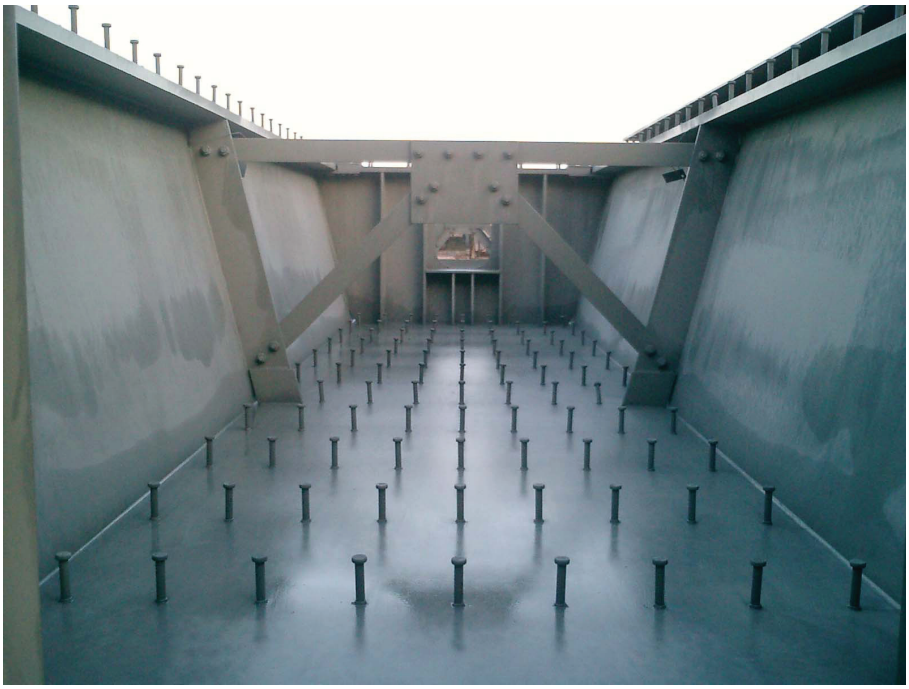
Florida Department of Transportation Research

Design and Evaluation of Steel Bridges with Double Composite Action
BD544-18

Bridge engineers are continually faced with the challenge of providing efficient and cost-effective structures. In particular, the Florida Department of Transportation (FDOT) has recognized the need to develop economical bridge configurations in the medium-span range of 200 to 400 ft.



Double composite box girder

The box girder bridge is one common design having support beams made up of girders in the shape of a hollow box with a rectangular or trapezoidal cross section. This type of construction provides better resistance to rotational forces, a beneficial feature if the bridge is curved. The box girder is typically comprised of a concrete deck made composite with a three-sided steel tub beam below.

Steel girder bridges are commonly designed to take advantage of composite action with the concrete top slab to improve the load carrying capacity and performance of the girder. This idea can be extended to double composite behavior by including a concrete bottom slab in the negative moment region of the girder.

Savings in double composite bridge design arise since steel is replaced by less costly concrete to carry compressive loads. However, limited research has been conducted on double composite designs, and current designs rely on existing specifications for conventional composite bridges.

To further investigate the extent to which current specifications are valid for the double composite design, researchers from the University of South Florida constructed a double composite box girder section. The trapezoidal box consisted of high performance steel with a concrete top and bottom slab. Researchers designed the section according to American Association of State Highway and Transportation Officials (AASHTO) specifications and conducted a series of fatigue, service, and strength tests.

The study identified important limitations of existing design guidelines and provided specific design rules for implementation of the double composite concept. Potential problems due to strain compatibility issues were identified by the research. These limit the effectiveness of high strength steels in these designs and, therefore, the potential cost savings.

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