Mass Timber Digest

JULY 2021

FEATURING:

Sidewalk Labs, Perkins&Will, DLR Group, MGA, Gray Organschi, Generate and, SERA Architects

PMX 15 | Sidewalk Labs
Image credit: Gensler

THINK WOOD®

A journal on innovations in mass timber research and design

VOL 1

Vanguards of Mass Timber

Welcome to the first edition of the Mass Timber Digest, a curation of the latest innovations in mass timber research and design. In the face of a rapidly changing climate and growing demand for eco-friendly building solutions, mass timber is a new category of wood product that can transform how America builds. Whether it's addressing the need for more affordable housing, advancing energy-efficient structural systems or reducing carbon emissions, mass timber has a role to play in improving the sustainability and livability of the built environment.

This inaugural release features the work of industry vanguards pushing boundaries with mass timber. Through demonstration projects, practical innovations, and ongoing research these mass timber innovators are showing how this naturally renewable material can help decarbonize our cities, streamline construction, mitigate global warming potential and contribute to increased occupant comfort and a sense of well-being.

The potential of mass timber is taking root, germinating new approaches to contemporary architecture. From bold, inviting interiors to dramatic and expressive structures, designers building with mass timber are commanding interest across the nation—and clients are taking notice.

In Volume 01, we dive into one project team's hypothetical experience building a mass timber hotel, examine the feasibility of constructing tall timber towers, discover research on using future cities for carbon storage, explore mid-rise timber construction in a seismic region, and more.

Each article offers an abridged summary of original research, written by the leaders and experts themselves, along with a link to read more from the source material. Opportunities for mass timber are advancing rapidly—get inspired and see what's possible with the *Mass Timber Digest*.

Are you innovating with mass timber?

We'd love to feature your research! Send us a line at info@thinkwood.com

Designing a Mass Timber Hotel

Portland and Oakland-based architecture firm SERA Architects dives into timber construction in the hotel industry with their Mass Timber + Hospitality working group, which includes architects, interior designers, engineers, and a leading hospitality executive.

While mass timber is gaining momentum in the U.S., its aesthetic, construction and sustainability advantages remain largely unexplored in hotel settings. With hospitality projects in particular, building designers must consider potential trade-offs like sound buffering between rooms and the up-front costs of construction; issues like these have made mass timber more of a question than an obvious solution for this market sector. Through first-person accounts, SERA Architects explores the process of designing a mass timber hotel from the perspective of a developer, architect, operator, and guest. Read on to get a glimpse of their research, and click through to read their full findings and discussions. discussions, published between September 2020 and March 2021.

Photos feature Hotel Magdalena, the first boutique mass timber hotel in Austin, TX, designed by Lake|Flato.

SOUND IDEAS

Podcast

Hear from SERA's Mass Timber + Hospitality working group in this podcast discussing how mass timber works, what it does well, and what you might expect to see as a traveler in the next few years.

Listen to the podcast

Hotel Magdelena | Lake|Flato
Photo courtesy: Casey Dunn

Gary Golla is a principal at SERA with 27 years of experience covering a wide range of building types and scale of projects—with a focus on hospitality design.

This hotel we're developing is different from others we have done before—it's a mass timber building. We did some initial research and met with the design team and contractor that designed and built a mass timber office project to help us analyze cost implications. We were looking at three potential projects at the time that were each very different in scale and construction type. We found that our proposed nine-story hotel was the best fit from a cost perspective. Mass timber priced out about 5 percent higher than concrete construction but would allow us to get to market 20 percent faster—offsetting the additional construction cost. The structure itself—which is inherently beautiful—could be used as the finish material so much of the interior finish work could be simplified. The advantages began to stack up.

We spoke to the jurisdiction. They already have another mass timber building being permitted so their systems for permitting and inspections are already in place. We also met with our insurance company to discuss the construction type. Our consultants walked them through the properties and code considerations that give mass timber buildings equal safety considerations in relation to other construction types, and how they can potentially be more resilient in a seismic event. After some education and negotiation, they have agreed there will be no premium for the mass timber construction.

In the end, after all of our research, pricing and debate, the development team and investors were in unanimous agreement that the project should move forward with mass timber.

Read the blog

Hotel Magdelena | Lake|Flato
Photo courtesy: Casey Dunn

Josh Cabot is a project architect and passionate mass timber advocate. He is interested in structural and passive design strategies that reduce energy, improve building resilience, and create conditions that inspire comfort and delight.

Golden panels of cross-laminated timber soar out toward a tree-tipped horizon, framed by a set of walls enclosing the main stair and evaporating into a skeleton of wood framing. I lose myself in the image for a moment, then look up from my screen and refocus. I need to push and finish this field report: 'Timber structure observed to be nearly complete on 6th floor and in progress on 7th floor above.'

This early focus on preconstruction has meant much deeper coordination with mechanical, electrical, plumbing, and fire sprinkler too. The beautiful exposed CLT ceilings meant extra care was needed during design when it came to routing the various ductwork, piping, and conduit—keeping lines concealed as much as possible.

Despite how fast I've had to move on my end to keep up with the construction crew on this job, I'm thankful it's been going smoothly. The timber contractor actually paired up with a supplier that offered 4D fabrication and delivery, which meant even the trucks that arrived onsite had been designed so that panels can get picked right off the truck, in the right sequence, at the right time. This is truly 21st-century joinery done at a massive scale.

Read the blog

Hotel Magdelena | Lake|Flato
Photo courtesy: Casey Dunn

Erica Spiritos is a preconstruction manager for Swinerton Mass Timber. Erica has long been interested in the design of urban environments in ways that honor the natural resources on which our lives depend.

I used to feel excited about the prospect of work travel — the luxury of jet-setting around the country to visit places far from where I was raised. All too often, the reality is that I am so drained of energy after a long flight and often stressed after a day of meetings that all I can muster is room service.

There is something different about this room I'm in tonight, in the way this space is making me feel.

Marvelling at the grain patterns, I wonder if the wood is just an aesthetic design element adhered to the surface beneath. I walk over to a column and rest my hand against the surface. It feels to be the same temperature as the air around me, and the face is smooth to the touch. Up close, I see that it is adorned with cracks along the face. This is not just a veneer; this is the structure. This is the first memorable hotel stay I have had in a while. I will be coming back.

Read the blog

ROOM WITH A VIEW

Mass Timber + Hospitality: Read All Five Perspectives

Compare the points-of-view from architect and developer to guest, and operator of a mass timber hotel.

Read the full series

written by Erica Spiritos

Hotel Magdelena | Lake|Flato
Photo credit: Nick Simonite

Offering Climate Solutions Without Extra Cost

Designed by Michael Green Architects (MGA) and developed by McKinstry subsidiary Emerald Initiative, Catalyst—an academic and office building at Eastern Washington University—signifies a new era of scalability in zero energy and zero carbon buildings. McKinstry shares how they did it in their recent case study.

Catalyst | Michael Green Architecture
Photo credit: Ben Benschneider

McKinstry believes we are in the midst of a climate crisis, much of which is attributable to building operations and construction, and that radical innovation must be applied to solve it. Similarly, we are in a construction affordability crisis, which limits financial resources generally.

A major reason for developing Catalyst is to demonstrate that innovation can drive out waste, and enable climate positive, outstanding buildings which cost on par with typical construction. This project demonstrates that climate solutions can be delivered at no net-cost increase and is a fully integrated living laboratory for new sustainability technologies, materials, construction techniques, operational practices and design.

Three Innovations Drive Performance

The development of Catalyst provided a testbed for three key innovations identified by McKinstry for reducing waste in this type of construction:

1. Sharing of heating/cooling systems across campus, enabling thermal waste transfer and economy of scale, substantially increasing efficiency while reducing cost.

2. Use of low-carbon materials such as timber for structure and decking, instead of heavier steel/concrete construction.

3. Mass assembly and alignment of disparate interior mechanical, electrical, fire, low voltage and IT systems.

These three major innovations involved primary building systems, making a more efficient sustainable building while enabling Catalyst to achieve its zero-energy and zero-carbon targets with no net cost increase.

Low-Carbon Mass Timber

Catalyst was the first office building in Washington State constructed out of cross-laminated timber (CLT), at the time of its construction. It uses CLT post-and-beams for the primary structure, and CLT floors and walls, eliminating major use of steel and concrete in the building. Wood was chosen for its substantially lower carbon footprint than steel and cement. Modern innovations in timber fasteners, and a better understanding of slow-burn/failure rates of heavy timber, allow the wood to be used in many types of construction and still provide safety, meeting up-to-date fire codes.

Catalyst | Michael Green Architecture
Photo credit: Ben Benschneider

Catalyst | Michael Green Architecture
Photo credit: Ben Benschneider

Patent-Pending Technology

Seeking synergies in reducing cost and achieving zero energy and carbon, McKinstry engineers and designers created a whole new building component, the patent-pending Overcast Cloud.

The Cloud pulls together a number of elements—heating and cooling point of use distribution, LED lighting, vacancy and IT sensors, acoustic attenuation, Wi-Fi, and other systems—in one integrated unit.

Other innovations used to achieve high-impact performance include boosted levels of insulation, triple-paned windows, night-time outside air cooling, deep daylighting and views, a highly efficient ventilation system, and air sealings that exceed Passive House standards.

Catalyst | Michael Green Architecture
Photo credit: Ben Benschneider

Catalyst | Michael Green Architecture
Photo credit: Ben Benschneider

A Stand-Out First-of-Its Kind Project

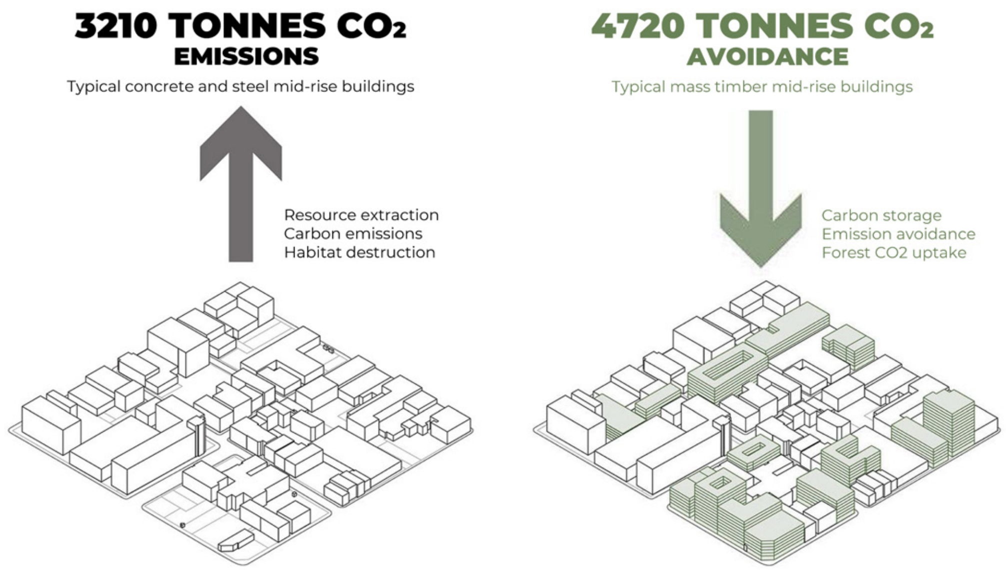
Overall, Catalyst stands out among the growing number of next-level green buildings. It's one of the world's largest ILFI Zero Energy buildings pursuing dual Zero Energy + Zero Carbon certifications; its CLT construction cuts embodied carbon substantially from typical steel and cement construction; 1,100,000 total kwh/year renewables; exceeds PHIUS air sealing standard (most stringent in world) by factor of two: 0.035 cfm/sf @ 75 pascals; and it's the first building in western hemisphere to use ILFI's innovative Zero Energy offsite renewable pathway.

Read the case study

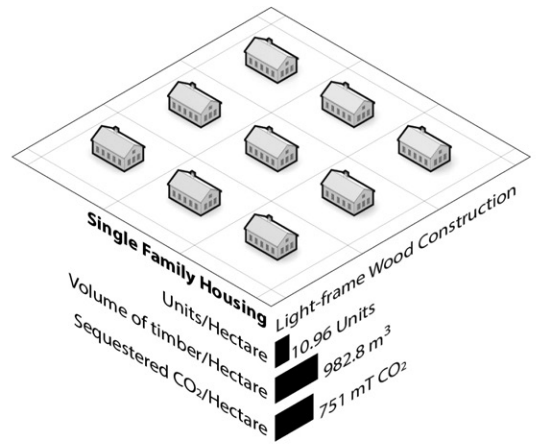
written by Gray Organschi

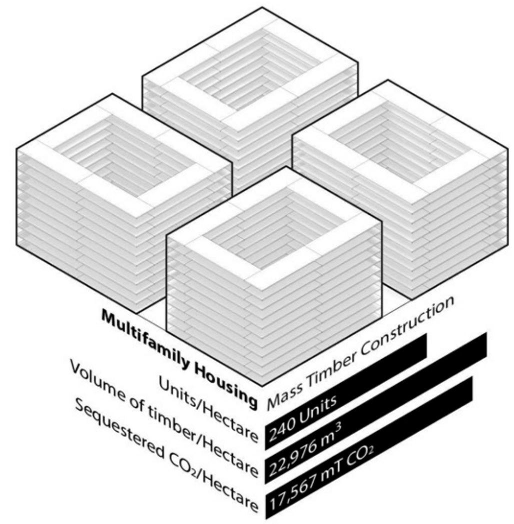
Using Buildings For Carbon Storage

The research initiative Timber City, spearheaded by Gray Organschi Architecture, proposes a radical pivot from construction practices that have dominated North American cities for over a century. Instead of utilizing steel or concrete, the architecture of the future city might be harvested from trees, and in turn store significant amounts of carbon.



Diagrams courtesy Gray Organschi Architecture





Timber City is an ongoing multi-year research project that explores the environmental efficacy and the industrial, structural, and architectural potential of urban mass timber construction technologies. A research initiative of Gray Organschi Architecture, Timber City is supported in part by the U.S. Forest Service and the Hines Research Fund for Advanced Sustainability at Yale University, the initial phase of research has led to four publications:

- Multiplier Effect: High-Performance Construction Assemblies and Urban Density in US Housing, which examined the compounding impacts of suburban housing morphology, high-performance building technology, and carbon emissions.
- Timber City: Speculations in a Black Market, which argued for the redirection of timber construction from the suburbs to dense urban applications.
- Timber City: Growing an Urban Carbon Sink with Glue, Screws, and Cellulose Fiber, which assessed the carbon storage capacity of a prototypical mass timber infill building and speculated on the systemic implications of deploying mass timber throughout urban environments.
- Buildings as a Global Carbon Sink, which explored the potential of mid-rise urban buildings designed with engineered timber to provide long-term storage of carbon and to avoid the carbon-intensive production of mineral-based construction materials.

Overall, the initiative is focused on how mass timber can help transform urban centers from being a source of carbon emissions to a solution for carbon storage through the development of new buildings and structural typologies in wood.

Ongoing research explores topics such as factors influencing the regional supply of mass timber and mass timber's role in a low carbon economy, along with an investigation of the complex spatial, architectural, legal, and logistical challenges of constructing timber buildings in dense urban centers.

Learn more about the initiative

Putting Prefab Prototypes to the Test

In a two-part series, Sidewalk Labs—the Alphabet-backed urban innovation company—explores how to boost the efficiency and seismic performance of factory-made mid-rise mass timber buildings.

PMX 15 | Sidewalk Labs
Image credit: Gensler

For the past few years, Sidewalk Labs has been researching and developing a factory-based approach to fabricating mass timber buildings. By manufacturing a core "kit-of-parts", the firm is planning to produce sustainable, high-quality mass timber buildings with greater speed and reliability, at a cost that meets market demands. As part of that work, they developed Proto-Model X (PMX for short)—a proof-of-concept for how factory-made mass timber buildings could work. PMX 15 is Sidewalk Labs' proto-model for a 15-story mass timber building.

Designing a mid-rise timber building to code in a seismic region

The Pacific Northwest is a North American leader in mass timber buildings, including the 18-story Brock Commons in Vancouver. It's also home to one of the world's most productive timber industries, showing the way forward for how to use the sustainably harvested forest to build dense urban environments.

But the Pacific Northwest is a very high seismic region, meaning any timber structures built there need to be designed for safety during and after a major earthquake. To tackle this design challenge, the PMX 15 team chose to locate their hypothetical building in Seattle, which lies squarely in the earthquake impact zone. Structural designs that are seismically viable in Seattle will be representative of a variety of building locations in cities up and down the West Coast—and other parts of the world.

PMX 15 | Sidewalk Labs
Image credit: Gensler

For PMX 15, the Sidewalk Labs team designed a lateral system with steel bracing distributed throughout the building to resist lateral movements and forces during seismic events. In the event of an earthquake, the ductile links connecting the steel beams would serve as an energy-dissipating element (often called a "fuse"). As the building rocks left and right, the links are designed to reduce forces and absorb energy. By directing the movement forces through the link connections in a controlled manner, the lateral system would prevent these forces from reaching other parts of the building, where more damage could occur.

In simple terms, the lateral system would help absorb the earthquake without breaking, keeping the building standing. Sidewalk Labs' calculations showed that the Eccentrically Braced Frame would withstand a 1-in-2,500-years earthquake, as required by seismic code.

Beyond the foremost objective of occupant safety, the Eccentrically Braced Frame has other advantages. One is the speed of reoccupation. By concentrating damage in the ductile links and limiting impact on the remaining structure, the Eccentrically Braced Frame for PMX 15 readily enables repair teams to replace these links without tearing down the building—getting people back in their homes or offices faster. A typical concrete lateral system has a higher chance of needing to be demolished after surviving a high seismic event, given the challenges that concrete presents for on-site repair.

Read the article

PMX 15 | Sidewalk Labs
Image credit: Gensler

Manufacturing high-design, low-carbon timber buildings as a more efficient "kit-of-parts"

A mass timber "kit-of-parts"—that could be likened to life-sized Legos—refers to the basic set of building components that can be made in a factory and assembled quickly at a construction site. For PMX, the kit includes three core components made in Sidewalk Labs' factory (floor cassettes, structural beams and columns, and facade panels) paired with other "fit-out" items procured through partners (kitchen pods, bathroom pods, and elevators).

For PMX 15, Sidewalk Labs increased the efficiency of the kit-of-parts in some key ways. The biggest involved the design advances for the floor cassette, which is the primary component that divides floors in a building. To do that, they actually changed the building layout itself. In a typical building, the vertical risers (things like plumbing and electrical ducts) are often housed in residential units, cutting through floor panels in oddly shaped ways. The team moved the risers into corridors so they no longer penetrate unit floors, enabling them to keep the cassettes standard. That left just three types of cassettes for floor geometry (left, right, center) and three more for the roof panels—all of this means more efficiency gains that lead to dramatic savings around project speed and cost.

Additionally, the PMX 15 team made sure the "fit-out" parts of the kit were also designed for efficient shipping, including kitchen and bathroom pods manufactured off-site by partner suppliers. A big challenge with modular kitchens is they often come as boxes, which means you're shipping the empty air in the middle of the box. PMX 15 kitchens were designed with linear modular sections, each two feet wide, that could be combined to create a variety of different setups, including L- and U-shaped kitchens.

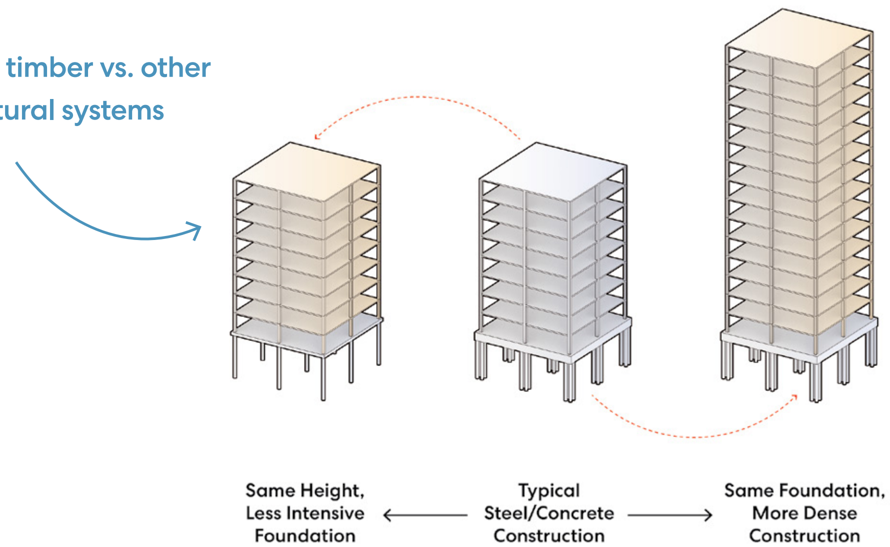
This modularity meant the team could pack numerous kitchen units onto a single truck, with minimal empty space. Combined with the ability to "flat-pack" timber beams, columns, and wall panels inside a standard truck, Sidewalk Labs estimates that PMX 15 would require 85 percent fewer site deliveries than a typical construction approach for a comparable building. This not only makes for faster completion, it also reduces shipping emissions, which brings further environmental savings.

Discover PMX 15 in this research series by Mark Bauernhuber, Lily Huang, and Kristin Slavin, published in May 2021

Comparing Structural Building Systems

In an effort to break down the barriers to wide-scale adoption of mass timber, Perkins&Will's San Francisco studio and its project partners are offering a peek behind the curtain to offer a clear view of the behind-the-scenes decisions, challenges, and lessons learned on a flagship project, 1 De Haro.

Mass timber vs. other structural systems



While steel and concrete may be the more conventional choice for construction worldwide, mass timber is gaining attention as a sustainable alternative with additional benefits from its wellness properties as well as time and cost efficiencies. In recent years, the San Francisco studio of Perkins&Will has been able to apply the firm's mass timber experience to the local market. The 1 De Haro project specifically analyzed mass timber alongside a steel or concrete structural alternative through the schematic design phase.

VIDEO

Lessons Learned

Watch this short film where the 1 De Haro project team discusses the sustainability and constructability of mass timber and what it means for the building industry with the adoption of the 2021 California Building Code.

Watch the video

1 De Haro | Perkins&Will
Image credit: Perkins&Will

Case Study: 1 De Haro, San Francisco, California

As San Francisco's first mixed-use commercial multi-story mass timber building, as well as California's first CLT building, the conditions on the triangular 1 De Haro site had the project team considering wood in early stages. The site is directly adjacent to an underground portion of Mission Creek and the poor soil conditions required deep piles to anchor the building to stronger footings. The ultimate weight of the building would determine the number of piles necessary. At one-fifth of the weight of a comparable concrete or steel structure, mass timber had a clear advantage. For comparison, Perkins&Will carried both concrete and mass timber designs through to the schematic design phase.

The City of San Francisco was supportive of the project's design and materials, but mass timber is still relatively new and 1 De Haro was subject to more restrictions than what is required in the new 2021 generation of building codes. The 1 De Haro project is a hybrid development of combined Production, Distribution and Repair (PDR) uses and office space. A concrete ground floor was necessary for the light industrial PDR use and qualified the development as Type IV heavy timber over a Type IA concrete podium.

As a speculative construction project, mass timber presented additional benefits as well. The wood beams and supports are a more forgiving and flexible framework than concrete or steel. The needs of future tenants are met by coring holes in the wood which can be easily plugged as needs change. Mass timber was also a key selling point as the developer marketed the space. Prospective tenants identified with the building's story of sustainability and light environmental impact.

Read the case study

written by Generate

Boosting Density While Curbing Climate Impacts

A coalition of industry pioneers led by Generate, have developed a digital catalog called Tallhouse—a plug-and-play kit-of-parts that is helping designers streamline and customize carbon-cutting solutions using mass timber.

A Coalition Committed to Curbing Climate Change

In a move that aims to revolutionize the construction industry by bringing down CO_2 emissions while streamlining the construction of cost-effective, urban housing, Generate—an AEC technology company—assembled a coalition of industry leaders (including Buro Happold Engineering, Niles Bolton Associates, Consigli Construction, Code Red Consultants, Olifant Market Development, Urbanica Development and Arup Engineering) to develop Tallhouse: an adaptable catalog of integrated design systems for carbon-conscious, high-density urban housing, focused on the structural use of mass timber.

Tallhouse Catalog Offers Four Structural Options

The four structural options offered by the Tallhouse are: (i) a hybrid steel/ CLT structure, (ii) a mass timber post, beam and plate structure, (iii) a hybrid light-gauge metal/CLT structure, and (iv) a full CLT plate honeycomb structure.

To evaluate each design, the team developed a thorough Carbon Data Analysis tool which validated significant savings in CO_2 emissions associated with building materials ("embodied" emissions). Emissions ranged from 14 percent to 52 percent. By displaying the CO_2 emissions associated with each building component, these systems aim to increase the transparency of different design options, raise carbon awareness, while permitting project stakeholders to adopt innovative materials economically.

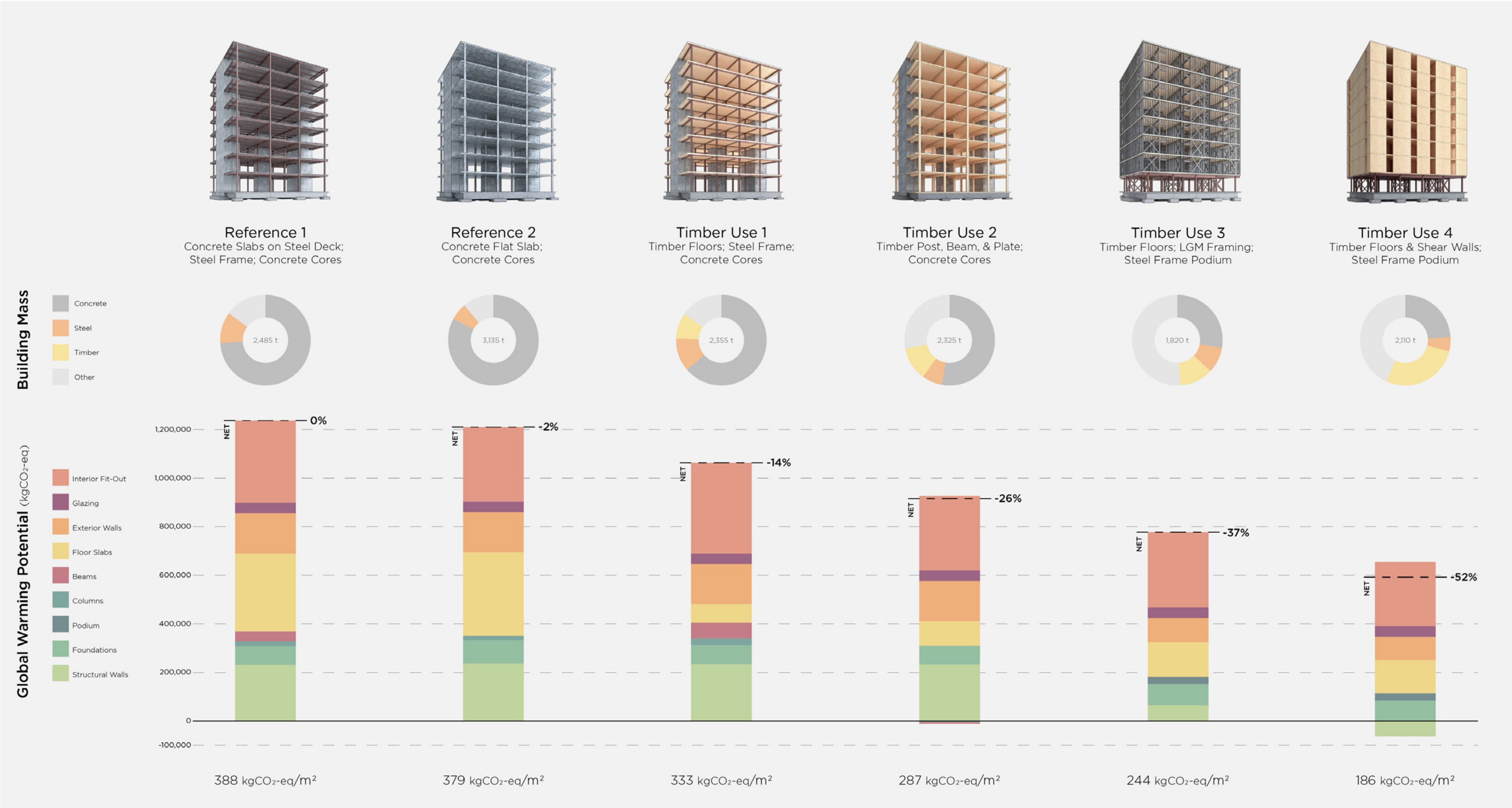
"Already, we are designing individual mass timber projects relying on these digital systems, which are now starting to go up in Boston," says John Klein, CEO of Generate and project leader. "But the Tallhouse catalog was developed with the specific intent of at once enabling our cities to achieve their ambitious CO_2 footprint reduction goals and to meet the growing demand for affordable, biophilic housing. We trust these systems will be widely accessible to architectural communities globally and serve as a vehicle to deploy sustainable materials at scale."

Tallhouse
Image credit: Generate

A Replicable Kit-of-Parts

The Tallhouse mass timber building systems are designed for 8 to 18 stories in accordance with the 2021 International Building Code. The systems are designed as a replicable kit-of-parts that accommodates most U.S., Canadian and European manufacturers' products and transportation logistics. While the majority of the structural systems are standardized, their external bays are adaptable to custom site profiles and can be articulated to meet a vast array of unique architectural designs.

To reduce costs, these structural bays are driven by the use of 5-ply CLT in the floor systems well-suited to rapid assembly. To maximize savings, the four systems were approached from an integrated design standpoint, with a prefabricated panelized exterior wall system, modular bathroom and kitchens and prefabricated mechanical, electrical and plumbing assemblies.



GLOBAL WARMING POTENTIAL & MATERIAL MASS
(PER BUILDING ASSEMBLY)

The total global warming potential (GWP) of each option is shown with a breakdown by building assembly. The Concrete With Steel Frame and Concrete Flat Slab options have the highest GWP, with the bulk of the impact embedded in the floor slabs. The Timber Use 1 (Floor Slabs; Steel Frame) option offers a slight reduction in GWP, with the most of the savings also embedded in the floor slabs. The Timber Use 2 (Post, Beam, and Plate) option offers a relatively typical approach to building with timber, showing savings in floor slabs, beams and columns. Since Timber Use 3 and 4 are cellular approaches with load-bearing walls, these options included steel podiums to accommodate the ground floor program. Timber Use 3 shows how a hybrid approach with light gauge metal yields GWP savings in structural walls and exterior walls, despite the addition of the podium. Lastly, Timber Use 4 emphasizes how a completely cellular CLT timber approach yields impressive reductions in nearly every category.

Tallhouse
Image credit: Generate

A Tool for Policymakers

Each system was carefully designed for manufacturing, relying on data from real products and materials. The Tallhouse catalog will serve to derisk the deployment of sustainable systems, aiding policymakers in the difficult decisions around building materials, through precise and pre-vetted data on different, code-compliant systems.

By replacing or hybridizing conventional construction materials with timber, Tallhouse will help offset carbon emissions. More eco-friendly materials, such as timber, help reduce emissions from the manufacture of materials while storing carbon in the timber structure over the lifetime of buildings.

Momentum for Mass Timber

The Tallhouse team is currently implementing these systems in over one million square feet of construction in the U.S., and looking for more developers interested in adapting these pre-engineered systems. The design images and plan in the team's package reflect early design concepts for the adaptation of an affordable, high-density and biophilic Tallhouse system in Boston. With strong industry support, this work was funded in part by the National Science Foundation, the U.S. Department of Agriculture, the Binational Softwood Lumber Council and the Commonwealth of Massachusetts.

Explore Tallhouse

Tallhouse
Image credit: Generate

Seattle Timber Tower
Image credit: DLR Group

Creating a Modern Office Tower

This 100-page report from DLR Group in collaboration with Fast + Epp, Wood Products Council, Swinterton, Martha Schwartz Partners, Heartland, LLC and Urban Visions, provides an insightful comparison between a mass timber (design case) and cast-in-place post-tension concrete (baseline) as structural framing systems for a 12-story, hypothetical mixed-use office tower in Seattle.

The Seattle Mass Timber Tower structure consists of a logical, restrained response to the building massing and floor plate geometry that also integrates well with architectural requirements, mechanical, electrical and plumbing (MEP) systems, and constructibility considerations. The report's primary goal is to establish the business case for a tall timber building that is efficient, simple, and therefore cost-competitive. The study includes an analysis of system design, structural cost, and constructibility while highlighting the overall challenges and opportunities of tall wood office tower. Fire performance, environmental footprint, and life safety are investigated in the report, along with health and wellness, procurement and labor, risk management and insurance.

A New Design Aesthetic

In North America, mass timber materials and assemblies of engineered wood systems are creating an opportunity to rethink form and function, maybe even to develop an emerging design language. A new design aesthetic can be explored, one that speaks to experimentation, lightness, the beauty of natural, high-performing materials and the grace of authenticity.

The form and massing of the Seattle Mass Timber Tower is a direct response to the proportion of the site parcel, accentuating and juxtaposing soft, curvilinear shapes and culminating, pointed forms. The tower maximizes opportunities for exposed wood surfaces on the interior beams, columns, walls and ceilings, and expresses these components through transparent and translucent expanses of the building envelope. The formal language of interlocking shapes is a subtle reference to the formal timber aesthetic of finger and dovetail joinery.

Standardized Adaptable System Design

The system design for MEP follows a tight rational path to ensure maximum standardization and economies of scale in various applications. This includes a building form that is adaptable to irregular site parcel configurations and/or design aspirations of individualized proportion and formal expression. The curvilinear form of the building is designed to work in concert with structural standardization, economies of manufacture, program requirements and architectural fit.

A Mass Timber Superstructure

The superstructure for the timber building is composed of 5-ply CLT floor plates forming the roof and floors over dropped glulam beams and glulam columns.

One of the best ways to achieve material efficiency with CLT is to use as much of a standard off-the-press panel (which is approximately 10'x40' in the Pacific Northwest) as possible and ensure the layout grid does not depend on the panels being exactly 10'-0" wide, since different suppliers have slightly different overall panel sizes.

Seismic Resistance

A unique aspect of the timber structure is the diaphragm that is used at the roof and elevated floor levels: the 5-ply CLT has plenty of capacity to resist the in-plane forces that will develop due to seismic loading and transfer these forces to the concrete shear walls. A simple plywood spline is employed to connect the panels and achieve the required global seismic behavior.

Fire Protection and Performance

The Seattle Mass Timber Tower falls under the Type IV-B category, so all primary structural elements must meet a 2-hour fire-resistance rating except the roof, which has a 1-hour requirement. To achieve this requirement, a large portion of the ceiling structure is covered with a gypsum board. Timber is left exposed on the bottom portion of the glulam beams, on a strip of CLT floor plate around the building perimeter and throughout the timber framing in the atrium space on all levels.

The timber columns throughout the structure have been designed to resist a 2-hour fire rating. This is achieved by oversizing the timber members to provide what is essentially a sacrificial wood layer that can safely ignite in a fire event, form a char layer, and protect the structural core of the column to maintain life safety and structural integrity in a rare case where the sprinkler system does not activate.

Costs and Savings

The mass timber tower is projected to emit nearly 10 percent fewer greenhouse gases (GHGs) per year than the Project Baseline in operational energy. When it comes to embodied carbon, the mass timber tower is projected to emit nearly 45 percent fewer GHGs in its extraction, processing, transportation and construction of materials when compared to the project baseline of a concrete structure.

The largest chunk of savings for the mass timber option is attributed to reduced fan energy, cooling energy, and lighting energy. Both the project baseline and mass timber design were modelled using Integrated Environmental Solutions (IES) software. Both options use an estimated 7.5 cents/kWh. The mass timber tower will save roughly $27,500 per year in utility costs or $1.4 million in 50 years life of the building, without capturing any escalation in electricity costs.

Overall, the study is a valuable resource for design teams looking to delve deeper into the cost benefits of tall mass timber building solutions. The report includes a rich appendix of practical modelling, construction scheduling and illustrated design examples.

[Read the report]

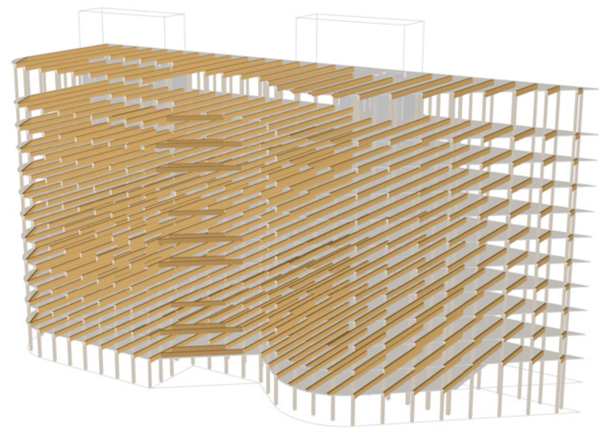


Fig. 41.1 | SMTT | Beams & Columns

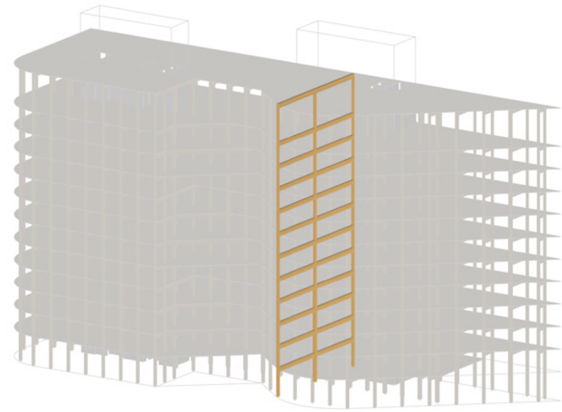


Fig. 41.2 | SMTT | Typical Beam & Column Bay

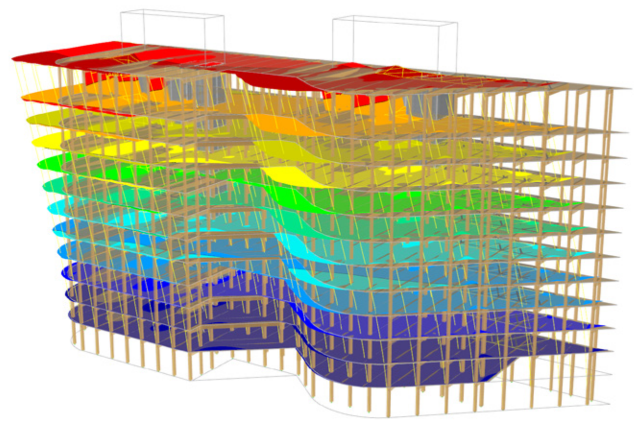


Fig. 41.3 | SMTT | Seismic Loading Lateral Deformation

As the referenced study was completed in 2018, cost, sourcing, performance, and code information has likely evolved and should be considered with a margin of error.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