An upgraded bounding-surface plasticity model to properly capture the cyclic behavior of clays.

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ABSTRACT

The purpose of this work is to develop a constitutive model capable of accurately describing the stress-strain behavior of saturated clay under cyclic loading conditions. Such states are typical for many geotechnical problems such as sidewalks under moving traffic loading and embedded coastal structures under wind and wave loading conditions. [1]

Cyclic triaxial tests conducted on this soil reveal its complex behaviour, characterized by closed hysteresis cycles, cyclic shakedown, and degradation [2]; to date, few works in the literature aim at and succeed in capturing these fundamental cyclic aspects [3].

In the light of the above, an updated version of the bounding surface constitutive model developed by Russell and Khalili [4] is proposed in this work. Closed hysteresis loops, typical of clay, are here achieved through the adoption of a radial mapping rule which passes through stress reversal points; so allowing to model the non-linear stress-strain behaviour under unloading and reloading. In addition a novel interpolation function of plastic modulus, associated with the deviatoric plastic shear strain, is here introduced by the authors to achieve cyclic shakedown and degradation.

Load-controlled cyclic triaxial tests are performed on a weak expansive clay, considering different confining pressures and loading frequencies, so to validate the proposed model. Comparisons between numerical and experimental results confirm the goodness of the constitutive approach, capable of correctly capturing and reproducing the key aspects of clay's cyclic behaviour.

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