Florida Department of Transportation Research

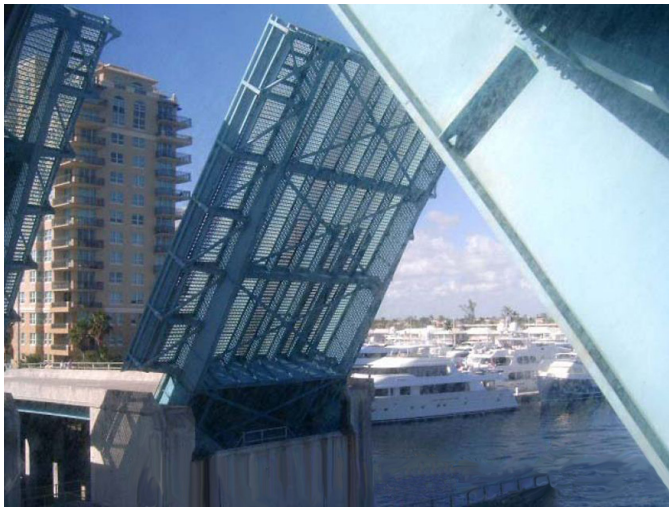
Bridge Maintenance Monitoring Demonstration
BDK78 977-07

A movable bridge's complex structural, mechanical, and electrical systems require much more inspection and maintenance than fixed bridges. Inspection and maintenance of a movable bridge's operating system and mechanical parts require special expertise. Malfunctions can cause unexpected failure of bridge operation, creating problems for roadway and waterborne traffic.

Florida's movable bridges face the usual challenges of wear and tear due to friction, fatigue, and weather exposures, and most are located on extremely aggressive environments, leading to corrosion issues. The State has several types of movable bridges on its inventory but the vast majority are bascule type (cantilever trunnions, simple supported trunnions, or rolling lift). In a previous project by researchers from the University of Central Florida (FDOT Project BD548-23), a monitoring system was installed on the bascule bridge which carries Sunrise Boulevard across the Intracoastal Waterway in Ft. Lauderdale. In that project, a wide variety of data was collected. Analysis of this data led to the development of methods to assess and identify structural changes as well as the effectiveness of maintenance on gears, gear boxes, and rack and pinion mechanisms.

The limited time allowed to that project did not permit a full account of the monitoring system. A follow-up study is the subject of this report. Between the projects, scheduled maintenance of the bridge, including sandblasting and painting, severely damaged the monitoring system in spite of extensive efforts to protect its sensors, wiring, and data acquisition devices. Repairing the system was the first task of the new project, which gave the researchers valuable information about designing a monitoring system for a working bridge and allowed installation of updated components.

An example which demonstrates two of the monitor types and corresponding methods of analysis is the system set up to identify



Sunrise Boulevard Bridge in Ft. Lauderdale, shown with its movable leaves in raised position.

lubricant level changes in the gears. Open gears were monitored by sensors and cameras. Closed gear boxes were monitored by sensors only. The researchers developed an analysis of the lubrication sensor data based on artificial neural networks, and for the camera data, they developed an image analysis approach based on edge detection. The open gear methods acted as cross-checks. Data from these analyses were used to automatically generate an assessment of healthy or unhealthy gear lubrication.

The restored monitoring system provided new data over a period of many weeks. Data was collected for the gear box, the electrical motor, open gears, rack and pinion, bridge balance, the span lock, and for other structural components. The additional period of data collection and analysis led to the establishment of baselines. Anomalies in certain readings were found to be early indications of maintenance needs, as confirmed by traditional inspection. This event indicated the value of monitoring as an adjunct to professional inspection and the potential for reducing the number of inspections needed for certain bridge components.

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