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Analytical Understanding of Sediment Supply and Calibration on River Width Adjustment in Gravel Bed Rivers

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Abstract

An One of the hydraulic parameters which signify downstream hydraulic geometry is river width. In fact, river width is influenced by a number of parameters among which sediment load is important in gravel bed rivers. In this research, a large data base for the downstream hydraulic geometry of gravel bed rivers is examined by a nonlinear four variables regression analysis. The data base includes gravel bed rivers with meandering to braided in planform geometry. These data points consist of bankfull discharge, mean bed particle size, channel slope and channel width, which were used to predict sediment load transport from bed load and total load functions. Results indicate that the equation derived from regression analysis with four variables include mean bed particle size, channel slope, bankfull discharge and total sediment load transport per unit width of the channel performs better than other regression equations in estimating the channel width. Also, the appropriate total load function for estimating regime width of gravel bed rivers was suggested Engelund and Hansen (1972).

Keywords: Width adjustment, Sediment supply, Bankfull discharge, Gravel bed rivers

1. INTRODUCTION

An alluvial river frequently adjusts its cross-section, longitudinal profile, course of flow and pattern through the processes of sediment transport, cut and fill. According to the water and sediment discharge, rivers create their own geometries, viz. slope, depth, width, and meandering pattern. Since the slope and meander pattern do not respond rapidly enough to follow seasonal variations of discharge, it is natural to invoke some kind of dominant or formative values of the discharge for these variables (Engelund and Hansen, 1972). The geometry of rivers affects many of the issues of concern in catchment management, including transmission of flow, sediment and nutrients. Channel geometry is an important consideration in the design of environmental flow regimes in regulated rivers and is one of the primary factors determining physical habitats in channels and surrounding floodplains. Changes to the river form and the associated processes of riverbank erosion are one of the potential consequences of altered flow regimes, future land use change and future climate change (Stewardson *et al*., 2005). The term hydraulic geometry connotes the relationships between the mean stream channel form and discharge both at-a-station and downstream along a stream network in a hydrologically homogeneous basin. Leopold and Maddock (1953) envisioned channel adjustment occurring in two different ways: 1) a channel cross-section or reach might be adjusted to accommodate the range of flows experienced at that location (termed "at-a-station" or "at-a-point" hydraulic geometry); 2) the river channel might be adjusted along its length to increasing flows resulting from increasing downstream drainage area (termed "downstream" hydraulic geometry).

However, equations derived from downstream hydraulic geometry are often referred to regime equations by river engineers and practitioners. Determination of stable or regime width dimension of channels is one of which to be concerned by river engineers and scientists. Up to now, four methods proposed for estimating dimension of stable width by river researchers: 1) empirical equations (Lee and Julien, 2006; Shirkhani, 2010), 2) semi-theoretical methods (Julien and Wargadalam, 1995), 3) mechanistic concept (Lane, 1955), and 4) procedures based on extremal hypotheses (Jia, 1990). It is still difficult to obtain a generalized model or equations to provide accurate estimation of downstream hydraulic geometry due to a lack of knowledge of some physical processes associated with channel formation and maintenance.

A river in regime is considered stable, not necessarily in the sense that the bed and banks are non-erodible and fixed with time, but that average channel dimensions are maintained over a period of years (Julien,