

## Reinforcement for a critical slope

Low-impact technology improves stability along a busy highway without disrupting traffic.

### Project

Slope stability, I-495 Capital Beltway, Fairfax, Va.

### Participants

Virginia Department of Transportation

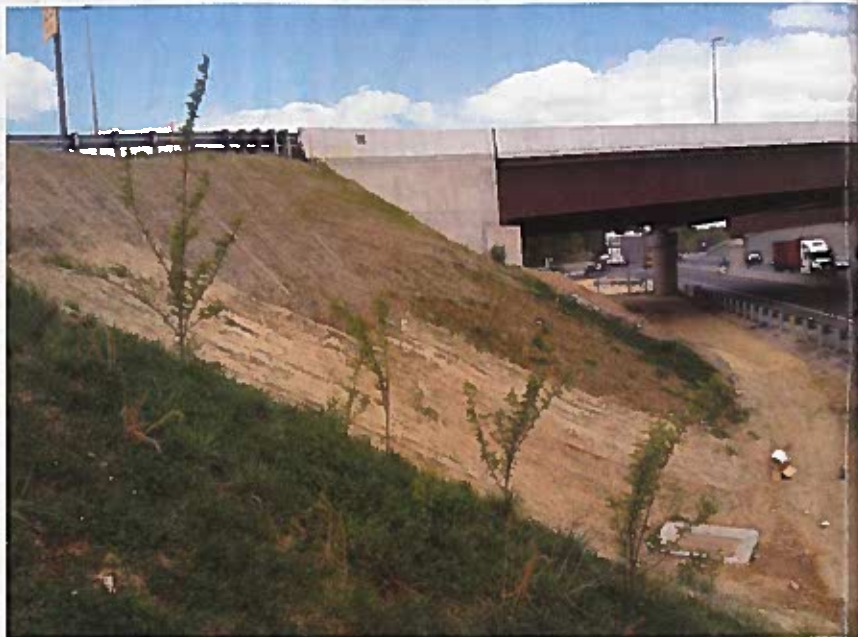
Fluor-Lane

ECS Mid-Atlantic, LLC

GeoStructures, Inc.

### Product application

Installed with small, mobile equipment, the Geopier SRT system improves the factor of safety against sliding along the Capital Beltway.



A marginally stable slope adjacent to a bridge abutment along the I-495 Capital Beltway had a low factor of safety against sliding.

**An existing slope** along the high occupancy toll (HOT) lanes of the I-495 Capital Beltway in Fairfax, Va., was determined to have a factor of safety (FS) against sliding of 1.2. Because of the critical location of the slope adjacent to a bridge abutment, the Virginia Department of Transportation (VDOT) requires that the slope have a FS of 1.5 or greater. The as-constructed slope has an inclination of approximately 1.5H:1V and a height of 25 feet. Soil conditions consist of firm to stiff silt with fine sand and silty sand fill extending to depths of approximately 28 feet below the ground surface. Average SPT N-values in the silty/sandy fill are 5 to 7 blows per foot in the upper 13 feet.

Fluor-Lane, the designer-builder for this Public-Private Transportation Act project, wanted to improve the predicted stability of this critical slope to meet VDOT standards. They also wanted to avoid disrupting traffic in such a critical area while keeping remediation costs to a minimum. Traditional methods such as retaining walls or over excavation and replacement were considered but were too costly, would take too long, and would cause major delays in regular traffic patterns.

The project geotechnical engineer, ECS Mid-Atlantic, LLC, recommended the Geopier SRT system as an alternative solution. The SRT system can be installed without disruption to traffic and with only minimal disturbance to the existing slope. Furthermore, in comparison with the traditional solutions, the SRT system is less costly and time consuming. After a review by its engineers and VDOT, SRT was accepted to stabilize the slope along the Capital Beltway.

The Geopier SRT system is a low-impact slope reinforcement technology used to stabilize shallow failing slopes or reinforce marginally stable slopes. It is well suited to rapidly and economically stabilize sites that have difficult access or require minimal environmental disturbance. The method has been proven on roadway slopes, commercial developments, creek bank repairs, unlined canal slopes, and moving landslides or mudflows.



Small, mobile equipment allowed for work to be performed directly on the slope with no interruption of regular traffic patterns.

SRT's patented Plate Pile method provides slope stabilization using an array of rigid Plate Pile elements, driven into the slope in a staggered pattern of uniformly spaced rows. The SRT system was developed initially in Northern California to stabilize active, shallow landslides. The method was validated through full-scale landslide tests in partnership with researchers from the University of California, Berkeley, and continues to be used with great success on projects around the country.

Plate Piles mobilize the strength of the soil through arching, and transmit slide forces to the underlying stiffer soil. The downslope force on each Plate Pile is resisted by the bending strength of the Plate Pile. Each project-specific Plate Pile solution is designed using limit equilibrium analyses of the unreinforced and reinforced slope, plus finite difference analyses (i.e. LPILE) of the Plate Pile structural capacity.

The Plate Piles consist of 6- to 14-foot-long (typical) steel sections (e.g. angles, S-shapes, channels) to which rectangular plates are attached using welds or bolts. Plate Piles are typically installed using small, tracked excavators with a hydraulic hammer attachment. Installation is a fast, clean, dry process that can occur even in bad weather. Following installation of the Plate Pile reinforcement, a vegetative erosion protection blanket may be placed over the reinforced slope area.

The SRT technology is best suited for slope inclinations between 17 degrees (3H:1V) to 45 degrees (1H:1V); shallow slides as thick as 15 feet; and all soil types (with the exception of very loose to loose sand) overlying a competent layer into which the Plate Piles penetrate.

The existing slope along the I-495 Capital Beltway was a perfect application for the SRT system. GeoStructures, Inc., Purcellville, Va., designed and installed the 188 Plate Piles at the project site. The Plate Piles were installed 4 feet on-center in the horizontal direction (i.e. parallel to the slope) and 5 feet on-center in the vertical direction (i.e. up

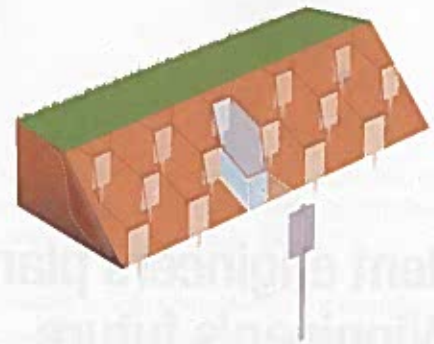


Plate Pile elements driven into a slope in a staggered pattern divide the slope into small increments supported by each Plate Pile.

the slope). An E66 Rammer breaker mounted on a John Deere 200 excavator was used to install the 13-foot-long black steel plate piles. A skid steer loader with fork attachment was used for unloading and moving the Plate Piles.

GeoStructures used an onsite crew of three men and completed the work in four production days. The use of small, mobile equipment allowed for the work to be performed directly on the slope with no interruption of regular traffic patterns. This project demonstrated that the SRT system can be installed successfully along roadways with difficult access, while decreasing construction time and earthwork operations.

This article was contributed by Geopier Foundation Company ([www.geopier.com](http://www.geopier.com)), a subsidiary of Tensar Corporation.

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