Numerical Simulation of Liquefaction-Induced Large Deformation of River Levee using Material Point Method

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ABSTRACT

Solid-fluid coupled large deformation analysis method for multi-phase mixed geomaterials is developed using Material Point Method (MPM)[1][2] for discretization of governing equations for whole mixture, combined with a finite difference method for discretization of those for fluids[3]. A cyclic elasto-plastic constitutive model for sand is used to simulate liquefaction caused by earthquake motion and subsequent large deformation of liquefied soil. In the present study, the applicability of the method to numerical simulation of liquefaction-induced large deformation is examined.

A dynamic centrifugal model test for a liver levee mounted on liquefiable foundation ground is numerically simulated. The input motion is a simple wave with constant amplitudes and frequencies. Evolution of pore water pressure and deformation mode are compared with the test results for validation of the simulation method.

Next, numerical simulation of a river levee constructed on liquefiable soil layer is performed using an observed irregular input motion. The analysis results are compared with those obtained by a finite element method with the same governing equations as those of the material point method. Material Point Method more reasonably simulates large settlement and lateral flow of the levee induced by liquefaction than finite element method.

REFERENCES

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