Comparing the Efficiency of Seismic Isolation and Seesaw Motion in Multi-story Regular Steel Buildings for Achieving the Immediate Occupancy Performance Level

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ABSTRACT
There are some important buildings which their performance level (PL) should not be lower than immediate occupancy (IO) based on the recent seismic design codes. The most common way for achieving this PL is using seismic isolation technique. However this technique has not been acknowledged worldwide so much, particularly in developing countries, mainly due to the high cost and the relatively large required free space around the building which is not usually acceptable for the buildings' owners. Another approach for achieving IO PL, proposed in recent years, is using a structural system which can have seesaw motion during an earthquake, and at the same time dissipate a major part of the input energy in its specific dampers or structural fuses, which can be easily replaced after the earthquake. The building with such a system which can be called 'seesaw building' needs to have, in addition to the structural fuses, a specific central support and a grid of strong girders at its lowest floor. These additional components add some cost to the costs of the building's structural system. The aim of this study is comparing the efficiency of common seismic isolation technique with that of the seesaw building, from both seismic performance and construction costs aspects. Special attention has been paid to the near-field earthquake to which the common isolation systems are weak. For comparing the seismic behaviors of the two systems, responses of the considered counterpart buildings have been obtained by a series of nonlinear time history analysis by using a set of selected far- and near-field earthquakes. Numerical results show that the seesaw building generally behaves better than isolated buildings, with less lateral displacements, and its cost is relatively lower as well. The only shortcoming of the seesaw building is its very little residual displacement at the end of the earthquake, which necessitates some attempts for bringing it back to the original position.

KEYWORDS: Repairable building, Structural fuse, nonlinear time history analysis, Near-field earthquake

1- Introduction

In structural engineering, the mitigation of damage induced by large loads is of paramount interest. Especially in seismic regions, earthquakes pose a serious threat to human lives and the integrity of the infrastructure. Passive energy dissipating systems such as viscous dampers, tuned mass dampers and base isolation systems have been installed in new or existing buildings (Noroozinejad and Adnan 2012, Matta 2011, Konara and Ghosh 2010, Fujita et al. 2010a,b, Patel and Jangid 2011, Silvestri et al. 2011, Abbas and Kelly 1993, Ahlawat and Ramaswamy 2000, Aiken et al. 1990, Ashour and Hanson 1987, Bhaskararao and Jangid 2006, Chang et al.