

Evaluation of Accelerated Bridge Construction (ABC) – A Forensic Analysis (on deck panels)

Description

Meta Fields

Category : Ongoing Projects
Group : Decks
Subject : Shear Studs for Panels
Abstract :

In the latest State of the Union address, President Obama reported to the American public on the status of our national infrastructure: over 25 percent of the Nation's 600,000 bridges are considered "structurally deficient" or "functionally obsolete." In other words, these critical links to public safety, economic vibrancy, and quality of life are in need of replacement or repair. However, a wide array of structure types, material characteristics, ages, daily traffic volumes, and climate conditions makes bridge replacement increasingly difficult.

To combat these issues, a number of new methods have emerged to expedite bridge construction. Accelerated Bridge Construction (ABC) technologies are one of the top priorities of the Every Day Counts 2 (EDC2) initiative—a Federal Highway Administration program that encourages keeping infrastructure in a constant "state of good repair" through effective management and innovative technologies.

Unlike traditional construction that could take months to complete, ABC technologies help replace bridges more quickly and cost-effectively. EDC2 promotes three methods of ABC: Prefabricated Bridge Elements and Systems (PBES), Geosynthetic-Reinforced Soil Integrated Bridge System (GRS-IBS), and Slide-In Bridge Construction. Each of these implements a combination of state-of-the-art techniques and materials to expedite construction schedules, minimize congestion, reduce construction costs, and improve safety for construction workers and motorists. The Utah Department of Transportation (UDOT) is considered to be a national leader of ABC adoption, with over 100 PBES bridges completed; PBES bridges are comprised of elements that are constructed offsite and assembled at their designated locations. With so many PBES bridges in close proximity, Utah State University (USU) civil engineering professor Paul Barr, Ph.D., in partnership with Bridge Diagnostics, Inc., led several studies to assess the structural performance of the state's ABC bridge network. One of these studies provided Barr and his team an unprecedented test specimen. Due to a roadway rerouting, UDOT decommissioned the PBES 8th North Bridge on I-15 in Salt Lake City, Utah, after only 2 years service. This afforded USU and their collaborative research partners, Bridge Diagnostics, Inc., to use this bridge as a living laboratory to evaluate the impacts of real-world loading conditions and simulated stressors on precast bridge decks. Testing such a young bridge gave USU researchers a unique opportunity to quantify the rate of structural performance decline near the beginning of the bridge's service life. First, they conducted extensive field tests to analyze the effects of weight and pressure on new bridges.

"We found these loads caused the bridge deck to shift unevenly near the supports due to insufficient placement of the shear pockets. This phenomenon is called noncomposite behavior," Barr said. "Conversely, the loading had little to no effect near the middle of the girder—the shear pockets, girder, and deck all behaved symbiotically, or displayed 'composite behavior.'" The bridge was decommissioned after the completion of the load tests. For the second part, Barr's team was able to do something no research team has ever done before. His team transported two full-scale bridge sections that included five of the PBES deck panels and four girders—each over 35 feet long—to the USU Systems, Materials, and Structural Health (SMASH) laboratory for forensic testing. "Based on our extensive performance tests, we recommended using a smaller shear pocket spacing near the supports to reduce the potential for the noncomposite behavior observed in the field," Barr said. Barr's team suggested several other long-term recommendations to improve the service life of PBES bridges. One of those suggestions, Barr said, is investing in higher grade concrete used in these bridge decks. Higher grade concrete is more resistant to stressors presented by severe weather situations, continued weight stress, and layer separation.

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The application of post-tensioning—or pulling bridge decks and girders together like a set of dental

