Florida Department of Transportation Research

MSE Wall Void Repair Effect on Corrosion of Reinforcement - Phase 2: Specialty Fill Materials

June 2015

Project Number
BDV25-977-07

Project Manager
Ivan Lasa
FDOT Materials Office

Principal Investigator
Alberto Sagüés
University of South Florida

Current Situation

Ramps leading, for example, to overpasses or bridges are usually constructed using mechanically stabilized earth (MSE) walls, earthworks retained by concrete walls. Because MSE walls are reinforced with steel embedded in the fill, their fill is carefully chosen for its electrical and chemical properties, to minimize corrosion. Voids that form in MSE walls due to settling are repaired with controlled low-strength material (CLSM), mostly made of cement, which is highly alkaline and can affect the pH of the fill, leading to more corrosion and accelerated deterioration of MSE wall reinforcement.

Concrete panels stacked in the foreground will be added to the MSE wall structure of this overpass.

Research Objectives

In this project, University of South Florida researchers investigated the extent to which current MSE wall void repairs may enhance corrosion of reinforcing steel. They also compared the corrosion effects of four repair materials: conventional cementitious CLSM; lower pH slag- and MgO-based alternative CLSM; and polyurethane foam injectable filler.

Project Activities

Through a literature review, the researchers identified possible void repair materials. Four mixes plus a polyurethane foam were selected for study. Corrosion effects were studied at small-scale in 10 × 20 cm cells and 15 × 15 × 22 inch soil tanks. Large-scale experiments were conducted in specially constructed boxes, 3 × 4 × 8 ft. Layering steel (an electrode) and fill or void repair material (a conducting medium) created an electrochemical cell. The potential of this cell and corrosion rates under a variety of conditions were measured, and the fill pH was monitored.

In large-scale experiments, fill was placed in half of the box and tamped. Reinforcing steel was set on top of this layer, and another layer of fill was added, one quadrant of which was a selected void repair material. Boxes were covered except during rainfall simulations. Electrical and chemical measurements were made for experimental setups for up to two years.

Computer simulations were also conducted. An exploratory corrosion distribution model was created in which an idealized MSE wall contained regularly spaced reinforcing elements. A statistical predictive model developed in previous work was also applied to reinforced fill to examine the potential service life of various kinds of steel. Computer experiments allowed simulation of the behavior of steel reinforcement over periods up to 500 years, far greater than laboratory experiments or the anticipated 75-year service life of real MSE walls.

Project Benefits

A better understanding of the interaction of fill and void repair materials with steel reinforcement can lead to better material selection for MSE wall void repairs, extended service life of MSE walls, and significant savings in maintenance or replacement of these walls.

For more information, please see dot.state.fl.us/research-center