

# Liberty Tunnels Phase 2

By Dennis Bittner

**T**he Liberty Tunnels were opened in January 1924. They consist of two tubes; each tube is 28.6 ft (8.7 m) wide, 20.75 ft (6.3 m) high at the arch, and 5889 ft (1.8 km) long. Owned by the Pennsylvania Department of Transportation (PennDOT), the tunnels serve as one of the main access points to the city of Pittsburgh.

The concrete in the tunnels was in desperate need of repair due to age. Because of the high volume of traffic, permanent closures were not possible. It was decided that the tunnels would close nightly from 10:00 p.m. to 6:00 a.m. for the work to be performed. Mosites Construction Company, based in Pittsburgh, PA, was chosen to complete the project. Due to the tight time frame, shotcrete was chosen as the repair method. The contractor opted for Quikrete Shotcrete MS prebagged dry process shotcrete—selected from the state-approved list—due to the stop-and-start

nature of the work. To meet additional performance requirements, fibers were added to control shrinkage cracking, and a migrating corrosion inhibitor was added for corrosion protection of embedded steel reinforcement. Both were blended into the product at the point of manufacture.

The project required a full mobilization each night. The tunnel was closed to traffic at 10:00 p.m., at which time all equipment and materials could be moved into the tunnels. First, the substrate was prepped using hydrodemolition. The aggressive nature of hydrodemolition left the substrate clean and with a very rough profile, and without any microfractures (bruising). The process was ideal for preparing the substrate to receive the shotcrete material. Next, any exposed reinforcing bar was cleaned using a pressure washer with a rotating head. Any mesh was removed and replaced with new stainless



*Prior to material installation, the substrate was prepared using hydrodemolition*



*The 3000 lb (1361 kg) bulk bags were predampened as a part of the installation process*



*Where necessary, additional reinforcement was installed*



*Finished patch on ceiling with white to clear curing agent*



*Prepared substrate ready for application of flashcoat*



*Shotcrete being applied vertically by an ACI Certified Nozzleman*

steel mesh. Then, the substrate was cleaned and moistened to a saturated surface-dry (SSD) condition using the same pressure-washing process used to clean the reinforcing bar.

The application of the shotcrete was next. The shotcrete was first predampened and then applied using an Allentown PD1-GRH 610 driven by a 750 ft<sup>3</sup>/min (21 m<sup>3</sup>/min) compressor. The depths of application varied from 1 to 26 in. (25 to 660 mm). In total, 10,000 ft<sup>3</sup> (283 m<sup>3</sup>) of shotcrete was applied. After shooting, the material was finished and a sealer was applied. After allowing time for proper curing, the sealer was removed with a pressure washer. A flash coat of shotcrete was then applied to give the appearance of a gun finish and to gain the appropriate finish texture to receive a topcoat of cementitious waterproofing.

Upon completion, the tunnel had the appearance of a new structure. The owner of the project was extremely happy with the work. A large portion of the tunnel was to receive hydrodemolition and cementitious waterproofing only. A contract addition was granted in these areas to the contractor for 76,000 ft<sup>2</sup> (7060 m<sup>2</sup>) of flash coat. The flash coat, applied at depths between 0.5 and 1 in. (13 and 25 mm), was installed to aid in the application of the waterproofing topcoat.



*Shotcrete being applied overhead by an ACI Certified Nozzleman*



*Finished wall with a white to clear curing agent*



*Finished tunnel*

All work was done in accordance with a shotcrete special provision written for PennDOT by members of ASA. The provision is extensive and covers any type of shotcrete application. It requires ACI Certified Nozzlemen, as was used by Mosites Construction Company. It also requires

state-approved materials, predampening of dry materials, and adherence to all applicable ACI guidelines. It ensures that proper steps will be followed in the shotcrete process, resulting in a first-class finished project.

Without the use of shotcrete, completion of this project would have been extremely difficult. The tunnel was able to be closed at 10:00 p.m., shotcrete was applied, and the tunnels reopened at 6:00 a.m. Completely eliminating formwork allowed for quick installation, and predampening the shotcrete greatly reduced dust. These, as well as other factors, allowed the tunnels to be placed into service each morning, ready to handle rush-hour traffic.

## 2010 Outstanding Underground Project

*Project Name*

Liberty Tunnels Phase 2

*Project Location*

Pittsburgh, PA

*Shotcrete Contractor*

Mosites Construction Company

*General Contractor*

Mosites Construction Company

*Architect/Engineer*

Parsons Brinkerhoff

*Material Supplier/Manufacturer*

The Quikrete Companies\*

*Project Owner*

Pennsylvania Department of Transportation

\*Corporate Member of the  
American Shotcrete Association



*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 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](mailto:dbittner@quikrete.com).*