

Territorial protection utilising seismic barriers using granular metamaterials

Bratov V^{4,6,5,@}, Kuznetsov S I^{1,2,3}, Morozov N F^{5,4} and Ilyashenko A³

¹ Bauman Moscow State Technical University, 2nd Baumanskaya Street 5, Moscow 105005, Russia

² Institute for Physics of Microstructures of the Russian Academy of Sciences, Academicheskaya Street 7, Afonino, Nizhny Novgorod Region 603087, Russia

³ Moscow State University of Civil Engineering, Yaroslavskoye Shosse 26, Moscow 129337, Russia

⁴ Institute of Problems of Mechanical Engineering of the Russian Academy of Sciences, V.O., Bolshoj 61, Saint-Petersburg 199178, Russia

⁵ Saint-Petersburg State University, Universitetskaya Naberezhnaya 7/9, Saint-Petersburg 199034, Russia

⁶ Peter the Great Saint-Petersburg Polytechnic University, Polytechnicheskaya 29, Saint-Petersburg 195251, Russia

@ vladimir@bratov.com

The paper presents an idea behind the utilisation of seismic barriers for territorial protection. The practical actuality of the approach is vividly demonstrated—no other contemporary seismic protection system can deliver the necessary protective properties combined with economic efficiency and a possibility to retrofit protection to shield the existing structure. Presented simulation results show that utilising seismic barriers filled with heterogeneous granular hyperelastic material for the rather extent area, magnitudes of displacements and accelerations, arising as a result of a seismic event, can be easily reduced by a factor of 4–6. It is shown, that the unique properties of granular metamaterials provide a very efficient dissipation of wave energy inside barrier in addition to reflection of energy and transformation of potentially dangerous surface wave energy into much less harmful energy of bulk waves.