

# Study on the Simple Evaluation Method of Piping Progress in River Levee

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## 1. Background of study

When deformation, such as water leakage or sand boil, is found in the river levee, measures against penetration, such as drain works or sheet piles, are usually taken. On the other hand, in the studies for the last several years, cases were reported where piping stopped after proceeding to some extent, although water leakage or sand boil occurred. If it is possible to evaluate whether there is progressiveness of piping, detection of the section where measures should be preferentially implemented can be identified from the sections where piping countermeasures are required.

## 2. Simple evaluation method to evaluate the progressiveness of piping

In evaluation of the progressiveness of piping, it is difficult even in these days when analysis technique has advanced to reproduce the process, with numerical analysis, in which piping is formed due to water leakage or sand boil and proceeds. Then, piping was simulated by setting the spots for which the coefficient of permeability was enlarged, and groundwater analysis was conducted after changing the length (Fig. 1). Note that the thickness of piping was fixed to 10 cm. As Fig. 2 shows, a case of decrease in local hydraulic gradient ( $i_h$ ,  $i_v$ ) when piping proceeds was confirmed. Decrease in local hydraulic gradient suggests a possibility that piping ends without proceeding to the river side. In order to verify the validity of the foregoing analysis, we conducted reproduction analysis of the levee model experiment <sup>1)</sup>. As shown in Fig. 3, the local hydraulic gradient decreases rapidly according to the progress of piping, but increases gradually when the length of piping reaches approx. 2m, which predicts the proceeding of piping. Since the situation where progress of piping once becomes slow was also confirmed in the experiment, the result of analysis generally reproduced the result of experiment.

## 3. Future study

We intend to apply the simple evaluation method proposed and discussed herein for the progressiveness of piping to various soil conditions to check the accuracy of prediction and improve it for securing required accuracy so that the method can be used in practice.

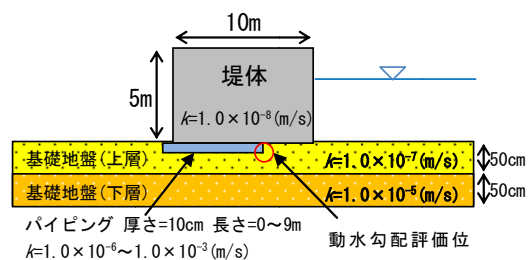


Fig. 1: Analytic model figure

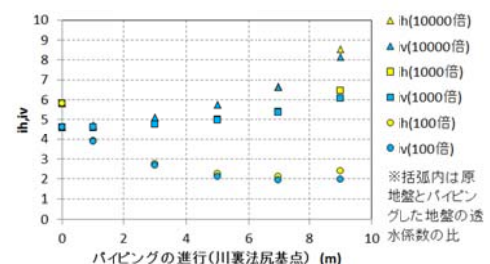


Fig. 2: Progress of piping and local hydraulic gradient

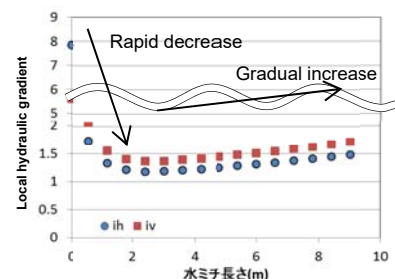


Fig. 3: Changes in local hydraulic gradient in reproduction analysis

See the following for details.

1) Tanaka et al., "Study on the evaluation of piping progress in river levee foundation ground," The 6th River Levee Technical Symposium, pp. 29-32, Dec. 2018