MASS TIMBER

a developer's guide

UBC TALLWOOD HOUSE |
ACTON OSTRY ARCHIITECTS
VANCOUVER, CANADA
PHOTO: SEAGATE STRUCTURES

JUNE 2017 | www.fastepp.com

TREET | ARTEC BERGEN, NORWAY

PHOTO: CTBUH GLOBAL NEWS

Mass timber is a relatively new construction type with unique opportunities and risks for real estate developers. Built with techniques and products developed primarily in Europe, this type of construction is gaining a foothold in North America and is attracting the attention of the design and development community alike. A small but growing number of builders in the US have exploited the time and materials savings of mass timber to compete with conventional systems on a total project price basis. These assemblers have created a supply chain with greater certainty on time and cost than other modular and prefabricated technologies.

Although the term "wood" often evokes light-frame construction typical of single-family homes, mass timber is a paradigm shift in wood construction. Large cross-section beams and columns and solid, prefabricated panels form structures that are assembled in a "kit-of-parts" fashion. Modern engineered wood products and connectors have opened up new structural possibilities, making mass timber suitable for a wide range of building types and sizes. The majority of modern mass timber buildings are composed of some combination of the following products:

GLUED-LAMINATED TIMBER (GLULAM OR GLT) >>

Softwood laminations, typically 1-1/2" thick dimension lumber, glued and pressed together into beams or columns with a wide range of cross-sections, or into panels. Panels typically range in thickness from 3" to 12" and are available in widths of 2 feet and lengths of 40-60 feet, depending on the supplier.

CROSS-LAMINATED TIMBER << (CLT)

Panels created by gluing together multiple layers of dimension lumber laid on the flat, with each layer perpendicular to the adjacent layer. Panels typically range in thickness from 4" to 12" and are available in widths of 8-12 feet and lengths of 40-60 feet, depending on the supplier.

NAIL-LAMINATED TIMBER (NLT) >>

Panels created by placing dimension lumber on edge and fastening the individual laminations together with nails. NLT can be supplied by any competent carpenter using locally available lumber stock, typically ranging from 2x4's to 2x12's. Prefabricated panels are often built in widths of 4-8 feet and lengths of up to 40 feet.

The first examples of large-scale modern mass timber buildings were multi-family residential towers built in Europe and Australia: the 9-story Murray Grove project in London, UK; the 10-story Forté building in Melbourne, Australia; and the 14-story TREET building in Bergen, Norway all helped pave the way for CLT in mid-rise construction. Large workforce housing developments built with CLT in the UK illustrate the potential for mass timber to address shortages of affordable housing.

In North America, the first mass timber buildings were constructed in Canada. The 18-story UBC Tallwood House student residence building in Vancouver, Canada, was part of a demonstration initiative sponsored by the Canadian government; the building was completed in 2017 for a total construction cost of approximately CAD$230/sf, or less than USD$180/sf. The project was successful in its aim to demonstrate that tall timber buildings can be cost-competitive with concrete construction in the Vancouver market. In the US, the success of the recently completed T3 office building in Minneapolis has prompted developers to look into replicating the project in other US markets. A US tall wood demonstration initiative, similar to the one sponsored in Canada, is helping to fund a 12-story mass timber mixed-use building in Portland, Oregon.

1 + 2: FRAMEWORK |
LEVER ARCHITECTURE
PORTLAND, OR
PHOTOS: LEVER ARCHITECTURE

3: MURRAY GROVE |
WAUGH THISTLETON ARCHITECTS
LONDON, UK
PHOTO: WILL PRYCE

4: UBC TALLWOOD HOUSE |
ACTON OSTRY ARCHITECTS
VANCOUVER, CANADA
PHOTO: SEAGATE STRUCTURES

5: FORTÉ |
LENDLEASE
MELBOURNE, AUSTRALIA
PHOTO: VICTORIA HARBOUR


2


4


5

6

7

OPPORTUNITIES

Mass timber presents a number of opportunities for developers who are willing to venture outside of current North American "standard" construction methods. For the right project, and with the right team in place, a mass timber building can be a commercial success that stands out from the crowd, particularly in today's market dominated by steel, concrete, and light-frame construction. As mass timber becomes more popular, and the uniqueness of these projects wears off, the early adopters will continue to have an advantage over the competition due to their deeper experience.

MARKET DIFFERENTIATION

Exposed mass timber creates a unique aesthetic that remains rare in the North American residential market, particularly for new construction. Mass timber construction is a modern take on historic heavy timber warehouse buildings, many of which have been successfully repurposed as loft apartments. Unlike concrete or light frame structures covered with drywall, solid wood lends a warmth to the interior; exposing mass timber allows the structure to do "double duty" as both structure and finished surface.

6: TALL TIMBER COMPETITION |
SHoP ARCHITECTURE
NEW YORK, NY
PHOTO: SHoP ARCHITECTURE

7: "HOHO" |
RÜDIGER LAINER AND PARTNER
VIENNA, AUSTRIA
PHOTO: RÜDIGER LAINER AND PARTNER

8: ALBINA YARD |
LEVER ARCHITECTURE
PORTLAND, OR
PHOTO: LEVER ARCHITECTURE

SUSTAINABILITY

As concerns about climate change continue to mount, consumers are placing more value on sustainable design. Mass timber is a renewable resource and a building material that has a much smaller carbon footprint than concrete or steel: not only is the energy required to produce it much lower, wood sequesters carbon from the atmosphere, storing that carbon for the lifetime of the structure. An analysis of the recent UBC Tallwood House project determined that building this 160,000-square-foot student residence out of mass timber instead of concrete created a carbon benefit equal to the amount of energy needed to power almost 250 homes for a year. Mass timber also integrates well with sustainable design strategies such as Passivhaus, as well as certification systems such as LEED, the Living Building Challenge, and the International WELL Building Institute. Advertising these benefits to consumers can tap into a growing sense of environmental responsibility.

CONSTRUCTION ADVANTAGES

Mass timber has a number of potential advantages over other structural systems during the construction phase, mainly speed, crew size, and site noise.

Mass timber's highly prefabricated components can be erected quickly; depending on the project size and local market conditions, a mass timber structural system can reduce the overall construction schedule, saving on general conditions and financing costs. On a recent mass timber hotel project in Alabama, developer Lendlease was able to erect the structure 37% faster and with 44% fewer person hours than their historical average, reducing the overall construction schedule from 15 months to 12 months. For projects such as these, as well as offices and rental apartments, tighter construction schedules also translate into earlier revenue streams.

Small construction crews help reduce labor costs and also create a safer job site. Mass timber buildings can typically be erected with a crew of 5-10 workers, proceeding as quickly as steel frames and faster than concrete. These efficient crews are particularly advantageous in markets with high labor costs and/or shortages of workers skilled in the construction trades.

Mass timber construction sites are remarkably quiet, particularly compared to concrete: instead of workers hammering formwork, trucks idling on site, and concrete pumps operating throughout the entire pour, the structure is installed with portable screwdrivers and little else. In congested urban areas, where site noise is a major disturbance, mass timber makes for happy neighbors.

9

10

9: CANDLEWOOD SUITES | LENDLEASE REDSTONE ARSENAL, AL
PHOTO: LENDLEASE

10: PRIVATE HOME | WOOD 1A NEW YORK, NY
PHOTO: WOOD 1A

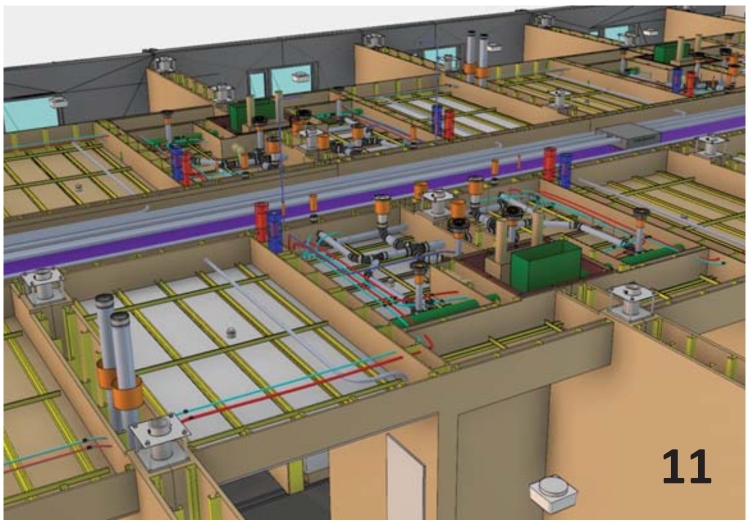
UBC TALLWOOD HOUSE |
ACTON OSTRY ARCHITECTS
VANCOUVER, CANADA
PHOTO: SEAGATE STRUCTURES

QUALITY

In addition to speed advantages, prefabrication offers a higher level of quality control than site-built assemblies. In the case of mass timber, maximum advantage requires a high level of collaboration among the design team, for example, coordinating all mechanical and plumbing penetrations in advance so that openings can be cut in the shop (and reinforced if necessary). This increased effort around "clash detection" in the design stage can lead to fewer construction delays, RFIs, and change orders.

11: UBC TALLWOOD HOUSE | ACTON OSTRY ARCHITECTS VANCOUVER, CANADA
PHOTO: CADMAKERS

12:PRIVATE HOME | WOOD 1A NEW YORK, NY
PHOTO: WOOD 1A



FOUNDATION COST SAVINGS

Because of timber's high strength-to-weight ratio, mass timber structures are significantly lighter than other systems, particularly concrete. On sites with poor soils or other challenging ground conditions, this reduction in the dead weight of the building can translate into savings on foundation costs. On projects with an overbuild atop an existing structure, mass timber may also reduce the need to reinforce the existing building and/or foundation elements.

RISKS

As with any new construction material or method, early adoption poses risks in addition to opportunities. As mass timber becomes more common and familiar to the development, design, and construction communities, these risks will begin to diminish, but they must be weighed against the potential benefits.

UBC TALLWOOD HOUSE | ACTON OSTRY ARCHITECTS VANCOUVER, CANADA

PHOTO: SEAGATE STRUCTURES

COST UNCERTAINTY

Given the small number of precedent projects, along with high variability among different markets across the globe (and even across the country), accurate cost estimates are more difficult to obtain for mass timber buildings than for more traditional systems. Although anecdotal evidence exists that mass timber can be competitive with concrete and steel for mid-rise buildings, the structural costs are typically higher: the overall project savings result from "knock-on" effects such as shortening the construction schedule or eliminating spray fireproofing and drop ceilings. For low-rise structures, up to 5 or 6 stories, mass timber typically cannot compete on a cost basis with stick frame, though the premium may be small relative to the overall project cost.

Although glulam and NLT are widely available from North American sources, CLT fabrication in the US is still in its relative infancy, with four certified suppliers. Additional suppliers are coming online, but the current lack of robust competition does pose an additional cost risk. CLT sourced from European suppliers tends to be highly cost competitive in North America, even with shipping costs factored in, but using European products requires approval of the authority having jurisdiction and creates additional hurdles in the approvals process (discussed in the following section).

APPROVALS

Most US jurisdictions base their code on the International Building Code (IBC); although mass timber is permitted as Type IV construction, the relatively modest area and height limits (up to 6 stories, depending on occupancy) have required many developers to seek variances through the IBC's "alternative means and methods" provisions. Although the code intent is not to prohibit such alternatives, every department of buildings (DoB) is autonomous and has final authority; previous experience with various US jurisdictions has shown wide disparities in their willingness to consider mass timber systems and their understanding of the intent of the code. Local fire departments are often involved in the approvals process as well, because wood is a combustible material; the same disparities exist in their interpretation of the code and their understanding of the char behavior of mass timber versus the light wood frame structures more familiar to them.

The use of CLT can also create an approvals risk in certain jurisdictions whose code is based on IBC 2012 or earlier, because CLT was not included in the IBC or the US wood code until the 2015 cycle. New York City is one prominent example: as of this writing, the NYC DoB has rejected all applications to use CLT and will not approve its use until the NYC building code is revised. Conservative building departments in other jurisdictions pose a similar risk, though many jurisdictions throughout the US have either adopted the 2015 IBC or allowed CLT as a variance to earlier versions of the code.

LACK OF EXPERTISE

In both the design and construction communities in North America, the number of people and firms with deep experience and expertise in mass timber is small. Assembling the right team is a critical part of mitigating risk.

On the design side, lack of expertise can lead to inefficiencies, as well as a failure to properly and fully coordinate the design prior to construction. For example, to fully take advantage of the prefabrication opportunities of mass timber, all mechanical penetrations through the structure should be precisely located in design; they should not be left up to the contractor, as is often the case.

On the construction side, an experienced foreperson or small core crew who can train the local labor force may need to be brought in from the outside. For example, on the Lendlease project in Alabama, three experienced carpenters were brought to site and trained eight laborers on site. These key people can help avoid construction delays that might offset the schedule advantages of mass timber. Training for other trades is also advisable, particularly mechanical, electrical, and plumbing (MEP): most MEP contractors are accustomed to cutting their own holes rather than working with a fully pre-coordinated design.

WEATHER PROTECTION DURING CONSTRUCTION

Unlike concrete and steel, wood shrinks and swells with changes in moisture content, which raises the issue of weather protection for the building during construction. If adequate protective measures are not taken and/or the building is not properly detailed to allow for dimensional changes, the risk of both cosmetic and structural damage can be significant in any climate that experiences regular snow or rainfall. Strategies to mitigate these risks can vary from simple and cheap (e.g. incorporating regular expansion gaps into the design to accommodate swelling) to complex and expensive (e.g. full tenting of the building). Appropriate measures will depend on multiple factors, including climate, building size, and construction schedule.

CONTACT US |

New York Office
41 East 11th Street 11th Floor
New York, NY, USA 10003
T: +1.212.905.8999

Vancouver Head Office
Suite 201- 1672 West 1st Avenue
Vancouver, BC, Canada V6J 1G1
T: +1.604.731.7412

Seattle Office
Suite 802- 603 Stewart Street
Seattle, WA, USA 98101
T: +1.206.775.8265

Email: mail@fastepp.com
Website: www.fastepp.com

T3 OFFICE BUILDING |
MICHAEL GREEN ARCHITECTURE
MINNEAPOLIS, MN
PHOTO: EMA PETER