C06

Urban Inundation Simulation Incorporating Sewerage System without Structure Effect

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Urban inundation due to torrential rainfall and climate change has been one of the most common natural disasters worldwide. In Japan, the many inundation disasters that have occurred due to locally heavy rainfall during a short period of time have reinforced the need for accurate models to simulate flooding.

Many researchers have developed numerical models in order to predict and prevent urban inundation caused by heavy rainfall. Hsu et al. (2000) developed a combined model for inundation simulation by coupling the SWMM model and the 2D diffusive overland flow model. However, this model could not deal with detailed information such as inundation zones and depths caused by pressurized water. Duchesne et al. (2001) demonstrated the efficiency of real-time control (RTC) to decrease storm overflows from combined sewers to receiving waters, but they did not consider exchange discharges between the ground surface and the sewer system. Akiyama et al. (2008) developed a dynamic network model for free-surface-pressurized flows, which, when combined with the Preissmann slot, simulated a closed conduit. Although this model successfully predicted areas with poor drainage and the locations of pressurized positions in the sewer pipes, it failed to simulate the exchange discharge between the ground surface and sewer pipes. Leandro et al. (2009) pointed out that sewer/surface linkages and virtual manholes were key factors for developing a more accurate combined model.

An integrated model was developed to produce more accurate results. It consisted of a 2D inundation model of the ground surface and a 1D network model of sewer pipes; a sub-model combined those two models and simulated the exchange of storm water between the ground surface and the sewer system (Kawaike and Nakagawa, 2007). This sub-model, which employed the step-down formula and the overflow formula, was found to overestimate storm water interaction discharge when compared to experimental results (Kawaike et al., 2011).

Our research group has been trying to develop more accurate urban inundation model through the laboratory scale experiments. We have focused on three points which should be emphasized and verified for developing accurate urban inundation model. As the first step, we conducted the experiments to confirm how much discharge can be drained through the storm drains (LEE et al. 2011), then another experiments were carried out to verify how complex interaction phenomena are occur between ground surface and sewerage system (LEE et al. 2013), and to analyze the mechanism using numerical model. As a result, integrated urban inundation model was developed (LEE et al, 2013).

In this study, the integrated urban inundation model is used to simulate the severe August 2011 flood in highly urbanized Nakahana area in Osaka city. Unstructured mesh is used for ground surface based on FDM numerical skim and 1 dimensional Pressmann-slot model is used for sewerage system. In order to link above two part interaction model is used. Finally, simulation results are compared with flood mark investigation data.