Development of the Pinpoint and Real-time Risk Prediction System for Rainfall-induced Sediment Disasters in Hyogo Prefecture

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INTRODUCTION

With natural and social conditions, Japan has been vulnerable to sediment disasters caused by heavy rainfalls and earthquakes frequently every year, and sediment disasters account for about a half of the dead and missing people by natural disasters. In particular, intensive rainfalls have been becoming heavier than past. Therefore, sediment disasters have been often occurring in many area, and damage of various facilities and lives has been large. In order to protect ourselves from sediment disasters, it is important to predict not only where sediment disasters are generated but when sediment disasters are generated, and to distribute real-time type hazard map as information of warning and evacuation. In recent years, it has come to obtain the short-term rainfall prediction information by upgrading the meteorological observation device. The sediment disaster warning, based on rainfall index using the short-term rainfall prediction information, is a public announcement, which is imparted to support people to evacuate from potentially hazardous area before the events. However, because this information is sent to the area size of the municipality level, information for each smaller area has been requested. From this kind of circumstance, Hyogo Prefectural Government has been developing the pinpoint and real-time risk prediction system for rainfall-induced sediment disasters in cooperation with municipalities, such as Toyooka, Tamba, Sasayama, Sanda, Nishinomiya, Kamigori, Kobe and Asago, since 2012. This paper describes the outline of the system.

EVALUATION MODEL FOR POTENTIAL OF RAINFALL-INDUCED SHALLOW LANDSLIDE

The most common trigger of sediment disasters in our country is shallow landslide. These shallow landslides are often triggered during heavy rainfalls when pore-water pressures build up at the contact between the surface soil layer and the underlying bedrock. A variety of evaluation model have been proposed to evaluate the potential of slope instability due to heavy rainfalls. These models are categorized into two types; the statistical analyses (bivariate or multivariate) and process-based models based on geo-engineering models. The approaches of the second group are formally more rigorous. Okimura and Ichikawa (1985) developed a simple prediction model as a process-based model. In our system, the potential of shallow landslides is evaluated by this model. This model is composed of two calculation models. One is the groundwater level estimation model, and another is the infinite slope stability analysis model. How the groundwater level in the field area changes due to rainfall is calculated by the groundwater level estimation model. That is to say, the groundwater level is calculated as a result of considering three-dimensionally catchment in the

field area, and rainfall characteristics such as intensity, duration and distribution. How the degree of shallow landslide potential (safety factor: *F*) in the area changes at time due to groundwater level is calculated by the infinite slope stability analysis model. These calculation procedure are carried out for all cells on DEM (the size of cell is 10 m) of the evaluation target area.

RISK ASSESMENT FOR RAINFALL-INDUCED SHALLOW LANDSLIDE

The rainfall data can obtain the predictive value of the rainfall for ten minutes up to the future of 3hours by using the short-term rainfall prediction information, and the predictive data is updated every 30 minutes. Therefore, this system can predict the risk of shallow landslide disaster up to the future of 3hours. Furthermore, the disaster risk is determined in consideration of not only the value of safety factor but the variation of safety factor (see **Fig. 2**).

The risk prediction results are displayed as a result of each sediment disaster prone area on the digital map and they are distributed through the internet as the real-time hazard map.

CONCLUSIONS

In this paper, the outline of the pinpoint and real-time risk prediction system for rainfall-induced sediment disasters is described. This hazard map is digital map that expressed slope stability evaluation result by the geo-engineering model, which is composed of the groundwater level estimation model and the infinite slope stability analysis model. In addition, shallow landslide dangerous area that changes hour by hour can be displayed by inputting the short-term rainfall prediction information. Hence, it can visually be recognized whether or not the degree of shallow landslide potential has risen by using this map several hours ago. This map is very useful tool for the decision making of the evacuation order and inhabitants to escape from the dangerous place.

REFERENCES

1) Okimura, T. and Ichikawa, R. (1985): A prediction method for surface failures by movements of infiltrated water in a surface soil layer, Natural Disaster Science, Vol. 7, No. 1, pp. 41-51.

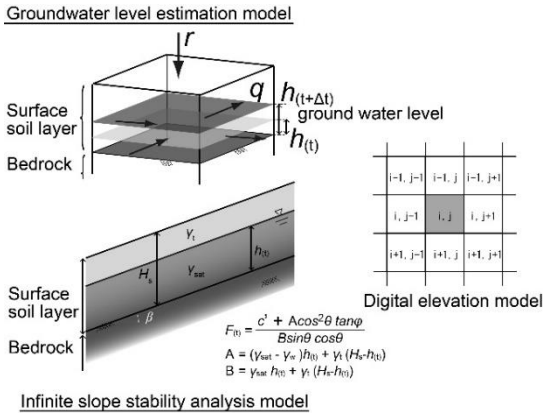

Fig.1 Evaluation model for potential of rainfall-induced shallow landslide

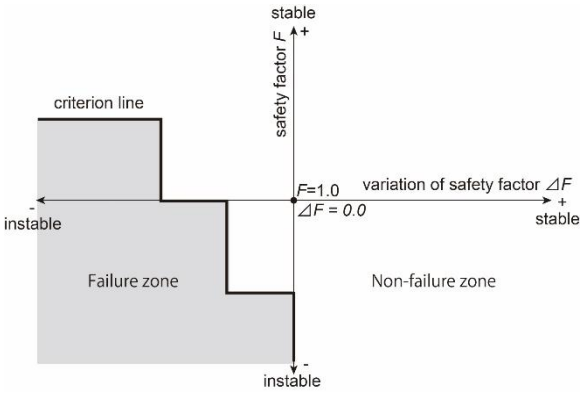

Fig.2 Risk assessment based on the value of safety factor and the variation of safety factor

Keywords: heavy rainfall, real-time risk prediction system, sediment disasters, warning and evacuation information