



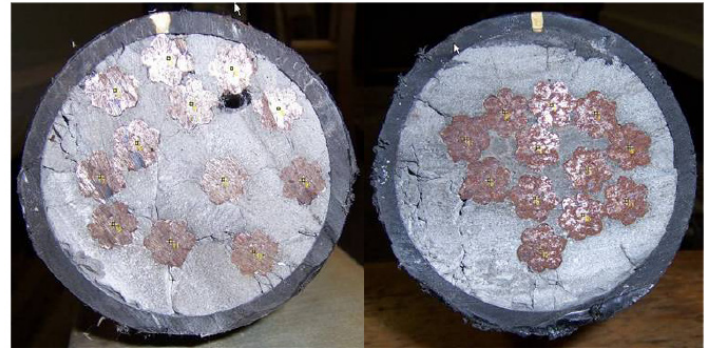
Florida Department of Transportation Research

Validation and Practical Procedure for Vibrational Evaluation of Tendons BC353-44

The use of post-tensioned steel tendons to strengthen concrete-segment bridges is common practice. However, if the tendons lose tension, the structural stability of the bridge can be at risk. FDOT routinely tests bridge tendons for tension strength. Because each bridge has thousands of tendons, field testing needs to be rapid and accurate.

FDOT previously has had success with a vibrational testing procedure for tendons. The technique involves applying a light lateral impact to the tendon so that it vibrates. Analysis of the vibration frequency provides a measurement of tendon tension strength. Sometimes the analysis is complicated as there are two distinct frequency peaks where only one was expected. FDOT contracted University of South Florida researchers to validate the test procedure, account for the dual peaks, and develop a simplified testing and analysis method for rapid screening of tendons in the field.

For the study, the researchers conducted laboratory vibrational tests on tendon samples. They also instrumented the samples with load cells to obtain independent measurements. The vibrational test results agreed closely with the load cell measurements, thus validating the procedure. Examination of tendons that showed dual frequency peaks during the tests revealed that the placement of strands in those tendons was asymmetric. This supported a hypothesis that asymmetric strands could be the cause of dual peaks, and allowed for more accurate tension calculations in those cases.



Bridge tendon cross sections showing varied configurations.

Based on these findings, the researchers developed a new procedure for analyzing the test results. The procedure is adaptable to commercially available software that can run on desktop computers, making it possible to quickly process data from hundreds of tendons. They also developed new vibration test field equipment and applied these methods on segments of the Sunshine Skyway Bridge. The equipment is compact, portable, and has a wireless remote actuator which allows testing to be done by a single operator. A step-by-step training manual is available with the equipment. This new equipment provides an additional, time- and cost-effective tool that will enhance bridge monitoring practice.