Abstract

This dissertation presents an elastomeric based seismic isolation bearing, referred to as Oval Leaf Spring mounts (OLS) isolator, for sensitive- motion equipment protection using the raised-floor approach. The OLS isolator is described, modeled and characterized. The effectiveness of the OLS isolator is numerically assessed considering the case of equipment housed in upper floors of a building, where the accelerations are amplified and the motion contains strong components at long periods. The numerical results reveal that the studied OLS isolator device can attenuate seismic responses effectively under different ground motion excitations while exhibiting robust performances for a wide range of structure–equipment systems.

The OLS, a class of passive isolation devices, has been successfully used as anti-shock and anti-vibration mounts to protect equipment and machinery. Available literature is insufficient to understand the behavior of OLS mounts. To estimate the spring stiffness, we conducted theoretical and finite element analyses (FEA) on a large number of springs having different geometrical and mechanical properties. Based on the principle of minimum potential energy, this dissertation presents theoretical expressions, which describe the linear static stiffness of OLS mounts subjected to line loading in the vertical (compression) and lateral (bending-shear) in-plane directions. Comparison studies showed a good agreement between numerical and analytical models. We observed a negligible effect of transverse shearing on the spring stiffness. In addition, it was demonstrated that the stiffness is more sensitive to the radius compared to the other geometric properties of the spring. Nonlinear FEA considering the hyper-viscoelastic behavior of the damping compound showed that the OLS mounts have higher energy dissipation capabilities in the lateral direction, which increase at low frequency and large amplitude loadings.

Keywords: Oval Leaf Spring, finite element analysis, stiffness, equipment, energy dissipation, nonlinear analysis.