

# Preface

This textbook summarizes the final results of the research group GEOTECH founded by the German Research Council (DFG) dealing with the holistic consideration of geotechnical installation processes. In this sense, the entire process for the realization of a geotechnical construction project starting from a well-defined initial stress and deformation state is taken into account.

From the engineering practice, it is well known that the installation process of structural elements into the ground may cause strong deformation and stress redistribution in the surrounding soil. Dealing with excavation pits in urban areas, installation processes like piling or anchoring therefore often lead to unexpected displacements of the shoring or neighbouring buildings exceeding those due to the excavation or dewatering of the pit. The assessment of the deformations resulting from geotechnical installation processes is, on the one hand, required from the codes (EC 7) or regulations but on the other hand, validated high-quality prediction simulations are still not available. Suitable numerical methods should be based on realistic and validated highly nonlinear incremental constitutive models for the soils under cyclic/dynamic loading conditions and advanced simulation tools. However, existing models do not offer up to now the required prediction quality.

The main target of the research group is the provision of suitable methods for the simulation of geotechnical installation processes based on fundamental research in order to reliably predict the serviceability state of supporting systems and nearby structures especially with regard to the vibro-installation of piles.

In order to achieve these targets, the research group operates in three levels:

- benchmarking projects with element-like and large-scale model tests for calibration and validation of the developed numerical models
- theoretical fundamental research for the development of high-quality constitutive soil models and contact formulations in combination with efficient numerical implementations and algorithms

- application of the developed theoretical models to boundary value problems with parametric studies of respective geotechnical installation processes and recommendations for further use of the numerical models in practice as well as for the practical optimization of these processes.

In this book, the final research results including not only the demonstrator experiments for pile installation as benchmarks are presented, but also the simulation results of recently developed numerical techniques and constitutive modelling for the description of the nonlinear behaviour of soils under dynamic/cyclic excitation. Furthermore, interesting results are presented associated with the vibro-injection pile installation with multimaterial flow and large material deformations. The presented results can also be used for validation of new techniques or material models in the future.

The contributions of our invited speakers (Prof. R.J. Finno, Prof. M. Taiebat, Prof. W. Fuentes and Prof. T. Schanz) in the final GEOTECH Workshop (23 and 24 February 2017 in Karlsruhe) are very much appreciated and are also included in this volume due to their relevance to the scientific targets of the group.

The editor likes to thank all his colleagues (Prof. Ehlers, Prof. Wriggers, Prof. Savidis, Prof. Rackwitz, Prof. Hettler) and co-workers (Dr. Niemunis, Dr. Osinov, Dr. Huber) for their valuable contributions and their extreme efforts and engagement in order to achieve the high scientific targets of the projects.

Furthermore, I would like to express my thanks to Mrs. Meininger for the organization of all the workshops of the research group GEOTECH and her engagement to make those events pleasant as well as Dr. Vogelsang for the assistance to prepare the book.

Finally, all of us like to express our deep gratitude to DFG (German Research Council) for the generous financial support of this very interesting research topic in geotechnical engineering.

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