CCA White Paper

Mass Timber

A FASTER, MORE AFFORDABLE, AND MORE SUSTAINABLE WAY TO BUILD HOUSING

CCA
CENTRAL CITY ASSOCIATION OF LOS ANGELES

Cover image: Banyan Wharf development in London | Source: Hawkins\Brown

Central City Association

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About CCA

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Established in 1924, Central City Association of Los Angeles (CCA) is the premier advocacy organization in the region and leading visionary on the future of Downtown Los Angeles. Through advocacy, influence and engagement, CCA enhances Downtown L.A.'s vibrancy and increases investment in the region. CCA represents the interests of 400 businesses, trade associations and nonprofit organizations that together employ more than 350,000 people in Los Angeles County.

www.ccala.org

Graphic Design by: Kellie Liu, kellieliu.com

§ 01

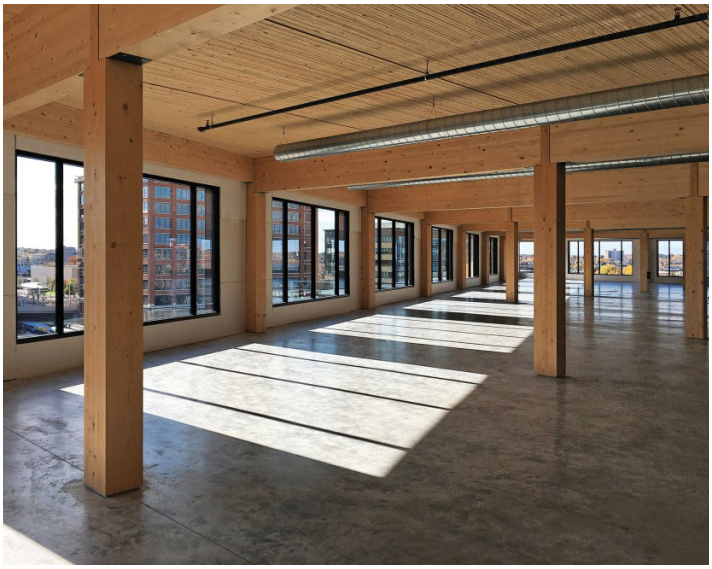
Introduction

Policymakers and communities across California are grappling with the cost of housing, a problem made worse by decades of underproduction, construction labor shortages, rising fees, and tariffs on many essential building materials. At the same time, we're working to house our homeless neighbors expeditiously, reduce our carbon footprint in the face of worsening climate threats, and design new buildings that are as diverse and beautiful as the historic neighborhoods we treasure.

The depth and complexity of these challenges can be intimidating, and their breadth highlights the importance of a comprehensive approach to fixing our housing market and the way we build cities. As policy experts are fond of saying, there is no silver bullet. The same can be said of mass timber construction, and yet few interventions present a better opportunity to tackle so many of these challenges at once.

Mass timber buildings use solid or engineered wood, such as cross-laminated timber and mass plywood panels, for their primary load-bearing structure. A relatively new and advanced building material, mass timber developments offer a range of benefits when compared to buildings constructed with other load-bearing materials such as concrete, steel, and light timber:

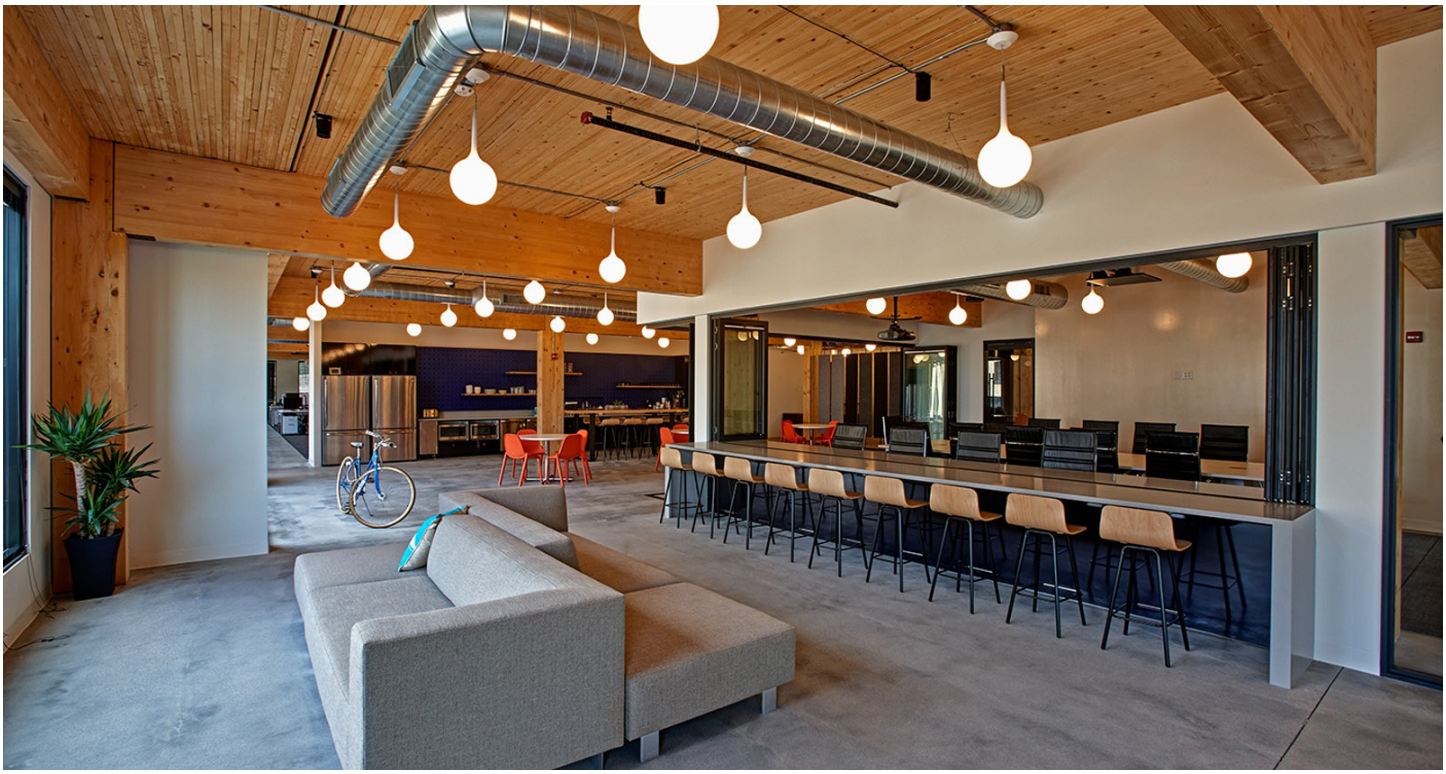
- They can be built on faster timelines, delivering much-needed housing more quickly.
- Savings on materials, labor, and construction schedule allow them to be built for lower cost.
- With responsible forest management, they can improve sustainability by sequestering carbon dioxide rather than emitting it.
- They can catalyze an entirely new market in the green economy, creating well-paying jobs in cities as well as rural communities.
- They offer improved safety for construction workers, residents, and commercial tenants.
- They provide a unique aesthetic that sets them apart from other construction materials.



T3 interior | Source: Architect Magazine

In this white paper, CCA explores in detail many of the benefits of mass timber construction – benefits already being realized in other countries and other cities in the United States. We identify obstacles that exist, with a focus on solutions for California and Los Angeles. We also explain why mass timber has a special role to play in Downtown L.A. and other urban centers.

We conclude the paper with specific actions that our state, city government, and local developers and architects can take to catalyze this exciting new market and begin delivering jobs and mass timber housing as soon as possible. We recommend using state and local funds, supplemented with local development incentives, to support mass timber manufacturing and the construction of affordable housing. We further recommend updating building and other codes to enable the use of mass timber as a viable construction material, and creating capacity within the workforce through training programs and partnerships.



T3 interior | Source: StructureCraft

§ 02

Mass Timber 101

Mass timber development is a construction methodology characterized by the use of large solid wood panels, beams, and columns. Engineered mass timber is constructed into large structural elements from smaller constituent parts, providing flexibility and strength comparable to common high-density building materials such as concrete and steel. This manufacturing technique also reduces the prevalence of knots and other imperfections, giving it additional strength and consistency compared to light timber structures.

Because of the added strength of mass timber compared to solid-sawn (light) timber, it can be used to bridge longer spans, support heavier loads, and accommodate a wider array of shapes and orientations. It is also less susceptible to severe fire damage than traditional light timber materials. Unlike other forms of wood construction, it is cut-to-size at an off-site location and then assembled at the construction site, expediting construction schedules and reducing on-site noise and dust.

Mass timber buildings can be designed with exposed wood on the interior of the building, giving them a unique appearance compared to other construction materials currently in use. And because of their strength, light weight, and dimensional stability, mass timber products offer a renewable and carbon-friendly alternative for building applications where wood hasn't always been considered.

Casual readers of architectural news may be more familiar with the term "cross-laminated timber," or CLT, than the broadly-encompassing "mass timber." CLT is one of the more commonly used derivatives of mass timber, so it garners a significant amount of press. However, there are many types of mass timber products available to North American building designers.

In addition to CLT, products in the mass timber family include nail-laminated timber (nail-lam or NLT), glued-laminated timber (glulam, or GLT when referring to panel products), and dowel-laminated timber (DLT). Product innovation is continuous, and a relative newcomer to this group is the mass plywood panel (MPP).

Cross-Laminated Timber

CLT consists of multiple layers of dimension lumber (typically three, five, or seven layers) oriented at right angles to one another and glued to form structural panels. CLT manufacturing plants that are operational and certified to U.S. standards include:

- DR Johnson Lumber (Oregon)
- Nordic Engineered Wood (Quebec)
- SmartLAM (Montana)
- Structurlam (British Columbia)
- KLH USA (Austria)

Nail-Laminated Timber

NLT has been used for more than a century but is undergoing a resurgence as part of the modern mass timber movement. It is created from dimension lumber (2-by-4, 2-by-6, 2-by-8, etc.), stacked on edge and fastened with nails or screws to create larger structural panels. NLT is highly accessible and can be made by many manufacturers.

Dowel-Laminated Timber

Similar to nail-laminated timber, DLT is created from dimension lumber stacked on edge, but is fastened with wooden dowels to create larger structural panels. It is available from StructureCraft in British Columbia.

Glued-Laminated Timber

Glulam, or GLT, is created from dimension lumber bonded together with durable, moisture-resistant structural adhesives. Glulam can be used to form beams, columns, or panels, as well as curved and arched shapes. It can be sourced from a wide variety of U.S. manufacturers.

Mass Plywood Panels

MPPs are new products that use very thin, densely-layered veneers to form large panels up to 48' long, 12' wide, and 1' thick. They also "use 20 to 30 percent less wood, cost less, weigh less and are as strong or stronger than lumber-based cross-laminated timber."[1]

Building Codes

In California, either light timber or mass timber can be used to construct non-residential buildings up to 85 feet tall, or six stories. However, residential projects built exclusively with wood can only be built to five stories tall. Combined with a concrete podium, timber buildings are permitted up to seven or eight stories. Wood buildings in California can currently only exceed these heights with extensive testing and documentation that is rarely economically feasible for private developers.

Changes to International Building Code, proposed by the International Code Council's (ICC) Ad Hoc Committee on Tall Wood Buildings, were approved by the ICC in December 2018. This will allow mass timber buildings up to 270 feet or 18 stories when structural timber is fully encapsulated, and 180 feet or 12 stories with some interior elements exposed.[2,3] These changes will eliminate the need for expensive, time-consuming testing and allow construction of tall wood buildings. The new rules will be included in the 2021 International Building Code and may be adopted into state and local building codes in subsequent years.

While this paper does not argue that mass timber is the best option for every project, experience in other cities and countries has shown that it's well-suited to many applications, either as the primary structural component or complementary to concrete, steel, and/or other materials. It's a valuable tool in the toolkit for cities and developers seeking to build faster, more sustainably, and more affordably.

Why Timber Matters for Downtowns

Development in Downtown L.A. – and downtowns of many other U.S. cities – is generally characterized by a combination of seven- to eight-story light timber buildings and 20- to 50-plus-story concrete or steel high-rises, with very little in between. Once a building exceeds seven to eight stories it must be built with concrete or steel, dramatically increasing per-square-foot construction costs and incentivizing developers to build much taller; a seven-story light timber building may actually be more profitable than a 10- or 12-story concrete building, despite the additional units that can be provided in the larger structure.

This interplay between building codes and construction costs forces developers to choose between a smaller number of slightly more affordable units (far below the 13:1 floor-area ratio permitted in much of Downtown L.A., for example), or a larger number of higher cost units that more fully utilizes a site's development capacity. In addition to the benefits described in the following section, mass timber can help fill this gap with 10- to 18-story buildings that provide more housing at lower cost, a key goal identified by Central City Association for addressing the housing crisis.

Finding suitable staging areas can also be a challenge in dense urban environments, where staging locations are disappearing as underutilized sites are redeveloped. Because mass timber is manufactured off-site, projects can be rapidly constructed without extensive staging areas for storing materials.

Urban centers across the state continue to grow up, facing obstacles in the leap from light timber mid-rise structures to concrete and steel high-rises. Mass timber, as a bridge between the two building types, will be a welcome addition for those working to solve the housing crisis and increase the diversity and affordability of our housing stock.

§ 03

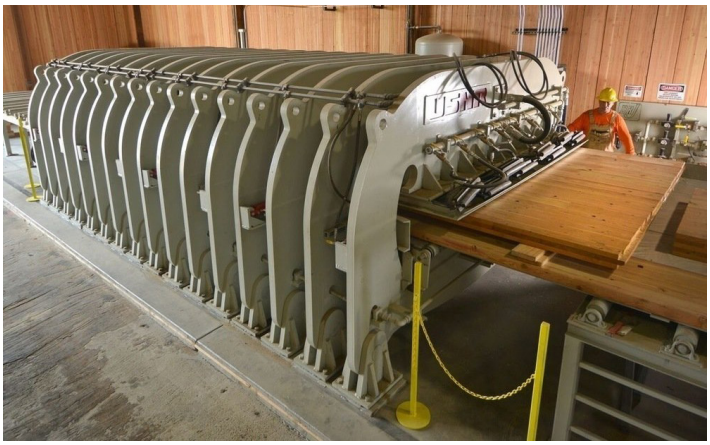
Benefits of Mass Timber

Mass timber buildings can provide numerous benefits to cities, developers, and residents. We summarize these benefits below, categorized by: Schedule/Delivery, Affordability, Sustainability, Jobs/Economy, Safety, and Aesthetic/Marketability.

Schedule/Delivery

Larger projects can take upwards of 24 months from the start of construction to lease-up. Combined with entitlement timelines of one to three years or more, this creates a significant lag time between project conception and tenant move-in. This is a pressing challenge for delivering housing at all income levels, but especially for affordable housing being built to address California's urgent homelessness crisis. **Mass timber can help deliver much-needed housing faster.**

Unlike regular timber, which is cut-to-fit on site, or concrete, which must be poured and cured over several days for each floor, mass timber is largely prepared off-site and assembled with minimal delay. As a result it enjoys many of the benefits of prefabricated or modular construction, including shorter construction times. **In one study exploring potential cost and schedule savings from wood skyscraper construction, it was estimated that mass timber construction could result in a 20% schedule savings compared with cast-in-place concrete, equal to about four months off the construction timeline.[4]**



CLT panel being manufactured at DR Johnson Lumber Co in Riddle, Oregon | Source: Lever Architecture

These time savings result from several features of mass timber, including:

- Mass timber weighs approximately one-fifth as much as concrete[5], and mass timber buildings (including concrete toppings, finishes, etc.) weigh approximately half, requiring less earthwork and smaller spread footings.
- Mass timber can be continuously erected without waiting for concrete elements to cure.
- Faster construction of structural elements improves labor workflows, allowing subsequent trades to start work sooner after each deck of structural elements is completed.
- Precision manufacturing increases compatibility with pre-fabricated modular components, e.g. use of modular bathrooms.
- Off-site materials preparation reduces the need for staging – especially important in physically constrained urban environments. Additionally, off-site preparation reduces noise and dust impacts common to other construction materials.
- Faster construction and reduced noise lessen the impact of construction on communities.

Affordability

According to a September 2018 report by the Government Accountability Office (GAO), the median per-unit cost for Low Income Housing Tax Credit (LIHTC) projects completed 2011-2015 in Los Angeles was $410,000.[6] A City of Los Angeles' September 2018 report on permanent supportive housing included per-unit costs ranging from $430,000 to $550,000.[7]

These costs are not fiscally sustainable in a state where millions of households are burdened by housing costs. **California cannot generate enough revenue to support housing expenses for so many residents and still maintain funding for other**

priorities like education and healthcare. A central goal of CCA is identifying strategies to deliver housing affordable to residents of all income levels, and mass timber can play a role in realizing that goal.

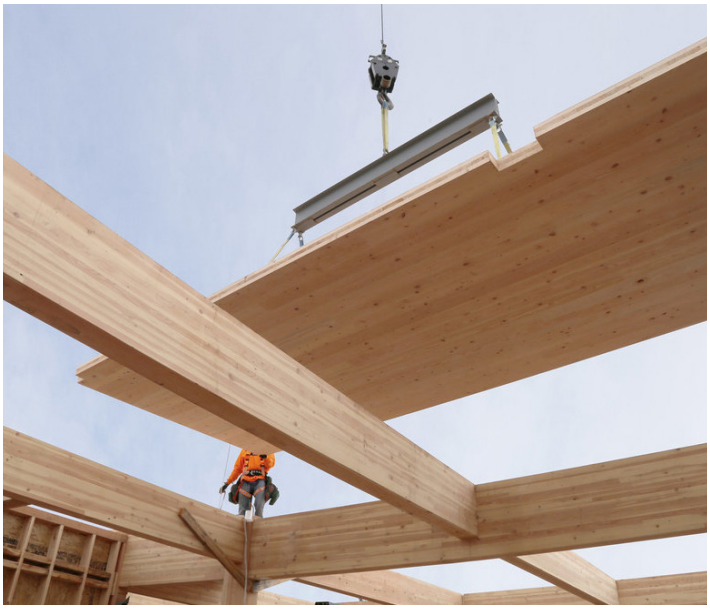
Estimates of material costs for mass timber vary significantly relative to concrete and steel. One university study found cost savings of up to 22%[8], while another study estimates that mass timber costs 18% to 25% more than concrete.[9] Another detailed report comparing mass timber to traditional construction estimated a cost savings of approximately 4%.[10]

As these studies highlight, the cost of mass timber is highly dependent on contextual factors such as building type, location, local approval processes, and labor availability. One important consideration is that while concrete and steel are mature markets, mass timber is still in its infancy and has yet to build capacity and economies of scale that will bring down costs. These studies also pre-date tariffs enacted by the Trump Administration.

Mass timber can reduce construction costs and improve affordability in the following ways:

- Locally-sourced timber isn't subject to tariffs like those on steel and other common construction materials.
- Shorter construction schedules reduce carrying costs and allow residents to move in (and start paying rent) sooner.
- Off-site materials preparation reduces labor costs.
- Because of mass timber's light weight, foundation costs are significantly reduced. Lower weights also allow for more materials to be shipped per vehicle trip, potentially reducing transportation costs.

Working with CCA, construction firm **Hathaway Dinwiddie** generously provided a construction cost comparison of steel, concrete, and cross-laminated timber (CLT) developments.



Construction of Albina Yard | Source: Lever Architecture

As the table below demonstrates, foundations for CLT tend to be less expensive than for steel and concrete buildings, in part because the lighter weight of CLT requires smaller foundations and potentially less complex below-grade work.

Presently, superstructure costs for mass timber buildings can significantly exceed those of concrete or steel. However, CLT has both a wider range of costs and a lower low-end cost, which are positive attributes at this stage of development in the mass timber market. These metrics point to a near future when mass timber development matures, and costs are lower than concrete or steel, and just as consistent and predictable.

Side by Side Structural Cost Comparison:
Figures for 3 to 5 Level Buildings in California 2010 to 2019

Uniformat Description	Steel Bldgs	Concrete Bldgs	CLT Bldgs
	$/SF Range	$/SF Range	$/SF Range
A10 – Foundations	$4.50 - $10.00	$7.00 - $14.00	$3.75 - $8.00
B10 – Superstructure	$40.00 - $60.00	$50.00 - $65.00	$40.00 - $100.00+

Side by Side Structural Cost Comparison:
Figures for 10 to 20 Level Buildings in California 2010 to 2019

Uniformat Description	Steel Bldgs	Concrete Bldgs	CLT Bldgs
	$/SF Range	$/SF Range	$/SF Range
A10 – Foundations	$4.00 - 8.00	$4.50 - $8.50	$3.75 - $8.00
B10 – Superstructure	$45.00 - $50.00	$47.00 - $55.00	$40.00 - $60.00

** Figures in the cost analysis above represent averages based upon a range of building types and delivery models across multiple building markets in the state of California. These figures are extracted from the full breadth of different project phases from final costs through conceptual estimates and have been leveled in order to maintain relevance across the data set.

Superstructure costs at the upper range reflect CLT's use in "statement" or "signature" works of architecture, where showcasing its beauty and novelty takes precedence over return-on-investment. This is often true of public or cultural buildings, for example. We can expect this range to narrow as mass timber becomes a more commonplace building material and efficiencies are realized.

The low-end costs of CLT (approximately $40/SF today) are also encouraging given the early stage of mass timber development in the U.S. Despite lacking economies of scale and local experience enjoyed by concrete and steel, CLT is already cost-competitive for some projects. These costs highlight the potential for mass timber to bring costs to a level significantly lower than concrete and steel as economies of scale are developed.

Mass timber construction is cost-competitive with concrete and steel, and will grow more affordable over time.

The opportunity to expose some components of mass timber structures also has an impact on cost beyond foundations and superstructure. Aside from aesthetic benefits, there is potential for cost savings associated with the reduction or elimination of construction assemblies such as fireproofing, interior column caps, interior soffits, and traditional ceilings. Quantifying savings in these categories can be difficult and will vary depending on whether comparing to concrete or steel. Also, different municipalities will have varying requirements based on their context and preferences.

Sustainability

The State of California has set ambitious goals for greenhouse gas emissions reduction and is investing billions of dollars in sustainability efforts, with a large share of funding coming from cap-and-trade program revenues.

Most of these efforts focus on reducing emissions from the transportation and electricity generation sectors, two of the largest contributors to greenhouse gas emissions. In contrast, relatively little attention is paid to emissions and embodied energy derived from building materials. **Cement and concrete production accounts for between 3.4%[11] and 7.0%[12] of global carbon dioxide emissions, so reducing the environmental impacts of new construction should also be a high priority. And unlike other sustainability investments such as electric vehicle rebates, financial support for mass timber should not require large ongoing subsidies.**

Source: Autodesk

Below are some of the ways that mass timber can contribute to our state's sustainability goals:

- Timber is a renewable resource that can be grown and harvested indefinitely. Building with sustainably-managed wood products helps sequester carbon out of the atmosphere, and according to one study by researchers from Yale and the University of Washington it could reduce global CO2 emissions by 14% to 31%.[13]
- Engineered wood products also require less energy to manufacture, and much of the energy is produced with renewable biomass such as bark and residual fiber (byproducts of wood harvesting) rather than fossil fuels.
- Wood has lower thermal conductivity than other common building materials, and mass timber buildings are exceptionally air tight due to precise manufacturing practices. These qualities both contribute to increased operational energy efficiency for mass timber structures.
- Timber can be grown in California and nearby states rather than being imported from other countries, reducing the environmental impact of shipping long distances.

Jobs/Economy

California is shifting toward a green economy with an increasing number of jobs held in industries like solar power and electric vehicle manufacturing. Mass timber is another green industry that can provide large numbers of well-paying jobs.

As of 2012, timber workers harvested 1,425 million board-feet of timber, 97% of which was processed within the state. Nearly 84% of harvested timber came from private lands, and approximately 77% of timber harvested in the state was also sold as final products here. Timber stays local, creating a multiplier effect for state and local economies.[15]

Despite these benefits, timber production in California has declined by approximately 36% since 2000.[16] Kickstarting a mass timber industry would help reverse this trend and improve the state's job market in the following ways:

An export industry creating green jobs where they're most needed.

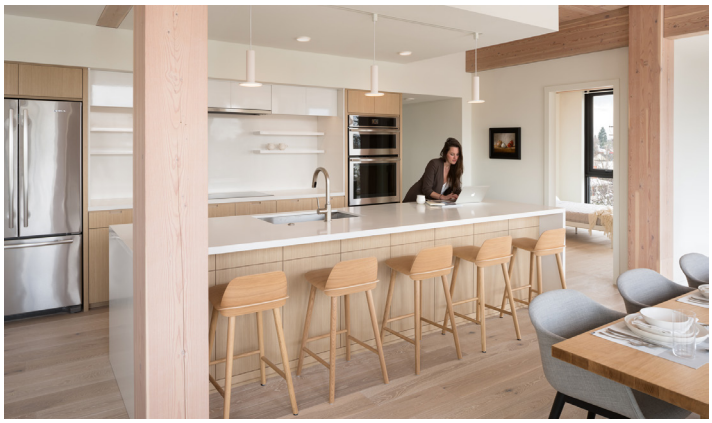
- Mass timber construction would create new jobs in the timber and manufacturing industries.
- Timber harvesting and manufacturing jobs could serve customers inside and outside of California, growing exports and our tax base while reducing greenhouse gas emissions.
- Mass timber is prepared at manufacturing facilities that offer skilled, well-paying jobs.
- Savings on materials, labor, and project schedules would increase the overall financial feasibility of housing development, increasing the demand for jobs across the housing development and construction supply chain.

Safety

Compared to other construction materials and their supply chains, there are many safety benefits to working with mass timber. These benefits accrue to residents, individual workers, and the California economy as a whole.

- A robust mass timber industry can spur improved forest management that reduces the risk of wildfires across the state.
- Especially important in earthquake-prone California, seismic demands on timber are lower than for concrete or steel.
- Higher-risk activities like formwork and reinforcing are reduced or eliminated, and shorter construction schedules mean less time spent working at greater heights.
- Timber product manufacturing increases the precision of structural materials and reduces the likelihood of construction failures that may harm workers or residents.

Aesthetic/Marketability



Carbon 12 PDX | Source: Kaiser Group / Path Archtecture

Mass timber projects aren't just constructed differently than other building types, they also look different. Many feature exposed structural elements that have a unique, warm aesthetic that can't be duplicated in concrete or steel construction and is especially welcome in dense urban environments. The distinctiveness of mass timber contributes to a variety of positive outcomes, including:

- Greater diversity in the look and feel of new projects not only adds to the beauty of our built environment, it can also help increase support for housing development.
- The distinctiveness of mass timber differentiates it from competitors, increasing its marketability to prospective tenants.
- Mass timber buildings can be built with thinner floor slabs than concrete or steel buildings, allowing for higher ceilings or lower cost. In either case, this further increases the desirability of mass timber housing for tenants.

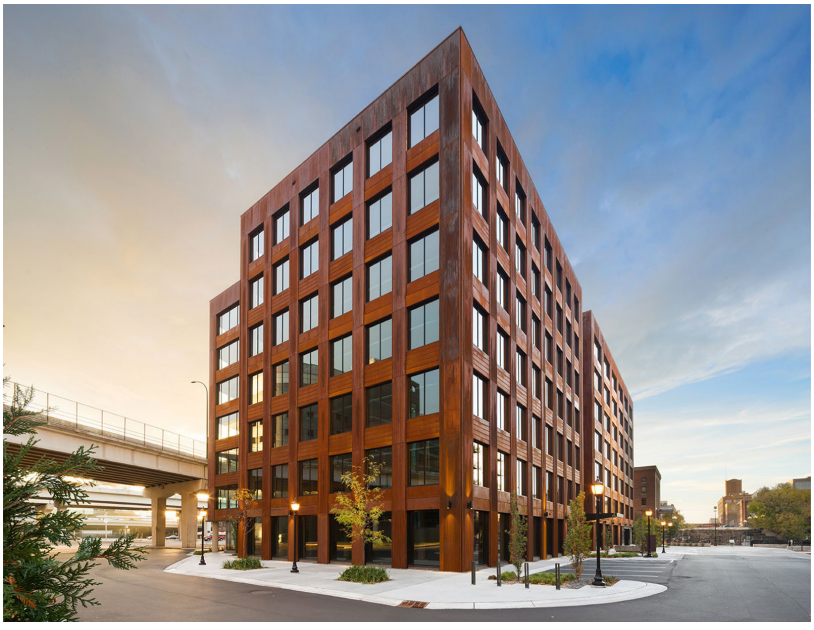
§ 04

Case Studies

Mass timber buildings are being constructed across the world, including mixed-use developments, offices, corporate headquarters, university buildings, elementary schools, student housing, hotels, distribution centers, and museums. Several illustrative projects are profiled in this section.

T3 (Minneapolis, Minnesota)

Use: Office and ground-floor retail
Year Complete: 2016
Developer: Hines
Designers: Michael Green Architecture; DLR Group; MKA
Cost: $30.9 million (value reported in construction permits)
Height: 7 stories, 85 feet
Size: 220,000 SF
Construction: 6 stories nail-laminated and glulam timber above 1 story concrete podium



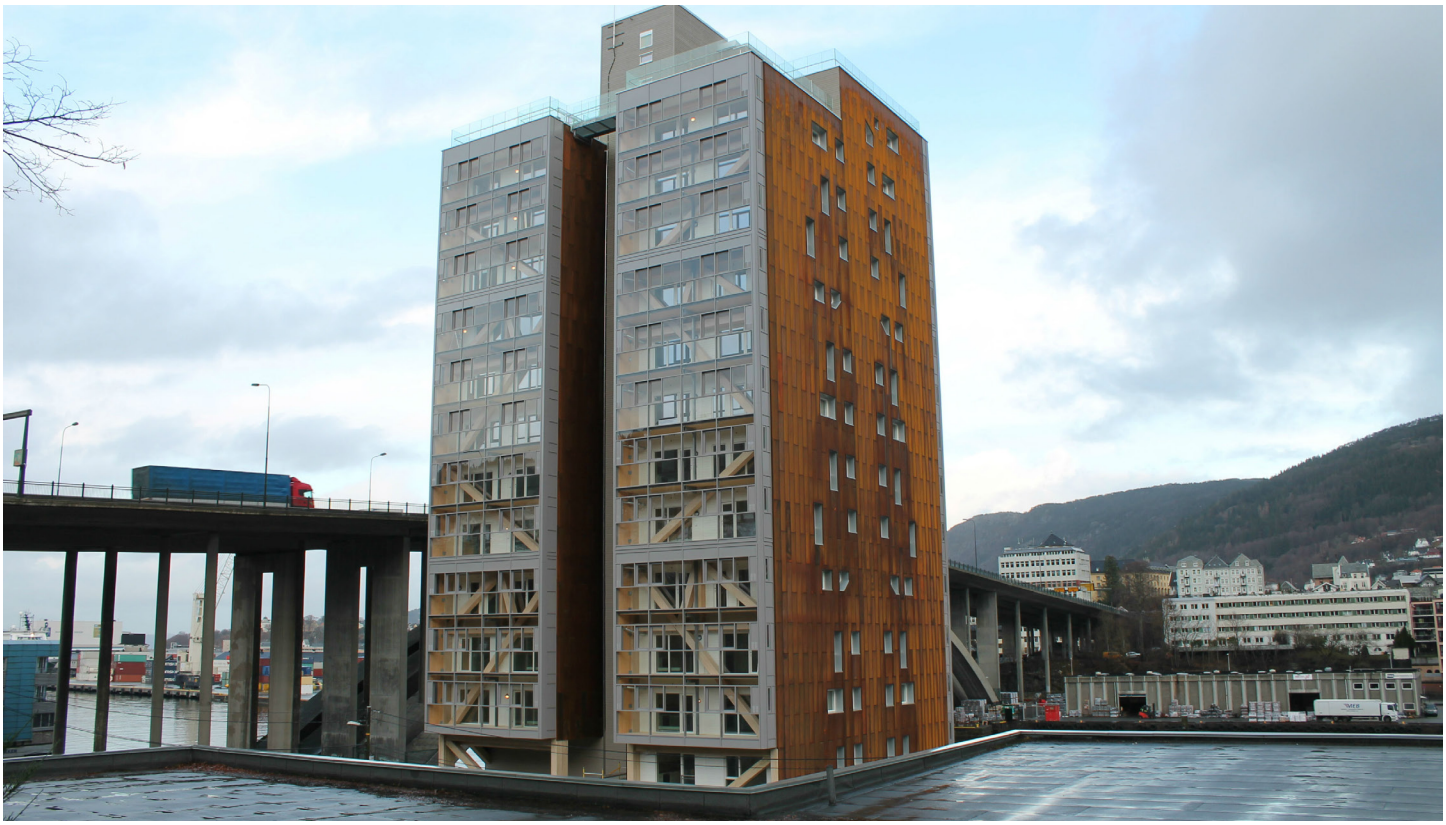
Source: EMA Peter

Source: Magnusson Klemencic

T3 – which stands for Timber, Technology, Transit – is a seven-story office building located in Downtown Minneapolis. It is the first modern wood office building of its size in the U.S.

The project used spruce pine nail-laminated timber (NLT) panels with a spruce glulam post-and-beam frame built on a one-story concrete podium. In addition to the sustainability benefits shared by other mass timber developments, T3 pushed the envelope further by sourcing the majority of its timber from trees killed by the mountain pine beetle.

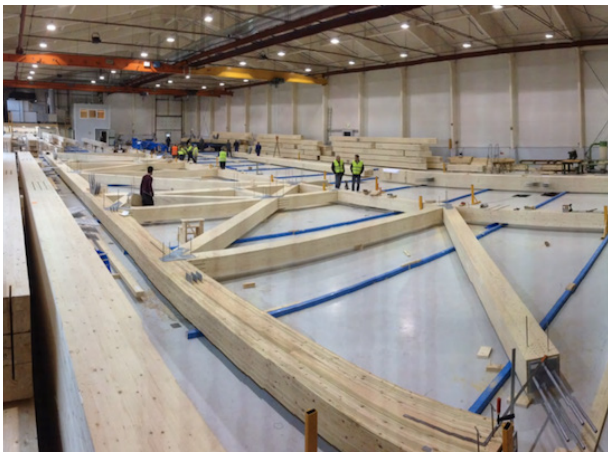
A prefabrication facility was set up 600 miles away in Winnepeg, Manitoba, and timber framing construction was completed in just 9.5 weeks. The T3 structure is as little as one-fifth the weight of a comparable concrete structure, reducing the foundation size, seismic loads, and embodied energy of the project.[17]

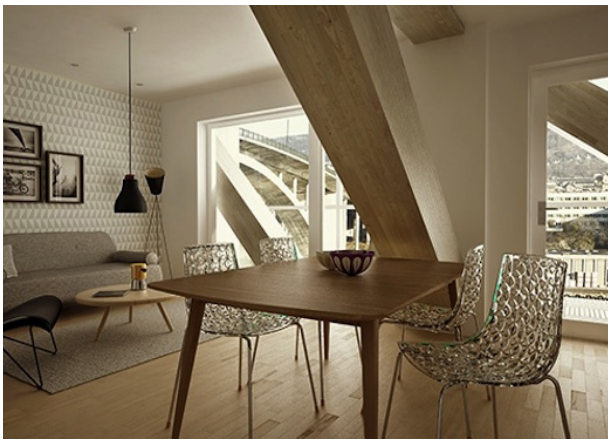


Source: Sweco / Artec

Treet (Bergen, Norway)

Use: Residential mixed-use
Year Complete: 2015
Developer: Bergen og Omegn Boligbyggelag
Designers: Artec; SWECO Norway
Cost: $25 million (22 million Euros)
Units: 62 apartments
Height: 14 stories, 147 feet
Size: 63,000 SF
Construction: 14 stories cross-laminated and glulam timber over underground concrete garage





Treet, or "The Tree" in Norwegian, is a 14-story residential tower in Bergen, Norway; it was the tallest timber building in the world at the time of its construction. It includes 62 apartments which started groundwork in April 2014 and completed with resident move-ins in December 2015.

The project uses a unique design that utilizes glulam trusses reminiscent of modern bridge structures for its structural load-bearing system, and cross-laminated timber (CLT) panels for its walls. The structure also includes prefabricated concrete slabs on the fifth and 10th floors which act as a base for the four levels above them.[18]

Treet was built to Passive House standards to maximize operational energy efficiency, and although initial costs were somewhat higher than concrete or steel construction, developers were able to reduce the construction timeline with four stories erected in just three days.[19]

Carbon 12 (Portland, Oregon)

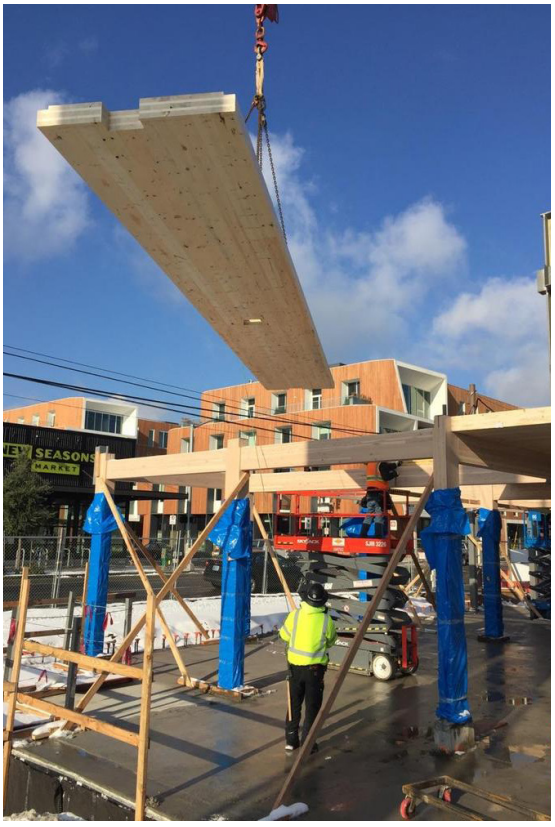
Use: Residential mixed-use
Year Complete: 2018
Developer: Kaiser Group
Designers: Path Architecture
Cost: Not reported
Units: 14 condominiums
Height: 8 stories, 85 feet
Size: 42,000 SF
Construction: 7 stories cross-laminated timber with steel supports over 1 story concrete podium

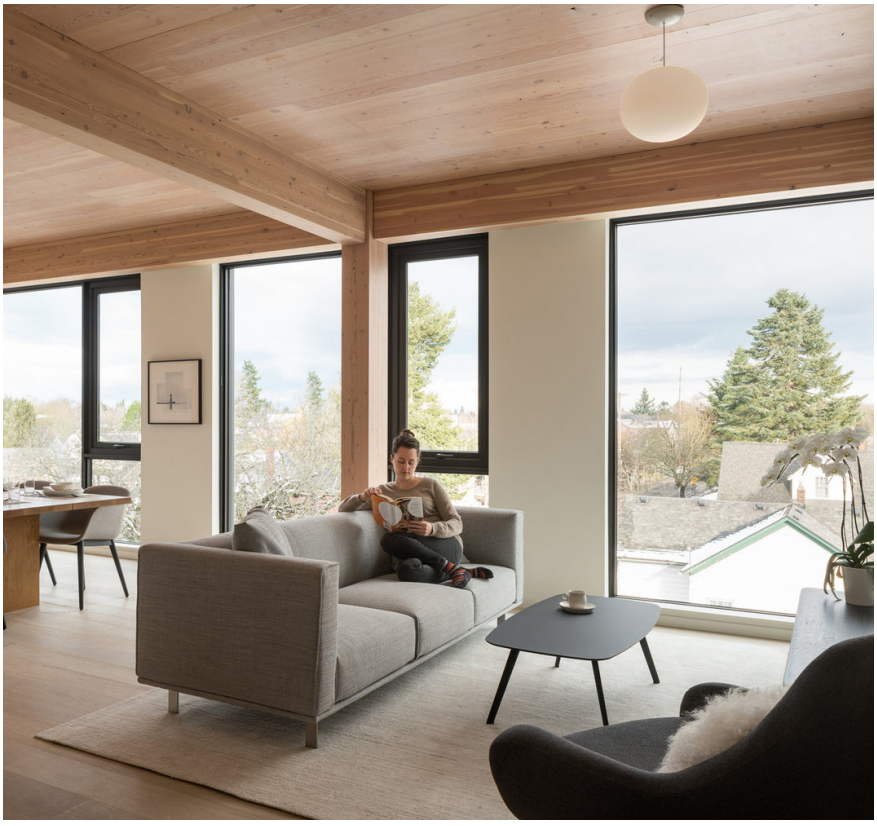
Source: Kaiser Group / Path Architecture

Carbon 12 is an eight-story, 14-unit condominium building in Portland, Oregon. Built from CLT, the project exceeded the city's 65-foot wood building height limit by agreeing to an external review of fire/life safety standards by state-approved inspectors. Although the exterior panels are made of metal, the developer left the CLT beams, columns, and undersides of panels exposed for a warmer interior aesthetic that sets the units apart from competitors and helped secure a premium sale price from buyers.

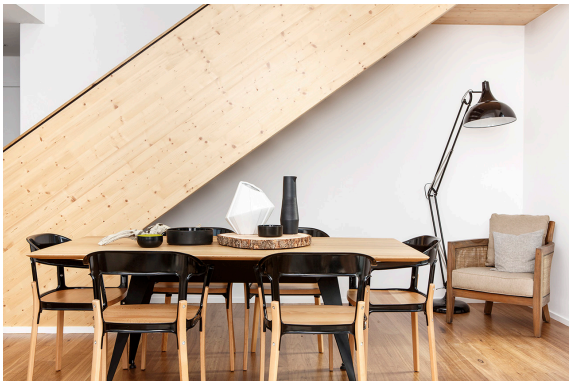
Carbon 12 also utilizes steel in the building core and diagonal braces, and concrete for the ground floor and the underground automated parking garage. Exemplifying the speed of mass timber construction, the tower crane was only on site for 2.5 months.[20]

Alongside other proposed mass timber developments in Oregon, Carbon 12 helped spur code changes in the state that will make future tall wood buildings easier to approve.





Source: Lendlease



Forté (Melbourne, Australia)

Use: Residential mixed-use
Year Complete: 2013
Developer: Lendlease
Designers: Lendlease
Cost: $7.8 million ($11 million AUD, construction cost only)
Units: 23 condominiums
Height: 9 stories, 106 feet
Size: Not reported
Construction: 8 stories cross-laminated timber over 1 story concrete podium

Forté is a 23-unit condominium development in Melbourne, Australia. It was the first CLT building in Australia and at nine stories, it was the tallest timber building in the world at the time of its completion.

The timber used for the project was harvested in Austria and shipped to Australia over water in 25 shipping containers. Structurally Forté is exceptionally reliant on CLT, even building the elevator shafts out of wood. Like other case study projects, Forté was ahead of its time and it had to pursue a performance-based alternative permit process, which it passed on all measures, to receive project approval.[21]

Forté captured approximately 700 tons of carbon in its structure. Taking into account the energy consumption required to manufacture alternative materials like concrete or steel, this increases the carbon reduction to over 1,400 tons, the climate equivalent of taking 345 cars off the road for one year – 15 times the number of residential units in the project. It is estimated that if just 2% of the homes in Australia were built with CLT each year, this would be the equivalent of taking over 19,000 cars off the road.[22] Using timber was also estimated to reduce water consumption by nearly eight million liters.[23]

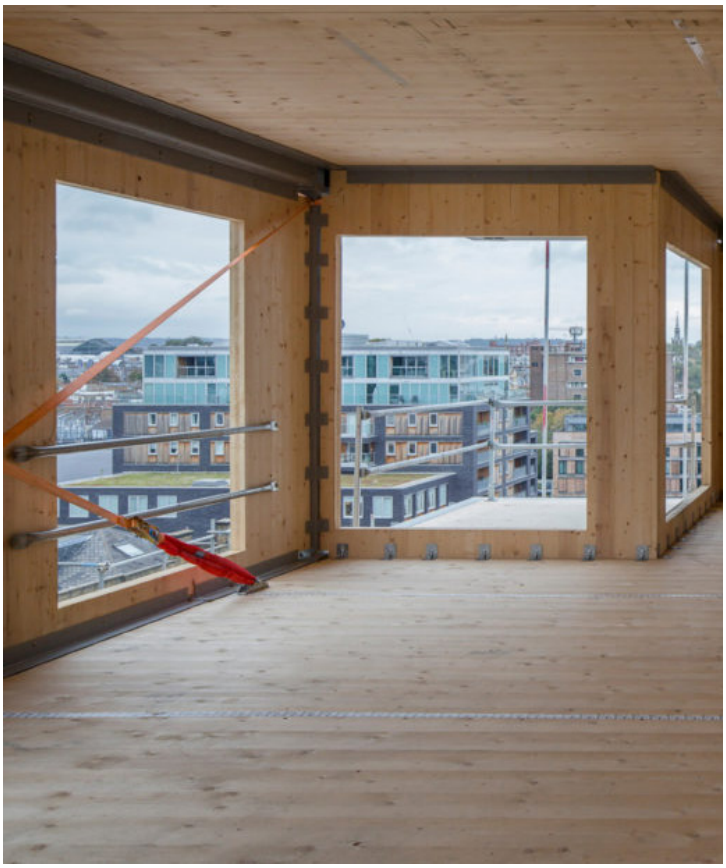
Source: Hawkins\Brown – Jack Hobhouse

The Cube (London, United Kingdom)

Use: Residential mixed-use
Year Complete: 2015
Developer: Regal Homes
Designers: Hawkins\Brown, B+K Structures
Cost: $13.7 million (£10.5 million)
Units: 50 condominiums
Height: 10 stories, 108 feet
Size: 72,000 SF
Construction: 10-stories cross-laminated timber with concrete core and steel cantilever supports

The Cube is a 50-unit condominium building in the Shoreditch neighborhood of London. The 10-story project utilizes a concrete core and steel cantilevers for structural support, but approximately 80% of the structure is built from timber, primarily CLT. The 1,300 cubic meters of timber used in the project are estimated to have removed 1,040 metric tons of carbon dioxide from the atmosphere.[24]

The building was designed in a twisted cruciform shape that provides every unit with three exterior walls offering excellent views, natural light, and air circulation. Highlighting the labor efficiency of mass timber construction, the entire structure was built in 30 weeks by just five people.[25] Similar to Forté, the timber was manufactured in and shipped from Austria and then delivered to the construction site in London using a just-in-time delivery process.



§ 05

Barriers to Mass Timber

Although mass timber construction has seen success in the U.S. and abroad, local barriers must be addressed before timber can reach its potential to improve affordability, sustainability, and project schedules. We discuss three of the greatest obstacles below.

1. Lack of labor expertise and manufacturing capacity

California currently lacks a construction labor force experienced working with mass timber. In contrast, construction workers have extensive experience building with concrete, steel, and light timber. Investment in education and training will be required to fully capitalize on the benefits of mass timber building, as well as time for workers – and the market as a whole – to adjust.

Similarly, support is also needed to grow the capacity of mass timber manufacturing. Mass timber, like prefabricated construction, has structural elements prepared off-site, requiring the development of manufacturing facilities (and timber harvesting infrastructure) that can scale up as timber use increases.

One advantage of mass timber is that while its manufacture is a highly technical and specialized process, finished timber products are easily assembled with relatively little expertise required. Once manufacturing capacity is established and contractors become familiar with the use of mass timber, worker training will likely be less intensive than for materials such as concrete and steel. Building Trades will be important partners since they have experience in developing new training and educational items needed to adapt to new construction methods.

2. State and local building codes

State and local building codes don't yet permit mass timber buildings over 85 feet tall. In December 2018 the International Code Council approved the construction of mass timber buildings up to 18 stories or 270 feet tall, but these changes won't go into effect until the 2021 International Building Code update and will still need to be adopted in state and local building codes in the coming years. Further, government employees who review building and structural plans will need to acquaint themselves with the new rules and the unique characteristics of mass timber construction.

The successful development of tall mass timber buildings in other parts of the world is a promising precedent for the approval of updated building codes in the U.S. and California, but it does not guarantee fast and efficient adoption here. Local stakeholders and elected officials will need to stay engaged to ensure that essential building code updates stay on track, and that government workers responsible for approving building plans enable mass timber.

Approval of new building codes will be especially important because mass timber will be more cost-competitive with concrete and steel skyscrapers than light wood-frame construction. If mass timber buildings over seven stories aren't permitted, they're unlikely to ever become more than a niche product. That said, given adequate labor experience and manufacturing capacity, mass timber may be cost-competitive even with light wood-frame construction in the future.

3. Inexperience of construction loan industry with off-site/prefabricated building practices

The cost of mass timber development is comparable to other construction types; however, because a large share of the structural materials are prepared off-site, costs may be front-loaded at an earlier stage in development than with conventional on-site construction. This can pose challenges to developers attempting to secure traditional financing from lenders accustomed to a more gradual "draw" on construction loans as developments progress floor-by-floor.

This can be a challenge for any prefabricated project, and may affect pre-cast concrete and steel construction to some extent as well. Over time, lenders will grow accustomed to the loan draw schedule associated with prefabricated construction – including mass timber – but early projects may face obstacles to traditional financing, highlighting the need for government and institutional support to set a strong foundation for the industry. This is why banks and other financial lending institutions will be important partners to support this emerging industry.

§ 06

Promoting Mass Timber in California

With such promising benefits, it's likely that the private market will eventually adopt mass timber construction. But given the severity of California's housing crisis and its mandate to aggressively reduce greenhouse gas emissions, we shouldn't be content to wait years – or even decades – for incremental private sector progress.

Without intervention, mass timber capacity is unlikely to improve significantly for at least the next three to six years as building codes are updated to permit taller buildings; the potential cost savings to builders may remain too low, and the risk too high. Instead of waiting until the mid-2020s for building code and zoning changes to bear fruit, state and local governments should work immediately to catalyze the growth of the mass timber industry – and they can do so at very limited cost.

Growing the mass timber industry will benefit from early support for two separate but related fields: Manufacturing and Planning & Construction.

Manufacturing

Manufacturing capacity is essential to the success of mass timber. Capacity reduces the time it takes to deliver orders, lowers costs through economies of scale, and helps ensure that manufacturing facilities are located closer to development sites, further reducing cost and environmental impact. Mass timber construction will continue to face headwinds without a mature timber manufacturing sector.

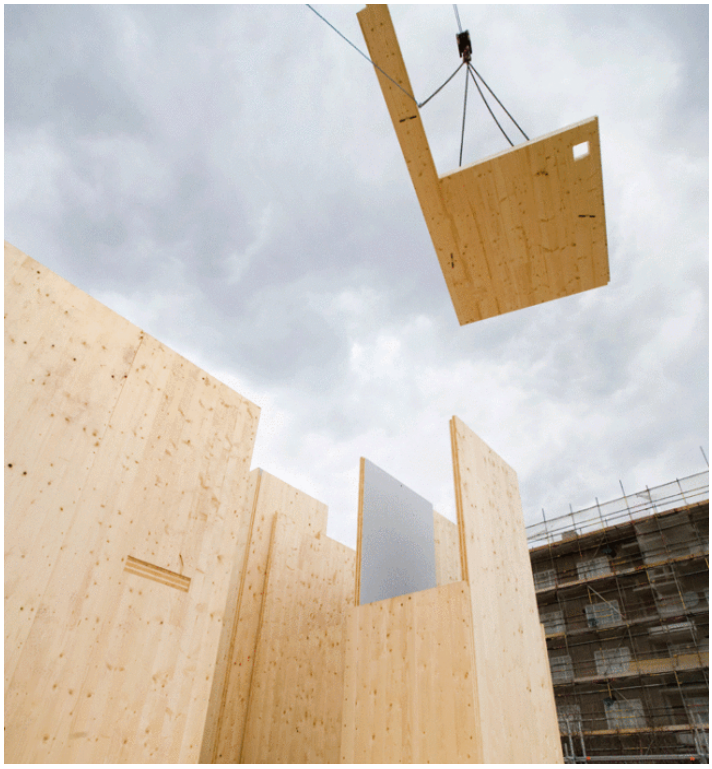
Transforming mature trees into mass timber for on-site assembly is an advanced process that requires special facilities and labor expertise. The state's capacity for mass timber production is limited and will need to grow significantly to become a reliable, affordable source of construction materials. Tax credits can help kickstart that growth.

Financial assistance: The state offers tax credits to qualifying manufacturers through programs such as the Greenhouse Gas Reduction Fund (GGRF), which is funded by cap-and-trade auction proceeds. The legislature and California Air Resources Board (CARB) should consider offering similar financial incentives to mass timber manufacturers.

The cost of these programs would be low compared to the long-term benefits to housing affordability, jobs and tax revenue, urban design, and sustainability. Environmental return-on-investment should be particularly high given that mass timber can become a self-sustaining market once it finds its footing.

Planning & Construction

Building code updates: The International Code Council has adopted changes to the 2021 edition of the International Building Code (IBC) allowing mass timber buildings up to 18 stories tall. Despite this important step forward, support for change at the state and local level is still essential to realize the benefits of the IBC update. Support from key stakeholders in development and construction, government, labor, and environmental groups will be necessary to ensure the quick adoption of tall mass timber buildings into local building codes and planning processes.



CLT panels being lifted into place at the Murray Grove timber tower | Source: Waugh Thistleton Architects

Additionally, although local building codes do not currently permit mass timber structures over seven stories or 85 feet tall, alternative compliance pathways exist that allow taller buildings. Advocates and government officials should strive to streamline these approval pathways while maintaining appropriate fire/life safety standards.

Building code updates will not eliminate all obstacles to mass timber development. Local bureaucracies will need time to adapt to new rules, manufacturers will be in relatively short supply, lenders may be wary of untested construction methods and prefabrication, and construction workers will need appropriate training.

Manufacturing support, government coordination, and construction incentives should work together to promote sustainable, affordable new housing.

We can begin to tackle these barriers now, before international, state, and local building codes are updated, to take full advantage of taller mass timber buildings once they're formally legalized for widespread development. The following should be addressed to support the mass timber construction sector:

Project approval streamlining: At the local level, cities should adopt processes for mass timber projects that minimize delay and uncertainty from application to project approval. Many cities already have streamlined or expedited approvals for affordable developments, and similar processes should be extended to mass timber developments.

Development incentives: State and local governments should also explore development incentives such as density, floor-area ratio (FAR), and height bonuses for projects that utilize mass timber. Government officials should collaborate with stakeholders in the development community to determine the appropriate level of incentives needed to tilt the scales in favor of mass timber projects.

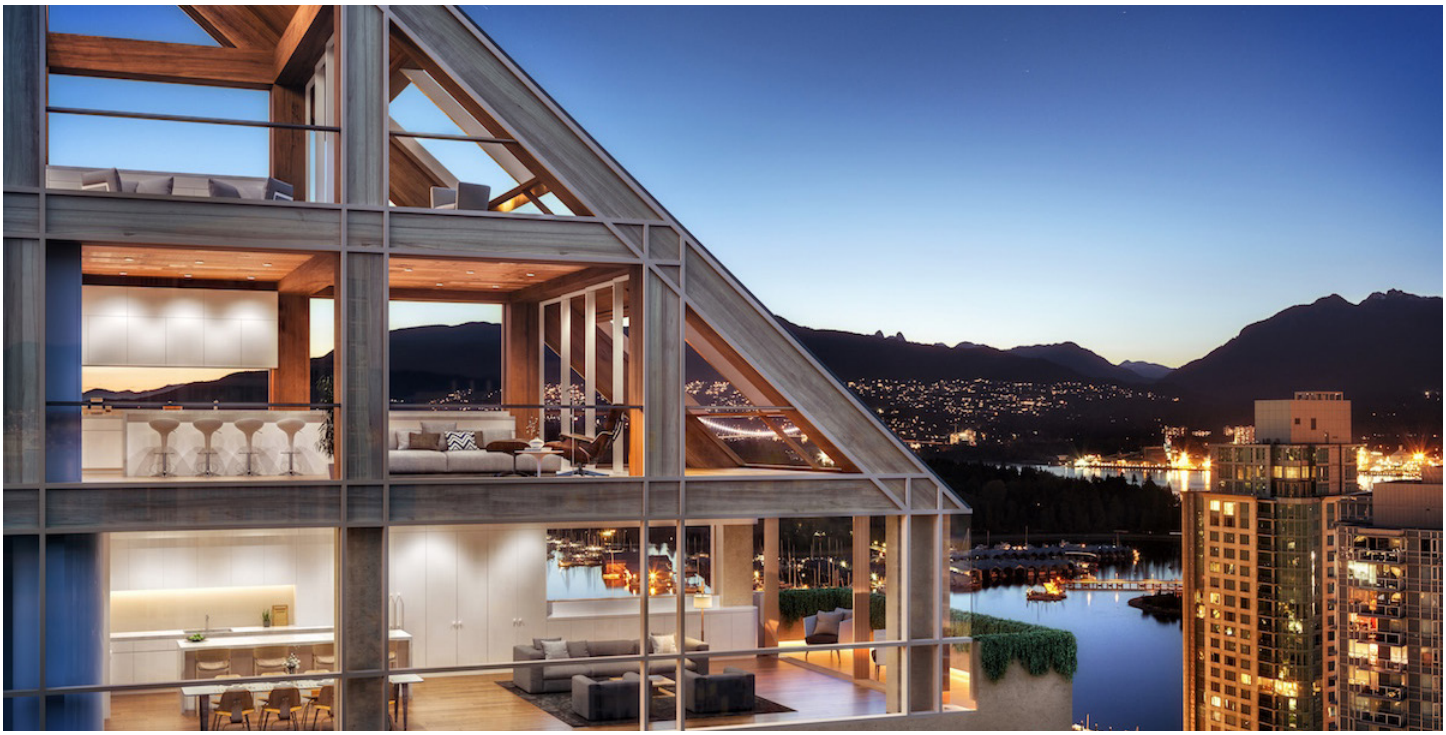
A strong market for mass timber construction will support the growth of manufacturing capacity, and vice versa. Public and private sector stakeholders should strive to support both, simultaneously, to ensure their mutual success. Furthermore, demonstrating early successes with mass timber manufacturing and construction will help lenders become familiar with the new processes and loan structures, increasing their comfort lending to builders.

Finally, state and local governments may also consider further support for reforestation efforts in response to wildfires and other sustainable timber management practices to increase the supply of timber. This would serve a variety of purposes including ecological protection, reduced timber costs, increased carbon sequestration, and job growth in rural areas throughout the state.

§07

Proposal:

Supporting Affordable Mass Timber Housing



Shigeru Ban's Terrace House in Vancouver | Source: Arch Daily

CCA recommends that the State of California dedicate revenues from the Greenhouse Gas Reduction Fund (GGRF) to support mass timber manufacturing and construction. Specifically, we recommend that supplemental grants be issued to affordable housing developers interested in exploring mass timber development, and that tax credits or grants be established for mass timber manufacturing. To the extent possible, state funds should be supplemented with local funds and development incentives.

GGRF funds could be appropriated through several state institutions that have a strong interest in promoting sustainable development practices, including the Strategic Growth Council, the Air Resources Board, and the Department of Forestry and Fire Protection. The Fund has distributed an average of over $1.7 billion per year since 2016, and only a very small portion of these revenues would be needed to seed a manufacturing and construction industry that can become financially self-sustaining in just a few years.

There are several reasons to start this program with affordable housing developers.

Affordable housing developers are already experienced working with public agencies and complying with mandates tied to the use of public funds. Affordable housing developers are held to a very high design standard – which mass timber can achieve – and they're subject to hiring standards, documentation, and community benefits agreements often associated with publicly-funded projects. Because these mandates typically result in higher costs, market-rate developers would have to weigh the value of public sector grants against these higher costs; affordable housing developers, already subject to these requirements, would not.

Affordable housing developers are particularly schedule-sensitive because they need to balance multiple funding sources with different eligibility requirements and cut-off dates. Mass timber's rapid construction schedule would help to expedite

Policy Recommendations:

State

• Utilize state cap and trade funds to encourage mass timber manufacturing and construction for affordable and mixed-income housing development.

• Work with state legislators to introduce legislation that would develop a program for streamlined CEQA review of affordable housing developments built with mass timber (or any other innovative construction type).

City

• Work with local elected officials, LADBS, and LAFD to create alternative compliance processes in accordance with the 2018 rules adopted by the International Code Council Ad Hoc Committee on Tall Wood Buildings before the 2021 International Building Code update. This will serve as a practical first step toward updating the L.A. Building Code.

• Work with local elected officials, LADBS, and LAFD to update the LA Building Code to include the 2018 rules adopted by the International Code Council Ad Hoc Committee on Tall Wood Buildings in accordance with 2021 International Building Code update.

• Partner with local elected officials and DCP to create land use and zoning incentives to encourage mass timber construction for affordable and mixed-income housing development.

• Work with DCP, LADBS and LAFD to develop a staff training program for the plan check process for mass timber developments.

• Leverage existing local funding mechanisms such as the City of L.A.'s Affordable Housing Trust Fund and the County's Housing Innovation Fund to incentivize mass timber construction of affordable housing.

• Work with EWDD and DCP to design a set of incentives to encourage mass timber development and manufacturing within the city's Opportunity Zones and other targeted areas.

New Partnerships

• Work with Building Trades to develop a mass timber construction training program to ready the workforce for this new building material.

• Convene financial institutions to discuss challenges and possible solutions to lending for mass timber housing development.

Key: DCP=LA Department of City Planning, EWDD=LA Economic & Workforce Development Department, LADBS=LA Department of Building and Safety, LAFD=LA Fire Department, CEQA=California Environmental Quality Act

project delivery, meet the timing requirements of various funders, and most importantly deliver affordable and supportive housing, which is desperately needed throughout the state, as quickly as possible.

As California makes progress on greening its electricity and transportation sectors, we must also recognize the important role of land use and building materials in climate change adaptation. Enacting the above recommendations will help California and its local communities meet statewide sustainability goals, delivering cost-effective greenhouse gas reductions while providing affordable housing, safe and healthy communities, and skilled, well-paying jobs. It will also help us continue to provide homes and employment opportunities where they're most welcome and can have the greatest environmental benefit: in our Downtowns and other urban centers.

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