Study of Morphological Changes in an Alluvial Channel due to Flow Discharge in an experimental physical model.

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1. INTRODUCTION

There are three types of river flow pattern which is straight, meandering and braided river somewhere along its length. There are a lot of chances for a river to divert its direction in nature for instance the local distortion where the fallen trees and placement of boulders that blocking the river from a straight course. Some of researchers made a conclusion that meander pattern of river flow is transformed, initiating from straight channel stage due to cut-off toward braiding and being dispersed flow over the whole width (Yong and Lee; 2018). Meandering of the river basically depends on many factors such as earth rotation, asymmetry in aspect ratio, velocity profile sediment distribution, secondary flow etc. Therefore, it is important to understand the hydraulic and hydrology of waterways which includes the characteristics of the river itself in order to sustain the river condition. For this study purposes, meandering river pattern have been chosen to investigate the characteristics and processes of its channel. In order to identify the characteristics and formation stage in meandering channel, a preliminary study and experimental works are carried out to study and investigate on this meander channel.

2. EXPERIMENTAL SET-UP AND METHODOLOGY

The Physical Model Study has been taken up at River Research Institute at Mohanpur, Nadia, West Bengal. The model bed is located in a covered shade of size 100.0m long x 10.0m wide and has the facilities for recycling of water and measurement of the bed morphology and different hydraulic parameters. Firstly we determined the bed slope of the model area on which the channel will be constructed. The model area has a bed slope of 1:300. A wooden template was constructed to make the channel; in that way the channel will have the same cross-section as that of the wooden template. An initial curvature of 1metre radius was constructed with the help of the wooden template. The entry and exit angle of the curvature was kept at 45 degree with the straight main channel. Then finally the whole channel was constructed which is 40 m long. The cross-section of the channel has a top width of 50 cm, bed width 10 cm and height 10 cm. After the complete construction of the channel, the channel was run with a very low discharge of 0.001 cubic meters per second for stabilized the dry sand bed. It was done to saturate the channel soil as much as possible without changing the cross-section of the channel. Then the channel was run with the experimental discharge of 0.005 cubic meters per second. The lateral changes and thalweg of the channel was noted and plotted in a excel sheet.

3. RESULT AND ANALYSIS

The initial channel with thalweg has been presented in fig.-1 after the initial curvature. The lateral movement of the channel and the changes in thalweg position was duly observed and plotted in the spread sheet. It was seen that with time the channel has started to migrate both in the lateral and longitudinal direction for a fixed discharge. The changes are shown in fig-2.

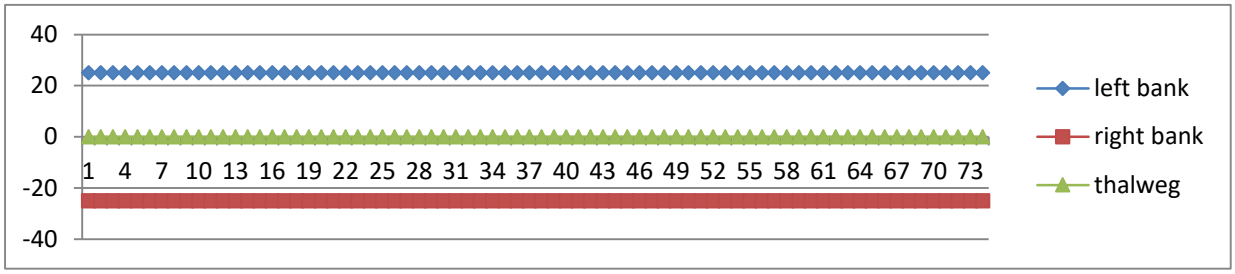

Fig. 1: Initial dimension of the channel with thalweg

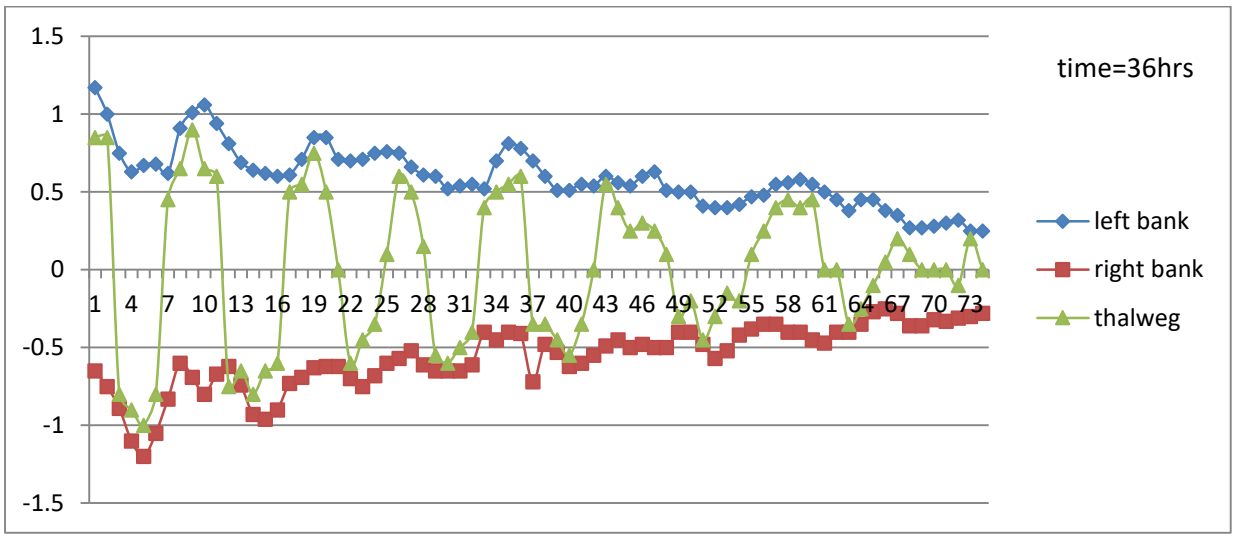

Fig. 2: Dimension of the channel after 36 hours of flow

4. CONLUSION

- After 36 hours of flow in the channel, banks have shaped meandering in nature. The thalweg is observed in sinusoidal nature from the initial straight line.
- After 37m in longitudinal distance the tendency of sinusoidal nature of thalweg is drastically reduced.

5. REFERENCES

1. Dietrich, W.E., and Smith, J.D. 1984. "*Bed load transport in a river meander.*" Water Resour Res, 20(10), 1355–1380. 10.1029/ WR020i010p01355.
2. Duan, J.G., and Julien, P. 2009. "*Numerical simulation of the inception of channel meandering.*" Earth Surf. Process. Landf, 30(9), 1093–1110. 10.1002/esp.1264.
3. Engel, F.L., and Rhoads, B.L. 2016. "*Three-dimensional flow structure and patterns of bed shear stress in an evolving compound meandering bend.*" Earth Surf. Process. Landf, 41(9), 1211–1226. 10.1002/ esp.3895.
4. Engelund, F. 1974. "*Flow and bed topography in channel bends.*" J. Hydraul. Div, 100(HY11), 1631–1648. 10.1061/JYCEAJ.0004109. Engelund, F., and Hansen, E. 1967. A monograph on sediment transport in alluvial streams, Teknisk Forlag, Copenhagen, Denmark.