

# BASCULE BRIDGE LIGHTWEIGHT SOLID DECK RETROFIT RESEARCH PROJECT

## PROJECT NEED

The deck on the majority of bascule bridges in Florida consist of steel open grid roadway flooring, except for the portion of deck over the machinery room, which consists of concrete filled steel grid roadway flooring to protect the operating equipment below. The original decision to use steel open grid deck was primarily to reduce weight and thus reduce load on the structure and operating equipment with corresponding cost savings. At the time the majority of these bridges were constructed (from the mid 1950's through the early 1970's) steel open grid deck was considered the only available and practical lightweight deck system.

However, steel open grid deck has been problematic for a number of reasons including:

- Openings in the deck permit dirt and debris to collect on the steel framing members below. The dirt and debris retains moisture that contains chlorides from the saltwater environment, which is conducive to corrosion development. The network of steel grid bars makes cleaning of the steel framing members difficult.
- Although the deck typically includes a serrated top surface to improve skid resistance, the top surface polishes over time from contact with wheels, which eventually reduces the skid resistance, especially when wet, and reduces safety.
- The welded fabrication of the steel open grid deck includes numerous fatigue sensitive details (Category E Details per AASHTO LRFD) that are prone to fatigue development and as such the deck design is typically governed by fatigue provisions. Bridges with heavier truck traffic have commonly experienced premature fatigue cracking and localized failure of the secondary and tertiary bars that result in larger holes in the deck.
- Fabrication tolerances of both the steel open grid deck and bascule leaf steel framing have resulted in difficulties in achieving uniform bearing of the deck main bars on the supports. Excessive root openings and poor field welding practices have resulted in widespread cracking of the deck attachment welds.
- Tires in contact with the network of steel open grid bars and corresponding openings between the bars create resonant vibrations that generate noise that is considered a nuisance to residences and businesses nearby these bascule bridges.
- The relatively large openings in the deck and the slippery surfaces make crossing the bascule span on a bicycle a challenge. The bicycling community considers steel open grid deck a safety concern.

Over the past 60 years, the Florida Department of Transportation has invested considerable resources in addressing the above concerns including frequent repairs and replacement of the decks, and research and development to address the safety and functionality concerns including methods to improve skid resistance, wheel paths to reduce noise, and implementation of bicycle friendly surfaces in the shoulder areas.

The Department has recognized for many years that a deck with a solid surface solves most if not all of these issues. Most new bascule bridges in Florida, constructed since 1999, have included a lightweight solid deck with a concrete riding surface. There have been a number of deck systems classified as lightweight solid deck systems that have been used on new bascule bridges throughout the United States and abroad including:

- Conventionally Reinforced Concrete Slabs using Lightweight Concrete,
- Concrete Filled Steel Grid Deck (a.k.a. Grid Reinforced Concrete) using Lightweight Concrete,
- Exodermic Deck using Lightweight Concrete,
- Steel Orthotropic Deck.

However, because the weight of these deck systems is significantly greater than those of steel open grid deck and there are limitations in the amount of weight that can be added to an existing bascule bridge, it is not practical to use these deck systems to retrofit existing bascule bridges. Therefore these deck systems were not evaluated in this study.