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Experimental Study on Hydraulic Behavior of Storm Water in the Sewer Pipe with Manhole for Urban Inundation Analysis

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Urban inundation due to climate change and torrential rainfall causes a serious problem for many cities worldwide. Therefore, it is important to accurately simulate urban hydrological processes and efficiently to predict the potential risks of urban floods for the improvement of drainage designs and implementation of emergency actions (Li et al., 2009).

The research group of authors has been making an effort to develop and to improve an integrated model based on physical experiment data. It consists of a two-dimensional inundation model on the ground surface and one-dimensional network model of sewer pipes; a sub-model combines those two models and exchange storm water between the ground surface and the sewerage system. This model reproduced experimental results well but it combined with only one sewer pipe. On the other hand, real sewerage system involves a lot of complex phenomena such as manhole shape, pipe configuration, benching etc.

There have been many researches which tried to determine the energy loss coefficients at manhole junction regarding to pipe configuration and flow regimes. Zhao et al. (2006) mentioned that surcharged flow most likely begins to form at sewer junction and may cause serious problems, such as blown-off manhole covers, sewer pipe rupture, flooding and soil erosion. There can be subcritical or supercritical open channel flow, transition flow or surcharged at manhole junction. Even though the energy losses at a manhole are relatively not so big, the total amount of local losses is significant because of a huge number of manhole and pipe configuration, located every 50-60 meters on each pipe (Mrowiec, 2007). The flow at the entrance and exit of a junction manhole is very complex phenomena in urban inundation analysis. Although subcritical flow can be treated as a one-dimensional flow, using energy equation and loss coefficients, the supercritical flow is more complicated and needs a two-dimensional treatment (Hager, 2010).

However there are lacks of previous research that can be effectively used to one-dimensional model in order to reflect various phenomena such as manhole shapes and pipe configurations.

Hence in this research, new experiments are carried in order to develop and to improve an integrated model based on proto-type experimental facility as shown in Fig. 1. It consists of three pipes and one manhole. The experiment involves many study cases according to different types of manhole shape (circle and square), pipe configurations (straight-through flow and T-shape configuration - 90°, 120° and 135°) and flow regimes, respectively.

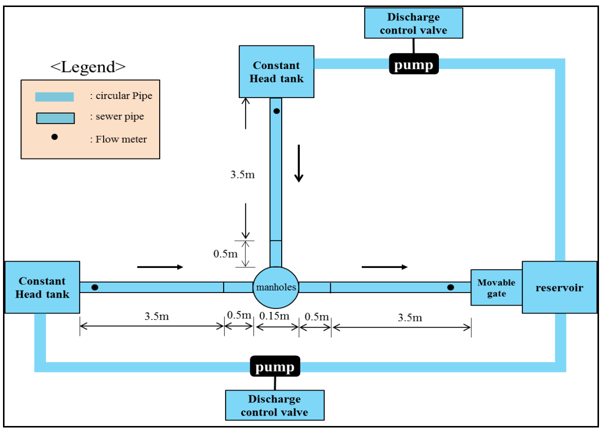

Fig. 1 Plan view of experimental facility