

# Protect River Levees from "Progressive Failure"

HATTORI Atsushi, Head (Dr. Eng.),  
MORI Hirotooshi, Senior Researcher (Dr. Eng.),  
FUKUHARA Naoki, Researcher,  
KURATA Daisuke, Guest Research Engineer,  
SHIMOKAWA Daisuke, Guest Research Engineer  
River Division, River Department

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### 1. Introduction

In July 2012, the levee of the Yabe River in Kyushu was breached and caused enormous damage to the hinterland. As a result of surveys, the cause of the levee breach was attributed to river water seeping into the foundation ground under the levee and causing the loss of soil due to seepage flow out to the landside (housing land, cultivated land, etc.). However, there are still many unclear issues including the process that led to the levee breach, external forces, and ground conditions. Moreover, levee failures from such permeable ground were also observed in the Koyoshi River, etc. in the Tohoku Region.

The River Division is researching ways to improve investigations, assessments, and countermeasures for levees so as to enhance the safety of levees. As part of this study, we are examining how to identify weak areas in levees that lead to so-called "progressive failure," i.e. the process of failure to breach in a one-time flood, as in the Yabe River.

### 2. Present issues and efforts for solutions

Main issues concerning progressive failure are the following three items.

Issue 1: Mechanism of progressive failure based on the foundation ground and external force conditions.

Issue 2: Development of methods of numerical analysis and evaluation that enable the mechanism to be appropriately identified and rated.

Issue 3: Development of method for identifying weak areas.

In the joint research with the Public Works Research Institute ("PWRI"), we have conducted experiments on levees simulating various ground conditions to examine the conditions causing progressive failure resulting in breach (Issue 1). We plan to start technical development next year including numerical analysis techniques in collaboration with academics and private sectors (Issue 2). For utilization of such techniques, it is necessary to grasp ground conditions fully, but it is not practical to conduct such ground investigation across the country. Then, we examine methods for identifying weak areas based on the results of Issue 1 with referring to results of the past surveys, water level history, etc. (issue 3).

### 3. For the evaluation of progressive failure

In fiscal 2014, we carried out model experiments for river levees. As a result, we observed that the breach was caused from the toe of the levee due to the seepage flow into the foundation ground (Fig. 1) and the process leading up to the breach vary according to ground conditions. Based on the results, in the next and subsequent fiscal years, we plan to pursue techniques for determining failure progress from the viewpoint of both ground and external force conditions, and study ways to identify weak areas in levees.

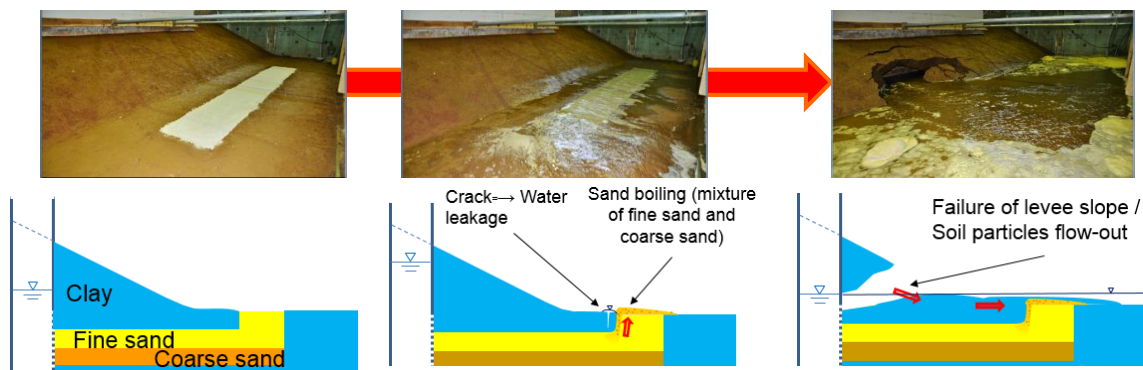


Figure 1. An Example of Process to Levee Breach in Experiment