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Study of Hydraulic Properties of Different Shapes of Shaft Spillways' Inlets

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Abstract

One of the most important, yet complicated, design problems in shaft spillways is vortex formation. A vortex may form with undesirable effects such as air entrainment, vibration, loss of performance, etc., hence much research have been done pursuing this phenomenon. In this study, more than 130 experiments were conducted using physical models of different inlets of shaft spillways. Three models of circular piano key inlets with different angles, one morning glory inlet, one morning glory inlet with vortex breaker and a simple vertical shaft were studied in the hydraulic laboratory of Bu-Ali Sina University in Hamadan, Iran. A Circular piano key inlet not only decreased the vortex strength but also could flow higher amounts of discharge in a constant head, experimental results showed. Among all different shapes of inlets, a circular piano key inlet with an angle of 90 degrees has better performance. Circular piano key inlet can flow a discharge of 14.2% more than a simple shaft spillway, experimental results showed. Among different circular piano key models, the one with the angle of 90 degrees has the highest amount of discharge coefficient, about 12.1% more than a model with an angle of 45 degrees and 5.5% more than a model with an angle of 60 degrees which shows its proper performance compared with other models. In lower heads, morning glory with vortex breakers has an appropriate performance, but in higher amounts of head, a circular piano key inlet shows an appropriate performance. Therefore, using circular piano key inlets as inlets for shaft spillways can be considered as a feasible solution for decreasing negative effects of vortex phenomenon.

Key words: Shaft Spillway, Morning glory Spillway, Vortex Breaker, Circular Piano Key Inlet, Discharge Coefficient.