DAM BREAK ANALYSIS USING HEC-RAS

Anjana K.T.K.[1], Dijo Joy[2], Revathy Manikuttan[3], Sachin Sas[4] , Binoy Alias M[5]

B Tech Students, Dept. of Civil Engineering, Mar Athanasius college of engineering, Kerala, India
[5]Professor, Dept. of Civil Engineering, Mar Athanasius college of engineering, Kerala, India

---

Abstract - *This paper describes how dam break analysis can be performed using HEC-RAS. This involves prediction of dam break parameters, flood hydrograph, time of arrival of flood wave, peak flow. HEC RAS offers user control over the parameters. HEC-RAS can be used to model both overtopping as well as piping failure breaches for earthen dams and concrete dams. The resulting flood wave is routed downstream using unsteady flow equations.*

Key Words: **HEC-RAS, Dam Break Analysis, St. Venant's Equations, Hydrograph, Manning's roughness**

1. INTRODUCTION

After the failure of reservoirs man begins to think about the solution, there comes the innovation of dam break models. Dams provide a range of economic environmental and social benefits including recreation, flood control, water supply, hydraulic power generation, river navigation and wild life habitat.

1.1 Objective and Scope

- To identify the flood prone area
- To give sufficient warning to the downstream side inhabitants
- To give an idea about the time and flood level at which the flood strikes a particular area

1.2 Methodology

Dam break analysis can be done using the flood routing techniques proposed by St. Venant's equations for unsteady flow. It consists of two independent variables Q and t. Solution of this equation depends on the number of cross-sections. Because of the complexity in solving the entire equation simultaneously software HEC-RAS is selected.

Equations

St. Venant's Equations:

Continuity equation

$$\frac{\partial Q}{\partial x}+\frac{\partial A}{\partial t}=0 \qquad (1)$$

Momentum equation

$$\frac{1}{A}\frac{\partial Q}{\partial t}+\frac{1}{A}\frac{\partial}{\partial x}\left(\frac{Q^2}{A}\right)+g\frac{\partial y}{\partial x}-g(S_o-S_f)=0 \qquad (2)$$

2. DAM BREAK SIMULATION

2.1 About the software

HEC-RAS is Hydrologic Engineering Center's River Analysis System software. This software helps to perform one dimensional steady flow, unsteady flow calculations, sediment transport computations and water quality analysis. HEC-RAS is designed for interactive use in a multi-tasking environment. This system consists of a graphical user interface (GUI), separate analysis components, data storage and management capabilities, graphics and reporting facilities.

2.2 Study area

'IDUKKI DAM' is the Asia's biggest Arch Dam of 555 feet height standing between the two mountains - 'Kuravanmala' (839 meters) and 'Kurathimala' (925 meters). This dam is situated in Idukki District and its underground Power House is located at Moolamattom which is about 43 kms from Idukki Dam. This dam was constructed along with two other dams at Cheruthoni and Kulamavu. The stored water is used to produce electricity at the Moolamattom Power house.

2.3 Model setup

The river valley is represented in the model by cross-sections at different intervals. Due to the highly unsteady nature of the dam break flood, closely spaced cross sections are considered for the analysis, particularly where the cross section is changing rapidly. The reservoir is normally modeled as a storage area to describe storage characteristics by the use of storage volume at different levels. In case of very long and wide reservoirs, the routing of the inflow flood is carried out and hence the reservoir is represented by cross sections at regular intervals.

3. RESULTS AND DISCUSSIONS

The HEC-RAS software is used for the study, gives the prediction of dam breach flood hydrograph. It also helps in routing the same through downstream valley to get the time series of discharge and water level at different location of the valley. River valley of 51km was considered for the analysis from Idukki dam to Thattekkad.

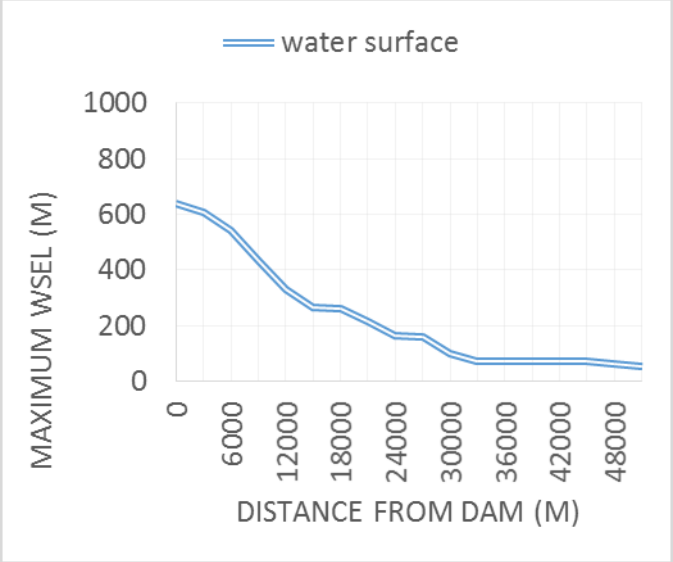

Chart-1: Maximum water surface elevation v/s distance from dam

Table-1: Output Table

SECTION NO.	LOCATION FROM DAM (m)	MINIMUM CHANNEL ELEVATION (m)	MAXIMUM WATER SURFACE ELEVATION (m)	TIME OF MAXIMUM FLOW (min)	VELOCITY (m/s)	MAXIMUM FLOW(m^3/s)
1	0	580	638.24	2	9.35	8027
8	7442	500	525.32	22	5.45	7197.6
13	9986	360	363.84	51	4.67	1368
28	21287	200	214.11	110	4.09	4210.3
40	30737	60	75.31	170	2.42	4753.10
59	50987	35	53.21	240	1.27	12080

Maximum water surface elevation at upstream of dam is 638.24m.This value decreases from upstream to downstream. Minimum channel elevation at Thattekkad is 35m. The maximum water surface elevation at downstream is obtained as 53.21m. This helps to assess the flood prone area.

4. CONCLUSION

The details of water surface elevations at different locations of the valley , gives an idea about extent of flooding. The authorities should give sufficient warnings to the downstream side inhabitants.

ACKNOWLEDGEMENT

The authors are grateful for the support of Civil Engineering Department of Mar Athanasius College of Engineering, Kothamangalam, Kerala

REFERENCES

[1]. Yi (Frank) Xiong, A Dam Break Analysis Using HEC-RAS, *Journal of Water Resource and Protection,* 3, 370-379

[2]. U.S. Army Corps of engineers, Using HEC-RAS for Dam Break Studies

[3]. U.S. Army Corps of engineers, HEC-RAS River Analysis System, Hydraulic Reference manual, Version 4.0,March 2008

[4]. R. A. Wurbs , Dam-Breach Flood Wave Models, *Journal of Hydraulic Engineering*, Vol. 113, No. 29, 1987, pp29-46