Topics

Report on a survey of damage to river levees caused by tsunami triggered by the Great East Japan Earthquake

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1. Introduction

In response to this tsunami damage, the Emergency Proposal of Countermeasures for River Runup of a Tsunami (River Tsunami Countermeasure Study Committee, August 2011) was compiled, organizing the handling of tsunami external force in river management and concept of levee height in facility planning. At the end of October 2011, the Law For the Creation of Tsunami Disaster Prevention Regions was approved by the Cabinet, and plans for the protection of regions from tsunami were enacted based on hypothetical inundation regions. In response to these events, it is necessary for river levees to also fulfill their stipulated functions as levee systems linked to coastline levees, but to achieve this, it is necessary to consider the fact that river levees are, structurally, extremely susceptible to damage by overtopping. For example, when exposed to action of a tsunami a little larger than the tsunami hypothesized for facility planning, it is predicted that temporary overtopping will occur even in river levee sections, so it is important to understand levee behavior in this event. Based on this point, the division looked back at the results of a survey of the state of damage along the Kitakami River, Abukuma River, etc., performed immediately after the earthquake to reorganize the characteristics of river levee damage caused by a tsunami.

2. Characteristics of damage to river levees by tsunami

In addition to the results of the on-site survey, traces of the tsunami runup, aerial photographs, and video and other types of data obtained by the Tohoku Regional Development Bureau and the Geospatial Information Authority were used to organize the water level and direction of flow of tsunami runup, and at the same time, link these different types of information to organize the form of and degree of damage to levees etc. The findings are described below.

[1] The second most severe form of damage after the breaching of levees is erosion of slopes on the protected side of levees caused by overtopping. Erosion of the slopes on the river side by the flow of the tsunami runup in the river course generally did not cause damage to the levee sections which appears very serious.

[2] One reason why levees were not breached by overtopping estimated to have exceeded about 1m is presumed to be the effects of a water cushion that restricted erosion of the toe and the slope of the levee.

[3] The flow on the front slope surface which occurred during tsunami runoff was of short duration, even though its flow rate was high, so in some cases, slope erosion is restricted by vegetation.

Judging from the above, erosion of the levee body caused by the flow of the tsunami as it ran up and flowed back downstream inside the river course, was generally smaller than that caused by overtopping, reconfirming that levees are susceptible to damage by overtopping. It was assumed that for levees laid out parallel to the direction of the runup of the tsunami, it is vital to consider not only the overtopping depth, but the water level difference between the river side and protected side of the levee and the duration of this difference, which are related to the scale of the effects of the water cushion.

3. Conclusions

The estimation was made by combining the results of the on-site survey with information which could be used until now. To increase the certainty of the results of the estimation and clarify the response of the river levees during overtopping based on differences between their structures etc., aerial measurement data obtained before and after the earthquake will be used to clarify the actual state of deformation of river levees in greater detail.。

[Reference]
Early report on the survey of damage to civil engineering structures by the Great East Japan Earthquake of 2011, Technical Note of the NILIM, No.645, pp. 243-341, July 2011.