An energy-robust nonlinear energy sink with inerter

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Abstract

This paper presents an inerter-enhanced nonlinear mass damper developed from an asymmetric nonlinear energy sink (Asym NES), which adds an inerter between the auxiliary mass of the Asym NES and a fixed point. The size of the Asym NES-inerter (Asym NESI) can be significantly reduced due to the inerter providing a large inertial effect with limited physical mass involved. The design concept of the Asym NESI will be described first. Subsequently, the performance of the Asym NESI will be evaluated on a three-story frame structure through computational investigations. Results show that the Asym NESI exhibites strong robustness against changes in both energy level and structural frequency. Driven by the inertial effect, the Asym NESI is excellent in control performance and installation flexibility under the seismic excitation considered, demonstrating great potential as a superior control strategy for response mitigation of building structures.

Keywords: nonlinear energy sink; inerter; mass damper; asymmetric restoring force; passive control.

1 Introduction

Structural control technologies including various types of dampers and base isolations have demonstrated great success in mitigating undesired responses of civil structures [1]. However, to ensure sufficient control effect, control devices are usually designed with huge masses and large dimensions which inevitably affect the architectural aesthetics of structures and utilization of functional space. To reduce the size of control devices and enhance their effectiveness, inerters, a type of two-terminal mechanical elements have been proposed and

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