University of Tabriz

Journal of Civil and Environmental Engineering
Volume 52 (2023), Issue 4 (Winter), 141-150

EXTENDED ABSTRACT

Experimental Investigation of the Effect of Gabion-Shaped Obstacles on Sedimentation

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Received: 27 March 2021; **Accepted:** 27 July 2021

Keywords:
Density currents, Gabion Obstacles, Head Flux, Momentum.

1. Introduction

The researchers tried to build gabion barriers by considering the materials around the dam. In this study, gabion barriers with applicability were used, in which trapezoidal barriers were made using metal mesh and these barriers were filled with sand grains with an average size of 0.5 cm. The reason for using these dimensions of aggregate was the presence of stones with dimensions of 0.5 meters in nature, and if the laboratory results are suitable, it is possible to use them in the implementation, while proper slope. According to the executive criteria, it was considered to build the sides of the barrier in order to evaluate the possibility of falling aggregates. In this design, an attempt has been made to investigate the effect of gabion barriers on the percentage reduction of flow head flow. To better understand their efficiency in different conditions, some important parameters such as concentration, inlet discharge, slope and height of barriers have been considered.

2. Methodology

2.1. Experimental study

In this study, a flume with a length of 7.8 m, a width of 35 cm and a height of 70 cm was used. These experiments were performed for 2 months in the hydraulic laboratory of the Department of Water Engineering in the Faculty of Agriculture, Shahid Chamran University, Ahvaz. To record all the movements of the flow, a video was taken from the time the valve was opened until the flow reached the end of the flume. These films were very useful for recording the velocity and height of the density current head. To determine the concentration of the flow head, siphons were installed before and after the obstacle at distances of 1.5 and 2.5 meters from the valve, which made it possible to record the concentration at different heights, then using sample containers. The concentration values of the collected samples were measured and recorded using an EC gauge with an accuracy of 0.1 micrograms per centimeter.

2.2. Flow flux

The flow head is a very effective factor in the movement and displacement of sediments and in this study, in order to properly understand its performance, the effective parameters that affect it have been investigated.

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For this purpose, the authors calculated the flow head flux to determine the simultaneous effect of different parameters. For this purpose, Equation (1) is used (Asghari Pari et al, 2019):

$$q = C_f U_f h_f \tag{1}$$

By calculating the flow flux values before and after the barrier, it was possible to measure the percentage reduction of density current flux (Te) using Equation (2) (Barahmand and Shamsai, 2010):

$$Te = \frac{(q_{in} - q_{out})}{q_{in}} * 100 \tag{2}$$

3. Results and discussion

3.1. Analyzing data of density current head

Increasing the height of the gabion barrier leads to better control of the concentrated flow head. The results showed that the reduction rate of the head flux for the obstacle with a dimensionless ratio of height one between 13.3 and 48.3% and for the dimensionless ratio of one and a half height between 23.3 and 60.1% and for the ratio The height of the two dimensions is between 47.2 and 100%. The effect of the barrier with the one-dimensional height ratio of one and one and a half is relatively good and close to each other, but in the case of the barrier with the two-dimensional height ratio, the effect has been very significant, so that in many full control experiments The flow is observed

3.2. Linear analyzing of density current data

To understand the process of the obtained data, linear fitting of the data has been done. The way it works is that 80% of the data were used for training and the remaining for testing. the modeling errors were close to zero and also the regression value of this model is close to one, which indicates the proper performance of this model

4. Conclusions

In this study, the effect of gabion barriers with aggregate diameter of 0.5 cm on the head of density current under variable conditions such as inlet discharge rate, concentration, slope, and barrier height was investigated. The main results of this article are as follows:

1) By dimensional analysis, a two-dimensional relationship was obtained according to the studied parameters, which has provided the possibility of application and accurate flow analysis and comparison between the results of this research and other researches.

2) By increasing the dimensionless height ratio of the trapezoidal gabion barrier used in this study, it was concluded that these changes improve the performance of the barriers. For example, an obstacle with an dimensionless height ratio of one is on average 32% and an obstacle with a dimensionless ratio of one and a half height on average 45% is able to control the flow head flux, but for an obstacle with an dimensionless height ratio of two controls was more than 92%, which in fact in most cases complete control was observed.

3) Density current momentum is very effective on the efficiency of barriers and by analyzing Table (2), it was found that the three parameters of discharge rate, concentration and slope of the flume floor increase the flow momentum and affect the performance of obstacles.

4) Although each parameter (discharge, concentration and slope) increases the momentum of the flow, but the effect of each alone was not very effective and the simultaneous increase of these parameters further reduced the efficiency of the barriers.

5) In general, increasing the dimensionless ratio of concentration, slope and dimensionless ratio of input discharge reduces the efficiency of barriers.

6) Obstacle with two-dimensional height ratio had two very large effects on the density current head, only in experiments with very low momentum where the head height is high and the momentum is not too high, part of the current was able to pass.

7) Linear fitting of the values of the percentage reduction of the density current head was performed and the results showed the proper performance of the linear model in data modeling.

5. Reference

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