International Journal of Engineering Research and General Science Volume 4, Issue 3, May-June, 2016
ISSN 2091-2730

Energy Dissipation By Using Different Slopes Of Ogee Spillway

DHAKTODE ASARAM, GATNE DEEPAMKAR, GURJEET SINGH, KASABE VISHAL, KASAWA AKSHAY

CIVIL ENGG. DEPT., P.D.V.V.P.C.O.E. A'NAGAR, MAHARASHTRA, INDIA, deepamkarsweet@gmail.com, mob:-+918698708088

Abstract— This study aims to investigate the effects of different slope of ogee spillway surface on energy dissipation. Three ogee spillway models were prepared with slope of 1:1, 0.85:1, and 0.75:1. 18 test runs were carried out to investigate the energy dissipation downstream the three spillway models.

Keywords— Energy Dissipation, hydraulic jump, Froude number, discharge, Spillways, Slope, Relative energy loss

1. INTRODUCTION

A spillway is a structure used to provide the controlled release of flows from a dam or levee into a downstream area.

Spillway with various shapes has been considered the most hydraulic structures which used in open channel flow. They are widely used in water flow measurements and control of water surface levels. Spillway is a major part of a dam, which is built to release flood flow. Depend on the hydraulic conditions of flow and the geologic characteristics of the dams site spillways can be built in different types and shapes.

Spillways are invariably provided for all types of dam which may be located either within the body of the dam or at one end of dam or entirely away from the dam as an independent structure.

Spillway is safety device in a dam. Many failures of dams have been reported due to inadequate capacity or improper design of spillway, especially for earthen and rock fill type of dam which is likely to be destroyed, if overtopped, unlike concrete dams which may not fail with slight overtopping for a small period of time.

Today whole world is worried about the water and its proper management. So India is focusing on water management through construction of dam. Many Indian dams which are already constructed are not giving full efficiency for which they are constructed. On other hand while constructing dam we have to face fund related issue. In short we have to construct dam with high efficiency and low cost. This research paper is focusing on reducing downstream scouring at toe by using different slopes of ogee spillway.

2. EXPERIMENTAL MODELS

The models were of a width 10 cm, height of 25 cm measured from the crest, and the base is varied according to the change in surface slope which is equal to 25cm, 21cm, and 19cm for slope 1:1, 0.85:1, and 0.75:1, respectively.

These models were made from wood and well painted by a water proof varnish to prevent wood from changing its volume by absorbing water.

3. LABORATORY WORK

All The tests were carried out in the fluid mechanics laboratory of P.D.V.V.P.C.O.E., A'NAGAR of the Savitribai Phule Pune University. The laboratory has a flume of 10m long horizontal tilting flume of 0.3m in width and 0.45m in height. The bed of the flume was maintained at a horizontal slope during all of the tests. A centrifugal pump having a rated capacity of 40l/s was used to deliver flow to the flume. Measurements of depths water levels were observed by point gages which have the accuracy of 0.1 mm. Measurement of water level is taken at u/s and d/s side of spillway. The crest of the spillway and the channel bottom were used as reference for the upstream and downstream point gages, respectively. Upstream water depth was varying between 1.2cm and 5cm above the crest level. At these water depths, the minimum and maximum discharges were obtained of 37.72 cm^3/sec/cm and 258.68 cm^3/sec/cm of the 1:1 model, 47.15 cm^3/sec/cm and 261.38 cm^3/sec/cm of the 0.85:1 model, 55.24 cm^3/sec/cm and 257.34 cm^3/sec/cm of the 0.75:1 model respectively,. Spillway models were placed within the flume.6 test run were carried out on each spillway model.

In all test runs on three models follow the same laboratory procedure, which is summarized as follows:

- Operating the flume pump.

- Adjusting the control valve to obtain the required flow depth.

- Measuring the upstream water depth.

- Measuring the downstream water depth.

Fig.1 flow over ogee spillway

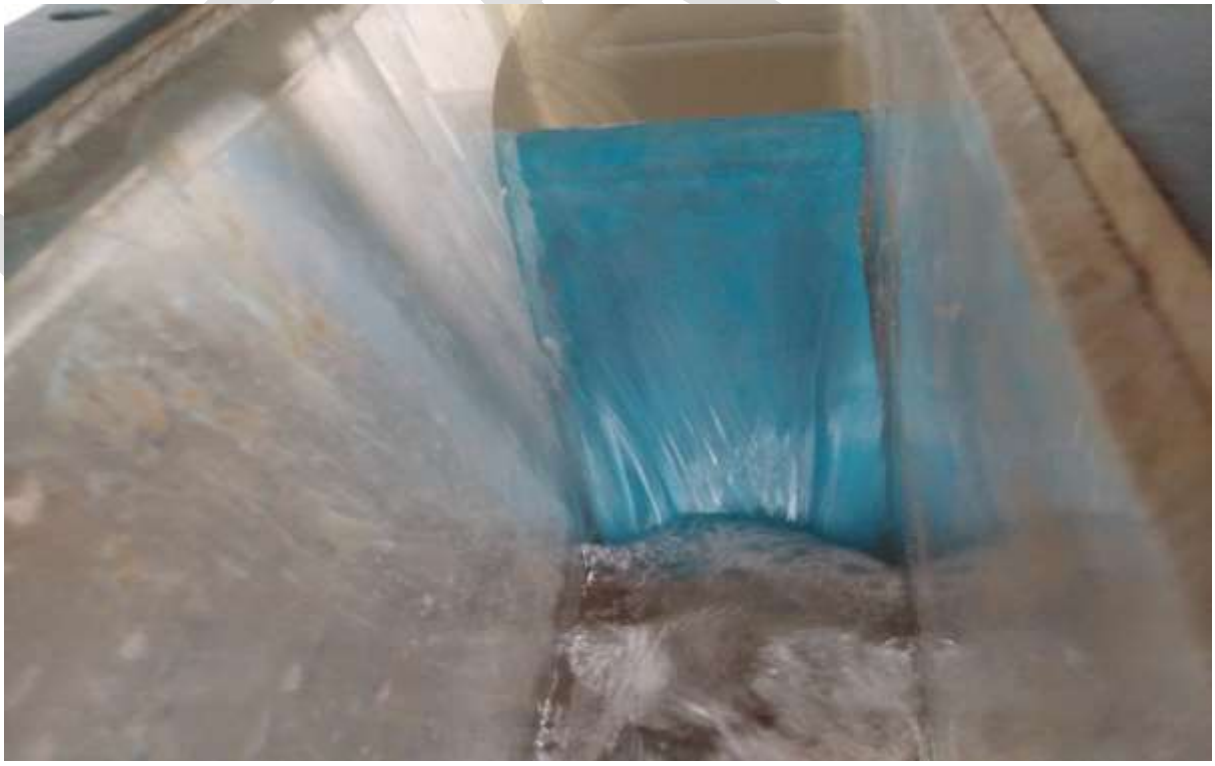
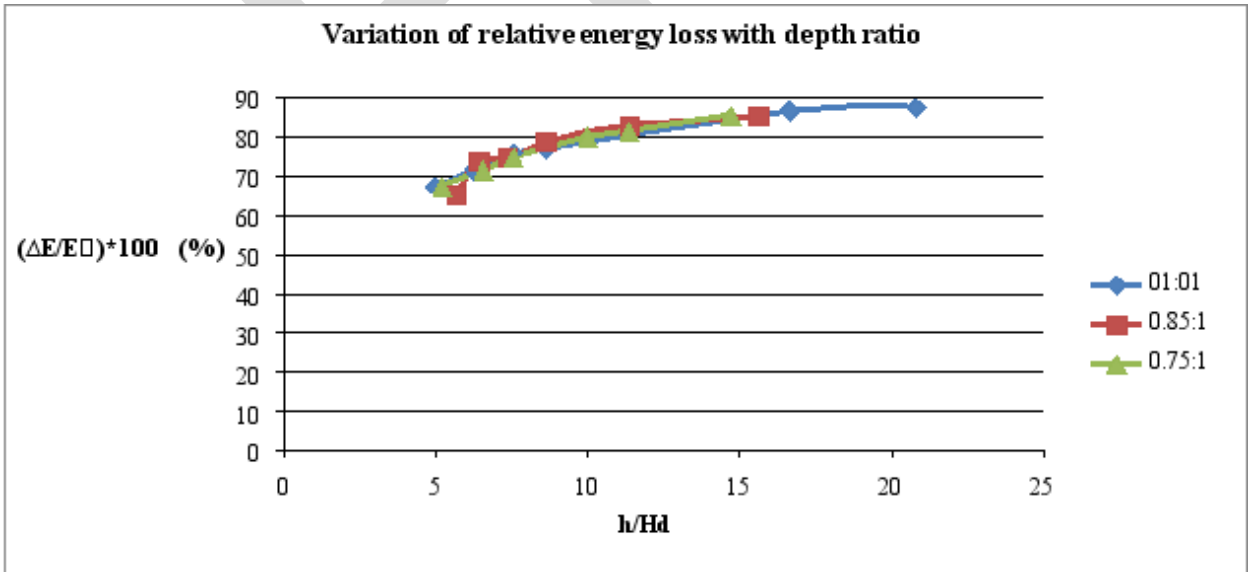


Fig.2 hydraulic jump at the toe of spillway

4. RESULT AND ANALYSIS

Eighteen tests runs were carried out on the three spillway models of different slope surfaces. For minimum depth ratio relative energy loss is 67%, 65.03%, 67.20% for slope 1:1, 0.85:1, 0.75:1 respectively. For maximum depth ratio relative energy loss is 87.17%, 85 %, 85.20% for slope 1:1, 0.85:1, 0.75:1 respectively.



CONCLUSION

In the entire tests, the flow over the ogee spillway was of high kinetic energy of the flow causes high values of ength of jump and height of jump to developed at downstream the spillway. As the slope of the spillway surface is milder as the values of length of jump

and height of jump are reduced. . In tests runs, the values of relative energy loss varied between 67% and 87.17% , 65.03% and 85 %, and 67.20 % and 85.20%, for spillway models with slopes 1:1, 0.85:1, and 0.75:1, respectively.

REFERENCES:

[1] Amir Abbas Kamanbedast, Mostafa Bahmani, Roozbeh Aghamajidi, The Effect Of Surface Roughness On Discharge Coefficient And Cavitations Of Ogee Spillways Using Physical Models, Journal Of Applied Science And Agriculture, May 2014, ISSN 1816-9112, pp. 2442-2448

[2] Bruce M. Savage, Michael C. Johnson, Flow Over Ogee Spillway: Physical And Numerical Model Case Study, Journal Of Hydraulic Engineering, Aug. 2001, pp. 640-649

[3] G. A. Barani, M.B. Rahnama, N. Sohrabipoor, Investigation Of Flow Energy Dissipation Over Different Stepped Spillways, American Journal Of Applied Sciences, 2005, ISSN 1546-9239, pp. 1101-1105

[4] Hinge G. A., Balkrishna S., Khare K. C., Pawana Dam Energy Dissipation – A Case Study, Australian Journal Of Basic And Applied Sciences,2010, ISSN 1991-8178, pp. 3261-3267

[5] Hinge G. A., Jadhav Y. S., Kulkarni V. S., Saudagar N. N., Devarde R. S., Dhurgude S.R., Hydraulic Jump Type Energy Dissipator For Sonurle M.I. Tank, International Journal Of Pure And Applied Research In Engineering And Technology, 2015, ISSN 2319-507x, pp. 355-362

[6] J. A. Otun, S. Munta, D. B. Adie, Modelling Flow Over Stepped Spillway With Varying Chute Geometry, Nigerian Journal Of Technology, July 2012, ISSN 1115-8443, pp. 206-212

[7] Jean G Chatila & Bassam R Jurdi, Stepped Spillway As An Energy Dissipator, Canadian Water Resources Journal, 2004, ISSN 1918-1817, pp. 147-158

[8] M. Shefai Bejestan & K. Neisi, A New Roughned Bed Hydraulic Jump Stilling Basin, Asian Journal Of Applied Sciences, 2009, ISSN 1996-3343, pp. 1-10

[9] Muhnad Mohammed Abbas, Experimental Investigation 0f Pressure Distribution Along Makhool Dam Spillway, Diyala Journal Of Engineering Sciences, June 2013, ISSN 1999-8716, pp. 122-138

[10] Najm Obaid Salim Alghazali, Salam M. Jasim, Location Of Air Inception Point For Different Configuration Of Stepped Spillways, International Journal Of Civil Engineering And Technology, April 2014, ISSN 0996-6316, pp. 82-90

[11] Neda Sharif, Amin Rostami Ravori, Experimental And Numerical Study Of The Effect Of Flow Sepration On Dissipating Energy In Compound Bucket, ScienceDirect, 2014, pp. 334-338

[12] Rajasekhar P., Santhosh Y. V. G., Soma Sekhar S., Physical And Numerical Model Studies On Cavitation Phenomenon-A Study On Nagarjuna Sagar Spillway, International Journal Of Recent Development In Engineering And Technology, Jan 2014, ISSN 2347-6435, pp. 1-10

[13] Rasul M. Khalaf, Raad H. Irzooki, Saleh J.S. Shareef, Hydraulic Characteristics Of Flow And Energy Dissipation Over Stepped Spillway, International Journal Of Civil Engineering And Technology, Aug. 2014, ISSN 0976-6316, pp. 68-88

[14] Riadh Zuhair Al-Zubaidi, Rasul Mejbel Khalaf & Sadif Salman, Hydraulic Performance Of Mandali Dam Spillway In Iraq, Journal Of Engineering Science, 2010, pp. 35-48

[15] Sung-Duk Kim, Ho-Jin Lee & Sang-Do An, Improvement Of Hydraulic Stability For Spillway Using CFD Model, International Journal Of The Physical Sciences, June 2010, ISSN 1992-1950, pp. 774-780