Florida Department of Transportation Research

Hillsboro Canal Bridge Monitoring

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Florida's inventory of 148 moveable bridges is the largest in the nation. Most employ open grid steel decks, which have important advantages over solid bridge decks: they can be assembled in the factory, are lightweight and easy to install; however, they also have disadvantages, such as high maintenance costs and low skid resistance when worn. Also, they provide poor riding comfort and produce high noise levels. A possible alternative to steel are decks made of glass-fiber reinforced polymer (GFRP). These decks share steel's ease of assembly and installation, are comparable in weight and dimensionality, but are more corrosion resistant, offering lower long-term maintenance costs.

To evaluate the real-world performance of GFRP decks, FDOT installed one on the Main Street bridge in Belle Glade, Florida. This bridge over the Hillsboro Canal serves an important route from sugarcane fields to processing plants and receives significant traffic and wear. University of Florida researchers received a contract to participate in load testing the GFRP deck and to monitor and examine its performance.

Several types of GFRP decks are available. For this project, a pultruded GFRP composite deck composed of a bottom panel with integral I-shaped webs, along with a top plate of the same material was selected. In addition to deck materials, a polymer concrete overlay was placed as a wearing surface to provide the necessary skid resistance. The deck was installed in August 2009.

Bridge tests performed in October 2009 and October 2010 characterized the effects of one year of service life. These tests were conducted using an FDOT five-axle truck-trailer designed to impose specific test loads. Both static and rolling tests were conducted in the two north-bound lanes. GFRP deck strains were found to be very sensitive to wheel position measured parallel to the direction of travel along the right of way. Influence lines for each strain gage were established using GPS monitoring of the load test truck. Shear and flexural distribution factors were obtained from these influence lines. Comparison of the two bridge tests indicated that the deck strains had increased in the right lane but that much less change had occurred in the left lane. This was attributed to truck traffic, which was more frequent and heavier in the right lane than the left. Resultant damage to the grout bearing layer was observed during the second bridge test. No deterioration of the GFRP deck, however, was noted during the bridge tests.

GFRP deck during installation shows the bottom layer, composed of interlocking I-beams. Top layer is being attached.

Strain, displacement, and temperature were monitored from October 2009 until April 2011. Strain gages and displacement gages were installed on the GFRP deck and the steel superstructure to monitor the traffic loads. Thermocouples installed at various points through the deck monitored daily and seasonal temperature gradients.

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