« Research Note »

Effects of Inflow reduction on Water Level, Morphology and Salinity Pattern of the Urmia Lake

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Abstract

Urmia lake is one of the largest and most saline Lakes of Iran. This lake plays a key role in an environment of the northwest of Iran. In the last decade, construction of several dams on the rivers discharging to the lake has caused water level decrease of the lake and as a result adverse effects on the lake environment. In this research, by using Mike 3D model, water level and salinity pattern of the Urmia lake have been predicted. Inflow decrease to the lake was considered to be both gradual and instantaneous. Salinity and water level of the lake during coming years were also simulated. According to the results obtained, reduction of inflow to the lake has caused decrease of water level in the lake. This decrease will cause atrophy of major part of the lake. Water level reduction of the lake varied from 1.5 to 2.5 meter depending on the amount of inflow diverted and used upstream. Furthermore, several scenarios have been investigated to improve the lake condition. These results have also shown that creating an extra opening in the west of causeway, does not have any significant effects on the salinity pattern of the lake.

Keywords: Urmia Lake, Water Level, Area Changes, Salinity, Hydrodynamic Model.

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Numerical Investigation on the Hydraulics of River Lateral Intakes by SSIIM2 Software

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Abstract

In areas with sediment laden floodwater, sediments are carried into the intakes and decrease the channel conveyance capacity. These sediments are settled at different locations, including the separation zone at the upstream section of the lateral channel. Therefore, it is important to determine the length and width of separation zone. In this study, hydraulics of the flow in an intake from a rectangular channel using SSIIM2 is investigated. The ratio of intake width to main channel width, diversion angle, Froude number and ratio of diverted discharge on separation zone dimensions are among the effective parameters in the hydraulics of intakes. These parameters were investigated and numerical results were compared with those of experimental ones. There was a good agreement between the numerical and experimental results. For estimation of the above parameters several equations were developed. k-ω turbulence model was also found to be suitable for intakes hydraulics.

Keywords: Lateral Intake, Separation Zone, SSIIM2, k-ω Turbulence Model.

Development of Unsteady State Bed Variations Simulation Model in Gravel Bed Rivers

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Abstract
Obtaining an analytical solution for bed variation equations, is a hard task and often impossible. However, if a quasi–steady state is considered for flow condition, analytical solution may not be unreachable provided that necessary simplifications are made. The main purpose of this paper is to develop an analytical model to predict bed variations in flood conditions with upstream sediment supply. In this study, non–uniformity of bed material size has been considered by hiding function. In addition, governing equations have also been applied and solved to compute values for unknown parameters such as hydraulic parameters, bed material size, water surface slope and elevation and bed load at various times from the beginning of flooding. Model validation with observed experimental data have been made and followed by sensitivity analysis. Finally the effect of flood hydrograph shapes has also been investigated on bed variations in gravel bed rivers. Results have shown that hiding function has modeled non–uniformity of the bed materials appropriately while a reasonable agreement has been found with observed experimental data for flow Froude number of less than 0.8.

Keywords: Bed Armoring, Hiding Function Analytical Model, Degradation, Hydrograph.

Risk Analysis for Dam Overtopping Considering Hydraulic and Hydrologic Parameters (Vanak Dam as a Case Study)

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Abstract

In this study, a probability- based methodology is formulated to evaluate quantitatively and systematically the overtopping risk of earth dams. This study considers the overtopping phenomena induced by the occurrence of flood and wind effects. The risk analysis based models for overtopping consist of random modeling of the flood generation, wind dynamic aspects, reservoir routing, reservoir geometry, inflow discharge, outflow discharge, dam height, initial water surface and correction factor for increasing water induced by wind. For calibrating the results of simulation and modeling, Vanak dam in Charmahal Bakhtiari is used as a case study. The case study was employed to demonstrate how the total risk of overtopping over a practical case could be estimated based on the proposed methodology. Annual maximum series of peak flow discharge and wind velocity of Vanak dam are used to analyze extreme flood and wind with different frequencies by using hydrological frequency analysis software (HYFA). Risk analysis results show that considering uncertainties of random parameters affects significantly the dam reliability. Also overtopping risk of Vanak dam is not sensitive to increasing initial water surface. By increasing uncertainty of inflow flood, overtopping risk is increased.Risk overtopping increases, while the uncertainty of reservoir geometry increased. Also dam reliability is decreased by malfunction of spillway's gates. Based on this analysis both the effect of wind and flood together influence the overtopping risk of earth dam.

Keywords: Uncertainty, Risk analysis, Overtopping, Monte Carlo Simulation, Vanak dam.

Motion Analysis of Particles and Estimation of Trap Efficiency in the Settling Basin Using Euler-Lagrangian Model

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Abstract
Several studies using Computational Fluid Dynamics (CFD) techniques for modeling the process of sedimentation in settling tanks have been carried out to predict the fluid flow patterns and particle deposition during advection and dispersion process in tanks. To simulate the movement of the sediments in the settling tank, a Lagrangian approach is implemented. For this purpose, the finite volume method is used. After modeling sediment flow pattern, analysis of particles move ment and trap efficiency in sediment tank are presented.

Keywords: Settling Tank, Sedimentation, Large Eddy Simulation, Stocks Equations, Trap Efficiency.

Assessment of Velocity Profile Variation of Hydraulic Jump in Relation to Changes in the length of Roughness

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Abstract

In this study, the variation of velocity profile at different sections of hydraulic jump were evaluated in relation to changes in the length of roughness on a rough bed performing the tests in a flume with length of 12m, width and the height of 0.40m. Nine profile variation tests were carried out for 3 Froude numbers and 3 lengths of roughness. In each test, four sections of hydraulic jump were selected in which the velocity was measured at 1 cm intervals. The impact of changes of roughness length on velocity profile was surveyed at short, medium and long reaches of effective length. The results indicated that although the dimensionless velocity profiles on the rough bed are similar, their shapes are different from that of on a smooth bed. The boundary layer was another subject studied in this research. The results showed that the boundary layer thickness increased with an increase in the length of roughness and finally dimensionless boundary layer thickness reaches the values of 0.26 for short and 0.37 for medium and long roughness lengths.

Keywords: Hydraulic Jump, Rough Bed, Velocity Profile.

Assessment and Comparison oF Fuzzy Automatic Control System using Two Rule Base Applied oN Pivot Weirs

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Abstract

Using effective methods to provide optimal performance of irrigation networks is inevitable because of limited water resources and poor performance of irrigation networks. Different algorithms are used for automatic control of water level in irrigation canals with their own limitations. Fuzzy logic is capable of resolving some of these limitations. Although fuzzy logic is successfully used in many engineering applications, it has not been used for water level control in irrigation canals. In this study fuzzy algorithm with two rule base is used for automatic water level control on pivot weir. Automatic control system was constructed on laboratory scale, and its performance for the situation of high flow variation was evaluated. One of the main components of the fuzzy controller is rule-base decision making. In the experiments conducted in this study two types of rule-base decision making are applied and the results are compared. The results show that in high flow variations (400%), maximum absolute error (MAE) and cumulative absolute error (IAE) indices values are in the range of 6.9 to 9.2 and 0.79 to 1.17percentages respectively and variations are stabilized within less than 2 minutes. Using the second type of rule-base, system, stability is improved and water level variations and number of structure adjustment is decreased. The fuzzy automatic control system is suitable in controlling water levels and its application for irrigation canal control is recommended.

Keywords: Fuzzy Control System, Irrigation Canals, Pivot Weir, Automatic Control System.