

2012 Outstanding Underground Project

CSX Pinkerton Tunnel

By Dennis Bitner, Nick Laviolette, and Denis 'Dan' Laviolette

As part of the National Gateway Clearance Project, the Pinkerton Tunnel, located in Markleton, PA, was to be removed because it did not have the required height clearance to accommodate double-stack freight railroad cars. An excavation adjacent to the existing tunnel was planned to provide a new alignment for the railroad track. Pinkerton Tunnel, constructed in 1884, had an arch shape spanning over the track and was lined with stone masonry walls and brick arches. After starting the removal process, large pieces of the tunnel's brick liner began to loosen and some fell on the single railroad track that occupies the tunnel. In addition, large cracks were forming throughout the 1080 ft (329 m) tunnel, and the situation was deteriorating.

Because detouring freight and long-distance passenger trains running through this tunnel was not a viable alternative, it was decided that immediate interim repairs would be needed to keep this major artery for CSX Transportation open until the adjacent new alignment was completed.

LRL Construction Company was brought on board to perform these repairs. Nick Laviolette, their Project Manager, together with the tunnel design team employed by the railroad, developed a solution that involved adding structural support to the tunnel by shotcreting 8 in. (200 mm) thick continuous leg-arch-leg supporting ribs on 4 ft (1.2 m) centers within the tunnel. A 4 in. (100 mm) layer of shotcrete, with material supplied by Quikrete, was then placed between the ribs. With



Fig. 1: Ribs 8 in. (203 mm) thick with 4 in. (102 mm) of shotcrete in between were placed

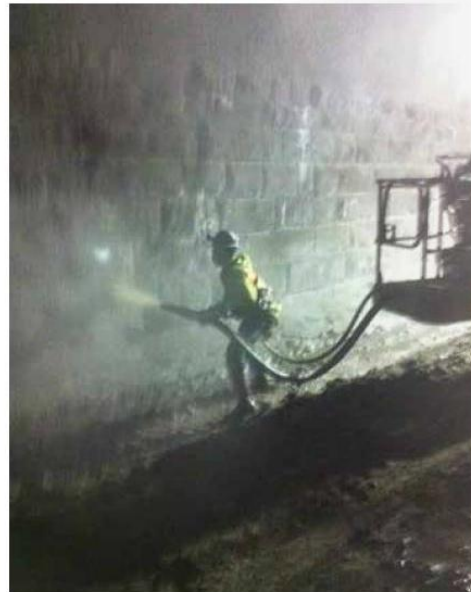


Fig. 2: Nozzlemen placed 100 bags of shotcrete a day, sometimes working on steep slopes

the additional structural support of the new shotcrete ribs, the existing brick liner was able to structurally bridge the area between the ribs. In addition to the time saved by using the rib solution versus using a more typical solution of a 12 in. (300 mm) thick layer of shotcrete over the entire liner, the quantity of shotcrete used was dramatically reduced (refer to Fig. 1 and 2).

The arch shape of the tunnel efficiently carries the external loads pushing on the outside of the tunnel by compressive stresses. This allows the arch to span a large open area and eliminates tensile forces across the arch and the potential for cracking caused by tension in the structure.

LRL Construction began the work by first removing (scaling) loose brick by hand so that a safe workplace could be provided. The scaling work then progressed with the workers always staying under the previously scaled areas. This technique minimized the risks associated with working under the loose areas of the original tunnel brick. Once the loose brick was removed, the contractor began applying shotcrete. At first, a uniform, thin coat of shotcrete was applied before starting the construction of the ribs. The tunnel, however, had a major seepage of ground water through the tunnel walls and when the shotcrete was applied uniformly, delamination occurred. LRL suggested that shotcreting be staged by first constructing the ribs and leaving the areas between ribs for groundwater to migrate through the brick lining. Once the ribs were complete, drain strips were installed in the areas between ribs. The drainage strips then diverted the flow of groundwater and allowed shotcrete to properly bond in the areas between the ribs. The construction management team and design management teams were pleased with the results obtained using these techniques (refer to Fig. 3).

The field-modified construction techniques succeeded, and the tunnel remained safely in

service throughout construction. The tunnel's structural integrity was significantly improved with a solution that was extremely quick (2 to 3 days) to construct and readily adapted to the conditions encountered; allowed the adjacent excavation to continue; and, most important, provided a tunnel able to continue safe passage of approximately 30 trains per day for 6 months until trains were able to be placed on the adjacent new alignment.

In construction, 1177 super sacks of shotcrete, 25 steel sets with channel lagging, numerous split bolts, and many yards of drain strips were



Fig. 3: Manlifts used to access the arch roof for scaling, drainage placement, and shotcreting



Fig. 4: Work was performed 24 hours a day for 28 days

installed in 4 weeks with work progressing 24 hours a day for 28 days (refer to Fig. 4).

The shotcrete was provided by The Quikrete Companies. Additional equipment was provided by United/RSC Rentals. Steel sets and split bolts were supplied by DSI Steel. Drain strips were provided by CSI Geosynthetics. Construction support was provided by Fay Construction. The engineering companies involved were AMEC; Shannon & Wilson, Inc.; Jacobs & Associates; and TranSystems Hill Gateway.



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.



Nick Laviolette is a Construction Project Manager and the son of one of the founding owners of LRL Construction Co., Inc. He has been involved with railroad tunnel repair, reconstruction, and clearance improvement projects for multiple rail line owners for 16 years. In addition to steel fiber-reinforced microsilica shotcrete placement as a tunnel liner, Laviolette has placed shotcrete by hand and using robotic nozzles for large-scale state DOT landslide repair projects and private slope stabilization projects. He has also placed shotcrete for mine shaft projects using the New Austrian method (NATAM).



Denis 'Dan' Laviolette is the sole owner of LRL Construction Co., Inc., and has over 38 years of tunneling experience. Laviolette started his company along with two business partners in 1996 and has since taken a small family-owned company into an empire. He takes pride in the specialized work that his company has come to master and is known for fast, safe results when needed most. His extensive knowledge and expertise in tunnel repair, shaft development, tunnel fires, and emergency collapse repair stems back to his mining days and have evolved over the years from working all over the world.

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Project Name
CSX Pinkerton Tunnel

Project Location
Confluence, PA

Shotcrete Contractor
LRL Construction Co., Inc.

General Contractor
LRL Construction Co., Inc.

Architect/Engineer
Jacobs & Associates/Shannon & Wilson, Inc.

Material Supplier/Manufacturer
The Quikrete Companies/
Shotcrete Technologies*

Project Owner
CSX Railroad

*Corporate Member of the
American Shotcrete Association