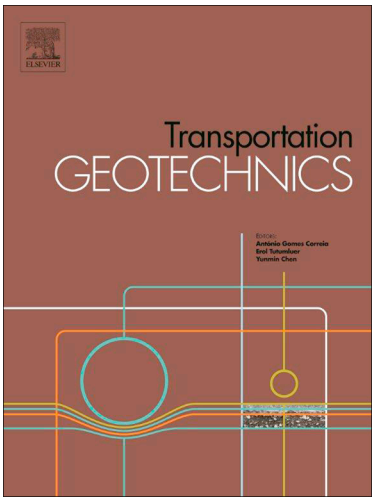

Laboratory investigation on the behaviour of an overconsolidated expansive clay in intact and compacted states

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Laboratory investigation on the behaviour of an overconsolidated expansive clay in intact and compacted states

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Abstract: Natural climatic phenomena and human activity frequently cause disorders in the masses of fine-grained soils characterized by very significant volume variation as soon as the conditions of their equilibrium are modified. A better description of the behaviour of fine-grained soils can be seen with respect to drying-wetting cycles. This paper presents a series of laboratory test results obtained on a heavily overconsolidated expansive clay, for which significant damages frequently appear in road and motorway infrastructures, in urban public utilities, as well as in civil and industrial low-rise structures. The effects of compaction and drying-wetting cycles on the mechanical parameters of this clay are analyzed to establish a predictive model of the soil movement following the in-situ water table variation. Comparative analysis between the deformability and strength characteristics of the clay in intact and compacted states are then presented. Tests results show that the values of the geotechnical parameters derived from these tests are depending on some experimental aspects such as the compaction energy, drying time, initial deformability and soil saturation. In all cases, the behaviour of intact and compacted clay samples is governed by the same laws of compressibility and consolidation, shrinkage and swelling as well as shear and failure.

Keywords: Expansive clay, compaction, compressibility-consolidation, swelling-shrinkage, shear-failure.

Introduction

Swelling soils are present worldwide and indexed in several countries (Magnan, 2013). These soils cover an important part of Algerian arid and semi-arid regions, which are delimited by the Tellian Atlas in the North and the Saharian Atlas in the South and extend from East to West until the bordering Maghreb countries. Some characterization studies of soils located in these zones have been carried out, among which the works of Derriche and Kebaili (1998) on In-Aménas clays, Hachichi and Fleureau (1999) on Oran clays, Djedid et al. (2001) on Tlemcen clays, and Medjnoun et al. (2014) on Médéa clays. These studies confirm the expansive character of the soils and measure the extent of damages caused to civil and industrial structures in such sites. In Algeria, urban works are nowadays booming due to a population growth amplified by a considerable economic and social development. This is the case of the province of M'sila, *inter alia*, of which the urban fabric extends towards virgin zones often less favorable than those already urbanized. This extension transforms villages into cities and cities into metropolises, which require the construction of new road and rail networks. The rapid development and the high demand for the natural deposits of good quality are becoming more and more rare and we have often recourse to problematic soils which do not always meet regulatory requirements: the expansive clays are a typical example. Existing road construction standards require the physico-chemical and mechanical properties of such soils to be identified. Thus, their use could be considered in construction of embankments and subbase layers with a secure margin (LCPC-SETRA, 2000).

Intact and compacted expansive soils have been the subject of many experimental researches for several decades. It was concluded that the behaviour of natural stiff clays and natural marls or compacted fine-grained soils can be described by responses characterized of different forms, but the behaviour laws which characterize them seem to be sufficiently similar so that we can extrapolate some aspects from one soil to another (Mestat, 2000; Magnan, 2013). However, the constitutive parameters of the laws of soil behaviour depend on the validity criteria of oedometric and triaxial tests results (Khemissa, 2016). Damages affecting the geotechnical structures can be explained by the