

PARAMETRIC FINITE ELEMENT EVALUATION OF RC BEAM-COLUMN JOINTS

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Beam-column connections in reinforced concrete (RC) structures play an important role when the frame is subjected to seismic loading. The overall stability of the structure and the formation of the optimal energy absorption mechanism in the beam plastic hinge zone depends on the role of the beam-column joints. The non-seismic detailing in the joint panel area can cause a partial or total collapse of the structure (Paulay & Priestley, 1992).

Researchers have provided a lot of experimental studies on beam-column connections, while experimental studies are usually costly and time consuming, and can be restricted by the test facilities and space (Hawileh et al., 2010). The behaviour of the RC beam-column joint is very complex and several parameters such as axial load ratio, reinforcement detailing, concrete strength have significant influences on its seismic performance. It is impractical to fully investigate all parameters through a limited number of experimental tests (Roehm et al., 2015).

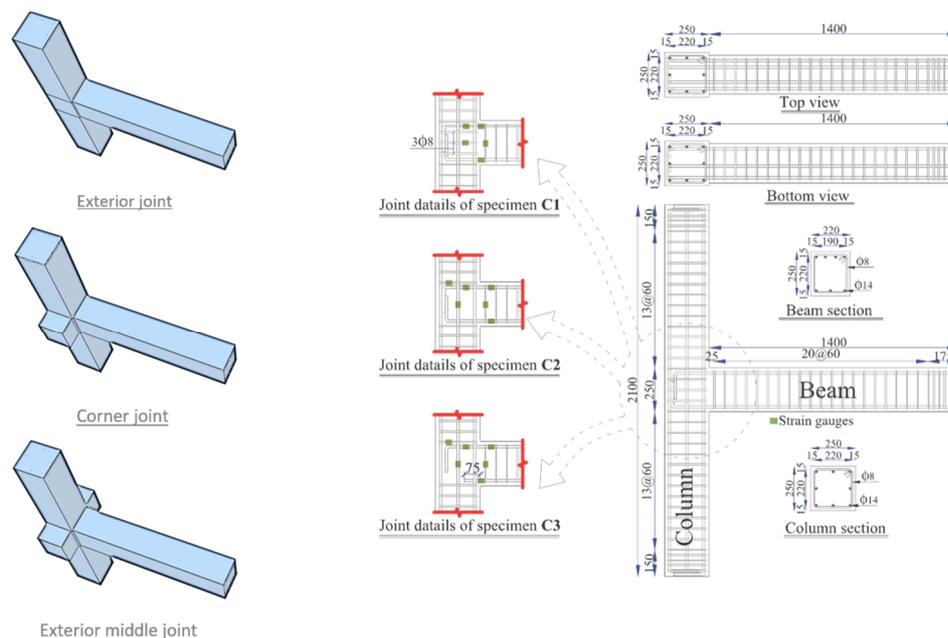


Figure 1. Different conditions of the lateral beam and reinforcement detailing of model C1, C2, and C3 (dimensions in millimeters).

Finite element modelling using ABAQUS software platform can provide an opportunity to study the various parameters governing the monotonic and cyclic behaviour of the beam-column joints.

In this study, by examining several parameters in the finite element model of the RC Beam-column connections in ABAQUS software, such as specifications of strain-hardening for steel, Bauschinger effects, concrete damaged plasticity

(CDP) in tensile and compression, concrete confinement effects, presence of lateral beam, and also bond-slip of reinforcing bars was investigated and leads to provides recommendations for finite element modelling of the RC frames. For this purpose, the behaviours of the seismically and the non-seismically detailed beam–column joints under monotonic lateral loading were evaluated in different conditions of the presence of lateral beam (see Figure 1). The meshed finite element model and stress results of non-seismic specimen C2 is shown in Figure 2.

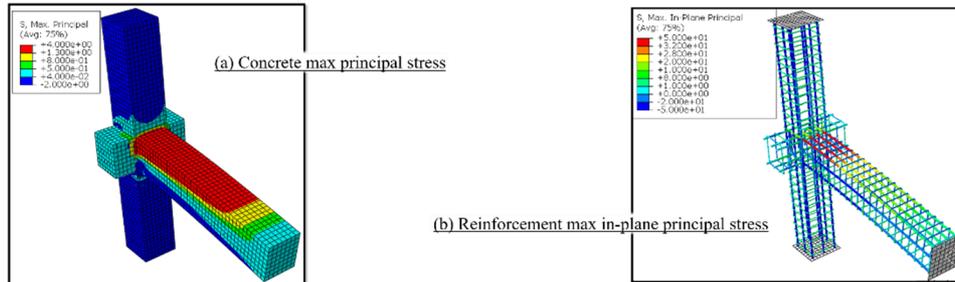
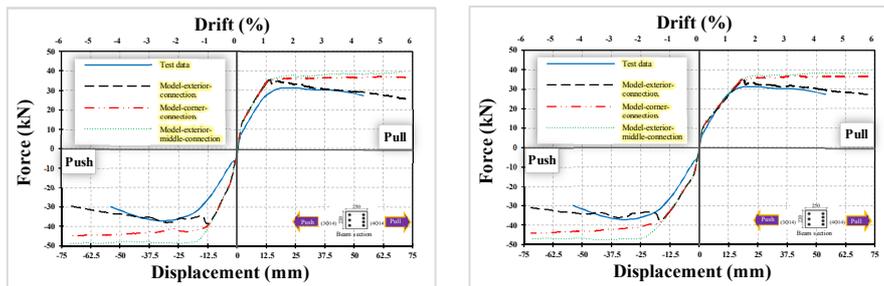


Figure 2. FEA outputs of the exterior middle beam column connection specimen C2.

The bond-slip effect is an important factor that influences the behaviour of the beam-column connections subjected to monotonic loadings (Alva & de Cresce El., 2013). Therefore, the effect of the bar slip is carefully considered in the numerical model (Feng et al., 2018).

As shown in Figure 3, numerical results showed that the use of finite element modelling in the proposed method is suitable for compatibility with experimental results which have been done by Shafaei et al. (2014) in terms of initial stiffness, maximum strength and ductility factor in monotonic lateral loading. Also it can be seen in Figure 3 that in non-seismic specimen, the presence of lateral beam due to the joint panel area confined improvement strength reduction in plastic deformation.



(a) Model C2 - without simulation of bond-slip effect (b) Model C2 - by simulation of bond-slip effect

Figure 3. Comparison of load–displacement curves of model C2 from experiment and numerical analysis in Different conditions of the lateral beam with and without bond-slip effect.

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