Cyclic Response of Concrete Columns Reinforced with Smooth Reinforcing Bars with Various Splice Details

M. S. Marefat[1], A. Amrollahi Biucky [2], K. Karbasi Arani[3], S. M. Hassanzadeh Shirazi[4], M. Zahedi[5], M. Khanmohamadi[6], H. Zare[7]

1- Professor, School of Civil Eng., University of Tehran, Tehran, Iran.

2- MSc Student, School of Civil Eng., University of Tehran, Tehran, Iran.

3- PhD Student, School of Civil Eng., University of Tehran, Tehran, Iran.

4- PhD Student, School of Civil Eng., Clemson University, South Carolina, U.S.A.

5- MSc, School of Civil Eng., University of Tehran, Tehran, Iran.

6- Assistant Professor, School of Civil Eng., University of Tehran, Tehran, Iran.

7- Expert of Structural Lab., School of Civil Eng., University of Tehran, Tehran, Iran.

Abamrollahi@ut.ac.ir

Abstract

After recent earthquakes, concerns about seismic performance of old buildings have increased and special attention have been paid to reinforced concrete structures. Buildings which have been built before 1970s have been reinforced with smooth bars without considering seismic effects. To study the response them, three half-scale columns have been tested. Reinforcement details are similar to those of available old buildings with three types of splicing details: continuous longitudinal reinforcement, straight lap splice, and hooked end lap splice. The tests indicated hysteresis response, deformation capacity and strength of the mentioned columns. The initial response was that of sectional properties, over post yield range the behavior shows relatively low ductility, flextural crack pattern, and relatively large slip of reinforcement.

Keywords: old reinforced concrete building, column, smooth bar, load testing

1. INTRODUCTION

To assess vulnerability of aging concrete buildings reinforced by plain bars, three columns have been tested under cyclic load. Properties, details and dimensions of the specimens are similar to outdated building American and European codes [1, 2, 3] that has been wrote between 1940S to 1970S. To assess the behaviors of concrete buildings reinforced by plain bars some investigations have been carried out to know the seismic response of them. There are numerous reports of experimental and theoretical studies on reinforced concrete members with deformed bars [4], [5], but study of members reinforced with plain bars is limited. Fabbrocinoa et al. [6] reported some key aspects of structural models of smooth reinforcement for old-type RC frame. Results of experimental tests on smooth bars and circular hooks and anchoring devices are also used to discuss some aspects of behavioral models of beam-to-column critical regions. Fabbrocinoa et al. [7] did a series of tests on smooth bars. The tests aimed at describing in detail the force–slip relation for the bond mechanism of straight bars and of anchoring end details. Fabbrocinoa et al. [8] presented an insight on the assessment of relationships between crack width and reinforcement stress in the critical regions of existing concrete buildings, such as column base or beam–column joints, reinforced with smooth bars. Bond strength results from 252 plain bar pullout specimens have been presented by Lisa R. Feldman [9]. Parameters investigated include: concrete compressive strength, bar size, bar shape, concrete cover, and bar surface roughness. Empirical equations based on test results are presented to predict the maximum and residual average bond stresses for plain bars. Jianzhuang Xiao and Falkner [10] reported a series of thirty six pullout tests in order to investigate the bond behavior between recycled aggregate concrete and two types of steel bars, i.e., plain and deformed. According to the results, the bond strength between the recycled aggregate concrete and the plain rebar decreases with an increase of the recycled aggregate concrete replacement percentage, whereas the bond strength between the recycled aggregate concrete and the deformed rebar has no obvious relation with the recycled aggregate concrete replacement percentage. Cem Yalcin et al. [11] has