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

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Seismic landslide is a common geological disaster, some of which has the characteristics of “large scale, long sliding distance, gentle sliding surface, fragmented slip mass, heavy losses and high risk”, usually causing serious casualties and economic losses. The study of the spectrum features of typical landslide sites is crucial to better understanding the possible site response during earthquake, and then evaluate the risk of landslide. Therefore, we chose the Subao landslide to carry out microtremor survey and spectral analysis. Subao landslide (Fig. 1) located in Subao village, Xiji county, Ningxia Hui antonomous region, China, which was a giant coseismic loess landslide induced by 1920 Haiyuan great earthquake (M = 8.5). The landslide was located in the IX-grade seismic intensity area, of shear liquefaction failure mode and belonged to a loess contact surface landslide. The landslide plane was of irregular configuration, about 1435 m in length, 400 m in width and 30 m in mean thickness, of the original height of 153 m, gradient of 12° and apparent friction factor of 0.14, a typical low angle and long distance landslide.

Fig. 1 The full view of Subao landslide

(Lens pointing, 165°)

To study the spectrum characteristics of Subao landslide site, we used a digital accelerograph to measure the microtremor on the sliding mass, landslide bed and soil mass of slopes around the landslide (Fig. 2). The sampling rate is 200, and the data acquisition time is about 600s.

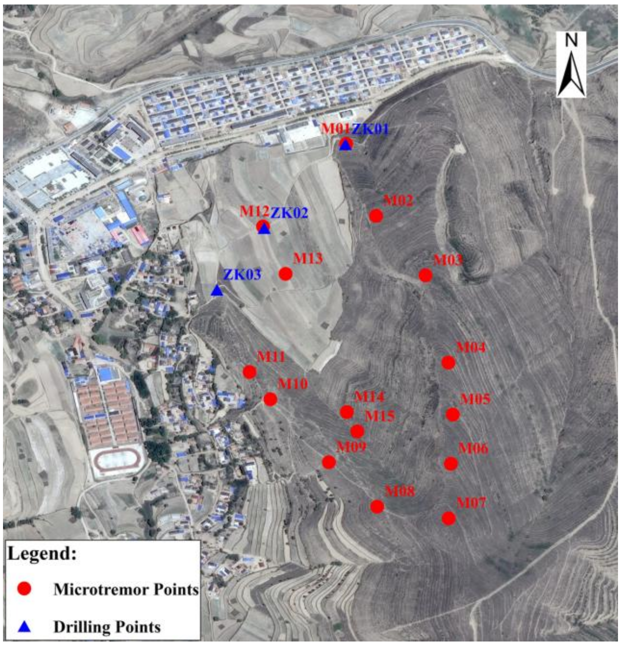

Fig. 2 The layout of microtremor points

Then, based on the H/V method, applying the open source software Geopsy (www.geopsy.com) to calculate and analyze the test data. The results are shown in Fig. 3. According to the results, we can draw the following conclusions: (1) Most H/V curves of soil mass of slopes around the landslide had clear peak, the range of the predominant frequency is 2.2~2.9Hz, the peak amplification factor is 2.3~4.0, which were well reflected the magnification effect of ground motion about the soil mass and terrain; (2) H/V curves

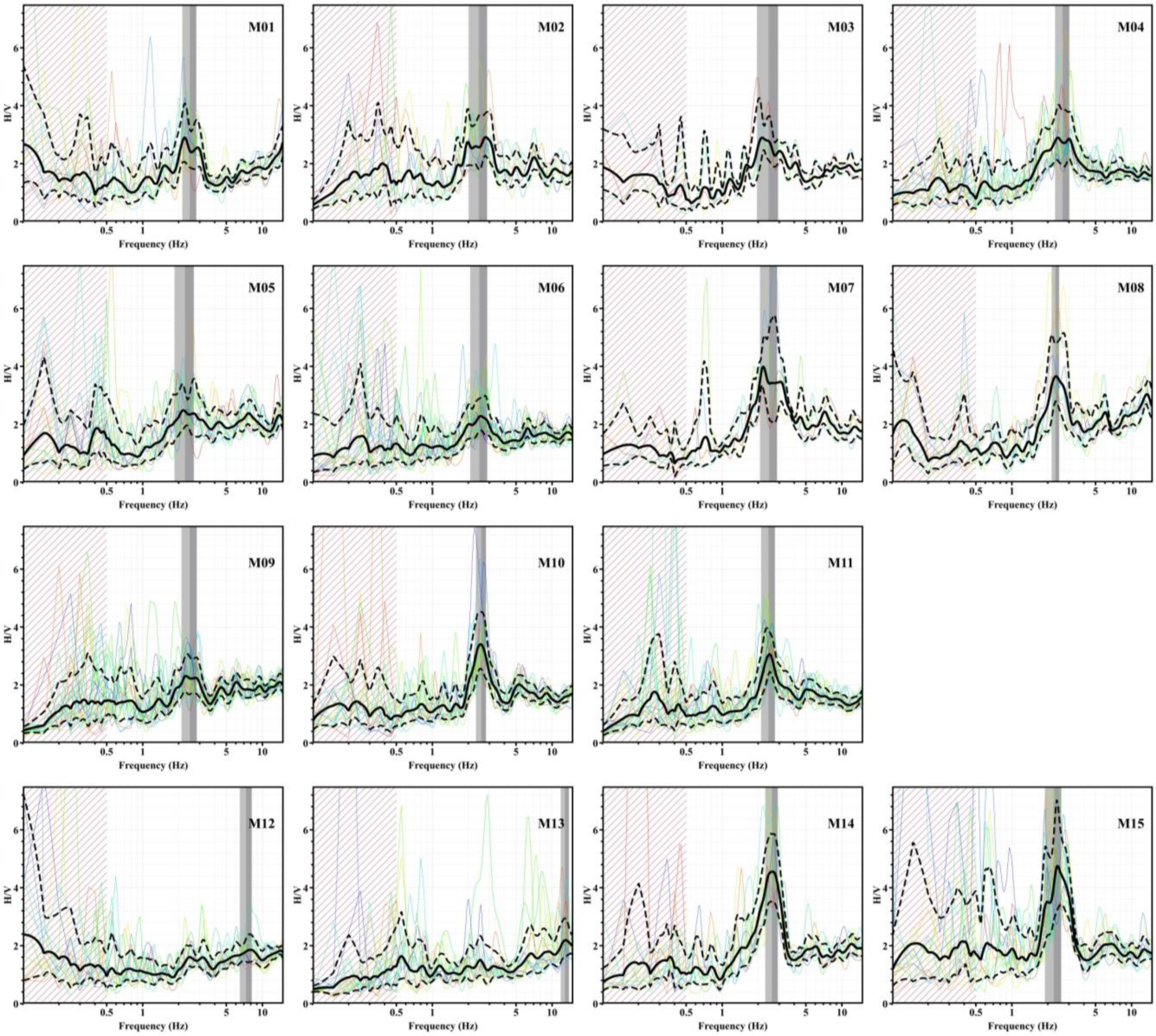

Fig. 3 The H/V curves for different points. The points M01~M11 are on the slopes around the landslide ,the points M12~M13 are on the sliding mass, and the points M14~M15 are on the landslide bed.

of the sliding mass were relatively gentle, multi-peak type, without significant predominant ranges, the peak amplification factor is 1.9~2.2, reflecting the complex interface of the soil after sliding and the no obvious amplification effect of the ground motion; (3) H/V curves at the outcrop of the landslide bed were had a narrow and steep predominant frequency band, the range of the predominant frequency is 2.4~2.6Hz, the peak amplification factor is 4.6~4.8, showing significant topographic effect; (4) Compared with the stable soil mass of slopes around the landslide, the sliding mass was of complicated soil structure and the spectral characteristics were not obvious, therefore unable to well reflect the spectral features of the landslide site.

Accordingly, we found the spectral characteristics of soil mass of the slopes around the landslide are the reliable parameters for studying the dynamic stability of the landslide site. This would not only provide a criterion for the reasonable establishment of geomechanical models of slopes, but also provide the important calculation parameter for the inversion of ground motion based on coseismic landslide.