corn, it is easy to visualize its consequences for the poor, who will not only be without a food source, but without a place to call home.

**Keywords:** Bamboo Construction, housing for the poor, sustainable construction.

## **1. INTRODUCTION**

The bamboo is the tallest grass in the world. It belongs to the gramineae family as does weed, wheat, and the corn. In four years it grows more than 30 meters and every part of the plant can be used. There are more than 1200 varieties and more than 150 uses. The bamboo shoot or new bamboo culm that comes out of the ground is food in many countries in Asia. Poor people in the world use bamboo in many ways: they build their houses, using the bamboo in the structural part; walls; doors; windows and trusses; roofs; hand rails; flooring; kitchen cabinets; closets; bathroom cabinets and hardware; for furniture, for the cup from which they drink; for the utensils to eat; the clothes they use; crafts; and musical instruments. Primitives used bamboo pipes for irrigation and acueducts. Thomas Edison used a bamboo filament when he was doing experiments while developing the light bulb and Alexander Graham Bell used bamboo for his first phonograph needle. The uses of the bamboo have grown over centuries and its versatility proves that the demand for this product is increasing in production and utilization.

### **1.1 HISTORY: OLD AND TRADITIONAL USES OF BAMBOO**

Native people in Central and South America, Asia, and Africa used bamboo for housing. Their architecture was called vernacular, a term used to categorize methods of construction which used locally available resources and traditions to address local needs and circumstances without the intervention of an architect or made by empirical builders. Vernacular architecture reflects the environmental, cultural, and historical context in which it exists. Sometimes it can be referred to as primitive or aboriginal architecture; indigenous architecture; ancestral or traditional architecture; popular or rural architecture; ethnic architecture; or informal architecture. Poor people who build their own houses fell into these categories.

In rural areas in many countries poor people were accustomed to building their houses with bamboo, because the material was easy to find. In the marginal areas of the cities, the bamboo was obtained after it was used in scaffolding (supporting the floor before pouring the concrete and for working at the façade) in the building process by the construction industry. Additionally, bamboo was used in concrete buildings or high rise buildings to lighten its weight (bamboo boxes were surrounded by concrete beams to alleviate the weight of the concrete). These practices changed when metallic scaffolding appeared and styrofoam replaced the covered bamboo.

Due to the fact that the primitives were the ones who used bamboo for housing and to the way people got the material (rural roads and construction debris) bamboo has been associated and recognized as “the wood for the poor” or “the poor man’s timber,” there is no difference in countries around the world: poor people usually build a modest home, but after the wealth of the family improves over time, and with more knowledge of the material, their houses improve.

A cultural shift occurred with the emergence of new materials like brick, concrete, and steel. Around the world the symbol of status changed because those materials were more solid and strong. In some areas, for instance, to encourage people not to build with bamboo, myths became common. In Indonesia, for example, people started to believe that bamboo encouraged snakes and in Thailand, the Thais believed the bamboo encouraged bad spirits.

## **2. SIMULTANEOUS CHANGES IN ASIA AND AMERICA**

Natives from Asia, Africa, and South and Central America have long been using bamboo for housing, sometimes in combination with clay. In Valdivia, Ecuador, the remnants of walls containing bamboo and clay were found during excavations dating back 7,550 to 5,500 years old (Hidalgo, 1978).

Four architects, two in Asia and two in South America, early in their professional life liked to design and build with bamboo, combining traditional uses with more modern architecture. Each of them contributed in different ways to the contemporary architecture with bamboo. They were the ones responsible for introducing bamboo during a time when other woods were becoming scarce and more expensive due to environmental restrictions; lack of reforestation; and a tendency to build sustainable construction.

Architect Shoji Yoh was born in 1940 in the city of Kumamoto, Japan. As a professor, he experimented with his students using bamboo as a main static structure. He attended the Vitra Design Museum workshop in the summer of 1989, being the only representative from Asia. At that event, he presented a Geodesic Cupola built from bamboo. Yoh won the Architectural Institute of Japan Award in 1989 for his series of 3-D Truss Wooden (Bamboo) Structure Buildings in Oguni and a shelter in Fukuoka that year. Yoh built The Naju Community Center (dome shell) and Nursery School and the Uchino Community Center for seniors and children (barrel vault), both in Fukuoka, Japan in 1995. Both of them have a 3-D structure in bamboo, with an upper layer in reinforced concrete (Shoji Yoh Architects, 2012). His advanced mathematical, computational, and structural skills helped him to meet the primitive workmanship with an advanced computer analysis. Probably these projects were his labs, testing different materials, since he later used concrete, steel, and glass in his designs in a non-conventional way. Computational analysis and knowledge of materials brought him to a specific style of architecture known as “Elastic Architecture.”

Architect Juvenal Baracco was born in Lima, Peru in 1940. Inspired in the traditional Pre-Columbian and Spanish colonial tradition of quincha architecture, he designed and built a set of houses where he combine the modern and the vernacular architectures in 1980. What influenced Baracco to use the traditional architecture into a more modern architecture was his participation as a board member of the Cartagena agreement in 1977 between Colombia, Ecuador, Bolivia, Peru, and Venezuela to promote wood construction. It later gave him the opportunity to be involved in a technical group testing different types of wood including bamboo. It also led to his participation in a technical manual promoting bamboo combined with loam, a rich soil containing a relatively equal mixture of sand and silt and a somewhat smaller proportion of clay inexpensive for low income families who wanted to build their houses themselves and at the same time withstand earthquakes (Carbonell and Galaor, 1988). His contribution lies in the influence he had on other young architects who were rediscovering the vernacular architecture combined with improving quincha and bamboo for more ecological constructions (Rodriguez-Camillioni, 2009).

Architect Simon Velez was born in Manizales, Colombia in 1949. His father and grandfather were architects. Simon Velez was born in a place surrounded by architects, bamboos, and coffee. The city of Manizales was

originally built with clay but a large earthquake destroyed the city. People reconstructed the city using bamboo, but because all houses were adjoined one to another a fire destroyed the city at the beginning of the last century when electricity was introduced. People then started using clay and concrete forgetting what happened before. In the 90s, another strong earthquake destroyed the city of Armenia and part of Manizales again. Simon Velez and some of his followers introduced bamboo as the perfect material for that specific area, given that bamboo is indifferent to earthquakes. He personally did some of the designs for the newly created neighborhoods built with bamboo. After the earthquake more than 250,000 houses were built with bamboo at a rate of 80 houses per day.

One day, early in his professional life, one of his friends who had a hacienda where there was a lot of bamboo growing, asked him to build a stable for his horses and he wanted it to be built with bamboo. Velez wanted a big roof, but he had never worked with bamboo and did not know how to join the bamboo canes, because nails and screws damage the canes. He decided to use bolts and to secure the nodes, injecting concrete to the ends of the bamboo sticks (Villegas, 2003). It made lasting joints and therefore created long spans and cantilevers. He never used structural calculations; he designed sketches in a notebook and convinced his clients to build the project (Kries, 2000). As architect Shoji Yoh did in 1989, Simon Velez attended the Vitra Design Museum workshop in summer of 1999 and during that workshop he built a garden pavilion in bamboo. For expo Hanover, he built a pavilion, but before he built a model 1:1 scale in his native city of Manizales. Calculations were not developed yet due to the lack of data and experience. Tests were carried out on the prototype in Manizales under the supervision and presence of a roof-planner and building authorities to get the construction license in Hanover (Steffens, 2000).

Velez's bamboo projects were countless and his clients ranked from low-income-class to upper-income-class due to the beauty of his designs. He had national and international clients: a cathedral in Pereira, Colombia in 1999; an observation tower in Park La Cafetera, Montenegro, Colombia in 1993; Belvedere in a bamboo park in Pereira, Colombia, in 2000; Social Interest Housing in 2003; Expo Shanghai Dome in 2010 in India 17 meters high; Cross Waters Hotel with 100 rooms and a bridge in Canton, China; an ecological hospital in China; some villages in Oaxaca (México) and Angra dos Reis (Brasil); a musical stage and housing projects in Ocho Ríos, Jamaica; projects in Panamá, and France, and nomad museums in Mexico City and Brazil.

Velez's contribution to modern architecture in bamboo lies in two things: first, bamboo construction became socially acceptable (Kries, 2000); and second, bolts connections, parallel connections, orthogonal connections and angle joints were among the most commonly used shapes with injected concrete at the end of the sticks allowing long spans and cantilevers (Rodriguez-Camillioni, 2009).

Architect Rocco Yim was born in Hong Kong in 1952 and graduated in 1974. In 1979 he established his own company, Rocco Design Architects Ltd. and in 1990 was elected Architect of the Year (University of Hong Kong, 2002). In 2000, he built a Bamboo Pavilion at the Festival of Vision, Hong Kong in Berlin, Germany. The name of his work was "The House of the Cultures of the World," built with 400 pieces of bamboo. The pavilion was used for drama, music, and fashion shows during the festival and for some time after the festival (Hope and Ryan, 2002). Recently, in 2010, he designed a pergola arch for public use outside of the Museum Of Contemporary Art, Shanghai, China. It is an abstract frame-work that fused the traditional and the contemporary, a dialogue between the East and West and an interpretation of art and ideologies (Rocco Design Architects Ltd., 2012). The importance of his work with bamboo lies in the fact that he brought the public into architecture.

All four of the architects combined tradition and modernity through the use of renewable and sustainable natural resource of rapid growth and outstanding environmental and aesthetic qualities that offered great economic possibilities for diverse regions around the world. These architects have inspired many young architects and students around the world to create new designs incorporating the beauty and flexibility of bamboo.

## **2.1 NEW USES DUE TO ARCHITECTURE INCORPORATION**

Lean, sustainable, and green architecture were some of the coined names for the new tendency toward building using only renewable resources and serving human needs without destroying resources based on what human civilization is based. It was the way our ancestor and primitive people used to live and that's the tendency today. Throughout history vernacular, or indigenous housing has permitted the use of natural and renewable resources. This type of housing has been verified through the centuries, and provided roofs for the poor who build their own houses using one of the indigenous materials which currently are used in a modern way, the bamboo.

Today bamboo is called the vegetable steel. Simon Velez is called the architect of the vegetable steel (Rodriguez-Camillioni, 2009) or the bamboo architect (Kries,2000). Velez talked about bamboo as “the vegetable alternative to steel” and many others recognize the efficiency of the high performance and ultra-economic technology of bamboo. Those who build with bamboo today, take into consideration quality, flexibility, and beauty.

## **2.2 WHY BAMBOO IS SEEN AS A GREEN GOLD?**

Bamboo is better than wood and is environmentally friendly. It grows more than 30 meters every four to five years and once it is cut, it can grow again. Growing bamboo is labor intensive for the first two years, but after that, farmers will get money for the next 50 years or more. Bamboo survives by bending with the wind. Bamboo is good for reforestation, controlling soil erosion, and stabilizing river banks. Bamboo can grow in lowlands, mountains, dry and humid tropics, wastelands, swamps or regularly flooded riverbanks and the cost is low. This is why bamboo is called the green gold.

The tourism industry has been promoting bamboo products as a part of the eco-turismo. Many hotels in the caribbean and other places have been built exclusively in bamboo and additionally many crafts, food and furniture are made in bamboo to get the tourists fully interested in that plant. Even some governments had declared the bamboo as a sunrise industry and helped to develop the markets of all its products and established some festivals to attract more tourists.

## **3. THE POOR IN LATIN AMERICA AND THE WORLD**

The way the poor in Latin America and other places around the world acquire a home is through a progressive housing. The formal sectors buy land, plan the home and construct it. Another way is to buy the house directly from a builder if it is new or from a secondary market when it is not new. In most cases, a bank or a corporation is involved due to the necessary mortgage when people do not have the total value of the home. The mortgage could have a span from 5 to 30 years. Usually the poor do not have a formal income to get a mortgage, which is why they purchase their home in different way.

In Latin America, owning a home is very important and because of that, there is a high rate of ownership: 73%, but from them 25% have an informal tenure. Compared with the high-income countries, it is 42% with 2% with informal tenure (Fay, 2005). Housing for the poor starts with occupation of a piece of land usually in risky locations or a piece of land sold by someone without a permit and no utilities. When poor people move in, they usually build with materials that come from debris or wood from the nearby area. When bamboo was the wood for the poor, many times it was because of two reasons: in a rural areas owners of haciendas gave it to the poor or their poor labor employees and in the urban area, bamboo came from debris of constructions. When the bamboo was no longer used in construction, the poor started using cardboard and felt. When the occupation is not opposed by authorities or landowners, the transition phase begins. More families arrive and they beg as a group, demanding utilities and services from the government. When the basic infrastructure and utilities are provided, they slowly add more permanent materials and finishes to their homes. In some countries, the government provides some subsidies to buy a home, but in many cases, these cannot be accessed due to the fact that poor people cannot demonstrate a formal income. That is the reason why poor people ended up borrowing money from relatives or informal financial institutions to improve their houses, paying most of the time higher interest than the ones from regulated institution. Always for the poor, everything is more expensive.

#### **4. CORN USE TO BE THE POOR'S FOOD**

Before corn was industrialized, it was available to many poor people. When corn was in the early stages of industrialization, the benefits of giving jobs to poor people was shown in many sources, but when technical plantation and new equipment arrived to different areas around the world, poor people moved from rural areas to big cities where they encountered misery and poverty. Other owners of land in rural areas were stripped of their land to establish large plantations. These people moved to the cities which increased the number of low-class citizen since they were accustomed to cultivating the land and in the big cities they did not have the skills to survive, increasing the number of marginal population.

Lately, ethanol has been the reason why grain prices are increasing. Ethanol is responsible for the rise of some other crops and food too. Farmers take advantage of the biofuels bonanza and since the demand for corn increased, they plant more corn. Farmers usually respond to price signal, they plant crops with higher market value. It creates slow increase in supply of other cereals and because the demand increases, then prices of other crops and cereals increase too; when demand is higher than supply, prices increase and rising prices in general hurt the most vulnerable sector of the population, the poor.

Gary Becker, a Nobel economics laureate at the University of Chicago pointed out that if the food prices rise by one-third, the living standard of the developed countries decrease about 3%, but the poor countries reduce over 20%. According to the World Bank, in January 2011, maize prices were around 73% higher than June 2010. Poverty as a result of price rises since June 2010 show there is a net increase in extreme poverty of about 44 million people in low- and middle-income countries (World Bank, 2012).

After the collapse of the mortgage market in the United States, institutional investors looked for other cost effective places to invest their money. Capitals will end up in the agricultural business, pushing prices and worsening the food price inflation. (Holt-Giménez, 2008).

Where we are going then? Taking the food of the poor to fill the gas tanks of cars for the rich. According to the World Bank, the grain to fill up a SUV would feed a person for a year. There is a shift here. Corn is no longer food for the poor. Corn is going now to feed the gas tank of the rich's cars.

#### **5. VERY SOON BAMBOO WILL BE NO LONGER THE POOR MAN'S TIMBER**

Bamboo is in the early stages of penetration to the market, but is very easy to visualize what is going to pass in a short term.

At present, there is demand for bamboo to be used in housing for the poor due to its low cost, but little by little the price is increasing due to bamboo's new uses in industrialized countries. Most of the time, governments with a good intention start programs in favor of the most disadvantaged groups, but in the long run, those businesses are undertaken by multinationals. In Vietnam, for example, the government with the International Finance Corporation are improving the supply chain bamboo to manufacturing flooring and furniture for IKEA, increasing the incomes of 400 farmers (International Finance Corporation, 2012). Similar to this project, there are many around the world. What is happening in a long run? Multinationals will offer the farmers to buy the land to create bigger farms and technical equipment will arrive in the same way as it happened with the corn industry in many areas around the world.

Actually many governments are promoting housing for the poor due to the qualities and low cost of bamboo, but how long will they do it? The demand for bamboo is growing very fast due to the expenses of other wood and the actual tendency towards sustainability that bamboo can be carried to the housing industry. After that it will be a mirror or the corn. Housing for the poor will be not possible with bamboo because of its cost. Rich people will

live in a beautiful house made with bamboo and poor people will live without a food and without a place to call home due to a social and cultural shift. The gap between the rich and the poor will increase notoriously.

## 6. CONCLUSIONS

Poor people in the rural areas were accustomed to build their houses with bamboo, but it is getting impossible due that the bamboo now is a green gold with a good price. Bamboo is no longer the poor man's timber or the wood for the poor. Bamboo is changing hands, is moving from the poor to the rich.

It has been a shift in the social and cultural use of bamboo. Upper classes due to good architectural designs now appreciate bamboo and believe that it has many structural properties that other woods do not have like being indifferent to earthquake. Bamboo is more appreciated today than ever before.

More demand for a material that in the past was used only by the poor, create social implications. The bamboo very soon will be no longer the poor's man timber and be more and more expensive and scarce for the low-income-classes, carrying an additional expense over them.

## REFERENCES

- Carbonell, Galaor, 1988. "Juvenal Baracco: Un Universo en Casa", Universidad de los Andes, Facultad de Arquitectura, Bogotá, Colombia. Escala Ltda.
- Fay, Marianne, 2005. "The Urban Poor in Latin America, Directions in Development. The International Bank for Reconstruction and Development, Washington D.C. pp 92-124.
- Hidalgo, Oscar. (1978). "*Nuevas Técnicas de la Construcción con Bambú*", Estudios Técnicos Colombianos, Bogotá.
- Holt-Gimenez, E. 2008. "La crisis mundial de alimentos: que hay detrás y que podemos hacer en: <http://www.ircamericas.org/esp/5627>. As seen December 20, 2011.
- Hope, Eliza and Ryan, Kate, 2002, "*City in Architecture: Recent Works of Rocco Design Limited*", Images Publishing Group. Hong Kong, pp. 16.
- International Finance Corporation, 2012. "IFC-MPDF Improves Supply Chain for Farmers", [http://www.ifc.org/ifcext/mekongpsdf.nsf/AttachmentsByTitle/Agri-biz-factsheet/\\$FILE/Agri-business-factsheet.pdf](http://www.ifc.org/ifcext/mekongpsdf.nsf/AttachmentsByTitle/Agri-biz-factsheet/$FILE/Agri-business-factsheet.pdf), as seen February 14, 2012.
- Kries, Mateo, et al. (2000). "*I am a Roofing Architect – Interview with Simon Velez*", Grow your Own Home, Vitra Design Museum Publication.
- Rocco Design Architects Ltd. (<http://www.rocco.hk/Projects.asp?lang=ENG>) as seen February 10, 2012.
- Rocco Design Architects Ltd. <http://www.hongkongberlin.net/> as seen February 10, 2012.
- Rodriguez-Camillioni, Humberto. (2009). "*Rethinking Bamboo Architecture as a Sustainable Alternative for Developing Countries: Juvenal Baracco and Simon Velez*", Proceedings of the Third Congress on Construction History, Cottbus, May 2009.
- Shoei Yoh Architects, <http://www.jade.dti.ne.jp/shoeyoh/Profile%20E.htm> as seen February 10, 2012.
- Shoei Yoh Architects, <http://www.jade.dti.ne.jp/shoeyoh/Essay/SUSTAINABLE DESIGN.pdf>. as seen February 10, 2012.
- Steffens, Klaus, 2000. "*Excerpt from an experimental evaluation of the load-bearing properties of the ZERI pavilion*", Grow your Own Home, Vitra Design Museum Publication.

University of Hong Kong, 2002. "The University and its graduates, the first 90 years. Hong Kong University press. pp. 154.

Villegas, Marcelo. 2003. "New Bamboo Architecture and Design". Villegas Asociados S.A. Bogotá, Colombia.

World Bank, 2012. "Food Prices Watch".

[http://www.worldbank.org/foodcrisis/food\\_price\\_watch\\_report\\_feb2011.html](http://www.worldbank.org/foodcrisis/food_price_watch_report_feb2011.html). As seen Feb 27, 2012.

### ***Authorization and Disclaimer***

*Authors authorize LACCEI to publish the paper in the conference proceedings. Neither LACCEI nor the editors are responsible either for the content or for the implications of what is expressed in the paper.*