CASE STUDY

1510 Webster

16 stories of mass timber change the game for affordable housing

When oWOW set out to build a 19-story apartment project in downtown Oakland, their goal as a vertically integrated development, design, and construction firm was unique—to provide affordable housing for what company President Andy Ball calls "the missing middle," households earning between 80 and 120 percent of the area's median income (AMI).

"No one has been building for this group," he said, "and that inspired us to develop an innovative and creative yet affordable housing solution."

While it's a common preconception that mass timber is best suited for projects where the wood can be left exposed, oWOW wanted to challenge that norm.

"Wood is certainly a beautiful, sustainable material, which is important to us," said Ball. "But our real target was speed of construction and cost, and that's why we used mass timber for 1510 Webster. And that's why we were also okay with covering it all up. I think people need to think beyond the beauty of wood and accept the fact that mass timber is just a great building material."

PROJECT DETAILS

1510 Webster

LOCATION:	Oakland, California
STORIES:	19 *(16 stories of mass timber plus a one-story steel penthouse over a two-level concrete podium)*
SIZE:	179,020 square feet
CONSTRUCTION TYPE:	Type IV-A over a Type I-A podium
COMPLETED:	Spring 2024 *(scheduled)*

PROJECT TEAM

DEVELOPER:	oWOW
ARCHITECT:	oWOW Design
STRUCTURAL ENGINEER:	DCI Engineers
GENERAL CONTRACTOR:	oWOW Construction
MASS TIMBER INSTALLER:	Webcor Timber
MASS TIMBER MANUFACTURER:	Freres Engineered Wood
COLUMN CONNECTORS:	Rothoblaas

Connect with the 1510 Webster team at *https://www.woodworksinnovationnetwork.org/projects/1510-webster*

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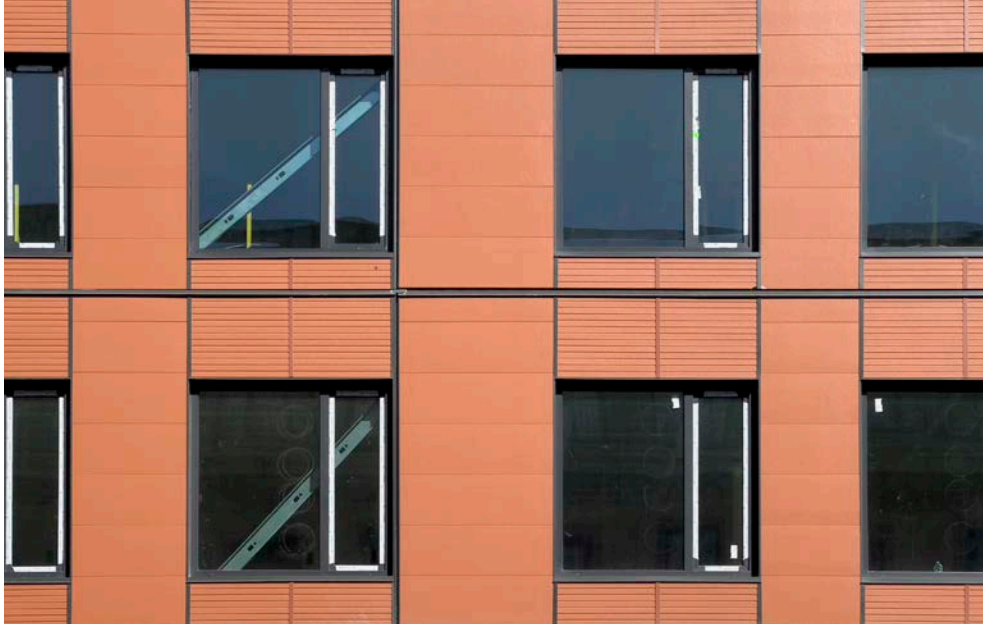

Saving Money, Saving Time

oWOW designed 1510 Webster using veneer-based mass timber products, including mass ply panels (MPP) and mass ply laminate (MPL) columns, in an innovative, point-supported beam configuration. It is the first prescriptive Type IV-A building in the U.S., and the requirements for this construction type meant they had to cover all the wood with three layers of gypsum wallboard. However, the choice to use mass timber still allowed oWOW to realize a $30 million savings in net project cost over that of a traditional concrete project of this scale.

And while they knew the structure would go up more quickly than a similar concrete development, the speed of construction surprised even oWOW. The team poured foundations in February 2023 and the first timber panels were placed in May 2023. All 16 floors of mass timber were installed in less than three months and the structure topped out more than a full month ahead of schedule.

A Different Way to Build

From the outside, 1510 Webster looks like many of the concrete buildings in this downtown neighborhood. The development contains 236 one- and two-bedroom units set over ground-level retail/restaurant and amenity spaces. Located just three blocks from a BART (Bay Area Rapid Transit) station, the building features a public roof deck with a bar offering views across the Bay area; another outdoor amenity area can be found on the eighth floor deck where the building steps back.

Even from the interior, it's hard to tell that 1510 Webster is different since its structural wood system is fully covered by gypsum wallboard. But the project distinguishes itself in several notable ways.

1. The building was fully constructed using veneer-based mass timber materials. Columns, 12.25x15.5 inches, support 5-inch-thick floor panels, 10 feet 10 inches to 11 feet 10 inches wide and 16 to 46 feet long. At 7 inches thick, the roof panels were a bit thicker, designed to support HVAC and other mechanicals. "One of the unique aspects about this product is that the same grade of wood and general layup can yield a panel, a beam, or a column," said Tyler Freres, Vice President of Freres Engineered Wood. "We engineered the mass timber for 1510 Webster specifically for a point-supported structural system, changing direction of the span so the major and minor force directions are equivalent."

2. The unique point-loaded mass timber structure took advantage of the panels' two-way spanning capabilities and eliminated the need for any beams. In addition, by conducting structural testing to verify point loading and deflection capabilities, and by changing from what would have been a typical 10x12 into a 12x15-foot grid, the design team eliminated the need for 47 columns on each of the building's 16 mass timber-framed floors.

3. Mass timber has an excellent strength-to-weight ratio; this helped reduce the weight of the building, reduced foundation requirements, and made the lateral system more efficient. Ball said, "We reduced the weight so much that we were able to eliminate one of the building's concrete cores. We ended up with just one core and one shear wall, which saved more than $2 million."

The oWOW team is quick to point out that not all the project's $30 million savings came from the structure. They also value engineered other systems such as cladding, electrical, mechanical, and plumbing to find savings.

"Structural concrete here runs around $70 per square foot, and this mass timber system ran about $50 a square foot," Ball said. "This includes the gypsum, spline strips, drag plates, and everything else needed to make it an apples-to-apples comparison with concrete. While that savings is significant, we were also able to reduce our cost of the exterior cladding by 32 percent. In the end, including installation, our cost for 1510 Webster was about $400 per square foot."

Investment in Structural Testing Pays Off

oWOW had used Freres' veneer-based panels on another Oakland project, 316 12th Street, but wanted to take full advantage of 1510 Webster's point-supported design. So, they collaborated with DCI Engineers and Freres, and hired an independent lab, Wood Research and Development (WRD), to conduct structural tests. What they learned made a big difference in how the project went together.

The testing ...

- Determined that floor panel thickness could be decreased from 7 inches to 5 inches
- Validated their deflection and vibration design values
- Confirmed punching shear capacity at the point supports
- Allowed them to increase column spacing, which significantly reduced the number of required columns

The testing was a worthwhile investment, said Ball. "It helped us better understand the limits of these panels in our specific configuration. For example, we did punching shear tests to make sure column connections wouldn't break through the floor panels when we moved the columns further apart. Our panel tests exceeded 140,000 pounds before there was a longitudinal flexural failure along the length of the panel. It was called a failure only because it exceeded a deflection of 12 inches. When the pressure was released, the panel returned to its original shape."

> ***"We built 1510 Webster faster and for a lot less money than if we'd used steel or concrete; that's what we wanted to prove. And we did it sustainably."***
>
> **– Andy Ball**
> **President, oWOW**

Construction Speed Surprised Everyone

One of the biggest contributors to the project's success was its speed of construction.

While Webcor had been researching mass timber since 2020, 1510 Webster was the company's first experience setting these veneer-based mass timber panels. Fortunately, as superintendent for both Webcor Timber and Webcor Concrete, Matt Miller brought deep perspectives on how to leverage experience with both.

"Webcor is a one-stop shop—we self-perform both concrete and timber—so we appreciate the importance of 'getting it right' with both materials," said Miller. "The same crews performing concrete work on 1510 Webster were also installing the mass timber panels and columns; there's a surprising amount of overlap in skills needed for each."

Webcor operated with a small and efficient crew composed of union carpenters, laborers, masons, and operating engineers. The concrete core installers worked a few floors above the crews installing the mass timber system, which typically included 60 columns per floor plus panels, drag plates, and panel splines.

Over the three-month period, Webcor's mass timber installation speed improved exponentially. For example, installation of the mass timber system for levels 4 through 8 took four days each; levels 9 through 17 took three days; and the top two levels required just two days to complete. Panel installation itself was a 'just don't blink or you'll miss it' process. Mass timber panels for the lower levels (31 panels per floor) were installed in a single shift; installation on the top floor, which had 23 panels, took just four hours.

In terms of sequencing, Webcor's crews would pour the core and shear walls for a single level, then strip off the forms and jump up to the next level while welders installed the core wall connections. Simultaneously, a level or two below, crews would set the mass timber columns across the entire floor. The columns weighed about 650 pounds each, which is lighter than an equivalent sized steel column but still required the crane. Even so, Miller said all the columns on an entire floor could be set in roughly half a shift. Crews then adjusted the pre-installed connections at the column bases, plumbed the columns, and installed bracing. Once columns were set, the crane would fly in the panels. Crews also worked to add guardrails around the perimeter, install the splines, which were standard metal straps, and connect the drag plates.

Smart Design and Planning Added to Installation Efficiency

Because they were using a point-supported system for the timber structure, connections at the core wall were critically important. "We worked with DCI Engineers and developed a connection to the core wall that allowed for tolerance and

efficiency during installation," Miller said. "We used what was basically an oversized I-beam coming off the embed on the core wall. It had an extra large plate on the bottom that allowed bearing for the timber panels, which were notched to fit. This also served as the connection for the drag plates, giving it dual purpose. Because the connection was oversized, it allowed us to work within the different tolerances of wood versus concrete and helped us keep the panels flat."

In total, the project required 75 truckloads of mass timber. Penetrations for plumbing and electrical were mapped, bolt holes were modeled, and everything was precisely precut in the factory before being shipped. Once the material was delivered to the adjacent laydown yard, crews installed the column connections before the columns were lifted into place.

Webcor worked closely with Freres to develop the delivery sequence. "Our crane operator and three of our crew members would arrive about an hour before our normal starting time, and they would offload the mass timber components," said Miller. "All material arrived stacked in reverse order, so the top panel on the first truck was the last to be installed."

He adds that smart design and close coordination provided valuable efficiencies. "Compared to a concrete structure, we shaved off two days a floor," Miller said. "When you extend that over 16 floors of mass timber, it adds up to a lot of time. We saved over a month just on the installation."

Freres said that 1510 Webster was his firm's largest project to date, but it fell "solidly in our wheelhouse. When we originally looked at the project, oWOW was talking about a 10-day turn per floor, but they got it down to three," he said. "I think we were all surprised at how fast it went together. Because things moved so quickly, and due to uncertainties caused by Bay Area traffic, we had to make some adjustments along the way to make sure we had material on site when it was needed, but we were able to do that. Our experience with 1510 Webster led to some very interesting metrics that Webcor and oWOW can use to prove this approach and apply it to future projects."

Managing Risk

It's always a risk to be first, but Mike Baker, oWOW's Director of Architecture, said they were confident in their decision to be the first to design a Type IV-A project in the U.S. "When we first began working on the project in 2019, we knew the new code was going to be adopted, so it was reassuring to know that this wasn't purely speculative."

Baker said they also worked to lower risk through collaboration. "It's impossible to overstate the value of a robust virtual design and construction process, and the importance of starting that process early, with all stakeholders involved. We also managed our schedule risk by focusing on logistics and by sequencing material deliveries so that we could maximize the value of the tower crane."

Risk mitigation came in other forms as well.

oWOW knew they needed a 19-story building to make the project pencil, but at the time, pricing for a high-rise concrete residential building was over $650 a square foot. “When construction costs get prohibitively expensive, there’s no financial return and financing becomes a challenge; we knew we needed to do something different,” Ball said.

But he also said their decision to use mass timber meant they had to introduce the structural system to those unfamiliar with the material. For example, he sent decision makers at his insurance company 5x8-inch samples of the mass timber panels so they could see and touch it. “I hope that as years go by, people will become more familiar with the fire-resistive properties of mass timber,” Ball said. “I did not hesitate to let them know that if I was going to be in a building that was on fire, I’d want to be in one built with mass timber.”

Audacious Concept, Game-Changing Results

Did 1510 Webster usher in a new standard for high-rise multi-family construction?

“Yes, I think so,” Baker said. “It proved to be a great solution, for this and potentially for a lot of different types of housing projects. The mass timber system was cost effective, and we showed that we can deliver a project more quickly than a normal steel or concrete project. We finished the structure more than four weeks ahead of schedule, which is extraordinary.”

Innovation and a willingness to take risks added to the project’s success. “We’ve shown that mass timber is not just for libraries or offices,” said Freres. “We proved that it is an effective option for budget conscious developers who are looking to create cost-effective housing.”

1510 Webster

Volume of wood products used:
67,435 cubic feet

U.S. and Canadian forests grow this much wood in:
5 minutes

Carbon stored in the wood:
1,706 metric tons of CO_2

Avoided greenhouse gas emissions:
660 metric tons of CO_2

TOTAL POTENTIAL CARBON BENEFIT:
2,367 metric tons of CO_2

EQUIVALENT TO:

500 cars off the road for a year

Energy to operate 250 homes for a year

Source: US EPA

Estimated by the Wood Carbon Calculator for Buildings, based on research by Sarthre, R. and J. O'Connor, 2010, A Synthesis of Research on Wood Products and Greenhouse Gas Impacts, FPInnovations.
Note: CO_2 on this chart refers to CO_2 equivalent.

Reducing Carbon Footprint

The use of wood lowers a building's carbon footprint in two ways. Wood continues to sequester carbon absorbed by the trees while they were growing, keeping it out of the atmosphere for the lifetime of the building—longer if the wood is reclaimed at the end of the building's service life and re-used. Meanwhile, the regenerating forest continues the cycle of carbon absorption. Wood products also require less energy to produce than other building materials, and most of that comes from renewable biomass (e.g., bark and sawdust) instead of fossil fuels. Substituting wood for fossil fuel-intensive materials is a way to avoid greenhouse gas emissions and reduce embodied carbon.

Affordable and Sustainable

Speed of construction and cost effectiveness weren't the only goals. oWOW wanted to provide affordable housing for 'the missing middle,' and they wanted to do so sustainably.

"Location is important; letting people live and walk to where they work reduces vehicle miles and carbon emissions," said Ball. "And when we add value to that by building a structure with a sustainable product like wood, taking steel and concrete out of the equation... it's huge."

Ball added that he's been in this business for 45 years and has worked on a lot of concrete and steel high-rises. "But what I really wanted to do here was to change the game, to do something very different," he said. "We built 1510 Webster faster and for a lot less money than if we'd used steel or concrete; that's what we wanted to prove. And we did it sustainably. I think once people look beyond the beauty of wood and start to recognize the practical value of mass timber as a product, we're going to see a lot more buildings like this."

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