SEISMIC EVALUATION OF DUAL HINGE DESIGN APPROACH OF RC SHEAR WALL IN DUAL STRUCTURAL SYSTEM CONSIDERING NEARFIELD EARTHQUAKES

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ABSTRACT

The impact of higher modes on the seismic response of dual structural system consists of concrete moment-resisting frame and RC shear walls is investigated against near-field earthquakes in this paper. a 20-story RC shear wall-special moment frame structure is designed in accordance with ASCE7 requirements and Nonlinear time history dynamic analysis with 2 near-field records is performed on them .In order to further understand the structural collapse behavior in the near field earthquake, the response of the structure at the moment of collapse especially the formation of plastic hinges is explored.

The results revealed that the amplification of moment at the top of shear wall as a consequence of higher modes, can cease formation of the plastic hinge in the upper part of wall in spite of the fact that it designed and detailed for plastic hinging at the base only (according to ACI code). On the other hand, shear forces in excess of capacity design values can develop due to the contribution of the higher modes can result in brittle shear or sliding failure modes.

The past researches on shear walls clearly showed that the dual plastic hinges design approach is effective at reducing the effects of the second mode of response. An advantage of this concept is that, when combined with capacity design, it can result in relaxation of special reinforcing detailing in large portions of the wall. In this study, to investigate the implications of multi hinge design approach, four models with various arrangements of plastic hinges at the base and along the height of the shear wall are considered. The time history analyses showed that the dual or multi plastic hinges approach can be useful in order to control the high moment and shear demand of higher mode effect.

INTRODUCTION

With the development of earthquake and structure sciences, structure codes and seismic provisions are being updated, but there are still many aspects that are not fully understood due to the random nature of earthquake motions as well as the complex features of higher mode effects on reinforced concrete structures.

Dual system, designed to provide greater strength and ductility, is one of the most common structural system especially in the tall buildings.

Past studies has revealed that in high-rise buildings, in addition to first mode, second and third structural modes can also have a considerable effect on performance of structures in earthquakes. DerechoA.T et al (1981)showed that higher dynamic modes, have a significant effect on the behavior of cantilever shear walls in high-rise buildings, and can considerably amplify the bending moment demand in the wall. Priestley and Amaris (2002)mentioned the amplification in bending moment and shear forces along