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Experimental Study on the Discharge Coefficient for Side Weir with Pressurized Flow in Circular Channel

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Even though a large number of researches related to reduction of the urban inundation damage have been proceeded, the damage is still serious problems yearly. Urban inundation has caused immense property damage and personal injury due to local heavy rainfall during a short-time and extreme climate in worldwide. In addition, most of the areas currently go through the process of urbanization rapidly, the risks are increased.

To mitigate this problem, the underground storage systems as an effective countermeasure have been discussed around the metropolitan area. The researches in terms of side weir related to fundamental underground storage systems are essential.

The side weirs are hydraulic structures that are used extensively as urban sewer systems, irrigation, and flood protection. A lot of researches suggested the discharge coefficient regarding the side weir with subcritical flow and supercritical flow in several channel conditions.

Nandesamoorthy et al. , Subramanya et al. , Yu-tech, Ranga Raju et al. , Hager, Cheong, Singh et al. , Jalili et al. , and Borghei et al. obtain the equations for discharge coefficients for rectangular, sharp-crested side weirs based on experimental results. Swamee et al. used an elementary analysis method to estimate the discharge coefficient in smooth side weirs through an elementary strip along the side weirs.

Ghodsian studied behavior in the rectangular side weir in supercritical flow. Khorchani et al. studied the overtopping discharge through the side weirs with a full-scale experiment using digital cameras.

Muslu, Yüksel and Muslu et al. used numerical evaluation to analyze the flow over a rectangular side weir(M. Emin Emiroglu et al. 2011).

Some previous theoretical analysis and experimental research is related to flow over rectangular side weirs in circular channel (Allen 1957 ; Uyumaz and Muslu 1985 ; Uyumaz and Muslu 1987 ; Hager 1987 ; Air R. Vatankhah 2012).

Generally, The method assumes one-dimensional flow conditions, thus neglecting the variations of overflow direction and the velocity distribution(Willi H. Hager 1987). The first theoretical method in terms of side weir in a rectangular main channel based on the constant energy head along the side weir was reported by De Marchi(1934). The equation is as follows,

$$q = -\frac{dQ}{ds} = \frac{2}{3} C_d \sqrt{2g}\,(h-p)^{\frac{3}{2}}$$

where q is discharge per unit length of side weir, Q is discharge in the main channel, s is distance along the side weir measured from upstream end of side weir, g is the acceleration of gravity, p is the height of the side weir, h is the flow depth at the section s, C_d is the discharge coefficient of side weir.

The discharge coefficient is influenced by the following parameters,

$$C_d = f(v, D, g, h, p, L, S \cdots)$$

Where L is length of side weir, S is slope of main channel.

The aim of this study is to determine the discharge coefficient in rectangular side weir for varying side weir length in circular channel and to obtain the experimental data for numerical model validation for estimation of overtopping discharge.