

Florida Department of Transportation Research

Evaluation of Disconnect Boxes and Signal Heads for Hurricane Resistance

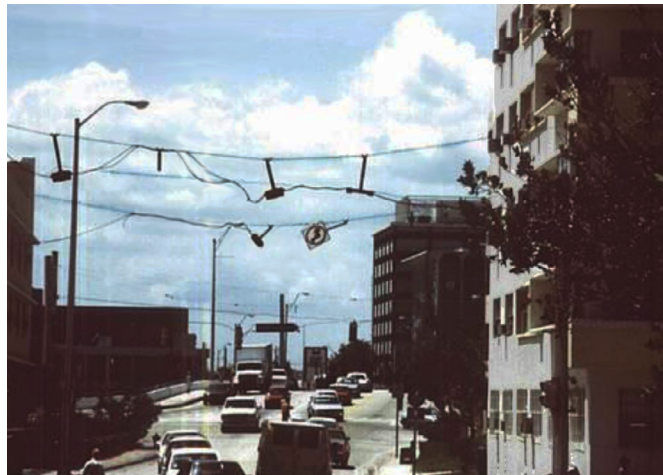
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In 2004, Florida was struck by four major hurricanes — Charley, Frances, Ivan, and Jeanne — within a five-week period. Extensive damage was caused statewide, including Florida's roads and highways. In particular, over 30% of intersections with suspended signals sustained damage. Examination of damaged and collapsed traffic signals revealed that a previous program of design improvements had not gone far enough.

A traffic signal is connected to its suspending span wire cable using three major components: the disconnect box, which is a junction box attached to the top of the signal; the signal hanger, which connects to the adapter hub on top of the disconnect box; and the span wire clamp, which fastens the signal hanger to span wire cable. Hurricane damage to suspended signals was found in each of these connection components. Follow-up studies were conducted to compare single-wire with double-wire suspensions and to evaluate the performance of signal hangers, leaving disconnect boxes and signals as the last elements needing formal investigation. Therefore, in this project, University of Florida researchers had as objectives to quantify load criteria for disconnect box and signal head products and to develop a repeatable program for product testing.

Tests were conducted on disconnect boxes and signals on the FDOT Approved Product List. Tests included flexure and tension series for each of five disconnect boxes, four signal heads, and a combined signal-disconnect system. Additional tests using retrofit reinforcement were performed on a representative large disconnect box, small disconnect box, signal head, and combined disconnect-signal system.

Flexure tests were conducted by adapting a tubular-steel frame constructed for previous signal testing. The frame allowed realistic suspension of signals and application of flexural force with a 10-ton, dual-action hydraulic actuator. Each of the products required slightly



In this photograph, traffic signal connectors have failed during a hurricane, leaving twisted suspension cables and partial connector systems.

different connections to the frame. A load cell mounted between the actuator rod and the signal recorded the applied force. Connections were tested to failure, evidenced by a drop in applied force and visible component failure.

Tension tests were performed using a Tinius Olsen 400 Super L hydraulic tester adapted for tension testing. Disconnect boxes and signals were tested with and without retrofit reinforcement. Connections were tested to failure, defined as a 70% drop in load.

Researchers identified several failure modes for the signal connection products. Locations shown to be weak during testing included the corners of disconnect boxes, adapter hubs, the top connection of disconnect boxes, and the top of signal heads. Based on the test results, strengthening these components is expected to lead to fewer failures under hurricane conditions. The project also produced a method for testing connection products in both tension and flexure, providing a standardized evaluation method. These results can produce more rugged and durable signal connections and reduce equipment failures in severe wind events.

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For more information, visit <http://www.dot.state.fl.us/research-center>