Application of Smart Isolation Technology: A Piezoelectric smart isolation system

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Abstract

Seismic isolation technology has been developed for decades and proven to be one of practical and effective means for seismic protection of equipment or structures. A conventional passive isolation system usually has constant system properties (such as isolation frequency and damping) that must be designed according to a given design earthquake. Due to the unpredictability of earthquakes, a conventional isolation system usually can not perform satisfactorily in an earthquake that is considerably different from the design seismic load. Actually, recent studies have revealed that that when a conventional isolation system is subjected to an unusual seismic event, such as a near-fault earthquake or earthquake with sever intensity, the system may incurs an excessive system response and endanger the isolated engineering object. On the other hand, there are some applications, such as critical facilities or precision equipments, which are very sensitive or vulnerable to external vibration and require more stringent seismic protection than the specified in the design codes.

In view of the above problems, smart isolation technology that incorporates smart materials or semi-active control technology in seismic isolation systems may provide one of the solutions. Due to its adaptive nature, the system properties of a smart isolation system can be adjusted according to the current system response or the seismic load, so the isolation performance can be improved in a wider range of earthquakes. In this research, an example of smart isolation systems, called Piezoelectric Smart Isolation System (PSIS), is investigated. The PSIS isolation system has variable friction damping that can be adjusted by an embedded actuator made of piezoelectric material. The piezoelectric material, which has the advantages of being lightweight, low energy demand, swift response, good durability and reliability, is a perfect candidate to offer the actuation capability for seismic vibration

control. The feasibility and performance of the PSIS has been verified experimentally via a shaking table test in this research.

Bibliography

Lyan-Ywan Lu received his Ph.D. degree in Civil Engineering from Duke University (Durham, NC, USA) in 1991. After returning to Taiwan in 1992, he joined the National Center for Research on Earthquake Engineering, and served as an associate research fellow. He is currently a professor of the Department of Construction Engineering at National Kaohsiung First University of Science and Technology (Kaohsiung, Taiwan), where he has been joined the faculty since 1999. His research has been primarily in the areas of seismic isolation, smart structures, semi-active control, dynamic testing, etc. He has published more than forty research articles in peer-reviewed journals, and holds several invention patents about innovative seismic isolation systems or energy dissipation devices.