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Investigations on Rubber-Sand Mixture Reinforced with Geogrid as a Low-Cost Geotechnical Seismic Base Isolation Technique

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Abstract

Nowadays, several structural base isolation techniques, such as dampers or elastomeric bearings, are commonly used to isolate structures from earthquake vibrations. However, the installation and maintenance costs of these energy-absorbing materials are quite expensive. Thus, studies are conducted on decoupling the structure from the base using a Geotechnical Seismic isolation (GSI) system, which can safeguard the structure from earthquake-induced vibrations. GSI system consists of soil mixed with high damping materials like shredded tires provides an efficient and economical option. However, the compressive nature of the rubber sand mixture (RSM) layer restricts its wide usage. The excessive strains in the RSM layer can be controlled by introducing geogrid. This paper presents the use of RSM reinforced with geogrid to provide a seismic isolation layer below the building foundation. Numerical analysis was done for a residential building using the finite element software PLAXIS 3D. Various parametric studies were conducted to find the minimum thickness of the RSM layer, the location of geogrid, and the number of geogrid layers to control the transmission of seismic vibrations. The effectiveness of the GSI was determined by comparing the parameter like peak spectral acceleration (PSA), and settlement of the system for various earthquake input motion with and without a rubber sand mixture layer. The results showed that the introduction of an RSM layer of thickness 0.05 - 0.15 times the width of the foundation can reduce the PSA up to 30-55%, and the addition of geogrid as a reinforcing material can reduce the seismic induced vertical settlement up to 68% which will ultimately lead to the broad applicability of RSM layer as a low-cost seismic base isolator.

Keywords: Geotechnical seismic isolation, Rubber sand mixture, Geogrid, Peak spectral acceleration, PLAXIS 3D