Mass timber brings market distinction to Class A office
Businesses in Tempe, Arizona now have a very different choice when it comes to Class A office space. Located on a prime site near Arizona State University, The Beam on Farmer is both strikingly beautiful and highly functional. As the first mass timber office building in the state, The Beam offers a distinctive interior with exposed glue-laminated timber (glulam) beams and columns and cross-laminated timber (CLT) panels. Large, efficient floor plates, a spacious 36x30-foot column grid, and 13-foot floor-to-exposed wood ceilings give future tenants maximum flexibility for buildout, along with an enticing aesthetic for those wanting to promote a return to the office.
Healthy Building, Happy Tenants

Built using renewable, sustainable materials, The Beam also differentiates itself by offering a clean, healthy work environment. Designed to meet requirements of the WELL building standard and LEED, the building also meets criteria for The 9 Foundations of Healthy Building from the Harvard T.H. Chan School of Public Health.

In a publication from Mortenson called Healthy Building, Happy Workforce, The Beam joins the discussion on Healthy Workplaces. The Beam is designed to meet the WELL building standard and LEED, while being a healthy work environment.

The biophilic benefits of building with wood are key contributors to The Beam’s healthy building, and it also incorporates a unique underfloor air distribution (UFAD) system, which improves ventilation, air quality, and energy efficiency. The system hides ductwork and mechanical units by housing them under a raised floor, keeping visual focus on the wood structure and protecting the tenant’s view of architectural artifacts. The UFAD system was new to both us and Mortenson, but we quickly learned it provided several benefits, especially with these big beams,” said Mike Duffy, Associate Principal at RSP Architects. “We’re seeing a higher demand for healthy buildings, so we’ve been exploring options to help clients figure out what’s best for them. This system was the perfect solution.”

The Beam on Farmer

LOCATION: Tempe, Arizona
STORIES: Five stories
SIZE: 184,163 square feet
CONSTRUCTION TYPE: IV-HT
COMPLETED: 2022

PROJECT DETAILS

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OWNER DEVELOPER:
Mortenson, PGIM Real Estate, Urban Development Partners
ARCHITECT:
RSP Architects
STRUCTURAL ENGINEER:
PK Associates Structural Engineers (Engineer of Record)
Robbins Engineering Consultants (Timber structure)
GENERAL CONTRACTOR:
Mortenson
MASS TIMBER PRODUCER/SUPPLIER:
Binderholz (CLT, glulam beams and columns)
MASS TIMBER TRADE PARTNER:
Holzpak (Design assistance, steel connections)
MASS TIMBER INSTALLER:
Lonsdale/Mortenson
UNDERFLOOR AIR SYSTEM:
Global IFS
"The Beam on Farmer takes full advantage of its mass timber elements," said Antonio Guariento, Principal, Holzpak. "When walking in, you immediately get the sense of a solid massive structure made of natural materials—it’s so unique to the area. The clean look and tight-fit connections add to the simple beauty of the building. Office buildings are a good typology for mass timber because people spend so much of their day inside, and this natural environment will certainly benefit the people who work here."

**Deciding to Pursue Mass Timber**

Mortenson was curious about the potential of the mass timber market, but they had no experience with the materials. So, in 2018, they formed eight people, including Michael Manos, Senior Superintendent, with the job of researching wood building options for the company. The group turned to WoodWorks, attending meetings, training sessions, and building tours. "This is where our relationship started," said Manos, "and WoodWorks has continued to be a valuable resource. It’s been a nice partnership."

A little more than a year later, Mortenson decided mass timber was a good fit for The Beam on Farmer and chose to work with Binderholz and Holzpak. "They provided both design assistance and fabrication for a full turnkey wood system—which was important, since mass timber was new to us," added Manos.

**New York-based Holzpak provided the initial layout and design assistance for the mass timber, which was produced by Binderholz in Austria.** Holzpak’s design team worked with Binderholz’s Holzbau Engineering to translate the differences in design requirements between the European code and American Wood Council’s National Design Specification® (NDS®) for Wood Construction. This step was also important since the project was designed and engineered both in metric and inches.

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**Deep Beams Had a Story**

The Beam on Farmer was a unique development for Mortenson in that there was a previously entitled project already planned for the property. "The city of Tempe has a lengthy, in-depth development approval process, so in order to build this project on a timetable that made sense for Mortenson, we decided to follow the existing entitlements," explained Chase Gibbs, Project Executive for Mortenson. "This meant we could go up 98 feet in height, but we could only have five stories."

Knowing that the extra allowable building height gave them flexibility, they considered multiple grid options and determined that, if they doubled up the glulam girders, they could achieve a 30x36 grid. By using double girders, they could meet the longer spans with shallower beams, which preserved the building’s interior clear heights and added to its spaciousness.

Efficient resource use was also important, not only for sustainability and efficiency, but also for cost, so Holzpak helped Mortenson analyze the overall volume of wood. "Interestingly, Holzpak calculated that if we had made the beams shallower with a tighter grid, we’d have ended up with more wood volumetrically than the solution we landed on," Gibbs said. "When you see these huge beams, it seems counterintuitive, but the configuration allowed us to use less wood overall."

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**Solid Yet Spacious**

Aptly named, The Beam on Farmer features a glulam post-and-beam frame with G12 floor and roof panels, all glulam. The structure relies on double girders, each 41 inches deep and 36 inches wide, along with 10-inch deep gluelam purlins. The spacious, 36x30 column grid maximizes tenant flexibility and allows 8 percent more people per square foot than typical, which Mortenson says translates to gross rent savings of over $240 per tenant. The deep beams also enable less visually distracting mechanical systems, as the upper floor is pure office, very open, with the warm tones of the wood highlighting the beautiful ceiling pattern created by the beams.

Binderholz manufactured 194 glulam columns, 1,170 glulam beams, and 893 CLT panels for the structure. Custom steel connectors, designed and sourced by Holzpak, were pre-mounted to the tops of columns and ends of glulam beams to allow for quick installation on site. "We were deeply involved in designing and managing the manufacturing and supply of these components," Guariento said. "We fabricated a mockup and collaborated closely with Binderholz to ensure the connections fit perfectly. We saw our client in pre-enclosed connectors because they bring so many benefits in terms of efficient installation."

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Extensive Design Collaboration
PK Associates engineered the building’s lateral system, and Robbins Engineering and Holzpak worked together to design the diaphragm connections to the lateral elements. With three stairwells, three elevators, a bathroom core and three corner balconies, the design team decided to use concrete masonry unit (CMU) walls for the vertical elements of the lateral force-resisting system, which allowed the cores to be constructed while the timber was being fabricated.

“We used a steel tie plate on top of the CLT panels to transfer the lateral load to the shear walls,” said Roger Yin, Project Engineer with Robbins. “We also used a screwed-in wood structural panel spline connection between CLT panels, but we relied on the tie plates, especially at the columns, to continue the force transfer.”

Because of the building’s height, the CMU block walls had a lot of rebar, which created challenges when connecting the mass timber structure to the core, said Todd Robbins, Principal at Robbins Engineering. “We ran into a few problems when the field crews installing the anchors hit rebar, which meant they had to adjust the plates to get the anchors to fit properly.”

To meet the challenge, Robbins’ team used finite element analysis software. “The software allowed us to evaluate capacity and adjust individual anchors if they needed to be moved or if bolt depth needed to be modified,” Yin said. “And we could evaluate those in real time; when an issue arose during construction, we could resolve it immediately.”

Another challenge came in balancing U.S. design standards with European criteria. “Both have different philosophies, material grading and measurement systems,” said Yin. “We evaluated vibration and deflection based on the U.S. standard, but we also used the European design criteria, making extensive use of NDS Evaluation Reports from Binderholz. The Eurocode was a little different design, which is in line with the U.S. load and resistance factor design. But like most U.S. engineers, we perform all our design calculations in accordance with the U.S. code, including the American Society of Civil Engineers (ASCE) 7 and NDS 2018. So, we evaluated all the inputs, not only for engineering safety purposes, but also because Arizona building officials worked with our design calculations, including the design of seismic elements.”

Sustainability Benefits Add Up
Efficient construction added to The Beam on Farmer’s sustainability. “There’s so much more to sustainability beyond the products used,” said Gibbs. “There was literally no waste on the jobsite, and a crew of just eight—six in the building and two unloading trucks—constructed the entire wood portion of the structure. In addition to speed, a smaller crew allowed us to work more safely.”

Demonstrating the efficiency of mass timber construction, wood members were delivered to the jobsite in the order of sequence, with each component labeled and numbered. A truck pulled into position, and the timber was picked off the truck with a crane and set into place. Holzpak included installation instructions for every beam, column and panel, which helped the process go smoothly. Ermanno Acler, Timber Structural Engineer for Holzpak, said, “We know that project success is dependent on how well organized we are with the installation sequence.” Crews constructed the entire wood system in four months.

That’s not to say the project was without challenges. Some of the mass timber shipments came through Los Angeles and were delayed due to truck driver shortages caused by the pandemic. The design team also had to take extra care in converting allowable European stress values to U.S. values. The U.S. code, Canadian code and Eurocode all have different starting points for their modification factors, calculations. “We still needed to do the calculations, so we didn’t just use a simple conversion. We also ran into some challenges when rounding measurements from inches to metric using Revit. But once we’ve done it once, the next time will be much easier,” Acler, who provided design assistance from Italy, agreed.

Acler, who provided design assistance from Italy, agreed, “Whenever an issue came up, we called for an immediate Teams meeting—we called it the Situation Room. It was a very collaborative process.”
Reducing Carbon Footprint

The use of wood lowers a building’s carbon footprint in two ways. Wood continues to store 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.

**Volume of wood products used:**
158,915 cubic feet

**U.S. & Canadian forests grow this much wood in:**
12 minutes

**Carbon stored in the wood:**
3,982 metric tons of CO₂

**Avoided greenhouse gas emissions:**
1,541 metric tons of CO₂

**TOTAL POTENTIAL CARBON BENEFIT:**
5,523 metric tons of CO₂

**EQUIVALENT TO:**
1,168 cars off the road for a year

**Energy to operate 893 homes for a year**

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**1,168 cars off the road for a year**

*Source: US EPA*


Note: CO₂ on this chart refers to CO₂ equivalent.