Florida Department of Transportation Research

Field Demonstration of Tendon Imaging Methods

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BDV25-977-52

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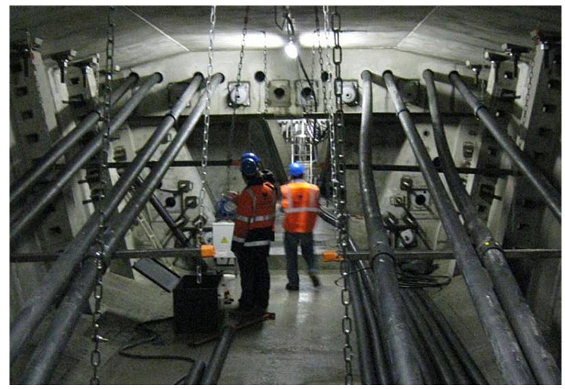
Current Situation

Tensile strength is added to concrete either through steel reinforcement bars, prestressing, or post-tensioning. The last two methods use a tendon, which is a bundle of steel cables that runs through a tube (the duct) which is then backfilled with grout to exclude air and water and then hardens. Despite great care, the presence of gaps in the grout is possible where moisture can accumulate and cause corrosion of the steel tendons. Detecting these gaps is difficult, but it is critical because the tendons are vital to the strength of the concrete component. Prestressing ducts are usually buried in the concrete where they are not directly accessible, but post-tensioning ducts lie outside the concrete, which creates an opportunity for noninvasive inspection with the right technology.



Workers inspect the post-tensioning cables that run through the inside of a box girder bridge.

Research Objectives

As part of a larger project (Project BDV25-977-24) to develop technology to inspect post-tensioning systems, University of South Florida researchers developed and field-tested a device that delivers and analyzes a cross-sectional image of a post-tensioning duct. The method and device are patented.

Project Activities

The researchers' non-intrusive method produces a cross-sectional image of a tendon, flagging air voids and other deficiencies in the grout that lies between the cable bundle and the inner surface of the duct. The device based on this method, the Field Tendon Imaging Unit (FTIU), first uses magnetism to locate the corss-sectional envelope of the steel cables within the duct and then uses impedance measurements to detect voids lying between the cable bundle and the duct's inner surface.

The FTIU met several design criteria. It was designed to be used with 4.5-inch diameter tendons, a common tendon size in Florida, but its flexibility allows it to be used with other common diameters with up to 10% ellipticity. The device's clamshell design allows easy placement and removal. The device acquires and displays a cross-sectional image of the tendon in 10 seconds or less on a laptop computer. Costs of construction and operation are low.

Field demonstration of the device was carried out at the Sunshine Skyway Bridge (one visit) and the Ringling Bridge (two visits). The visit to the Sunshine Skyway Bridge introduced the project team to a number of field conditions; for example, the tendons had been wrapped with repair tape, which interfered with the initial design. Nevertheless, useful images were obtained, and the device design was adjusted. The next two visits met with similar success and resulted in additional design modifications that simplified and improved field operations.

Project Benefits

Better testing methods can reveal grout defects to post-tensioning tendons earlier, helping to ensure a longer service life with less major repair.

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