MODELING APPROACH TO BULK DRAG COEFFICIENT OF REGULAR ARRAY IN SUBMERGED DENSE VEGETATION UNDER GRADUALLY VARIED FLOW

ABSTRACT

The conveyance capacity of a vegetated channel is governed by the hydraulic resistance induced by the vegetation. In this work the wake interference effects among submerged blade-type vegetation stems on the hydraulic resistance in open channel flows are studied experimentally. The stems are arranged in a regular array pattern and the areal density of vegetation is varied by changing the longitudinal spacing or lateral spacing of stems. The hydraulic resistance force is parameterized by a bulk drag coefficient with the approaching velocity used as the velocity scale (*Cd*). The results shown that the bulk drag coefficient decreases with the Reynolds number, decreases with longitudinal stem spacing, and slightly increases with the lateral stem spacing. It can have multiple values for a given areal density of vegetation. In numerical modeling the bulk drag coefficient using the stem-layer velocity scale *Cd’* is generally required. A 3D numerical model is used to determine Cd’ through calibration against the experimental data. The value of *Cd’* is found to increase with the decrease in longitudinal stem spacing, which is different from that of *Cd*. The effect of stem distribution pattern is most significant for low areal density of vegetation.

Keywords: Drag coefficient, submerged vegetation, distribution pattern, open channel flows