

# Research Trends and Results

## New Monitoring Method for River Levee

HATTORI Atsushi (Dr. Eng.), Head, MORI Hirotoishi (Dr. Eng.), Senior Researcher,  
SASAOKA Shingo, Researcher, KURATA Daisuke, Guest Research Engineer, SHIMOKAWA  
Daisuke, Guest Research Engineer  
River Division, River Department

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### 1. Introduction

River levees, which protect houses and fields from floods, are constructed of soil. Generally, river levees run a number of kilometers along the river and have been constructed over the years, so it is unknown what kind of soils they are constructed of.

Also, river levees will be failed when hit by a major flood, as seen in the Kinugawa River last year, which is called levee breach.

### 2. Catch signs of breach!

In 2012, river water in the Yabe River, Fukuoka, leaked through the foundation of the levee, and sand in the foundation boiled, which resulted in a levee breach. Such phenomenon is called "piping." The cause of this breach is considered to be the sand layer under the levee, though which river water is likely to leak.

To investigate what kinds of soils lie in and under levees, "boring," a method for sampling long cylindrical soil samples, has generally been used. However, the sand layer that caused the aforementioned breach was present in a section of only 130 m in length in the river levee running a number of kilometers, so it was almost impossible to find such layer. The river levee has been inspected by staff twice a year, but it is very difficult to grasp a sign of damage just by looking at the surface of levee that appears in normal time. Therefore, we are studying whether we can find weak areas of river levees by mechanical measurement of ground uplift that appears in case of a flood and would be a sign of piping.

Figure 1 is a photo taken in the experiment of measuring the ground uplift with a laser scanner by creating a sand layer under the levee to check what kind of uplift appear on the ground when the level of river water is high. The figure shows that a large uplift has the size of slightly less than 3 cm (brown part in Figure 2). In this experiment, piping occurred later and resulted in levee breach.

### 3. What is dangerous uplift?

What is the limit of ground uplift at which a levee breach occurs? To find that out, it is important to grasp what is happening in the foundation of river levees when piping occurs. However, it is impossible to directly see piping that occurs in the soil. We are therefore using the particle method, which calculates soil movement with computer, in order to find out the relations between ground uplift and what is happening under the uplift. <sup>2)</sup>

Figure 3 shows the result of calculating the data of the experiment above by the particle method. The Figure shows the sand from the ground blowing out of the ground.

### 4. Conclusion

River levees have been mainly constructed and maintained based on empirical wisdom. We are going to continue the study consistently so that we can provide new monitoring methods for river levees by using up-to-date technologies and considering as well variations including uplift and sand boil.

☞ See the following for details.

1) Kurata et al., "The Model Experiments for the Precursor of the Progressive Failure of a River Levee by the Measurement of Surface Displacement," The 3rd Symposium for Levee Technologies from the Viewpoint of Geotechnical Engineering," pp. 17-20, Dec. 2015, Japanese

2) Shimokawa et al., "The SPH method for simulating a slip and piping of a river levee by a permeable foundation ground," The 3rd Symposium for Levee Technologies from the Viewpoint of Geotechnical Engineering," pp. 81-82, Dec. 2015, Japanese

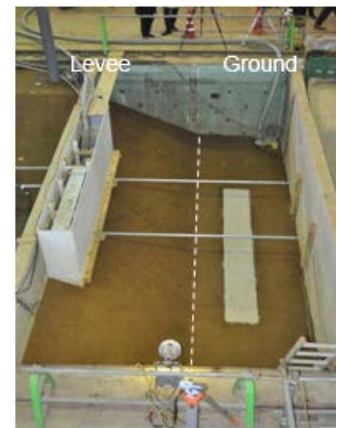


Figure 1: Photo of experiment

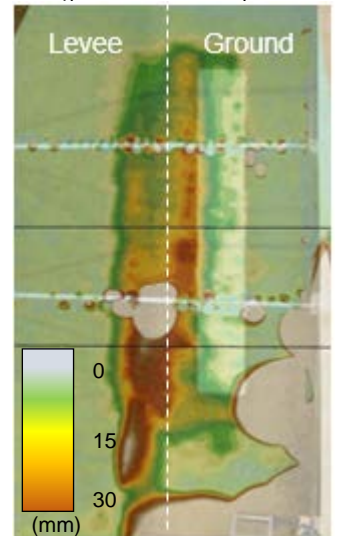


Figure 2: Ground uplift

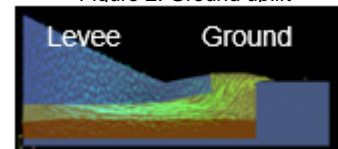


Figure 3: Sand boiling (sectional view).