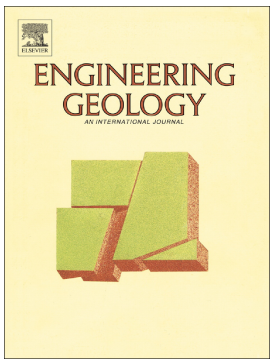

Rainfall-induced slope collapse with coupled material point method

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RAINFALL-INDUCED SLOPE COLLAPSE WITH COUPLED MATERIAL POINT METHOD

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Abstract

Rainfall-induced slope failures are a major category of slope failure, with incidents likely to increase with the predicted escalation of extreme rainfall events. Traditional numerical methods such as the finite element method are often restricted in their applicability to small deformation analyses. Therefore, incomplete descriptions of the failure mechanism and failure consequence may be obtained, due to the evolving deformations and progressive failure being ignored. A one-point, two-phase material point method (MPM) formulation is proposed to consider the influence of rainfall on slope failure. Due to the characteristics of MPM in capturing the large deformations, the complete failure process, from initiation to failure, of a slope subjected to rainfall infiltration is presented. The soil behaviour is described by a Mohr–Coulomb strain-softening model based on Bishop's effective stress. The two-phase analysis shows that the rainfall-affected slope is initially stable, until the soil shear strength reduces due to the reduction of suction in the slope starting from the surface, leading to a superficial failure mode, which in turn leads to a complete slope failure. Friction angle and residual cohesion are shown to play important roles in the development of the slope failure.

Keywords*: large deformations, material point method, rainfall-induced failure, slope stability, unsaturated soils*