Flow Pattern in a Mild Ingoing Meander River Bend

Hossein Hamidifar[1], Alireza Keshavarzi[1,2] and James Ball[2]
1-Water Engineering Department, Shiraz University, Shiraz, Iran
2- School of Civil and Environmental Engineering, University of Technology Sydney, Broadway, NSW, Australia

Abstract

Flow pattern in the mild meandering rivers is completely different from that of strongly curved meanders. The results of this experimental study showed that in mild meander rivers, the maximum velocity is about 1.3 times the mean flow velocity. The maximum dimensionless radial and vertical velocity components was found to be about 8% of the mean velocity. Also, the maximum values of MKE occured at the locations of the maximum streamwise velocity whereas high values of TKE occured at the inner bank of the region downstream of the bend apex. The above results can be used to find meandering patterns in river training works.

Keywords: river engineering, mild meanders, flow pattern, turbulence, ADV.

Introduction

Determination of flow characteristics in river bends is an important issue in river training work and flood plain management. The current knowledge of meandering open-channel flows is still not completely understood. This may be attributed to the fact that different meandering streams exhibit different geometric characteristics, flow regimes, etc., and in any given stream the conditions differ from one meander loop to another (Duarte 2009, da Silva et al. 2006).

Both flow measurements and numerical solutions have shown that the vertically averaged flow in meandering channels is convective (da Silva et al. 2006). That is, the vertically averaged streamlines are not parallel to each other and their direction deviates from the direction of the coordinate lines.

River meanders can be categorized as ingoing ($\theta_0 \leq 30$) and outgoing ($\theta_0 \geq 70$), based on the values of θ_0 (see Fig. 1 for the definition of θ_0), the deflection angle (da Silva 1995).The vertically averaged flow in sine-generated channels having a flat bed was the objective of many laboratory researches for example by Whiting and Dietrich (1993), da Silva (1995), and Termini (2004). In these studies, the values of the deflection angle θ_0 was selected for their experimental channels as to exemplify “small” and “large” θ_0, i.e., “small” and “large” sinuosity. A “small” value of θ_0 was used by da Silva 1995 (θ_0=30°); “large” values of θ_0 were used by Whiting and Dietrich (1993) (θ_0=100°), da Silva (1995) (θ_0=110°), and Termini (2004) (θ_0=100°). From these experiments it became apparent that the streams corresponding to “small” and “large” values of θ_0 have clearly different flow patterns, i.e., markedly