Geophysical Research Abstracts
Vol. 21, EGU2019-15227, 2019
EGU General Assembly 2019

Geomorphic assessment of sediment particle entrainment in the arched bridge profile under various simulated climatic conditions

Damir Bekić (1), Gordon Gilja (1), Manousos Valyrakis (2), Kyle Henderson (2), Panagiotis Michalis (3), and Eamon McKeogh (4)

(1) University of Zagreb, Faculty of Civil Engineering, Zagreb, Croatia (damir.bekic@grad.hr), (2) University of Glasgow, School of Engineering, Glasgow, United Kingdom, (3) Canary Wharf Consulting Ltd, London, United Kingdom, (4) University College Cork, School of Engineering, Cork, Ireland

Abstract

On smaller streams position and the extent of the scour zones in the bridge profile formed in the post-flood streambed can vary significantly after each flood event. Scour development under high flow conditions can be challenging to estimate in streambeds consisting of sand/gravel mixture where grains of different sizes are entrained by different flow conditions. This study aimed to investigate the range of geomorphic activity for streambed with sand/gravel mixture in terms of scouring at the abutment of an arched bridge for a number of different climate change scenarios. Model experiments were conducted on physical model scaled 1:7 to the prototype masonry arch bridge in south Ireland. Experiments have been carried out for several boundary conditions to assess the transport regime for three distinct types of non-cohesive sediment particles introduces into flow at a drop zone in controlled flow conditions. Selected flow rates are overtaken from the previous experimental tests in the same flume resulting from characteristic hydrological events. Total of nine experiments combining all sediment sizes and flow rates were conducted and sediment entrainment and deposition was evaluated at two zones: intermediate zone in mid-profile where flow is deflected towards the abutment and scour zone next to the abutment. During every experimental test instantaneous flow field was measured to determine conditions under which the particles are entrained and transported by the flow. Effect of sediment size, sediment availability, shear stress and local turbulent flow field characteristics on deposition are evaluated both for the intermediate and scour zone as well as effect of sediment size, sediment shape factor and shear stress on sediment transport. The sediment deposited at each time interval is estimated based on the video recording and patterns between the different flow rates and the sediment sizes are defined. Location and mass of the sediment that is deposited and transporter is collected for both zones. Based on the observations and flow field characteristics it can be concluded that: (1) Shields' diagram can be used to predict sediment entrainment; (2) sediment transport is dependent on the local turbulent flow characteristics and (3) sediment size is more relevant for particle transport than its shape factor.

Acknowledgement

The authors wish to acknowledge the financial support of the European Commission, through the Marie Curie action Industry-Academia Partnership and Pathways Network BRIDGE SMS (FP7-People-2013-IAPP-612517) and Staff Mobility Programme under University of Zagreb.