Identifying Unstable Rock Blocks by Measuring Micro-tremors and Vibration on Slopes

H. Tanaka (1), K. Fujisawa (1), K. Asai (1)

(1) Public Works Research Institute, Japan

(h-tana44@pwri.go.jp / Phone: +81-29-879-6787)

It is important to identify unstable rock blocks and take countermeasures to prevent sudden rock fall disasters. However, identifying such blocks visually is extremely difficult, so an identification method using peculiar features of unstable blocks needs to be developed. The method reported here uses a vibrometer, which is low cost and easy to operate.

In order to assess the feasibility of the method, a field experiment was carried out on rock slopes, 30 m in width and 30 m in height, in three regions of Japan, where unstable blocks were expected to exist. Thirteen vibrometers, measuring 8 x 8 x 4 cm, were set up on the slopes to capture two types of vibration waves in three dimensions, i.e., micro-tremor and reactive vibration. The former type naturally exists all the time, while the latter is generated only by giving stimulation waves. At least one of the vibrometers was installed on stable bedrock to compare the results with the wave patterns of unstable rock blocks.

In addition to conventional items (amplitude, frequency spectrum, vibration particle trace), trace accumulation length, the accumulation of the trace length of a vibrating particle for ten seconds, was introduced to analyze the patterns for both types of wave.

As a result, unstable rock blocks were found to generate higher amplitudes of vibration waves than stable rock blocks, and different patterns of frequency spectrum, direction of vibration particle trace, and trace accumulation length.

Hence, vibrators were shown to be useful for identifying unstable rock blocks. In particular, by using trace accumulation length as an indicator, the stability of a block can be evaluated without generating stimulative waves, providing a direction for developing a cost-effective simple method for identifying unstable blocks in future.