

# Upper Perry Arch Bridge Repairs

La Grande, Oregon

Submitted by The Euclid Chemical Company



*Upper Perry Arch Bridge after restoration*

**T**he Upper Perry Arch Bridge spans the Grande Ronde River and the Union Pacific Railroad in Perry, OR. It is one of the many historic bridges designed by Oregon's first State Bridge Engineer, Conde McCullough. McCullough was known for the aesthetic qualities of his bridges. This bridge, built in 1923, features the classic Conde bridge design elements of sweeping arches, railings of gothic-arched panels that support beveled handrails, and decorative brackets lining the outer edges of the road deck. He believed that wherever possible, views of the entire span should be had as the traveler draws near. Such is the case with the Upper Perry Arch Bridge. The bridge is 309 ft

(94 m) long with Roman-style semicircular arches on the spandrel columns between decks that go down either side of its 135 ft (41 m) long arch. McCullough also included functional elements, such as blast shields beneath the bridge to protect it from the bursts of engine smoke billowing from trains passing along the Union Pacific rail line below.

In the 1970s, the Oregon Department of Transportation (ODOT) recognized that a significant number of its historic bridges were deteriorating in ways conventional maintenance could not control. A new engineering unit was assigned to perform a thorough condition evaluation of the coastal bridges most at risk and develop techniques to restore the



*80 years of deterioration*

bridges to their original condition while preserving them from further deterioration. The Upper Perry Arch Bridge is one of the bridges to benefit from this program.

The ODOT considered demolishing the bridge, but after further inspection and input from an architectural committee, determined that rehabilitation was a viable option. The bridge was in very poor condition, and the deck was riddled with cracks and spalls, crumbling rails, and exposed reinforcing bars in numerous locations.

Because of its poor condition, weight restrictions were imposed, allowing only passenger-car traffic to cross.

One goal of the design was to salvage as much concrete as possible. The sustainability was accomplished by repairing concrete using epoxy crack injection and repair grout methods. Also, by adding a cast-in-place longitudinal center beam, the designer was able to reduce the deck thickness from 14 to 8 in. (355.6 to 203 mm), which reduced the total amount of concrete used on the project. Several expansion joints were also eliminated to minimize future maintenance costs. The anticipated extended service life is 50 years.

As is quite common with concrete restoration projects, once demolition began, the deterioration was worse than originally thought. During renovation, it was discovered that both of the foundation columns at one end of the bridge were completely sheared. The entire bridge was demolished, except for parts of the columns and the repaired arches, which were used to support the new cast-in-place concrete. The entire span was temporarily suspended with false work and the columns and footings were removed and replaced with new cast-in-place concrete.

Deteriorated concrete had to be removed using handheld jackhammers and replaced with repair grout before other work could begin.



*Upper Perry Arch Bridge prior to restoration*



*Arch deterioration*





*Work performed from man-lifts and netting used to contain concrete debris during surface preparation*



*Arch deterioration accessible by man-lift*



*Suspended arch while footing and columns replaced in one section*

This work included rehabilitating four approach spans and complete replacement of the span supported by the main arches. All bridge rails, cross-beams, decks, spandrel posts, sidewalk brackets, and corbels were demolished and replaced. The arches and bents were salvaged; the cracks were injected with epoxy; and the unsound, deteriorated concrete was removed and repoured in place.

Repair work to the bridge included a total of 1130 linear feet (344.4 m) of epoxy crack injection, over 2000 ft<sup>2</sup> (185.8 m<sup>2</sup>) of regular cast-in-place concrete repair (up to 2 in. [50.8 mm] in depth), and 810 ft<sup>2</sup> (75.3 m<sup>2</sup>) of deep concrete repair (up to 16 in. [406.4 mm] in depth), which was also cast in place. Over 2800 ft<sup>2</sup> (260 m<sup>2</sup>) of damaged concrete was removed and replaced with 550 ft<sup>3</sup> (15.6 m<sup>3</sup>) of the prepackaged repair mortar, which is 65% more damaged concrete than originally anticipated.

A total of 306 dentils and 68 sidewalk brackets (corbels) were demolished, meticulously formed, and cast in place.

Over the duration of the project, 580 yd<sup>3</sup> (443.4 m<sup>3</sup>) of concrete was cast in place in 35 separate pours. These pours do not include the 618 linear feet (188.4 m) of precast decorative bridge rail. Special steel forms were used to fabricate 46 pieces of rail.

Several unique concrete applications were used on the project. With the exception of the decorative rail, all of the concrete on the project was hand-formed. The use of concrete made it possible to meticulously recreate the intricacies of the dentils, sidewalk brackets, fascia beams, post caps, and all of the arched surfaces.

The owner, design team, and contractor worked together to address the special considerations regarding sequencing, which were necessary so that the arch was loaded equally during demolition, repair, and construction.

Reinforced 4350 psi (30 MPa) high-performance concrete and conventional concrete mixtures were used for structural members and 3600 psi (24.8 MPa) concrete was used for nonstructural members. A prepackaged concrete repair mortar was used to replace damaged concrete. This mortar was extended with pea gravel for deep repairs. A high-strength, fluid, ready mix concrete was used for the precast decorative rail because of closely spaced reinforcement.

Various concrete placement methods were used, including pressure grouting and gravity feeding. The mortar was hand-mixed and pumped as high as 30 ft (9.14 m) with grout pumps for placement out of man-lifts and work platforms.

At times during construction, the temperatures dropped to -15°F (-26°C), which required the use of heated, tented areas; heated water; and electric



blankets. Due to the poor condition of the concrete, only 10 ft (3.05 m) sections of each arch could be repaired at a time.

For the areas that were fully demolished and replaced (the deck, crossbeams, bridge rail, dentils, and corbels), the concrete was pumped and tailgated into the formwork. The construction team cast in place 580 yd<sup>3</sup> (443.4 m<sup>3</sup>) of concrete, which was placed in 35 separate pours to accommodate the intricate sequencing required to control cracking during concrete shrinkage. All of the pours for the main arch span were placed equally from each side of the bridge to balance loading. The arch ribs supported the formwork and the work platform. These pours required an additional placement crew and additional coordination with the concrete supplier, pump trucks, and material technicians.

After the formwork was removed, the entire structure was patched, ground, painted, and sealed. The entire structure was Class 1 and 2 surface finished. Class 1 involved grinding the surface to remove laitance and surface film. Then, a silane sealer was applied. The Class 2 surface finish had an additional step between the laitance removal and



*Deck shoring from below*



*Repaired arch*





*Extensive deterioration to corbels and dentils*



*Repaired corbels and concrete railings*

coating application. The surface was floated with a rubber sponge (or float) using a paste of sand, cement, and a bonding agent mortar to fill all surface voids to bring the surface to a uniform texture. For the Upper Perry Arch Bridge, 20,000 ft<sup>2</sup> (1858 m<sup>2</sup>) of the structure was Class 2 finished, and 10,000 ft<sup>2</sup> (929 m<sup>2</sup>) of the structure was Class 1 finished. These areas were also coated and sealed with a waterproof sealer.

The restoration met the goal of recreating the original look of the structure sought by McCullough 90 years ago while protecting the bridge from deterioration for another 50 years. Despite the challenges, the arch was successfully rehabilitated ahead of the revised schedule and within the revised budget.

## Upper Perry Arch Bridge

### OWNER

**Oregon Department of Transportation**  
*La Grande, Oregon*

### PROJECT ENGINEER/DESIGNER

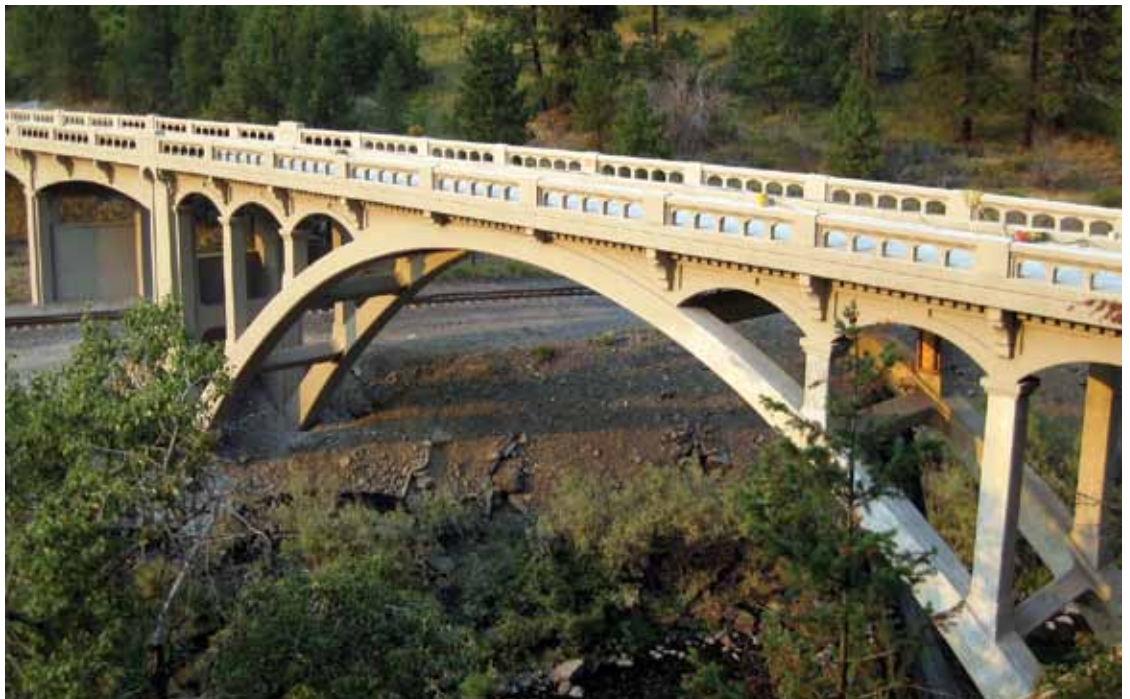
**OTAK, Inc.**  
*Portland, Oregon*

### REPAIR CONTRACTOR

**Wildish Standard Paving**  
*Eugene, Oregon*

### MATERIAL SUPPLIER/MANUFACTURER

**Masons Supply**  
*Portland, Oregon*



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