Discharge Estimation for Submerged Parallel Radial Gates

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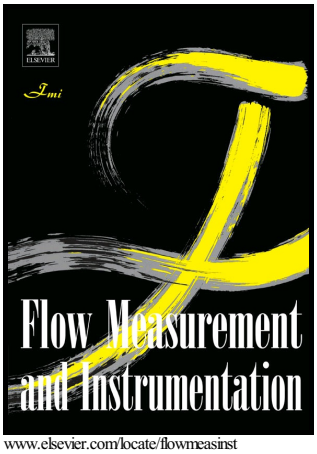

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ABSTRACT

Seven hundred ninety-seven field-measured data points were collected to calibrate multiple parallel radial gates. Data were collected from three control structures (i.e., Al-Tawfiki, Al-Menoufi, and Abasi regulators), which are located in the Delta irrigation district of Egypt. Upstream and downstream water depths, gate opening size, and flow discharge was measured at each structure. Additionally, previous calibration methods were reviewed and evaluated. Dimensional analysis with application of the incomplete self-similarity concept demonstrated the best results for the study area. Based on the field measurement data, a simple formula that implicitly considers the discharge coefficient is proposed for estimating the flow rate through submerged parallel radial gates.

Keywords: parallel radial gates; submerged flow; field measurements; irrigation structures.

1. Introduction

Radial gates are water control structures found in most irrigation systems in Egypt, as well as in other countries. Radial gates have a minimal lifting force compared to vertical sluice gates, and they measure flow rates in addition to regulating flow. However, the accuracy of radial gates may vary depending on the condition of the flow that is conveyed through the gate (i.e., free or submerged flow). Discharge calculation errors of calibration methods used for gates operating under free and submerged flow conditions are ± 5% and up to ± 50%, respectively [1]. Accuracy of the discharge calculation is critical for effective operational management and

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