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A Numerical Study on Semi-Active Control of a Bridge Deck under Seismic Excitation

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Abstract : This study investigates the benefits of implementing the semi-active devices in relation to passive viscous damping in the context of seismically isolated bridge structures. Since the intrinsically nonlinear nature of semi-active devices prevents the direct evaluation of Laplace transforms, frequency response functions are compiled from the computed time history response to sinusoidal and pulse-like seismic excitation. A simple semi-active control policy is used in regard to passive linear viscous damping and an optimal non-causal semi-active control strategy. The control strategy requires optimization. Euler-Lagrange equations are solved numerically during this procedure. The optimal closed-loop performance is evaluated for an idealized controllable dash-pot. A simplified single-degree-of-freedom model of an isolated bridge is used as numerical example. Two bridge cases are investigated. These cases are; bridge deck without the isolation bearing and bridge deck with the isolation bearing. To compare the performances of the passive and semi-active control cases, frequency dependent acceleration, velocity and displacement response transmissibility ratios T_a(w), T_v(w), and T_d(w) are defined. To fully investigate the behavior of the structure subjected to the sinusoidal and pulse type excitations, different damping levels are considered. Numerical results showed that, under the effect of external excitation, bridge deck with semi-active control showed better structural performance than the passive bridge deck case.

Keywords : bridge structures, passive control, seismic, semi-active control, viscous damping
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