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Strength and stiffness modeling of extended endplate connections with circular and rectangular bolt configurations

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Abstract. The results of a series of finite element (FE) simulations and experimental studies are used to develop strength and stiffness models that predict the failure capacity and response characteristics of unstiffened extended endplate connections with circular and rectangular bolt configurations associated with deep girders. The proposed stiffness models are composed of multi-linear springs which model the overall extended endplate/column flange system deformation and strength of key-components. Comparison of model predictions with FE and experimental results available in the literature show that the proposed models accurately predict the strength and the response of extended endplate/column system with circular and rectangular bolt configurations. The effect of the bolt configuration (circular and rectangular) on the prying phenomenon encountered in the unstiffened extended endplate/column system was investigated. Based on FE results, extended endplate with circular bolt configuration has a more ductile behavior and exhibits higher total prying forces. The proposed models can be used to design connections that cover all possible failure modes for extended endplate with circular bolt configuration. This study provides guidelines for engineers to account for the additional forces induced in the tension bolts and for the maximum rotational capacity demand in the connection which are required for seismic analysis and design.

Keywords: extended endplate; failure modes; circular bolts; finite element; strength and stiffness models; ductility

1. Introduction

Extended endplate connections have become the choice of many structural engineers in designing connections for moment resisting frames in seismic areas. Extensive experimental and analytical work on full-scale extended endplate connections was performed during the past three decades. Previous research work and experimental tests were developed to provide guidelines and recommendations for the design of extended endplate connections. Studies on the behavior of extended endplate connections for improving the ductility and strength of the connection were conducted earlier by Sumner and Murray (2002), Kiamanesh *et al*. (2013), and recently conducted by Akgőnen *et al*. (2015) and Ghassemieh *et al*. (2015).

Previous studies considered that the endplate thickness is a major parameter that affects the

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