Micro-scale considerations on the onset of contact erosion

A. Scheuermann
School of Civil Engineering, University of Queensland, St Lucia, Australia

H.M.D. Harshani, S. Galindo-Torres, M. Aminpour, T. Bittner & L. Li
School of Civil Engineering, University of Queensland, St Lucia, Australia

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Contact erosion is a well-understood hydro-mechanically induced deformation process. At least, this is what we think. And the numerous criteria lead us to believe that. However, do we really know under which geometrical, mechanical and hydraulic conditions on the micro-scale contact erosion starts? And do we really know how erosion proceeds once it is initiated within the sample? Conventionally, tests with potentially geometrically unstable base/filter combinations are conducted with slowly increased hydraulic gradients until we see first particles transported out of the sample. And the corresponding hydraulic condition is then considered the critical one. But, could it be possible that there is a “self-healing” effect? Practitioners frequently report on particle transport which stopped at some stage e.g. during a flood event.

In order to improve our understanding on the onset of contact erosion and the corresponding parameters influencing contact erosion, micro-scale investigations have been conducted experimentally using a novel Particle Image Velocimetry (PIV) system and computationally using a coupled DEM/LBM (Discrete Element Method / Lattice Boltzmann Method) model. Experimental investigations have been primarily conducted to investigate and quantify the flow conditions on the pore scale within monodisperse packings first and then in the transition zone between base and filter layers. The DEM/LBM simulations have then been used to generalise the experimental findings and to quantify the conditions when contact erosion starts for the first time.

The presentation will introduce the experimental set-up and the numerical model. Computational and experimental results will be presented and discussed. Together with experiments on the macro-scale, a new picture about the process of contact erosion is revealed providing additional insights.