

Simulating water and soil gushing around shield tunnel with Material Point Method

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ABSTRACT

In recent years, serious accidents due to sand and water gushing around shield tunnel happen from time to time. Sand and water gushing could lead to large soil displacement, change soil stress field around tunnels, and then threaten the safety of tunnel structures. To date, there is a lack of theoretical research on the evolution of sand and water gushing, and the numerical simulation of the process is challenging because soil-water interaction, soil-structure interaction and large deformations have to be accounted for. In this paper, the Material Point Method (MPM) is used to deal with large deformation and various simulation cases considering different gushing locations at tunnels are carried out to investigate the development of soil displacement and stress around tunnels due to water and soil gushing. The results show that position of the gushing point greatly affect the damage scope. The sand gushing rate, the soil displacement and stress field, the ground settlement trough, and the earth pressure on the tunnel linings develop completely differently due to the varying position of the gushing point, which are analyzed to suggest reasonable guidance and countermeasures for preventing future sand and water gushing accidents.

Keywords: Water and soil gushing, MPM, Soil displacement, Shield tunnel