In North America, headed shear studs (stud rails) are typically placed perpendicular to column faces in a so-called orthogonal (or cruciform) layout to reduce interferences with slab flexural reinforcement. A potential issue with the orthogonal layout of shear studs is that large regions of the slab extending out from the corners of the columns are essentially unreinforced in shear. This issue can be addressed by placing stud rails that project radially out from the corners of the column, referred to as a radial layout. Conflicting results were found from research investigations on the effect of the two shear stud layouts. These conflicts are likely related to the percentage of flexural reinforcement in the slab near the slab-column connection.

An experimental program consisting of five full-scaled slab-column connections was conducted to study the effect of the layout of stud rails and the percentage of slab flexural reinforcement on the behavior and shear strength of slab-column connections. Test results showed that significant differences in failure mode were observed between slab-column connections with shear studs arranged in a radial layout and those with an orthogonal stud layout, and also that shear strength equations in the ACI Building Code overestimated the strength of the slab-column connections that had a relatively low percentage of slab flexural reinforcement. A minimum percentage of slab flexural reinforcement was proposed to ensure the nominal shear strength given by the ACI Code for slab-column connections can be reached.

Three-dimensional finite element models were also developed in Abaqus to simulate slab-column connections. In those F.E. models, concrete and reinforcement were modeled using 8-node brick and truss elements, respectively, and they were connected using the “embedded” method. The “concrete damaged plasticity” model was used to simulate concrete behavior. The developed F.E. models were able to simulate shear strength and behavior of the test specimens with reasonably accuracy.