複合災害科学部　災害機構解析分野

2012年融雪により発生した新潟県上越市国川地すべりの数値解析的の検討

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1. Introduction

On 7 March 2012, a snowmelt-caused landslide occurred at Kokugawa village, Itakura district, Joetsu City, Niigata Prefecture (Hereinafter called Kokugawa landslide). The width of Kokugawa landslide is about 150m and the length is about 500m. The depth of the sliding surface is presumed 20m~30m. The volume of the sliding sediment mass is estimated to be 750,000m^3. The slope failure generated initially as a rotational landslide which continued to enlarge and outflow from the hill in the afternoon of 8th march, then turned into earthflow. Figure 1 shows the movement process of the landslide mass. Although no one was killed or injured in this disaster, 11 houses were completely destroyed and part of road was blocked by the outflow soil mass.

The moving soil mass traveled out of the hill and changed the traveling routine and moved about 250m along the flat paddy field. Comparing with the failing mass, the sliding soil mass did not spread out and lateral ridges were developed along the right side of the mass on the paddy field. The flow-like movement can be considered as one of the most dangerous and damaging of all landslide phenomena because their run-out distances, the possible propagation extent, the velocity of the mass, and the area of deposition are not easy to predict. In this study, in order to simulate the runout distance and the affected area, the forms of movement of the sliding soil mass are assumed to be the two patterns as following. One pattern is that the sliding soil mass moves downward as a whole body in which the internal structures are not changed. This pattern will be simulated using a GIS-based 3D limit equilibrium movement model. Another pattern is that the mobilized material can be considered as the fluid-like deformation. This pattern will be simulated using a GIS-based 2D depth-averaged numerical model.

2. Numerical simulation of movement

2.1 Simulation of Kokugaw landslide as a whole body movement form

Wang et al. (2011) developed a GIS-based revised Hovland's column-based model to simulate the sliding process. When the slope fails, based on the revised Hovland's column-based slope stability analysis model, the sliding process simulation will be done step by step until the 3D factor of safety is larger than 1.0. In this study, two cases: no drainage works and using drainage works are analyzed. Table 1 shows the parameters for the two cases. The results are shown in Figure 2. In case 1, there are no drainage works, the runout distance is 313m. In case 2, the parameters are increased a little after the drainage works have been made for deceasing the moving distance and the runout distance

is 267m. Comparing the results, the effect of drainage works is clear.

2.2 Simulation of Kokugawa Landslide as flow-like form

Wang et al. (2008) developed a GIS-based 2D depth averaged numerical model to simulate debris flow. Here, we will use this model to analyze the flow-like landslide. The simulation results are shown in Fig. 3 and Fig. 4 using the parameters shown in Table 2.

Table 1 the parameters for pattern 1

	c (kN/m^2)	ϕ (°)	γ (kN/m^3)
Case 1	2	6	18.1
Case 2	2.1	7	18.0

Table 2 the parameters for pattern 2

ρ(kg/m^3)	α	β	μ(Pa·s)	g(m/s^2)	$tan\,\phi$
1800	1.25	1.0	0.15	10	0.13

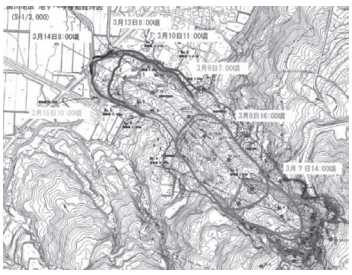

Fig.1 the movement process (after reference [1])

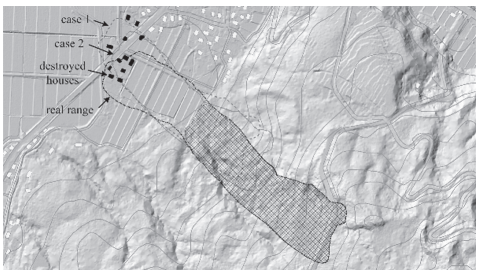

Fig. 2 the simulation results for pattern 1

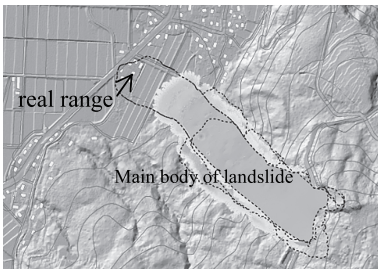

Fig 3 The moving similar to the situation in 9th March.

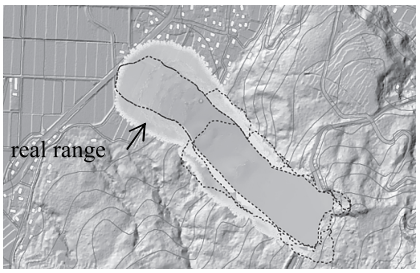

Fig. 4 The moving similar to the situation in 13th March

3 Conclusions

Two movement patterns were considered for simulating the Kokugawa landslide. The effect of drainage works made the runout distance to shorten about 46m. Using GIS-based 2D depth averaged numerical model, the simulation redisplays the propagation and deposition of the flow-like Kokugawa landslide across the actual topography.

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References

1) The Japan Landslide Society, Niigata Branch, Kokugawa landslide, the document for No. 40 field trip, 2012.