VARIATION OF TURBULENCE INTENSITIES IN/AROUND EMERGENT VEGETATION ZONES

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Abstract

Presence of vegetation in open channels has important effects on physical properties of the flow. Most of the studies about turbulent in open channel were related by turbulent influence on sediment transport such as Sumer *et al.,* (2003). In this study, they focused on effect of turbulent intensities on sediment transport and gave the turbulent distribution for different turbulence quantities by using grids that made by steel mesh.

Vegetation has an influence on the flow resistance, velocity distribution and sediment transport mechanisms (Yen, (2002)). Studies about vegetation in open channels have generally concerned with flow resistance. Submerged vegetation can be considered as channel boundary and has a flow resistance influenced by several factors such as vegetation type, age and density. Researches investigated the vegetation resistance coefficient. Hickin (1984) stated that the vegetation has an essential role in stream morphology formation. Stephan and Gutknecht investigated the influence of the submerged aquatic vegetation to the flow resistance (Stephan and Gutknec, 2002). They suggested that the mean deflected plant height is an ideal parameter for estimating hydraulic roughness. Wilson et al. (2003) worked on the turbulence characteristics on submerge and flexible vegetation. They used rod and rod/frond vegetation and measured turbulence quantities in and over vegetation zone. They found turbulence intensities took larker values just above the vegetation and reported the transition zone for the turbulence between vegetation and main flow because flexibility of the plants.

In this study, a 2D experimental work was executed to determine the variation of the turbulence characteristics in the flow caused by emergent vegetation with different flow conditions, bottom roughness and vegetation densities.

Experiments were carried out in a 0.5 m wide, 0.5 m deep and 18 m long re-circulation flume. Emergent vegetation is generated, at least inflexible, to resist emergent against the flow in the nature. For simulating of this situation, sedges are used for experiments. They are placed on the channel bottom in three different configurations, two of which as an orthogonal grids and the last in diamond shape. Velocity measurements were achieved by an Acoustic Doppler Velocimeter with a temporal sampling resolution of 25 Hz. Bottom roughness was created by gravels with two different sieve sizes.

Experiments were conducted on different sectional mean velocity, discharge, water depth, and roughness and vegetation density configurations. In each velocity profile was determined at upstream and, downstream of the vegetation and within the vegetation. Within the first 1 cm over the bed, velocity measurements were made in 1 mm layers. Above this point, measurements were made in every 1 cm because of logarithmic scale. Velocity measurements were recorded with 25 Hz. The time average of the streamwise and vertical velocities ($\overline{u}$, $\overline{v}$) and also fluctuating components of the velocities (u', v') were measured.

The results of tests are presented in turbulence variations by depth in the figures such as in the Fig. This fig. plotted for each test run presents the changes in the turbulence characteristics in/around emergent vegetation.

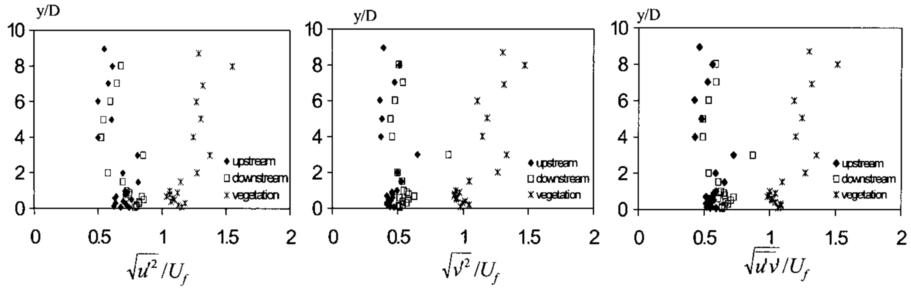

Fig. Turbulence quantities and shear stress distribution for 5 cm uniform vegetation grid.

The turbulence quantities within the vegetation are much higher than the upstream and downstream points except the last case (diamond shaped least dense vegetation).

The results of the measurements are summarized as follows; While there is an irregular and turbulent flow character within the grid shaped uniform vegetation, turbulence significantly decreases within the diamond shaped vegetation. Shape parameter has a more important role on this issue than the density parameter for the experiment conditions with which this study was carried out. On smooth bed conditions flow passed through vegetation does not significantly effected in turbulence point of view, in other words, on smooth bed turbulence characteristics seems not to be changing from upstream to downstream. Rough bed conditions disturb the turbulent characteristics more than smooth bed conditions between upstream and downstream and turbulence intensities increase near the bottom, in these cases fine sediment erosion under the vegetation could be higher. Emergent vegetation plays an important role on the turbulence characteristics both within vegetated area and downstream of vegetated area. It can not be said that emergent vegetation always increases or damps turbulence, but the properties of the vegetation decides whether turbulence will be increased or damped together with the flow and bed conditions.

Keywords: Emergent vegetation, Turbulence intensities, Vegetation density, Bottom roughness

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