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FLOOD MANAGEMENT BY USING HEC-RAS SOFTWARE

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ABSTRACT

The flood and drought condition in our country has been more frequent in the recent past due to changing climatic conditions of the world. Prediction of river stage during the flood requires mathematical modeling of the river to take decision related to the flood protection and disaster management work. In Maharashtra, Pune City, faces problems of floods and damages during monsoon. Many bridges over Rivers get submerged, resulting failure of communication facility, inundation of the city and surrounding area during this period. The weather extremes, such as excessive rainfall, result in debris flow, river overflow and urban flooding, which can pose a substantial threat to the community. An effective flood model is therefore a crucial tool in flood disaster control and mitigation. The flood prediction of Mula-Mutha river using HEC-RAS is discussed in the project. This is helpful in the preparation of Flood Mitigation Plan for Pune city as a curative measure for the control of flood in the Mula-Mutha river. Thus this present project describes the setting up of hydraulic model In HEC-RAS 5.0.1 for Mula-Mutha River in Study reach. HEC-RAS 2D is a hydraulic model which is used to simulate water flowing through rivers and open channels.

Keywords: Flood Mitigation, HEC-RAS, Inundation, Excessive Rainfall, Simulate.

I. INTRODUCTION

Flooding may occur as an overflow of water from water bodies, such as a river, lake, or ocean, in which the water overtops or breaks levees, resulting in some of that water escaping its usual boundaries, or it may occur due to an accumulation of rainwater on saturated ground in an areal flood. While the size of a lake or other body of water will vary with seasonal changes in precipitation, these changes in size are unlikely to be considered significant unless they flood property or drown peoples and domestic animals. Floods can also occur in rivers when the flow rate exceeds the capacity of the river channel, particularly at bends or meanders in the waterway. Floods often cause damage to homes and businesses if they are in the natural flood plains of rivers. While riverine flood damage can be eliminated by moving away from rivers and other bodies of water, people have traditionally lived and worked by rivers because the land is usually flat and fertile and because rivers provide easy travel and access to commerce and industry.

Flooding can lead to secondary consequences in addition to damage to property, such as long-term displacement of residents and creating increased spread of waterborne diseases and vector-bourse diseases transmitted by mosquitos. There are different types of floods, including floods caused by prolonged groundwater accumulation in sudden rainfall and storm conditions. In developed countries, the loss of life is reduced due to the development of flood detection services, while in less developed countries this problem is larger. While most of the methods used for flood control and analysis were labor-free methods up to ten years ago, in recent years, ready to-use package programs have been used like HEC-RAS.

The hydraulic model used for present study is based on Hydraulic Engineering Center's River Analysis System (HEC-RAS), version 5.0.1. It is a freely available software developed by US Army Corps of Engineers and can perform one- and two-dimensional hydraulic calculations for a full network of natural and constructed channels. The model equations for 1D flow are described by Horritt and Bates and modified by Brunner (2016) for 2D flow conditions. The HEC-RAS model is one of the most commonly utilized flood modeling pieces of software in hydrodynamic simulation. This model is designed to perform 1D steady flow and 2D unsteady flow simulations for a river flow analysis, as well as sediment transport and water temperature/quality modeling. The model uses geometric data representation and geometric and hydraulic computation routines for a network of natural and constructed river channels. While there are a large number of capabilities this model can perform, the research shall only focus on HECRAS's ability to run 1D river flow and 2D flood inundation and the combined approach, especially the analysis of flood inundation instigated by a dam or levee breach. HEC-RAS has the ability to make the calculations of water surface profiles for steady and gradually varied flow as well as for subcritical, super critical, and mixed flow regime.

Figure 1: Situation in Pune during flood

II. OBJECTIVES

1. Using HEC-RAS and historical flood data or discharges, compute the various cross-sections.

2. To see if the existing portion can withstand a carry flood of various magnitudes.

3. To suggest steps to ensure safe flood conveyance for the study reach, such as raising the retaining wall height or proposing new bunds or retaining walls.

4. Identifying crucial sections in the research region for water spread.

5. To make use of the best available data in order to identify the location and potential impacts that natural hazards as floods can have on people, property and natural environment. to improve the systems of warning and emergency communications.

III. ADVANTAGES

1. The management of flood the saving the life of peoples and their living standard.

2. It will be reduced the erosion of structure of cannel and river bed.

3. Just a few days in advance we will know how much flood is going to happen.

4. It will save the farming land and crops.

5. It will convey excess water directly in sea.

6. The results of the model can be applied in floodplain management and flood insurance studies.

7. Improving water quality and reducing erosion.

IV. DISADVANTAGES

1. High erosion of soil and bad effect on climate condition.

2. Wastage of crops, food, money. And Risk of peoples life.

3. Impact of flood include loss of human life, damage to property.

4. It impact on human health and increase the various diseases.

5. It is impact on economy of the country.

6. Contaminated drinking water

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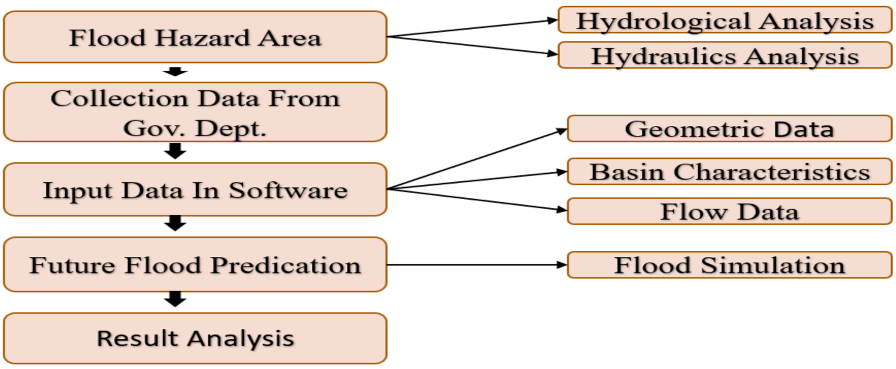
V. PROBLEM STATEMENT

The overall carrying capacity is reduced. When the reservoirs reach their full capacity during the monsoon, the water is released from the dam. When the water from the dam is released, the river is unable to contain the water within it, resulting in flooding. To determine the entire water carrying capacity, we must first determine the nature and depth of the river basin. This endeavour entails examining the river's cross-section to determine its carrying capacity and other vital information parameters and also generate warning for the areas under risk that require immediate attention. By reducing carrying capacity on adjoining areas and modifying the channel it will helpful in the preparation of flood mitigation plan for Pune city as a curative measure for the control of flood in the MulaMutha river. Thus, the modification of river channel is done to increase the carrying capacity of the rivers in Pune and thus reducing the effect of flood in Pune city and surrounding region. In view of that, various flood protective works have been carried out by strengthening and raising the height of existing of embankment or retaining wall by 2 to 3 meters so as to protect the city against the heavy flood in future.

VI. STUDY AREA

Every year during the monsoon season in Maharashtra, the city of Pune experiences flooding and devastation. The release of water from reservoirs in the upper portions of the Mula and Mutha Rivers is causing the troubles. During these seasons, many bridges spanning rivers become drowned, cutting off communication and inundating the city and surrounding area. The district of Pune is in the Bhima basin, while Maharashtra is in the Krishna basin. Mula, Mutha, Pawana, Ram, and Dev rivers are among Pune's five rivers. The Mutha river begins in the Western Ghats, some 45 kilometres west of Pune, in the town of Vegare. Mutha river has two tributaries, Ambi and Moshi.There are two dams on Mutha river, at Temghar and at Khadakwasla. There are two dams, Panshet on Ambi and Warsgaon on Moshi.After confluence, the joint flow of Ambi and Moshi joins Mutha river just before Khadakwasla dam reservoir.Mula and Mutha river meet near the College of Engineering, Pune. After confluence the river is known as Mula-Mutha. Mula-Mutha meet Bhima river at Ranjangaon Saandas in Shirur Tehsil.

VII. METHODOLOGY



1. Flood Hazard Area:-

a) Hydrologic Analysis:- Hydological analysis consists of the application of HEC-RAS model in flood hazard area. In that study of rainfall , Runoff model of river basin of 10 to 50 years.

b) Hydraulics Analysis:- Application of HEC-RAS to obtain flood extent and depth HEC-RAS software were used. The tools allow users to pre and post process the data for HEC-RAS. It creates an input file for HEC-RAS.

2. Collection Data From Government Departmendepart:-

a) Water Resource Department website.

b) Meteorological department pune website.

c) Irrigation department of Pune Website.

3. Input Data In Software:-

a) Geometric Data:-The requisite geometric data includes stream centerlines ,cross section cut lines,River reach ,Size and Shape of River etc and these are prepared using field measurements or from a USGS quad map. Then import of the prepared data into the HEC-RAS model.

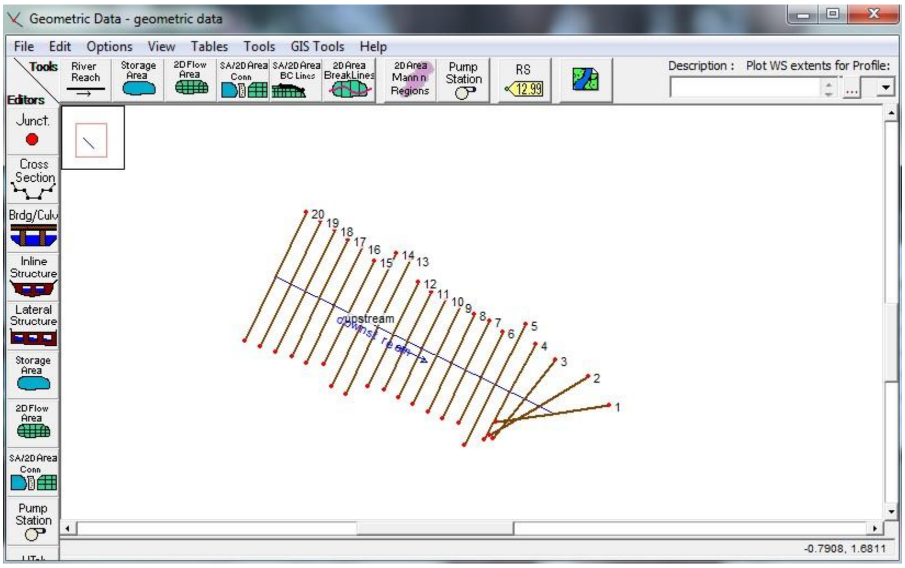


Figure 2: Geometric data view

b) Basin Characteristics:-

Manning's friction coefficient 'n' falls under this category. Use Standard n values found on many charts of government data base. Put Manning's n value (for left and right channel 0.035 and0.03).

c) Flow data:- In flow data study of Velocity, Discharge and water level values make the upstream and downstream boundary conditions. The type of flow data entered depends upon the type of analysis to be performed in the project. In present paper, the steady flow analysis is performed. It includes the flow data, number of profiles computed and river system boundary conditions. Boundary conditions are required to perform the calculations. In this study, the normal depth is used as a boundary condition and steady flow data and gate opening schedule is entered. As the worst flood is considered in the present modeling, all the gates are opened to their full extent.

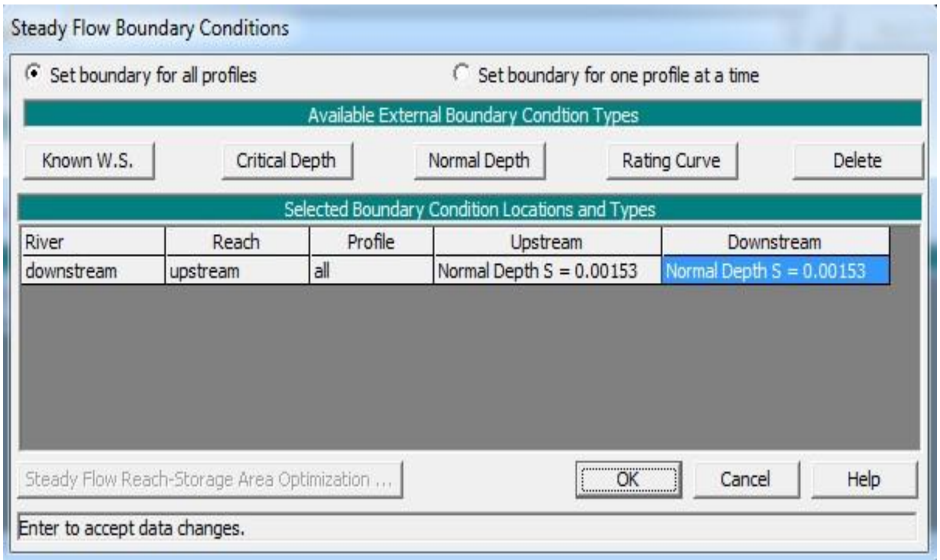


Figure 3: Steady flow boundary conditions

4. Future Flood Prediction:-

Flood Simulation:-Having completed the setup of the system with the requisite model parameters and variables. For further process Run data in HEC-RAS Software which gives the Future flood extents visualization.

5. Result Output:-

HEC-RAS gives result output in the form of XYZ perspective plot , and tables of notes of changes need to be made of cross-section and flow distribution system. Following are some example table.

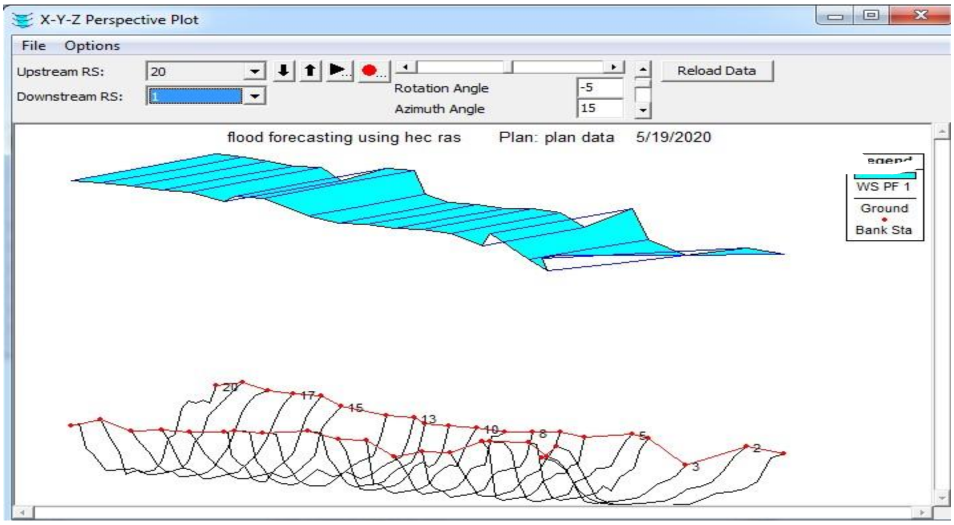
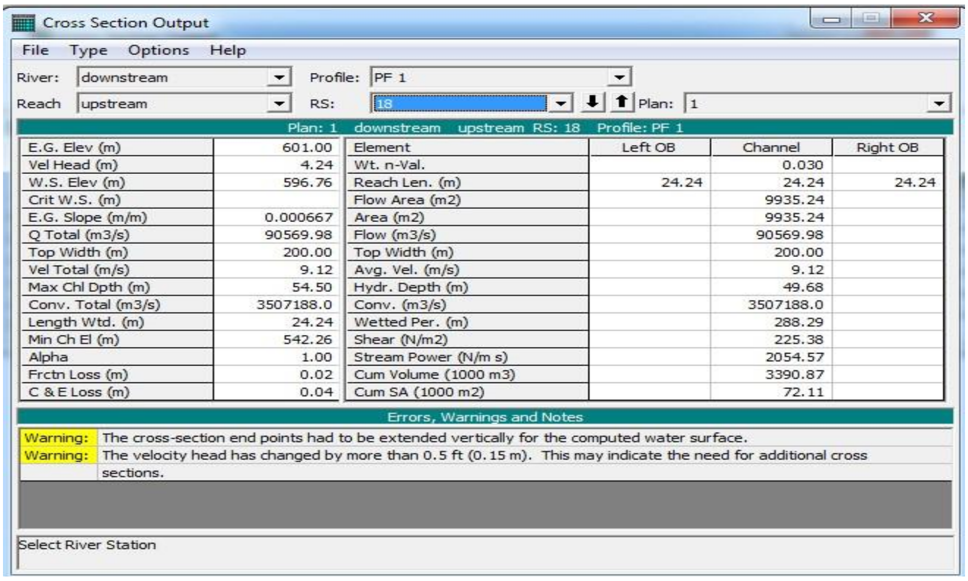


Figure 4: X-Y-Z Perspective Plot


Cross Section Output

River: downstream Profile: PF 1
Reach: upstream RS: 18 Plan: 1

Plan: 1 downstream upstream RS: 18 Profile: PF 1

		Element	Left OB	Channel	Right OB
E.G. Elev (m)	601.00	Wt. n-Val.		0.030	
Vel Head (m)	4.24	Reach Len. (m)	24.24	24.24	24.24
W.S. Elev (m)	596.76	Flow Area (m2)		9935.24	
Crit W.S. (m)		Area (m2)		9935.24	
E.G. Slope (m/m)	0.000667	Flow (m3/s)		90569.98	
Q Total (m3/s)	90569.98	Top Width (m)		200.00	
Top Width (m)	200.00	Avg. Vel. (m/s)		9.12	
Vel Total (m/s)	9.12	Hydr. Depth (m)		49.68	
Max Chl Dpth (m)	54.50	Conv. (m3/s)		3507188.0	
Conv. Total (m3/s)	3507188.0	Wetted Per. (m)		288.29	
Length Wtd. (m)	24.24	Shear (N/m2)		225.38	
Min Ch El (m)	542.26	Stream Power (N/m s)		2054.57	
Alpha	1.00	Cum Volume (1000 m3)		3390.87	
Frctn Loss (m)	0.02	Cum SA (1000 m2)		72.11	
C & E Loss (m)	0.04				

Errors, Warnings and Notes

Warning: The cross-section end points had to be extended vertically for the computed water surface.
Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.

Select River Station

Figure 5: Example of Cross Section Output For Station No. 18

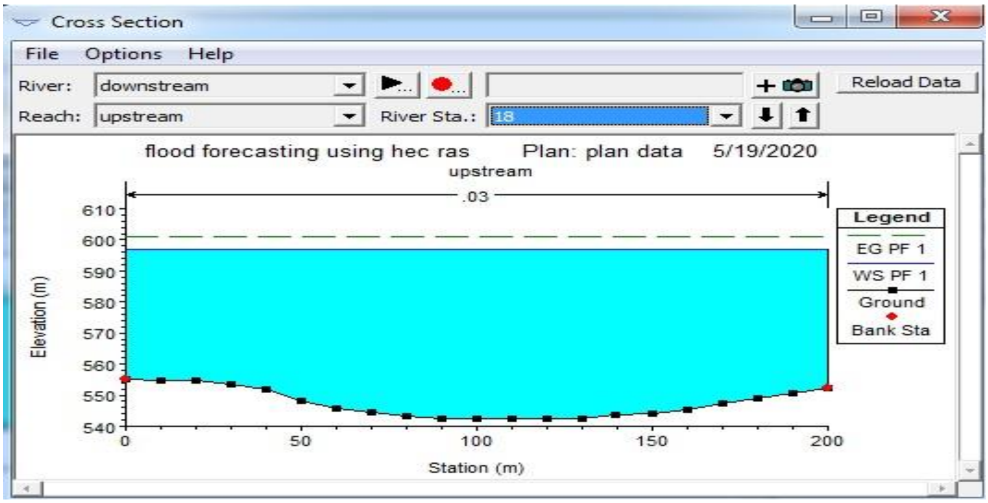


Figure 6: Example of Cross section for river station no. 18

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VIII. CONCLUSION

This project presents a methodology for modelling and forecasting of flood caused due to many reasons like heavy rainfall, poor river basin, lack of space for rainwater flow in riverbed due to urbanization. The use of HEC-RAS software made the forecasting & modeling process easy and also produced more easily understandable results. The cross-sections of river bed were cross sections prepared in HEC-RAS. The areas susceptible to flood are recognized by analyzing XYZ perspective view and warning table simultaneously which are developed by software itself. It is clearly seen that the cross-section end points are needed to be extended vertically for the computed water surface. Otherwise it will cause overflow of flood water through river basin. Thus, our study area needs immediate attention during flooding situations & should be assigned high priority. The result table of hydraulic properties and all profile plots can also be used in future planning of developemetal works. Present situation of river basin is not that capable to carry huge flood. So it is very important to increase size of river basin horizontally as well as vertically.

Following are some warnings developed by HEC-RAS with respect to each section.

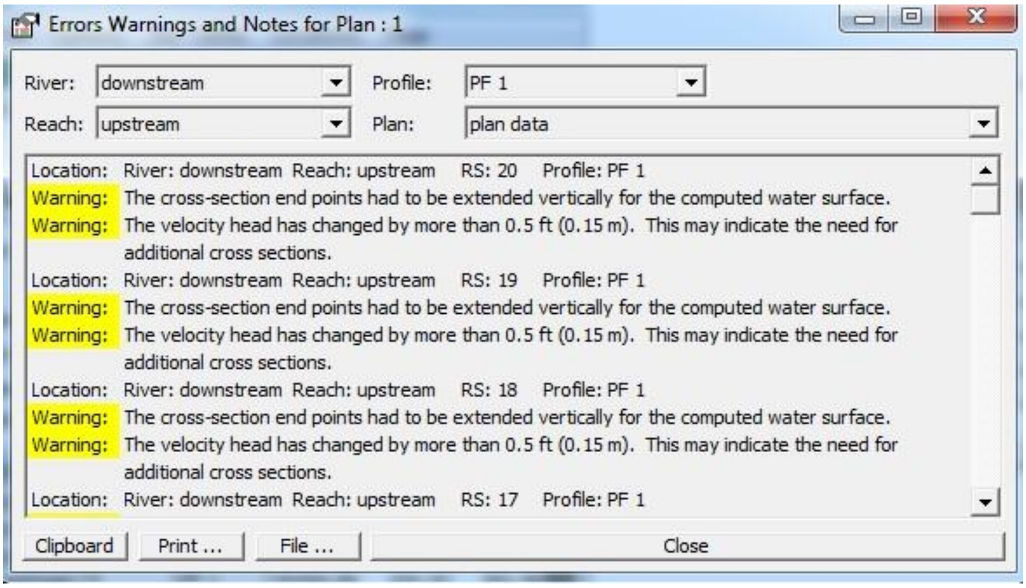

Figure 7: Example of Warning table

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