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DETERMINATION OF THE STAGE DISCHARGE CURVE USING HEC-RAS

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Abstract —*Constant measurement of the river flow in normal condition is difficult and costly and in flood risk condition it is perhaps impossible due to the measurement problems and probable risks. Therefore, in hydrometric stations through continuous reading of the scale and finding the relationship between stage-discharge and the flow rate is obtained for the times when the measurement is not done. Stage-discharge relationship is a kind of flow resistant equation which is used to determine the flow rate when the hydraulic radius or depth, channel shape, slopes and bed material characteristics are known. The present research was conducted to determine stage discharge relationship in the River at different stages. First of all, the needed data were collected including cross sections, hydrological data, hydrometric stations data, etc at the River. The models used in this research are HEC-RAS software which are important software in river engineering sciences.*

Keywords*- Flood, Flood damage, HEC-RAS, Stage-discharge, River*

I. INTRODUCTION

Water plays an important role in our daily life and without it no life on the earth. According to the study of Hydrology, river is defined as a natural stream flow in a channel. River water quality is affected by a wide range of natural and human pollution. With rapid advancement in computer technology and research in numerical techniques, various hydrodynamic models, based on hydraulic routing, have been developed in the past for flood forecasting and inundation mapping. The discharge and river stage were chosen as the variables in practical application of flood warning. The discharge, river stage and other hydraulic properties are interrelated and depend upon the characteristics of channel roughness. Estimation of channel roughness parameter is of key importance in the study of open channel flow particularly in hydraulic modelling. Channel roughness is a highly variable parameter which depends upon number of factors like surface roughness, vegetation, channel irregularities, channel alignment etc. HEC-RAS is a piece of software developed by the U.S. Army Corps of Engineers which allows to perform one dimensional steady and unsteady river flow hydraulic calculations, sediment transport-mobile bed modelling and water temperature analysis. HEC-RAS is equipped to model a network of channels, a dendritic system or a single river reach. Certain simplifications must be made in order to model some complex flow situations using the HEC-RAS one-dimensional approach. It is capable of modeling subcritical, supercritical, and mixed flow regime flow along with the effects of bridges, culverts, weirs, and structures. It is costly and difficult to do constant measurement of the rivers flow in normal conditions and in flood risk condition. It is impossible due to the measurement problems and probable risks. So, in hydrometric stations through continuous reading of the scale and finding the relationship between stage-discharge, the flow rate is obtained for the times when the measurement is not done. Stage-discharge relationship is a kind of flow resistant equation which is used to determine the flow rate when the hydraulic radius or depth, channel shape, slope, bed material characteristics, and temperature are known. The rating curve is a very important tool in surface hydrology because the reliability of discharge data values is highly dependent on a satisfactory stage-discharge relationship at the gauging station. Although the preparation of rating curves seems to be an essentially empiric task, a wide theoretical background is needed to create a reliable tool to switch from measured water height to discharge.

II. OBJECTIVE

The objective of the study is to Determine Stage Discharge Curve Using Hydraulic Software which is HEC-RAS. By using field data for the river, hydraulic geometry assessment and flood conveyance performance will be conducted and prediction of the Discharge of river study reach is carried out using HEC-RAS software.

[1] For engineering design of the facilities, such as bridges, dams and hydropower structures.
[2] To measure difference in water level during the flood in particular river.
[3] Control the flood damages occur during floods.
[4] Control the flood during high amount of water level.
[5] To know about water level during different discharge.

III. STUDY AREA

The Purna is a river of western india.it is one of the chief tributaries of Tapi River and empties in it at chanqdev in jalgaon Maharashtra. Purna river is an important west flowing river with its catchment in Gujarat and Maharashtra. The river Purna rises in the Saputara hills of the Western Ghats near the village Chinchi in Maharashtra. The length of the river from its source to outflow in the Arabian Sea is about 180 km.

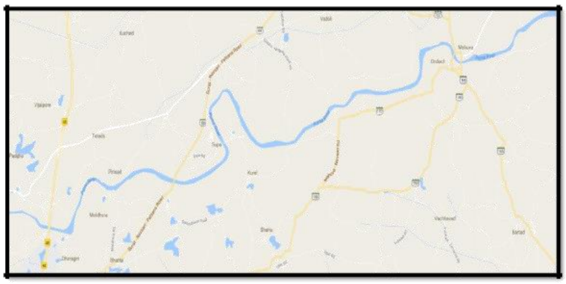


Fig.1 Study Area

IV. METHODOLOGY

Step 1 Calculate the design bank-full flow using HEC-RAS

- Create a new HEC-RAS project.
- Create a new river and reach in the geometry editor window.
- Create a new cross section. Paste the surveyed station/elevation points into the new cross section and then add the location of the left and right bank station.
- Choose the Run/Hydraulic design function menu item from the main menu.
- Choose the Type/ Uniform flow menu item.
- If it is not already selected, choose the correct river and reach from the drop down combination boxes.
- Enter the elevation of the field-selected bank full stage and the channel slope into the appropriate fields.
- Click inside of the "Discharge" field then click the "Compute" button to calculate the discharge.

Step 2 Choose a value for Manning's 'n' for the channel side walls and bed.

- Click on the field next to the elevation on the station/elevation point for the start of the movable bed under the heading "Equation" and choose the Brownlie resistance equation.
- Choose the Manning's resistance equation for the left most station/elevation point in the cross section and for the point at the end of the moveable bed. Enter the same Manning's n‟ value at these points.
- Click the compute button to calculate the water surface elevation. This Manning's n value is the sidewall Manning's n-value for use in the Copeland method stable channel design.

Step 3 Create a Prismatic Hydraulic Model for the Upstream Reference Cross Section

- Set the bank stations to the edges of the movable bed (not the bank full level) and set the overbank and main channel n-values
- Create Cross Section At Different Gauging Station.
- Adjust the elevations of Cross Section by slope
- Set the downstream reach lengths for All Cross Section
- Exit the cross section editor then in the Geometric Data editor, save the geometric data as Prismatic.
- From the main menu, open the steady flow editor and input the design bank- full discharge of past flood event.
- In Steady Flow Editor, input the "normal depth" downstream boundary condition. Enter the slope.
- From the main menu run the steady flow analysis of the prismatic upstream reach.
- Determine the bottom width and height of equivalent upstream trapezoid.
- Calculate the side slopes of the equivalent trapezoidal channel for the upstream cross section.
- Choose the Run/Hydraulic Design Functions menu item from the main menu
- Enter the design discharge. Keep the defaults for specific gravity and temperature. The optional input boxes can be left blank
- Choose the desired design from the table of solutions. HEC-RAS plots the chosen solution. The channel has been designed to carry incoming bank-full flow at the bank-full stage and to have the same sediment transport capacity at bank-full flow as the upstream cross section
- After completing all the steps, with the help of all parameters and by computing, HEC-RAS will give
- Trapezoidal shape using Copeland method.

V. RESULT & DISCUSSIONS

In this, uniform flow computation is carried out using HEC-RAS and flood data of 2008, 2009 and 2010 having peak discharge 41.92, 53.67 and 87.78 Cumecs. The comparison of existing levels and computed levels on left bank are shown in table1.

Table 1 R.L of Left bank (Purna River)

Cross Section	2008		2009		2010		WHETHER SECTION IS CRITICAL
	Existing R.L	Computed R.L	Existing R.L	Computed R.L	Existing R.L	Computed R.L	
CS-1	22.25	27.65	21.23	27.88	21.56	27.54	**YES**
CS-2	23.25	27.32	22.52	26.54	22.54	26.55	**YES**
CS-3	24.54	26.65	23.21	25.65	21.25	25.45	**YES**
CS-4	23.65	26.55	22.32	22.54	21.54	24.54	**YES**
CS-5	25.65	24.54	23.25	27.89	20.22	25.54	**YES**
CS-6	24.54	25.32	24.54	28.99	23.22	24.54	**YES**
CS-7	26.25	26.54	26.32	28.75	21.25	26.33	**YES**
CS-8	24.54	26.54	25.22	26.55	24.85	24.21	**YES**
CS-9	21.22	27.32	21.56	24.56	20.54	23.25	**YES**
CS-10	23.25	25.32	20.22	22.54	21.65	25.45	**YES**
CS-11	24.53	26.54	21.25	26.98	23.25	21.22	**YES**
CS-12	23.24	25.65	23.25	23.55	21.54	20.66	**YES**
CS-13	22.25	27.65	21.23	27.88	21.56	27.54	**YES**

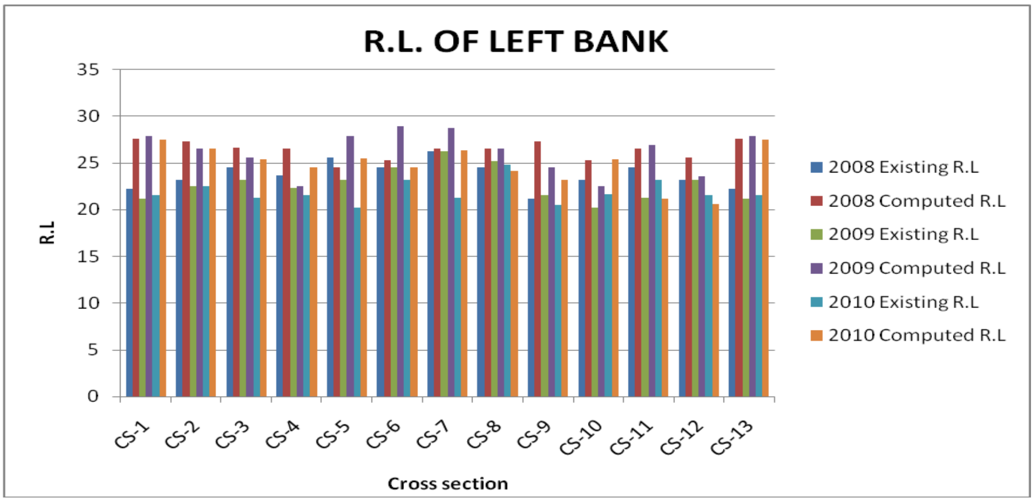

Fig. 2 Graphical Representation for R. L of left Bank

In this, uniform flow computation is carried out using HEC-RAS and flood data of 2008,2009 and 2010 having peak discharge 41.92 , 53.67 and 87.78 Cumecs. The comparison of existing levels and computed levels on Right bank are shown in table 2.

Table 2 R.L of Right bank (Purna River)

Cross Section	2008		2009		2010		WHETHER SECTION IS CRITICAL
	Existing R.L	Computed R.L	Existing R.L	Computed R.L	Existing R.L	Computed R.L	
CS-1	25.25	27.65	22.21	21.23	22.66	27.54	**YES**
CS-2	23.25	27.32	22.32	22.52	22.64	26.55	**YES**
CS-3	22.55	26.65	21.22	23.21	22.26	25.45	**YES**
CS-4	23.45	26.55	22.42	22.32	22.64	24.54	**YES**
CS-5	25.45	24.54	21.26	23.25	20.22	25.54	**YES**
CS-6	22.55	25.32	24.34	24.54	24.22	24.54	**YES**
CS-7	24.25	26.54	26.42	26.32	22.26	26.33	**YES**
CS-8	22.55	26.54	26.22	25.22	24.86	24.21	**YES**

CS-9	21.25	27.32	22.36	21.56	20.64	23.25	**YES**
CS-10	23.25	25.32	20.22	20.22	22.66	25.45	**YES**
CS-11	22.53	26.54	22.26	21.25	24.26	21.22	**YES**
CS-12	23.22	25.65	21.26	23.25	22.64	20.66	**YES**
CS-13	25.25	27.65	22.21	21.23	22.66	27.54	**YES**

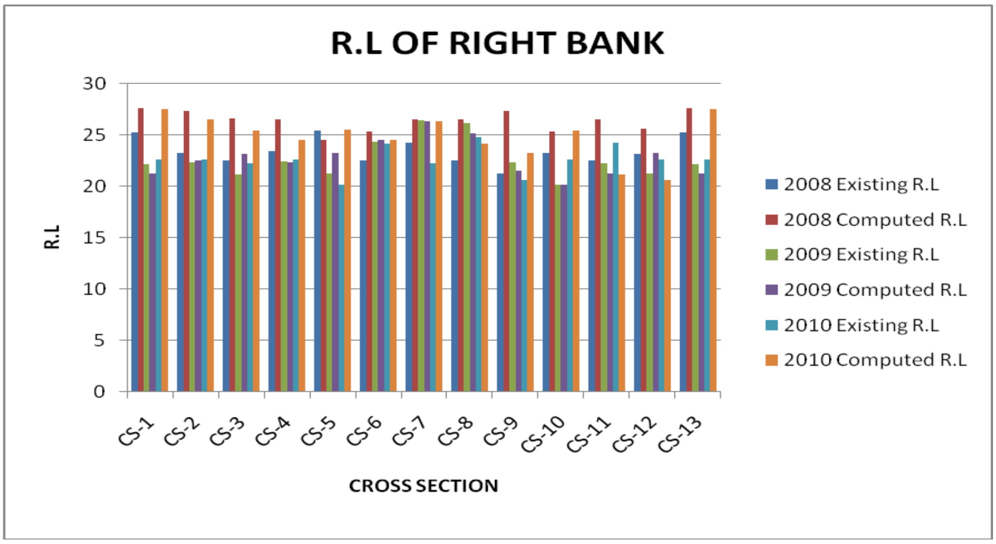

Fig. 3 Graphical Representation for R. L of left Bank

VI .CONCLUSION

- It is strongly recommended that the sections found critical in the present study require restoration work/design and needs to be raised as per requirement.
- It is strongly recommended that the width of the river in no case be encroached as already sections are sensitive to high floods, encroachment will result flooding of study region.
- It is strongly recommended that no new construction is allowed in flood plain area.
- Construction of storm drain to river Purna river may be implemented on the both the banks and necessary flood gates must be placed.
- Out of a 13 storm drains the flood gates are provided at 5 locations so it is strongly recommended to provide the flood gate on remaining storm drain to prevent entry of flood water in the study reach.
- In our study and analysis we found that in the year 2008, 2009 and 2010 the highest flood level has been reached during these years.

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