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Fluctuation in excess pore water pressures triggered by earthquakes at the Busuno landslide

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1.Introduction

There are not many observations in pore water pressure induced by earthquake (EQ) at a landslide area. We observed seismic motions and coinstantaneous pore water pressures in a landslide area, and considered their relationships in some aspects.

2.Seismic motions and pore water pressures for analysis

We installed some piezometers at the Busuno landslide area in Niigata Prefecture, and observed five fluctuations in pore water pressures corresponded to following earthquakes: the Niigataken Chuetsu Earthquake in 2004 (EQ1), the strongest after shock of EQ1 (EQ1'), the Niigataken Chuetsu-oki Earthquake in 2007 (EQ2), the Naganoken Hokubu Earthquake in 2011 (EQ3) and the strongest after shock of EQ3 (EQ3'). Since we started a seismic observation from 2010 at the Busuno landslide site, the strong motions by EQ1 to EQ2 were estimated based on that from National research institute for earth science and disaster prevention K-net Yasuzuka (NIG 024). To estimate the peak ground acceleration and peak velocity acceleration of the Busuno landslide, we have adopted the attenuation relationships using the shortest fault distance (Si and Midorikawa, 1999). Five piezometers were installed at the middle block from 2002, and observed pore water pressures for EQ1, EQ1' and EQ2 every 10 minutes. Since they were broken by heavy snow in 2005, two were newly-installed and observed them for EQ3 and EQ3'.

3.Results and discussions

All piezometers showed ?uctuations in pore water pressures at the time of five earthquakes. For EQ1, EQ1, and EQ2, the pore water pressures showed spike-like fluctuations by receiving rapid elastic compression in the low permeability layer. The pore water pressures fluctuated larger as the peak acceleration becomes larger. The highest peak ground acceleration was observed by EQ3 (NS 236 gal, EW 382 gal and UD 108 gal with a dominant frequency of 3Hz), and the largest rise in pore water pressure (15 kPa) was observed. Other earthquakes caused much lower fluctuations in pore water pressure less than 1 kPa even in maximum. We considered the possibility of a snow pack effect on the slope. The landslide area was covered by around 3 m depth of snow when EQ3 occurred (March, 12, 2011). Therefore, higher pressure acted on the sliding surface during EQ3. Okamoto et al. (2006) reported that the high pore water pressures remained for 8 to 24 hours both after EQ1 and EQ2 at the site, and referred that was because it was consisted of two components which are the transform elastic compression (spiking ?uctuations) and the plastic compression (remaining high pressure) of the ground at the time of the earthquake. The similar fluctuations were observed by EQ3 and EQ3'

References

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