



Metamaterials and composite foundations for seismic cloaking of buildings

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Metamaterials, when properly engineered to interact with waves, find applications in different fields like optics and acoustic. Their important properties are useful at various scales spanning from nano- to large-scale scenarios where seismic waves are manipulated to realize seismic cloaking. We introduce the concept of composite foundation that is composed by the combination of a standard foundation and a seismic metamaterial based upon periodic mass-in-mass systems that is capable of filtering the S-waves of earthquakes. The key ingredients of this solution are: (i) a local resonance to have a sub-wavelength manipulation of waves and (ii) a dual stiffness structure to maintain a large (small) rigidity for compression (shear) effects. Laboratory tests demonstrate a spectral band gap beginning at 4.5 Hz which filters more than 50% of the seismic energy via an internal dissipation process. This result has an impact towards the seismic resilience of buildings and critical infrastructures from shear seismic waves achieving a potential, in terms of efficiency, higher than traditional seismic insulators, passive energy dissipation systems and other seismic metamaterial solutions.