# Chambers Covered Railroad Bridge Salvage and Rehabilitation

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Greg has more than 27 years of civil/structural design and project management experience, and since 1989 has had the distinctive experience of being the designer and/or project manager on rehabilitation and repair projects for 32 of Oregon's 50 covered bridges.

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Inspired by the graceful bridges on the Oregon Coast, Tony became an engineer after building custom furniture for 15 years. He's been engaged in structural design for 20 years, and has been lead design engineer on 18 covered bridge rehabilitation projects.

## Summary

The Chambers Covered Bridge was built in 1925 and is the last remaining covered railroad bridge in Oregon, possibly the only one west of the Mississippi. Therefore, its rehabilitation was critical to historic preservation efforts of the country's remaining covered rail bridges. Before rehabilitation, the 27.4 m (90-foot) long timber structure was in danger of collapse after decades of neglect. In 2010 a windstorm threatened to destroy the bridge. This unique, single-span, four-leaf Howe truss structure was dismantled and rebuilt using almost all the original iron and hardware, and 25 percent of the original timber. The bridge was reconstructed on dry ground and launched onto the existing concrete piers. The rehabilitated Chambers Covered Bridge now serves as a landmark pedestrian and bicycle crossing that provides safe access across the Coast Fork of the Willamette River. Locomotive-inspired artwork within and around the structure evoke the bridge's history.

**Keywords:** Howe Truss, railroad, covered bridge, rehabilitation, new use, pedestrian bridge

## 1. Introduction

### 1.1 Historical Background and Context

J.H. Chambers built the Chambers Covered Bridge as part of the development of his new sawmill in Cottage Grove, Oregon, in 1925. The bridge carried a railroad spur from timber land west of the city to the Chambers mill. In August 1942 the sawmill burned to the ground, and J.H. Chambers passed away before he could finish rebuilding it. His son sold the mill to Warren Daugherty, who reorganized it under the name Lorane Valley Lumber Company. Six years later, the mill burned down again, and Daugherty sold the railroad line to a scrap firm in Seattle, at which time the tracks were removed. No maintenance was performed after 1951, and the bridge


*Fig. 1 J.H. Chambers Sawmill, ca. 1928*

*Fig. 2 Bridge, 1975*

remained abandoned at the edge of the old mill site, suffering the ravages of neglect, weather, and vandalism.

The City of Cottage Grove obtained ownership of the bridge in 2006 and hired OBEC Consulting Engineers (OBEC) to inspect, inventory, and document the structure; and to assist in the grant application process. Funding was obtained in 2009, and OBEC was hired to design and oversee the rehabilitation into a pedestrian and bicycle bridge. Then, after sixty years of unchecked deterioration and with the design process underway, a strong wind during a winter storm in early 2010 brought the Chambers Covered Bridge to near collapse. This made it even more crucial to quickly execute the safe emergency removal of the derelict structure. Before disassembly began, a model was produced from a laser scan as final documentation.

### 1.2 Design

A variety of alignment and structure type alternatives for the bridge approaches were explored, as well as options for lighting and interpretive displays. Structural modeling was done with finite element analysis to optimize the design of the approaches and to establish the actual capacity of the rehabilitated timber truss.

The design of the approaches had to consider impacts to the floodplain and be sensitive to the historic context while providing a safe and aesthetically pleasing structure. The west approach also had to fit within the tight space between the river bank and River Road. It now has a 26.8 m (88-foot) long ramp providing Americans with Disabilities Act (ADA) compliant access for wheelchairs as well as bicycles, and a gracefully curved concrete stairway for pedestrians. The concrete ramp has a very thin profile and is elevated above the ground to reduce floodplain impact. The east approach is a short, level, earth-filled ramp.

## 2. Physical Description of Bridge

The covered bridge spans 27.4 m between concrete piers and is a tall, massive structure originally designed to carry loaded freight trains pulled by steam locomotives. It is the only covered bridge in Oregon with four-leaf trusses. The Howe trusses are approximately 7.6 m (25 feet) tall with 3.8 m panels. The floor beams are on top of the bottom chords, and originally there were six floor beams in each panel spaced less than 600 mm on center. On the floor beams are six lines of evenly spaced stringers. Originally there was no deck; instead, railroad ties were attached to the stringers, which were grouped closely under each track, and tracks to the ties. All of the wood in the bridge is local Douglas fir, and the original material was all very high quality from old-growth trees.

*Fig. 3 Bridge in 2008*

Where diagonal timber truss members intersect with chords, forces are transmitted through massive cast-iron hardware that is carefully let into the timber members with precisely cut dados, efficiently transferring forces while removing the smallest possible amount of wood. Similarly, splices in the bottom chord are joined using elaborate but efficient cast- and wrought-iron hardware that requires minimal disruption of wood fiber. Each truss has three hanger rods at each panel point, varying in diameter from 50 mm at mid-span to 60 mm at the ends. The ends of the rods have forge-rolled upset threads that are larger than

the rod so that the root diameter of the thread is the same as the body diameter of the rod, an extremely material-efficient design which is no longer used.

The house siding along the sides of the bridge is 8.5 m tall and was never painted; it has no windows. The portal openings are 4.9 m wide and 6.7 m tall measured from the elevation of the tracks (now measured from the deck). The roof has always been corrugated metal. The metal roofing is light and relatively inexpensive, and afforded some resistance to fire that could have been ignited by the shower of sparks spewing from the stacks of steam locomotives.

## 3. Chronology of Development and Use

As mentioned above, the bridge carried trains delivering logs to and lumber from the sawmill. It served this function for approximately twenty-five years until the mill burned and the rail line was abandoned.

*Fig. 4 Chambers Bridge before rehabilitation*

At the bridge location, the east bank of the river, where the mill once stood, is approximately 1.8 m higher than the west bank. As long as the bridge has existed there has been a frontage road, River Road, running parallel to the west bank. Originally the rail line was carried by a trestle over the road to the bridge, and the road was cut deeper to provide clearance. Since the river's floodplain extends beyond River Road, this depressed section of road was flooded for much of the year. Eventually the road was built up to create an at-grade crossing, but when the rail line was abandoned and the tracks were removed, the road was graded level, and the west end of the covered span was left dangling 1.8 m above ground.

Before its rehabilitation, the bridge site was an environmental hazard. From 1925 to 1951, Chambers Covered Bridge provided the railroad crossing for the J.H. Chambers sawmill in Cottage Grove. Throughout those years toxins associated with the operation of the mill had accumulated in soil around the east approach to the bridge. This was removed as part of the rehabilitation project.

*Fig.5 Bridge deterioration*

For over sixty years the bridge was neglected and attracted vandalism. Most of the siding was kicked off, and local youths would jump from the trusses into the river. Twice fires were built in the abandoned structure, but luckily it did not fall. Large sections of roofing were missing, so the structure was no longer protected from weather. The 2006 inspection revealed that at one location near mid-span of the bottom chord, the combination of decay and vandalism left only 7 percent of the original material intact. It is a testament to the original robustness of the structure that it continued to stand after such aggressive deterioration.

# 4. Description of Most Recent Rehabilitation Project

## 4.1 Emergency Removal

*Fig. 6 Bridge being dismantled*

Removal of the existing bridge was an emergency that could not wait for the next in-water work period. Furthermore, the bridge spans the Coast Fork of the Willamette River, an environmentally sensitive stream that is very popular with boaters and anglers. Therefore, no supports could be placed in the active channel during removal. The design involved construction of steel tracks attached to the existing piers and a rolling platform that spanned the river. The platform was built adjacent to the bridge then rolled under it, where it was anchored in place and used to stabilize the existing structure and to provide a work surface. Removal was very systematic, and complex hardware assemblies were kept together and in sequence to facilitate future reassembly.

## 4.2 Retaining Original Features

Almost all of the original hardware, including the hanger rods with upset threads, was cleaned by shot-blasting, then painted and reinstalled. Unfortunately, the hanger rod nuts had to be cut off; however, the machine shop in Cottage Grove that had fabricated the original nuts is still in business, and they were able to make replacements identical to the originals. Though most of the timber was in an advanced state of decay, a portable sawmill was set up on site, and all members that contained sound wood were resawn into smaller but usable sizes. Approximately 25 percent of the wood in the rehabilitated bridge was cut from old bridge timbers.


*Fig. 7 Rehabilitated bridge being moved into position*

Every member of the rehabilitated covered bridge is identical to the original in size, shape, number, orientation, and configuration except there are now only two floor beams per panel rather than the original six, the stringers are spaced evenly, and the ties and tracks were replaced with timber decking and bridge rail. When the bridge carried trains there were floor beams every 600 mm to control deflection. However, under pedestrian loading the stringers can easily span 3.5 m, and since there is now a solid deck they are visible only from the river. Installing more floor beams than were needed would have been an unnecessary added expense. Because the new function of the bridge is to serve pedestrians, the use of pressure-treated wood was deemed inappropriate except on the corbels that are in direct contact with the concrete piers.

## 4.3 Rehabilitation and New Features

All timber members and the siding were coated with a clear sealant that provides the appearance of the original bare wood but affords some protection from moisture and fire. The new roofing is corrugated metal like the original but with a continuous strip of translucent skylight along the ridge.

The skylight is not visible from outside the covered bridge but washes the interior with natural light.

Before rehabilitation began, a set of steel tracks was erected spanning the river from the east bank to the west pier on deep wide-flange beams. The bridge was erected on these tracks over dry land and rolled into position after completion, then lifted with hydraulic jacks and lowered onto the piers. Finally, the tracks and steel beams were removed, and the approach spans completed. A video of the launching can be found at http://www.obec.com/bridge/chambers-covered-bridge.html.

*Fig. 8 Bridge lighting at night*

High-efficiency electric lights were added, discretely concealed above the top chords of the trusses and controlled by exterior light sensors. They are aimed upward and reflect off the underside of the metal roofing, providing pleasant, indirect interior lighting after dark. There are also LED strip lights tucked under the eaves that softly wash the sides of the covered bridge, making it visible at night to passers-by.

To evoke images of the railroad, alternate deck planks are stained to resemble ties, and two continuous steel strips are imbedded into the wood spaced at standard track gauge. Artists from Sea Reach, Ltd. created two full-scale sculptures of one of the locomotives that used to traverse the bridge. One of the sculptures is on an inside wall and one stands outside on a short section of train tracks that are aligned with the track pattern on the bridge deck. Informational placards are placed on the handrail throughout the length of the covered bridge.

*Fig. 9 Interior with "tracks"*

Although most residents in Cottage Grove do not remember trains actually using the bridge, they can appreciate the historical depth Chambers Covered Bridge brings to their community. Part of the rehabilitation effort included creation of an interpretive center displaying pictures and descriptions of the bridge and its history. This interactive feature provides an opportunity for residents of Cottage Grove as well as visitors to learn the story of this magnificent bridge.

### 4.4 Awards

Since rehabilitation, the bridge has won numerous awards and received international attention. The bridge rehabilitation has garnered an ACEC Oregon 2013 Grand Award, 2012 Oregon Heritage Excellence Award, and 2012 First Place Renovation Award for Oregon top projects. That attention is bringing increased tourism to Cottage Grove.

## 5. Conclusion

When rehabilitation work began, the bridge was near collapse. The fact that such a severely deteriorated structure could be completely rehabilitated and repurposed within the awarded budget was a noteworthy achievement made possible by the innovative approach taken to both the

emergency removal and the repair of the bridge, and by the amount of original material that was salvaged and reused.

The dire condition of the bridge made it necessary to replace a good deal of the existing structure. Careful documentation of existing conditions provided accurate detail on the original design prior to deconstruction and was critical to the accuracy of the subsequent rehabilitation effort. Damaged material was, where possible, re-milled into smaller dimension elements, maintaining character and historic fabric,and retaining integrity. Any material too damaged to repair was replaced in kind. Changes in use that required modification from the original construction, such as the installation of a continuous deck and rail, were designed with respect to the bridge's historic function. Translucent roof-top panels that were installed to provide natural illumination, also a safety requirement, were integrated into the historically-based metal roofing and held back from the eave and gable ends, to reduce visual impact from virtually all external viewpoints.

The bridge now provides safe passage for pedestrians and bicyclists, connecting the local high school with the rest of Cottage Grove and providing convenient access to a city park currently under development. It has become a venue for local gatherings and weddings. In addition, as the only remaining railroad covered bridge in Oregon and perhaps the only one left west of the Mississippi River, it is a tourist destination and, as such, a boost to the local economy.

*Fig. 10 Bridge entrance after rehabilitation*

### 5.1 Rehabilitation Project Team

OBEC Consulting Engineers – Prime Consultant
Hamilton Construction Company – Contractor for emergency removal
Heritage Research Associates, Inc. – Cultural and Historical Resources
Sea Reach, Ltd. – Interpretive Exhibits Design and Fabrication
Cascade Earth Sciences, Ltd. – Hazardous Materials
Foundation Engineering, Inc. – Geotechnical
Pacific Habitat Services, Inc. – Environmental
Wildish Construction Co. – Contractor for reconstruction