Modeling and analysis of transient air-water flow & the influence on design and management of urban storm water drainage systems

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Abstract: Under the influences of global climate change and rapid urbanization, extreme rainstorm events and associated urban flooding have become more frequent and intensive in the world, which have caused enormous losses in resources as well as human lives.

Optimization of the drainage system, however, plays a crucial and meaningful role in flooding control in the downstream areas of the urban storm-water system, which indicated the importance of taking unsteady flow analysis into account in design and operations of the drainage system by numerical modeling such as SWMM. Actually, this macroscopic planning method could also integrate uncertainty-analysis and Low-Impact-Development (LID) measurements in the improvement in urban storm water systems.

Even so, during the transient drainage process in micro perspective, air is easily trapped in the drainage pipeline, which can easily form blockage in the pipeline and thus can reduce severely the pipe drainage capacity as well as cause series problems in the stormwater drainage system such as geysering and flooding. The transient interaction and evolution process between different phases near their interface tends to be highly complicated, which is involved with drastic topology changes and pressure oscillations due to the large density and viscosity difference of air and water. Therefore, further Modeling and analysis of transient air-water flow may help to better understand the physical formulation and mechanism of this transient air-water interaction process.