Florida Department of Transportation Research

# Non-Destructive Testing (NDT) of a Segmental Concrete Bridge Scheduled for Demolition, with a Focus on Condition Assessment and Corrosion Detection of Internal Tendons

*June 2017*


**Project Number**
BDV29-977-05

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## Current Situation

Pre- and post-stressing are techniques by which tensioned steel cables, or tendons, add compressive strength to concrete structural members. Stressing techniques allow concrete components to be made in longer spans, which decreases the number of vertical support structures needed. These stressing techniques help to create stronger, lighter structures that are more economical to build. However, in Florida's humid environments, especially salty ones, the steel components in stressed concrete can become corroded, jeopardizing its strength and structural integrity. This damage is not visible, and more effective means of detecting damaged tendons are constantly being sought.

## Research Objectives

In this project, Florida International University researchers used segments from a demolished concrete segmental bridge with internal tendons to study damage to post-stressed tendons and to test the effectiveness of various methods of non-destructive testing (NDT) for detecting damaged tendons.

*Segments from this decommissioned ramp were used to evaluate non-destructive testing methods.*

## Project Activities

Tendon damage was investigated by examination of segments removed from an interstate highway off-ramp, in laboratory tests of mockups, and in computer simulations. Six detection technologies were studied, some onsite and some in the laboratory: impulse response, infrared thermography, magnetic flux leakage, acoustic emission, interferometric phase radar, and inductance measurement.

Onsite field tests using impulse response showed a reduction in global stiffness of the ramp due to its partial deconstruction. Acoustic emission demonstrated the potential usefulness of vibration measurement to detect tendon breakages. Infrared thermography (IRT) helped to identify ducts with deficient grout onsite, leading to further study in the laboratory. Also, IRT demonstrated the ability to detect wire breakages in encapsulated grout. Magnetic flux leakage was used to detect damage in internal tendons in the presence of secondary reinforcement, using both a laboratory test setup and segments of the deconstructed off-ramp. The inductance method showed promising results for tests of ramp segments and mockups, but obscuring of signals due to mild steel reinforcement presented a challenge. Additional laboratory work will be needed for the development of internal post-tensioning strands damage detection tools.

## Project Benefits

Improved methods of inspecting concrete structures for damage to tensioning cables can help to detect damage earlier, prevent more serious damage, and lead to a better understanding of the processes that damage tendons and better construction methods.

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