CASE STUDY

EGGER Wood Products

Wood manufacturer uses mass timber for innovative industrial plant

When a global manufacturer of wood products expands their production capacity to the U.S., it's natural that they might want to use or highlight wood somewhere in their new facility. Traditionally, industrial buildings have been built with steel and concrete, as was the case with the rest of this 825,000-square-foot manufacturing plant in North Carolina. But EGGER Wood Products chose a unique mass timber system designed for long spans and heavy loads to construct a portion of their new particleboard production facility, a building they call the centerpiece of the plant.

A family-owned, Austria-based business, EGGER's choice to use mass timber reflects their dedication to the wood industry and confirms their commitment to innovative plant design. "Although mass timber is not yet commonly used for industrial construction in the U.S., we wanted to make a strong statement to the market by using wood to build our facility," said Christian Kasper, Construction Project Manager for the EGGER Group.

Construction of the new plant, EGGER's twentieth globally and their first in the U.S., began in late 2018. Installation of the mass timber system took just three weeks and EGGER began producing panels in the facility less than two years later.

Mass timber was used to form a portion of the roof structure for the particleboard production building, a key component in phase one of EGGER's three-phase construction project. The building stands out because it houses the company's continuous press, which has the capacity to produce approximately 23 million cubic feet (650,000 cubic meters) of particleboard annually.

The production building itself is about 201,000 square feet; the mass timber system was used for the section where the continuous press is housed, about one-third of the building's total footprint.

Limitless Possibilities

EGGER and their design team chose a unique mass timber system from HESS TIMBER, a member of the HASSLACHER Group. The system uses glue-laminated timber (glulam) beams, which are prefabricated in Austria into easy-to-ship lengths. The beams are manufactured with a special end-joint system that can be field-spliced and glued together onsite under HESS's supervision to create members with the long spans needed for industrial applications such as EGGER's.

Ease of shipping was an important consideration for the huge beams, the largest of which were about 10 inches wide and 7 feet tall. Once they were field-spliced and glued at the jobsite, the girders were lifted into place and set 19 feet 8-¼ inches (6 meters) on center; they had a clear span of about 100 feet.

Jeff Barrett, Principal of Professional Engineering Associates (PEA) said, "The ability to splice together sections of the glulam beams to form long spans gave us the versatility we needed in terms of production, transport, and logistics. Once the individual members are connected and installed, it is nearly impossible to see the location of the splices."

Each of the 36 girders was manufactured in five pieces (three beam portions and two tension wedges), then packed in containers for shipment. This reduced transport costs and risk of damage, both in transit and once they arrived at the jobsite.

PROJECT DETAILS

EGGER Wood Products Particleboard Production Building

LOCATION: Lexington, North Carolina

STORIES: One story

SIZE: 67,000 square feet *(Mass timber portion)*

CONSTRUCTION TYPE: Type II-B, III-B *(Mass timber portion)*

COMPLETED: 2020

PROJECT TEAM

OWNER: EGGER Wood Products LLC

DESIGN LEAD: Professional Engineering Associates, Inc.

ARCHITECT: LS3P Architects / AGD

STRUCTURAL ENGINEER: Professional Engineering Associates, Inc.

CONTRACTOR: Gray

MASS TIMBER SUPPLIER: HESS TIMBER GmbH, a member of the HASSLACHER Group

Connect with the project team at *https://www.woodworksinnovationnetwork.org/projects/egger-production-hall*

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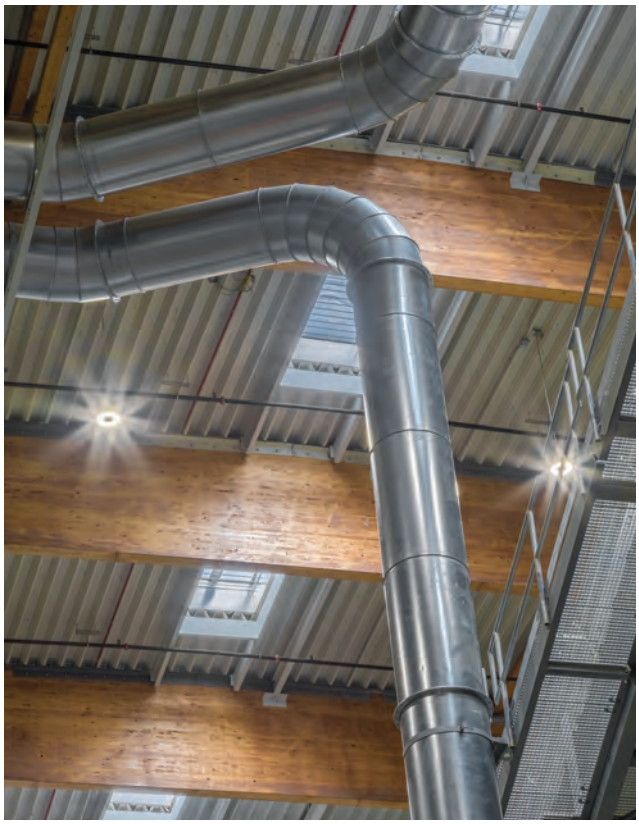
Use of the unique glulam product came with challenges, but PEA's experience designing manufacturing facilities, specifically wood-related production facilities, proved helpful. "This mass timber product and the specific technology of the HESS system were new to all of us," said Barrett. "We found it even more important to spend time confirming interfaces between the trades, as compared with traditional steel and concrete construction materials."

Mass Timber: A Fire-Safe Building Choice

Fire protection is a concern for any industrial building. EGGER's production facility was classified as Factory Industrial Group F-1, which still allowed the use of mass timber because the glulam beams provided natural fire resistance. "Wood burns at a certain speed from the outside, while the rest of the cross-section stays fully intact," said Kasper. "This means we can calculate the duration until a wood roof structure fails in case of a fire. On the other hand, when a steel structure reaches a certain temperature, it fails immediately. Also, a glulam beam does not provide any horizontal surface for dust to collect, which further reduces our fire hazard."

Barrett added, "With large manufacturing clients, fire protection requirements dictated by a facility's owner or insurance carrier are commonly in excess of what the U.S. building code requires. As a result, the building material, fire suppression systems, and enhanced firewall layouts all come into play during the design phase to ensure both life safety of personnel, and protection of the owner's assets housed in the facility."



Aesthetics also played a major role in EGGER's decision to choose mass timber. "Certainly, the visual element of the glulam beams aligned with our company as a wood products manufacturer," Kasper added. "The wood structure provides a more appealing work environment for our employees, which is important to us."

EGGER did an initial cost comparison evaluating various construction types. They found that the cost for the mass timber option was only 8 percent higher than the steel construction type used for the rest of their buildings at the plant. Mass timber's other benefits—including aesthetics, speedy installation, and long-span capabilities—helped balance the equation.

Industrial Building Design Challenges

With a project of this size and complexity, Barrett said the structural engineering challenges associated with each design discipline were unquestionably unique. He cited four:

1. As is typical with industrial buildings, coordination of the design and installation of mechanical and process piping was paramount. They paid particularly close attention to the timber element spacing to make sure all mechanical systems fit efficiently.

2. Fire resistance considerations and the introduction of fire partitions and maximum foreseeable loss (MFL) firewalls added complexity related to both code compliance and insurance mandates.

3. The aspect ratio of this building, coupled with the combination of a deep metal deck with timber framing, required specialized modeling to analyze the diaphragm systems.

4. Equipment foundations are sensitive to movement. While this didn't directly impact the mass timber roof structure, this consideration required extensive overall structural modeling and detailing to ensure the facility and equipment function as expected.

Design of the mass timber portion of the roof was fairly straightforward. Each of the glulam girders bears directly on top of a precast concrete column, with the exterior precast wall panel bypassing the exterior face of the column to form the parapet. The tops of the columns were notched, and each notch holds the full depth of a glulam beam. Holes in the columns allowed easy through-bolt connections for the glulam.

The design team explored the use of cross-laminated timber (CLT) for the decking but ended up choosing a deep metal roof deck because they thought it would be more appropriate for the 19-foot 8-¼-inch spans. However, Barrett said they found designing the deep steel roof deck as a diaphragm to be challenging. The European supplier did not have published data that met the diaphragm design requirements of the U.S. building code. There was also limited U.S. design guidance for connecting a metal deck to a timber member, especially under these spans.

EGGER Wood Products Particleboard Production Building

Volume of wood products used:
15,927 cubic feet

U.S. and Canadian forests grow this much wood in:
1 minute

Carbon stored in the wood:
396 metric tons of CO_2

Avoided greenhouse gas emissions:
153 metric tons of CO_2

TOTAL POTENTIAL CARBON BENEFIT:
549 metric tons of CO_2

EQUIVALENT TO:

116 cars off the road for a year

Energy to operate 58 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.

"It's worth noting," said Barrett, "that a traditional CLT or panelized light-frame wood deck may have resolved some of these design considerations. As a result, these types of wood alternatives may be a more attractive option in the future."

Often a consideration for industrial buildings, the design team evaluated vibration, but it was not of particular concern for the mass timber roof system, since this production area has no manufacturing equipment hanging from the structure; it has only process and fire protection piping and a suspended equipment access platform.

Construction itself went smoothly, despite challenges caused by COVID and hurricane delays, and Gray was able to complete the project on schedule. The facility was recognized by *Engineering News-Record* as the Southeast region's Best Project in the manufacturing category; it was also honored for Excellence in Safety.

"EGGER is a fantastic company, and this project is a prime example of the excellence that can be produced through an effective partnership," says Brett Goode, Executive Vice President at Gray. "We are proud to be a part of this great facility that will continue to produce quality products for decades to come."

Forward-thinking Industrial Design

All involved agreed that, with careful consideration, mass timber can be integrated into industrial buildings and provide considerable benefits.

"The primary lesson I learned from the EGGER project was to be mindful and avoid approaching every industrial project with the same engineering solution," Barrett said. "I've spent the bulk of my career in design management and structural engineering of industrial and manufacturing projects. Unfortunately, people often tend to use the same old approach because the industrial facility is needed fast or as cheaply as possible. But this project proved that, with a forward-thinking client like EGGER, alternative and sustainable design approaches are possible, even in the industrial construction world. Moreover, when done correctly, these approaches can provide long-term efficiencies, energy savings, and quantifiable returns to the owner for years to come."

From EGGER's point of view, their use of mass timber to build an industrial building benefitted employees and the industry overall. "We consciously used mass timber beams for the supporting structure of the press building, which is the centerpiece of our plant," Kasper said. "This not only enabled us to bring a piece of timber construction tradition from our home in Europe to the U.S., but also, as a manufacturer of wood-based materials, let us send a clear signal of our commitment to wood as a valuable material."

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