Seismic Response of Dual Systems in Tall Buildings Under Influencing Pulse Type Earthquake Records

Hamed Movahed[1], Afshin Meshkat-Dini[2], Mohsen Tehranizadeh[3]

1- MSc. Graduated, Earthquake engineering, Amir-Kabir University of Technology, Tehran, Iran.

2- PhD. Graduated, Structural engineering, Amir-Kabir University of Technology, Tehran, Iran.

3- Professor of Civil Engineering, Amir-Kabir University of Technology, Tehran, Iran.

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h.movahed60@gmail.com
a_meshkat@yahoo.com
m.teh.2008@gmail.com

Abstract

In this paper characteristics of the seismic response of dual systems used in tall buildings as earthquake resistant systems are presented. The results are discussed based on conducting a number of non-linear dynamic time history analyses which were executed according to some chosen strong earthquake records. The tall building structural models are consisted four 30-story frames; steel Special Moment-Resisting Frame with Shear Wall and steel Special Moment-Resisting Frame with Concentric Braced Frame. The structural models have been designed for lateral seismic load according to the Iranian seismic code 2800 (3rd Edition). To evaluate the aseismic response properties of all structural models, the non-linear analyses have been conducted according to three different groups of earthquake records which are classified based on the type of velocity pulse or pulses would be appeared in their time history. It is totally concluded that both general parameters i.e. the structural systems and the distinct characteristics of strong earthquakes, especially coherent velocity pulses can obviously affect the seismic responses of tall buildings. Hence it is important to taking into account the effects of the kinematic energy imposed by the near field strong earthquakes on response parameters of tall buildings.

Keywords: Seismic response, Dual system, Tall building, Near-field, Velocity pulse.

1. INTRODUCTION

After several strong ground motions, in two last decades, which caused serious damage to structures in near-field areas, attention on the effects of near-field earthquakes has increased. On the other hand, addition to the ground motions, seismic behavior of structures for example maximum inelastic displacement depends on its inherent properties [1]. These properties can be defined the type of lateral resistant systems and the height of structures as well as the kinematic energy imposed by the strong earthquakes. Despite some limitations that walls and braces impose with regard to the architectural design, dual systems are currently a common choice for buildings. Dual systems are commonly used in tall buildings with the aim of increasing the resistance to lateral loads [2,3].

Seismic response of dual systems used in tall buildings as earthquake resistant structures is studied in this paper. Four 30-story frames in group of tall buildings that are consisted of steel special moment-resisting frame with shear wall and steel special moment-resisting frame with concentric braced frame have been designed for seismic lateral load according to the Iranian seismic code 2800 (3rd Edition) [4]. The sections, joints and members of all models have been designed according to the Iranian national building code; concrete structures (Part 9) [5] and the Iranian national building code; steel structures (Part 10) [6].

Three different groups of strong ground motions have been chosen for the non-linear dynamic time history analyses. These earthquakes are consisted of six records which have been classified based on the type of velocity pulse or pulses in their time history. The earthquake record groups involve; groupe1: near-field earthquakes with long period coherent velocity pulse, groupe2: near-field earthquake with non-coherent velocity pulse and groupe3: far-field earthquakes without any velocity pulse.