Preface

The theory of effective stresses developed by K. Terzaghi in the early 1920s lays down the fundamentals of the modern soil mechanics. According to this theory, all changes in soils are related to external gravitational stress (σ') transmitted to the soil skeleton, i.e., the effective stress, which may be found from equation $\sigma' = \sigma - u$, where σ is the total stress and u is the neutral stress transmitted to the pore water. The Terzaghi theory is successfully applied to problems related to consolidation of porous permeable soils, sand liquefaction during earthquakes, as well as to a number of other tasks. At the same time, the practical experience shows that the Terzaghi theory cannot be adequately applied to low-permeable fine-grained soils (clay) with closed porosity, as it leads to the discrepancy between calculated and experimentally obtained data. The explanation is that this theory considers soil as a homogeneous unstructured body, and does not take into account the existence of internal forces of molecular, electrostatic, and structural mechanical origin manifested in thin hydrate films of adsorbed water molecules at the contacts of structural elements, which produce the so-called internal disjoining pressure. These forces can be estimated based on the theoretical achievements of molecular physics and colloidal chemistry.

The book presents a new theory of effective stresses in soils. Unlike the well-known Terzaghi theory, it considers soil as a structured system with acting external and internal stresses of gravitational and physicochemical nature. Stresses calculated with the consideration of both stress types correspond to the actual effective stresses existent in a structured porous body.

The book characterizes both types of stresses and provides equations for calculating the total actual effective stresses in soil. The calculation of the internal stresses is based on the theory of contact interactions and the theory of disjoining effect of boundary hydrate films. Modern colloid chemistry and molecular physics permit interpreting the theory of effective stresses in terms of physicochemical mechanics.

The theory presented in this book was first published in Russia in 2012. The current edition is based on the original Russian text of the book with minor revision. The book covers mainly the results of long-term investigations performed by

Russian experts in physical chemistry and molecular physics under the guidance of P.A. Rebinder and B.V. Deryaguin, Full Members of the Russian Academy of Sciences. Scientists from other countries have been also conducting studies in this field. Therefore, this novel theory demonstrates the general modern trend in the development of soil mechanics.

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