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RAISES THE STAKES

Bricks and mortar have long dominated the South African building industry. Commercially, concrete and steel are king. Yet recent advances in timber technologies show that solid mass timber and cross-laminated timber may soon compete strongly with their counterparts as the sustainable building material of choice.

WORDS MARY ANNE CONSTABLE

In his compelling TED talk ‘Why we should build wooden skyscrapers’, American architect Michael Green explains that as cities rapidly grow, timber should be used for constructing tall buildings. The building industry represents 47% of carbon emissions (US statistic), with steel and concrete representing around 3% and 5% respectively. Timber, on the other hand, absorbs carbon as it grows and when harvested it stores that carbon, eliminating it from the atmosphere.

Historically, timber’s limitations as a structural material have restricted its use for buildings to no more than two or three storeys. Construction was limited to post and beam, and stick frame timber systems. Green highlights recent developments of engineered solid mass timber panels, made from small trees and small pieces of wood, and glued together to form incredibly large and strong structural elements. “Mass timber is like the 24-dot Lego bricks [three times bigger than the ubiquitous eight-dot Lego brick], that is set to change the scale of the timber buildings of the future,” he says.

Michael Green Architecture’s eight-storey Wood Innovation Design Centre, based at the University of British Columbia, is currently the tallest example of a modern, all-timber structure, and serves as a showcase for the beauty and potential to increase the use of wood in mid- and high-rise buildings.

A HEALTHY SUSTAINABLE ALTERNATIVE

Timber contributes to a healthy indoor environment with enhanced insulation properties. To demonstrate the advantages of solid mass timber as a building material, Swiss company HWZ International partnered with local supplier Ian Fuller Agencies to build a cross-laminated timber (CLT) house in Hout Bay. A three-year research project in collaboration with South African and European universities will monitor the performance of this type of timber construction in the Cape Town climate.

CLT is a type of mass timber that involves gluing together several layers of timber, each rotated at 90 degrees to each other. The crossing of the timber grains eliminates twisting and stabilises the board, creating an extraordinarily strong and stable product. Extensive research is going into the types of glues that are best for structural applications, with a focus on developing bio-adhesives that don’t contain formaldehyde or other harmful chemicals. “Although about 95% of all wood adhesives are from fossil petrochemicals, adhesives usually comprise

less than 1% of the volume of CLT and do not have a large impact on the overall product environmental impacts,” says Dr Brand Wessels, Stellenbosch University Forest and Wood Science Department senior lecturer and wood products researcher.

Resilience to the elements (rain and fire) is a key requirement for any building. Unlike log construction, solid wood doesn’t burn quickly or easily, which means CLT can have equivalent fire ratings to steel and concrete, says Gareth Hare, head of the construction division at Ian Fuller.

The structure of the Hout Bay House walls includes an air gap between the cladding and the insulation layer and solid laminated timber wall, which ventilates the wall and allows moisture to evaporate. The advantage of CLT, explains Hare, is that moisture resistant and anti fungal additives can be added during the beam composition process (unlike a tree which can only be treated on the surface). The Hout Bay House will be airtight thanks to imported timber frame double glazed windows. The thermal properties of the walls and insulation means the building will not require any heating or air-conditioning.

THE DEMOCRACY OF WOOD

Only 2% of timber produced in South Africa is used for construction, says South African architect Richard Stretton of Koop Design, an expert in timber construction and widely known for his work on the Dalton Private Reserve in the Drakensberg, which won the 2010 SAIA-Afrisam award for sustainable architecture. Alien timber cleared from the property was used to build luxury accommodation employing local labour.

Due to a decrease in demand for paper products, it makes sense to use surplus timber to create sustainable buildings, Stretton says.

Timber is a ‘democratic’ material, he argues, because “any person can shape a piece of wood and make something functional or beautiful out of it. Timber can provide solutions from toothpicks to multi-storey buildings”. Timber construction is also relatively simple and straightforward, requiring simple tools. The modular nature of timber structures means components can be manufactured by different role players in the market. It is this democratic nature that embodies the potential for individuals to develop micro enterprises and decentralise the market.

Timber can be used as an affordable housing

solution too – “people can build their own houses”, Stretton points out. Furthermore, people can learn a new skill to create their own work for life (even if it is manufacturing furniture), unlike construction work, which relies heavily on the availability of large construction projects. When given a sense of autonomy in their work, people

gain more satisfaction from it, he adds.

As well as being a renewable material that provides a healthier indoor environment, timber is also a dry trade, therefore creating less mess on-site. At about half the weight of concrete, it is light and thus reduces transport costs and emissions, craning and size of foundations.



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Koop Design's Dalton Private Reserve in the Drakensberg won the 2010 SAIA-Afrisam award for sustainable architecture. Alien timber cleared from the property was used to build it using local labour.

ROOM FOR GROWTH

In South Africa, the CLT industry is still in its infancy. Restrictive legislation is a hurdle that must be overcome before we will be able to build very tall wood buildings here, says Stretton. “Alternative building methods face a lot of resistance.” This highlights the importance of a research project like the Hout Bay House, which can help identify the best solutions for our unique climate and context.

Sustainable forestry certification is another growing practice in South Africa, which ensures that timber for construction comes from sustainably managed forests (see p. 47). Stretton points out that there is a huge difference between plantations, where

one single crop is grown, and forests. Sustainable forests encourage biodiversity; they retain local ecosystems by planting a mixture of species, unlike monoculture plantations. Sometimes different crops, such as rice, can be grown on the forest floor until the trees reach a certain height. Only certain portions of the forest are harvested at a time and usually only alternate rows of trees are removed to maintain the integrity of the forest. As such, true sustainable forestry emphasises and encourages the unity of nature.

Although a large number of mass timber buildings to date express a fairly rectilinear rational design response, one international research project has



Hout Bay House is a three-year research project in collaboration with South African and European universities that will monitor the performance of cross-laminated timber construction in the Cape Town climate.

NUTSHELL

Location • Hout Bay, Cape Town

House size • 248m² (total floor area)

Total cost • R3 450 000

Project goal • To discover how European woods behave in specific South African conditions, and to promote timber building solutions for sustainable housing

Length of project • Three years of research into performance

Basement level materials • Brick cavity wall, topped with concrete ring beam

Facade and terrace materials • Siberian Larch, European Spruce and thermally modified pine

Structure of walls • 84mm Novatop solid wood CLT panels. Insulation – 80mm wood fibre insulation, 100mm air gap, plus cladding of choice during the first year. 120mm wood fibre insulation, 60mm air gap, plus cladding of choice during the second year

Structure of roof • Novatop prefabricated multilayer panel with Pavatex wood fibre insulation and air gap. Profiled roof sheets

Wood surface treatment • For external facade OSMO protective coating based on natural vegetable oils. Western facade is untreated. For interiors light white wash treatment to protect the spruce walls against dirt and UV radiation (otherwise the spruce will yellow)

Flooring • Oak solid wood boards in the living room and kitchen, Siberian larch boards in the bedrooms (one bedroom with transparent oil, other with white oil), and thermally modified ash flooring in the bathroom

Windows • Double glazed timber frame windows imported from Europe

Measuring points • Seven sensors measuring surface temperature of the facade, temperature and humidity in the walls, surface temperature of interior wall. Three CO₂ sensors evaluating quality of indoor climate



INTERESTING FACTS

- At the end of construction, the Hout Bay House was only 3mm out of alignment
- It took 23 days to construct the basic timber shell (excluding finishes) of the Hout Bay House
- The main supporting beam for the roof in the Hout Bay House is 800mm deep on the one side and 1.8m deep on the other side

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RICHARD STRETTON, ARCHITECT, KOOP DESIGN

produced a 3D printer that uses wood flour to print wooden beams that are equal in strength to concrete and steel. Unlike sawn timber, the product can be moulded to suit any shape, opening up a myriad of avenues for creative expression. At the 2015 World Forestry Congress, a wood flour 3D printed (functioning) car was presented, says Stretton. Perhaps 3D printing of individual timber houses will be possible in future. Despite the excitement, he emphasises that in the South African context we must believe we have the capacity to design solutions to our problems, and only then will the sky be the limit. ●

SOURCEBOOK

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SUSTAINABLE FORESTRY

Despite timber's renewable qualities as a material, it cannot technically be considered sustainable unless it is sourced from a certified sustainable forest. Forest certification acts as a guarantee to customers that the timber meets specific standards that uphold sustainable values and principles. Audits done by an independent body allow for objective analysis of observed forestry management practices. Two well-known international organisations, the FSC (Forest Stewardship Council) and PEFC (Programme for the Endorsement of Forest Certification), currently provide forest management certification for the timber industry worldwide. The two systems have similarities, while PEFC is still relatively new in South Africa compared to FSC, which has been used in the country for almost 20 years. However, a custom made PEFC national forest certification system for local application is in development.

Thorsten Arndt, head of communications at PEFC International, says the core pillars of sustainability – environmental, social and economic – must underlie the management approach of sustainable forests anywhere

in the world. “Sustainable management must maintain and increase the health and vitality of the forest, protect ecologically important areas and prohibit forest conversions and illegal logging,” he says. Sustainable forestry creates employment opportunities and enhances the health and safety of forest workers and communities. Added to this, local tradition, cultural and spiritual practices, and the rights of indigenous people must be respected.

FSC Africa regional director Chris Burchmore says the first FSC forest management certificate was issued in South Africa in 1996. “Since then the numbers have grown to the extent that about 85-90% of the forestry in South Africa is FSC certified. This is not just for plantations but even the Knysna Forest is FSC certified, and some harvesting takes place of indigenous species particularly for the furniture market.” An FSC Chain of Custody Certification (similar to an ecolabel) tracks the supply chain of the timber product from forest to consumer, ensuring all facets of the process adhere to sustainable practices. These can be found on a variety of products, from cork, paper, packaging and paper bags to timber and flooring – the list goes on.