Ultimate Displacement of Reinforced Concrete Columns with Light Transverse Reinforcement

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This article presents the analytical and experimental investigations carried out on reinforced concrete (RC) columns with light transverse reinforcement. A semi-empirical model is developed to estimate the ultimate displacement (displacement at axial failure) of RC columns with light transverse reinforcement subjected to simulated seismic loading. The developed model is calibrated using the collected data of RC columns tested to the point of axial failure. A series of experiments is conducted on five RC columns with light transverse reinforcement to validate the applicability and accuracy of the developed model. It is concluded from the study that the mean ratios of the experimental to predicted ultimate displacement and its coefficient of variation are 1.077 and 0.194, respectively, showing a good correlation between the developed model and the experimental data.

Keywords Reinforced Concrete; Seismic Loading; Ultimate Displacement; Axial Failure; Column

1. Introduction

Structures consisting of reinforced concrete (RC) columns with light transverse reinforcement are very common in regions of low to moderate seismicity, and are the predominant structural system in Singapore. Recent post-earthquake investigations [EERI, 1999a, 1999b, 1999c; Moehle, 1991] have indicated that extensive damage occurred in such RC columns as a result of excessive shear deformation, leading to shear failure, axial failure, and full collapse of structures.

The literature reviews conducted have shown that extensive research studies have been carried out in various countries on ductile columns throughout past decades. However, there are limited research studies related to RC columns with light transverse reinforcement. Only a few researchers, namely Yoshimura and Yamanaka [2000], Lynn [2001], Sezen [2002], Nakamura and Yoshimura [2002], Yoshimura et al. [2003], and Ousalem [2003] studied the seismic behavior of RC columns with light transverse reinforcement up till its axial failure point (the point at which the column is unable to sustain its applied axial load). This has resulted in a limited understanding of the collapse mechanisms of RC columns with light transverse reinforcement.

The Nanyang Technological University (NTU) in Singapore conducted a research project with an aim to attain a better understanding of the collapse mechanisms of RC columns with light transverse reinforcement. A simple model is developed and presented.