

ABSTRACT

Tunnelling in urban environment with tunnel boring machines makes some deformations in the ground which should be quantified and taken into account during the design of the tunnel and the definition of mitigating measures, in case that they are necessary.

In order to evaluate these movements in the ground it is absolutely necessary the deepest knowledge of the geotechnical properties of the materials found during the excavation, as well as the constructive process. Later, the prediction of the ground movement should be done by different ways.

The construction of the Line 9 of Metro in Barcelona was divided in some parts. One of them, in Santa Coloma de Gramenet, is the point of study in this document. The tunnel, 4 km long, is driven with a dual machine able to bore in rock and in soft ground. It runs in a granite substrate which presents all the possible alteration stages. Over it lays the clays from the Quaternary Era. Dikes and some faults are also found in the zone. The crossing of the tunnel through the valley of Fondo is specially studied. The TBM finds there the poorest granite in its latest alteration grades. It is called *sauló*. Some triaxial tests have been carried out in the laboratory to have a better determination of its properties. Three samples were taken to failure and drained strength parameters were deduced.

A simple "state of the art" is made in order to keep the existing investigation lines of making predictions of the ground displacements. Another point revised in bibliography is the stability of the front face of the tunnel. The study of its affection to buildings and structures is also done.

It has been seen that there are some different ways to predict ground movement. The semi-empirical methods, specially those based on the inverted gaussian distribution of the settlement, are world wide accepted. This curve is governed by two parameters: the volume loss and the horizontal distance to the axis of the tunnel of the inflexion point. Most of the studies found in the bibliography try to fit these values the best. Centrifugal tests are also successful, and well developed in the United Kingdom. In other hand it is found that numerical analysis is increasing its value in the investigation field. Both two and three dimensional analysis allow the user to incorporate details of its own problem. A simple comparison between two methods is made, and no big differences are found in the solution.

At last, the monitoring installed is described, with the latest innovations in lectures and transmission of the data. The analysis of field data from monitoring during the excavation is done, checking the parameters of the settlement troughs obtained.