Modelling of the Selborne failure and post-failure with the MPM

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ABSTRACT

Traditionally, slope stability has been focused as a static problem; therefore the essential objective was to find a measure of safety against failure. However, the interest in determining the mobility of the soil mass that may be unstable has increased in recent years. Indeed, the risk associated with ground movement depends on its displacement and velocity. Usually, the movement involves large deformations in the sliding surfaces and the finite element methods are poorly conditioned to approach this behaviour due to mesh tangling. Alternatively, other methods have been developed, such as the Material Point Method (MPM) [1], which analyses the dynamics of movement and allows large deformation analysis.

The Selborne experiment was designed to induce failure in an excavated slope by raising pore pressures within the slope by injecting water in vertical boreholes. It was held in the South of England in 1989 [2]. The material was Gault Clay, which is high plasticity clay, overconsolidated and brittle, and whose properties were provided by a laboratory test program. The slope was well instrumented in order to monitor, among other things, the development of progressive failure in the brittle clay. Moreover, movement vectors were also measured in some points of the slope surface. This case provides a good opportunity to test the ability of MPM to analyse such a failure.

The modelling of the Selborne failure is presented in this work by means of MPM, considering the available data. A complete analysis of the whole instability process, including the progressive failure mechanism and the post-failure behaviour, has been done. In order to simulate the brittleness of the material a strain softening constitutive model is used. A calibration of the rate of strength decrease is carried out in order to minimize the mesh dependency. Finally, a sensitivity analysis is presented analyzing the effect of several parameters, such as the loading time period, the permeability of the clay, meshing details and the time step increment.

REFERENCES

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