Experimental and Numerical Evaluation of the Shear Behavior of Reinforced Concrete T-Beams with Hybrid Steel-FRP Stirrups

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Abstract:

This study presents the shear behavior of reinforced concrete (RC) T-beams with innovative steel stirrups hybridized in the longitudinal direction with a fiber-reinforced polymer (FRP) composite. Six beams were experimentally tested: three beams were reinforced with the hybrid steel-FRP stirrups, and the others served as control samples and were reinforced with conventional steel stirrups. Furthermore, a two-dimensional finite-element (FE) model was created and executed using FE analysis software to examine the effect of several influential parameters, including the type and amount of FRP used in producing the hybrid stirrups. Large-scale beams reinforced with carbon FRP (CFRP) stirrups were numerically simulated before and after replacing the transverse CFRP reinforcement with steel-FRP stirrups. Compared with conventional RC beams, concrete beams reinforced with steel-FRP stirrups successfully showed a considerable increase in the beam shear strength and deformability. Moreover, hybrid steel-FRP stirrups can provide design engineers with a new, flexible design to control both the structural response and the construction cost.

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