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Thesis

Punching Shear Strength of Interior and Edge Column-Slab Connections in CFRP Reinforced Flat Plate Structures Transferring Shear and Moment

Abstract

The purpose of this investigation is to study the punching shear strength of interior and edge column-slab connections where the slabs are reinforced for flexure, or for flexure and shear, with CFRP, and they are subjected to combined shear and moment transfer. Two interior and ten edge column-slab connections are tested to study the effect of a number of parameters, including the type and amount of slab flexural and shear reinforcement. The flexural reinforcement is either steel or CFRP while the shear reinforcement is either steel headed studs or a CFRP shear rail introduced in this study. It is found that the shear reinforcement increases the punching shear strength by 20% to 26.7% in the case of the interior column connection and by only about 10% in the case of the edge column connections. This increase is predicted with a reasonable degree of conservatism by using basic $(V_c + V_s)$ approach of the ACI Code in conjunction with a proposed equation for calculating V_c, i.e. the concrete contribution to the punching shear strength, which accounts for the effects of the slab flexural reinforcement rigidity and the column size, relative to the slab thickness, on the punching shear strength. In addition to the above simplified method, a refined and more rational model for predicting the strength of the tested specimens is also introduced. This model uses the compatibility and equilibrium requirements at the connection and a more realistic punching shear perimeter for calculating the punching shear capacity of slab-column connections, but its results are not as accurate as those of the simplified method. Consequently, the use of the proposed simplified method is recommended for practical applications.

Degree

Ph.D.

Completion

2007

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