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ANALYTICAL MODELING OF CAP BEAM-COLUMN JOINTS IN ORDINARY RC MULTI-COLUMN BRIDGE BENTS IN IRAN

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INTRODUCTION

This paper presents nonlinear modeling of exterior and interior cap beam-column joints without transverse reinforcement in existing multicolumn bridge bents. Two experimental tests were conducted by Bahrani et al. (2017) and Khanmohammadi et al. (2016) for typical multi-column bents in Iran as generally designed by common regulation and construction practice of the 2000s. The tested specimen by Bahrani (2017) was a 1/3- scale specimen representing the top half portion of a three column bridge bent. The specimen was tested by Khanmohammadi (2016) was ¼- scale specimen representing four column bents. Both experimental tests showed that ordinary RC multi-column bents with inadequate detailing of cap beam-column joints were vulnerable to premature fractures when subjected to cyclic loading. Cap beam-column joints which lack transverse reinforcement (unconfined joints) were severely damaged during the tests. The tests also indicated that external joints were damaged more extensively than internal joints (Figure 1).

Figure 1. The experimental tests by Bahrani et al. (2017) and Khanmohammadi et al. (2016).

METHODOLOGY

Cap beam–column joints with no transverse reinforcement in the panel zone typically have a degrading moment-rotation envelope and a highly pinched hysteretic characteristic. Hence, the proposed analytical model for the joints was based on the model developed by Ibarra-Medina-Krawinkler (Ibarra et al., 2005) with pinched hysteresis response. Joint deformation generally consists of two independent contributions, the shear deformation of panel zone and the excessive rotation due to reinforcing bars slip. In the proposed model shear and bond-slip behavior was simulated by a single nonlinear spring in OpenSees platform (Altoontash et al., 2004). The effect of bond slip is taken into account thorough a reduced envelope for the cap beam-column joint moment-rotation relationship (Celik et al., 2008). The proposed backbone curves for external and internal cap beam-column joints are shown in Figure 2.

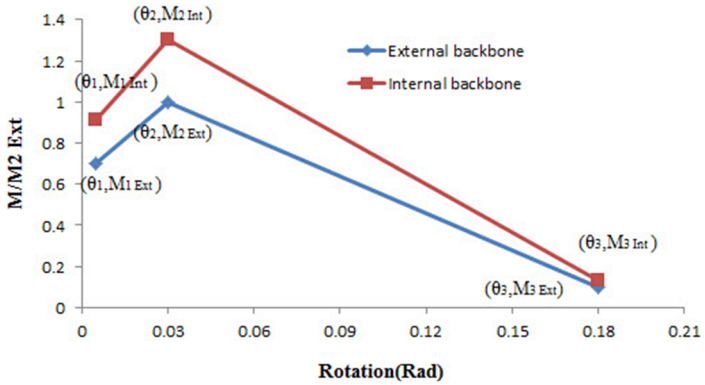

Figure 2. The backbone curve for external and internal cap beam-column joints.

RESULTS AND CONCLUSION

Analytical models were validated using two experimental test results. The analytical and experimental cyclic responses are compared in Figure 3. The nonlinear analysis responses were in good agreement with results.

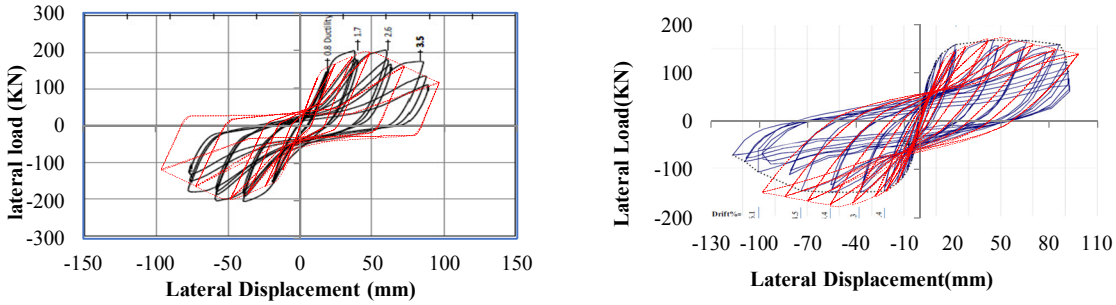

Figure 3. The model verification with proposed backboned curve.

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