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DAM BREAK HAZARD MAPPING: A CASE STUDY OF MULLAPERIYAR DAM

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Abstract -Mullaperiyar Dam is one of the oldest and weakest dams which is on the verge of collapse. Failure of the dam will have a catastrophic effect on people and property downstream. Thus, Dam break analysis has become increasingly critical for enabling rigorous scientific inquiry and analysis into the eminent risk so that proper remedial measures can be taken. Our project aims at performing the dam break analysis of the Mullaperiyar dam and the following Idukki arch dam. The Idukki dam is the largest arch dam in Asia and has an enormously large capacity. If a dam break happens it will be heavily affected by the thickly populated state of Kerala, so it is necessary to do the flood hazard mapping of both the dam. The final product of our project is to construct a flood inundation map.

Key Words: Flood, Dam, Capacity, Flood Hazard Mapping, Inundation

1. INTRODUCTION

Dams are across the world in large numbers. The dams are very much beneficial to us in many ways such as irrigation, power generation, flood protection, etc. But the failure of this dam causes a large devastating flood. Overtopping is the major cause of failure about 34 percent of total dam failure, foundation defects cause 30 percent, and piping and seepage cause 28 percent. Since most of the dam failure is due to overtopping, we are considering the Mullaperiyar dam failure to be due to overtopping. The initial task of performing dam failure is to find the route downstream of the dam break flow. The dam break analysis is done by using HEC-RAS (Hydrologic Engineering Centre River Analysis) software, it is modeling software that models hydraulic flow through a river valley in different scenarios. The program was developed by the American Army corps of Engineers. The main objective of performing dam break analysis is to find the

- First arrival time of Flood
- Maximum depth of the Flooded water
- Maximum velocity
- Maximum Water Surface Elevation
- Duration of flood

The preparation of the DEM file from the ALOS DEM downstream of the Mullaperiyar and Idukki dam is also a part of it.

2. METHODOLOGY

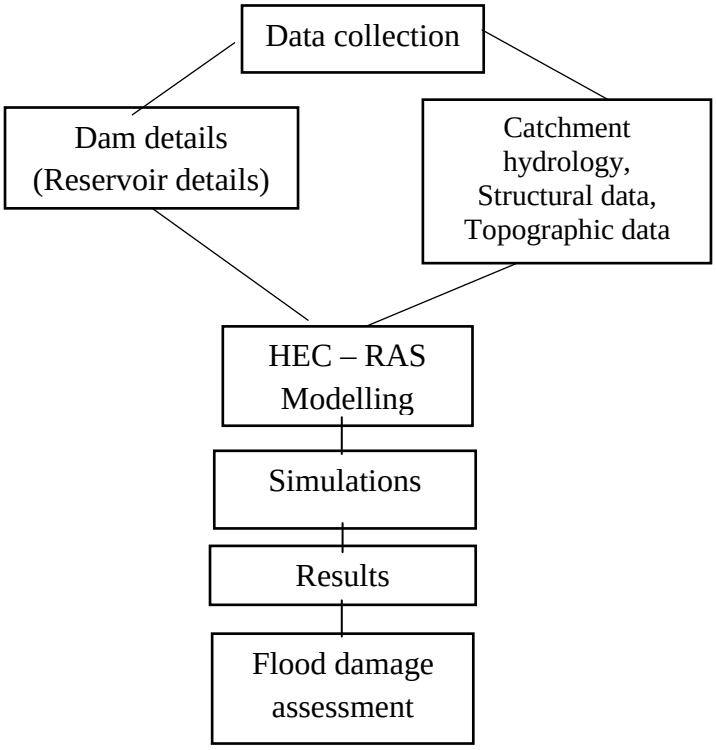
The dam break analysis is done by using the flood routing techniques by St. Venant's formula. This approach deals with the solving of the continuity and the momentum equations.

The initial step of the process is to input the basic input data. The input data are generally are;

- Topographic data
- Catchment Hydrology data
- Inflow data
- Reservoir data
- Dam details

The topographic data are derived from the DEM(Digital Elevation Model), It is the topographic undulation of the downstream regions. The Inflow data are the Inflow hyetograph to the dam. Reservoir data and the dam data include the dam height, weir width, capacity, water elevation storage elevation curve, and location details.

The entire process is done in two steps, Mullaperiyar dam to the Idukki dam's upstream valley and the Idukki dam to the Bhoothathankettu barrage, and finally to the Arabian sea.



The Inflow data for the analysis is taken from the maximum flood inflow in the history of the dam. The peak inflow to the Idukki dam happened during the 2018 flood, and this is taken as the input.

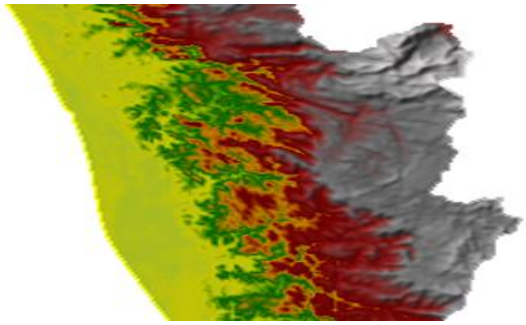


fig -1: DEM file

3. STUDY AREA

The primary study area is the Mullaperiyar dam a gravity dam on the Periyar river valley. It is 881 m above sea level on the Western Ghat in Thekkady in the Idukki district.

The next study area is the Idukki dam, which is a combination of three dams(Idukki arch dam, Cherthoni dam, and Kulamavu dam) having shared reservoir data. The arch dam is constructed across the Periyar river basin which is very narrower at the site.

4. RESULT AND ANALYSIS

The result obtained is in the form of simulation of water flow on rearranging it the various details such as depth, velocity are obtained from the analysis of Mullaperiyar to Idukki dam;

Location	Depth (m)	Time of travel (min)	Maximum velocity (m/sec)	Water Surface Elevation (m)
0	45.26	1.8	9.6	879.11
3580	29.45	22	12.8	858.42
7428	28.42	25	9.52	838.12
35979	25.42	122	8.63	783.95

Table – 1: Results obtained from simulation

The location 35979 is upstream of Idukki dam, 3580 is at the vallakadavu town and 7428 is Vandiperiyar.

From the analysis of the Mullaperiyar dam, it is about 85 percent of the water from the Mullaperiyar will reach the Idukki dam, so for the analysis of the Idukki dam, the inflow is taken as the sum of the actual inflow to the Idukki dam, discharge from the breach of Mullaperiyar dam and the actual inflow to the Mullaperiyar dam.

Place	Location (m)	Depth (m)	Time to reach (m)	Velocity (m/sec)
Boothathankett	47260	39.25	110	6.32
Kothamangalam	44710	27.82	165	4.84
Perumbavoor	63760	20.10	369	1.97
Aluva	73360	15.96	582	2.00
Ernakulam	76254	7.52	1145	0.68

Table – 2: Result from simulation of Idukki dam

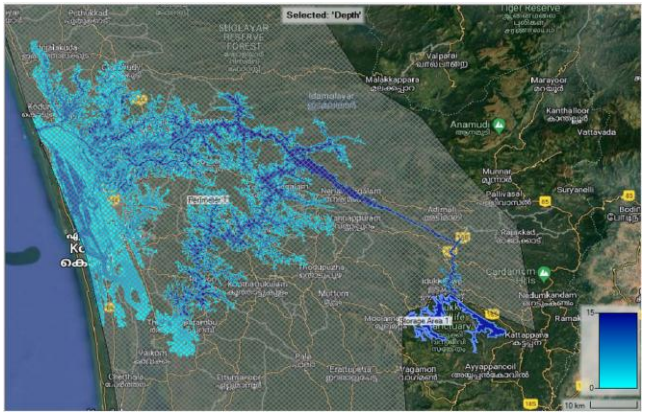


Fig – 2: simulation of Idukki dam

5. CONCLUSION

On the analysis performed on the dam break analysis of Mullaperiyar and the following Idukki dam the major results obtained were as;

- The maximum velocity of flow from Mullaperiyar dam is 12.8 m/sec
- The maximum velocity from the Idukki arch dam is 6.32 m/sec
- Idamalayar and Malankara dam the downstream of Idukki dam has no impact due to the breach of Idukki
- The peak outflow from Mullaperiyar at breach is 89121 cumecs, which is 10.54 times the actual maximum inflow.
- The peak outflow from the Idukki dam at breach is 30458 cumecs, which is 12.18 times the actual inflow.

Knowing the max depth, time of arrival, and duration of flood at the place; can take necessary steps for mitigation.

6. REFERENCES

[1] Bharath, A.v Shivapur, C. G. Hiremath, and R. Maddamsetty, "Dam break analysis using HEC-RAS and HEC-GeoRAS: A case study of Hidkal dam, Karnataka state, India," Environmental Challenges, vol. 5, p. 100401, Dec. 2021, DOI: 10.1016/j.envc.2021.100401.

[2] "GUIDELINES FOR DAM BREACH ANALYSIS" State of Colorado, Department of Natural Resources, Division of Water Resources (2020)

[3] Sammen S S, Mohamed T A, Ghazali A H, Sidek L M, El-Shafie A 2017 An evaluation of existent methods for estimation of embankment dam breach parameters, Natural Hazards 87 (1), 545-566

[4] Tariku Tadesse (December 2015), Dam Breach analysis and risk assessment. A Case Study of Tendaho DamEthiopia

[5] "A Dam Break Analysis using HEC-RAS" Yi(frank) Xiong Department of Civil & Environmental Engineering, Mississippi State University (2011)