Florida Department of Transportation Research

Flexural Capacity of Concrete Elements with Unbonded and Bonded Prestressing

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Current Situation

Prestressed concrete is widely used in bridge construction because of its cost effectiveness and efficiency. However, durability issues have arisen which have been attributed to grouting practice or material performance. To improve durability, bridge construction projects in Florida may now incorporate flexible fillers in lieu of cementitious grout – a widely-used design approach in Europe that is relatively new in the United States.

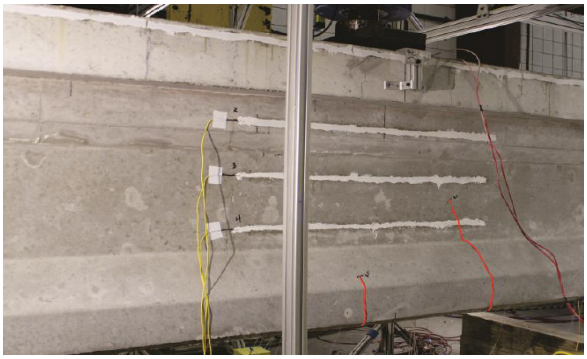
While the approach addresses durability issues, the flexural behavior of prestressed concrete members are affected by flexible fillers and current design guidance underestimates the flexural capacity – the ability to resist bending and breaking under load - of prestressed concrete members.

Research Objectives

The objective of this research was to develop improved guidelines for computing the flexural capacity of prestressed concrete members with mixed reinforced conditions.

Project Activities

Following a literature review and development of a numerical model, the University of Florida research team designed and constructed three experimental prestressed concrete beam specimens. The first two were 70-ft long precast concrete I-shaped sections and the third section was a 31-ft long cast-in-place beam.



Indicated by red markings, the first observed cracks on this specimen occured at 80 kip.

The team then conducted full-scale tests on bending of the specimens to investigate the flexural behavior of the beams. For testing, loads were applied to the beams incrementally, then inspected for cracks. If the specimens were deemed safe, loading was continued until the test was terminated due to compressive failure, compressive concrete strains were larger than 0.003, or maximum predicted load was exceeded.

The team then validated the modeling data against the experimental

Project Conclusions and Benefits

FDOT now has an empirical method to compute the flexural strength of prestressed concrete members with mixed reinforcement, which can reduce the possibility of strands bending or breaking before flexural capacity is reached.

For more information, please see fdot.gov/research.