Stability analysis of landfills based on SPH simulation

Yangjuan Bao[2], †Yu Huang[1, 2]

[1] Key Laboratory of Geotechnical and Underground Engineering of the Ministry of Education, Tongji University, Shanghai 200092, China

[2] Department of Geotechnical Engineering, College of Civil Engineering, Tongji University, Shanghai 200092, China

†Corresponding author: yhuang@tongji.edu.cn

Abstract

Municipal solid waste (MSW) rapidly increases with the development and the population quantity of city. As a main disposal method of MSW, the landfill stability is of great importance. The landfill is composed of MSW which is a special soil and this is the main distinction between landfill and natural slope. Many scholars have studied the landfill stability based on FEM and FDM. However, MSW landslide is usually accompanied by large deformation of soil which is difficult to deal with for FEM and FDM. To avoid the limitations of FEM and FDM, the paper applies smoothed particle hydrodynamics (SPH) to analyze the stability assessment of landfill. Firstly, Drucker-Prager constitutive equation with non-associated plastic flow rule is selected to describe the stress strain relationship of geo-material and an elastoplastic shear strength reduction SPH written by Fortran language is established. Then in order to verify the accuracy of the proposed SPH, the sand collapse is modeled as a benchmark. The movement process of sand under the action of gravity is captured by SPH. A great similarity between configuration of the SPH results and test results is observed. Finally, the verified solid SPH program is applied to the landfill composed of different layers by aging. The safety factor calculated by SPH and the shape of failure surface are similar to the FEM results.

Keywords: Landfill, Stability, Smoothed particle hydrodynamics, Municipal solid waste