Saturated granular flows: constitutive modelling under steady conditions

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Abstract

Numerical simulations of flow-like landslides are commonly carried out by tackling separately the inception and evolution of the gravitational movement, by employing different numerical approaches and different constitutive models. This kind of computational analysis is quite challenging since large displacements, large strain rates and, when the soil is under saturated conditions, hydro-mechanical processes have to be considered.
In order to address the task by means of a single approach, working both for the inception and the evolution, a constitutive model capable of simulating the material behaviour in the two stages is required. In this work, a model suitable for granular mixture saturated with water under steady simple shear conditions is presented.

The approach proposed is based on the assumption that the energy balance is governed by the combination of three different mechanisms. Concerning the granular phase, two are the contributions through which the granular system is assumed to dissipate energy: quasi-static and collisional. The former one is active when the grains interact in force chains, i.e. when the material behaves like a solid. On the other hand, the second contribution stands for particles interactions through collisions. Since the model is intended to simulate the behaviour of saturated granular mixtures, a third dissipation mechanism is introduced, in order to reproduce the interaction of grains with the liquid phase.
The model is based only on two state parameters: the granular temperature, representing a measure of the degree of agitation of the system, and the solid volume concentration.

Keywords: Constitutive modelling, Saturated granular flows, Landslides

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