



Florida Department of Transportation Research

Alternatives to Steel Grid Decks - Phase II

BDK80 977-06

Most of Florida's extensive inventory of movable bridges are decked with open steel grids. While lightweight and easy to install, once in service, these decks have poor skid resistance, tend to wear down and separate from support structures, present high noise levels, low riding comfort, and more. Seeking an alternative, the Florida Department of Transportation contracted researchers from both Florida International University and the University of Central Florida to study options. Previously (project BD015-22), the researchers had examined three deck types: aluminum; ultra-high-performance concrete (UHPC) reinforced with high-strength steel (HSS); and UHPC reinforced with fiber-reinforced polymer (FRP). They found UHPC-HSS to be the most promising alternative. In this project, the researchers developed data needed for implementation of UHPC-HSS decks on Florida bridges, and they conducted further studies of a proprietary, FRP-only deck product.

A UHPC-HSS deck is a thin slab with integral primary and secondary ribs. UHPC-HSS is a special formulation concrete reinforced by 0.008-in. steel fibers, often subjected to post-casting treatment. Deck units weigh 25 lb/ft², the maximum under current design requirements. Deck units were investigated on the component and system level.

Researchers investigated the long-term performance of the UHPC-HSS deck system. A series of tests – including shear and uplift testing of deck-to-girder connections, deck-to-deck connection tests, lateral distribution of live loads, and fatigue and residual strength tests – revealed that, due to the unique properties of UHPC-HSS, both mechanical properties and failure modes of reinforced members of UHPC differed from normal concrete. Further study of UHPC-HSS failure modes included dowel action shear tests and uniaxial fatigue tests. The researchers noted the significant contribution of dowel force.

In the second part of the project, an FRP deck



This post-test view of the underside of a UHPC-HSS bridge deck unit in an experimental setup shows the basic deck structure with primary and secondary ribs.

product (Structural Composites, Inc., Melbourne, FL) was tested under static and fatigue loading. FRP decks are in service on 40 bridges in several states, including Florida. The FRP bridge deck system was first subjected to a static load up to a target service load to determine its serviceability. The specimen was then unloaded and tested under cyclic (fatigue) loading. Finally, residual strength was evaluated with static loading up to failure. Under static loading, the FRP deck showed linear deflection and strain responses attributable to the linear elastic behavior of the material. After two million cycles of fatigue loading, the deck showed no signs of damage or failure, and deflections and strains were similar to the initial static test. The FRP deck showed residual strength of at least three times the target design load.

This project advanced design knowledge of UHPC and FRP bridge decks significantly. Additional studies of serviceability, especially wearing surfaces, and for UHPC, investigation of weight reduction are needed. Results confirmed earlier evidence demonstrating that UHPC and FRP are excellent alternatives to steel grid decks, promising increased service life, safety, and reduced maintenance for Florida bridges.

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