Study and Research on the Mitigation of Inland Flood Damage in the Drainage Area of a Large Stormwater Storage Pipe (Yokohama City)

Year of Research	2011・2012	Implementation of anti-inundation measures

(Purpose)

The large stromwater storage pipe subject to this study has a drainage area of over 4,000ha and is connected to many trunk sewers and pump stations. Operating this storage pipe to utilize its maximum storage capacity requires a complicated maneuver because rain does not fall uniformly over the drainage area, and there are time lags in the arrival of rainwater into the trunk sewers. The purpose of this study is to conduct a runoff analysis toward efficient operation of pump stations and effective utilization of trunk sewers below and above the probable maximum precipitation, as well as to examine hardware and software solutions to the problems identified as a result of the analysis.

(Results)

Outlined below are the contents and results of this study.

(1) Designing Flood Control Systems

At a 10-year probability precipitation, certain locations would not be able to eliminate excess runoff even with the completion of the large stromwater storage pipe due to lack of capacities of branch sewers, etc. We then examined what types of facilities would be needed to prevent flooding in all locations. After eliminating flood by adding bypass pipes and other facilities, we calculated the inflow volume of water into the storage pipe, which turned out to be 120,000 tons greater than before adding the facilities, verifying that such facilities could further enhance the effective utilization of the storage pipe.

(2) Prioritizing the Districts to be Improved

We evaluated each district based on five factors (flood area, number of floods recorded, probability of occurrence, cost effectiveness, and easiness of implementation) to prioritize the districts. We classified the districts into 4 ranks based on the total score, which was derived by grading each factor on a scale of 1 to 2 (or 3). As a result, it was found out that the district currently under development had a very high priority.

(3) Formulating a Plan to Further Raise the Target Standard

Using a simulation model, we estimated the inflow volume into the storage pipe after installing additional facilities to accommodate rainfalls exceeding the 10-year probability precipitation (57.9mm/hr) in order to determine if the target service standard of the storage pipe could be raised further. We constructed an excess rainfall model by raising the rainfall intensity by up to 5mm/hr to create the same curve shape as that of the 10-year probability precipitation and calculated the inflow volume into the storage pipe, which became full when the hourly precipitation was raised by about 5mm/hr from the 10-year probability rainfall to 65mm/hr. Inundation below floor level did not occur even when it was raised by 10mm/hr, confirming that the storage pipe and other facilities designed to stand against the 10-year probability rainfall would also be effective in mitigating flood in case of excess rainfall. It was also verified that inundation below and above floor level could be prevented against the largest rainfall recorded (75mm/hr) by making additional investment of about 300 million yen to the flood control works against the 10-year probability precipitation.

(4) Examining the Use of Storage Pipe as Part of Network

We examined whether or not the storage pipe could be utilized even more effectively if it was used as part of a network connecting the pump stations in the area. In order to see if flooding would increase when the pump stations in the drainage area of the storage pipe stopped operating, we chose three pump stations to run simulation models in a 10-year probability rainfall event. Stopping any one of the pump stations did not result in an increase of flood magnitude, confirming that some pump stations could be stopped because of the effect of the storage pipe. This means that when it becomes necessary to reconstruct these pump stations, they can be stopped without installing a substitute pump.

(Conclusion)

This study revealed that the deep underground large stromwater storage pipe would be greatly effective in compensating for a lack of trunk sewer capacity and also provide protection against excess rainfall. The storage pipe is to be connected to the existing pipes to form a network in a large area, and this study was able to suggest effective approaches to its optimum utilization.

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