

Interstate 81 Safety Corridor Improvements

By Albert Pugliese

On July 15, 2010, CH2M Hill Constructors, Inc., was awarded a contract by the Virginia Department of Transportation (VDOT) for the design-build project Interstate 81 Corridor Safety Operation Improvements. Faulkner Construction was the general contractor. Proshot Concrete, Inc., was awarded a contract in June 2011.

The VDOT specifications required the construction of a mechanically stabilized earth (MSE) wall with use of rock bolts and shotcrete. The project's purpose was to rebuild the north- and southbound bridge over Norfolk Southern main rail lines due to aging of the bridges and lack of clearance for the railroad. The first phase of the project was to widen the lanes for truck traffic; then, the rock bolts were installed and shotcrete was applied. The final MSE wall was approximately 150 ft (46 m) long and nearly 28 ft (9 m) high and required over 200 yd³ (153 m³) of shotcrete.

The project was bid in two phases: Phase 1 from station 96+09 to 97+97 and Phase 2 from 96+97 to 97+56. Once the excavation was complete, the layout for the rock bolts was determined and guide wires were installed.



Fig. 1: Drain board and weep pipes were incorporated before applying the shotcrete to allow for drainage

CH2M Hill Constructors was required by VDOT to attend a preliminary inspection meeting in September 2011. The coordination with the railroad can sometimes be very frustrating and unpredictable. All parties were present to ensure a timely and efficient work schedule.

All workers coming within 100 ft (300 m) of the railroad were required to attend Norfolk Southern's Safety Training Class. In addition, all employers must provide their employees E-Rail Certification cards. This is essentially a Homeland Security background check, required well in advance of the project's start date. All personnel were required to carry the E-Rail Certification card at all times.

Prior to mobilization, all submittals of rock bolts/grout, reinforcing steel, shotcrete mixture designs, and work schedule were required. The rock bolts were provided by Williams Form Engineering, as well as the testing equipment required for "pull" load testing.

Proshot Concrete, Inc., started Phase I on October 24, 2011. The drill rig (Flexiroc T35) provided by Atlas Copco arrived a few days later, once the bolt pattern and layout were complete. The drill had to be able to drill at a 90-degree angle due to clearance of the railroad track. The rock excavator drilled and blasted rock to even the plane as close as possible. The excavation was conducted in three lifts to allow a stabilized area for the rock drill. The excavation depths were 12, 9, and 11 ft (3.7, 2.7, and 3.4 m).

Prior to drilling the rock-bolt holes, shotcrete was applied in varying thicknesses to the surface to help stabilize the drilling operation. The rock bolt holes were to be drilled on 6 ft (1.8 m) centers between the abutment caissons. The rock bolts ranged from 15 to 30 ft (4.5 to 9 m) in depth. Most of the bolt lengths were changed to 30 ft (9 m), as additional soil borings were obtained. The drill shafts were 3 in. (75 mm) in diameter and 1 in. (25 mm) diameter galvanized rock bolts were used with centralizers every 10 ft (3 m). The rock bolts were secured in the drilled holes with high-strength cementitious grout. Each bolt required a specific "pull" load test.



Fig. 2: An initial layer of shotcrete was applied to stabilize the drill bit during the drilling operation

After the pull test, geo-composite drain mats were installed between all rock bolt locations to allow drainage behind the wall. The wall was reinforced using No. 5 (No. 16M) bars horizontally and No. 4 (No. 13M) bars vertically. The total wall thickness was 11 in. (280 mm). In addition to the reinforcing bars, 6 x 6 in.—W4.0 x W4.0 (152 x 152—MW26 x MW26) welded wire fabric was also incorporated.

Guide wires were installed vertically and horizontally to maintain the tolerance requirements. Due to the hardness of the bedrock and excavation access, large voids and indentations existed. This required additional reinforcing steel and additional shotcrete to be installed.

The new three-lane bridge was constructed on the northbound side to accommodate traffic and clearance for the railroad. The old northbound bridge was then removed.

Phase 2 of the MSE wall was constructed on the northbound lanes using the same construction sequence. There was significantly more shotcrete used on this phase due to the irregularity of the excavation. The shotcrete in some areas was as deep as 24 in. (610 mm) and the original wall thickness was specified to be 11 in. (280 mm). A



Fig. 3: Manlifts were used to address the wall because scaffolding was not an option so close to the railroad



Fig. 4: The finished wall ranged in depth 11 to 24 in. (279 to 610 mm) with two mats of reinforcing steel in some places



Fig. 5: A float 'finish' was required. The shotcrete depth was greater than 36 in. (914 mm) in some areas

float finish was specified and concrete insulating blankets were required for cold-weather protection and curing.

The wall construction served three purposes:

1. Support new abutments;
2. Prevent soil erosion; and
3. Minimize silt and debris from falling on railways, road beds, and ditches.

A crash wall was also constructed to forestall the impact of potential train derailment on the new bridges.

The Outstanding Infrastructure Project

Project Name:

Interstate 81 Safety Corridor Improvements

Project Location:

Christiansburg, VA

Shotcrete Contractor:

Proshot Concrete, Inc.*
Albert Pugliese, Project Manager
Darrell McCravy, Project Superintendent

General Contractor:

Faulkner Construction/
CH2M Hill Constructors, Inc.
Kevin Strahley, Project Manager
Mike Powers, Structural Superintendent

Architect/Engineer:

Virginia Department of Transportation (VDOT)

Material Supplier/Manufacturer:

Williams Form Engineering, Rock Bolts
Chandler Ready Mix Shotcrete

Project Owner:

CH2M Hill Constructors/
Virginia Department of Transportation
Jeff Stanley, Senior Quality Control
Penny Connor, Quality Control Inspector

*Corporate Member of the
American Shotcrete Association



Albert Pugliese has been with Proshot Concrete, Inc., since its inception in 2006, previously working with Pressure Concrete in 2000. He is the Regional Manager for the Northeast Region (with 26 years in shotcrete construction) and also assists in specialty projects nationwide. Pugliese is a graduate of Pennsylvania State University (1988), where he received his BS in civil engineering. His shotcrete/gunite experience began in 1990 while developing SewperCoat (manufactured by Lafarge Calcium Aluminates) for the gunite process, as well as other spray applications.

Pugliese's involvement in major projects includes the Maryland Department of Transportation Culvert Rehabilitation, Statewide; Hampton Roads Sanitation Dist. Pump Station, Virginia Beach/Chesapeake/Newport News, VA; Norfolk Naval Base Pier Repairs, Norfolk, VA; City of Virginia Beach Lesner Bridge, Virginia Beach, VA; Toys R US Culvert rehabilitation, Dickson City, PA; and Virginia Department of Transportation Culvert Rehabilitation, Culpeper, VA.