

## NUMERICAL STUDY ON THE EFFECTS OF SECONDARY FLOW ON RIVER BEND

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Under the natural conditions, the rivers rarely take a rectilinear outline in plane. It is generally assumed that the governing forces in a bend flow are the centrifugal forces due to the vertical non-uniformity of the velocity profile combined with the flow curvature, the shear stresses, and the transverse pressure gradients caused by the transverse inclination of the water surface.

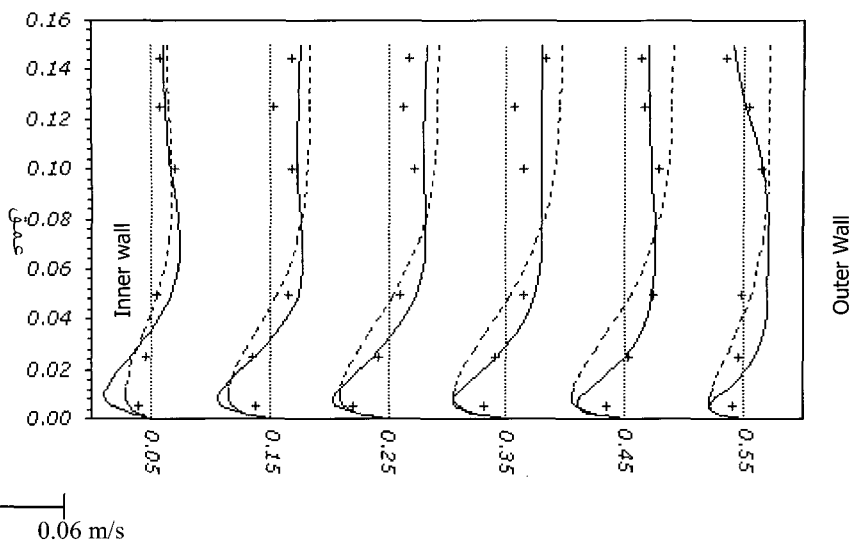
The balance between the governing forces tends to produce a helical flow pattern in the bend and a tilting of the channel bed, with an increase in depth near the outer (concave) bank. The helical motion causes to redistribute the main momentum. Interaction of the complex flow and solid boundaries lead to erosion result in the bank often undermined and eroded

In this study, the structure of turbulent flow in a 180 degree bend is investigated and the role of the secondary flow on the main flow and scouring of the bed and outer bank are discussed.

A computation model is used for the simulation of the strongly three-dimensional turbulent flow in curved channel preceded and followed by straight channels. Two turbulence models are used and it is found that the  $k-\omega$  model is more appropriate than the  $k-\epsilon$  model (Fig.1). Vectorial representation of secondary flow shows that at the exit of the bend there are two secondary flow cells. The  $k-\omega$  model predicts the probable scouring regions along the bed and outer wall of the channel. There are two scouring region in two halves of the bend. The first hole occurs about section  $\theta = 50^\circ$  and the second one, forms at the bend exit (Fig. 2).

### REFERENCES

- Pirestani, M., 2004. An Investigation of Flow Pattern and Scour for Intakes in the Bend Channel. PhD. Thesis, Azad University (in Farsi).  
Dehgani, A.A., 2004. Experimental Investigation on Sediment Control at Lateral Intake in 180° Bend. PhD. Thesis (Undergoing Study), Tarbiat Modarres University (in Farsi).



[+] Experimental (Pirestani, 2004) [- - -] Numerical (Present Study,  $k-\epsilon$  Model) [—] Numerical (Present Study,  $k-\omega$  Model)

Fig. 1 Comparison Between Predicted and Measured Transverse Velocity Profiles in Section  $\theta = 180^\circ$ .

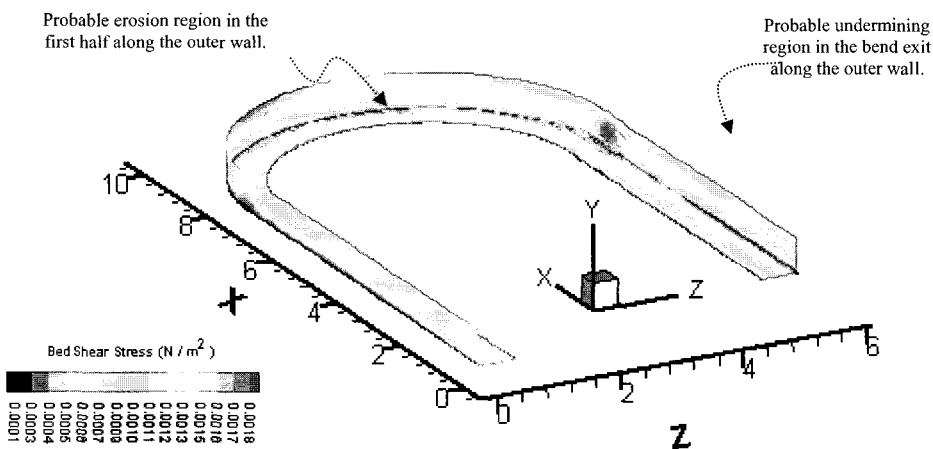


Fig. 2 Calculated Bed and Outer Wall Shear Stress Distributions.