

## **ABSTRACT**

The “Soil Nailing” technique is a ground reinforcement procedure used consistently to stabilize slopes and land sections in geotechnical engineering projects. This technique is frequently used in the city of Quito (Ecuador) to reinforce the ground and improve slope stability during the excavation process for various underground parking levels. Such deep excavations are common in the city’s most important real estate projects, in which “Soil Nailing” is used with different variations that are adjusted in accordance with the construction resources available in the particular environment.

Despite its widespread use, this technique which has proven to be so effective in stabilizing excavations during the construction of underground structures in the soils of the city of Quito, currently suffers from a lack of local theoretical, numerical or experimental research based on the geotechnical properties of the city’s characteristic soils.

This Doctoral Thesis was supported by the Geotechnical Engineering Laboratory and the Structures Laboratory of the Concrete Science and Technology Institute (*ICITECH*) of the *Universitat Politècnica de València*. It presents an experimental and numerical study of the behavior of two excavations reinforced with the Soil Nailing technique for the construction of the basement structures of two important buildings located in the north-central area of the city of Quito.

Both the experimental and the numerical study focus mainly on the stress of tension forces exerted on the steel bars of the "Soil Nails", analysis of horizontal wall displacements and analysis of settlements of the ground behind the walls, which were induced by the construction of each underground level. As part of the numerical analysis through finite elements, different constitutive soil models were considered, the parameters of which were determined in detail in accordance with laboratory testing from the geotechnical characterization study for this research.

This Doctoral Thesis, therefore, constitutes one of the first complete studies in the region aimed at explaining the experimental and numerical behavior of excavations through the Soil Nailing technique, supported by complete geotechnical characterization work which was carried out for the purpose of forming part of this study.

**Keywords:** Soil nailing, soil nail wall, excavation, underground parking, underground levels, numerical study, finite elements, experimental study, instrumentation, monitoring, geotechnical characterization, constitutive soil model, volcanic soil.