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# Consideration to the early warning rainfall criteria of landslides after strong earthquake in Japan

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1. Objective

The research on the warning rainfall criteria of landslides after strong earthquakes is conducted associated with the great earthquake in Eastern Japan (M=9.0). After this kind of strong earthquake, soil strength of the slopes in the region that were exposed to the strong seismic forces are generally reduced by seismic shaking (vibration) or disturbance by certain slope deformation. In this situation, the revised rainfall criteria for landslides are required. On this point of view, we are intrigued to elucidate the response of landslide to rainfall under this weaken soil condition. Hence, the impact of rainfall events on the specific landslide slopes that experienced the strong seismic shaking is analyzed using numerical simulation method i.e. finite element method (FEM) in order to evaluate the critical rainfall for landslide occurrence.

2. Method and target areas

Field investigation, field survey and geotechnical test with the samples from the landslide slopes are conducted to obtain the basic data for FEM analysis such as topographical, geological, geotechnical features including hydraulic conductivity "k" and soil shear strength at the slopes that experienced strong earthquake.
Then, FEM analysis which consists of seepage analysis and slope stability analysis combined with the rain data at nearest meteorological observatory are conducted under the earthquake impact i.e. the slope condition with cracks which are located near the top of the slope and have high "k" or reduced soil strength. Comparing the FEM results with ones without earthquake impact, the influence of the earthquake shaking to the landslide slopes is estimated.

3. Result and consideration

In the result of FEM analysis, the cracks induced by the earthquake are effective to increase the seepage and render the slopes instable. Also, reduced soil strength such as 4% decrease in internal friction angle caused instability of the slope. The slope deterioration mentioned above due to the impact of earthquake causes 40∼50% reduction of critical rainfall for landslide occurrence for a while, corresponding to decrease in safety factor of the slopes from Fs=1.02∼1.04 to Fs=0.83∼0.95. This reduction rate of critical rainfall is as same level as in the earlier researches based on field observations.

4. Conclusion

Consequently, the impact of giant earthquakes causes at most 50% reduction of the critical rain amount with which landslides may occur. It is quite large influence that we have to consider in the aftermath of strong earthquake.