C08

Seismic Capacity of Retrofitted Frame in Existing Steel High-Rise Buildings

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1. Introduction

When long period ground motions -hit, high-rise buildings would sustain large cumulative inelastic deformations. A large-scale shaking table test was conducted on a high-rise steel building The test results indicated a long-period ground motion generated fifteen times larger cumulative deformation that that generated by the design earthquake wave, which may result in multiple fractures. In this study, three types of retrofit methods are proposed to improve the seismic capacity of the damaged connections, and their performance are evaluated by a series of large-scale shaking table tests.

2. Test description

The test specimen, as shown in Figure 1(a), represented a twenty-one story steel high-rise. The test specimen consisted of a four-story frame structure that featured full-scale steel members and reinforced concrete slabs, and substitute layers that were placed on top of the frame and represented the upper stories. Within the four story steel frame, twenty-four beam-to-column connections were field-welded and retrofitted by the supplemental welds, wing plates and haunches as shown in Figure 1(b) to (d). In addition to the scaled design earthquake waves, long-period ground motions were inputted repeatedly until fractures of multiple connections to evaluate the retrofit performance of connections.

3. Test results

The retrofitted test specimen sustained scaled El Centro and Hog waves, which were equal to the level 2 seismic loading in the seismic design, and two more cycles of the largest synthesized long-period ground motion before fractures. Figure 2 shows the cumulative plastic rotations of connections. In comparison with the capacity of the unretrofitted connection, the cumulative plastic rotation capacity of connections was improved at least six times when the retrofit methods were applied. The retrofitted capacities were at least five times larger than the demand of the long-period ground motion.

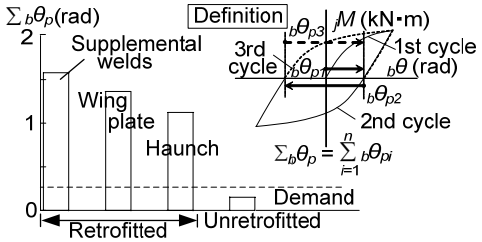
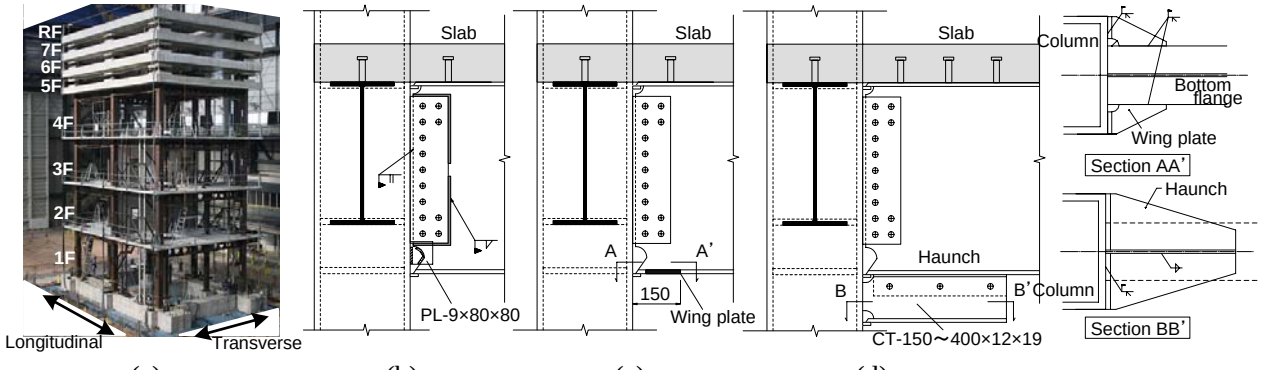


Figure 2 Cumulative plastic rotation of connections



(a) (b) (c) (d)

Figure 1 Test specimen: (a) Overview of test specimen; (b) Supplemental welds; (c) Wing plates; (d) Haunch