



Numerical study on the sediment control of meandering channels

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Upstream of meandering reach in mountainous rivers reveal backwater effect and velocity decreasing features. The sediment transport in the upstream of meandering reach is therefore affected by the plane morphological characteristics. The upstream reach could possibly play a role of sediment control section for temporary sediment trapping and mitigation similar like natural notches. The flow conditions in channel bends can be characterized by the secondary flow that develops as a result of the super-elevation of the water surface and centrifugal forces imposed on the flow due to the meandering geometry. Secondary flow develops a shear stress across the transverse section and consequently influences the spatial distribution of sediment erosion/deposition. In this study, a three-dimensional CFD model FLOW-3D[®] incorporated with secondary flow was applied to evaluate the influence of bending angle on sediment control in the upstream reach of meandering channel. FLOW-3D[®] specializes in the accurate simulation of free surface flows, using the Volume of Fluid (VOF) technique. FLOW-3D[®] is able to handle different turbulence closures such as Prandtl mixing length model, turbulent energy model, $k-\varepsilon$ model, Renormalized group (RNG) model and Large-Eddy simulation (LES) model. The turbulent models were tested and the RNG model was used in our study. An empirical relation proposed by Beck (1988) for delineating the transverse bed elevation in channel bend was applied to established the initial experimental scale topographical models based on three different bending angles (30, 60, 110 degrees). In additions, a 0.5 m length of straight channel was connected to the upstream of channel bend for testing the hydro-dynamical and sediment transport ahead of channel bend. Numerical results showed that the sediment transport rate in the straight channel reach decrease with the increasing of the channel meandering. Sediment deposition in the straight channel reach and bend channel reach both are inversely proportional to the degree of channel meandering. The research results preliminary reflect the possible sediment control of meandering channel.

Beck, S. M. 1988. Computer-simulated deformation of meandering river patterns. PhD Thesis. Department of Civil Engineering, University of Minnesota, Minneapolis, Minnesota, USA.