

Experimental study on the failure mechanism of the Zhoujiashan landslide under the combined effect of rainfall and earthquake in Tianshui City, Northwest China

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Abstract: Catastrophic loess-mudstone landslides have long been a major concern in Northwest China due to the extreme weather and frequent earthquakes in history. To investigate the potential deformation feature and failure mode of the loess-mudstone landslide under the combined effect of rainfall and earthquake in the study area, the Zhoujiashan landslide was selected as the target and detailed field investigation, shaking table tests, as well as numerical analysis were conducted in this work. The test results and numerical simulation indicate that rainfall infiltration has limited impact on the overall stability as the infiltration depth is limited and the pore pressure variation pattern is consistent both in the shaking table test and numerical calculation. In terms of seismic response, the earthquake has obvious amplification effect with the inherent period of 0.2-0.4 s. Under the peak seismic conditions of 0.1 g and 0.3 g, deformation appears at the slope surface, but the overall slope will not be completely damaged. Under the seismic condition of 0.6 g, liquefaction occurred at the sliding surface due to the rise of the groundwater level, indicating that the slope was overall damaged. In this process, the overall failure mechanism of the slope is vibration liquefaction at the sliding surface, and the liquefaction position is in the middle of the landslide. The failure mode is summarized as shearing-liquefaction-slippage. This work is expected to contribute to the prevention and control of loess-mudstone landslides in northwest China.

Keywords: Combined effect of rainfall and earthquake motion; Shaking table test; Numerical calculation; Earthquake response; Failure mechanism; Seismic liquefaction