	Postdoctoral position in geotechnics and underground works	
	Evaluation of the impact of tunnel boring machines on piles: field data analysis and numerical modelling	

Description of the project

Context

In urban areas, mechanized tunnelling requires a good estimate of the effects of tunnel boring machines (TBM) on neighbouring deep foundations in order to optimize the design of future infrastructures and to improve risk management during the construction phase. The problem of TBM/soil/pile interaction is relatively complex due to its three-dimensional nature, the multiple sources of displacement around the machine, the difficulties inherent to the soil behaviour (non-linear mechanical behaviour, hydro-mechanical coupling, effect of time, *etc.*), and the specific difficulties related to the definition of the soil/pile interface properties.

Objectives / Method

The goal of this project is to investigate TBM/soil/pile interaction in order to gain a better understanding of the mechanisms involved during tunnel excavation near piled structures, to identify the main parameters of the problem (including those relating to the geometric configuration of the worksite, the geotechnical characteristics of the excavated ground, the conditions under which the TBM is operated, the nature of the piles,…), and ultimately to propose a reliable method for predicting the behaviour of TBM/soil/pile interaction in various configurations.

The research will be based on the use of experimental data obtained from a full-scale experiment carried out on the Grand Paris Express construction site, and also on the use of a numerical model currently being developed in the LTDS. This 3D finite-difference numerical model developed on Flac3D software uses a Lagrangian approach in which the progress of the TBM in the ground is simulated step by step.

As a first step, the postdoctoral researcher will have to further develop the numerical model, in particular in order to improve the explicit modelling of the various actions of the TBM on the ground, to provide the possibility of considering the material anisotropy of the excavated soil layers, and to reproduce the coupled hydromechanical phenomena capable of occurring in the ground around the TBM. By comparing the numerical results with the experimental data available in the LTDS, the ability of the model to reproduce the mechanisms observed on site will be analysed and the most influential parameters will be identified. Then, the model will be reduced and the limitations induced by these simplifications will be quantified; their relevance to the practical dimensioning of structures will be assessed. This final stage should lead to the formulation of simplified design tools and recommendations for use by engineers.

This project is the subject of a research partnership between the LTDS/ENTPE (UMR CNRS 5513) and the French Centre for Tunnel Studies (CETU).

To apply, please send your cover letter and CV to the ENTPE supervisors indicated below.

ENTPE supervisors	**Denis BRANQUE** – Senior Researcher - University of Lyon, ENTPE, LTDS - UMR CNRS 5513, Vaulx-en-Velin, France – denis.branque@entpe.fr **Antoine RALLU** – Researcher- University of Lyon, ENTPE, LTDS - UMR CNRS 5513, Vaulx-en-Velin, France – antoine.rallu@entpe.fr
CETU supervisor	**Nicolas BERTHOZ** – Head of the geotechnical division – French Centre for Tunnel Studies, Bron, France – Nicolas.berthoz@developpement-durable.gouv.fr
Location	ENTPE, Laboratory of Tribology and System Dynamics, 3 rue Maurice Audin, 69518 Vaulx-en-Velin, France
Duration	12 months - Starts as soon as possible
Required skills	- PhD graduated in the areas of civil engineering or geomechanics /geotechnics are mostly welcome. - Good knowledge of constitutive modelling of geomaterials and numerical methods (FDM, FEM) is required. - Good practice of numerical modelling tools using finite differences (or finite elements) is also required. Experience of ITASCA software (FLAC3D, 3DEC) is a strong asset for the candidate. - The ability to communicate orally and write in English is required.