Florida Department of Transportation Research

# Diagnostic Investigation of Excessive Camber in Prestressed Slab Units

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## Current Situation

Prestressed concrete beams are used on the majority of Florida's bridges. The location of the prestressed reinforcement in the bottom of the beams produces camber in the beams that must be accounted for in the construction of the bridge deck. Camber can be unpredictable and is affected by prestress forces, workmanship, concrete properties, ambient conditions and thermal effects. Camber which differs drastically from predicted values can cause changes and delays in construction due to unexpected additional dead load, required geometric adjustments, or the need to re-cast beams.

*Figure 1. Slab with higher camber than expected.*

## Research Objectives

During a recent bridge project, 57 flat slab beams were cast. Although they were all pretensioned at the same precast facility and during the same time of the year, the other beams were high relative to the predicted values. The objective of this research was to investigate the cause of excessive camber on the six rejected slabs.

## Project Activities

The researchers investigated several hypotheses. They hypothesized that the high camber could be due to excess force in the pretensioned strands, the length of debonding being shorter than required, properties being different from what was assumed for design, compressive stress causing micro-cracking and a reduced moment of inertia, and thermal gradient due to solar effects.

They designed an experimental program that included crack opening tests to determine the decompression load by testing the slabs in bending using four-point loading, ultimate capacity tests, investigating the properties of the concrete by extracting samples, mapping cracks, and saw-cutting specimens to determine the debonded length of strands. The information from these tests was used to determine the effective prestress, prestressing losses in the slab, moment capacity, and concrete properties.

The prestress losses found in four of the six slabs, tested two years after construction, averaged 27%. The as-built concrete strength was found to exceed the design value while the weight of the concrete was lower than expected. A lower weight corresponds to a lower initial modulus of elasticity and therefore a member with less stiffness. The compressive stress at release was found to exceed the limit of 0.6f'c by approximately 2.9%. Cracks observed in the top of the slab beam had an average depth of 1.75 in., with a higher concentration at 4 ft. to 10 ft. from the ends. The actual ultimate capacity was higher than design capacity by an average of 12.5% and 1% higher than predicted capacity using as-built concrete properties.

## Project Benefits

This research provides information on a diagnostic investigation of a case study of slab beams cast for a bridge project which had excessive camber.

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