BEHAVIOR OF SLIDING ISOLATORS WITH VARIABLE FRICTION UNDER NEAR-FAULT EARTHQUAKES

Ali Akbar SHAIKHZADEH
Graduate Student, Ferdowsi University, Mashhad, Islamic Republic of Iran
ali.shaikhzadeh@stu.um.ac.ir

Abbas KARAMODDIN
Assistant Professor, Ferdowsi University, Mashhad, Islamic Republic of Iran
akaramodin@yahoo.com

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One of the ways to make FPS adaptable is to make its friction coefficient variable. For a sliding isolator with variable friction (SIVF), the sliding surface may have a constant radius, but the friction coefficient of the isolator is assumed to be a function of the isolator displacement which results in adaptive damping that varies along the isolator displacement.

On the basis of this theory, Variable Friction Pendulum System (VFPS) (Panchal and Jangid 2008) have been introduced. The VFPS is very similar to FPS except that the friction coefficient of FPS is considered to be constant whereas the friction coefficient of VFPS is varied in the form of a curve shown in Figure 1. However, such variation of coefficient of friction seems to be difficult and impractical for an isolator to achieve in the real world.

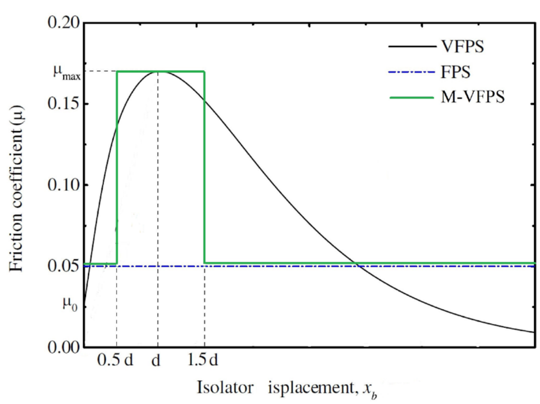

Figure 1. Comparison between friction coefficient of FPS, VFPS and modified VFPS

The present study defines a modified variation of coefficeint of friction such that it is identical to FPS all through the isolator except in the displacement range from 0.5d to 1.5d (d is the isolator displacement corresponding to peak friction coefficient of VFPS) through which the coefficient of friction is μ_{max} of VFPS as shown in Figure 1. This leads to a modified VFPS (M-VFPS) isolator which is more practical to be used.

An idealized 2-DOF shear building with an isolation system modeled by a nonlinear friction element and a variable spring element is simulated by using a general mathematic model, as shown in Figure 2. The superstructure chosen to be isolated has the same mass, stiffness, and damping properties as the superstructure in the Pranesh and Sinha research (Pranesh and Sinha, 2000). Moreover, a set of seven near-fault earthquake excitations, recommended for evaluation of smart base isolated building (Narasimhan et al., 2006) are considered for evaluation purposes with two main aspects governing effectiveness of isolator: (1) base displacement and (2) super-structural acceleration.The dynamic equation of motion of the idealized model in Figure 2 can be expressed in state-space form (Lu and Yang, 1997).

The first order ordinary differential equations obtained from state-space formulation of equations of motions are solved simultaneously using the *ode15s* solver in MATLAB.

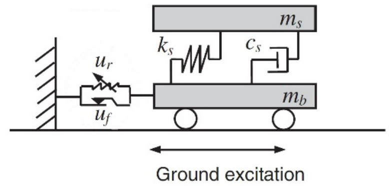

Figure 2. The mathematical model for simulating a SIVF-isolated structure

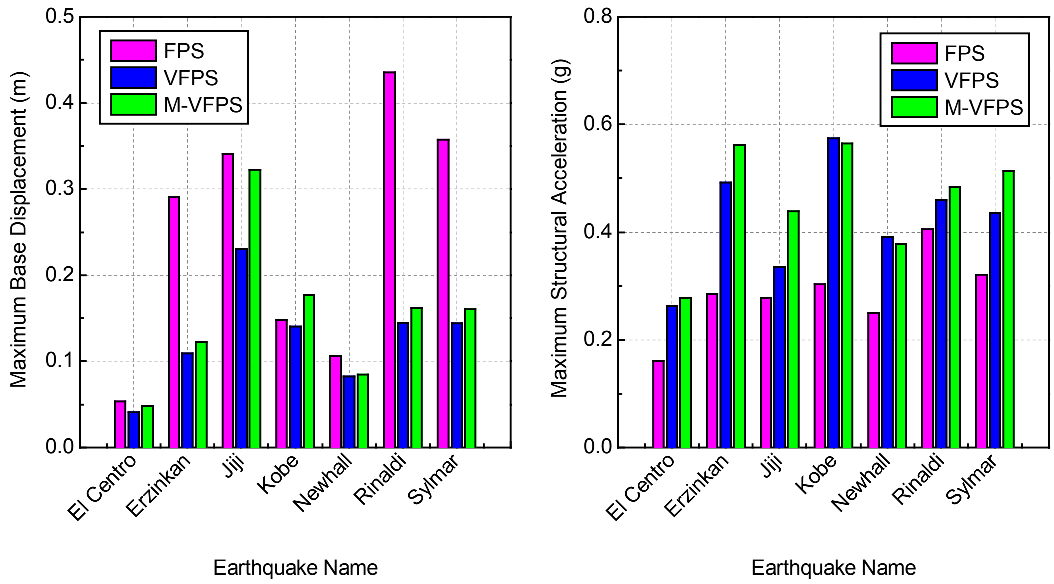

Figure 3. Comparison of maximum responses of FPS, VFPS, and modified VFPS

Figure 3 indicates that the seismic behavior of M-VFPS is close to that of VFPS under nearly all the earthquakes. Therefore, the M-VPFS isolator is proved to be a good practical alternative to VFPS. Moreover, as shown in Figure 3, in comparison to the seimsic behavior of the conventional FPS, both VFPS and M-VFPS behave well in reduction of base displacement while they do not show a good performance in controlling of the transmitted acceleration to the super-structure.

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