Proceedings of the 9th World Congress on Civil, Structural, and Environmental Engineering (CSEE 2024)
London, United Kingdom – April 14-16, 2024
Paper No. ICGRE 143
DOI: 10.11159/icgre24.143

Determination of the seismic factor for Dry-Stone Retaining Walls: A Fully 3D Numerical Study

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Extended Abstract

Dry-stone retaining walls (DSRWs) are a widespread type of structure that can be found all over the world. Dry stone constructions are built by fitting interlocking stones together without any binder. This technique requires two fundamental elements: the availability of stones on site and the expertise of highly skilled masons. In recent decades, the dry-stone building technique has garnered increasing attention, primarily due to the growing need for cultural heritage preservation and due to sustainable development efforts. However, the lack of scientific information on dry-stone masonry for design and repair, triggered the development of research works in this field. The present work contributes to these investigations. The lack of finalized design rules, particularly concerning the seismic resistance is one of the challenges identified.

The general objective of this study is to better understand the mechanical behavior of DSRWs under seismic conditions in order to propose a suitable sizing method. The first approach considered to study the seismic behavior of DSRWs corresponds to a pseudo-static approach recommended by European standards (Eurocode 8) [1]. However, in order to moderate the oversizing aspect of the simplified pseudo-static method, a seismic behavior factor r used in Eurocode 8 should be identified. This involves reducing the site acceleration by the factor r to take into account the energy dissipation due to the dynamic movement. In the present study, a fully 3D digital tool based on the FDM-DEM approach (**3DEC**, **ITASCA code**) is conducted, in order to characterize a suitable seismic behavior factor r for DSRWs. Unlike previous research that relied on just 3D-plane strain digital tools [2, 3, 4], the approach herein considers the heterogeneous nature of wall assemblies and gives a more accurate representation of reality. The numerical approach is employed to model the static and dynamic behavior of slope dry-stone retaining walls. At the first stage, the numerical approach is validated based on results obtained from true dynamic scaled-down experiments in the literature [3]. Herein, the results obtained show that the numerical simulations are conservative compared to the experiments. At the second stage, the numerical approach is validated on full-scale DSRWs involving true recorded motions during earthquakes. The main model parameters are taken from the literature [5, 6]. Based on the results of the dynamic simulations, the behavior factor r is deduced and compared to the one obtained through plane strain analyses.

References

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