ABSTRACT

River flooding is common to many parts of the world. It causes immense damage to the life and property and affects the people living on either sides of the river plains. It is quite common that all alluvial rivers tend to meander. In fact, straight alluvial channels longer than 10 to 12 channel widths are rather rare. Whether by nature or by design, rivers have compound sections comprising of a main channel, which always carry low flows and one or more floodplains disposed to its sides, which carry flows above bank-full stages during floods. Engineers need methods to calculate river system performance for over-bank stages. The existing "divide channel" method of discharge calculation uses conventionally a vertical, horizontal or a diagonal plain of separation of compound channels, the discharge for each zone of the section is calculated by Manning's or Chezy's equation and added up to give the total discharge carried by the channel. However, errors up to 30% may result. This is mainly due to the neglect of the interaction taking place between the deep main channel and shallow floodplain flows across the interface plain of separation. An interface plane of zero shear is proposed to divide the compound channel section into hydraulic homogeneous zones for the purpose of accurate discharge calculation. Using such an interface (variable) plain, a river engineer can determine the discharge capacity of meandering and straight compound channels more accurately. The procedure of locating such a variable interface plain for a particular depth of flow in a compound section is rather simple. A method to predict stage-discharge relation for a meandering compound channel by correlating coherence and discharge adjustment factor is proposed. Distribution of energy in a meandering compound channel is an important aspect. This has been addressed adequately by incorporating the variation of Manning's n, Chezy's C, Darcy-Weisbach friction factor f and the parameter $\sqrt{S}/n$ with depth of flow from in-bank to over-bank stages in all the type of channels. The proposed models also predict successfully the percentage of flow carried by the main channel, lower main channel and floodplain. Considerable effort have also been given to model successfully the depth averaged and point tangential (longitudinal), radial (transverse) and vertical velocity in simple meander channels and also in the meander channel - floodplain geometry. The distribution of boundary shear in the main channel and floodplain plays a key role in selecting the interface plane of zero shear (variable interface plane). Estimation of percentage of shear force carried by floodplain and the percentage of flow carried by various zones of the compound channel section are found to be adequately represented by five dimensionless channel parameters. The interaction loss for the vertical, horizontal, diagonal and variable interface planes have also been evaluated by an interaction loss parameter (I). The loss parameter is found to be maximum for the vertical interface and minimum for variable inclined interface. The methods of discharge calculation have been extended to a natural meandering channel draining an area of 8570 sq. km and also to a higher sinuous laboratory test channel (sinuosity = 2.06) successfully.

Key Words :

Meander channel, Floodplain, Compound channel, Energy loss, Stage - discharge relation, Boundary shear, Compound channel discharge, Interaction loss, Velocity distribution, Tangential velocity, Radial velocity, Vertical velocity, Apparent shear, Phase lag, Discharge adjustment factor, Coherence. Interface plains (Vertical, Horizontal, Diagonal and Variable).