Development of design criteria of welded moment connections with reduced beam section

Mohammad Davarpanah, Hamidreza Ronagh, Parham Memarzadeh, Farhad Behnamfar, Aug. 2020

One of the disadvantages of the reduced beam section (RBS) connection is the possibility of lateral-torsional buckling in the beam. Based on previous researches, reducing the cross-section along the web rather than the flange is one of the effective ways to prevent this phenomenon. In this study, a beam-column connection was introduced in which an elliptical opening was located in the beam web. The proposed connecting cycle behavior (RWS-E) was compared with a reduced beam section connection (RBS-R). The moment capacity of the E-RWS connection is about 8% more than that of the R-RBS connection. The effective stiffness and ductility ratio of the E-RWS connection are about 5% and 3% more than those of the R-RBS connection, respectively. In addition, numerical analyses were used to evaluate the nonlinear behavior of experimental specimens using Abaqus finite element software. A good agreement was found between numerical and experimental results. The performance of the RWS-E connection is better than the RBS-R connection in terms of strength, stiffness, ductility, energy dissipation and lateral-torsional deformation reduction. The ratio of the base shear at the drift angle of 0.06 to the base shear peak for the R-RBS frame and E-RWS frame is 0.52 and 0.72, respectively, which indicates a lower strength degradation of the E-RWS frame than the two other frames. This frame has undergone less strength degradation at higher drift ratios due to a less lateral deformation of the E-RWS frame than the R-RBS frame. According to the results of this study, a step-by-step design process for the E-RWS connection was presented. The results emphasized that, the creation of an elliptic opening in the beam web can replace the reduced-beam section connections as a suitable method, which can improve the seismic behaviors of MRFs.

Keywords: Beam with reduced flange section, Beam with reduced web section, Experimental study, Finite element analysis, Cyclic loading.