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# COMPARISON OF VARIOUS SLIDING BEARINGS UNDER NEAR FAULT GROUND MOTIONS

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There are several methods to reduce the induced damage in structures (Naeim, 1999): 1) using the concept of elastic design, 2) using the concept of base isolation or energy dissipation. Base Isolators are used for four decades to reduce the earthquake demands in structures such as buildings, lifeline structures and bridges. Sliding bearings and elastomeric bearings are two common type of Base Isolators. Although there are several studies about sliding bearings, there are lacks of study on the behavior of the sliding bearings under near fault ground motions. Near fault ground motion has special characteristic due to long period component and can cause excessive damages compare to far fault ground motions.

The first generation of Friction Pendulum System (FPS) was introduced by Zayas et al. in 1987 (Zayas et al., 1987). They did shake table test on FPS isolated buildings and found that the FPS provide a simple and effective way to achieve earthquake resistance for buildings (Zayas el al., 1987). Later on, Pranesh and Sinha introduced the variable frequency pendulum isolator (VFPI). They describe the mathematical formulation for a response of a SDOF structure and found that the VFPI is fully effective in reducing the responses (Pranesh and Sinha, 2000). Theoretical and experimental study of sliding isolators with variable curvature (SIVC) was done by Lu et al. (Lu et al., 2011). They demonstrated that the SIVC is able to effectively reduce the isolator drift (Lu et al., 2011).

The aim of this paper is to scrutinize the seismic behavior of various sliding bearings such as FPS, Sliding Isolators with Variable Curvature (SIVC), Variable Frequency Pendulum Isolator (VFPI) under near fault ground motions. For this purpose, a single degree of freedom system (SDFs) is considered and subjected to various near fault ground motions. Finally the results of the structure are compared with both fixed and isolated conditions. Furthermore the results of each isolator are compared. The considered results are: roof acceleration and displacement, bearing displacement and base shear. For the required analysis, at first, the equations of motions are derived and then these equations are solved using state-space method. The nonlinear time history analysis is conducted out by employing MATLAB (The Mathworks, Inc., Natick, Massachusetts, United States) program.

The ground motions are scaled to represent BSE and MCE code-based design spectrum of Iran seismic code (standard 2800-third edition). The properties of considered ground motions are presented in Table 1.

The SDOF superstructure considered to be isolated has the same mass, stiffness and damping properties as the superstructture in the Fenz and Constantinou (Fenz and Constantinou, 2008). So the total weight of the structure, stiffness and damping is W = 116, 800 kN, ks = 283 KN/mm and cs = 2.07 kN-sec/mm.

Table 1. Properties of near fault ground motions

| Record No. | Earthquake | Station | Distance to fault (km) | PGA(g) |
|---|---|---|---|---|
| SN-10 | Loma Prieta | Gilroy - Gavilan Coll. | 9.96 | 0.29 |
| SN-16 | Northridge | Newhall – Fire Sta. | 5.92 | 0.723 |
| SN-17 | Northridge | Newhall – W Pico Canyon Rd. | 5.48 | 0.425 |
| SN-18 | Northridge | Rinaldi Receiving Sta. | 6.5 | 0.869 |
| SN-20 | Northridge | Sylmar – Converter Sta East | 5.19 | 0.828 |
| SN-22 | Kobe | KJMA | 0.96 | 0.854 |
| SN-23 | Kobe | Takarazuka | 0.27 | 0.645 |

Figure 1 shows the structure acceleration in both fixed and isolated conditions with various isolators under Loma Prieta BSE ground motion. The results show that the FPS, VFPI, VCFP-6th order and VCFP-4th order reduce the structure acceleration 75.94%, 76.67%, 76.28% and 76.28%, respectively. Therefore VFPI has the best performance under Loma Prieta BSE ground motion.

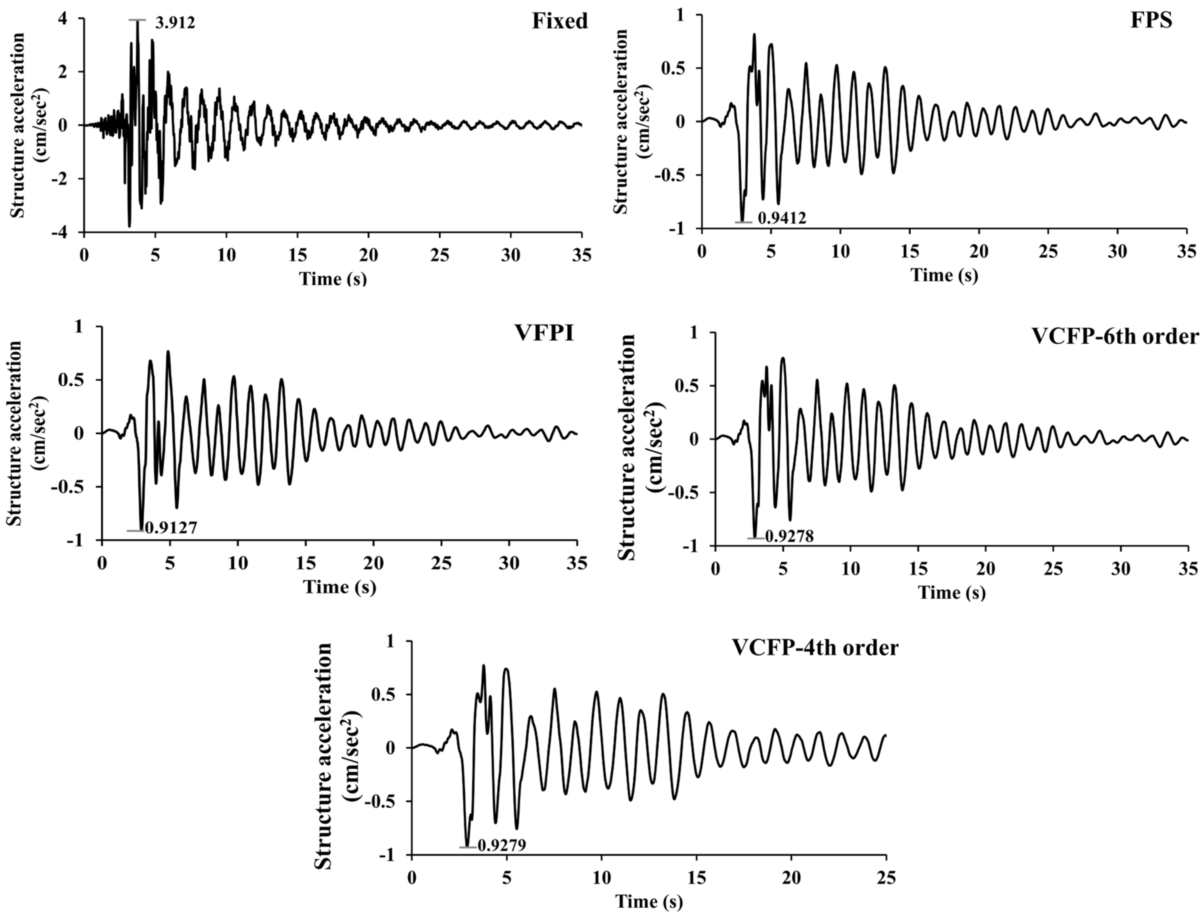


Figure 1. Structure acceleration in fixed and isolated condition

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