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Acoustic Emissions Monitoring In Soil Compressibility Laboratory Tests

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Extended Abstract

The detection and monitoring of acoustic emissions in soil mechanics is a study technique still little developed and investigated, although the applications that can be derived from this new discipline are very numerous. Among these, the most interesting from the geotechnical point of view are the study of soil compressibility [1] and the ground shear strength [2]. For this reason, in the Geotechnics Laboratory of the Universidad Politécnica de Cartagena (UPCT) an investigation that aims to delve into this discipline has been started, in order to find trends or correlations between the compressibility and shear parameters of the soil and the characteristics of the acoustic emissions generated by the relative movement of grains.

The research is in its initial phase, although all the necessary equipment to carry it out is already available: in addition to the classic laboratory equipment (oedometric bench; uniaxial loading cell for simple compression; direct shear equipment), there is a multi-channel acoustic emission capture equipment (Vallen AMSY-6), to which a pair of low-frequency sensors (with sensitivity between 10-100 kHz) and another pair of medium-high-frequency (with sensitivity < 900 kHz) are connected.

In this first phase of the investigation, the tests that are being carried out are those of compressibility under oedometric conditions (with lateral confinement that avoids horizontal deformation), on sand samples with different granulometries (between 0.075 and 2 mm), humidity (between 0 and 12%) and different densities. Regarding the deformation of the sample, the tests are divided, mainly, into two groups: tests with increasing stepped load and constant strain rate tests.

In the first, carried out at medium-low stress levels, the samples, initially preloaded at an effective stress of 12.5 kPa, are subjected to different loading, unloading and reloading steps, with a load ratio of 2:1 between successive steps, and reaching a maximum stress of 800 kPa. Thus, the first loading stage, in which 100 kPa is reached, is followed by an unload up to 25 kPa. Subsequently, the sample is reloaded until reaching the maximum of 800 kPa. Finally, in a second unloading stage, the sample's effective stress is reduced to 100 kPa.

On the other hand, the imposed deformation tests at constant speed are carried out for medium-high pressure levels, reaching a maximum stress of 5000 kPa. In this test, the sample, also preloaded at 12.5 kPa, is subjected to a single loading stage, with a strain rate of 1 mm/min. Once the maximum stress of the test is reached, an unloading stage begins at a 0.3 mm/min rate, until the sample is subjected to practically zero stress (< 10 kPa).

During the tests, the deformation of the sample and the stress to which it is subjected, as well as the acoustic emissions that come from the relative movement between the soil grains, are always monitored. The first tests are yielding very promising results, since the characteristics of the acoustic emissions (duration, energy, amplitude...) vary throughout the tests, both depending on the stress level of the sample and the nature of its deformation. Regarding the latter, the first results seem to corroborate that it is possible to differentiate elastic deformation processes from plastic ones [1], based on correlations between the compressibility coefficient of the soil and the characteristics of the acoustic emissions.

References

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