Florida Department of Transportation Research

Long Spans with Transportable Precast Prestressed Girders
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Despite the fact that concrete is more cost effective and easier to maintain than steel in superstructures, concrete is rarely used in spans longer than 150 ft due to weight and length limitations preventing their transportation to the work site. Concrete girders in excess of 200 ft can be constructed, but the maximum transportable length is approximately 180 ft. However, splicing allows long spans to be made in shorter, transportable segments that can be assembled on site. Spliced girders have typically been used for continuous support bridges, but this type of construction presents many short- and long-term design challenges. Simply supported designs can require less design time and be more flexible when designs include vertical or horizontal curves.

In this project, University of Florida researchers identified a number of splice techniques to lengthen the span of transportable precast prestressed concrete girders and then to develop a selected design and test it. This work builds on the development of the Florida I-beam (FIB), which can be constructed as long spans; the FIB96, for example, can span a maximum of 208 ft with 8.5 ksi concrete and 215 ft with 10 ksi concrete. A prototype design using the FIB96 was developed along with a number of possible splice configurations.

The final splice design was selected in consultation with the Florida Department of Transportation (FDOT) based on a variety of technical and aesthetic considerations. In the final design, the tendon for the full span is prestressed, and a gap is left in the beam at third points during casting. Strands are cut prior to transport and then spliced on site. Prestressing force is applied to the system by a hydraulic jack on each side of the girder web, operating against brackets secured by through-bolts. If the splice is placed low enough on the section, then tie-downs may not be necessary. After the target stress is achieved, the hydraulic jacks are locked, and splice concrete is placed.

This bridge in Nebraska uses 207-ft spliced girders, similar to the type explored in this project.

To evaluate the splice design assembly procedures and structural behavior, nine specimens were constructed using the AASHTO Type II cross-section; three control specimens and six spliced specimens were fabricated. To accomplish this, fifteen precast prestressed segments were constructed at a precast facility. The precast segments were then transported to the FDOT Structures Research Lab where six spliced specimens were assembled, splices stressed, and closures poured. The assembly and stressing procedure included instrumentation to evaluate the procedure. Decks were poured on each specimen in preparation for testing.

Load testing of the completed specimens was conducted to evaluate flexural, shear, and fatigue behavior. Prestress losses were measured, and cracking development was observed to assess service behavior. Additional component testing of the coupler used in the splice design was performed at the State Materials Office.

This project demonstrated the feasibility of a new splicing technique for precast prestressed concrete girders intended for simply supported bridges. Testing revealed many possibilities for improvement that can make this a practical construction technique. The ability to create longer simply supported spans can simplify the design process and produce more cost effective and easier to maintain bridges.

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