Seismic Metamaterials Shields in Viscoelastic Soils

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Abstract

Earthquakes represent one of the most catastrophic natural events affecting mankind. At present, a universally accepted risk mitigation strategy for seismic events remains to be proposed. However, recently introduced approaches based on the remote shielding of incoming seismic waves through large scale metamaterial structures has shown promise. We discuss the feasibility of such a passive isolation strategy, including in-depth numerical analysis of both surface and guided waves, soil dissipation effects, and adopting a full 3D simulations. The study focuses on realistic structures that can be effective in frequency ranges of interest for seismic waves, and optimal design criteria are provided, exploring different metamaterial configurations, combining phononic crystals and locally resonant structures and different ranges of mechanical properties. Dispersion analysis and full-scale 3D transient wave transmission simulations are carried out on finite size systems to assess the seismic wave amplitude attenuation in realistic conditions. Results reveal that both surface and bulk seismic waves can be considerably attenuated, making this strategy viable for the protection of civil structures against seismic risk.