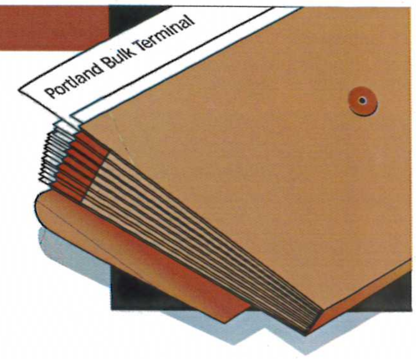
CASE STUDY



Mineral Storage Facility is One of Oregon's Largest Wood Buildings

Project Summary

PROJECT
Portland Bulk Terminal, LLC

LOCATION
Portland, Oregon

OWNER
Hall-Buck Marine, Inc.

STRUCTURAL ENGINEER
Smith, Monroe and Gray, Engineers, Inc.

GENERAL CONTRACTOR
Spantec Constructors

ROOF DESIGNER/ERECTOR
Western Wood Structures, Inc.

BUILDING SIZE
236,000 square feet

GLULAM MANUFACTURERS
Willamette Industries, Inc.
American Laminators, Inc.

COMPLETED
Fall, 1997

As the trains carrying potash from Canada roll to a stop near the colossal mineral export terminal in Portland, Oregon, the size and complexity of the building become evident. The glued laminated timber (glulam) arches, now sheathed in plywood and green shingles, rise majestically, nestled between train tracks and the banks of the Willamette River. The impressive facility is 160 feet wide and 1,475 feet long, with a floor area of 236,000 square feet, making it one of the largest wood-framed buildings in Oregon.

The mineral export terminal, located at the Port of Portland, is leased by a Canadian-American joint venture that is 90 percent owned by a consortium of Canadian mining companies, and will store potash destined for export across the Pacific. Potash is a highly corrosive salt-like fertilizer ingredient, which poses a storage challenge for any exposed structural framing. Steel, for example, requires a three-step epoxy paint process to make it suitable to withstand the effects of exposure to the corrosive potash. Stainless steel could have been used, but it is an expensive option and often requires long lead times for procurement.

Engineered wood, which is readily available, and can be exposed to such corrosive environments without special treatments, was a natural choice. Glulam beams, wood structural panel sheathing, and other APA trademarked engineered wood products are frequently used in applications where resistance to corrosive materials is required.

Steve Turner, President of Western Wood Structures of Tualatin, Oregon, the firm responsible for the design and erection of the structural wood building, noted that using engineered wood helped control costs because it didn't require special treating.

"We used epoxy coated steel purlin hangers in the building, and those alone cost around $50,000, so you can imagine the cost of an entire building in epoxy coated or stainless steel," said Turner.

The 236,000 square foot potash storage building in Portland, Oregon features APA EWS glulam arches in its design.

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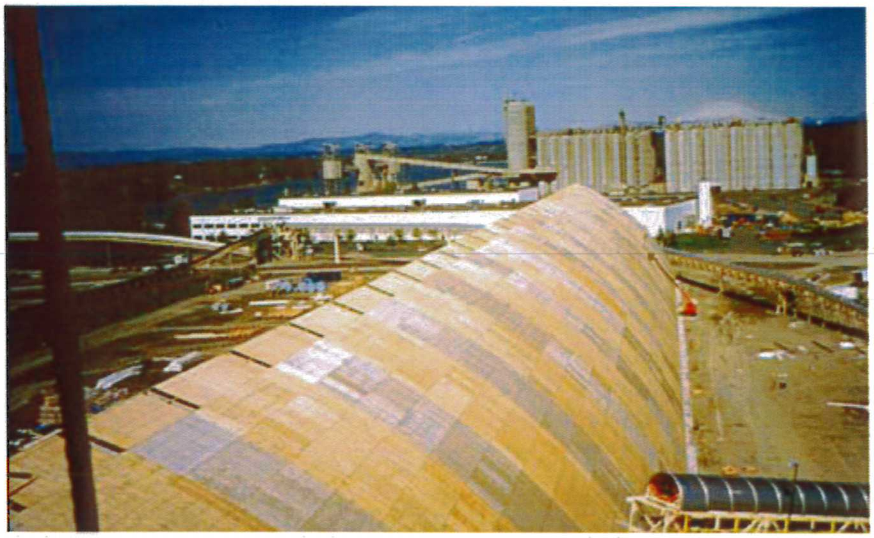
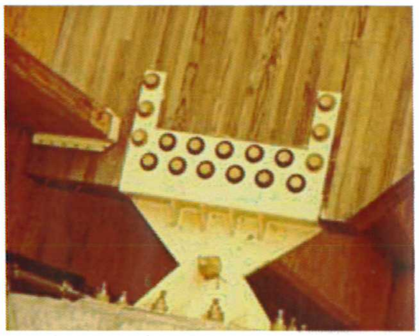


Nearly 350,000 board feet of 1-1/8" tongue-and-groove APA plywood sheathing was used in the project.



Epoxy-coated steel connection at concrete base.

The building owes much of its flare to the stately glulam arches. The average size of the 100 arch members, which were spaced 32 feet on center, was 8-3/4 inches by 55-1/2 inches in cross-section, by 115 feet in length. With these dimensions it is easy to see why it took over 750,000 board feet of glulam arches to erect this building. All of the glulam members are Douglas-fir.

The arch segments were manufactured by Willamette Industries, Inc. in accordance with *APA EWS* lay-up combination 24F-V8 and were trademarked under the provisions of Engineered Wood Systems (EWS), a related corporation of *APA – The Engineered Wood Association.*

Eight-foot-high cast-in-place concrete walls and slabs were used as the base for the pinned connection system of the glulam arches. Concrete was chosen because it also is not affected by the corrosive potash that will be stored against it.

A three-inch-diameter steel pin connection was used at the base of the arches to connect them to the supporting concrete substructure. Each connection resists 55,000 to 65,000 pounds of force.

Each arch was pinned at the top and bottom creating a three-hinged arch structure. The arches were also braced by diagonal knee bracing used to keep the members from rotating. Glulam purlins, spaced 48" on center, span between the arches and support the 1-1/8" tongue-and-groove APA trademarked plywood sheathing. The glulam purlins were manufactured as a 24F-V4 lay-up by American Laminators, Inc., another EWS member. The roof system meets the design criteria for Type IV heavy timber construction.

Cranes were used to set the mammoth arches. Workers installed the pinned end connections at the top and at each support as they were lifted. The crew working for Western Wood Structures never exceeded twenty.

Not only is the building 236,000 square feet in floor area, about the size of 5 football fields, but with the arched glulams, it is a towering 85 feet tall, with capacity to hold 100,000 metric tons of potash. Potash is stored in large piles that fill nearly the entire building with equipment used to move the potash taking up the remaining space. A two-part conveyor system is used to transport potash from one place to another, one part suspended at the peak of the arches, and another below at ground level. The red, rock-salt sized material is taken from the trains onto a 6-foot-wide conveyor belt which transfers the material to the top of the building where it is dropped into the various piles for storage. The ground level conveyor belt takes the potash from the piles down to barges on the nearby loading dock. Accommodating specialized transport equipment is one of the reasons the building was designed with such tall dimensions.

One end wall in the building was panelized using 4 x 8 ft. cement-impregnated plywood panels. The wall was pre-assembled in 25 x 50 ft. sections, lifted into place, and mechanically fastened to the arch structure. This type of panelization makes it quick and easy to take down and reuse the endwall, as future needs dictate. In fact, even before the erection of the main building was completed, expansion of an additional 500 lineal feet was already considered. This expansion would make the building almost 2,000 feet in length.

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