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Book review

Soil Machine Interactions

A Finite Element Perspective, by Jie Shen and Radhey Lal Kushwaha; Marcel Dekker, New York

The book is primarily concerned with the development of the finite element method of analysis and its application to problems encountered in typical soil–tool interaction situations. The material is presented at a level that can be easily followed by senior undergraduate students and postgraduate students wishing to learn more about soil–tool interaction mechanics. It is also well suited for researchers and practitioners who want to learn how to improve the efficiency of their soil–tool system.

The book consists of seven chapters. The first chapter provides a very good summary review of the various limit equilibrium models for soil–tool interactions, beginning with the classical Prandtl two-dimensional model for a passive wedge. Geotechnical engineers will recognize this as the passive wedge portion of the limit equilibrium analysis for foundation bearing capacity first introduced by Terzaghi.

Chapter 1 also includes the limit equilibrium three-dimensional models, beginning with Payne's model. The physical basis for the models, and the structure of the limit equilibrium analyses are given for all the models presented. This is a very handy review of the available models, and permits the reader to obtain a quick appreciation of the merits and limitations of these models.

Chapter 2 provides the rudiments of application of FEA. It presumes some knowledge of the fundamentals of the FEM of analysis, and the basis for application of FEA. The simple example provided in this chapter does not relate to the soil–tool problems, but permits one to grasp the essential items required in application of the FEA.

Chapter 3 is concerned with the presentation of soil constitutive models. It is not concerned with the development of the models as such, but presents the material for all the models in a fashion that could be considered as a detailed dictionary of the more popular available models. The models presented include linear and non-linear types, elastic and plastic (and somewhere in between), and dynamic or rate dependent types. The reader will need to refer to the developers of the models to obtain the basic background to the final product obtained. Furthermore, the reader will need to refer to the various conference and journal papers on constitutive modelling to obtain the necessary perspective on the various merits and deficiencies of all the models. The various speciality conferences and workshops dealing with constitutive

modelling in the period between 1975 and 1995, sponsored by the learned societies dealing with mechanics of materials, should be consulted if the reader wishes to learn more about the “do’s and don’ts” of all the models available. As the authors of the book rightly pointed out, the material in this chapter is designed only to provide the reader with the capsule picture of constitute models in a fashion that would permit them to choose their particular model for their FEA.

Chapter 4 provides a good grounding on the application of the FEM analysis procedure. In particular, the various types of elements needed to provide for proper simulation of the soil–tool interface and the interactions are well documented. This followed by the material in Chapter 5 on various algorithms for the static and dynamic situations, and the linear and non-linear cases. The two chapters are well documented, and provide the reader with a methodical application of the FEA. The material in these two chapters is well structured and is presented in a fashion that is easy to follow and to apply.

Chapter 6 provides a good collection of examples that demonstrate the use of FEA for the subject being considered. The authors have collected and distilled the examples from various studies previously presented by other researchers. In doing so, they have provided the reader with a good review of the basic essential steps considered by those researchers in the development of the FEA for the problems analysed. They have also provided their own insight into the methods used by those previous researchers, and have commented on the methods and results obtained.

Chapter 7 details the programming techniques that can be used for the FEA. They have provided the reader with various strategies for program management that is something that most readers will appreciate.

The book is well written and the material has been logically mounted and presented. The authors have performed a very valuable service to the profession by providing the material in this book in a fashion that permits one to grasp the essential elements of the complex procedures required in the application of the FEM of analysis of the stability of interfacing bodies. The book can be well recommended for serious students of the subject, and for researchers and practitioners in the field of agricultural and machine tool–soil interaction. It provides a very basic development of the method of application of finite element analysis (FEA) as a tool for the study of interfacing elements.

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