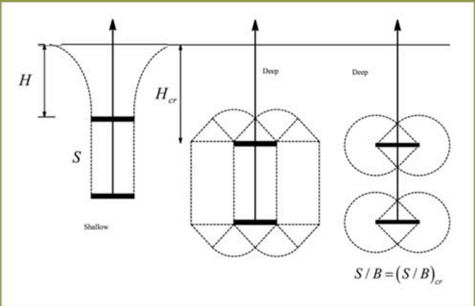
Soil Behavior and Geo-Micromechanics



Geotechnical Special Publication No. 200

Edited by
Roger Meier
Andrew Abbo
Linbing Wang

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GEOTECHNICAL SPECIAL PUBLICATION NO. 200

SOIL BEHAVIOR AND GEO-MICROMECHANICS

PROCEEDINGS OF SESSIONS OF GEOSHANGHAI 2010

June 3–5, 2010
Shanghai, China

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Shanghai Society of Civil Engineering, China
Chinese Institution of Soil Mechanics and Geotechnical Engineering, China

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Preface

This special publication contains 41 technical papers addressing many different areas of soil behavior, constitutive modeling, and geo-micromechanics. The papers range from experimental studies of soil shear strength and compressibility to theoretical advances in Biot consolidation theory and constitutive modeling to numerical studies of shear banding and microstructure. The research described herein advances our understanding of soil as an engineering material and improves our ability to model the behavior of soil in slopes, foundations, and earth structures.

Each paper published in this ASCE Geotechnical Special Publication (GSP) was evaluated by two or more reviewers and the editors. The authors of the accepted papers have addressed all of the reviewers' comments to the satisfaction of the editors. All published papers are eligible for discussion in the *Journal of Geotechnical and Geoenvironmental Engineering* and are also eligible for ASCE awards.

The papers in this publication were presented during the GeoShanghai 2010 International Conference held in Shanghai, China, June 3-5, 2010. This conference was hosted by Tongji University, the Shanghai Society of Civil Engineering, and the Chinese Institution of Soil Mechanics and Geotechnical Engineering in cooperation with the ASCE Geo-Institute, the Transportation Research Board of the National Academies, the East China Architectural Design & Research Institute Company, the Deep Foundation Institute (USA), the University of Kansas, the University of Illinois at Urbana-Champaign, the Vienna University of Natural Resources and Applied Life Sciences (Austria), the Nagoya Institute of Technology (Japan), the Georgia Institute of Technology, the University of Newcastle (Australia), the Alaska University Transportation Center, and the University of Tennessee.

I would like to thank Professor Yongsheng Li, Conference Chair of GeoShanghai 2010, as well as his co-chairs Maosong Huang and Imad Al Qadi. I would also like to thank Baoshan Huang and Xian Liu, Secretaries General of the conference, and the rest of the Organizing Committee. Their leadership and hard work have made this conference possible.

Most importantly, I want to thank my co-editors, Andrew Abbo and Linbing Wang, for their tireless efforts bringing this publication to fruition. I could never have produced this volume without their extraordinary assistance.

Roger Meier
The University of Memphis, Tennessee, USA
January 6, 2010

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One-Dimensional Consolidation of Saturated Clays Under Time-Dependent Loadings Considering Non-Darcy Flow

Zhongyu Liu[1], Liyun Sun[2], Jinchao Yue[3]

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ABSTRACT: Hansbo's formula for non-Darcy flow was introduced to modify Terzaghi's 1-D consolidation equation, and the modified equation was generalized to account for the consolidation case under time-dependent loading. Numerical analysis was performed by using the finite volume method. The effects of the parameters of non-Darcy flow and the rate of loading on the consolidation process were investigated. The numerical results indicated that non-Darcy flow delays the dissipation of pore water pressure in saturated clay layers; thereby the rate of settlement of these soil layers is less than the solution based on Darcy flow. In addition, the influence of loading rate on the consolidation behaviors is remarkable in the construction period and in the initial stage after its completion of construction.

INTRODUCTION

Although the 1-D consolidation theory developed by Terzaghi in 1923 has had extensive use in practice, there sometimes exists notable difference between the solution based on Terzaghi's theory and the field settlement observations. This can be to some extent ascribed to the Terzaghi's assumptions that the external vertical load is constant in time and the flow of pore water follows Darcy's law.

In practice, since the external load gradually increases in the construction period and can be regarded as a constant with time only after its completion for a given building, the differential settlement of the foundation increases rapidly in the construction period and in the initial stage after its completion, which will possibly result in some cracks in the building. Therefore, the variation of the external load in the construction period should be important to estimate the settlement of foundation. Thus, Terzaghi's theory had been continuously modified to account for time-dependent loading by Biot (1941), Poskitt (1969), Mesri and Rokhsar (1974), Olson (1977), Lee et al (1992), Li et al (1999), Xie et al (2002) and Chen et al (2005). Almost all of these modified models