Florida Department of Transportation Research

Development of Quality Assurance and Quality Control System for Post-Tensioned Segmental Bridges in Florida: Case of Ringling Bridge – Phase II

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Current Situation

The first bridge to cross Sarasota Bay was built in 1925 by John Ringling. By the late 1950s, the two-lane bridge could no longer handle the traffic crossing the bay, and it was replaced in 1959 by a four-lane drawbridge. But by 2000, it was clear that between traffic volumes and the number of openings required for marine traffic, the bridge was no longer adequate. The 1959 bridge was replaced in 2003 by the John Ringling Causeway. With four lanes for traffic, emergency and bicycle lanes, plus sidewalks, the bridge is able to serve all types of users, and with a clearance of 60 feet, marine traffic can easily pass. In 2011, two external post-tensioned (PT) tendons in the Ringling bridge were found to have corroded steel strands caused by deficient grout, particularly voids in the grout where moist air can initiate corrosion. This highlighted the need for better means of inspecting the quality of post-tensioned installations.

A worker begins testing on a post-tensioning tendon inside on the of the box girders that make up the Ringling Bridge.

Research Objectives

Following an in-depth evaluation of nondestructive testing (NDT) techniques, Florida International University researchers supported and documented the efforts of two companies selected to test the integrity of external post-tensioning cables on the bridge by nondestructive methods.

Project Activities

In Phase I of the project (FDOT project BDV29-977-18), several commercially available non-destructive testing technologies and the practitioners offering testing services were evaluated by means of blind mockup tests. From these companies, two using complementary technologies were chosen to participate in the Phase II field testing of Ringling Bridge tendons. NDT Corporation (Sterling, MA) was chosen for its ultrasonic/sonic testing (UST) to identify grout anomalies within a duct. Tokyo Rope USA, Inc., was chosen for their ability to detect steel strand metal loss using a modified magnetic main flux method (MMFM).

UST and MMFM were applied to the 44 tendons located in the open centers of the box girders. The inspected tendons have a combined length of over 12,000 linear feet. Some of these tendons were original to construction while some were installed as part of 2012 repairs. UST identified four potential anomaly locations to be opened for verification, and MMFM identified five more. A tenth, exploratory site was also chosen. Tendons were opened for direct inspection of grout and tendon condition.

UST and MMFM proved to be sensitive and accurate tests for grout and steel integrity, respectively. Further testing of the UST method was recommended to improve its interpretation of possible grout cracking.

Project Benefits

Improved methods of nondestructive testing can improve quality control of post-tensioned structures as well as preventing costly repairs or tendon failures.

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