

The Role of Bamboo in Green Building Design

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1. Summary

Despite of the long tradition of building with bamboo, the material is not used frequently in modern building constructions. Or can we see a change in the use of bamboo?

In the past years architects have been using bamboo in different ways in their designs. From interior finishes to bamboo constructions. The application of bamboo in design is still developing and there are more new applications to be expected.

Materials that are used in green design are always assessed for their environmental impact. Bamboo can replace concrete, steel or wood, depending on the situation and the application, although more built examples and dissemination is needed.

2. Bamboo and Buildings

Three fields of application can be identified: construction, decoration and building components. In Asia and South America bamboo constructions are well known. In Europe however it is not used very often. Probably one of the first large applications was during the World Fair in Hannover in 2000. This construction, designed by Simón Vélez from Colombia, was a good example of bamboo as a building material and its possibilities. Simón Vélez has build up a lot of experience with this type of constructions in his own country. This type of construction clearly shows both the beauty of bamboo and its strength.

Bamboo can also be used in a very efficient and industrial way. Instead of using the whole bamboo poles, a laminated product can be used too shape different beams. (This can be all sorts of I- or box-shaped beams.) In combination with bamboo plywood, modern wood frame constructions are available. It is even possible to realise a 100% bamboo construction by making use of insulation wool made out of bamboo.



Fig.1 The bamboo house at the Commune by the wall, Badaling

At this moment, there are plenty of good looking examples in the world. One project in China has become a very famous example as the project developer won a prize for it at the Biennale of Venice in 2003. This house is part of the “Commune by the Wall” development in Badaling, Beijing. The Japanese architect Kuma designed a house that is a showcase for bamboo. Although the construction is made out of steel and concrete, Kuma shows us how bamboo can be used in a very refined architectural way. In his house sunlight is filtered by

bamboo sunshades. Privacy is kept without preventing daylight to enter. Other applications he used are bamboo flooring and bamboo cladding on the walls.



Fig. 2 + 3 A bamboo sunscreen that filters the incoming daylight at Badeling.

The use of bamboo as a building material like sunshades is seen in many places. Dutch architects introduced these sunscreens in the nineties already. The big value of bamboo screens is the fact that it is open to daylight and air. So the gap between screen and window is very well ventilated. The rays of sunlight entering through the screens look nice but don't result in overheating of the house.

3. Bamboo and Green Design

The International Network for Bamboo and Rattan (INBAR) (www.inbar.int) and WWF China (www.wwfchina.org) have jointly launched the project "Promotion of Energy Efficient Buildings: Integration of Bamboo and Renewable Energy Technologies" in March 2002. The objective of the project was to design model houses, hotels and school buildings for south western China, particularly in Yunnan Province where abundant bamboo resources are available and which has a tradition of using bamboo as a building material. Because of the climatic variations in Yunnan, one should take the different local conditions into consideration and use the available resources.



Fig. 4 + 5 Pingbian (Yunnan) school under construction.

One of the projects that has been finished is the Pingbian school. The elementary school is used by 200 students and 14 teachers. The original construction is based upon concrete columns and beams. This open construction would have been filled with floor elements based on laminated bamboo beams and flooring with bamboo plywood. The space between the columns was to be filled with bamboo-frame elements. The basic construction is the same as the Canadian wood-frame (platform) construction method.

Unfortunately the certification of the different bamboo products was not finished in time and the amount of bamboo used in this design decreased. One building block has bamboo wall panels and a bamboo roof construction by means of an experiment.

Because of the climatic circumstances the building construction needs to be insulated for cold winter days. At the same time big south windows will warm the classrooms. A very heavy and massive construction is not necessary because of the semi-mountain climate with moderate winters and warm summers. For that reason, sunshades and overhangs are useful and an insulated building is necessary.

Another project is done by BEAR Architekten in co-operation with the Nature Conservancy (TNC) in Kunming and INBAR. New houses for Tibetan people and an energy-efficient office have been designed for the Botanical Garden of Zhongdian (Shangri-La). The buildings are mainly constructed in a rather heavy way because of the cool to very cold weather in this area and the high insulation of solar radiation in the heating season.

The goal of this project is to built comfortable and energy-efficient buildings with the use of local materials. The situation in many traditional houses is that rather scarce wood is used for heating and cooking. Construction of the buildings in general is done in reinforced concrete. Together with KUST (Kunming University of Science and Technology) a combination is made between the concrete “post and beam” system and the possibilities for insulated bamboo walls. The outside of the construction is finished with the traditional adobe. The building construction will be finished in december 2005.



Fig 6 + 7 The EE-office in ShangriLa Botanical Garden under construction.



Fig. 8 + 9 Solar design for Tibetan houses in ShangriLa.

In general it can be said that green building projects focus on three main points:

- energy (energy conservation and the use of solar energy);
- materials (embodied energy and renewables);
- water (conservation and re-use).

It will be clear that building designs should be different for different climatic regions. Design taking climate and local resource in consideration is called “Bio-climatic design”. The main objective of bioclimatic design is to provide ‘comfortable’ living conditions with a minimum and meaningful input of artificial energy. This reduces investments and running cost (energy) as well as ecological damage.

It is obvious that keeping the building warm in the cold season and keeping the building cool in the hot season is the main design objective for comfortable buildings. Depending on the climatic circumstances this can be translated in the following rules:

- in hot climates: keep the sun out;
- in cold climates: led the sun in;
- in moderate climates: keep the sun out in summer and let the sun in in winter.

Looking to the broad scale of bamboo products, this means that we can introduce these products in all kind of climates and all kinds of building types.

In general: the application of bamboo products will add to the “Green” image of the building.

4. Future strategies

Although there is a large interest in Bamboo building products, most of the applications are not structural but more decorative. To make a step forward, from decoration to structures, certified products are needed. The building industry is rather traditional and requires certificates and standards for building products.

This is the first step but in general not enough to convince people. The decision makers in design are the architects. They love new products and new applications of products. However they need examples and well prepared information.

Architectural magazines play an important role in the dissemination of new products.

Interesting buildings are published world wide and as a result more architects follow. Other possibilities are trend magazines or art magazines.

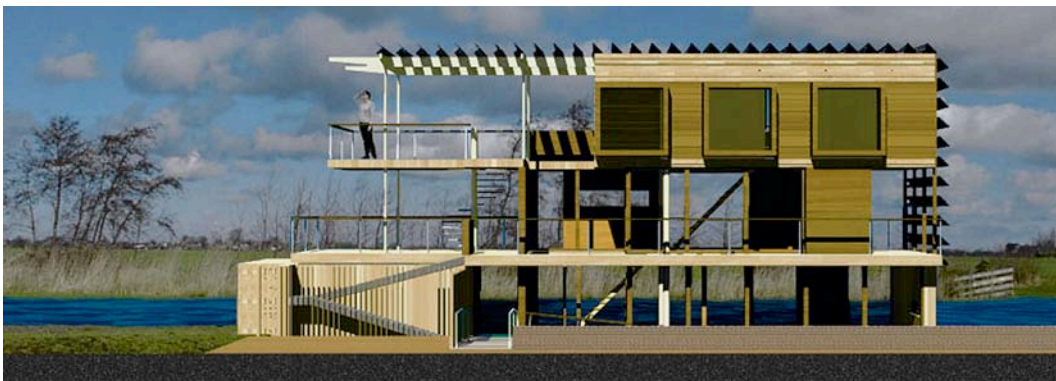


Fig. 10 A sustainable modern house design in Rotterdam (The Netherlands)

One of the possibilities is to initiate demonstration projects. The type of demonstration projects depends on the location. Exhibitions or fairs that last a whole summer are good opportunities to show the possibilities and advantages of bamboo products and constructions. As mentioned before one of these demonstration already took place at the world fair in Hannover, Germany in 2000. Other demonstrations could be trendy family houses. As an example, BEAR Architecten designed a very special sustainable one-family house in Rotterdam (The Netherlands). In this design, bamboo was used for different applications like beams, floors, walls and shading systems.

By using bamboo in modern houses its image can change from an alternative to a modern and more widely accepted material.

5. References

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6. Figures and pictures

BEAR Architecten, Tjerk Reijenga - Figure 1, 2, 3, 6, 8, 9, 10.

Tang Di - Figure 4, 5.

Tang Letian - Figure 7.