**Hydraulic jump control using stilling basin with adverse slope and positive step**

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**ABSTRACT**

Water flow often releases excess energy after passing through gates and spillways. This energy should be reduced to avoid destruction of downstream structures. The hydraulic jump, a natural phenomenon, inevitably reduces incoming flow energy. In this research, effect of adverse slope and positive step on hydraulic jump characteristics including sequent depth ratio, jump length, roller length and energy losses were simultaneously investigated. In place of four adverse bed angle slopes of 0, 0.015, 0.03 and 0.05 (m/m) and three positive step heights of 0, 3 and 6 (cm) were tested. An analytical solution, based on momentum equation, was developed for estimating the sequent depth ratio with considering initial Froude number, bed slope and positive step height and its estimations were compared to the experimental measurements. Results showed that although both the adverse slope and positive step reduced the sequent depth ratio, jump length and roller length to a greater degree compared to the classic jump, the effect of adverse slope was greater than the positive step. Energy loss in the presence of adverse slope and positive step was greater than in the classic conditions. Furthermore, the result of the analytical solution was in good agreement with the corresponding experimental measurements.

KEYWORDS: [Adverse slope](https://www.tandfonline.com/keyword/Adverse+Slope), [analytical solution](https://www.tandfonline.com/keyword/Analytical+Solution), [energy loss](https://www.tandfonline.com/keyword/Energy+Loss), [hydraulic jump](https://www.tandfonline.com/keyword/Hydraulic+Jump), [positive step](https://www.tandfonline.com/keyword/Positive+Step)