# ABSTRACT

Title: Advantages and disadvantages in the use of the variable loading consolidation tests in the characterization of clay soils.

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A way of estimating the settlement produced in a saturated soil by a certain load is by means of the consolidation tests. The standard consolidation test provides to us some information about the soil compressibility, and it allows to us to estimate, in a few weeks, the magnitude and the time in which this settlement of the soil will be produced in one-dimensional conditions (1-D).

Between 1960 and 1970 various alternative testing methods have been developed trying to reduce the testing time to a fewer days or a fewer hours. Constant Rate of Loading consolidation test (CRL), Controlled Gradient consolidation test (CG), Constant Rate of Strain consolidation test (CRS) and those which keep a constant "rate of loading/pore water pressure" ratio (in the undrained base of the specimen), the Continuous Loading consolidation test (CL) are the most common alternative testing methods in comparison with the variable loading consolidation tests. The common feature in all these tests is that the vertical loading applied on the samples is a continuous one and variable with the time, in addition of the possibility to keep recording the pore water pressure generated in the undrained base of the specimen during all the testing time. On the other hand, in the standard consolidation test, vertical loading is applied by steps, and this is constant in every applied step and it does not offer the possibility of keeping recorded the pore water pressures.

The main purpose of the present work is a setup of a test procedure for variable loading consolidation tests in order to overcome the limitations observed in the work done by Martin, 2002, and to explore the possibilities, advantages and disadvantages of this kind of tests.

First of all, the S. Sadurní d'Anoia clay is tested by means of the CRL, CG and CRS tests. The goal of these tests is to adjust the equipment to a more plastic soil with lower rates of loading in comparison with those applied in the plain soil of Barcelona (by Martin, 2002), to adjust the equipment to the CRS test, to analyze the representativity and validity of the developed theories about the CRL, CG and CRS tests in order to calculate the coefficient of consolidation $c_v$ during the course of these tests, to know the advantages and disadvantages of every one of the CRL, CG and CRS tests and to compare the results of the obtained consolidation parameters in comparison with those obtained by means of the standard consolidation test.

Once the results of the CRL, CG and CRS tests on the S. Sadurní soil have been analyzed, as soon as the advantages and disadvantages of every testing method, a CRL test on the FEBEX bentonite is carried out since this one is the easiest test to programme and which allows to us to control the vertical loading. The aim of this point is to obtain, in a few weeks, the value of the permeability of this soil and its variability with the void ratio by means of a variable loading consolidation test and to compare it with the obtained results in some other permeability tests (Villar, 2002) which had duration of some months.

According to the executed tests it can be stemmed that the continuous consolidation equipment is correctly adjusted to the S. Sadurní clay at lower loading velocities than those applied in the reference work, in the case of the CRL tests. In the CG tests it is very difficult to keep constant the gradient in the sample and the system has to be charged and discharged continuously in order to be able to control the pore water pressure. In addition, if the constant loading velocity applied in the previous step of the CG test in order to achieve the imposed gradient is high, then the pre-consolidation pressure is achieved before that the CG test is started. Concerning to the CRS test, the equipment is correctly adapted and the pre-consolidation pressure is recorded easily. The latter and the CRL test are the easiest in order to program and they offer the best results and show fewer limitations.

Concerning to the CRL test carried out on the FEBEX bentonite, it can be stated that this is an advantage in order to calculate the permeability of low permeability expansive clay as FEBEX bentonite. Testing time is reduced, from a month to three weeks as minimum, in comparison with some other procedures in order to determine the permeability, as it can be the constant head permeameter (adapted to expansive soils). Reliability of the results will depend on the degree of saturation of the specimen and the system, and on how is saturated, it means by free inflating or constant volume. Anyhow, it has to be taken into account the difference in the microstructure generated in both saturation procedures, which can determine the value of the final result.

Another important issue of this work is that it is necessary to assure that, as in the undrained triaxial tests, the Skempton parameter B has to be near to unit in order to the continuous loading tests give to us reliable values of the consolidation and permeability parameters, which is difficult to get in non re-moulded samples without using a back pressure.