Modeling velocity and shear stress profiles for the ecological channel with floating vegetation

jiao zhang

Water Conservancy and Hydropower School, Xi’an University of Technology

Xi’an, China

Floating vegetation appears in various environments, such as artificial floating islands, wetlands, river courses, and lakes, acting as an important part of river landscape and ecological restoration. Vertical distribution of streamwise velocity in the floating vegetated channel is of the utmost importance, which is the basis of research on bed erosion and pollutant transport. Laboratory experiments in an open channel covered by floating vegetation with unanchored roots show that the velocity profile has a two-layer structure and the Reynolds stress deceases rapidly across the interface in the vegetation layer and decreases gradually in the non-vegetation layer. The flow is divided into four subzones vertically according to the experimental flow structure: (I) uniform region deep within the non-vegetation layer, (II) outer region in the non-vegetation layer, (III) inner region in the vegetation layer, and (IV) uniform region deep within the vegetation layer. An analytical model based on the momentum balance in each sub-zone is developed to predict the velocity and Reynolds stress profiles. Predictions from the analytical models have good agreement with laboratory studies on floating vegetation. The analytical model lays the theoretical foundation of future studies on water eutrophication and the transport of pollutants, sediment, and algae.