



Study Title

Mitigation of End Zone Cracking
in Prestressed Concrete Girders

Brief Type

Final

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Mitigation of End Zone Cracking in Prestressed Concrete Girders

Study Objectives

To control end-zone cracking in prestressed concrete girders using effective reinforcement schemes

Background

End-zone cracking, which occurs in the horizontal and diagonal directions when strands are detensioned, is commonplace in prestressed concrete girders. The distribution of stresses in end zones is complex due to the simultaneous interaction of multiple prestressing strands and ordinary rebars under transferred forces. Premature end-zone cracking can cause problems in both functionality and durability. Another issue is that, once initiated, cracks can evolve over time and shorten the service life of girders. For these reasons, end zones are considered an important component of pretensioned girders and transportation agencies are eager to find effective solutions that can alleviate the repercussions of unintended cracking.

Methods

This report presents two major aspects related to the end-zone behavior of prestressed concrete bulb-tee girders: i) laboratory experiments and ii) full-scale finite element modeling. The first part of the report discusses the behavior of anchorage zones, also known as end zones, with discrete rebars and continuous meshes. The second part of the report deals with the effectiveness of various reinforcing schemes in the end zones of prestressed concrete bulb-tee girders. The default girder taken from the Colorado Department of Transportation includes C-bars and spirals, which are intended to control cracking, and three-dimensional finite element analysis is conducted.

Results

This report has discussed the end-zone behavior of prestressed concrete girders based on laboratory testing and full-scale finite element modeling. The formulated models are used to evaluate the breadth of end zones, strain responses, cracking patterns, damage amounts, and splitting forces, depending upon the configuration of the end-zone reinforcement.

Research Benefits

The research suggests effective reinforcement methods to control end-zone cracking in prestressed concrete bulb-tee girders. By adopting the proposed approaches, the sustainability of bridge structures is expected to improve in both the short- and long-term.

Recommendations for Implementation (or Next Steps)

Practical reinforcement schemes are proposed alongside welded wire fabric (W4xW4).