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Performance Evaluation of Saturated Slope Subjected to Repeated Shaking Events Using 1-G Shaking Table Experiments

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Abstract

The rainfall in the state of Uttarakhand has a dynamic version. The erratic cloudbursts with unpredictability in rainfall intensity usually cause sudden variation in slope saturation especially during monsoon seasons. This led to frequent rainfall-induced slope failures in past years. Additionally, the region is also categorized under seismic zone IV and V as per the Indian seismic zonation map. When unforeseeable seismic events may associate with these partially saturated slopes, the sudden slope failures can endanger human lives and can affect major infrastructures in these regions. The observed re-peated shaking events such as the Japan earthquake (Tohoku) (2011), Nepal earthquake (2015), etc., highlighted the possibility of multiple shaking events and its influence on the infrastructures. Considering the above, this study aims to evaluate the behaviour of the partially saturated slope subjected to repeated dynamic loading conditions. Using 1-g shaking table experiments, the dynamic response of slope was evaluated. For experimental studies, de-bris material collected from the lower Himalayan region in Uttarakhand was used for model slope preparation for simulating field behaviour. For experimental testing, slope having 45^{o} slope angle with 60% density was prepared using 10% water content for achieving 40% partial saturated conditions. The model slope was then subjected to repeated incremental dynamic loading conditions of 0.1g, 0.2g, 0.3g, and 0.4g acceleration intensity respectively. To compare the influence of repeated shaking on the slope and its interaction with the adjacent structures; a scaled-down model structure was installed at a 250 mm distance from the crest portion of the slope. The influence of acceleration response, pore pressure generation, soil settlement and structure dis-placement were evaluated and compared. In addition to above instrumentation scheme, a 2-D digital image correlation system was additionally used for slope and structural displacement. An attempt also made to model the experiments using FLAC 3D software for estimating the failure conditions. Based on the obtained test results, parameters influencing the stability of partially saturated slope subjected to repeated acceleration loading events have been evaluated and its influence on the adjacent structure is presented.

Keywords: Partially saturated slope, 2-D Digital image correlation, Slope-failure, Repeated dynamic Events, FLAC3D