Application of Flood Routing Technique in River channel

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Abstract— Flood may be termed as high stage of water level in a river. Normally the level at which the river overruns its banks and overwhelms its adjoining area. The damages caused by floods are in term of loss of life, property and economic loss which is due to unsettling of economic activities are all well known. Thousands of crores are spent in flood control and flood forecasting every year. Flood routing technique has been an important tool in predicting stages of natural river channel. Flood routing using hydrological methods (Muskingum Method) implemented have been presented for each flood events of a season at Khairmal downstream of HIRAKUD DAM. Despite the simplicity of these methods and their wide applicability on most natural channels is merit of this methodology. This method is based on certain assumptions such as initial storage is zero, and storage inflow relationship is linear. It has wide application in natural river channels.

Key words: Flood Routing, Muskingum method, Hydrological methods, Hirakud Dam

I. INTRODUCTION

Flood routing is a tool obtaining or developing hydrograph at a particular downstream section of a river stream by usage of the previous data of flow in river stream at one or more than one upstream sections.

Flood routing studies are useful in design of spillway, design of reservoir, flood forecasting and flood protection. Flood routing related investigation are utilized to estimate maximum water level flowing in river stream. This maximum water level is highly concern with fixing maximum design discharge for a spillway.

The flood control is generally describe every possible action to be taken to minimize loss to lives and properties under flood condition. The flood control measures requires flood routing studies may be one of as follows:

Storage reservoirs is constructed for effective and reliable mechanisms of flood controlling measures. This a flood control method in which a share of storage water in the reservoir is reserved aside to soak the coming flood and this storage water is released in a way which is under control over an extended period of time to prevent downstream channels do not facing flood conditions. In order to carry out above tasks flood routing studies are required i.e. through reservoir routing.

A detention reservoir has its own advantage in flood control and in which an obstacle or obstruction is made to a river reach with an uncontrolled outlet at end section.

Barriers commonly parallel to the river stream course may be in form of levees, floodwalls, highway embankments or railroad embankments

Flood ways provide an extra storage channel for reserving a share of flood and providing a separate channel to convey a share of the main stream.

Channel improvement may be done by enlarging the cross sectional area of the river channel or by cleaning vegetation from channel perimeter or by keeping roughness of channel to a limit or by increasing of slope of channels.

Diversion is a type of flood controlling action which provides a separate channel to convey extra flow without any damage in those which are foolproof from flood.

Flood plain zoning is essential to ensure proper development of nearby area of river stream.

Flood forecasting before flood prevails is a cautionary statement issued in the people interest by responsible authority. Sometimes for worst flood condition civil and defence measure to be arranged. It may be said that it is an important to minimize loss due to flood. This is classified as non- structural flood control measure. It is meaningful if it is given in advance.

Flood forecasting involves the volume of runoff obtained by the storm rainfall should be predicted and prediction of the distribution of runoff with time.

II. METHODOLOGY

In a channel routing method, there are two type storage and they are in form of prism storage and wedge storage.

The only one factor control the rise and fall of water level in a river channel that is the wedge storage. Increased wedge responsible for increment in total storage of a river channel and decreased wedge storage responsible for decrement in total storage of a river channel. Thus wedge storage is undergone changes due to change in value of inflow and outflow both which is affected by outflow only.

Inflow storage $S_I = kI^n$

Outflow $S_O = kO^n$

Where k is storage constant

Total storage = Wedge storage + Prism storage

= Inflow storage + Outflow storage

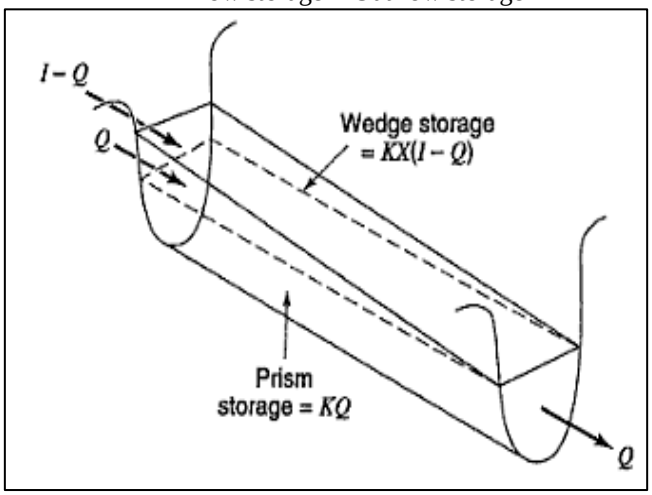

Fig. 1:

$S = xS_I + (1-x)S_O$

$S = x\,kI^n + (1-x)\,kO^n$

Where x is weight factor accounting for relative importance of inflow and outflow storage

Assume n=1

$S = k[xI + (1-x)O]$

Water Budget Equation (within time step Δt)

$\bar{I}\Delta t - \bar{O}\Delta t = \Delta S$

Rearranging

$O_2 = C_0 I_2 + C_1 I_1 + C_2 I_1$

Where

$$C_0 = \frac{0.5\Delta t - kx}{k(1-x)+0.5\Delta t}$$

$$C_1 = \frac{0.5\Delta t + kx}{k(1-x)+0.5\Delta t}$$

$$C_2 = \frac{k(1-x)-0.5\Delta t}{k(1-x)+0.5\Delta t}$$

Here k and x are two Muskingum parameter which is to know for routing purpose.

Generally, k is defined as time interval measured from occurrence upstream peak to downstream peak of a flood current in river channel.

And the value of x is taken in between 0 and 0.5 as weigh factor.

After knowing values of k and x, Muskingum coefficient C_0,C_1,and C_2 can be calculated and outflow hydrograph may be routed from any inflow hydrograph.

I have analyzed all six flood event of a season at Khaimal location by taking outflow at dam as inflow hydrograph for Khairmal location.

III. Result and Discussion

Muskingum method of flood routing is most reliable method which is very useful to predict the higher stages at a particular location. By using this method, Time lag and Attenuation can be easily worked out. And Flood forecasting can be done.

Figure shown below is inflow flood hydrograph at dam and corresponding outflow hydrograph (discharge vs time) is shown in figure no 3.

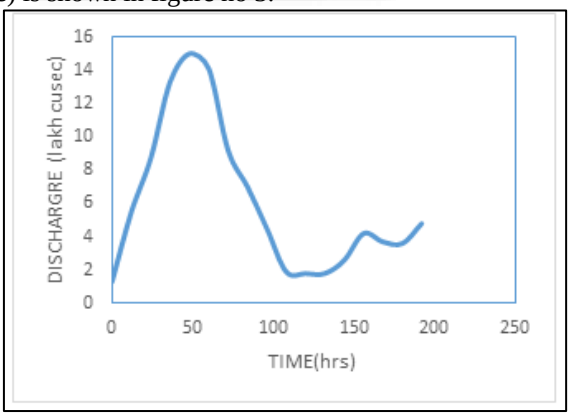

Fig. 2:

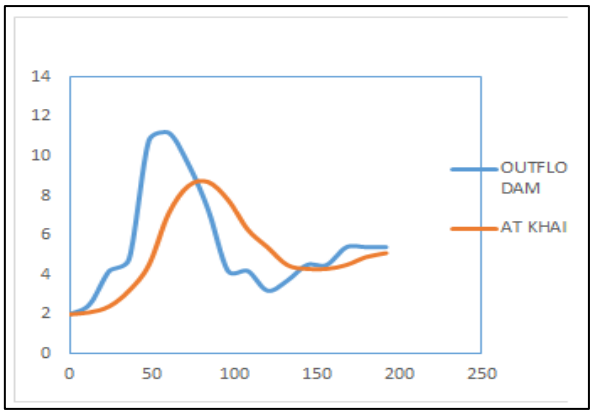

Fig. 3:

In Fig.3 blue color shows outflow hydrograph at dam where as in orange color it is outflow hydrograph at Khairmal location. It has been computed by Muskingum method assuming outflow hydrograph at dam as input hydrograph for Khairmal location. For different section, value of Muskingum coefficients will be different as value of k and x are different for different section. For flood forecasting purpose. I have analyzed six flood event of a season and their maximum discharge (lakh cusec) at Khairmal has been as shown in following figure.

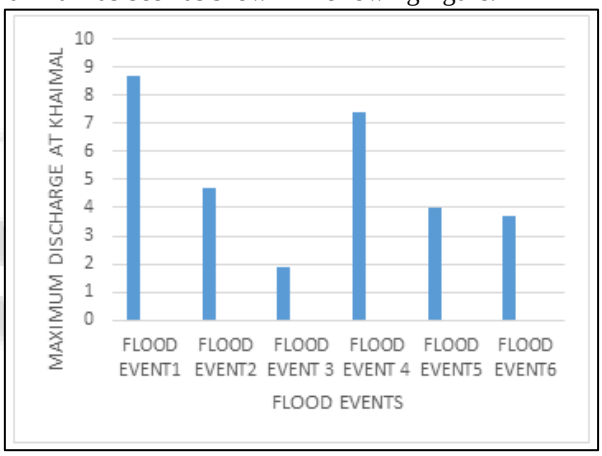

Fig. 4:

After knowing maximum discharge for each flood event at Khairmal location it can easily be assessed that which flood event was most severe. Accordingly, flood forecasting can be done and flood warning may be issued in public interest.

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