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Study on Estimation for Applicability of Overflow Discharge Equation Under Pressurized Flow Condition

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1. Introduction

Before urbanization, there are wide permeable areas such as farming land and forest, but after urbanization, permeable area has decreased as a result of increase of roads area, construction of buildings etc. Due to this, the most of the storm water dose not infiltrate into the ground and total amount of storm water runoff has increased, which can lead to urban inundation. To mitigate this problem, underground storage systems as an effective countermeasure have been implemented especially in highly urbanized areas. However, there are no criteria on the degree of mitigation effect that can be expected from installation of such underground storage systems. In many cases, those storage systems are attached to sewerage systems, and some part of the stormwater within a sewerage pipe is diverted over the side weir into the storage system. Therefore, the research regarding side weirs of stormwater storage systems which can be considered as effective hydraulic structure to mitigate the urban flooding and estimation of overflowing discharge over the side weir into those storage systems are significant. Fig. 1 shows the structure of underground storage system briefly.

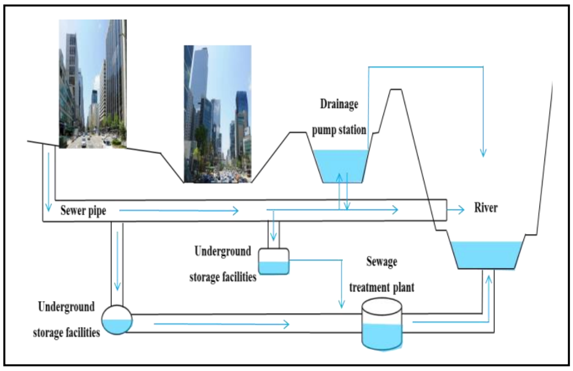

Fig. 1 Underground storage system

The present study is undertaken to determine the appropriate equation to estimate diversion discharge to storage system. Some previous theoretical analyses and experimental researches have been reported in terms of flow over rectangular side weirs in circular open channel(Allen 1957 ; Uyumaz and Muslu 1985 ; Air R. Vatankhah 2012). The main contributor to the understanding of hydraulic behavior of side weir is De Marchi(1934). The equation is as follows,

$$q = \frac{dQ_{out}}{dL} = \frac{2}{3} C_d \sqrt{2g} (h - p)^{1.5}$$

where q is discharge per unit length of side weir, L is length of side weir, p is height of the side weir, h is flow depth at the section L, C_d is discharge coefficient of side weir.

In the cases of open channel flow condition, De Marchi's equation is usually employed, and its discharge coefficient has been suggested by many researchers. However, no study has verified the suitability of this equation in pressurized flow condition, which would be often the case within sewerage systems during urban flooding.

2. Conclusions

In this study, under the assumption that De Marchi's equation is applicable to the pressurized flow condition, the numerical model is used to validate the experimental results using the discharge coefficient obtained by experiment. Finally, the suitable discharges coefficient for each different weir condition and empirical correlation are suggested through the comparison between experimental and simulated results. However this study is limited to the steady condition only for simplicity.

Next step will be to verify the numerical model under unsteady condition, which would enable to estimate the overflow discharge from sewerage to storage systems and the mitigation effect of those storage systems.

References

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