ANALYTICAL INVESTIGATION OF A NEW THROUGH-COLUMN-TYPE JOINT FOR REINFORCED CONCRETE AND STEEL FRAMES

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The Composite structures consist of steel and reinforced concrete members have been used during the last 30 years in various forms. One of these systems which resists seismic moments based on the moment connection between reinforced concrete columns and steel beams are called RCS systems. There are two main categories in RCS connections so far including the through-beam type and the through- column type. Although many researches have been done on the behaviour of the composite RCS beam–column connections (Shen and Qiang, 2010; Alizade et al., 2013), a few details are related to the through-column type connections. Furthermore, the details offered for through- column type connections using diaphragms or cover plates to connect the steel beam and column (Nishiyama et al., 2004), generally are complicated and the explanation of the force transferring mechanisms is difficult. Additional effort in connection details to ensure a better seismic capacity in terms of strength and ductility is needed. According to good features of through-column type connections further research is required to improve existing methods. The main objective of this study is to propose a new Through-Column-Type Joint that uses different ways for developing a reliable load path. The joint is reinforced by cover plates and a vertical plate passing through the column, and then beams connect to the vertical plate as shown in Figure 1. All the forces resulting from the beam plastic hinge are located in the through plate plane, consequently, most welds are loaded parallel-to-axis which supply more convenient performance.

This study includes finite-element analyses of mentioned connection to investigate the structural performance and the stress transfer mechanisms. The finite element model has been verified with experimental results of a specimen tested by Cheng and Chen (2004). Then the verified model changed to appropriate dimensions according to proposed connection. In this study, a finite element pre-processor ABAQUS/CAE is used to create the three dimensional model for the test.

Deformed shape of the model at 6% story drift and maximum principal plastic strain distribution are presented in Figure 2. It shows that the beam plastic hinge forms at the expected location after the through plate. Based on the finite element results, all steel parts of the connection except the beam remained relatively elastic.

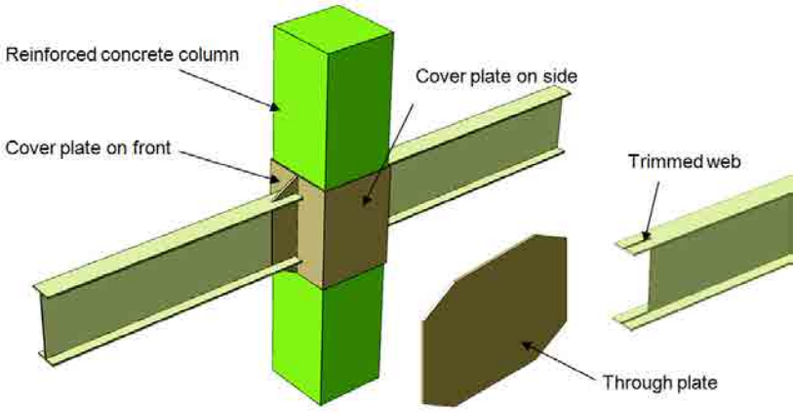

Figure 1. Proposed composite moment connection

The induced forces of the beam plastic hinge tend to rotate the through plate relative to the column which are resisted by three mechanisms including in-plane resistance of the through plate and cover plates and strut action of concrete in the panel zone. According to the finite element results, these mechanisms provide reliable load path for transferring the moment and forces of steel beam to concrete column.

Based on the finite element results, the concrete contribution to the load transfer mechanism is more than the other components and consists 55% of the total shear forces transferred to the column. The portion of the through plate and side plates of shear forces are 37% and 8% respectively.

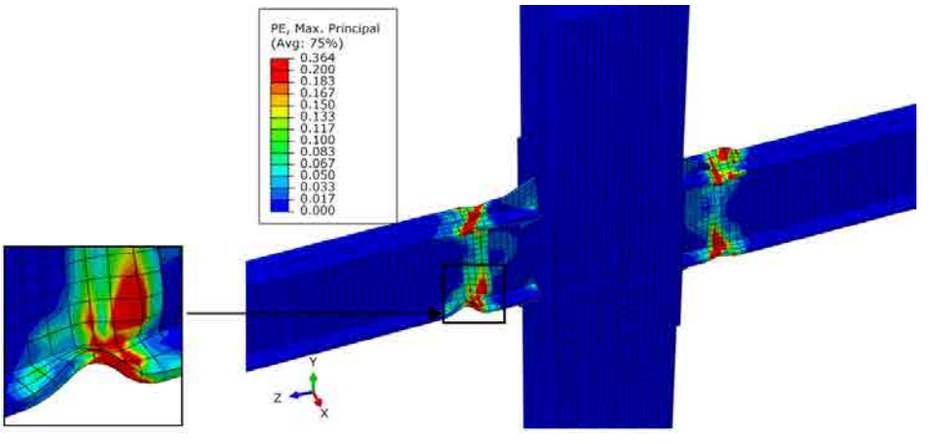

Figure 2. Deformed shape and maximum principal plastic strain distribution at 6% story drift

REFERENCES

Alizadeh S, KA Attari N and Kazem MT (2013) The seismic performance of new detailing for RCS connections, *Journal of Constructional Steel Research*, 91: 76-88

Cheng CT and Chen CC (2005) Seismic behavior of steel beam and reinforced concrete column connections, *Journal of Constructional Steel Research*, 61: 587-606

Nishiyama I, Kuramoto H and Noguchi H (2004) Guidelines: seismic design of composite reinforced concrete and steel buildings, *Journal of Structural Engineering ASCE*, 130(2): 336-342

Shen HX and Qiang G (2010) Nonlinear finite element analysis of exterior RC column to steel beam connection, *Proceedings of ICCASM*, Taiyuan, China