2023 Shotcrete Awards: Honorable Mention

The Neville Island Bridge Project

By Ted Sofis

Fig. 1: The river span over the main channel of the Ohio River.

The Neville Island Bridge Rehabilitation project originally came out for bid in 2018. The bridge is located in Allegheny County, PA and within PennDOT's District 11. In the bid package, it was noted that construction could not begin until a nesting pair of Peregrine Falcons had fledged their young, which translated to a late summer start. The construction delays were then compounded with the outbreak of COVID-19 in March of 2020. When the pandemic occurred, the State of Pennsylvania closed down all construction operations, except for emergency repairs, for several months. As an ultimate result, along with necessary prep work, our shotcrete operations did not begin until May of 2021. The Trumbull Corporation's $43 million dollar project included structural steel repairs, full structure painting, deck repairs and overlays, and other items in addition to the substructure repairs.

HISTORY

The Neville Island Bridge, northwest of Pittsburgh, is a tied arch bridge carrying Interstate 79 over the Ohio River and Neville Island. It has 29 spans from the back channel over Neville Island, the river, and the Borough of Glenfield, all with multiple traffic lanes. The adjacent girder spans extend over the low-lying areas on the south end and over areas to the north. Originally opened to traffic in 1976, the bridge provided the last section of the 180-mile Interstate highway to be completed. The bridge's Ohio River span is the 2nd largest span in Allegheny County, which is known for having

Fig. 2: Gunning a pier at the river's edge. When shooting from a man lift, each patch or area must be shot, cut down to grade and finished before moving on to the next.

the most bridges in the nation. Pittsburgh, "The City of Bridges," and the county seat, has more bridges than any other city in the world.

REHABILITATION

The restoration project included the substructure repairs on the piers of the 29 spans. This repair work extended from Coraopolis, PA on the south end, over the back channel of the Ohio River, the Neville Island community, the main Channel of the Ohio River, and over the Borough of Glenville on the north riverbank. Also included in the project was the rehabilitation of the smaller four-span bridge at Deer Run, just north of the Neville Island Bridge. The substructure concrete repairs were specified for conventional form-and-pour repairs but also allowed for an alternate shotcrete option. Needless to say, we chose to go with the shotcrete option.

The general contractor, Trumbull Corporation, began the demolition and concrete preparation work early in the 2021 construction season. Our shotcrete placement throughout the project was sequenced to follow as each area became available. Coordination was excellent between the owner, PennDOT District 11; the general contractor, Trumbull Corporation; and us as the subcontractor.

Fig. 3: Finished pier at the river's edge.

Fig. 4: A pier is prepped and ready for gunning.

DRY-PROCESS SHOTCRETE

As in many repair projects, using dry-mix shotcrete provided us with several advantages. Dry-mix gives the nozzleman greater control to make fine adjustments with the water and air as needed. The repair areas were scattered, which necessitated a stop-and-go sequence; this also lends itself to use of dry-mix shotcrete. With the dry-mix method, the gunning hose is completely discharged when you stop; therefore, there is no material remaining in the hose when shut off. This is both convenient and efficient when performing work of an intermittent nature. Also because of the many locations and varying distances between piers and spans, we often had to break down our equipment "set-up" and move the operation to other locations for placing shotcrete. Access to the work required several moves in each area of the project. Most of our shotcrete work was performed using JLG manlifts. Because we could only fit two men in the basket, each and every repair had to be shot, cut down to grade, and completely finished before moving on to the next area. With this type of repair, it's not possible to gun continuously.

MATERIAL

The material that we used on the project was Shotcrete MS, manufactured by Quikrete. Shotcrete MS is a micro-silica enhanced, pre-packaged concrete repair mortar that is specifically designed for shotcrete applications. For most of the project, we used the pre-packaged material in 3000 lb (1400 kg) bulk bags. In certain areas, like the piers on the median of the divided highway under the north end of the bridge, it was more convenient to use 2400 lb. pallets of 50 lb (23 kg) bags.

Fig. 5: Shooting a pier on an approach span on the south end of the Neville Island Bridge.

Fig. 6: Dry-mix shotcrete gunning of bridge pier to the right with finished sections to the left side of the pier.

Fig. 7: Pre-packaged material, Quikrete Shotcrete MS, being loaded into a bulk hopper. The concrete repair mortar is then pre-dampened immediately prior to gunning and then water is added at the nozzle.

Using a pre-packaged repair material saves time by eliminating on-site mixing. It also provides the contractor and customer with a level of quality control with a uniform, pre-mixed manufactured product. With kiln-dried, aggregates and dry cement products, it is recommended that the material be pre-dampened with a 4% to 6% moisture content prior to gunning. With dry-mix shotcrete, there are several advantages to pre-dampening. First and foremost, it greatly reduces dust which creates a safer and cleaner work

environment for all involved. With pre-dampened material, there is less separation, due to wind, between cement and aggregates in the nozzle stream while shooting. Also, the dampened material more efficiently accepts the rest of the water that is introduced at the nozzle, providing better mixing.

EQUIPMENT

The dry-mix equipment used on the project were continuous-feed rotary bowl type guns, the Airplaco C-10s, in conjunction with an auger-type predampener. Unlike batch-type mixers in pre-dampening, the auger-type are continuous feed, so the shotcrete repair mortar is dampened immediately before being fed into the dry-mix gun. There are no issues with a moistened material sitting and reacting in a holding hopper when delayed. Our gunning equipment was then positioned below a large bulk hopper which could hold five bulk bags of the Shotcrete MS.

For the gunning, it's advisable to use a large air compressor with a minimum of 400 to 600 CFM with dry-mix shotcrete. Additionally, we chose to use a separate, smaller compressor to run our air-powered pre-dampener. This was done so there would be no other draw of air that could cause fluctuations in air pressure while gunning. For the rotary guns, we used a minimum of 425 CFM to 825 CFM depending on the area or distance involved.

Fig. 8: Holding hopper being loaded with a 3,000 lb bag of pre-mixed material. The hopper holds 5 bulk bags of the Shotcrete repair mortar.

Fig. 9: Shotcrete being gunned in place on a riverbank pier. Dry-mix shotcrete works well with the stop and go nature of concrete repair applications.

PERFORMANCE

The surface preparation work was performed by the general contractor, Trumbull Corporation. We were fortunate to have an excellent GC to work with. Because the prep work took longer than the shotcrete placement, we needed several mobilizations during the two years we were on the job. As mentioned earlier, our gunning operations began in May of 2021 on the south approach pier spans. Initially after starting, we were only able to gun for a short time due to flooding conditions and rising river levels.

Our work around the piers near the railroad tracks had to be performed on Saturdays, which required backtracking and some additional moving and relocation activities. When working near and around railroad tracks, special precautions needed to be taken with the railroad company, including suspending the work when oncoming trains were approaching.

On a job that covers the distance and number of exits that the Neville Island bridge has, conditions can vary greatly from one section of the project to another. In the main river channel of the Ohio River, it was necessary to work from a barge.

Consequently, when flooding occurred, our work had to be suspended temporarily. In February of 2022, there were a few overhead sections where the underside of the bridge delaminated and needed to be addressed immediately. Precautions were taken for winter conditions and the overhead shotcrete repairs were quickly undertaken and completed. We hold fast to guidelines regarding acceptable

Fig. 10: Installing Shotcrete from a barge in the main channel of the Ohio River. Note the prepared area on the left face of the river pier.

Fig. 11: The cutting-down and finishing work has to be done in a timely manner. Working out of man lifts necessitates a stop and go procedure.

Fig. 12: A close-up picture of a bridge pier with the newly installed shotcrete adjacent to the existing concrete.

Fig. 13: Four gunned and completely finished piers in the Glenfield Borough section of the project.

temperatures being 40 °F (4 °C) and above before gunning, or we provide adequate tenting and heating to achieve that.

CONCLUSION

After 47 years of performing shotcrete work as an owner of Sofis Company, I recently retired from the business. The completion of this project was bittersweet for me. I began working as a laborer during the summers in the early 1970s after high school. After graduating from college, I worked in the local steel mills as a nozzleman and gun operator shooting refractory for lining steel teeming ladles, Treadwell "submarine" ladles, and blast furnace troughs. Much of

2023 HONORABLE MENTION

Project
The Neville Island Bridge

Project Location
Coraopolis, PA

Shotcrete Contractor
Sofis Company Inc.

General Contractor Superintendent
Rob Opel

Engineer
SAI Consulting Engineers

Project Manager
Ted Sofis

Superintendent
Rob Svihla

Materials Supplier
The Quikrete Companies

General Contractor
Trumbull Corporation

Owner
Pennsylvania Department of Transportation

my work involved shotcrete refractory installations, re-lining ash hoppers, and servicing coal-fired power plants. Over the years we, as a company, have performed shotcrete work in power plants, steel mills, dams, tunnel spillways, culverts, slope protection, and in many other shotcrete-related applications. Some of the notable shotcrete projects that we've performed over the years include the Baltimore Harbor Tunnel, the 41st Bridge in Baltimore, Union Station in Washington, DC, the McKees Rocks Bridge, the Noblestown Road Bridge, and the Neville Island Bridge in western Pennsylvania.

Ted W. Sofis *is an ACI Shotcrete Nozzleman Examiner and has served on the ASA Executive Board of Directors, on the ASA Board, and as the Chair of ASA Publications Committee (11 years); he has also served as a member on several other ASA committees. Ted began performing shotcrete work during summers while in college from 1971 to 1974. After graduating from Muskingum College in 1975, he began full time as a nozzleman and gun operator, gunning refractory in ladles and blast furnace troughs in the steel industry. Ted has worked in the shotcrete industry performing work in the power generation and steel industries, and on bridges, tunnels, dams, spillways, slope-protection, and a variety of other installations over the years.*