Florida Department of Transportation Research

End Region Detailing of Pretensioned Concrete Bridge Girders
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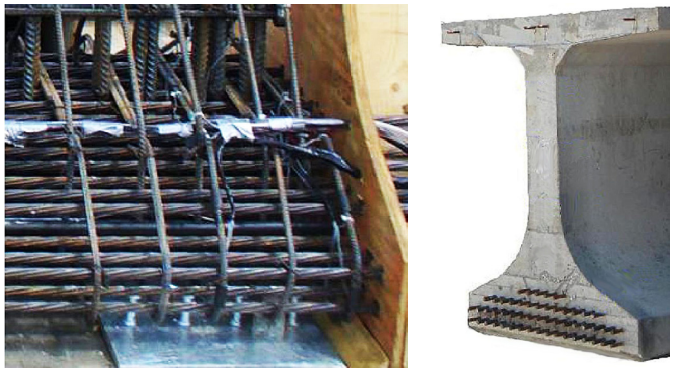
Introduction of the Florida-I Beam (FIB) in 2009 renewed interest in prestressed concrete beam design, especially end region details. In this study, University of Florida researchers examined construction detailing at the FIB end region.

End region detailing has a significant effect on the serviceability, behavior, and capacity of pretensioned concrete girders. In this project, experimental and analytical research programs were conducted to evaluate and quantify the effects of different end region detailing schemes. Using results from these programs, two end region design models were developed. The first model can be used to design confinement reinforcement to prevent lateral-splitting failure at ultimate strength. The second model focuses on serviceability criteria and can be used to calculate bottom flange stresses due to prestressing and thereby assess the likelihood of bottom flange cracking in the end region.

The experimental program was conducted using fourteen Florida I-Beam (FIB) specimens. Cracking and strain data were collected during prestress transfer and during the months following transfer. These data were used to evaluate serviceability criteria. Following serviceability evaluations, specimens were load-tested to determine capacity and behavior due to applied loads. Specimens were loaded in three-point bending at a shear-span-to-depth (a/d) ratio of approximately 2.0. Variables considered in the experimental work included confinement reinforcement, steel bearing plates, horizontal reinforcement, vertical reinforcement, strand quantity, strand shielding, and strand layout.

The analytical program was conducted using finite element analysis (FEA). FEA models were validated using data from the experimental program. Variables considered in the analytical program included bearing pad geometry, bearing pad stiffness, steel bearing plates, transfer length, and prestress release sequence.



Left: close-up of pretensioning strands and reinforcing bar in the Florida I-Beam (FIB) form before concrete is added. Right: end view of the FIB.

A test program was also conducted to evaluate the shear strength of 1950s era pretension girders used in the Florida highway system. These girders are of interest because they have thin 4-inch webs and very little specified shear reinforcement. Six test girders were removed from an existing bridge and were tested to failure in the laboratory. Results from the testing will be useful in determining the shear strength of similar pretensioned girders.

In the project report, recommendations are provided with regard to detailing of confinement reinforcement, embedded bearing plates, strand shielding, and crack control. Recommendations are also given regarding evaluation of early pretensioned girders.

Prestressed concrete beams are the main members in thousands of transportation structures in Florida. Improved reliability and serviceability of these beams will extend service life for these multimillion-dollar structures and produce considerable savings for Florida taxpayers.

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