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Improving Seismic Performance of Concrete Buildings with Special Moment Frames Using Viscose Damper

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Abstract

The present study attempted to investigate the effect of viscose damper on the performance of 10 and 16-story structures. Data modeling was done based on PERFORM 3D software and energy absorption amount was examined in different modes through viscose dampers. To investigate the effects of the so called dampers on the seismic behavior of the structures, the performance of special moment frames with and without viscose damper with the protection power of 20% to 30% against earthquake damages was considered. Also, hysteresis diagram was studied. The research findings revealed an appropriate effect of viscose dampers on decreasing seismic effects of earthquake such that the structure with damper showed significant energy depreciation in comparison with the structure without damper and the damper with higher damping force plays a more effective role in increasing energy depreciation. Therefore, viscose dampers with higher damping percentage (30%) have a good capability to retrofit structures.

Keywords: Viscose Damper, Special Moment Frame, Concrete Buildings

1. INTRODUCTION

In seismic retrofitting of structures, using dampers are of the methods decreasing the lateral force and increasing the energy loss due to earthquake [1, 2]. The phenomenon in which the amplitude of vibration is gradually decreased is called damping. In damping, the vibrational kinetic energy of the system is depreciated due to various mechanisms [3]. Some of the most commonly used dampers include viscose and viscoelastic dampers and frictional and metal dampers [4]. With non-similar dynamic characteristics, these dampers show different performances against earthquake input energy [5]. As one of the characteristics of viscose dampers, their ability in depreciating earthquake input energy against a wide spectrum of simulation frequencies can be mentioned [6]. Viscose dampers present a strategy to absorb earthquake energy. In viscose dampers, energy is depreciated by moving viscose liquid inside the cylinder; this liquid is a non-flammable kind of silicon (the oil containing oxygen and quarts). Viscose dampers are highly used in seismic retrofitting due to ease of installation, compatibility with other members, various sizes, high water absorption, and lack of deformation in structure [7, 8]. Moment frames bear the lateral loads by rotating nodes through creating anchor and cut in the frame member. Furthermore, due to reverse anchors created by the lateral forces, the axis forces are created in the frame`s columns [9]. Moment frames mostly resist against the lateral loads due to nodes' rotation; therefore, displacing or changing the lateral places of such frames is significant against strong earthquakes [10]. During the recent years, many efforts have been done to develop the concept of inactive energy depreciation or additional damping and a lot of these equipments have been installed on structures all around the world [11]. Although it is very difficult to fully avoid the resulted damages due to strong earthquakes, losses and damages due to the future earthquakes can be decreased to a great extent by increasing the security level of structure and the percentage of the wasted energy through proper retrofitting and immunizing. The present paper tends to investigate the seismic behavior of reinforced concrete special moment frames with viscose dampers under different earthquake effects. Viscose dampers can be used in seismic retrofitting of reinforced concrete special moment frames which are vulnerable against earthquake as well as in enhancing their seismic performance. To study the effects of these dampers in structures` seismic behavior, the performance of special moment frames with and without considering damper against earthquake was investigated.