# Florida Department of Transportation Research

Base Connections for Signal/Sign Structures

BDK75 977-32

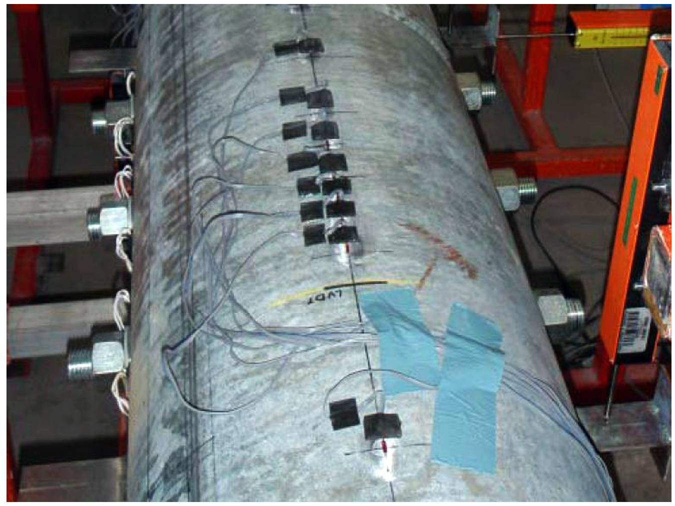
During six weeks in 2004, four major hurricanes struck Florida, and extreme wind-loading caused several large cantilever sign structures on the Interstate to fail.  The Florida Department of Transportation (FDOT) began a research program to address these failures and, in particular, the pole-to-foundation connection. The first project (BD545-54) sought the cause of the failures, identified the proper design procedures, and developed a retrofit option. The second project (BDK75 977-04) explored a variety of alternative load transfer systems to eliminate anchor bolts from the base connection of cantilever sign and signal supports.

In this third project, University of Florida researchers examined and tested alternative base connection designs. A number of design options had been presented in project BDK75 977-04, and two additional alternatives were uncovered during background research for this study. Ideally, the new base connection would have a better load transfer mechanism and a higher AASHTO fatigue threshold than the anchor bolt/annular base plate system.

For a typical mast arm signal structure, a tapered steel pole fitted onto a concrete-anchored, tapered steel stub through a telescopic slice presented several advantages. In the telescopic splice design recommended in BDK75 977-04, the pole is prevented from rotating around the stub by through-bolting.

As in previous projects, the assembly was built and tested at half scale. Previous projects focused on interactions within the concrete foundations of sign structures, but this project focused on how the steel stub base above the concrete installation transfers flexural and torsional loads to the pole through the bolted telescopic splice.

Components of the test system, including all concrete and steel components, were designed and fabricated to detailed specifications. Material



*The telescopic splice with strain gauges placed on the compression face of the outer pole.*

strengths of all components were precisely measured to develop a full understanding of the expected failure loads. Reactions were monitored with a variety of gauges. In the first of two tests, the structure was loaded to through-bolt failure to determine if the yield point can be reasonably predicted using standard design procedures, as set forth by AASHTO. In a second test, additional through-bolts were added to prevent through-bolt failure and permit comparison of the telescopic joint's response to high torsional loads.

The results of the test program provide a detailed representation of the behavior of the telescopic connection components. The data and observations during and after testing reveal how the load is transferred along both the length of the telescopic splice and across the through-bolts. The tapered through-bolted telescopic base connection was shown to be a viable alternative for transferring both flexural and torsional loads as applied to cantilever signal or sign structures.

Project Manager: Andre Pavlov, FDOT Structures Office
Principal Investigator: Ronald A. Cook, University of Florida
For more information, visit http://www.dot.state.fl.us/research-center