2021 Outstanding Rehabilitation & Repair Shotcrete Project

10th Avenue SE Bridge Rehabilitation

By David Graham

BRIDGE HISTORY

Listed on the National Register of Historic Places in 1989, the 10th Avenue Bridge in Minneapolis features seven reinforced concrete arches to span the Mississippi River. The historic 1,141-ft (348 m) open spandrel column arch structure carries over 10,000 vehicles daily, as well as hundreds of pedestrians and cyclists between downtown Minneapolis and an area dominated by the University of Minnesota on the east bank.

Original construction was completed in 1929, and the Minnesota Department of Transportation last restored the bridge in 1976. After 45 years of leaking bridge deck expansion joints and seasonal freeze-thaw damage, the City of Minneapolis initiated an extensive rehabilitation project that would include replacement of the bridge deck and all spandrel column caps, select spandrel columns, and repair of substructure elements including 8 piers, 7 arch rib spans and 146 spandrel columns.

BRIDGE SUBSTRUCTURE REPAIR

After initial sounding and removal of deteriorated concrete, existing reinforcing steel and arch rib Melan truss angle iron was abrasive blasted to near white metal condition and coated with a zinc protective coating.

The next step in the process was to install new #4 and #5 (#13M and #16M) hot-dip galvanized reinforcing bars 12 in. (300 mm) on center both ways. New galvanized reinforcing bars were installed in all concrete surface repair areas. Dry-mix shotcrete was used as the primary method of historic concrete surface repair.

This contract required a preconstruction mockup process where we were required to produce various color samples and submit them to the owner designated historical consultant for approval. As we learned through previous experience from completing historical bridge repair projects, the color selection process can be tedious and lengthy. Fortunately, we were able to provide a satisfactory color sample on the second round of sample submittals. After mockup approval, a specially tinted, prepackaged dry-mix shotcrete material was selected for use on this project. Form-and-pump methods were used to place material for the top of arch rib repairs. A prepackaged, low resistivity material was the required material for the form-and-pump repair areas which were to receive future cathodic protection by thermally applied metal spray.

> THIS PROJECT PROVIDED MULTIPLE PROJECT CHALLENGES.

ACCESS

How does one best access the work areas to maximize concrete repair productivity and coordinate the removal and replacement sequence. Due to complex access requirements, including two 290-ft (88 m) major river spans, both rising 118 ft (36 m) above river elevation and multiple bike paths and roadways that were to remain open to the public,

we decided to use a suspended work platform system for access to the arch ribs and scaffolding for access to the piers and land based arch spans. The Safway QuikDeck® system provided a solid work platform from which we could erect supplemental scaffolding, as required, to access various elevations of curved arch rib elements including bottom, side and top surfaces, as well as various spandrel columns that required repair for the top of arch ribs.

CONSTRUCTION SCHEDULE

As a subcontractor on a project of this size, one of the biggest challenges is to execute your work within the limits of the overall construction schedule. Of primary significance on this project was working around the bridge deck removal and replacement schedule. Original plan quantity for concrete surface repair was 24,200 ft^2 (2250 m^2), however, the actual completed quantity totaled over 39,000 ft^2 (3620 m^2), a 61% increase from original plan quantity. On a project like this, a quantity over run does not provide automatic schedule extension. This proved to be challenging and required various methods to overcome.

We started work in October 2019, at pier 6 on the north side of the river. In an effort to get ahead of schedule we elected to house and heat this area and continue our operations throughout the winter months. Once work began, we realized there could possibly be continuous quantity overruns throughout the project. Over the course of two winter seasons, arch spans 1 and 2 and piers 3, 4, and 6 were enclosed and heated for completion during cold weather months.

Work completed during the winter required containment and heating provisions, supplemental ventilation, dust collection, and temporary lighting. To meet the compressed construction schedule and follow bridge deck replacement sequence, both concrete surface repair and thermally applied metal spray activities were required to proceed continuously for 24 months, 6 days per week, 10-12 hours per day. Arch span and spandrel column repairs were sequenced around deck removal and replacement activities.

Dry-mix shotcrete was placed using Allentown GRH shotcrete machines, and where possible, two shotcrete machines were operated simultaneously to increase production, thus reducing schedule activity duration. We were able to meet all required schedule milestones and were not responsible for causing delay to bridge deck replacement sequence. Depending on the work area available, labor resource requirements varied from 15-35 workers per shift.

HISTORICAL ELEMENT

To duplicate the original 1929-era construction appearance, a board form finish was applied to 29,500 ft^2 (2740 m^2) of the repaired surfaces. This historical finish was accomplished by one of two methods; hand tooling was applied to vertical non-formed surfaces or, where formwork was required, using rough sawn 2 x 10 construction lumber.

CATHODIC PROTECTION

After all concrete surface repair was completed on an arch span, at top surface of arch ribs, CorrSpray® aluminum/zinc/indium thermal metal spray cathodic protection was applied. 25,600 ft² (2380 m²) of thermally-applied metal spray was completed on this project.

MISCELLANEOUS REPAIR

Epoxy injection was used to seal arch rib cracks and the grout-and-seal method was used at construction joints between spandrel columns and top of arch rib.

PROJECT INVOLVEMENT

- Project design was provided by Short Elliot Hendrickson, Mark Maves, project engineer.
- Structural engineer was Steve Olson, Olson, Nesvold Engineers.
- Historical Consultant was Charlene Roise, HessRoise.
- Prime contractor was Lunda Construction Co, Black River Falls, WI. Dan Duffy, Project manager.
- Dry process shotcrete material was provided by TCC Materials.
- Prepackaged low resistivity material was provided by King Packaged Materials/Sika.
- CorrSpray® metal spray wire was provided by Structural Technologies.
- BrandSafway provided and installed QuikDeck® work platform as well as Systems™ scaffolding at arch ribs and spandrel columns.
- Advantage Scaffolding provided and installed sectional scaffold at all piers and at arch rib spans 1 and 2.
- Gary Carlson Equipment provided Putzmeister and Allentown equipment support.
- Gunite Supply and Equipment provided shotcrete hoses and accessories.

***David Graham**, Project Manager for PCiRoads, LLC, since 2007, is an ACI Certified Nozzleman for both dry- and wet-mix shotcrete. With over 30 years of experience in the shotcrete industry, he has managed numerous projects nationwide that include the use of shotcrete on buildings, bridges, tunnels, dams, silos, tanks, and soil stabilization.*

2021 OUTSTANDING REPAIR & REHABILITATION PROJECT

Project Name
10th Ave SE Bridge Rehab

Location
Minneapolis, MN

Shotcrete Contractor
PCiRoads, LLC

Architect/Engineer
Short Elliott Hendrickson

Material Supplier/Manufacturer
TCC Materials & Sika STM

Equipment Manufacturer
Gary Carlson Equipment / Putzmeister

General Contractor
Lunda Construction Co.

Project Owner
City of Minneapolis