SEDIMENTATION MODELING IN STREAMS WITH OBSTRUCTIONS

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ABSTRACT

For maximum benefits from water resources in rivers and streams, it has been necessary to build hydraulic structures in them for a variety of purposes. Some of these are navigation, flood control, irrigation, environmental protection, and water supply. The introduction of man-made obstructions (from the river flow point of view) into the streams and rivers can cause significant changes in sedimentation processes. Not only are local scours and deposited dunes found in the vicinity of these obstructions, but the bed form, bank erosion and water quality in regions farther afield are also affected. At a time when society is greatly concerned about both environment and the quality of the water supply, it is very important to determine the impact to these obstructions before construction takes place.

Within the past several years, a well-integrated methodology, utilizing both hydraulic and numerical modeling, has been applied to the study of hydrodynamic problems in rivers by the author and others. This hybrid approach is used in the present study to simulate the erosion and sediment transport phenomena in streams affected by man-made obstructions. The time-dependent, diffusion-convection equation in three-dimensions is used to describe the sediment movement in suspension. The sediment diffusion coefficient is a function of the turbulent eddy viscosity. The damping of the turbulence due to the presence of sediment particles is also considered. The sediment concentration at a reference level near the bed is computed as a function of the bed-load. The inclusion of these latest developments into the mathematical model has improved the accuracy of the model.

The highly irregular domain is discretized into a system of vertical cylinders with a quadrilateral cross-section in the horizontal plane. Each cylinder may have a different top and bed surface. A new numerical scheme has also been developed to efficiently transform the the partial differential equations into ordinary differential equations. The final set of first-order ordinary differential equations is solved by a predictor-corrector, time-marching algorithm. Preliminary tests have shown that the newly completed methodology is much more cost-effective than many existing methods reported in the literature to date. Examples are presented to demonstrate the capability, accuracy, and efficiency of this new computational model for erosion and sedimentation studies.

This paper was not presented at the conference. Further information about the subject can be obtained by writing the author at

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