The Oregon City Bridge, which spans the Willamette River between Oregon City and West Linn, OR, served the community for nearly a century before recently getting a major overhaul. Originally completed in December 1922, this steel box girder arch bridge was—and still is—a beautiful landmark of the region. Designed under the direction of State Engineer Herbert Nunn, the plans of State Highway Engineer C. B. McCullough were adopted and carried out. A unique feature of the project was the encasement of the steel structure in what was then called “gunite” to protect it from the emissions of the paper mill located close-by.

The bridge is 900 ft (274 m) long, including the viaduct design approaches. The center section of the bridge measures a horizontal distance of 140 ft (43 m) with the supporting arches above built on a 160 ft (49 m) radius. The remaining 210 ft (64 m) of the center span are supported from below by the continuation of the arches on a 306 ft (93 m) radius. The box beam arches start with a section of 10 ft (3 m) deep at the base, reducing to a 6 ft (1.8 m) depth at the top with the width remaining the same throughout. This all supports a roadway deck 18 ft (5.5 m) across curb to curb with a sidewalk on each side and the added bonus of restrooms located at the piers under the sidewalk at...
"A feature of special interest was the work of encasing the steel ribs of the arch with concrete, which was applied with a cement gun. The cement gun was used also in producing a concrete web, extending from rib to rib on the underside of the arch. The gunite web was backed by steel reinforcing on the steel struts and braces between the ribs.

The guniting was done under subcontract by Lanning & Hoggan and was directly supervised by A.C. Forrester, Civil Engineer. The outfit used was the N-1 type cement gun of the Cement Gun Co., Inc., and the necessary auxiliary equipment. The latter comprised a J. I. Case 45-hp tractor engine, an Ingersoll-Rand single stage air compressor of 325 cubic feet displacement. The air was conducted through 100 feet of 1-1/2 inch rubber hose to the cement gun on the east shore. A line of Pioneer Rubber Mills’ 1-1/4 inch sand blast hose extended from the cement gun to the points of gunning, this distance varying from 100 to 450 feet laterally and to a maximum of 120 feet vertically. A 3/4-inch water line, connected to a city main, served to deliver water to the engine and for cooling the air compressor, as well as furnishing a supply to the 1 inch gunite nozzle.

The cement gun charge was made up in the ratio of 1 part cement to 3 parts washed river sand, the latter being graded from 1/2 inch down to fines. The moisture in the mixture was reduced by a railroad sand drier. However, this moisture reduction was varied some according to the humidity of the atmosphere. The volume of water coming in contact with the sand and cement in the gunite nozzle was so regulated by the operator as to produce concrete that would conform to standard practice—admitting water sufficient to hydrate the cement. In applying the gunite a distance of about 3 feet was maintained between the nozzle and the surface being gunited, the gunite being shot at a velocity of about 300 feet per second under an initial pressure of 60 pounds.

This work required 40,000 square feet of 2 inch guniting on the steel ribs; 1200 square feet of 6 inch guniting for the web on the underside of the arch; 800 square feet of 4 inches thick; 1200 square feet of 3 inches thick, and 2800 square feet varying from 6 inches down to 2. The 2 inch gunite coat over the steel ribs was shot against No. 28 U.S. Steel Co. wire mesh, fastened to steel rods, the latter being spot-welded to the steel structure. On this particular part it is figured that 75 square feet of gunite resulted from each cubic yard of sand used. The 6 inch gunite was applied to build up the concrete web between the steel ribs and this extended from the base of the arch up to the first panel. This web was continued higher up in 4 and 3 inch coats. All inside struts and braces below deck were wrapped with wire mesh and sheathed with gunite. Relative to applying the 2 inch gunite which constituted the major part of the job, it is stated that the work carried on at the rate of 500 square feet per day of 8 hours.

In the illustrations given herewith there is shown some of the scaffolding required in carrying through this unusual job of guniting. All the gunited surfaces were gaged by straight edge to a true plane, giving them a finished appearance. The efficiency of the cement gun and accessory equipment on this piece of work was demonstrated to the satisfaction of those assumed responsibility for the character and speed of construction. The aesthetic features of the bridge as they appear in the general view, will commend themselves to those who like to see a touch of the artistic imparted to a structure of severe utility.”

(Note: 1 in. = 25 mm; 1 ft = 0.3 m; 1 ft² = 0.09 m²; 1 lb = 0.45 kg)
During my first visit to inspect the bridge, I must say I was more than a little overwhelmed by the craftsmanship of this structure. It was and still is amazing to me. The quality of the gunite that these crews produced so long ago is impressive. Not that there weren’t any problems, but for the most part, the gunite has held up incredibly well over the years. The finish, the consistency and, again, the overall craftsmanship produced by the crews must have made subcontractor Lanning & Hoggan immensely proud (and I hope some money). Most of the deficiencies I saw really didn’t have anything to do with the gunite but were inherent to the design. It was amazing to see reinforcing steel mesh exposed in a hydrodemolition test area in the same condition as when it was placed on the bridge 90 years earlier.

As I walked the job, it became more and more amazing to me what these early shotcreters had accomplished nearly a century ago. Even with all the modern shotcreting tools we have today, duplicating the quality of the shotcrete work on this bridge would be a major challenge.

In April 2010, Wildish Contractors was awarded the contract for the rehabilitation of the Oregon City Bridge. Its goal was to upgrade the structure to regain the capacities it once had while keeping the original appearance of this historic icon. A great deal of work would be necessary to carry out this upgrade within the short time frame of only 2 years. The history behind the building of this bridge plays a large role in this two-part story of an old bridge becoming new again. Stay tuned in 2013 for the second half of this transforming story!

References

*Marcus H. von der Hofen*, Vice President of Coastal Gunite Construction, has nearly two decades of experience in the shotcrete industry as both a Project and Area Manager. He is an active member of American Concrete Institute (ACI) Committees 506, Shotcreting, and C660, Shotcrete Nozzleman Certification. He is a charter member of ASA, joining in 1998, Co-Chair of the ASA Education Committee, and a member of the ASA Board of Direction.