ABSTRACT

Pay, Ali Cihan Ph.D., Purdue University, December, 2005. Bond Behavior of Unconfined Steel and FRP Splices in Concrete Beams. Major Professor: Robert J. Frosch.

Corrosion of steel reinforcement in reinforced concrete causes deterioration of concrete which can result in costly maintenance and loss of serviceability. Fiber reinforced polymer (FRP) bars which are corrosion resistant have become available as a solution to the corrosion problem in reinforced concrete structures where corrosion is a concern. However, due to differences in the mechanical and physical properties of FRP and steel reinforcement, there may be differences in the behavior of members reinforced with these materials. Of partial interest is the bond strength of tension lap splices. The objective of this research study is to evaluate the effects of the axial stiffness, modulus of elasticity, reinforcement size, surface deformation, splice length, and casting position on the bond behavior of FRP and steel reinforcing bars spliced at tension, as well as to develop a plausible model for the bond strength of FRP and steel bars. The investigation consists of two phases, an experimental and an analytical. In the experimental phase, forty-six glass FRP, carbon FRP, and steel reinforced concrete beams with unconfined tension lap splices were tested. Test results indicate that FRP bars reach lower bond strengths than steel bars. In addition, it was observed that the bond strength was a function of the axial stiffness (AE) of the reinforcement. The analytical phase focused on the relationship between the axial stiffness, the splice length of the reinforcing bar, and the splice strength of the reinforcement. A simple, empirically developed model is introduced to calculate the bond strength of reinforced concrete beams for tension lap splices for both FRP and steel reinforcement.