« Research Note »

Upwind Finite Volume Solution of Water Hammer in Pipes without Column Separation in Unsteady Friction Model

A. Abbasi[1], S.R. Sabbagh-Yazdi[2*]

1. M.Sc. Graduate in Hydraulic Structures, Department of Civil Engineering, K.N. Toosi University of Technology.
2. Associate Professor, Department of Civil Engineering, K.N. Toosi University of Technology.

[*] **syazdi@kntu.ac.ir**

Abstract

The waves resulting from instantaneous and complete valve-closure in pressurized pipe systems, propagate upstream and/or downstream in the hydraulic system .The pressure (head) and velocity of the flow (waves) are important parameters in the design of pipeline systems. A simple and efficient approximation to the Vardy–Brown unsteady friction equation is implemented within a FVM solution for unsteady pipe flows. The model is compared with measured data and numerical data produced by a two-dimensional turbulence water-hammer model. The results show that the model is in good agreement with both laboratory and numerical results. The computed minimum and maximum values and the time period of the pressure waves are in close agreement with the 2-D numerical solution and experimental measurements.

Keywords: Water-Hammer, Finite Volume Method, Unsteady Friction Model.

Experimental Study of 3D Flow Field and Scour in a 90 Degree Bend

M. Vaghefi[1], M. Ghodsian[2*], S. A. A. Salehi Neyshabouri[3]

1. Assistant Professor, Department of Civil Engineering, Persian Gulf University, Bushehr, Iran.
2. Professor, Water Engineering Research Center, Tarbiat Modares University, Tehran, Iran
3. Professor, Water Engineering Research Center, Tarbiat Modares University, Tehran, Iran.

[*] **ghods@modares.ac.ir**

Abstract

Flow is affected by both the pressure gradient and the centrifugal forces in the bend of rivers and their interaction leads to secondary flow. In this study the flow field and scour in a 90 degree bend were experimentally measured. Experiments were carried out in a channel with mild curvature. A three-dimensional Acoustic Doppler Velocimeter (ADV) was used for measuring the flow field. Also, a laser bed profiler was used for measuring the variation of bed topography. The results show formation of a main secondary flow in the bend and another second secondary flow near the outer bank. The direction of the second secondary flow is opposite to the direction of the main secondary flow. This flow pattern is evident from the middle sections of the first half of the bend up to the end of the bend. The results of flow pattern and bed scour were also addressed. In addition, the vortices in the bend, the changes in the secondary flow and the vortices and the scour pattern at the outer bank and sedimentation at the inner bank are investigated.

Keywords: Flow Pattern, 90 Degree Bend, Vortex, Secondary Flow, Bed Topography.

Effects of Bed Roughness Shape on the Length of Hydraulic Jump

M. Shafai Bejestan[1*], K. Neisi[2]
1. Professor, Shahid Chamran University, Ahwaz, Iran.
2. Graduate student, Shahid Chamran University, Ahwaz, Iran.

[*] **m_shafai@yahoo.com**

Abstract
In this study, effects of shape of roughness elements on the length of hydraulic jump have been investigated experimentally. For the purpose of this study, prismatic roughness elements with different shapes (rectangular, triangular, circular, lozenge and hexangular) have been tested in a rectangular flume 7.5m long and 30cm wide. Experiments were performed in the hydraulic laboratory of Shahid Chamran University, Ahwaz, Iran. The roughed elements are glued on the bed of flume downstream of ogee spillways in such a way that the incoming water jet is just above the element surface. It should be noted that in previous studies the rough elements have been tested such that the incoming jet was at the same level of the element bottom so the elements act as baffle blocks. Each rough element was tested under different flow conditions. The incoming Froude number was in the range of 4.5 to 12. During each test the water surface profile, the roller length and the jump length were measured. In few tests the longitudes and vertical flow velocity were measured. The results indicate that the presence of rough element can reduce the hydraulic jump length and the amount of the reduction depends on the Froude number and the roughness shape. The lozenge element shape was found to produce lesser jump length (up to 40% of the smooth bed jump). Relations have been presented in this study to predict jump length, roller length and the amount of energy which is dissipated. Comparison of this study with previous results reveals that using the rough element can reduce the hydraulic jump as much as the block elements do, and the rough element can not cause separation of flow which might be subject to cavitations.

Keywords: Hydraulic Jump, Roughness Element, Jump Length, Roller Length, Stilling Basins.

Effect of Slot on Stability of Riprap around Bridge Piers

M. Heidarpour[1*], B.Ghorbani[2], M. Keykhai[3], R. Pirmohamadi[4]

1. Associated professor, Department of Water Engineering, Isfahan University of Technology
2. Assistant professor, Department of Water Engineering, Shahrekord University
3. M.Sc. Graduate, Isfahan University of Technology
4. M.Sc. Graduate, Isfahan University of Technology

[*] **heidar@cc.iut.ac.ir**

Abstract

An accepted engineering method to deal with local scouring at bridge piers is to place riprap material around the pier foundation. Field experience has shown that riprap stones often disappear with time, with most severe failure occurring during floods; and refilling is frequently needed to replenish the lost stones. Therefore, notice to riprap stability is necessary and has been the aim of this paper. In this research, four sizes of riprap located above, the same level and below the surface of the streambed and two slot sizes continued to the streambed were used. Effect of presence and size of slot on riprap stability and minimum necessary dimensions for finished riprap covering have been studied. The results obtained in the experiments range; show that riprap is more stable when using slot and this stability is more evident with bigger slot. The performance of the two slot sizes decreases when using the bigger stones. Decrease in performance of the big slot using the bigger stones is more than that of the small slot. Furthermore, results show that the slot decreases the finished riprap covering and consequently the riprap volume will decrease effectively. It has been found that the riprap placed above and below the streambed have the most and the lowest stability, respectively.

Keywords: Control of Scouring, Bridge Pier Slot, Riprap Stability.

An Investigation into the Effects of the Experimentation Scale Upon Unsteady Non-Darcy Flows Through Rubble Mound Breakwaters

S. Nezafatkhah[1*], H. O. Bayat[2]

1- Post Graduate Student, Civil & Environmental Department, Amirkabir University of Technology

2. Associate Professor, Civil & Environmental Department, Amirkabir University of Technology

[*] **sadafnez@aut.ac.ir**

Abstract

As the pore pressure within core materials in rubble mound breakwaters affect the armours stability, it is often necessary to consider scale effects when related designs call for a hydraulic model study based on the Froude criterion. This paper describes findings of an analytical evaluation of unsteady transitional flow regimes through coarse porous media in an attempt to develop a modelling law based on similarities between hydraulic behaviours of the model and the prototype. A non-linear analysis approach based on the so-called modified Forschhiemer equation has been employed in developing necessary equations needed for scale effects assessments. It has been made clear that the grains scale ratio is not a constant and its power varies with variations of the flow regime. The extent of the validity of findings in enabling correct interpretation of experimental results have been examined using available field data published by previous researchers for rubble mound structures.

Keywords: Scale Effect, Unsteady Non-Linear Flow, Rubble Mound Breakwaters, Porous Media.