Geophysical Research Abstracts
Vol. 12, EGU2010-14310, 2010
EGU General Assembly 2010

Hydro-dynamic and geotechnical effects in bridge scour processes

alessio radice (1), francesco ballio (), and chau tran ()

(1) Alessio Radice, Assistant Professor, Politecnico di Milano, Dept. I.I.A.R., Piazza Leonardo da Vinci 32, I-20133 Milan, Italy, (2) Francesco Ballio, Professor, Politecnico di Milano, Dept. I.I.A.R., Piazza Leonardo da Vinci 32, I-20133 Milan, Italy, (3) Chau K. Tran, Ph.D. student, Politecnico di Milano, Dept. I.I.A.R., Piazza Leonardo da Vinci 32, I-20133 Milan, Italy

Local pier and abutment scour is a crucial topic in hydraulic engineering, due to the significant social and economical impact of bridge failure. Therefore, reliable tools for scour prediction are necessary for both design and vulnerability evaluation of the structures.
In recent years, phenomenological studies of the local scour dynamics have been undertaken, to yield insight over the small scale mechanisms of the process. Experimental measurement and numerical modelling of the scouring flow field have shown the horseshoe vortex and the principal vortex as the most evident features of the flow pattern at piers and abutments, respectively. The vortex structure near the obstacles typically presents a high turbulence level compared to that of the incoming flow, and the temporal fluctuations in water velocity make the coherent vortical structures unstable in time. Furthermore, the statistical distributions of velocity values in junction flows often present a bimodal shape.
The kinematics of the bottom grains reflects the unsteadiness of the flow pattern. Indeed, recent detailed measurements of particle motion in an abutment scour hole proved that a succession of opposite motion events takes place at several locations within the hole. Events of sediment motion directed away from the obstacles can be attributed to sediment pickup and transport by the turbulent flow field, whilst those with motion towards the abutment can be associated to sediment sliding along the slopes of the hole due to geotechnical instability. On a qualitative basis the presence of geotechnical effects is indeed relatively acknowledged.
Despite the general agreement on the qualitative features of the scour process, a quantitative definition of the relevance of sliding for the sediment kinematics in a local scour process is still lacking. Therefore, the purpose of the present work has been to make a specific analysis of the different types of sediment motion events, aimed to a quantification of the relevance of sediment sliding for a proper process modelling. Two experimental configurations have been considered, namely a vertical-wall abutment and a circular pier. Attention has been focused on the well developed stages of the erosion process, where the grain instantaneous movements have been divided into two populations, namely the “turbulence-dominated” events (those in which the particle motion is triggered by the turbulent flow field) and the “gravity-dominated” events (those in which the particles slide along the slopes of the scour hole due to geotechnical instability). A relevant difference has been found between the dynamics of gravity-dominated and turbulence-dominated events. In addition, it has been found that the presence of geotechnical effects in the erosion hole may significantly alter the scour rate. Potential implications of the present results for the modelling of local scour processes have been discussed.