

Study of new method for retrofitting pre-Northridge connections by reducing beam section

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Summary

Many steel buildings suffered from fracturing of beam-to-column connections in the Northridge earthquake and Kobe earthquake. From the studies, it was indicated that most collapses in frames were due to cracking welds between lower beam flanges and column flange plates, and upper flange resisted because of the stiffness and strength contributed from floor slabs. So, in order to prevent cracking welds and consequently joint brittle fracture, various reinforcement methods can be utilized. One of these methods is lower beam flange cut in a certain section, because lower flange is usually available and is not inside concrete slab. Therefore, the connection is converted from a ordinary moment frame connection into a more ductile connection that can tolerate more plastic rotation, and, in general, structure ductility increases. Cutting form is similar to RBS (Reduced Beam Section) connection with radial cut. Here, we examined these models by ANSYS software. Studying hysteresis curves, we found that creating a RBS joint in lower beam flange in balanced model increases its plastic rotation by 30%. In addition, a applied force at panel zone (according to resistance of panel zone) is decreases. So it causes decreasing in plastic rotation at panel zone. Additionally, it is investigated the amount of beam energy dissipation in conditions before and after retrofitting.

Keywords: RBS connection, Moment frame, ductility, hysteresis curve, panel zone.

1. Introduction

After Northridge earthquake, most researches were directed toward making bending connections in steel structures more ductile. One of the different kinds of these connections is RBS (reduced beam section connection). In this kind of connection, reducing flange section near the end of the beam and within a definite length makes the plastic hinge move to the reduced part and expanding plastic hinge in the length of cut area causes a significant ductility in the plastic hinge. In fact reduced flange section acts like a fuse and prevents the initial cracks in the connection [1]. The most common kinds of RBS connections are: (i) RBS with straight reduced section, (ii) RBS with tapered cut reduced section, (iii) RBS with radius-reduced section [2, 3].

2. Investigating the accuracy of the analysis carried out by ANSYS and the experiments which are done

For investigating the accuracy of the manners according to the finite element modelling was done, the modelling of one of the experiments that has been done by Engelehardt [3] was compared with. In order to do so the DB4 was modelled and then the model underwent cyclic loading (see figure 1). The diagram for moment- rotation for this substructure is shown in figure 1-a.