The Promising New Bamboo Construction Technology

The emerging economies, the climate change and the rural migration result in unprecedented urbanization trends in most low income regions of the world. The increasing demand for building materials combined with the higher costs of urban land is further marginalizing huge numbers of poor people.

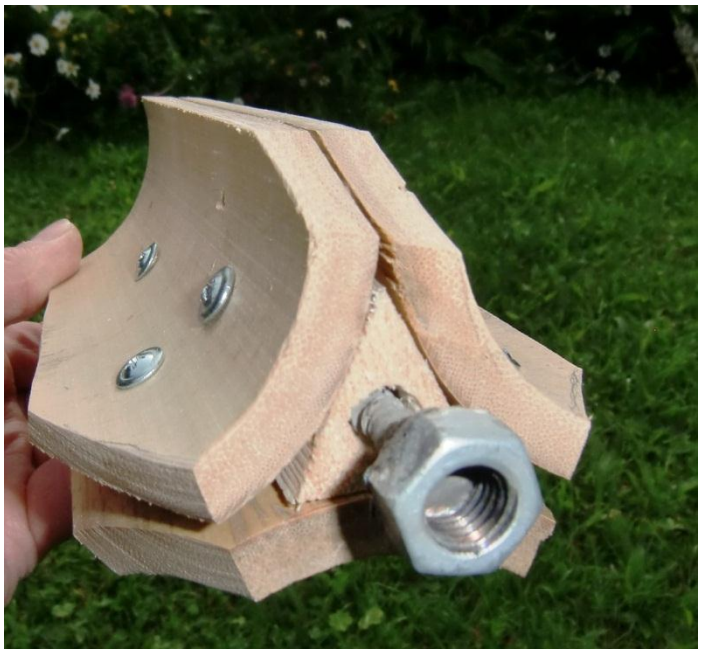
However, a low-cost and renewable resource for permanent construction could be based on bamboo, even in urban densities. In tropical regions construction size bamboo reaches full strength already after 3-4 years. Growing on hill sides and along roads and fields it does not encroach on agricultural land either. On the contrary, bamboo can prevent erosion and even revitalize devastated rain forest soil. Local economy can be promoted at all steps in the supply chain.
Globally bamboo can help the whole world by its remarkable CO_2 sequestrating capacity.

Most of the traditional issues associated with bamboo construction such as degradation by insects and fungi, sagging connections and flexing members have been resolved today. The still prevailing opinion of bamboo as “poor man´s timber” is simply a matter of ignorance. Eco-friendly and fairly low-cost impregnating methods based on borax and boric acid have proved to be efficient, especially in Colombia, and also in Brazil, Indonesia, Vietnam, the Philippines etc.

Yet, architects and engineers need to embrace new design parameters in order to protect the bamboo components against weather, UV radiation, humidity and flooding. Critical connections where concentrated forces have to be transferred must be carefully detailed so as to avoid cracking and breakdown. Simply nailing and bolting as done in wood would be devastating. Therefore a proven method is the bamboo > mortar > steel configuration whereby the stress is distributed evenly and channeled to a fixture that easily can be bolted to another.

The "Pet Crown" space frame connector for eight elements converging into one moment free point.
Architect: Ingemar Saevfors, 2012

Another issue to confront is the uneven and slightly tapered shape of bamboo as given by nature. This is sometimes difficult to combine with perfectly planar and flush industrial materials such as roof sheets, solar panels, boards and similar products when tight joints are expected. However, bamboo can also be machined, predrilled and reassembled to meet these requirements.



Reassembled back-to-back purlins for a dimensional standard height.
Architect: Ingemar Saevfors, 2012

Assembly of a Spaced Column resistant to buckling, with Joerg Stamm at Eco-Bamboo, Colombia, 2009.

The mechanical properties are amazing: a tensile strength well over 150 MPa; some species are even comparable to steel grades. Compression strength is maybe only a third, but with mortar in-fills at critical sections this can be compensated. With the right structural design columns, beams and floors made of bamboo components could replace reinforced concrete and steel structures to a large extent.

Buildup of a multistory structure

Another method to get standardized dimensions out of the irregular bamboo poles is the Vierendeel design, named after a Belgian bridge engineer. If the beam is manufactured in a simple rig an equalized height is easy to achieve. This type of design is truly cost effective as the construction materials are mainly utilized where the tensile, or the compressive stress, is at its maximum and not in the passive middle layer. Another advantage is that the deflection is much easier to control. The moment of inertia and the section modulus reach comparatively high values which is important for the flexural resistance.

Mounting of a prefabricated floor joist

Wall design is a challenge when building with bamboo. Urbanizing people expect:

- Flush and planar surfaces, as with plastered brick houses, easy to paint.
- A tight envelope against mosquitos and flies
- If aware of energy costs, insulation for air-conditioning.

At the same time a bamboo wall has to be protected against driving rains as well as being resistant to mechanical impact.

A bamboo wall segment protected by an exterior plate of thin ferro-cement

With a honeycomb structure though, an extraordinary strength and a totally standardized width of the wall can be achieved.
This design is known from aircraft industry and is easy to adapt to accurately cut bamboo stubs.

Bamboo poles may take on the loadbearing function whereas the honeycomb cluster becomes perfect for bracing.

The interior wall surface could be made of practically any material.

The architectural potentials the new bamboo technology now can offer are beyond common imagination. For a quick impression try to visit http://www.bamboocompetition.com/

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