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A Study of Flood-Plain Analysis using HEC-RAS Software

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Abstract: Dams have proven to be beneficial for mankind serving to various basic needs of human life. Also, being a massive structure, flooding due to failure of dams is supposed to be one of the catastrophic events witnessed. One of the forms of flooding is identified as discharge flooding. This paper emphasizes on how computations of discharge induced flood can be carried out using Hydrologic Engineering Centre's River Analysis System (HEC-RAS) software to know the details of parameters causing destruction.

Keywords: ArcGIS, Digital Elevation Model (DEM), Discharge flood modelling, Flood Plain Analysis, HEC-RAS 2D model, Khadakwasla Dam.

I. INTRODUCTION

Dams are constructed to serve various needs of human life like domestic, irrigation, industrial, hydro-electricity generation, etc. However when the dam reaches its full capacity the water is required to be discharged in order to ensure the safety of the dam irrespective of the effects of discharge on the downstream side of the dam. This event can prove to be destructive for the human settlements as well as loss of property on the downstream side. In recent years, due to industrialisation and urbanisation, the damage caused to the environment resulting to irregularity of rainfall pattern and several events of cloud bursting. These situations leading to increased runoff into reservoir making it necessary to discharge excess water frequently for dam's safety. Hence it becomes necessary to study the details of discharge induced flood on the downstream side of the dam. This paper deals with discharge induced flood plain mapping using HEC-RAS software for Khadakwasla dam. Using HEC-RAS software following parameters will be studied.

- A. Flow Depths at different reaches
- B. Flow Velocity at different reaches
- C. Lateral spread of the flow in the defined area of study.

II. LITERATURE REVIEW

Several research papers were reviewed to study how the HEC-RAS can be used for its applications. Reviewing papers helped in determining and limitation and the scope of the study. In literature study, the results forecasted in the research papers were also compared with the real incidents that had happened in recent years, ascertaining the accuracy of the software. The results in research paper on Dam Break Analysis of Idukki Dam using HEC RAS found matching to recent event happened in Kerala floods.[10]

III. METHODOLOGY

A. Appropriate Selection Of Software

After exploration, appropriate software selection amongst several applicable softwares (like SOBEK CM, MIKE 11, etc.) that can be utilised to carry out computations depending on the availability and reliability of the software was carried out in the beginning and finally, HEC-RAS software was finalized being open software for utilization and most reliable till date.

B. Discussions with Expert

Since a number of software were available for computing, it was necessary to consult experts from this field. 2 experts working with similar field of interest were consulted:

- 1) Prof. Mrs. Mrunal Joshi, Assistant Professor SCOE Pune.
- 2) Sr. Engineer Mr. Sanjay Heganna, Irrigation Department Pune, Govt. of Maharashtra.

C. Understanding Necessary Inputs

Carrying out trial attempts made it easy to understand the minutes of HEC-RAS software and also the necessary inputs like Digital Elevation Model (DEM), flow pattern, discharge details, etc. were recognized.

D. Selection of Study Area

Amongst several dams available to be studied like Ujjani, Pawana, Khadakwasla, Vir, Idukki, etc. finally Khadakwasla Dam was selected to be studied since it was physically approachable and the inputs necessary for HEC-RAS could be conveniently acquired for studying.

E. Collection Of Data And Computation Procedure

Several data needed to be collected and further the computation was carried out. Following is the procedure of carrying out computation:

- 1) Toposheet of the area of study was obtained from the Survey of India Department, Pune.

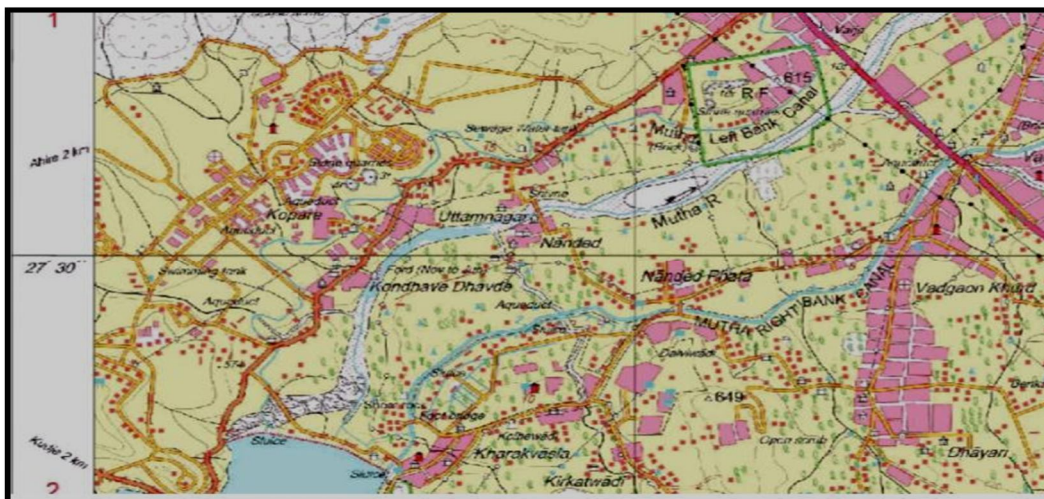


Fig. 1 Part of Toposheet tile number 47F/15 of Khadakwasla region

- 2) The Toposheet was further used to create Digital Elevation Model (DEM) of the study area which will be used as an input to the software. In order to generate DEM, georeferencing of the map was necessary which was accomplished using ArcGIS. The necessary data like elevation, slope, cross sections, etc of the region under study is retrieved from DEM. DEM input to the software assures accuracy in the results since DEM reflects on the real-time data which is acquired from satellite imagery. Different colors in the DEM symbolize difference in elevation of that region. Below figure Fig. 2 shows DEM of study area.

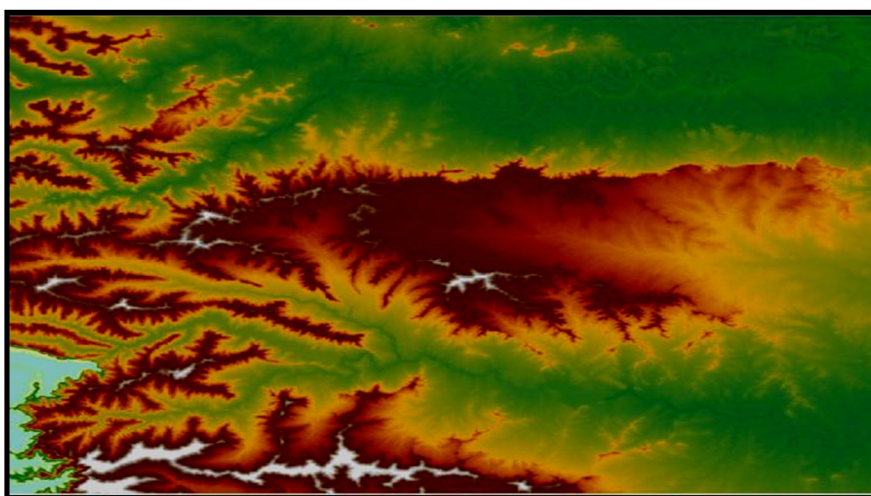


Fig. 2 Digital Elevation Model (DEM) of Khadakwasla region

IV. CONCLUSIONS

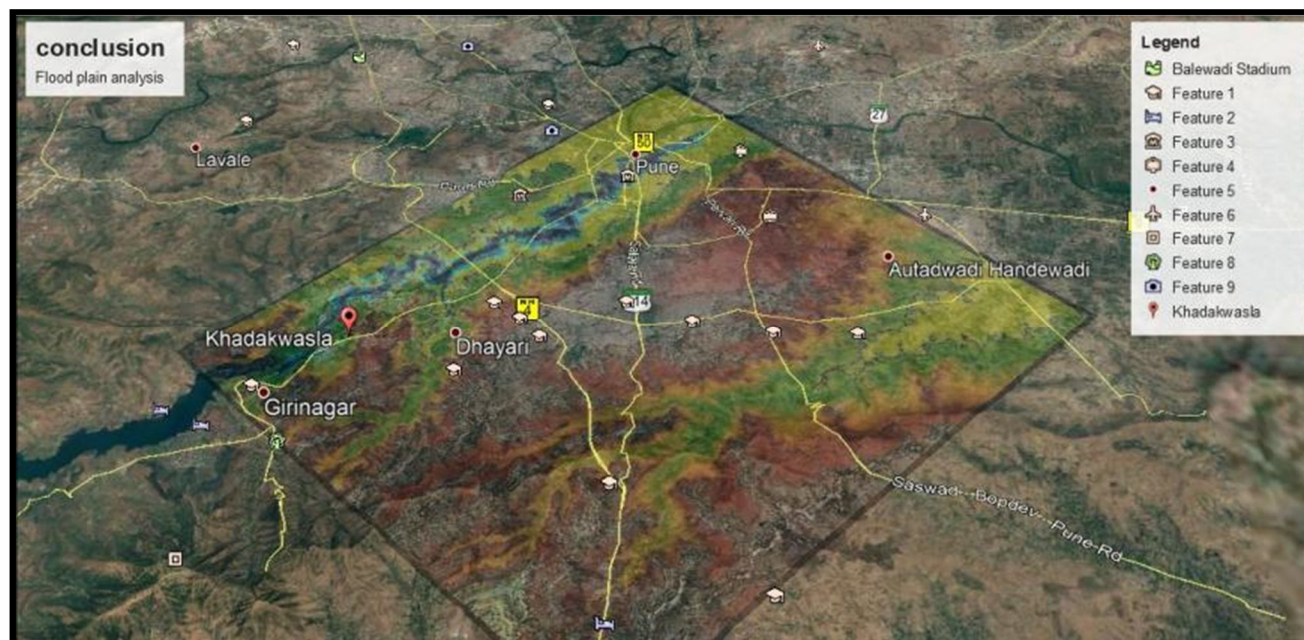


Fig. 5 Flood line over the flood affecting region

It is evident from the above image that the water that flows on the downstream side will be exploiting the human settlements available beyond the flood line. This demonstrates that there is a severe need to revise the flood line which was marked earlier for Khadakwasla region. Similarly remapping of flood line for all metropolitan cities across the nation is also necessary in order to decrease the loss of human lives and property due to flooding.

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