

Effect of Reynolds Number on Wall-normal Turbulence Intensity in a Smooth and Rough Open Channel Using both Outer and Inner Scaling

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Abstract : Sudden change of bed condition is frequent in open channel flow. Change of bed condition affects the turbulence characteristics in both streamwise and wall-normal direction. Understanding the turbulence intensity in open channel flow is of vital importance to the modeling of sediment transport and resuspension, bed formation, entrainment, and the exchange of energy and momentum. A comprehensive study was carried out to understand the extent of the effect of Reynolds number and bed roughness on different turbulence characteristics in an open channel flow. Four different bed conditions (impervious smooth bed, impervious continuous rough bed, pervious rough sand bed, and impervious distributed roughness) and two different Reynolds numbers were adopted for this cause. The effect of bed roughness on different turbulence characteristics is seen to be prevalent for most of the flow depth. Effect of Reynolds number on different turbulence characteristics is also evident for flow over different bed, but the extent varies on bed condition. Although the same sand grain is used to create the different rough bed conditions, the difference in turbulence characteristics is an indication that specific geometry of the roughness has an influence on turbulence characteristics. Roughness increases the contribution of the extreme turbulent events which produces very large instantaneous Reynolds shear stress and can potentially influence the sediment transport, resuspension of pollutant from bed and alter the nutrient composition, which eventually affect the sustainability of benthic organisms.

Keywords : open channel flow, Reynolds Number, roughness, turbulence

Conference Title : ICSRD 2020 : International Conference on Scientific Research and Development

Conference Location : Chicago, United States

Conference Dates : December 12-13, 2020