B110

Study on the effects of the combination of on-site and off-site water storage facilities for inundation mitigation in urban area

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Introduction

In recent years, inundation disasters caused by heavy rainfall have led serious threats in many countries. In order to mitigate the hazards of inundation, governments of various countries have come up with many methods, one of which is to establish water storage facilities.

On-site storage facilities (**Figure 1, 2**), such as small tanks which are installed in house, playgrounds or roads, they usually can immediately collect the stormwater and store them on-site. Off-site storage facilities (**Figure 3, 4**) usually have large volume, such as retarding basins, regulating ponds and underground tanks, stormwater propagating away from remote locations is stored via rivers or sewer pipes. Simultaneous installation of these two facilities can reduce inundation hazards faster and more effectively.

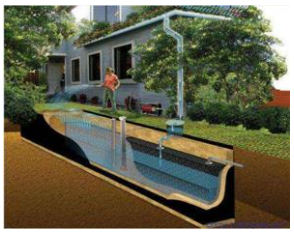

Figure 1 and **Figure 2** on-site storage facility

Figure 3 and **Figure 4** off-site storage facility

Kawaike et al. (2018) indicated that on-site facility cannot provide sufficient mitigation.

Ko et al. (2018) indicated that off-site storage facility can reduce the inundation damage but does not have a significant effect.

The objective of this research is to evaluate and demonstrate the mitigation effects provided by the simultaneous installation of on-site and off-site facilities in a target area, and their ability to prevent pluvial inundation damage.

Methodology

The integrated model for this research consists of a 2D model of ground surface and 1D model of sewer network (Lee et al.,2013; Lee et al.,2016).

Figure 5 shows the target of this study in Osaka City: Nakahama Treatment Area. Our lab has applied our model to this area several times (Lee et al.,2016; Ko et al., 2018).

Figure 6 shows the rainfall pattern of the 50-year rainfall probability used here. The rainfall type is center and the duration time is 3h.

In on-site storage part, as **Figure 7** shows**,** the meshes in the model are divided as single-family housing, apartment housing, offices, schools, playgrounds, streets, and others. Each category except streets and others has assumed on-site storage tank capacity to store rainfall.

Figure 7 also shows the position of an assumed off-site storage tank with a volume of 10000m^3.

In this research, we simulate inundation situation in four cases: no facilities, only on-site storage facilities, only off-site storage facilities, and the combination of two facilities. Comparing the results of these four cases and make a discussion.

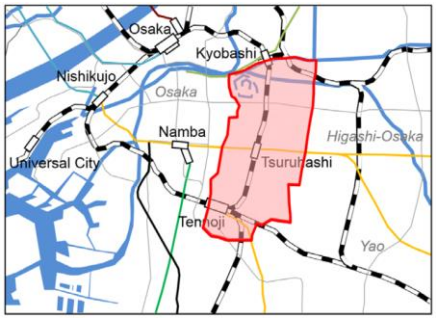

Figure 5 Target area

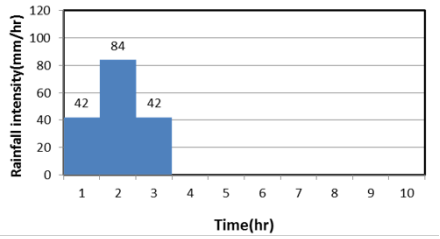

Figure 6 50-year rainfall

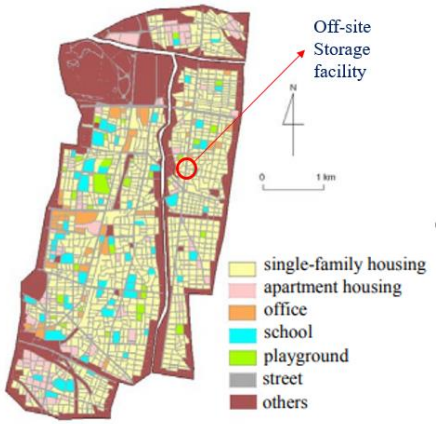

Figure 7 7 categories of on-site storage facility and the position of off-site storage facility

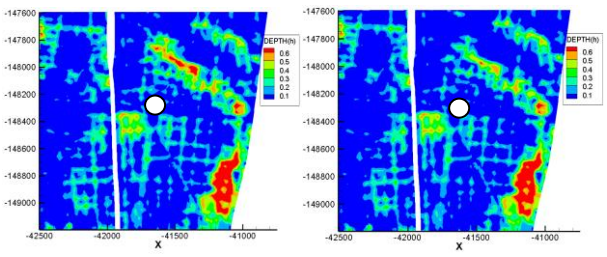

Figure 8 max inundation depth (only on-site)

Figure 9 max inundation depth (the combination)

Result and discussion

Figure 8 and **Figure 9** show the max inundation water depth of only on-site storage facilities case and the combination of two facilities case around off-site storage facility（the white circle is the position of off-site storage facility）. Figure 8 has more red areas than figure 9, so, it has more heavily inundated areas.

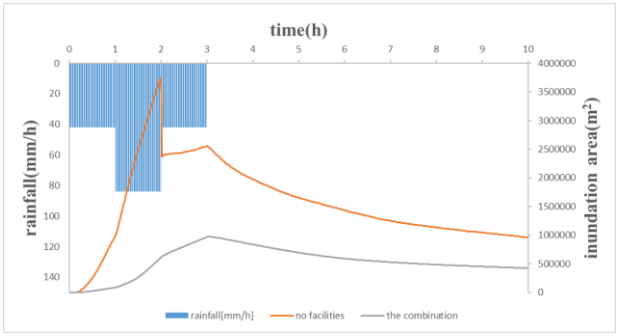

Figure 10 the inundation area of two cases

Figure 10 shows the inundation area of no storage facilities case and the combination of two facilities. The value of the former is significantly greater than the latter, so the combination of two facilities can mitigate the inundation obviously.

Conclusion

The combination of on-site and off-site storage facilities shows good effectiveness for mitigating pluvial inundation hazard in urban area. The effects of this combination of on-site and off-site storage facilities are compared with the case of either on-site or off-site storage only. It shows the effect of this combination is more obvious than the single one.

Reference

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Dongwoo Ko et al (2018): Field application studies of the effect of an underground storage chamber using an urban inundation model, J. of Flood Risk Management, Vol.11, Issue S2, pp. S1125–S1136.

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