

Punching Shear Strengthening of Flat Slabs Using Ferrocement

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ABSTRACT

Punching shear failure is a big issue in flat slab-column connections where the failure is a sudden and brittle. It has been shown that punching shear failure can be divided into two types, pure shear punching and flexural punching. In the former type, which is the case for slabs with large reinforcement ratios, failure occurs suddenly with small displacement. For the case of small reinforcement ratios, flexural punching takes place after relatively large displacement.

This research presents a proposed method for strengthening flat slab-column connections using ferrocement laminates. Both experimental and numerical investigations were carried out to study the effectiveness of this method in strengthening.

An experimental program, ten square slabs with a concentric column was tested. Two specimens were kept as control specimens, and eight of them were strengthened with ferrocement laminates. The studied parameters were thickness of ferrocement laminates, type of wire mesh, volume fraction of reinforcement and strengthening type.

The finite element software program (ANSYS 9) was used in the numerical analysis to model the strengthened slab-column connections in order to extend the parametric study to include cases that were not experimentally investigated. The experimental results were compared with those obtained from the numerical analysis. In addition to that, a numerical study was conducted to observe the effect of other parametric studies on the enhancement of punching shear stress such as thickness of ferrocement, wire mesh volume fraction, location of ferrocement, orientation of expanded wire mesh, and strengthened distance from the periphery of the column.

The experimental and numerical results of the strengthened slabs demonstrated that, ferrocement laminates can be successfully used for increasing the ultimate carrying capacity, strength, energy absorption, and stiffness of slab-column connections. It was found that strengthening using two ferrocement laminates in a sandwich form increased the punching capacity, gain in energy and stiffness than that obtained when flat laminate was used.