9th International River Engineering Conference
Shahid Chamran University, 22-24 Jan 2013, Ahwaz

Vegetation Effect on Shear stress and Bed-load Transport in a Gradually Varied Flows

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Abstract

Vegetation is an important factor in river geomorphology due to its effects on bed and bank erosion and sediment transportation. In this study 38 series of steady, gradually varied flow experiments were performed in a rectangular rigid boundary flume. Two types of flow, i.e. with and without sediment were used to investigate the impact of un-submerged rigid vegetation-like elements on the flow conditions. The results show that the presence of un-submerged rigid vegetation increases the resistance to flow and the total shear stress. Also the results prove that the measured bed-load transport data are very close to the results obtained from the Ashida & Michiue's bed-load transport equation.

Keywords: Vegetation, Drag force, Shear stress, Bed-load transport.

Introduction

Rivers are one of the most important resources for the water supply required for human activities and have great effects on neighboring areas. Any changes in the rivers flow quality and capacity can disturb economic and community activities of residents around the river and risk their lives. So to protect the neighboring lands against flood, prediction of water level and flow capacity is important and an accurate estimation of the resistance coefficients such as Manning coefficient due to roughness effect on water level and flow velocity is needed. One of the factors affecting the hydraulic roughness is vegetation on the bed and sides of the river.

In the past, eliminating vegetation from the floodplain area was thought to be one of the essential mechanisms of reducing resistance to flow and improving river condition and flow capacity. But nowadays, tendency has been returned to the understanding of the significant benefits that vegetation provides for the ecosystem stability. Plant stems increase bed roughness, decrease flow velocity, and depreciate flow energy on the walls. Vegetation also reduces bed shear stress that leads to the reduction of sediment discharge and its deposition in the space between the stems. Another important effect of vegetation in the rivers is how the roots consolidate soil grains and improve soil structure and, therefore, increase bank stability. Vegetation in flood plain area may also act as barriers to make flood storage in pick flow and reduces the sediment transport capacity.