Feasibility Investigation Of A Negative Stiffness-Based Base-Isolation Seismic Design For Bridges

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Advanced seismic isolation devices and systems have been recognized as promising measures toward resilient design of bridge structures. A base isolation device installed at pier base, named as LRB-NS, is proposed in current research, combining traditional lead rubber bearing and negative stiffness springs that is realized by pre-compressing. The springs can provide negative stiffness and negative storing force under slight shaking which elongates the structural periods; while these springs will offer positive restoring force during strong excitations, which helps to prohibit excessive deformation demands of bearings and prevent failure. The configuration and mechanism of the proposed LRB-NS are introduced, followed by illustrating its efficiency by comparing the seismic responses of typical bridges using LRB-NS with those of non-isolated and traditional LRB systems. The results show that the LRB-NS device can be well designed to mitigate seismic demands of bridge columns, as well as highly effective to suppress the excessive deformation in bearings that often occurs in the traditional LRB system under strong excitations. The LRB-NS device can be used to facilitate the resilient seismic design of bridge structures.