Seismic Pounding between Adjacent Concrete Frames

Roya Moghabeli[1,1*]- Hossein Parastesh [2] - Hamid Lotfollahian [3]- Mohammad Parvaresh [4]
[1]Msc student of science and culture University of Tehran, E-mail: roya.moghabeli@gmail.com.
[2]Assistant Professor, Technical and Engineering department of science and culture University of Tehran.
E-mail: parastesh@usc.ac.ir
[3]PhD, Gazi University of Ankara, E-mail: hamid_19732002@yahoo.com
[4] Msc student of Islamic Azad University, Maraghe branch, E-mail: m_parvaresh90@yahoo.com

ABSTRACT

Investigations of past and recent earthquake damage have illustrated that the building structures are vulnerable to severe damage and/or collapse during moderate to strong ground motion. Among the possible structural damages, seismic induced pounding has been commonly observed in several earthquakes. During an earthquake, different seismic behavior of adjacent buildings, causing the collision and impact which are critical loading conditions in comparison with no-collision condition causes. Amount of buildings without construction join, increases the importance of investigating this issue. In order to evaluate the effect of impact force on the seismic performance of RC frame structures, two buildings of 6 and 12 story reinforced concrete frame were selected and their seismic performance under the impact of the collision phenomenon is examined. At first frames were designed in SAP software and then have been modeled in OpenSEES software with different heights, hardness under earthquake records, and were analyzed by a set of nonlinear dynamic time history analysis. Then seismic response of these models is investigated through base shear and roof displacement.

Keywords: adjacent buildings, Seismic pounding, separation distance, nonlinear dynamic analysis.

1. INTRODUCTION

Earthquake leads to pounding of adjacent buildings with limited gap with different dynamic properties. This phenomenon as defined as structural pounding creates damage and collapse of buildings. To avoid this phenomenon in earthquake, seismic codes have considered the minimum seismic gap in adjacent buildings as obligatory. In most of existing buildings not designed based on new seismic codes or those without separation joint in execution or those with unsuitable materials in the gap between the structures, we can expect seismic –induced pounding. The damages of pounding were observed in most of the past earthquakes as Mexicocity (1985), Loma Prieta (1989), Nortridge (1994), Turkey (1999) and Italy (2009).

By development of numerical methods and non-linear analytic tools of structures, numerical simulation of structures pounding in recent decade has been considered mostly. AbdelRaheem by a set of three earthquake records evaluated the seismic-induced pounding of adjacent buildings as numerical [1]. Dogan and Gunaydin performed numerical simulation of the effect of gap between structures on contact force of two structures [2]. Shakya et al. investigated the effect of interaction between soil and structure on seismic-induced pounding of adjacent reinforced concrete [3]. In these studies, the pounding effect is simulated by simple linear models, Hertz model or non-damping model.

The present study attempted to model adjacent reinforced concrete frames in case of level difference between the adjacent floors and evaluates their behavior with Elcentro record under non-linear dynamic analysis and also pounding of structures is studied. To perform dynamic non-linear analyzes, OpenSEES software is applied [4]. This software with a set of different non-linear elements can analyze different structural systems of reinforced concrete and soil and it is designed in Berkly University of California. For analysis of structures pounding, a collision spring contact element with simulation ability of compressive force transfer with non-linear behavior after occurrence of contact and equivalent non-linear damping is introduced. The studied structural frames are simulated by non-linear elements and fiber sections and can simulate elastoplastic behavior. Thus, contact element is a node to node element and is applied in probable pounding sites of two structures [5].

* [1] **Corresponding author: Science and technologhy center of Ardabil municipaty, Ardabil, Iran**