Effect of Steel Plate Jacketing of Columns in Seismic Behavior of Concrete Beam-Column Connections

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Abstract

Design philosophy of having weak beam – strong column is recommended almost in all design codes. But in some cases, in prior buildings, this philosophy is ignored. In these structures, during major earthquakes, failure mechanism would begin from columns leading to sever damages. To avoid this event, column in the connection zone must be strengthened to conduct the plastic zone to the beams. There is several ways for strengthening concrete columns and one of the efficient ways is using steel plates surrounding column in the critical zone. In this paper, using steel plates for seismic upgrading of Concrete Beam-Column connections has been investigated numerically. Effect of plate thickness, length and beam-column dimensions is taken into account. Some empirical results are used to verify the finite element approach. Analyses are conducted with the use of some modeling methods including various geometrical models and material behaviors. The results from various methods are compared and the suitable model is proposed.

Keywords: Finite Element Modeling, Concrete Damage Plasticity, Steel Plate Jacketing, Joints, Cyclic Behavior

1. INTRODUCTION

By updating building codes, some existing structures may not conform to current standards even though they may have been appropriately designed and constructed consistent with previous building standards. Therefore, strengthening of some elements may be necessary in the useful lives of structures. Preferably, the strengthening must not restrict the function of the structure.

A reinforced concrete (R/C) building in has usually been designed for a large earthquake load, which normally resulted in wide columns. Therefore, the damage within a beam-column joint was barely observed in the past earthquakes. However, the advancement of design calculation and the use of higher strength materials might reduce column dimensions, especially with the adoption of an ultimate strength design procedure relying on the ductility. Then, the beam-column joint may become the weak link of a chain.

A heavy damage in a beam-column joint should be avoided during an earthquake because (a) the gravity load is sustained by the joint, (b) a large ductility and energy dissipation is hard to be attained in the joint, and (c) a joint is difficult to repair after an earthquake. However, an excessive complication of reinforcement detailing should be avoided to assure good construction and workmanship. Therefore, joint shear failure should be prevented up to an expected structural deformation.

This paper discusses the strengthening procedure of joints using column steel jacketing. Some finite element models have been built and original model is verified with experimental results. Then, parametric analyses conducted to compare effects of various thickness and axial load levels on the hysteresis behavior of such connection.