

NOBLESTOWN ROAD BRIDGE RESTORATION PROJECT

EDITED BY KELLY M. PAGE

After years of constant use and not enough focus on structural repairs, the mid-century bridge that supported an important Pennsylvania state highway was in desperate need of repair. But, rather than simply focusing on cosmetic surface treatments, which was the case in past repairs, crews decided to rehabilitate the bridge and its piers by



Mid-century bridge in need of repairs



Bridge showed years of deterioration

removing all unsound, deteriorated concrete and filling in any voids with shotcrete.

The rehabilitation of the bridge, which took place from July 2008 to November 2008, involved concrete repairs to the substructure, concrete piers, and deck and expansion joints. Given the structure's poor condition and a strict sequence of operations, the rehabilitation required effective communication and cooperation between the general contractor, subcontractors, and material suppliers to complete the necessary repairs by the steadfast completion date of November.

PROJECT CHALLENGES

This project had several logistic challenges. First, due to structural concerns, crews could not concurrently remove concrete from the piers' hammerheads at the same time. This meant that concrete had to be removed, the surfaces had to be prepared, and one side had to be shotcreted and then given time to cure before beginning the removal and replacement on the other side.

The sequence of operations also dictated that only half the bridge could be closed at any given time to accommodate the work. Therefore, all eastbound traffic was diverted to the two westbound lanes and vice versa as crews worked on the structure.

Once traffic was rerouted and the weight of the cars was removed from the deck, crews erected towers to support the bridge. This helped further alleviate the weight of the bridge deck and allowed crews to more easily and safely remove the crumbling concrete from the bridge's deck, substructure, and piers.

SHOTCRETE REPAIR

As part of the repair process, the shotcrete contractor finished the piers with a gun or "flash finish" to give the concrete surface a lightly textured aesthetic.

In addition, this particular bridge rehabilitation required an extensive refurbishment of the entire supporting structure. In the past, much of the work completed on the bridge was cosmetic in nature and had little structural value. In this particular repair, it was important to get behind the outer layer of reinforcing bars to secure the shotcrete better than

any other anchor or dowel was capable of. On shotcrete installations in the past, where crews took the time to get behind the reinforcing bars, the end result was a stronger structure that did not need as much rehabilitation in the following years. That was the primary objective with this bridge repair.

On this project, the shotcrete contractor was responsible for a number of tasks, including saw cutting the perimeter of the repair areas, tearing out the deteriorated concrete, and sandblasting the reinforcing bars. In addition, the shotcrete contractor added new reinforcing bars where needed, installed mesh, drilled and installed epoxy anchor bars, and concluded by placing shotcrete to restore the rounded concrete piers to their original contours.

While the shotcrete repair was being completed, the general contractor was also responsible for areas requiring concrete repairs. This required work to be coordinated between both the general contractor and shotcrete contractor to properly sequence the repair work.

To rehabilitate the bridge, crews opted to use a dry-mix shotcrete process. Dry-process shotcrete is a very efficient method for making repairs to horizontal, vertical, and overhead surfaces. The process allows for the placement of the repair material at a very low water-cement ratio (w/c) with a high degree of compaction. The dry-mix process also allowed overhead and vertical areas to be shot to the full depth of the needed repair without using accelerators.

A single full repair is preferred, as it eliminates potential voids that could serve as points of failure. In addition, with scattered repair areas, the dry-mix shotcrete process alleviated concerns about stopping work and leaving wet material in the hoses, as is the case with the wet-mix process.

From the nozzleman's perspective, using the dry-mix shotcrete process made it possible to adjust the water content at the nozzle and allowed the material to be placed with much lower water content. The material installed was essentially a zero-slump pneumatically placed concrete.

For this project, the premixed material was predampened with an auger-type predamper, and the shotcrete was shot with a rotary gunite machine. Both the auger-type predamper and the rotary gunite machine are continuous-feed devices. Once the premixed material was dampened, it was immediately conveyed into the gun and through the hose. Using this method also allowed the application to be as continuous as possible, although there were still a number of starts and stops given the nature of the job.

Because the material could not sit once moistened, the material was dampened just before crews fed the material into the gunite machine and shot it onto



Before repairs, bridge showed major damage due to deterioration



Bridge support ready for repair material

the bridge's piers. An ancillary benefit of this approach is that workers did not have to worry about the material while in transportation as they would with ready mix concrete, nor would they have to concern themselves with the moist sand reacting with the cement in large holding hoppers, which is the case with some of the older batch-type mixing rigs. A total of 116 3000 lb (1360 kg) bags of shotcrete preblended with a migrating corrosion inhibitor were used in conjunction with a silo system on the project. The shotcrete was a one-

component dry-process shotcreting material containing microsilica that was designed for high strength, improved sulfate resistance, high adhesion, low permeability, low rebound, and low sag.



Shotcrete being applied to Noblestown Road Bridge



After shot of repair on bridge

QUALITY CONTROL

As with any project, crews had to test the material to ensure that it met and exceeded the specifications for the job. To test the material, crews “shot” a panel and then took core samples, which were sent for testing. This testing ensured that the material’s strength exceeded the standards defined by the Pennsylvania Department of Transportation (PennDOT).

In addition, crews were faced with a steadfast completion date of November. After November, the weather would be too cold for crews to reasonably work outdoors without employing more extreme methods to keep the concrete and the work site from freezing overnight and potentially freezing during the day. Even though the project was mostly completed in the summer and fall months while crews shot concrete during the day, the partially completed project was covered at night to protect it from the elements and ensure that it did not freeze. The project was completed by the scheduled date and to the satisfaction of PennDOT.

Noblestown Road Bridge

OWNER

Pennsylvania Department of Transportation
Harrisburg, PA

PROJECT ENGINEER/DESIGNER

Thornbury, Inc.
West Sunbury, PA

REPAIR CONTRACTOR

Sofis Company, Inc.
Clinton, PA

MATERIAL SUPPLIER/MANUFACTURER

The Quikrete Companies
Atlanta, GA