XVII[th] World Congress of the International Commission of Agricultural and Biosystems Engineering (CIGR)

Hosted by the Canadian Society for Bioengineering (CSBE/SCGAB)
Québec City, Canada June 13-17, 2010

FLUME ANALYSIS OF IN-CHANNEL RESTORATION STRUCTURES AND IMPACTS TO SECONDARY CIRCULATION FLOWS

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CSBE101526 – Presented at 10th American Ecological Engineering Society Annual Meeting (AEES) Symposium

ABSTRACT River restoration with natural channel design utilizes in-channel restoration structures to redirect cut bank flows toward the channel center and reduce scour erosion. Prior research has utilized primary circulations or streamwise flows along the channel to site in-channel structures, trying to move the higher velocity water away from the cut bank. This research used a series of flume experiments to characterize the impact of in-channel structures on the cross-channel flows, also known as secondary circulations. Our flume experiment represented the geometry of pool-riffle systems and used width to depth ratios between 3 and 8, and flows from 2 to 10 Litres per second. The in-channel structure was a j-hook, which consists of a vane tied in at the bank with a bankfull elevation, extending at an angle of 30 degrees off of upstream, and sloping toward the channel bed. A mesh frame was inserted in the channel to fix sampling locations, and dye injection used to determine local vector components of the secondary circulation. The in-channel structure disrupts the secondary circulation, breaking a single circulation cell into 2 circulation cells. The larger cell is located on the opposite bank to the structure, while the smaller cell is contained within the wake zone of the structure. This disruption of secondary circulation has potential impacts on sediment transport along alluvial channels, and may lead some adjustments in point bar and cut-bank geometry. River restoration engineers should consider both secondary and primary circulation patterns when setting in-channel structures. Computational fluid dynamic simulations were used to further refine the characterization of these secondary flow impacts on river hydraulics and sediment transport.

Keywords: River restoration, Hydraulics, Flume analysis.