



## Investigating the Flow Hydrodynamics in a Compound Channel with Layered Vegetated Floodplains

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### Abstract

In natural rivers, vegetation grows on floodplains, generating complex velocity field within the compound channel. The efficient modelling of the flow hydraulics in a compound channel with vegetated floodplains is necessary to understand and determine the natural processes in rivers and streams. As the three dimensional (3D) flow features are difficult to capture through experimental investigation; therefore, the present numerical study was carried out to investigate the complex 3D flow structures with the vertically layered vegetation placed over the floodplains in a symmetric trapezoidal compound channel. The simulations were conducted using a Computational Fluid Dynamics (CFD) code FLUENT, whereas a Reynolds Averaged Navier-Stokes (RANS) technique based on Reynolds stress model (RSM) was implemented for turbulence closure. The numerical model successfully replicated the flow behavior and showed a good agreement with the experimental data. The present study concluded the presence of quite-S shaped velocity profile in the layered vegetated floodplains when the short vegetation was submerged during high flows or floods, whereas the velocity profile was uniform or almost logarithmic during low floods or when both short and tall vegetation remained emergent. The lateral exchange of mass and momentum was promoted due to the flow separation and instability along the junction of the floodplains and main channel. The flow velocities were significantly reduced in the floodplains due to resistance offered by the vegetation, which consequently resulted in an increased percentage i.e. 67-73%, of passing discharge through the main channel. In general, the spatial distribution of mean flow and turbulence characteristics was considerably affected near the floodplain and main channel interfaces. Moreover, this study indicated a positive flow response for the sediment deposition as well as for the nourishment of the aquatic organisms in the riparian environment.

*Keywords:* Compound Channel; Vegetated Floodplains; Numerical Modelling; Flow Characteristics.

### 1. Introduction

Vegetation on flood plains is a world-wide engineering problem in most of the natural rivers, which does not only affect the flow conveyance capacity but also influences the ecological system of rivers [1]. Natural rivers are generally functioned by the main channel for conveyance of the primary flow and a vegetated floodplain to carry the extra flow during floods. The vegetation on the floodplain offers hydraulic resistance as it typically leads to the reduced flow velocity and increases the difference in velocity between the main channel and the floodplain. Many river problems demand accurate predictions of the flow conveyance in compound channels. It facilitates the engineers in the

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