

Preface

This textbook summarizes the midterm results of the research group GEOTECH 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. For every subsequent construction stage, as e.g., the vibro-installation of piles in excavation pits, the changes in stress and deformations caused by the installation process are calculated.

It is well known that the majority of events with unacceptable deformations of nearby structures due to the geotechnical construction activity were caused during the installation of the supporting elements (D-wall panels, pile installation, etc.) and not by the pit excavation or insufficient stiffness of the shoring system. Construction steps like excavation, dewatering, shoring support of the pit, etc. implemented in commercial codes can reliably predict the deformations using appropriate input parameters for soil–structure interaction. However, accompanying measurements in accordance with the observational method in geotechnics on construction sites testify that the deformations of the supporting system in large excavation pits and nearby structures caused by the installation processes are the most significant ones over the entire construction procedure, but unfortunately up to now they are not satisfactory predictable.

In the light of EC 7, it is on the other hand crucial for the serviceability state to estimate the deformations and distortions of the supporting systems taking also into account the effects of construction (installation process).

Within the frame of the envisaged research plan, the research group tackles this problem creating the necessary fundamental knowledge for the improvement of the soil–structure interaction models in order to describe the installation process especially in the case of the vibro-installation of piles.

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 demonstrator experiments for pile installation as benchmark are presented with very interesting results which can be used either for validation of numerical simulations/calibration of simulation purposes or for further experimental and numerical investigations. Further simulation methods for vibro-injection pile installation with multimaterial flow and large material deformations are also presented.

The mortar contact formulations for soil–structure interaction problems with a hypoplastic material model and the evolution of effective stress around a vibrating pile toe using a combination of a hypoplastic model with an explicit formulation for very high numbers of cycles implementing new numerical strategies are described.

A new hypoplastic formulation and an improved integration for explicit high-cycle loading using hierarchical, enhanced, and assumed strain finite elements is described as well as experimental results on strain response-envelopes of sandy material for monotonic and low-cycle loading processes.

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.

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

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Th. Triantafyllidis

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