



**INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS**

Name of the Student : THOKCHOM BEBINA DEVI
Roll Number : 126104013
Programme of Study : Ph.D.
Thesis Title: HYDRODYNAMICS OF VEGETATIVE CHANNEL WITH DOWNWARD SEEPAGE
Name of Thesis Supervisor(s) : Dr. BIMLESH KUMAR
Prof. SUBASHISA DUTTA
Thesis Submitted to the Department/ Center : CIVIL ENGINEERING
Date of completion of Thesis Viva-Voce Exam : 15/12/2016
Key words for description of Thesis Work : Quadrant, Seepage, Submerged, Vegetation

SHORT ABSTRACT

The presence of vegetation in an open channel can significantly affect the hydrodynamic behaviour of the flow and consequently sediment transport by obstructing the flow and changing the flow characteristics. Understanding the hydraulics of flow over vegetation is very important to support the management of fluvial processes. The present research work experimentally investigates the flow over flexible vegetation. Experimental data collected in a straight flume having a bed covered by grass-like vegetation have been used to analyze different flow characteristics for flexible submerged elements. Experiments were conducted for both artificial as well as natural vegetation. An important parameter of sand bed channels, downward seepage, was considered in the present work on vegetated channel. Two different seepage percentages, 10% and 15%, were considered for exploring the change in flow characteristics with respect to no seepage case.

Vegetation height is an important parameter in influencing the flow characteristics in a vegetated channel flows where velocity is reduced near the top of the vegetation. Velocity profiles show the presence of an inflection point near the top of the vegetation where maximum Reynolds stress is achieved. Results show that velocity measured at upstream vegetation section is always higher than the downstream section even with the application of downward seepage. The maximum value of Reynolds stress occurs near the top of the vegetation. When the flow enters the vegetation section, the local effect of the presence of vegetation on sediment transport is more at the upstream vegetation section and then decreases which is shown by

higher Reynolds stress at the upstream as compared to downstream vegetation section highlighting the importance of vegetation in providing as an erosion control. The velocity profiles measured in the unobstructed region of uniform pattern is higher as compared to the velocity measured in line with the vegetation stems of staggered pattern. Downward seepage increases the velocity, Reynolds stress and turbulent intensities. It can be inferred from moment analysis results that the downward seepage increases the flux transport in downward direction and diffusion in the streamwise direction which is shown by the governance of sweep event over ejection event from quadrant analysis. Turbulent Kinetic Energy (TKE) budget is also evaluated. Turbulent diffusion or transport is one of the essential components of TKE budget. Turbulent diffusion transports the energy near the vegetation edge towards the free-surface as well toward the vegetation zone. The transport towards the vegetation zone increases with the downward seepage while it decreases in the upper free surfaces.

Vegetation density is one of the important parameters that affect the flow resistance. The present study shows that higher vegetation density when placed at the downstream side leads to a reduction in velocity, Reynolds stress and turbulent intensities. Downward seepage decreases the effect of drag offered by the vegetation stems. Smaller vegetation spacing (or higher vegetation density) provides more resistance to flow because of which lower velocity is achieved. The length scale and time scale increases with increase in percentage of seepage.

For a channel covered partially with vegetation, an increase in the flow characteristics such as velocity, Reynolds stress and turbulent intensities are observed in the unvegetated region as the flow goes downstream. The maximum depth of erosion with downward seepage is more than for the case of no seepage and erosion increases as the flow goes downstream.