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Seismic Stability Analysis of Saturated Slope Reinforced with Pervious Anti-Slide Piles Subjected to Repeated Shaking Using Shaking Table Tests

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Abstract

Occurrence of sudden cloudbursts found common in slopes of Uttarakhand region, especially during monsoon seasons. This led to a sudden increment in water content within the slope, causing a variation in slope saturation. In case, when these partially saturated slopes are subjected to dynamic events, the consequences are highly unexpected and can cause serious threat to the adjacent infra-structures located nearby. To improve the stability of slope, various slope improvement measures such as providing drainage, use of slope reinforcement, installation of anti-slide piles etc. are adopted in the field. However, very limited studies were available on the combined effect of drainage and slope reinforcement techniques. Also, detailed studies regarding the influence of these combined effects in partially saturated slope under dynamic loading are not available. Considering this, an attempt has been made to evaluate the influence of pervious anti-slide pile for slope reinforcement and drainage is proposed in this study. For understanding dynamic improvement characteristics, repeated shaking tests were performed to evaluate the efficiency of this control measure during multiple shaking events. The selection of repeated loading events simulates the occurrences of repeated shaking events as reported in several case studies in past. For experimental testing, debris soil collected from the Uttarakhand region was used. A 1:1 slope having dimensions of 600 mm × 600 mm slope with 200 mm bed depth and 750 mm width was prepared with 45% Saturation and 16 kN/m^3 density equivalents to in-situ field density as observed in similar site in Narendra Nagar, Uttarakhand. The slope was subjected to repeated incremental shaking of loading intensity 0.1g, 0.2g and 0.3g with 5 Hz frequency. To simulate slope-structure interaction, a scaled-down G+3 storey building structure was installed at 200 mm distance from the crest portion of the slope. Parameters such as pore pressure response, acceleration response, slope and structure displacement under repeated shaking loading has been evaluated. For assessing the slope and structural response, 2-Digital Image Correlation technique was used. Based on the obtained test results, the seismic stability of the reinforced slope was assessed and presented.

Keywords: Slope stability, Partially saturated slope, Pervious anti-slide piles, 2D DIC