CASE STUDY

The Beam on Farmer

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 a Healthy Building*[1] from the Harvard T.H. Chan School of Public Health.

The biophilic benefits of building with wood are key contributors to The Beam's healthy building appeal, outlined in a publication from Mortenson called *Healthy Building, Happy Workforce: Redefining the Built Environment at The Beam.*[2] Besides offering natural lighting, views, and improved ventilation, The Beam distinguishes itself with its warm timber interior. Biophilic design is associated with positive outcomes in humans, including stress reduction and higher productivity, and has been used to boost occupant well-being by using natural elements to create a clear connection with nature.[3]

The Beam 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 timber's clean architectural aesthetic.

"The UFAD system was new to both us and Mortensen, 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."

PROJECT DETAILS

The Beam on Farmer

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

PROJECT TEAM

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

Connect with The Beam on Farmer's project team at https://www.woodworksinnovationnetwork.org/projects/the-beam-on-farmer

WOODWORKS INNOVATION NETWORK.ORG

“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 tasked eight people, including Micheal 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 did the fabrication and shop drawings, and worked with Arkansas-based Robbins 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.

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 entitlement restrictions,” 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.”

Solid Yet Spacious

Aptly named, The Beam on Farmer features a glulam post-and-beam frame with CLT floor and roof panels, all 5-ply. The structure relies on double girders, each 41 inches deep and 10-1/4 inches wide, along with 36-inch-deep glulam purlins. The spacious 36x30 column grid maximizes tenant flexibility and allows 8 percent more people per square foot than typical, which Mortenson says transfers to gross rent savings. “It’s a very productive floor plate,” said Gibbs. “The deep beams, spacious column grid, and lack of visually distracting mechanical systems give the space an open, airy quality, while the warmth of the wood highlights 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 connectors,” Guariento said. “We fabricated a mockup and collaborated closely with Binderholz to make sure the connectors fit precisely. We see a lot of interest in pre-mounted connectors because they bring so many benefits in terms of efficient installation.”

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 steel 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 European code uses a limit state design, which is similar to the U.S. load and resistance factor design. But, like most U.S. engineers, we perform allowable stress design for wood members per PRG 320[4] and NDS 2018.[5] So, we evaluated all the elements, not only for engineering safety purposes, but also because Arizona building officials wanted all our design calculations, including fire design of wood members."

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 European code all have different starting points for their modification factors," said Robbins. "We still needed to do the calculations, so it wasn't just a simple conversion. We also ran into some challenges when rounding measurements from inches to metric using Revit. But now that we've done it once, the next time will be much easier."

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

Distinct Differentiation

The first CLT building in Arizona; spacious interiors; stunning beams; sustainable, health-focused design… there's a lot that sets The Beam on Farmer apart from other office space.

"This is a speculative office building, and there are millions of square feet of spec office space in the Phoenix and Tempe area," said Gibbs. "That's why it was important for us to differentiate ourselves. When tenants walk into this building, they get that 'wow' factor. The Beam is a space people want to work in, a reason for them to come into the office."

Duffy agreed, adding, "This is the type of space people gravitate towards; it's something that gives them more than just a desk, a computer screen, and a place to sit down. Many of us learned we can get that when working from home. But a unique workplace like The Beam on Farmer will give people a different energy than working from their spare bedroom."

The health and sustainability benefits of The Beam on Farmer have also contributed to its success as a coveted workplace address. Manos said that Mortenson is used to having customers concerned about schedule and money. "But now, they're telling us they're focused on how healthy a building is, and how it was built."

All agreed that the focus on healthy, sustainable buildings is something they expect to continue. "It's challenging us to think differently about how we build," added Gibbs.

[1] Harvard T.H. Chan School of Public Health. (2017). *The 9 Foundations of a Healthy Building.*

[2] Mortenson. *Healthy Building, Happy Workforce.*

[3] Think Wood. WoodWorks. (2021). *Biophilic Design LookBook.*

[4] American National Standards Institute (ANSI). (2019). ANSI/APA PRG-320: Standard for Performance-Rated Cross-Laminated Timber.

[5] American Wood Council (AWC). (2018). 2018 National Design Specification® (NDS®) for Wood Construction.

The Beam on Farmer

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 CO_2

Avoided greenhouse gas emissions:
1,541 metric tons of CO_2

TOTAL POTENTIAL CARBON BENEFIT:
5,523 metric tons of CO_2

EQUIVALENT TO:

1,168 cars off the road for a year

Energy to operate 583 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 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.

Funding provided in part by the Softwood Lumber Board
WoodWorks is an equal opportunity provider.