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STUDY ON SEISMIC ANALYSIS OF BUILDINGS USING COMBINATION OF DIFFERENT ISOLATION SYSTEMS

Ali MOEINADINI
PhD Student, Department of Earthquake Engineering, Science and Research Branch, Islamic Azad University, Tehran, Iran
a.moeinadini@srbiau.ac.ir

Masoud NEKOOEI
Assistant Professor, Department of Earthquake Engineering, Science and Research Branch, Islamic Azad University, Tehran, Iran
nekooei@iiees.ac.ir

Sobhan ROSTAMI
PhD Student, Department of Civil Engineering, Shahid Bahonar University of Kerman, Kerman, Iran
rostami_sobhan@yahoo.com

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The basic idea of base isolation system is to reduce the earthquake induced inertia forces by increasing the fundamental period of the structure (Trevor and Kelly, 2001). The aim of this study is the use of Lead rubber bearing (LRB) and friction pendulum system (FPS) as an isolation device and then to compare various parameters between fixed base condition and base isolated condition. With an aim of better including/understanding the effect of the emplacement of these devices on the response of the structures, the comparative studies were carried out in this article. The analysis is carried out by three comparative studies: the 1st between a fixed base structure and a base isolated (FPS and LRB) and the 2nd comparative study between two base isolated structures, respectively LRB and FPS and the 3rd between combination of isolation systems.

The structure used in our study is a building of reinforced concrete of 4 levels with rectangular form in plan including three spans respectively in the two directions, longitudinal and transverse (Figure 1). A dynamic analysis of the response by time history is used for the three types of studied structures (at base fixes and base insolated, LRB, FPS, LRB+FPS). We considered an excitation of the the El Centro 1940 and another Northridge earthquake 1994.

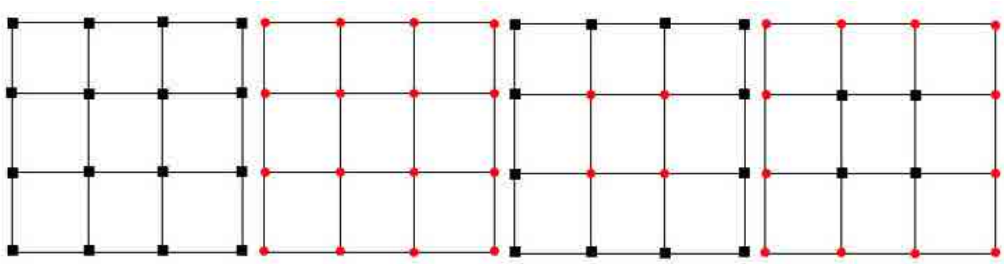

Figure 1. Plan view of the building being isolated and various emplacements of the seismic base isolation

Three different isolation systems were investigated when mounted separately and when mounted in combination. From this research, it was demonstrated that the use of base isolation is an advantageous technique to diminish significant damages in structural elements and contents by avoiding the total transmission of the ground motion into the superstructure (Kelly and Farzad, 1999). Isolate the structure at its base lengthens the first period, hence provides high flexibility to this latter and shifts the structure from the dominance and severe region of ground motion, the lengthening of period was about 3 times (Soong and Dargush, 1997). The dynamic analysis carried out for the structures enabled us to compare the results of displacements, accelerations of last level, and the base shears in the two directions (X) and (Y). Displacement results are represented as follows:

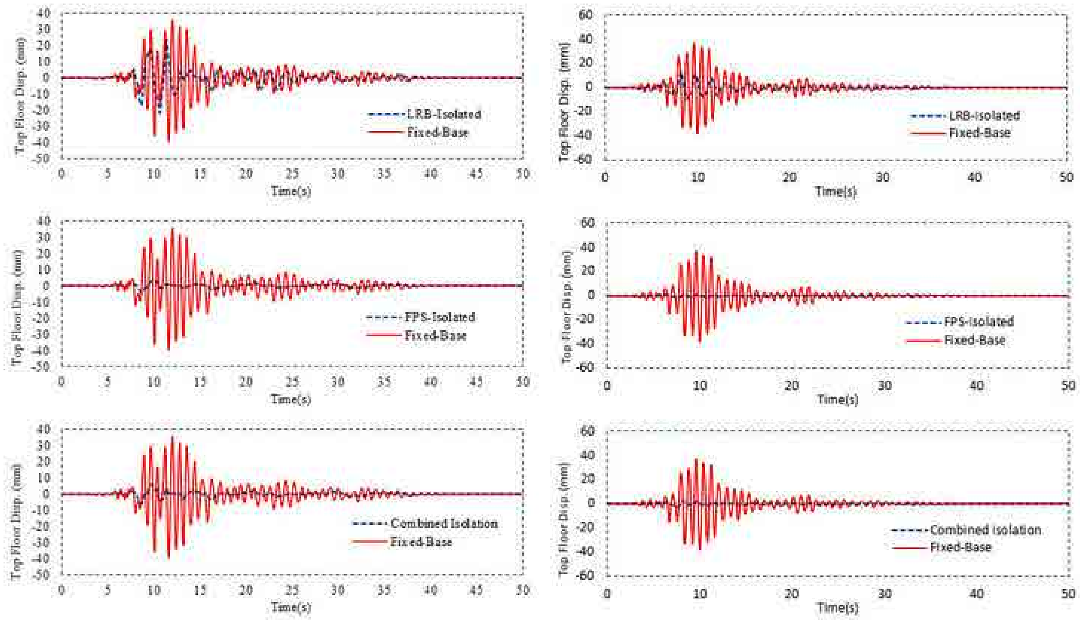

Figure 2. Comparison of top level displacements of structures in X direction

Table 1. Comparison of top level displacements for various emplacements of the seismic base isolation

Earthquake	Fixed-Base Disp.(mm)	LRB-Isolated Disp.(mm)	FPS-Isolated Disp.(mm)	LRB+FPS-Isolated Disp.(mm)
El centro	39.6069	23.67	3.8827	6.29626
Northridge	38.6118	12.48	1.63686	3.18123

This analysis carried out by three comparative studies, the 1st between the fixed base structure and the base isolated structure (FPS and LRB) and the 2nd comparative study between two isolated structures, respectively LRB and FPS and the 3rd between two isolated structures with (FPS+LRB). The isolated structure by FPS system decreases displacements, accelerations and shear forces compared to the structure isolated by LRB. The isolated structure with (FPS+LRB) combined system decreases the displacements and shear force compared to the isolated structure with LRB system and isolated structure with (LRB+FPS) combined system.

From this study, we conclude that the use of FPS as a unique isolator is a good idea when the total cost is considered as an important thing. However, combining the FPS with a rubber-based isolator provides a good seismic isolation to the structure, diminishes the total cost. In addition, the number and the location of the FPS at the base of a structure when is combined with a rubber-based isolator affect the response of the structure.

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