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## EXTENDED ABSTRACT

# Experimental Investigation of Energy Dissipation in the Sudden Choked Flow with Free Surfaces

Rasul Daneshfaraz [a,*], Ali Rezazadeh Joudi [b], Sina Sadeghfam [a]

[a] *Faculty of Engineering, Department of Civil Engineering, University of Maragheh, Maragheh, Iran*
[b] *Young Researchers and Elite Club, Maragheh Branch, Islamic Azad University, Maragheh, Iran*

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## 1. Introduction

One problem of accumulation and water flow is the increase in the kinetic energy experienced by the flow. Amortized energy regulators can be used to reduce this effect. If the kinetic energy of the falling flow is not controlled, considerable damage may be done to canals and downstream, structures. Due to the importance of making structures for energy dissipation lots of studies have been done so far that for instance studies of Peterka 1983 and Carvalho and Leandro (2012) must be noticed. A hydraulic jump is a common phenomenon that occurs downstream of hydraulic structures, such as weirs and grates which increase the fluid depth by converting from supercritical to subcritical flow conditions in a relatively short range. These jumps have an important role in the energy dissipation. The possibility of shrinking sections in the supercritical flow that may result from construction of a bridge foundation makes it necessary to calculate the energy dissipation caused by exposure to supercritical flow. In this study, supercritical flow behavior near sudden constrictions is evaluated.

## 2. Methodology

In studying the effective flow parameters, physical models were built in the hydraulic laboratory of the University of Maragheh. The channel has a length of 5 meters, a width of 30 cm and a height of 50 cm. The walls are made from polymer plates to provide good visibility. The flow current is provided by two channel pumps installed in a tank. The pumps provide between 300 and 1000 liters per minute of water flow. Flowrate measurements were made by a rotameter on a drift tube. Comparisons of rotameter flow measurements with velocity based flow calculations were made. In this study, a slide valve is used to help create supercritical flow the slide valve is installed at a distance of 5.1 meters from the entrance channel. To create a sudden contraction in the flow path, panels with length of 50 cm, width of 5.7 cm and height of 45 cm were used. The panels were, polished to create a flat surface that were both oil and water resistant. The polishing also removed sharp corners in the system. Two triangular panels of 5.7 cm length of 5.22 cm thickness were used at the end of the structure. Water depths were measured using a point gage connected to a computer. The gage point accurately measures 5.0 mm in depth and is positioned on a carriage that is mounted to be able to move in the longitudinal and transverse directions. Computerized data collection will result in data collection at one-minute intervals at desired measurement locations. Measurements of the depth of flow at sections C, D, E, F, and B will be taken. Figure 1 shows twitching schematic image of the test plan. In this way, section A, follows the supercritical valves, section C. The flow immediately is choked upstream f locations D, E, and F, respectively, the flow at the beginning, middle and end of the contract period. Section B shows the flow after a transformation.

* Corresponding Author
*E-mail addresses:* daneshfaraz@maragheh.ac.ir (Rasul Daneshfaraz), alijoudi66@gmail.com (Ali Rezazadeh Joudi), s.sadeghfam@maragheh.ac.ir (Sina Sadeghfam).

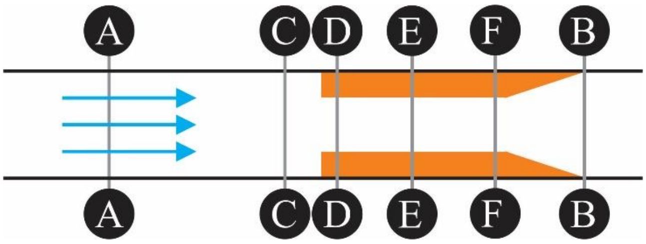


**Fig. 1.** Schematic illustration of test plan and measurement locations

## 3. Results and discussion

In this study, the Froude number is used is the main parameter and takes values in the range of 3 to 8. The Froude number was studied that by changing the input discharge. Evaluation of the results using two dimensionless parameters, the energy dissipation of the upstream ($\Delta E_{AB}/E_A$) and downstream energy dissipation ($\Delta E_{AB}/E_B$) have been made. In all cases, the energy dissipation caused by a sudden contraction, is greater than the energy dissipation caused by a classic free jump that this is due to eddy discharges in the cross-shrunk. The highest amount of energy dissipation is related to the sudden contraction at this stage to increase the flow rate and subsequently increasing the Froude number. The results show that the energy dissipation upstream and downstream, respectively, are 11.43 and 65.03 percent that of the free hydraulic jump. A closer examination of the results shows that as the upstream Froude number increases, the difference between the two parameters of energy loss ratio also increases.

## 4. Conclusions

The results indicate that in all cases, the energy dissipation caused by a sudden contraction, is greater than the energy dissipation caused by a classic free jump. The energy loss is related to the sudden contraction at this stage and the increase in velocity and subsequently the Froude number. The results also show that choked point is effective in stabilizing the jump length.

## 5. References

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