Rankin Bridge

By Dennis Bittner

The Rankin Bridge is a cantilever bridge spanning the Monongahela River in Pittsburgh, PA. The bridge has a steel superstructure resting on concrete piers. Originally opened in 1951, the structure, which is 505 ft (154 m) long and 75 ft (23 m) high, accommodates 26,400 cars daily. At one time, this bridge served as a critical access point to Pittsburgh's steel industry. Now, it serves as Pittsburgh's main access point to the Kennywood Amusement Park and the Waterfront Complex. The complex sits on the site of the historic Homestead Steel Works, and it has been redeveloped to contain vibrant shopping, offices, and condominiums.

Due to the wear and tear of age, the bridge was badly in need of repairs. Like so many bridges in the U.S., the bridge had been deemed structurally deficient, scoring a sufficiency rating of 31.4 out of 100. The owner, The County of Allegheny, requested bids for a total rehabilitation of the bridge.

The total contract for the structure was $47.8 million. It included several facets, such as building a new, wider deck; repainting the superstructure; and improving access lanes. The contract also called for full rehabilitation of the concrete piers. Originally, the pier repair work was specified using "form and pump" methods. Through an on-site field demonstration, however, the contractor was able to demonstrate the viability of shotcrete as an equal or superior alternative method of repair.

The dry-process shotcrete method was chosen. Alkali-resistant short-strand fibers were added for shrinkage crack control, and a corrosion inhibitor was added for corrosion resistance. Both the fibers and corrosion inhibitor were included in the prebagged mixture. The corrosion inhibitor had a pH similar to that of concrete. This addition prevented any retarding of the mixture that could lead to sagging. Dry-process shotcrete was selected due to the start-and-stop nature of the work.

First, the piers were prepared. All loose, unsound materials were removed, exposing sound concrete. During the demolition phase, the areas were pressure washed to remove any fractured concrete. Sometimes neglected, proper substrate preparation is essential to any type of concrete repair. All embedded reinforcement exposed by the demolition and surface preparation was sandblasted clean. Deficient reinforcement was removed and replaced. Next, the shotcrete was installed. All shotcrete was applied using a predampener in the shotcrete delivery system. Predampening greatly reduces dust, allows the material to begin to hydrate, and helps ensure proper hydration of the product. Excess material was trimmed to match the original round face of the large piers. Immediately after finishing, the

Piers after application of an epoxy coating

After completion of the project, the structure looks like a new bridge

Shotcrete applied at full depth over reinforcing bar and mesh

Large, round piers can be brought back to their original shape using shotcrete

material was sprayed with a state-approved volatile organic compound (VOC)-compliant curing compound. The spray cure was chosen over water cure due to the vertical orientation of the piers. The use of a spray-on curing compound is often more economical and can be applied to freshly cut material to combat early-age plastic shrinkage cracks. Later, the piers were pressure washed and a "concrete gray" epoxy paint was applied. The contractor used exclusively ACI-certified nozzlemen for the material installation. Using certified nozzlemen helped ensure a quality shotcrete installation. The experience of the contractor and the shotcrete crew allowed the project to stay on schedule. The entire project used just over 6000 ft^3 (170 m^3) of shotcrete.

This project was a prime example of the advantages of the shotcrete process over the traditional form-and-pour repair method. There are often concerns about the ability to match the shape of round bridge piers on large patches with the shotcrete process. On the Rankin Bridge, the original shape of massive piers was replicated. The speed of the shotcrete installation versus forming contributed significantly to the timely completion of the project between August 2008 and November 2010. Shotcrete can offer large dollar savings over traditional form-and-pour repairs. Currently, an estimated 26% of bridges in the U.S. are considered "structurally deficient or obsolete." Twelve percent of U.S. bridges are in such bad condition that they need annual inspections to remain in service. The cost estimates for these repairs vary greatly, but most put the cost of necessary bridge repairs in the U.S. at hundreds of billions of dollars. Cost savings through the use of shotcrete repair methods would allow the federal, state, and local governments to stretch their limited infrastructure repair dollars and potentially repair or restore more bridges. Anyone who finds themselves in the Greater Pittsburgh area should stop by the Rankin Bridge and see what types of bridge repairs are possible via the shotcrete method.

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Project Location
Pittsburgh, PA

Project Owner
The County of Allegheny
Allegheny County Public Works

Contractor
Mosites Construction Company
Pittsburgh, PA

Materials
Quikrete Shotcrete MS
(PENNDOT approved material list)
Cortec MCI 2006 NS corrosion inhibitor

Dennis Bittner *is a Construction Products Representative for The Quikrete Companies. He has been involved in both wet- and dry-mix process projects in multiple arenas of shotcrete construction, with an emphasis on bridge and tunnel projects for state departments of transportation (DOTs) and the rail industry. In addition to being an ASA Corporate member, Bittner sits on the Board of the ICRI Pittsburgh Chapter. He can be reached at dbittner@quikrete.com.*