SEISMIC PERFORMANCE COMPARISON OF MID-RISE MOMENT RESISTING FRAME AND SHEAR WALL SYSTEM

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ABSTRACT

Nowadays, RC structural systems are being used in construction industry worldwide. The observed response of medium rise building, based on post-earthquake damage assessment reports, during the latest earthquakes in the USA, Chile, Mexico and Japan have indicated that buildings including shear walls and dual structural systems behave considerably better during strong shaking. The viewpoint that shear walls are inherently brittle is still held in many countries (correspondingly in the codes) as a consequence of failures in poorly detailed RC walls. In this investigation, several RC frames, with and without shear walls, are designed according to the seismic codes, and then their nonlinear duplicates are exposed to a set of severe quakes. The time history nonlinear analyses results of these prototypes are then used to probe the effect of the existence of shear walls through using performance based design method. It is concluded that in general the existence of shear walls results in a noteworthy decline in the seismic deformation demand. These changes happened in both the plastic rotations in main RC structural members and the inter story drifts ratio. Hence, it is concluded that the existence of shear walls mostly improves the safety of medium rise RC frames within the assessment framework of performance based design codes such as ASCE41 (2006).

INTRODUCTION

Post-earthquake damage evaluation has shown that although buildings with shear walls had an appropriate overall performance in the last twenty years sever earthquakes, in some cases, columns as well as shear walls have been damaged, due to presence of short structural elements and inadequate transverse reinforcement. These memories amongst engineers have promoted this attitude that shear walls have brittle structural manner. Indeed, investigations on the nonlinear behavior of shear walls has shown that slender shear walls with flexural dominated behavior have a good seismic performance and resilience great enough to absorb earthquake's energy (Panagiotou et al. 2011; Zhang and Wang 2000; Ioannis and Michael 1990). These investigations also reveal that even squat shear walls could be designed in a way that their behavior would be similar to that of slender walls (Pilakoutas and Elnashai 1995; Salonikios et al. 1999). Considering these matters, designed shear walls with recent guidelines have high shear strength and also a respectable energy absorption ability which comes from yielding of longitudinal steel bars and boundary transverse reinforcement. The conviction that shear walls are inherently brittle still prevails amongst engineers, and therefore, they usually prefer to choose moment resisting RC frames without shear walls. In this study, couples of three, four and six stories 3D structures with and without shear walls have been linearly designed as a representative for low to mid rise buildings with concurrent Iranian buildings codes and for assessing the seismic performance of these designed buildings, nonlinear model of them have been reproduced in