Performance of “reference” critical shields stress and bed-load formular using different particle size representative: a case study for coarse bedded streams

ABSTRACT

Surface bedform in the form of immobile clast is deduced to be presence at micro-scale. Immobile clast is believed to modify the flow field and provides sink and source for incoming sediment particles. The dynamics of bed load rate in the presence of immobile clast are always puzzling due to wide range of particle size and presence of roughness elements. Alterations to the bed compared to a non-organized state come largely from hydrodynamic hiding or sheltering effects and modification of grain pivot angles. These grain-scale arrangements and trapping or sourcing of sediment occurs at a very localized level and may dynamically change through the course of a flood event. This paper attempts to look at the performance of “reference” critical Shields stress and bed load formula using different particle size representative. The immobile clast provides hiding function and has been incorporated in the bed load derivation formula. In addition, presence of fine particle at the interstices of immobile clast offers wide ranges of particle size representatives; spanning from surface, subsurface and hybrid distribution. Existing “reference” critical Shields stress is tested against the bed load data using reference transport method and flow competence approach. It seems that the “reference” critical Shields stress using the reference transport approach is far better than the flow competence approach. The performance of Shields stress, however, is very much related to the accuracy of existing bed load prediction. Thus, existing bed load formula of Recking (2010) and Recking (2013) was tested using data at coarse bedded stream. The original 84% percent finer (d_{84}), arithmetic mean size (d_{a}), geometric mean size (d_{g}) and representative mean size (d_{σ}) for surface, subsurface and hybrid distribution were used to test the existing bed load equation. It was found that surface distribution performed better than the rest and the use of representative mean size (d_{σ}) can give better estimation than 4% percent finer (d_{84}) in sediment transport calculation.

Keywords: Bed load transport; Hiding function; Reference critical Shields stress; Reference transport method; Grain size distribution