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# Historical, Current and Future Tall Wood Buildings

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## DES600-A Historical, Current and Future Tall Wood Buildings

### Description:

Wood is a natural and renewable building material that has long been preferred for its high strength-to-weight ratio, ease of assembly and availability. Timber structures from ancient times far surpass current limitations set by many of the modern building codes worldwide. Recently, the international architecture, engineering, and construction industries have developed renewed interest in specifying and using wood in multi-storey building designs mainly due to its aesthetics, versatility, environmental benefits and cost-effectiveness. This article will provide an introduction to historic wood structures and modern innovative wood structures.

### Learning Objectives:

After reading this article, you should be able to:

1. Learn about historic wood structures ranging in age from 100 to over 1000 years.
2. Learn about new engineered mass timber products which are allowing designers to build taller with wood.
3. Become familiar with the new generation of tall wood structures around the world.
4. Learn about hybrid systems using wood being developed and used in new structures.

To receive credit, you are required to read the entire article and pass the test. Go to <http://awc.org/education/selfstudycourses> for complete text and to take the test for free.

# Historical, Current and Future Tall Wood Buildings

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## Timber Pagodas from a Millennium Ago...

Timber pagodas built hundreds of years ago in China and Japan are still standing today despite exposure to seismic events, strong winds, and high-moisture environments. The Yingxian Pagoda is believed to be the oldest surviving large wood building in China. Built around 1056 AD, it is 67 meters high. Horyu-Ji is a five-story wooden pagoda in Nara, Japan that is 32.5 meters high. This temple was built around 711 AD, and is considered the oldest pagoda that is still standing today.



Lam, He, & Yao, 2008

## Tall Wood Building from a Century Ago...

In the early 1900s, in Canada and elsewhere, tall timber structures were built using a “brick and beam” structural system. As was common at the time, the exterior walls were constructed with bricks or masonry, while a heavy timber post and beam structure was used for the interior. There are many examples of tall wood buildings from the early 20th century that are still in service today. The city of Toronto has at least 19 tall wood buildings that are



1905, Canada

seven or eight stories high and Vancouver has six of these buildings that range from seven to nine stories high. Tall brick-and-beam buildings in these cities reach to a maximum height of 30 meters.



1905, Sweden

A decline in the construction of tall timber-based buildings was observed over the second half of the 20th century due to the technological advancements in alternative construction

materials. It is relatively recent that the international architecture, engineering, and construction industries have developed renewed interest in specifying and using wood in multi-story building designs.

### Mass Timber Reaching 10 Stories After a Century

Recent advancements in innovative engineered wood-based products and systems, in addition to the introduction of objective- and performance-based building codes, have significantly contributed to the revival of mid- and high-rise wood construction. A new generation of engineered wood-based products including cross-laminated timber (CLT) and structural composite lumber (SCL) has been developed. These products provide designers and engineers with alternative options with comparable performance with enhanced environmental attributes. Recent advancements in fire safety and protection engineering, building science, and structural engineering analysis have also benefited wood construction.

Over the course of the first two decades of the 21st century, several tall wood buildings, where wood is the primary structural material, have been constructed worldwide and several others are either under construction or at the design stage.



Sweden



England

Courtesy of Lehmann

The City of Växjö in Sweden has a sizeable development called “Välle Broar” for which four 8-story wood buildings were constructed. Called the Limnologen project, these four multi-unit residential buildings were completed in 2008. In each building, the first floor is concrete and there are seven mass timber stories above. The gravity and lateral load carrying systems were primarily made of glulam and CLT. In the UK, the Stadhaus building, also known as Murray Grove, is a nine-story residential building that was constructed in London in 2009. The entire building is platform-framed CLT, with the exception of the ground floor, which is made of reinforced concrete. Bridport House is yet another nine-story platform CLT building. It was constructed in

November of 2010 and marks the first time that cross-laminated timber (CLT) was chosen in the UK for an entire multi-story structure, including the ground floor, which is constructed from concrete in other projects.



Italy

Courtesy of Fabrizio Rossi



Australia

Courtesy of Lend Lease

In Via Cenni, Milan, Italy, a social housing project was built in 2012 that included four 27-meter-tall, nine-story timber towers built primarily using CLT. Forté in Melbourne, Australia is a 10-story residential building with nine stories of timber construction on a single-story concrete podium. The building was completed in 2012.



Canada Courtesy of MGA | Michael Green Architecture Norway



The Wood Innovation and Design Centre (WIDC), completed in October of 2014, is a six-story building in Prince George, BC, that is 29.5 meters high. This building contains glulam columns and beams as well as CLT floors and shearwalls. Additional elements include structural composite lumber (SCL) products such as laminated veneer lumber (LVL), and parallel strand lumber (PSL).

In Bergen, Norway, construction of a 14-story mass timber building composed of glulam braced frames, CLT cores and light-frame modular residential units is currently underway.

### Hybrid Concepts to Go Taller with Wood

Many engineering challenges in tall timber construction can be overcome by combining different structural materials to create hybrid buildings.



CREE by Rhomberg, 2012



Courtesy of CREE by Rhomberg

The CREE company has developed a timber-concrete hybrid concept called LifeCycle Tower (LCT) with potential heights of up to 30 stories and floor spans of up to 9.4 meters. LCT involves the use of glulam beams and columns as the primary building material, with concrete used in prefabricated concrete-timber composite deck elements. All components are prefabricated to support modular installation. LifeCycle Tower One (LCT One) is an eight-story timber-concrete hybrid building in Dornbirn, Austria that was erected in 2012.

CEI Architecture, along with Read Jones Christoffersen, developed a proposal for a 40-story timber-concrete hybrid building. The proposed building has a concrete core, and wood-concrete hybrid floor panels, similar to CREE's system, that span nine meters. Mass timber trusses at the building perimeter are on every second floor, and span an entire floor, with the top and bottom chords supporting the hybrid floor panels. Concrete piers are positioned to support the wood trusses which cantilever past the piers.

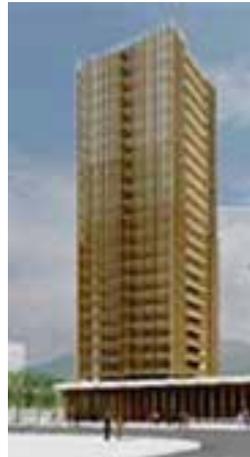


Courtesy of Bevanda, 2012

Timber-steel hybrid buildings are another option for timber high-rises. Steel elements can be designed to provide ductility, high tensile capacity, and predictability, where required, while timber is used for weight reduction and high bearing capacity parallel to grain. Steel and timber working together is not new; many timber connections rely on steel to transfer loads from plates, bolts, screws, etc. Although timber-steel hybrid structures are relatively



uncommon in Canada, such systems may provide an excellent model for tall timber hybrid buildings. The 12-story Scotia Place in New Zealand is a good example of a timber-steel hybrid.



FFTT System  
Courtesy of MGA | Michael Green Architecture



Courtesy of SOM

Finding the Forest Through the Trees, or FFFT, is a timber-steel hybrid concept by Michael Green Architecture and engineers Equilibrium Consulting, for high-rises up to 30 stories in height in high seismic regions. FFFT relies on a “strong column – weak beam” approach to building design. The Skidmore, Owings & Merrill (SOM) architectural and engineering firm proposed a new system for a 42-story, timber-composite high-rise. SOM published a report in 2013 detailing the proposed system: a Concrete Jointed Timber Frame (CJTTF).

### A Renaissance in Mass Timber Construction in 21st Century

The 21st century is witnessing a renaissance in timber construction. Early adopters are finding cost-effective sustainable solutions for future cities in response to ever increasing demand for urbanization. A recent study by Perkins+Will (funded by British Columbia Forestry Innovation Investment and the Bi-national Softwood Lumber Council) indicated that the key driver in Europe for tall wood construction has been the strong regulatory support for low carbon content materials, renewable resources and energy efficient construction. Such policies directly and indirectly encouraged tall wood and mass timber construction. 

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