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EXTENDED ABSTRACT

Evaluation Effect of Changing the Sill Geometries and Positions on Discharge Coefficient of Vertical Sluice Gate

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1. Introduction

In controlling water resources, sluice gates have received attention from researchers due to the ease of installation and simplicity of the operation and the governing equations. The experimental study of (Henry, 1950) is one of the first research publications in this field that estimated the flow discharge coefficient for the sluice gate with a diagram. The studies of (Alhamid, 1999), Rajaratnam and Subramanian (1967), Ferro (2000), Daneshfaraz et al. (2016) and Heidari et al. (2020) are other studies in the field of hydraulics of sluice gate, that explains the importance of research in this field. In the present paper, results of experimental investigations on the effect of applying sill on discharge coefficient in different positions of the sluice gate are presented. The effect of sills including semi-cylindrical, cylindrical, pyramidal and rectangular cube in different widths was investigated.

2. Methodology

2.1. Experimental study

The experiments were performed in a laboratory flume 5m long, 0.30m wide and 0.45m high. The laboratory channel has a floor and walls made of Plexiglass and is equipped with a point depth gauge with an accuracy of ±1mm. In all experiments, the gate opening was considered constant and equal to 4cm. The effect of the sills with semi-cylindrical, cylindrical, pyramidal, and rectangular cube geometric shapes and with widths of 7.5, 10 and 20cm in different position relative to the sluice gate were investigated experimentally.

3. Results and discussion

3.1. Effect of changing the location of the sill relative to the sluice gate on the discharge coefficient

Results showed that Sills with pyramidal, semi-cylindrical, cylindrical, and rectangular cube geometric shapes have increased the discharge coefficient in the tangential state downstream of the sluice gate in (b=7.5cm) compared to the position of the sill under the sluice gate by 3.88, 0.69, 1.85, 1.63 percent, respectively.

Examining the changes in the discharge coefficient in the position of the sill tangent to the upstream of the sluice gate showed that the pyramidal, semi-cylindrical, cylindrical and rectangular cube sills with a width of 7.5cm have increased the discharge coefficient by 5.77, 2.93, 2.86 and 2.63 percent, respectively compared to the position of the sill under the sluice. The schematic view of sill's position is shown in Fig. 1.

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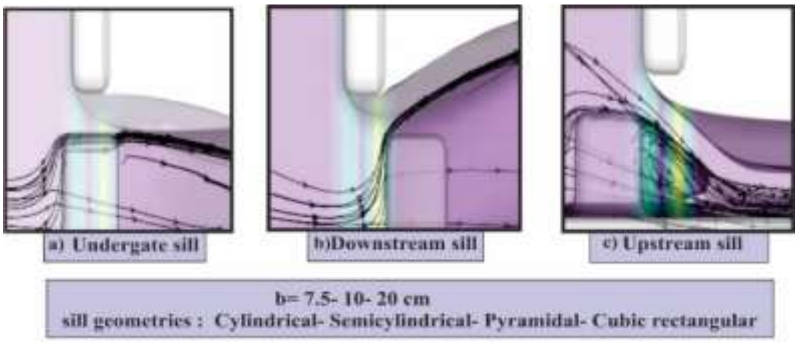

Fig. 1. Schematic view of sill's position

3.2. The effect of sill geometry on the discharge coefficient

The results showed that in the condition of sill under the sluice gate, the highest flow coefficient is related to semi-cylindrical, cylindrical, pyramidal and rectangular cube sills, respectively. But with the placement of the sill in the tangent state downstream of the sluice gate, the highest discharge coefficient was assigned to the pyramidal, semi-cylindrical, cylindrical and rectangular cube sills, respectively. By changing the position of the sill to tangent to the upstream of the sluice gate, pyramidal, semi-cylindrical, cylindrical and rectangular cubical sills respectively have the highest discharge coefficient.

4. Conclusions

The results showed that changing the position and geometrical shape of sill affects the discharge coefficient of sluice gate. The results showed that the change in the location of the sill affects the discharge coefficient. By changing the position of the sill, the maximum flow coefficient was assigned to the tangent state upstream the sluice gate, tangent to the downstream of the sluice gate, and then to the sill under the sluice gate, respectively. Because placing the sill in the tangent mode upstream of the sluice gate increased the contraction of the flow compared to other models. The results showed that the discharge coefficient is affected by the sill geometry. Because in the sill position under the sluice gate, the maximum discharge coefficient was assigned to the sill with semi-cylindrical geometry and in the tangential states downstream and upstream of the sluice gate, to the pyramidal sill.

5. References

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