Study on analysis of inundation phenomena in urbanized area

Whole term	2006.4～2007.2	

(Purpose)

The local governments which have the jurisdictional rivers specified by the law; Particular Urban River Flood Damage Protection Legislation enforced in May 2004, must designate the possible urban flood and submerged area (PUFSA) as soon as possible. In order to analyze the possibility of flood and inundation in an urbanized watershed of a jurisdictional river, Flood Research Laboratory (FRL) has been developing the NILIM (New Integrated Low-land Inundation Model) to assist local governments.

Although the overflows from manholes of drainage systems are most dominant phenomena in inundations of urbanized areas, there are few observed hydraulic data sets of the overflows, which are necessary for evaluation of the model's accuracy. Therefore FRL had decided to carry out the experimental analysis of overflow phenomena from manholes with the physical model as shown in Figure 1 and figure out their properties for evaluation and improvement of NILIM.

(Methods)

(1) 1／5 Scale model of road and its drainage pipe system had made in Froude's similarity rule as shown in Figure 1.
(2) The diameters of manhole outlets were variable.
(3) The flow velocity of horizontal pipe was set to 0.3m／s which modified 0.68m／s of the original scale of the drainage pipe in Froude's similarity. The flow rate velocity of the load surface was set to $0.01m^3$ in the same way.
(4) P iezometric head and flow rates along the horizontal pipes, vertical pipes and surface road were measured continuously.

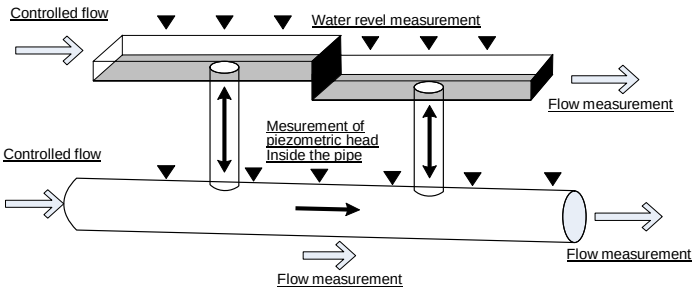

Figure 1. Schematic of physical model

(Results)

The results of experimental analysis are as follows,

(1) In both cases, overflowing from the manhole to the suface and re-entering from the surface to the manhole, a fair correlation is confirmed as shown in Figure 2, that is Q ∝√⊿h (⊿h: piezometric head difference between the pipe and the ground water). This indicate that the flow rate calculation will be possible applying hydraulic equations such as an orifice equation (Q =C･a･(2gh) 0.5).
(2) The regression lines between the root of piezometric head difference (the pipe - the surface water) and overflow (re-enter) volume did not hit origin and y-intercept of them took negative values. They supposed to be caused by the head losses during the overflow or re-enter processes. A further question is how to estimate the influence of head losses during the overflow or re-enter processes to the piezometric head difference between the pipe and the surface water for accurate calculations of flow rates.

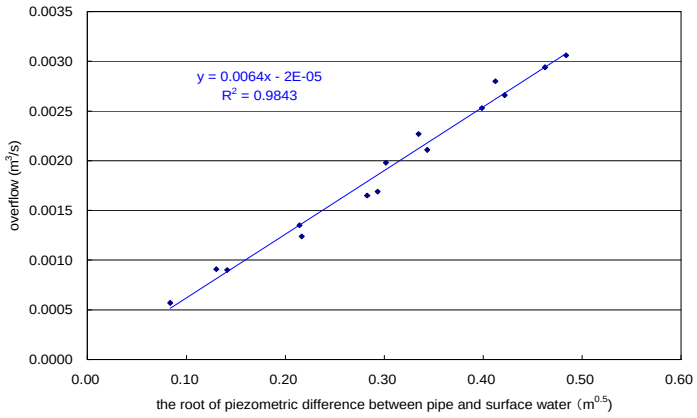

Figure 2. Flow and piezometric head difference between pipe and surface water
(In case of overflow from outlet of manhole; D=5cm)

(3) When the diameter of outlet of a manhole is equal to the inside diameter of a manhole, flow rate coefficients in cases of re-enter is smaller than those in cases of overflow. They supposed to be affected by the generation of vortex or separation of flow.

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