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Toward a microscopic-macroscopic coupled evaluation of the stability of a landslide dam during overtopping

Qingfeng Feng, Detian Liu, and Xudong Fu
Department of Hydraulic Engineering, Tsinghua University, Beijing, China (xdfu@tsinghua.edu.cn)

We explore the failure process of a landslide dam during overtopping, using a microscopic-macroscopic coupled simulation method. The numerical simulation contains two parts: the FVM (finite volume method) calculation for macroscopic external and internal erosion and the LBM (lattice Boltzmann Method)-DEM (discrete element method) calculation for microscopic shear failure. The FVM module provides the boundary condition (e.g., water discharge, confining pressure) and internal condition (e.g., porosity, gradation of soil particles) of each sub-region of a landslide dam. The LBM-DEM module calculates the shearing process of soil particles within each sub-region. The location and size of shear zone is identified in each sub-region and then integrated into shear zones across sub-regions. The shear zones changing during the overtopping process are captured and analyzed. We assume that, if some shear zones form into an area with strong concentration and connectivity at the macroscopic scale, the dam will be unstable and is undergoing the failure process. Two real cases of landslide dam in the "May 12, 2008" Wenchuan Earthquake hit region are analyzed. The potential applicability of the present method is demonstrated.