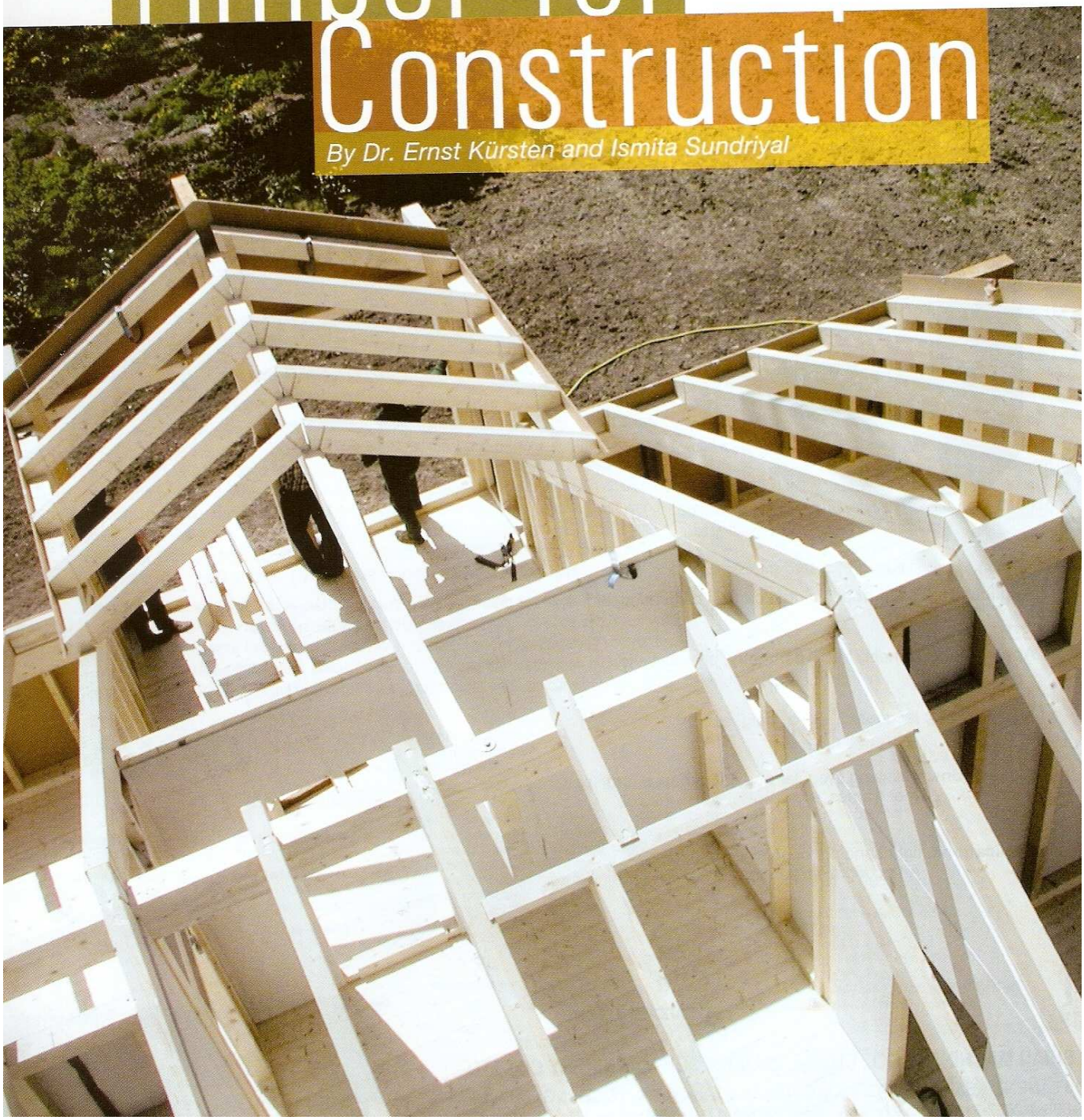
WoodNews Feature

Wood News
Vol. 18 No. 3
Sept – Oct
2008
pp. 8 - 14

Timber for Construction

By Dr. Ernst Kürsten and Ismita Sundriyal



Timber for Construction – Old Ideas for a New Era

Timber has been used as a construction material for millennia. In India, you can find very old wooden constructions in many places, particularly in forest-rich mountain areas. However, since forests reserves have been depleted during the last century, conservation of forests became the main focus of India's forest policies in 1988, and the supply of wood from the forests as a raw material for industrial use got the lowest priority (Kishwan et al. 2007). As a result, nowadays on construction sites timber is mainly being used for shuttering, but not as a permanent part of the construction, except in windows and doors.

Apart from the supply aspect, the use of timber is suffering from the fact that newer construction materials like steel and concrete are regarded as easier to handle and superior in their properties. As early as 1936, the Forest Research Institute (FRI) in Dehra Dun published a series of leaflets ("Timber Development Series") to promote the use of timber for construction. S. Kamesan, Officer in Charge of the FRI Timber Development and Wood Preservation Sections, tried to refute many prejudices and opinions concerning timber which still are dominating the minds of architects, civil engineers and laymen today, including the following:

- Steel and concrete are stronger than wood: "Weight for weight, timber, almost irrespective of the species, is as strong as steel, and about six times as strong as cement concrete. In the case of concrete, compared to steel and wood, structures are loaded with great masses of sand and stone which contribute more weight than strength." (Kamesan 1936a)
- Wooden constructions are more prone to fire: "It is the content of a house that almost invariably starts a fire and not the material out of which it is built. As long as we have highly inflammable papers, clothing and other necessities of life which are highly combustible, a house built of incombustible materials is really superfluous." Most important is to prevent fire from spreading rapidly from one room to the other and to prevent the construction from collapsing. This is mainly a matter of fire-resistant design. While unprotected steel girders will warp, bend, and collapse rapidly under heat, large-sized wooden beams will be charred on the surface but still carry the roof. The charcoal layer will act as insulation and protect the interior from burning for some time. Roof trusses which are nailed, bolted or pegged together from smaller boards should be covered, e.g. with gypsum board, fireproofed by chemical treatment, or sprinklers may be applied (Kamesan 1936c, d c).

This cross-section of a gluelam beam is showing how the outer layer of charcoal prevents it from completely burning and collapsing. In addition you can nicely see how gluelam beam are made from several layers of quality boards.

- Wood will be destroyed by insects and fungi. Of course, biological deterioration can destroy wooden constructions if they offer appropriate living conditions for insects or fungi. If protected from moisture (more than 20% moisture content) fungi cannot attack wood. The main insect pests in India are termites, especially subterranean termites. If termite-resistant timber species are not available, treated wood can be used: "The science and art of wood preservation have been so perfected that practically any timber which is not durable in its natural state can be made to last for an almost indefinite period in inside locations and for at least 25 or 30 years in outside locations." (Kamesan 1936a).

It is worthwhile to recall this old knowledge just now, as steel prices in India have risen by nearly 50% since January 2008. High prices and even scarcity of steel and cement are already hampering many construction projects (Desai 2008). That is a good reason to think about alternatives. In many European countries, wood has been experiencing a comeback as a construction material for many years. In the United States and Japan it has always played an important role, last but not least because of another aspect which also matters very much in India: earthquake resistance. The action of the horizontal shocks sets up a couple, which is the product of the horizontal acceleration, the total weight of the building, and the height of the centre of gravity above ground level. The wood's high strength linked with low weight makes it the perfect construction material in earthquake-prone areas. "A careful analysis proves that no common building material, even including steel, can surpass treated wood in this respect." (Kamesan 1936b, Zeitter 2004).

Finally, a roof construction made from timber is not only beneficial in the rare case of an earthquake, but on a daily basis due to its climatic advantages as compared to concrete. It is well known that life under a concrete roof in the tropics can be very uncomfortable, as this heavy material absorbs a lot of heat during daytime and transmits it to the rooms below. As a general rule, in a humid tropical climate the roof should be very light to avoid this effect. In a study with a 10 m^2 air-conditioned (AC) building in Delhi, having commonly-used concrete construction, Bansal and Mathur (2006) found the biggest heat gains (21%) coming from the roof. That makes obvious the importance of better insulation on top of the house for the reduction of energy consumption for air conditioning. A sloping timber roof construction would not only care for a much better climate inside and worldwide, but also reduce the risk of water infiltration more than a flat concrete roof would. If a storey should be added to a house, the roof could be temporarily removed and then put onto the new floor.

For earthquake-resistant houses in hot regions: a wood-frame wall filled with clay bricks

As in other Asian countries like Japan, China, and Korea, so too India could satisfy its timber needs partly by imports. The U.S., New Zealand, Australia and even Germany are offering their surplus timber from sustainable production to the world market. Anyway, there is also tremendous potential for increased domestic production on forest lands. Maybe even more importantly, Indian farmers are growing more and more timber for industrial needs on their lands, mainly in agroforestry systems. In 1965, scientists at FRI developed a series of all-wood trusses from 3 to 20 metres, using small-dimensioned stock of secondary species. When properly seasoned and treated with wood preservatives, it was found that they "would give longer service if the same care is given to them, as is given to the steel and concrete structures" (Masani 1967). The author suggested that structural components for assembling in the structural frames could be produced in small scale and cottage industries with a "portable sawmill and other ancillary equipment required for a small wood workshop." Finally, it has to be emphasised that even bamboo trusses may be a good alternative. Vengela et al. (2007) found them to be 50% less expensive than steel trusses when applied for school houses and industrial buildings.

Wooden constructions in general are more flexible and can be more easily adapted to changing needs of a family or a company.

In addition, construction with timber is a means for rapidly building small houses, big apartment blocks and industrial structures: Prefabrication of wall and roof elements under controlled conditions render possible a faster progress of construction and a higher quality standard.

Now there are so many good arguments and ideas for using timber in India but there are three obstacles which have to be overcome:

1. Additional timber suitable for construction is hardly available in India.
2. There are no processing facilities to convert sawn timber to high-quality glued laminated timber (gluelam) or prefabricated construction elements in this country.
3. Architects, construction workers and even timber engineers are not used to planning wooden constructions, and also skilled labour for the necessary processing plants is missing.

Glued laminated timber to support big roof constructions are being used more and more worldwide due to their economic, ecological and aesthetic advantages. Rising prices for steel and concrete are a good reason for Indian architects to think about this alternative as well.

To produce modern high-quality duo/trio or glued laminated timber (Germantimber 2008), mainly from imported softwood sawn timber or laminated veneer lumber (LVL), preferably from Indian poplar or eucalyptus round wood, new factories with modern machinery are necessary which are nonexistent in India right now. To build such processing facilities might be an interesting investment opportunity for entrepreneurs related to the construction industry.

In fact, the biggest problem might be the actual lack of experienced staff and education in the field of timber engineering in India. In some cases, consultants from other states have already been employed. Regarding the operation of modern machinery, the suppliers will offer training courses for the workers. In the longer run, help could come from international cooperation in the form of vocational

training and joint degree programmes, such as Germany, for example, is actually working to establish with Indian universities.

In addition to all the important technical and economical advantages of wooden constructions mentioned above, the ecological aspect shall finally be stressed: Energy conservation, climate change mitigation and Green Building are high priority topics today. It was already mentioned that rooves made from lumber may reduce the consumption of energy for air conditioning. Similarly, well-insulated wooden walls and window frames reduce heat transmission. Furthermore, the production of construction elements from timber often needs less energy than their counterparts from steel, concrete or plastics (Kürsten 2008). All this contributes to reduced emissions of greenhouse gases, namely CO_2. India's Energy Conservation Building Codes (ECBC) were developed after the enactment of the Energy Conservation Act of 2001. They "provide minimum standards for reducing energy demand of the buildings through design and construction practices while enhancing the occupants' comfort" (Hong et al. 2007). These ideas are being adopted by the present "Green Building" movement. Three major promoters are:

- The Confederation of Indian Industry (CII) (LEED = Leadership in Energy and Environmental Design)
- The Indian Green Building Council (IGBC) = IGBC Green Homes Rating

A wooden roof reduces energy consumption of AC and heating, and by this contributes to climate change mitigation. It also reduces the risk of earthquake damage, and it can be easily adopted to changes of the construction, like adding a new storey.

Prefabrication of wooden wall or roof elements under controlled condition can ensure a higher quality standard and a more rapid progress of work on the construction site: an economic advantage!

- The Energy and Resource Institute (TERI) (GRIHA = Green Rating for Integrated Habitat Assessment).

These certification schemes ask for the "use of recycled and environmentally friendly building materials" (CII 2008) and the "selection of ecologically sustainable materials (with high recycled content, rapidly renewable resources with low emission potential, etc.)" (TERI 2008). Obviously wooden constructions are the answer!

In conclusion, it is a well-known axiom that there is a right place and a wrong place for everything, and it is not the intention that wood should be looked upon as the favoured and pampered child of wealthy parents. All we ask is that it should be given a fair hearing and that engineers "honestly and without prejudice" should consider the "old ideas for a new era", use their own special qualifications to check them up and give treated timber the same consideration as they give other structural materials. **WN**

Portable sawmills, as presented here at Indiawood in Bangalore in March 2008, can help farmers to produce high quality timber for roof trusses and other construction elements from their agroforestry plantations and by this contribute to rural development.

References

Bansal, N.K. and J. Mathur 2006: Energy Efficient Windows. Anamaya Publishers, New Delhi

CII 2008. Green Building Movement in India – Catalysts and Course. Download: http://www.igbc.in/igbc/mmbase/attachments/1649/Green_Building_Movement_in_India_-_Catalysts_and_Course.pdf (August 4, 2008)

Desai, T. L. 2008. Steel – the complete scenario. Indian Construction 41 (7), 49-51

Germantimber 2008. http://www.germantimber.com/en/timber_products/timberproducts_duo_trio_beams/ (Sept. 1, 2008)

Hong, W., Chiang, M.S., Shapiro, R.A. and M.L. Clifford 2007. Building Energy Efficiency – Why Green Buildings are Key to Asia's Future. Asia Business Council, Hong Kong

Kishwan, J., Pandey, D., Goyal, A.K. and A. K. Gupta 2007. India's Forests. Govt. of India, Ministry of Environment and Forests, New Delhi

Kamesan, S. 1936a. Wood's challenge to steel and concrete. Timber Development Series No. 1, FRI, Dehradun

Kamesan, S. 1936b.Treated timber for earthquake resistant structures. Timber Development Series No. 6, FRI, Dehradun

Kamesan, S. 1936c. How to build fire-resistant timber structures. Timber Development Series No. 19, FRI, Dehradun

Kamesan, S. 1936d. Fireproofing of wood. Timber Development Series No. 20, FRI, Dehradun

Kürsten, E. 2008. How forest industries may contribute to environmental protection. Wood News 17 (6), March-April 2008, pp. 8-15

Mansani, N.J. 1967. Significance and scope of timber engineering for economic development of construction industry. In: Council of Scientific & Industrial Research (ed.), Working Group 14. Buildings, roads, civil engineering, materials. New Delhi, 104-112

TERI 2008. http://www.teriin.org/bcsd/griha/green.htm (August 5, 2008)

Vengela, J., Shyamasundar, K., Naida, M.V. and C.N. Pandey 2007. Study on bamboo trusses in housing. J.Ind. Acad.WoodSci (N.S.), Vol. 4 (102), 99-107

Zeitter, W. (ed.) 2004. Earthquake risks? More safety with timber construction. Holzabsatzfonds, Bonn, Germany, online for download: http://www.germantimber.com/download.php?file=934351