

Preface

This book is based on a course of lectures given over the last 15 years at Technion (Haifa), Georgia Tech (Atlanta), UPC (Barcelona) and ETH Zurich. The purpose of this course has been to bridge the gap between the graduate courses in Geomechanics and those in Numerical Geotechnical Modelling. Traditionally, in many geotechnical programs, Geomechanics is not taught within the rigorous context of Continuum Mechanics and Thermodynamics. There is a good reason for that – the behaviour of soils is very complex: it is more advantageous to explain it at a semi-empirical level, instead of scaring the students away with cumbersome mathematical models. However, when it comes to Numerical Modelling courses, these are often taught using commercially available finite elements (e.g. ABAQUS, PLAXIS) or finite differences (e.g. FLAC) software, which utilize constitutive relationships within the Continuous Mechanics framework. Quite often students and practitioners have to learn the challenging subject of constitutive modelling from a program manual, sometimes ending up with using models which violate the Laws of Thermodynamics!

The book is introductory - by no means does it claim any completeness and state of the art in such a dynamically developing field as numerical and constitutive modelling of soils. Our intention is to achieve a basic understanding of conventional continuum mechanics approaches to constitutive modelling, which can serve as a foundation for exploring more advanced theories. A considerable effort has been invested here into the clarity and brevity of the presentation. We focus on helping the readers to understand how different aspects of complex soil behaviour can be modelled using conventional constitutive models, which can be readily found within the available numerical codes. Another important feature of this book is that it explores thermomechanical consistency of all presented constitutive models in a simple and systematic manner.

The book is built of three parts. Part I gives an introduction into continuum mechanics. Part II deals with the modelling of reversible soil behaviour, while Part III introduces the modelling of irreversible soil behaviour. Finally, Appendix A focuses on modelling the undrained soil behaviour and Appendix B demonstrates an example of incorporation of an irreversible constitutive model into a numerical algorithm for solution of boundary value problems.

We believe that this book can be a useful reference both for researchers and geotechnical engineers, as they face more and more often the necessity of the numerical analysis in their practice. Understanding of the limitations of the built-in constitutive models is crucial for critical assessment of the results

of numerical calculations, and, hence, for the safe and cost efficient design of geotechnical structures.

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Introduction

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