8th National Congress on Civil Engineering, 7-8 May 2014
Babol Noshirvani University of Technology, Babol, Iran

Analytical Study on the Important Parameters Effective of Cyclic Behavior of Reduce Beam Section Moment Connections

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Abstract

The recent earthquake have been shown steel moment frame (SMF) with weld connections are so brittle. According to researches, the more damage were due to cracking of the weld between the beam flange and the column face and induced concentrated stresses in this area. A useful approach to reduce the stress concentration at the panel zone is using of reduce beam section (RBS). Given the enormous impact of seismic behavior and ductility of the panel zone, RBS moves plastic hinge formation at appropriate distance from column face. In this study, two bolted moment connections and welded connections, in both ordinary SMF and RBS, have been modeled and compared with each other during cyclic behavior by numerical method. This study show that the RBS connections are increased 25% and 30% the ductility of beam and panel zone on bolt moment connections and weld moment connections respectively.
Keywords: RBS connections, Cyclic behavior, Ductility, Panel zone

1. INTRODUCTION

The 1994 Northridge earthquake showed that the conventional moment connections are susceptible to unpredictable damage (Miller 1998 and Mahin 1998). Consequently, the moment frame, which was formerly recognized as a ductile seismic resistant system, is not capable to reach adequate ductility. The pre- and post-Northridge laboratory observation have also shown the inherent disability of the conventional moment connections to develop enough ductility (Engelhard and Husain 1993, Calado 2000)[8].

Since the Northridge earthquake, a number of various studies have been carried out in order to improve the seismic performance of the conventional welded connections. One of the most promising ways to modify the behavior of the conventional moment frame is to soften a portion of beam flanges near the column face (Plumier 1997, Engelhard et al. 1998, Yu et al. 1999, Yu and Yang 2001)[7]. The connection so softening may be accomplished trimming of circular selectors from the beam flanges near the column. This solution, so-called reduce beam section (RBS) method, leads plastic hinges toward the beam span away from column face, resulting in reduction of stress concentration at the interface of beam and column. However, as the consequence of reducing the beam section within a sensitive zone, the beam becomes more prone to buckling. Some studies have been conducted to assess key issues influencing the instability of RBS beams (Yang and Fan 1999, Yang and Fan 2001, Moslehi Tabar and Deylami 2005)[1]. Moslehi Tabar and Deylami (2005)[1] defined a new lateral slenderness parameter, which is in good agreement with the experimental data. According to this definition, the cyclic behavior of RBS beams is mostly affected by their lateral instability and the beam depth-to-length ratio. Column panel zone flexibility is another concern affecting the behavior of RBS connections. Tsai and Chen (2002) and Jones et al. (2002) experimentally illustrated that RBS moment connections with moderately strong panel zones show appropriate performance. Sang-Whan Han, Ki-Hoon Moon and Bozidar Stojadinovic (2009)(2010)[10,11] studied on design equations of RBS connections and found that RBS-B connection moment strength equation specified in FEMA-350 consistently overestimates the actual strength of the RBS-B connections measured in tests and the reduction of beam sections according to FEMA-350 may, therefore, be insufficiently to protect the RBS-B connections. This, in turn, may lead to RBS-B connection failure before a plastic hinge forms at the reduced beam section of the beam. Rahnavard and Siahpolo (2013)[2] have been study on bolt moment connections in both with and without reduce section. They made two model in Abaqus and compare them and also found that the RBS connection increase ductility of beam and panel zone.