Microtremor Survey and Spectrum Analysis of a Coseismic Landslide: a Case Study in Subao Village, Ningxia, China

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Coseismic landslides usually cause severe casualties and economic losses. The study of the spectrum characteristics of coseismic landslide sites is crucial to better understanding the possible site response during an earthquake, and then evaluate the risk of landslides. Therefore, we chose the Subao landslide to carry out microtremor survey and spectrum analysis. Subao landslide located in Subao village, Xiji County, Ningxia Hui autonomous region, China, which was a giant coseismic loess landslide induced by 1920 Haiyuan great earthquake. The plan of the landslide was irregular, with a length of nearly 1435 m, a width of almost 400 m, a height of nearly 172 m, and a mean thickness of almost 30 m, which indicated it was a typical low-angle and long-runout landslide.

To study the spectrum characteristics of the Subao landslide site. We applied a digital accelerograph to measure the microtremor on the displaced material, the outcropped surface of rupture, and also the slope outside of the landslide area. Based on the microtremor data, we used the open-source software Geopsy (http://www.geopsy.org/) to calculate and analyze the H/V value for all the measured data. Combined with three boreholes data, we can draw the following conclusions. (1) Most H/V curves of soil mass of the slope around the landslide had a clear peak, the range of the predominant frequency is 2.2 ~ 2.9 Hz, the peak amplification factor is 2.3 ~ 4.0, which reflected the magnification effect of ground motion about the soil mass and terrain. (2) H/V curves of the displaced material were relatively gentle, multi-peak type, and no significant predominant range. The peak amplification factor is 1.9 ~ 2.2, reflecting the complex interface of the soil after sliding and without amplification effect of the ground motion. (3) H/V curves at the outcropped surface of rupture had a narrow and steep predominant frequency band. The range of the predominant frequency is 2.4 ~ 2.6 Hz, and the peak amplification factor is 4.6 ~ 4.8, which was showing a significant topographic effect. (4) Compared with the stable soil mass of slopes around the landslide, the landslide deposits were of complicated soil structure, and the spectral characteristics were not distinct, therefore unable to well reflect the spectral features of the landslide site.

Accordingly, we found that the spectral characteristics of the slope around the landslide area are the reliable parameters for studying the dynamic stability and disaster mechanism of the landslide. The results would not only provide a criterion for the reasonable establish of geomechanical models of slopes but also provide the vital calculation parameter for the inversion of ground motion based on the coseismic landslide.

Keywords: Coseismic landslide, Microtremor, H/V method, Spectrum characteristics, Dynamic stability

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