ABSTRACT

Prestressed concrete girders are a common choice for bridge designers throughout the world. These bridge girders generally contain pretensioned strands, post-tensioned strands, or a combination thereof. Post-tensioning utilizes a duct, made of plastic or metal, to create a void along the length of a girder when the concrete is cast. Strands are fed through the duct and stressed after the concrete reaches the desired strength. The ducts are typically grouted to bond the strands to the girder and provide corrosion resistance. Another option that is gaining interest is to fill the ducts with a flexible filler. Tendons filled with flexible filler act as unbonded tendons but can facilitate inspections of the strands and provide for potential replacement of the strands. The interest in flexible fillers has driven research to understand the structural behavior of post-tensioned girders with unbonded tendons in the web. Of specific interest is the shear behavior considering that extremely limited research exists on specimens with these details and there currently is no design guidance. This experimental investigation included tests of 29 moderate- and full-scale girders. The specimens contained different bond types, transverse reinforcement ratios, duct diameter to web width ratios, and section types. Based on the experimental investigation, an analytical model is proposed to estimate the shear strength of girders with bonded and unbonded tendons in the web. Finally, current shear design tools are examined and refined for girders with bonded and unbonded tendons in the web. This research provides effective tools to assist engineers in designing and evaluating post-tensioned structures.