

**Project Number**

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Impedance-Based Detection of Corrosion in Post-Tensioned Cables: Phase 2 from Concept to Application

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Current Situation

Segmental bridges are made from precast concrete parts that resemble boxes with two opposite open sides that can be joined to create long spans. The segments are held together by steel cables which run through plastic tubes, or ducts, then pulled very tight using special jacks; this is called post-tensioning. To protect the cables against corrosion, the tubes are filled with a cement-like material called grout. The duct with its cables and grout in place is called a tendon. The grout is intended to seal the cables and prevent corrosion, but despite the precaution, corrosion does sometimes occur, threatening the structural integrity of segmental bridges. Therefore, it is important to regularly inspect these bridges and to find new means to detecting corrosion in the tensioning cables.

Research Objectives

University of Florida researchers explored the use of indirect impedance as a method of corrosion detection on post-tensioned cables.

Project Activities

In the first phase of experiments, corrosion of the type of steel used in tensioning cable (ASTM A416) was studied in isolation. Steel samples were exposed to solutions similar to the moisture that resides in the pores of grout. The researchers worked to determine the thickness of oxide coatings that the steel develops upon exposure to the simulated pore solution. These studies also gave the researchers a first look at the sensitivity of electrical impedance measurements to corrosion.

Methods developed in the first project phase were tested on corroded tensioning cable (tendons) obtained from the Ringling Causeway Bridge in Sarasota. Bridge tendons were replaced during repair operations, and lengths were retained by the Florida Department of Transportation for testing. Impedance measurements corresponded appropriately to corroded areas of the tendons when the measurement electrodes were close to the corrosion. Tests on an actual specimen helped the researchers define the real-world challenges of the method.

The researchers then tested the impedance method on tendons of a large-scale mock bridge at Texas A&M University. These tendons had been intentionally damaged to provide a site for non-destructive testing. The impedance method was applied to the documented defects of the tendons of the mock bridge. Responses ranged from no impedance measurement to specific and well-characterized measurements, further defining the limitations of the method.

Finally, the researchers conducted computer simulations of indirect impedance measurements on bridge tendons to further understand how the grout's electrical resistance affects these measurements. The results gave a more precise picture of the grout's electrical behavior, which may make it possible to better isolate the effects of corrosion and locate it.

Project Benefits

Better means of detecting corrosion in bridge tendons will help to schedule timely maintenance and prevent costly damage to bridge structures.

For more information, please see www.fdot.gov/research/.



This section of a bridge tendon shows the thick outer wall of the duct and the cables embedded in grout on the inside.