B09

Study on field application to evaluate the effect of the underground storage box

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1. Introduction

Recent years have seen major flooding, which involves inland flooding caused by a lack of drainage capacity and drainage pump systems, as well as insufficient water retention due to increasing runoff flow by urbanization. Impervious areas have increased rapidly over the past several years, and most drainage systems are insufficient to control normal storms. Due to this, urbanization has increased peak flows and surface runoff volume over pre-urban levels, as shown in Fig. 1.

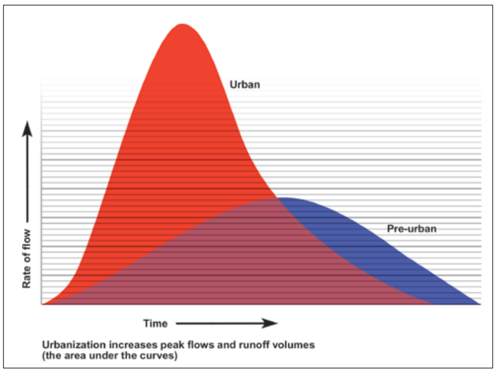

Fig. 1 Effects of urbanization on volume and rates of runoff

Metropolises and central city areas such as Tokyo and Osaka in Japan are no exception, and flood damage has also occurred in underground spaces associated with such areas. This is highly dangerous and can be lead to catastrophe. The design criteria for sewerage is often 10-year probability rainfall, which corresponds to about 50mm/hour all over the country in Japan, but the rainfall intensity has frequently exceeded this level in recent years. In order to promptly remove the storm water, drainage systems and pumping stations must be maintained to increase the efficiency of the sewerage treatment capacity. However, huge costs and amounts of time are required to conduct this maintenance. Therefore, underground storm water storage boxes are installed ideally in order to temporarily capture and store runoff in a large space. Generally, the storm water poured down onto the ground is reduced using various storage methods, which such as lower parking lots, the ground, tanks installed onto houses and buildings, and side weirs attached to the sewer system. These systems provide peak runoff control, and the stored storm water can be drained back into the environment later, making these systems ideal for highly urbanized areas.

In this study, we considered the side weir attached to the sewer and two-dimensional ground surface and one-dimensional sewer network models (Kawaike et al., 2002) are used to reproduce the inland flood and storm water drainage process, in an integrated flood analysis model developed by Lee et al. (2015). Nakahama District in Osaka is the target area, which is located in the eastern part of Osaka City. Three installation sites are determined considering different area features, where A is the lowland, B is the middle, and C is the upstream portion in the Nakahama area, as shown in Fig.2.

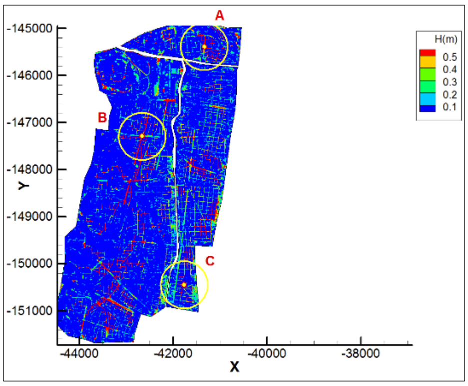

Fig. 2 Installation areas

Therefore, storage box’s effects is verified along changes in location, its capacity, rainfall type, and condition of side weir that divert part of the storm water within a sewer pipe into the storage box. Finally, a suitable installation site is verified though assessments of inundation damage costs.

2. Conclusion

The rear and center intensity rainfall conditions influenced urban inundation. The impact of the fore intensity rainfall condition was less than the other rainfall distributions.

The mitigation effect differed depending on the installation position of the storage box. An important point was that when the storage box was located at the downstream portion of the sewer pipe, the mitigation effect was better than at the upstream position.

Since the mitigation is thought to differ depending on the installation position for storage capacity and its effects, it is necessary to be compared in a variety of combined cases.

The storage box reduced the inundation damage but did not have a significant effect. Since area B was estimated to receive the highest inundation damage, compared with the other areas, if a storage box will be installed in one of areas A, B, and C, the area B is most suitable as an installation location. However, since the effect of the storage box is smaller than in the other areas, the installation position and storage box’s effects should be considered carefully to obtain greater effects, financially.

References

Kawaike K., Inoue K., Hayashi H. & Toda K.(2002) : Development of inundation flow model in urban area, Japan Society of Civil Engineers, pp. 1–10.

Lee, S., Nakagawa, H., Kawaike, K.(2015) : Urban inundation simulation considering road network and building configurations, Journal of flood risk management.