ABSTRACT

Wesson, Michael D. Ph.D., Purdue University, December 2013. Influence of Strand Debonding on the Shear Strength of Prestressed Concrete. Major Professor: Robert J. Frosch.

Strand debonding is a common method used to reduce flexural stresses caused by prestress transfer in the end regions of pretensioned concrete beams. Debonding is especially useful when section geometries prohibit draping such as U-beams. Based on concerns regarding shear strength, the AASHTO bridge design specification currently limits the percentage of strands that can be debonded. These limits have been found in practice to limit both the efficiency and economy of bridge girders. For this reason, a number of states chose to ignore these limits. The objective of this research is to improve the understanding of the influence of debonding on shear strength. The shear strength of U-beams is of particular interest considering that this section is commonly constrained by the debonding limit. To achieve this objective, a four phase experimental investigation was conducted. The first phase evaluated the effectiveness of debonding sheathing to ensure that proper debonding is being achieved. The second phase evaluated the influence of the percentage of debonded strands on shear strength using rectangular and I-shaped cross sections to investigate flexure-shear and web-shear strengths, respectively. While this phase concentrated on the shear strength resisted by the concrete, the influence of transverse reinforcement was also evaluated. The third phase evaluated the influence of varying strength concretes, which are commonly used in composite sections, on shear strength. Finally, the fourth phase evaluated the shear strength of a 50% debonded U-beam both with and without transverse reinforcement. Through the investigation, the experimental results are compared using design approaches from ACI and AASHTO as well as a shear strength model. From the results, an improved understanding of the

influence of debonding on shear strength is obtained. Recommendations are provided to improve the analysis, design, and construction of girders with debonded strand while maintaining their safety.