Flood Risk in Traditional Building Preservation Districts on the Asano River

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INTRODUCTION

Torrential rains have occurred frequently in recent years, resulting in an increased risk of sediment-related disasters. Several groups of traditional buildings have been developed and maintained along the river, many of which are at high risk of sediment-related disasters. In this study, we assess the current inundation situation in the region of the Asano River, where a sediment disaster occurred on July 28, 2008, using the river simulation software iRIC and evaluate potential countermeasures for flood prevention in three traditional building preservation districts.

STUDY METHOD

This study focuses on three regions of the Asano River, in Kanazawa city, Ishikawa prefecture: the Kazue-machi, Hgashiyama-higashi, and Utatsu-sanroku preservation districts, which contain groups of traditional buildings (**Fig. 1**). In the upstream area of the Asano River, a drainage channel runs to the parallel-flowing Sai River. On July 28, 2008, at the time of a disaster resulting from heavy rainfall, the discharge amount was measured at 150 m^3/s. Since the completion of the Sai River-Asano River Service Project in 2013, the maximum discharge amount has increased, with a current level of 250 m^3/s.

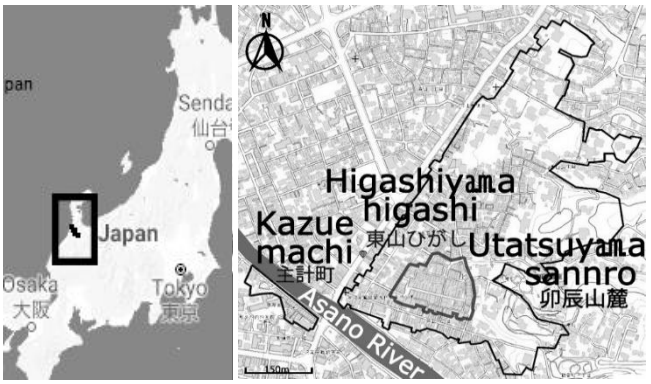

Fig. 1 Overall view of the target area (Added to the map from GIS).

In this study, 10-m mesh elevation data were obtained from Geospatial Information Authority of Japan (GIS). To assess the risk of damage associated with the current flood-control capacity of the Asano River, two cases were distinguished according to the increase in discharge amount (150 m^3/s and 250 m^3/s). The maximum discharges amount in cases 1 and 2 are 150 and 250 $m^3/$, respectively.

RESULTS AND DISCUSSION

1. Analysis results of water level change and flooded area

1.1 Water level changes

According to the analysis of water level changes (**Fig. 2**), once the water level had exceeded the flood-risk level of Asano River (1.5m), the subsequent decline in water level took 149 and 112 minutes in cases 1 and 2, respectively. This indicates that the water level will decline more rapidly in proportion to the increase in discharge amount.

1.2 Inundation area at time of water level decline

According to the analysis of the water level decline at 12:00 P.M. (**Fig. 3**), widely flooded areas remained in the Utatsu-sanroku and Kazue-machi districts in case 1, but not in case 2. These results indicate that an increased discharge amount causes floods to decline more rapidly.

2. Considerations of countermeasures

The following four countermeasures were examined in terms of their suitability for each study region.

2.1 Additional embankment

Raising the embankment may have a negative impact on the surrounding landscape of the region. Under the high-density housing conditions of the entire area adjacent to the Asano River, it is difficult to determine the location at which measures to reduce flood duration would be optimal prior to its entry into the floodwater drainage system.

2.2 Increases in discharge amount

Although our analysis showed that an increase in discharge amount will allow effective management of stormwater runoff, there is no opportunity to increase the discharge amount due to the current capacity of the Sai River.

2.3 Addition of a new dam

As demonstrated by the simulation results of case 2, only a dam with a volume exceeding 9,060 m^3/s can completely prevent flooding. However, the upstream topography of the Asano River does not satisfy the conditions required for dam construction.

2.4 Addition of a new retention basins system

For reasons similar to those impeding the construction of a new dam, a ground area sufficiently large to accommodate a general retention basin remains elusive. A reasonable and viable alternative, therefore, would be the construction of an underground system of retention basins, to ensure the availability of sufficient land.

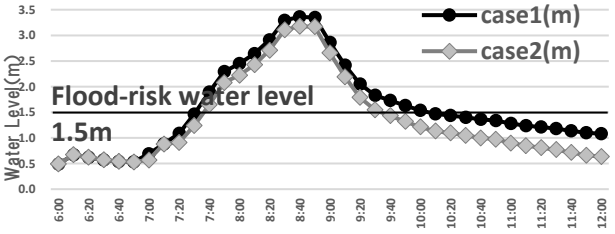

Fig. 2 Water level changes in cases 1 and 2.

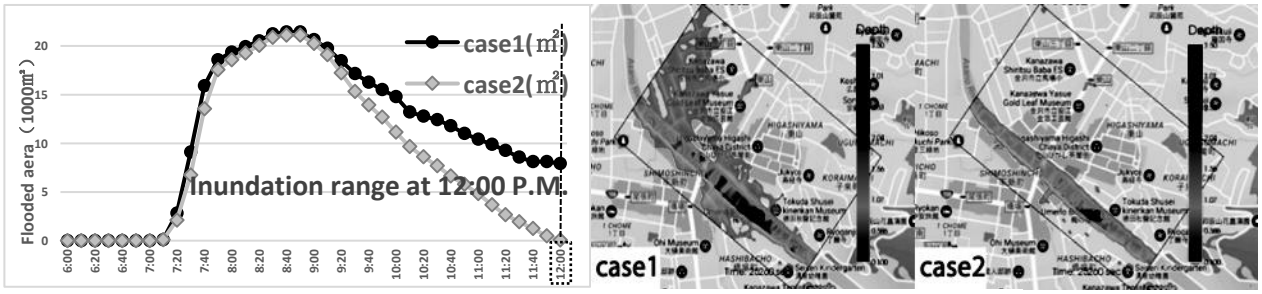

Fig. 3 Flooded area at the time of water level decline (12:00 P.M.).

CONCLUSION

In this study, we showed that the current capacity of the Asano River is insufficient to prevent inundation, such that a high risk of flooding in the event of a disaster equal in magnitude to that of 2008. This study proposes four such measures and evaluates their feasibility. Considering the characteristics of each part of the study area, the addition of an underground system of retention basins is recommended along with other countermeasures.

Keywords: Heavy rainfall, Inundation, iRic, Groups of Traditional Buildings, Asano River