



# Geotechnical Engineering

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CIVIL ENGINEERS ARE IN THE MIDST of a construction revolution. Heavy structures are being located in areas formerly considered unsuitable from the standpoint of the supporting power of the underlying soils. Earth structures are contemplated that are of unprecedented height and size; soil systems must be offered to contain contaminants for time scales for which past experience is either inadequate or absent. Designs must be offered to defy the ravages of floods and earthquakes that so frequently visit major population centers.

All structures eventually transmit their loads into the ground. In some cases this may be accomplished only after circuitous transfers involving many component parts of a building; in other cases, such as highway pavements, contact is generally direct. Load transfer may be between soil and soil or, as in retaining walls, from soil through masonry to soil. Of fundamental importance is the response that can be expected due to the imposed loadings. It is within this framework that *geotechnical engineering* is defined as *that phase of civil engineering that deals with the state of rest or motion of soil bodies under the action of force systems*.

Soil bodies, in their general form, are composed of complex conglomerations of discrete particles, in compact arrays of varying shapes and orientations. These may range in magnitude from the microscopic elements of clay to the macroscopic boulders of a rock fill. At first glance, the task of establishing a predictive capability for a material so complicated appears to be overwhelming.

Although man's use of soil as a construction material extends back to the beginning of time, only within very recent years has the subject met with semiempirical treatment. In large measure, this change began in 1925 when Dr. Karl Terzaghi published his book *Erdbaumechanik*. Terzaghi demonstrated that soils, unlike other engineering materials, possess a mechanical behavior highly dependent on their prior history of loading and degree of saturation and that only a portion of the boundary energy is effective in producing changes within the soil body. Terzaghi's concepts transferred foundation design from a collection of rules of thumb to an engineering discipline. The contents of the present section offer, in a concise manner, many of the products of this and subsequent developments.

Had the section on geotechnical engineering in this handbook been written a mere decade or two ago, the table of contents would have been vastly different. Although some of the newer subjects might have been cited, it is unlikely that their relative importance would have precipitated individual chapters such as contained in the present section, namely: Chapter 16, "Accounting for Variability (Reliability)"; Chapter 24, "Geosynthetics"; Chapter 25, "Geotechnical Earthquake Engineering"; Chapter 26, "Geo-Environment"; Chapter 27, "In Situ Subsurface Characterization"; and Chapter 28, "In Situ Testing and Field Instrumentation." These make up approximately half the chapters in the present section on geotechnical engineering in the *Handbook*. Necessity *does* give birth to invention.