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ARTICLE

Empirical Studies in Alluvial Streams

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ABSTRACT

Meander flow takes place in one single channel which oscillates more or less regularly with amplitudes that tend to increase with time. Meanders are found in beds of fine sediments with gentle slopes. In this study, effort will be made to investigate meanders' turbulent boundary layer and to improve the present knowledge about the river meandering phenomena. It is assumed that the development of the perturbations which develop into meanders or braids, is longer than the width of the channel. Interaction between the flow and mobile boundaries produces channel patterns which are classified as meandering or braided. It is therefore long compared with the ripples or dunes which cover the bed of such a channel and whose wavelength is shorter than the width of the channel. The variation of resistance to flow and rate of transport of bed material with velocity are discussed briefly and taken into account. Meander flow and meander shear stress distribution of the channel are described. The basis is a steady, two-dimensional model of flow in an alluvial channel with variable curvature. The meander development is described by forcing a travelling, small-amplitude channel alignment wave on the system, and determining the growth characteristics of the wave. Laboratory data are used to verify the formulas.

1. Introduction

The alluvium and boundary layer of channel occurrences are distinguished while these events can be controlled at the laboratory by the scientists. Any parameter which is selected as an independent variable is classified as long-term and short-term in the field. It is given as three different following classifications: 1. Steady time, 2. Graded time,and 3. Geologic time that it is divided into short - term, long – term, and very long-term time spans, respectively [1].

The first time period is given in days, the graded time is in the value of a few hundred years, and the geologic time may have a value of millions years. It is dependent to the size of the drainage area on alluvium. Here is the most important events which have different properties can be shown as cause or as effect depending on time scales. The sediment discharge is an important parameter in the steady time duration which can be transmitted as a water velocity function in empirical relationships [1].

In the last observation the water velocity is given as the reason and the sedimentation is the result. This is usually correct for the short-term evaluation but not so for the long-term graded time duration equilibrium conditions where flow inflow and sedimentation are searched on the drainage boundary layer as independent parameters for the flume [2]. These amounts of drainage area are flowing

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from upstream and from the tributaries which are observed at the upstream and tributary entrances to the basin. During the long –term period of river flow the different parameters like transport capacity and the inflow amount must show an equilibrium condition on the river valley. In the empirical relationships channel migration rate is given as the function of width, depth and slope in the alluvium like the relative curvature r_m/B and definition of r_m [12]. If there is no aggradation braided channel formations occur in quasi-equilibrium conditions.

The primary reasons at the channel alluvium may be given the braided channel formations [12]. The results of primary occurrences are:

(1) Over-sedimentation because of heavy sediment transportation from the upstream boundary layer

(2) Because of steep horizontal slopes

Analysis of braided river conditions is out of scope of this paper.

2. River Types

River types with point bars in nonsinuous patterns can be met at heavy bed-material and low silt-clay mixture on horizontal steep valley slopes. Flumes with these properties have mean values of lateral curvature at the valley route where one of the multiple tributaries moves against the inner bank boundary layer. The differences between sinous flumes and nonsinuous braided rivers are given with two contrast in width-depth ratio, slope, channel and bank stability and other properties. It seems to be contrasted in:

(1) Blockage of a main channel by ice blocks in northern hemisphere,

(2) Different topographical properties of river boundary layers

(3) Geological reasons such as alluviums or different soil aspects

By different researchers the reason for meandering channels is given as the soil properties of the river valley environment which shows the quasi-equilibrium condition. Anabranches rivers have more steeper borders than the undivided river patterns where they have low sediment transport rate and the meanders have high sedimentation for having equilibrium conditions on the river reaches.

3. Threshold in River Morphology

The relationships for river morphology cannot continue undefinitely because of the auter effects of the natural disasters like earthquake, flood conditons and drought conditions where there is observed different thresholds and discontinuities. The length along the meandering patterns is given as

$$M = 2 \pi B \quad (1)$$

where B is the width of the channel curvature illustrating diffent frequency distributions. The properties for 8 alluvial and 5 bedstone armour streams are reported [11]. The other approach is given for different river pattern curvature where the transverse oscillation of the water velocity takes place against the river bank degradation. Meandering river pattern shows good agreement with the evaluation of river plan formations. In a bedrock environment the meander formation about gooseneck is shown [12] (Figure 1).

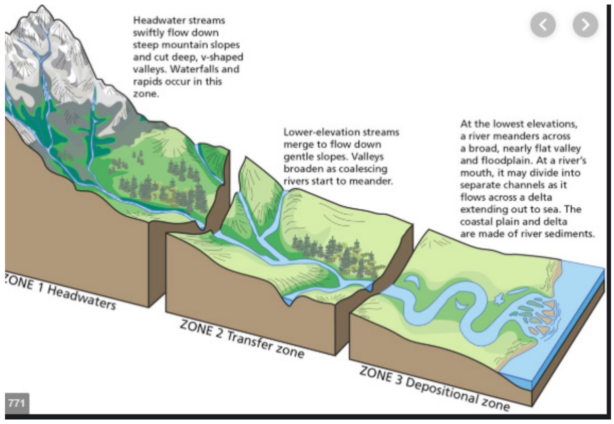

Figure 1. Gooseneck river meander

The oscillation of boundary layer in river meanders is dependent on the sedimentation amount from upstream reach. There is another damping constant which is dependent on the water velocity with different reverse components. It is invented new relationships about discharge and wavelength using the formula [6-9],

$$\frac{\lambda}{AB^{1/2}} = 72FB^{0,52} \quad (2)$$

$$\lambda = 39\ Q^{0,41} \quad (3)$$

where A is the cross-sectional area and B is the width , F Froude number and λ is the river oscillation wave-length (Figure 2).

Figure 2. Sedimentary Deposition Environment

The above relationships have statistically character by collecting different laboratory and natural data. There are also distributed in different 60 constant discharge laboratory evaluation. At the lower discharge condition the alternate bars occur at the river boundary layer with different characteristics. In several researchesar the alternate bar conditions can be seen with controlled discharge and bank stabilization near alternate sides of the river boundary layer. At higher stages of flow conditions alternate bars dissappeared. It is the reason of higher velocities in the channel. There is directly connection between alternate bar formation and curvature migration in the boundary layer. In the erosion condition of meandering rivers alternate bars change their forms quickly in free developing curves. In different conditions where water depth has fifth percent of width is observed alternate bars occurs at the river axis scour. Alternate bars at the meandering conditions are significant effect on river geology and river ecosystem. It is also concluded in this condition meander length $\lambda / A^{1/2}$ changes into Froude number with 0,5 exponent and their wavelength changes with the discharge of 0,4 exponent. Different researchers give the same idea that the laboratory observations are not the same as the natural phenomena because of different impacts of the river shoreline.

4. Results

River types with point bars in nonsinuous patterns can be met at heavy bed-material and low silt-clay mixture on horizontal steep valley slopes. Flumes with these properties have mean values of lateral curvature at the valley route where one of the multiple tributaries moves against the inner bank boundary layer. The differences between sinous flumes and nonsinuous braided rivers are given with two contrast in width-depth ratio, slope, channel and bank stability and other properties. It seems to be contrasted in [5-7]

(1) Blockage of a main channel by ice blocks in northern hemisphere,

(2) Different topographical properties of river boundary layers

(3) Geological reasons such as alluviums or different soil aspects

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