Florida Department of Transportation Research

Movable Bridge Maintenance Monitoring
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Maintenance costs for movable bridges are considerably higher than for fixed bridges, mostly because of the complex interaction of mechanical, electrical, and structural components. Malfunction of any component can cause unexpected failure of bridge operation, creating problems for both land and maritime traffic. Maintenance of the structural and mechanical parts requires special expertise, increasing costs and service delays.

In this project, University of Central Florida researchers devised and installed a comprehensive monitoring system on Sunrise Bridge (a bascule bridge in Ft. Lauderdale) to track the behavior and condition of several critical mechanical, electrical, and structural components. Monitoring the bridge yielded a wide variety of data, which were analyzed with methods developed by the research team. Collected data were compared with ongoing maintenance logs to understand the data's correlation with maintenance events, helping to identify the most pertinent data.

Monitoring system data were used to fine-tune methods and algorithms for mechanical components, such as the gearbox, electric motor, and the rack and pinion system, as well as the structural components of bascule bridges. The process was accelerated by the use of descriptive statistics; the three primary methods were robust regression analysis, moving cross correlation analysis, and moving principal component analysis. In addition, novel methods were developed and verified by the researchers. Evaluation and refinement of methods was an ongoing part of the project. Additional data came from testing that simulated damage scenarios.

The project was interrupted by scheduled bridge painting, which despite protective efforts, severely damaged the monitoring equipment. The researchers repaired the system and continued collecting data. (Details of the extensive field work needed to repair the damaged monitoring system are presented in the project report.)

A failure of the intricate equipment that operates a bascule bridges can have a severe effect on both land and maritime traffic.

Monitoring system data led to establishment of baseline response and thresholds for acceptable behavior of bridge components. This, in turn, led to the identification of unanticipated behaviors for two components, the span locks and the gearbox. Monitor system findings indicating the unanticipated behavior were corroborated by independent maintenance reports, and these components required maintenance work.

This project demonstrated the possibility and usefulness of automated monitoring of a bascule bridge. The devices and software were not changed during the project so that data over the entire project would be comparable, but more modern technology could make such a system more compact and more robust.

Electronic monitoring of the mechanical bridges by systems like the one in this project could give early warning of impending problems, allowing for scheduled repairs and reducing unexpected service interruptions. Considering the investment in Florida's many bridges and the amount of traffic they carry, direct and indirect cost savings compared to the cost of monitoring systems could be significant.

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