Seismic reliability analysis of soil slope based on Newmark sliding block model with representative slip surfaces and response surfaces

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April 20, 2023

Abstract

This paper presents a framework combining Monte Carlo Simulation (MCS) and the Newmark sliding block model with Representative slip surfaces (RSS) (model II) and Multiple response surfaces method (MRSM) to conduct seismic reliability analysis and risk assessment of soil slopes. An empirical threshold is introduced to define the limit state function to identify the failure samples in MCS and the sliding area and Newmark sliding displacement are multiplied to quantify the failure consequence. The proposed methodology is illustrated through a soil slope with multiple layers. The calculation results demonstrate that traditional Newmark sliding block model (model I) tend to underestimate the variations of yield acceleration. Both the failure probability and landslide risk exhibit decreasing trends with the increase of threshold. Significant discrepancy in failure probability and landslide risk between two models is found even for a small threshold. It is therefore, the proposed methodology is highly recommended in seismic reliability analysis and risk assessment. The contributions of RSSs to the failure probability and landslide risk are insensitive to the variation of displacement thresholds.

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