Florida Department of Transportation Research

Key Royale Bridge Five-Year Evaluation
BDK75 977-52

The Florida Department of Transportation (FDOT) maintains more than 6,500 bridges. Considering the expense of repair and replacement of bridges, extending their durability and service life is important. Of special concern for bridges in marine settings is corrosion of steel reinforcing rods or prestressing cables resulting from chloride ions migrating through concrete. The cost of corrosion nationally has been estimated at $276 billion per year.

FDOT is constantly seeking improved bridge construction, and key to this is improved concrete components. Replacement of the Key Royale bridge in Sarasota County in 2006 presented an opportunity to test new materials for concrete piles, specifically, additives to the concrete mixtures (supplementary cementitious materials — SCM) that can slow chloride intrusion and corrosion. Even the pile instrumentation was novel, promising better corrosion forecasting data.

University of Florida researchers worked with FDOT to design the bridge, the concrete mixtures for its pilings, and the instruments embedded in the piles. These researchers monitored the pilings after completion of the bridge, and in this report, they present the accumulated findings of the first five service years for the Key Royale bridge.

The primary focus for the researchers was evaluation of the SCM used in the bridge piles. Five SCM — fly ash, ultra-fine fly ash, blast furnace slag, metakaolin, and silica fume — were used to create six concrete mixtures used in the bridge and fender piles. Full-scale application allowed monitoring under realistic exposure conditions in real time rather than performing accelerated corrosion testing in laboratory conditions.

Data gathered during the five years since the bridge was erected indicated that corrosion had not yet initiated in either bridge or fender piles. Electrical measurements taken at

Bridge and fender piles of the Key Royale bridge are marked with access points of embedded instruments.

selected intervals to assess the condition of the prestressing steel in the piles indicated a very low probability that corrosion was occurring in the prestressing steel, corresponding to the indications of the embedded sensors. Host fender piles were cored to evaluate chloride ingress.

Removable host fender piles made with the same concrete mixtures and prestressing strand will be removed after 15-20 years of seawater exposure to be examined for ingress of chlorides and corrosion damage. These segments were hung from the fender piles for consistent exposure conditions and instrumented with corrosion sensors and temperature sensors for long-term corrosion monitoring, although none of the remaining operable sensors indicate the presence of corrosion.

Construction methods and materials that extend the durability and service life of Florida's bridge can save many millions of dollars a year in repair and replacement costs, and many billions over the lifetime of the state's bridge inventory.

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