Special Issue: Tall Timber

Using Design-Build to Drive Tall Timber Efficiencies
Ask a CTBUH Expert: Mass Timber Best Practices
In Numbers: Tall Timber Global Audit 2022
Fire Strategies for Exposed Mass Timber
Talking Tall: New Timber Codes
“Certification can be a great protection and verification of resource utilization, but then all building products should be third-party certified.”

Martin, page 7
The pace of proposals and construction of tall buildings around the world continued to move along at good speed, as the world began to shake off the effects of the COVID-19 pandemic. This article highlights projects featured in the CTBUH Tall & Urban News feed from the period October 2021 to February 2022.

**Americas**

**New York City**, the USA’s skyscraper capital, continued to be a font of development news. Though the city was still seeing significantly reduced numbers of office workers commuting in, there still seemed to be a healthy appetite for office, residential and mixed-use towers. One key aspect of developing in New York was unchanged—its inextricability from politics. When the State of New York released an RFP to develop a site across from the Javits Convention Center, the audacious and appropriately named *Affirmation Tower* stole headlines with its striking “upside-down” proportions and proposed 507-meter height. But in late December, its future looked slightly less affirmative, as Governor Kathy Hochul rescinded the RFP, which had originally been issued by Andrew Cuomo, the previous governor, who resigned amidst a sexual harassment scandal. A new RFP with potentially more required affordable housing was yet to be issued at press time.

On the other side of Midtown, the city council granted approval to the massive redevelopment of the Grand Hyatt Hotel at 175 Park Avenue, which would see the 30-story hotel replaced by an 83-story, 480-meter hotel and office tower designed by Skidmore, Owings & Merrill. The approval was granted on condition that significant public amenities and transit connections be built into the project, which is directly adjacent to Grand Central Terminal.

Also just making the city council’s end-of-year approvals list, the *River Ring*, a two-tower complex of 49 and 61 stories designed by Bjarke Ingels Group will not only bring two mixed-use towers to the Williamsburg neighborhood, but will also deliver a public waterfront park, a cove, a 50,000-square-foot (4,645-square-meter) YMCA, affordable housing, and other public infrastructure upgrades.

Further uptown, *Claremont Hall*, a high-rise residential, office, and education building adjacent to the Columbia University campus, topped out, on its way to a 2023 completion. The 42-story Robert A.M. Stern Architects-designed edifice will have a prominent profile, as it is situated atop the ridge along the Hudson River running along Manhattan’s west side.

In **Toronto**, Canada’s skyscraper mecca, proposals were coming fast and furious. A 52-story residential tower at 252 Church Street was proposed near Dundas Square, with a completion date set for 2024.

Rezoning applications have been submitted for 586 Eglinton Avenue East. The site is located in the Sherwood Park neighborhood. Already occupying the site is an eight-story office building. If this new proposal moves forward, the existing office building will be replaced by a 32-story, mixed-use building. The architect for this new project is *architectsAlliance*. The same studio has also proposed a unique arrangement with the Ontario government, which is investing in the Lower Yonge Precinct Elementary School as part of the *Sugar Wharf* development, which features nine towers, including six exceeding 250 meters.

A 60-story development at 260 Adelaide Street West would bring over 800 residential...
Making Tall Timber Financially Viable: The Design-Build Approach

Abstract

As the tall building industry increasingly becomes interested in using engineered mass timber to construct high-rise buildings, the economical and construction-efficiency advantages need to be as well-understood as the environmental and aesthetic benefits. The author has compiled experience developing, designing, and constructing high-rise mass timber projects in several markets, noting the particular relevance of the design-build approach to drive efficiencies. This paper explores the applicability of the design-build approach to the prevailing and emerging techniques of mass timber procurement, prefabrication, and site assembly, as well as configuration of project teams. All of these are undertaken with the end goal of making tall timber “pencil out”—achieve financial viability.

Keywords: Constructability, Design-Build, Financing, Mass Timber, Prefabrication

Introduction

Whether you're interested in the sustainability benefits, the construction efficiencies, or the increased rent potential driven by biophilia, mass timber construction has become a hot topic globally. But with many owners, architects, and builders trying their hand at this new technology, a disproportionate number of projects suffer from a “failure to launch.” The most common reason is an inability to make tall timber “pencil out”—to be cost-effective enough to meet the owner’s goals.

Tall timber, for the purposes of this paper, represents the use of one of the three new International Building Code (IBC) construction types (Type IV-A, Type IV-B, and Type IV-C), in which mass timber is used for some or all of the structure. Mass timber describes a range of timber products, including glued laminated timber (glulam), laminated veneer lumber (LVL), nail-laminated timber (NLT), and cross-laminated timber (CLT), that are typically used as structural elements in construction. These products are manufactured and prefabricated off-site and offer inherent fire resistance, unlike traditional structural materials. Tall timber has become an attractive alternative to steel and concrete for a few key reasons:

• Environmentally, mass timber has a lower carbon footprint than its steel or concrete counterparts. With the drive to reduce carbon dioxide emissions globally and across the construction industry, a mass timber structure has a positive impact on carbon life cycle analysis, even before considering the carbon that timber naturally removes from the atmosphere.

• Socially, the biophilic impacts of mass timber structures have demonstrated qualitative benefits to occupant health, creating an overall better built environment. The construction process itself produces less dust and noise, and when planned properly, it also has a reduced construction time, meaning less impact on the surrounding community.

• Economically, the off-site manufacture and prefabrication of these elements delivers a high-quality product with reduced on-site labor and a shorter construction assembly period. This offsets the slightly higher material cost of mass timber, and should lead to lower construction costs than traditional approaches.

Despite the myriad potential benefits, mass timber projects are challenged to capitalize on these benefits due to a lack of experience and understanding throughout the industry. This is still a new technology, being used in new and innovative ways, with lots of lessons being
State of Tall Timber 2022

Abstract

The past few years have seen tremendous interest in the development of mass timber buildings of increasing height, in urban settings, many of which are hybrid structures with other materials. This study identifies 84 mass timber buildings of eight floors or higher, currently completed or under construction around the world, with analysis by region, function, and structural type. The accumulated knowledge around these projects continues to grow, embracing proposed buildings, and will inform future inquiry for the tall building industry. The data collection is supported by, and related to, research projects currently being conducted by CTBUH, and the network of CTBUH member firms contributing data on their projects.

Keywords: Carbon, High-Rise, Prefabrication, Steel-Timber Hybrid

Introduction

In 2017, the Council on Tall Buildings and Urban Habitat published "Tall Timber: A Global Audit" (CTBUH 2017). This three-page data study accounted for all 48 known mass-timber projects of seven stories or higher that had either been proposed, were under construction, or were completed.

This paper and the accompanying data study (see Tall Buildings in Numbers, page 30) represent the momentum the mass-timber movement has gained over the five years elapsed since the previous study, including the evolution of building codes to allow much higher mass-timber construction. There are now more than 200 mass-timber projects of seven stories or higher, proposed, under construction, or completed, more than a four-fold increase. The tallest in the world is Fig 1. Mjøstårnet, Brumunddal, Norway (see Figure 1) at 85.3 meters and 18 floors, but this building is set to be eclipsed by Ascent, Milwaukee, USA, at 86.5 meters and 25 floors, upon the completion of the latter building in August 2022 (see Figure 2).

Range of Dataset and Survey Methods

The data in this study have been collected over nearly a decade of scholarship, ranging from papers published by CTBUH members in the CTBUH Journal, to volunteer research committees and conference presentations. More recently, CTBUH has undertaken several funded research projects exploring various aspects of mass timber as used in high-rises (see “CTBUH Mass Timber Research Projects,” page 29). Virtually all timber projects that come to the attention of the CTBUH network of CTBUH member firms contributing data on their projects.

Figure 1. Mjøstårnet, Brumunddal, Norway, is the current world’s tallest timber building, at 85.3 meters and 18 floors. © Nina Rundsveen
Tall Buildings in Numbers

Tall Timber: A Global Audit

This data study comprises the 84 mass timber buildings eight stories and taller, built or under construction, organized by structural type and by region, globally. Key projects of each type are highlighted, and the proportion of each structural type within each region is shown in the ring diagrams. The three tallest buildings of each structural type are shown as elevations with project data. The data in this study are accompanied by a research paper on pages 22–29, which provides the context and additional information on the current state of tall timber buildings as of February 2022.

Elevation drawings of three tallest buildings of each structural type.

Structural Types

- All-Timber
- Concrete-Timber Hybrid
- Steel-Timber Hybrid
- Concrete-Steel-Timber Hybrid

Project Name

Stadthaus, London, was built in 49 weeks, compared to a 72-week construction time of a concrete-framed building of this size.

Origine, Québec City, is estimated to have released 900,000 fewer kilograms of CO₂ equivalent than a conventional concrete and steel building.

HoHo, Vienna’s structural timber, was completed in 2020 and is 84.0 m tall.

It took just 17 minutes for Austrian forests to grow the volume of timber needed for HoHo, Vienna’s structural timber.

Stadthaus
Status: Completed (2018)
Location: London, United Kingdom
Height: 46.8 m

 Origine
Status: Completed (2020)
Location: Québec City, Canada
Height: 41.6 m

HoHo
Status: Completed (2020)
Location: Vienna, Austria
Height: 84.0 m

It took just 17 minutes for Austrian forests to grow the volume of timber needed for HoHo, Vienna’s structural timber.
Industrializing Construction

The Empire State Building took just over 13 months to build in 1930, and yet today we can’t complete a typical mid-rise housing project in the same time period. McKinsey Global Institute’s report (Barbosa, et al. 2017) highlights why and how we could tackle the root causes that underlie the industry’s poor productivity. The reason mass timber is such a key to construction efficiency is because it incorporates some aspect of each of these levers for higher productivity, either directly or indirectly.

• Reshape regulation and transparency. The new International Building Code (IBC) provisions for mass timber represented a dramatic reshaping as the most significant code change since its inception. While these codes are prescriptive, authorities are quickly recognizing the value of performance-based fire and structural engineering approaches, which provide a means for objective-based design.

• Rewire the contractual framework. Mass timber projects require a collaborative approach, due to so many design interdependencies (fire, structure, aesthetics, acoustics, etc.). Therefore these projects are exploring new contract arrangements, such as design build and integrated project delivery. The up-front engagement of trades reduces the number of design iterations and improves productivity.

• Rethink design and engineering processes. The financial success of a mass timber project is tied to high levels of repeatability, both within the project itself, and from project to project, which is a much different approach to the traditional one-off design approach. The value of timber on a per-volume basis all but forces the designer to prioritize the manufacturing efficiency and constantly consider the waste factor. Off-site prefabrication and manufacture of other non-timber components is also synergistic with a mass-timber structure, both because of the dimensional stability and accuracy of the material, and also because of the pre-planning and on-site equipment already necessary to deliver the structure.

• Improve procurement and supply chain management. Many mass timber factories are highly automated, with manufacturing and fabrication reliant on Design for Manufacture and Assembly (DfMA) techniques. Digitally-enabled procurement improves planning and transparency between contractors and suppliers, providing precise models with high levels of development (LOD) for quicker procurement and project execution. The repetition or “kit of parts” approach instituted on mass timber projects also provides predictability and can drive economies of scale for the supply chain.

• Improve on-site execution. Mass timber’s large-panel components, with fewer details and unique connectors, reduce the complexity of site assembly and the total number of parts compared to conventional construction. Fewer, more-standardized parts allow for interchangeability, more predictable outcomes, and easier quality control. Because of these advantages, we’ve seen reductions of 30-50 percent in on-site labor hours, and schedule reductions of over 30 percent. Companies like Lendlease’s Podium MX Studio are capturing even deeper labor and schedule savings through a special prototype testing process called Design for Site Assembly (DfSA).

• Infuse digital technology, new materials, and advanced automation. Digital twins, generative models, automated design solvers, and integrated software platforms with real-time cost capabilities are at the core of businesses like Lendlease Podium. These technology leaps couple very well with DfMA-enabled physical products like mass timber, and are often embraced with these new materials.

• Reskill the workforce. Skilled construction labor is disappearing. In response, we need to increase productivity by training a 21st-century construction workforce with a flexible skillset that transcends traditional trade scopes and is transferable across building components. Because mass timber structures are ideal for componentized delivery, a single crew of well-trained installers and a crane can assemble a structure, façade, and MEPF system that are designed to be plug-and-play. Through DfSA, installers can be trained in these techniques to improve their productivity while also improving safety and ergonomics.

How Does Mass Timber Improve Tall Construction Productivity and Sustainability?

The future of building construction is being shaped most significantly by two factors: the knowledge that the construction industry suffers from a severe lack of productivity improvement, averaging one percent growth per year over the last two decades, and the inescapable reality that buildings are the source of more than one-third of the world’s carbon dioxide emissions. CTBUH asked an expert how mass timber can address both these issues.

Ask a CTBUH Expert: Lisa Podesto

Industrializing Construction

The Empire State Building took just over 13 months to build in 1930, and yet today we can’t complete a typical mid-rise housing project in the same time period. McKinsey Global Institute’s report (Barbosa, et al. 2017) highlights why and how we could tackle the root causes that underlie the industry’s poor productivity. The reason mass timber is such a key to construction efficiency is because it incorporates some aspect of each of these levers for higher productivity, either directly or indirectly.

• Reshape regulation and transparency. The new International Building Code (IBC) provisions for mass timber represented a dramatic reshaping as the most significant code change since its inception. While these codes are prescriptive, authorities are quickly recognizing the value of performance-based fire and structural engineering approaches, which provide a means for objective-based design.

• Rewire the contractual framework. Mass timber projects require a collaborative approach, due to so many design interdependencies (fire, structure, aesthetics, acoustics, etc.). Therefore these projects are exploring new contract arrangements, such as design build and integrated project delivery. The up-front engagement of trades reduces the number of design iterations and improves productivity.

• Rethink design and engineering processes. The financial success of a mass timber project is tied to high levels of repeatability, both within the project itself, and from project to project, which is a much different approach to the traditional one-off design approach. The value of timber on a per-volume basis all but forces the designer to prioritize the manufacturing efficiency and constantly consider the waste factor. Off-site prefabrication and manufacture of other non-timber components is also synergistic with a mass-timber structure, both because of the dimensional stability and accuracy of the material, and also because of the pre-planning and on-site equipment already necessary to deliver the structure.

• Improve procurement and supply chain management. Many mass timber factories are highly automated, with manufacturing and fabrication reliant on Design for Manufacture and Assembly (DfMA) techniques. Digitally-enabled procurement improves planning and transparency between contractors and suppliers, providing precise models with high levels of development (LOD) for quicker procurement and project execution. The repetition or “kit of parts” approach instituted on mass timber projects also provides predictability and can drive economies of scale for the supply chain.

• Improve on-site execution. Mass timber’s large-panel components, with fewer details and unique connectors, reduce the complexity of site assembly and the total number of parts compared to conventional construction. Fewer, more-standardized parts allow for interchangeability, more predictable outcomes, and easier quality control. Because of these advantages, we’ve seen reductions of 30-50 percent in on-site labor hours, and schedule reductions of over 30 percent. Companies like Lendlease’s Podium MX Studio are capturing even deeper labor and schedule savings through a special prototype testing process called Design for Site Assembly (DfSA).

• Infuse digital technology, new materials, and advanced automation. Digital twins, generative models, automated design solvers, and integrated software platforms with real-time cost capabilities are at the core of businesses like Lendlease Podium. These technology leaps couple very well with DfMA-enabled physical products like mass timber, and are often embraced with these new materials.

• Reskill the workforce. Skilled construction labor is disappearing. In response, we need to increase productivity by training a 21st-century construction workforce with a flexible skillset that transcends traditional trade scopes and is transferable across building components. Because mass timber structures are ideal for componentized delivery, a single crew of well-trained installers and a crane can assemble a structure, façade, and MEPF system that are designed to be plug-and-play. Through DfSA, installers can be trained in these techniques to improve their productivity while also improving safety and ergonomics.
About CTBUH

The Council on Tall Buildings and Urban Habitat (CTBUH) is the world’s leading non-profit organization for all those interested in the future of cities. It explores how increased urban density and vertical growth can support more sustainable and healthy cities, especially in the face of mass urbanization and the increasing effects of climate change worldwide.

Founded in the US in 1969, the CTBUH member network embraces more than a million professionals working in all building industry sectors in almost all countries of the world. With offices in Chicago, Shanghai, and Venice, the Council runs hundreds of multidisciplinary programs across the world each year, through its regional chapters and expert committees, its annual conferences and global awards program, through funded research projects and academic collaborations, and via its extensive online resources and physical outputs. The Council is perhaps best-known to the public as the arbiter of tall building height and the global authority that bestows titles such as "The World's Tallest Building." Operating on a global scale, CTBUH serves as a platform for both cutting-edge information-share and business networking for all companies and professionals focused on the inception, design, construction, and operation of cities, and the buildings they comprise.

CTBUH Headquarters
104 South Michigan Avenue, Suite 620
Chicago, IL 60603, USA
Phone: +1 312 283 5599
Email: info@ctbuh.org
CTBUH.org

CTBUH Asia Headquarters
College of Architecture and Urban Planning (CAUP)
Tongji University
1239 Si Ping Road, Yangpu District
Shanghai 200092, China
Phone: +86 21 65982972
Email: china@ctbuh.org

CTBUH Research Office
Iuav University of Venice
Dorsoduro 2006
30123 Venice, Italy
Phone: +39 041 257 1276
Email: research@ctbuh.org

CTBUH Academic Office
S. R. Crown Hall
Illinois Institute of Technology
3360 South State Street
Chicago, IL 60616
Phone: +1 312 283 5646
Email: academic@ctbuh.org

ISSN: 1946 - 1186