DETERMINATION OF OPTIMAL STABLE CHANNEL PROFILES

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(ABSTRACT)

A numerical model which determines the geometry of a threshold channel was recently developed. Such a model is an important tool for designing unlined irrigation canals and channelization schemes, and is useful when considering flow regulation. However, its applicability is limited in that its continuously curving boundary does not allow for sediment transport, which is an essential feature of natural rivers and streams. That model has thus been modified to predict the shape and stress distribution of an optimal stable channel; a channel with a flat-bed region over which bedload transport occurs, and curving bank regions composed of particles that are all in a state of incipient motion. It is the combination of this channel geometry and the phenomenon of momentum-diffusion, that allows the present model to simulate the 'stable bank, mobile bed' condition observed in rivers. The coupled equations of momentum-diffusion and force-balance are solved over the bank region to determine the shape of the channel banks (the bank solution). The width of the channel's flat-bed region is determined by solving the momentum-diffusion equation over the flat-bed region (the bed solution), using conditions at the junction of the flat-bed and bank regions that ensure matching of the bed and bank solutions. The model was tested against available experimental and field data, and was found to adequately predict the bank shape and significant dimensions of stable channels. To make the model results more amenable to the practicing engineer, design equations and plots were developed. These can be used as an alternative solution for stable channel design; relieving the practitioner of the need to run the numerical program. The case of a stable channel that transports both bedload and suspended sediment is briefly discussed. Governing equations and a possible solution scheme for this type of channel are suggested; laying the groundwork for the development of an appropriate numerical model.

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