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Seismic Performance of High-Rise RC Shear Wall Buildings Subjected to Ground Motions with Various Frequency Contents

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Abstract

Construction of tall buildings in societies is rising up for the increased population and limitation in horizontal expansion of cities. Therefore, behavior of these structures against earthquake essentially requires investigation. Recent research has shown that frequency content parameter of an earthquake has remarkable impacts on seismic response of buildings. This study aimed to investigate direct effects of frequency content on high – rise buildings. Thus, six Reinforced Concrete (RC) central core 10, 15, 20, 25, 30, and 35- story buildings were built in open source software OpenSees, and their seismic behavior under seismic records with various frequency contents were investigated. In this research, non – linear dynamic Time – History was carried out and also behavior of buildings was compared in drift, shear force of stories, and maximum displacement of stories. Results of Time – History analysis showed that low – frequency content records have the highest effects on buildings. Most of the responses of drift and displacement of stories pertained to low – frequency contents in low – rise 10 and 15-story buildings. Although the most shear force of stories was related to low – frequency contents, with increasing height of buildings, shear force of stories increased, too. So that under Kobe Japan record which has the lowest frequency content among all records in this paper. Maximum shear force of stories was 6840 ton in 10-story building, whereas it was 12332 ton in 35- story building.

Keywords: Seismic Performance; High-Rise Buildings; Reinforced Concrete Shear Walls; Frequency Content.

1. Introduction

Since the late nineteenth century, structural engineering in conjunction with high-rise buildings has greatly improved. The use of different components, various structural systems, and more height are examples of these advances. In terms of structure, tall structures require appropriate structural solutions in order to provide adequate stability and rigidity. As a matter of fact, while in designing short buildings the impacts of dead and live loads are the main factor, by increasing the height, the focus of structural engineers is on controlling horizontal displacement. Properly designed shear walls have shown acceptable seismic performance in many tests conducted [1, 2] and also, numerous analytical studies have been carried out by researchers on shear walls [3-5]. Additionally, the shear wall system seems economical for 30 to 40- story buildings. Above this height, the stresses resulting from lateral force necessitate a reduction in the required thickness for the shear walls, and this is rather cost-effective [6]. High-rise buildings with reinforced concrete shear walls and core layout are suitable for structural engineers because, comparing high-rise buildings with other systems resistant to horizontal forces, the benefits

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