Triaxial Testing Of Soils  |  6ee1b9c60661a41578149d30c02a2ecd

Geotechnical Investigation and Testing. Laboratory Testing of Soil. Unconsolidated Undrained Triaxial TestTriaxial Testing of SoilsTriaxial Testing of Soils and Bituminous Mixtures, Proc. Mtgs. Held San Francisco, 1949 and Atlantic City, 1950A Cost Effective Triaxial Test Method for Unsaturated SoilsMultiphysical Testing of Soils and ShalesGeosynthetics in Civil and Environmental EngineeringTriaxial Testing of Soils and Bituminous MixturesTriaxial Testing of Soils and Bituminous MixturesEvaluate Unsaturated Soil Behavior Using Constant Water Content Triaxial TestsTriaxial Testing of Soils and Bituminous MixturesHandbook of Research on Trends and Digital Advances in Engineering GeologyLaboratory Shear Testing of SoilsUnsaturated Soil Mechanics in Engineering PracticeA Versatile Control System for Triaxial Testing of SoilsTriaxial Testing of Soils and Bituminous MixturesA New Triaxial Testing System for Unsaturated Soil CharacterizationTriaxial Testing of Soils and Bituminous MixturesUnsaturated Soils for AsiaTriaxial Testing of Frozen Soils--State of the ArtTriaxial Testing of SoilsTriaxial Testing of Granular Soil Under Elevated Cell PressureTriaxial Testing of Soils and Bituminous MixturesConsolidated Drained Triaxial Testing of Piedmont Residual SoilState-of-the-Art PaperTriaxial Testing of Soils and Bituminous MixturesTriaxial Testing on Soils from Newfoundland AreasLaboratory Testing of Soils, Rocks, and AggregatesAdvanced Triaxial Testing of SoilsManual of Soil Laboratory TestingEffects of Loading Method on Triaxial Test ResultsThe Measurement of Soil Properties in the Triaxial TestTriaxial Testing of SoilsAdvanced Triaxial Testing of Soil and RockTriaxial Testing of Soils and Bituminous MixturesTriaxial Testing of Soils and Bituminous MixturesTriaxial Testing of Soils and Bituminous MixturesMultistage Triaxial Test for Unsaturated SoilsRepealed Load Triaxial Testing of SoilsState-of-the-Art PaperEquipment for Triaxial Testing of Soil Under Repeated LoadingTriaxial Testing of Soils explains how to carry out triaxial tests to demonstrate the effects of soil behaviour on engineering designs. An authoritative and comprehensive manual, it reflects current best practice and instructions. References are made throughout to easily accessible articles in the literature and the books focus is on how to obtain high quality experimental results. Contains virtually all current laboratory tests for soils, rocks and aggregates in one volume with references to international standards: ASTM, ISRM, BS, and AS. Significant advancements in the experimental analysis of soils and shales have been achieved during the last few decades. Outstanding progress in the field has led to the theoretical development of geomechanical theories and important engineering applications. This book provides the reader with an overview of recent advances in a variety of advanced experimental techniques and results for the analysis of the behaviour of geomaterials under multiphysical testing conditions. Modern trends in experimental geomechanics for soils and shales are discussed, including testing materials in variably saturated conditions, non-isothermal experiments, micro-scale investigations and image analysis techniques. Six theme papers from leading researchers in experimental geomechanics are also included. This book is intended for postgraduate students, researchers and practitioners in fields where multiphysical testing of soils and shales plays a fundamental role, such as unsaturated soil and rock mechanics, petroleum engineering, nuclear waste storage engineering, unconventional energy resources and CO2 geological sequestration. The definitive guide to unsaturated soil—from the world's experts on the subject This book builds upon and substantially updates Fredlund and Rahardjo's publication, Soil Mechanics for Unsaturated Soils, the current standard in the field of unsaturated soils. It provides readers with more thorough coverage of the state of the art of unsaturated soil behavior and better reflects the manner in which practical unsaturated soil engineering problems are solved. Retaining the fundamental physics of unsaturated soil behavior presented in the earlier book, this new publication places greater emphasis on the importance of the "soil-water characteristic curve" in solving practical engineering problems, as well as the quantification of thermal and moisture boundary conditions based on the use of weather data. Topics covered include: Theory to Practice of Unsaturated Soil Mechanics Nature and Phase Properties of Unsaturated Soil State Variables for Unsaturated Soils Measurement and Estimation of State Variables Soil-Water Characteristic Curves for Unsaturated Soils Ground Surface Moisture Flux Boundary Conditions Theory of Water Flow through Unsaturated Soils Saturated/Unsaturated Water Flow Problems Air Flow through Unsaturated Soils Heat Flow Analysis for Unsaturated Soils Shear Strength of Unsaturated Soils Shear Strength Applications in Plastic and Limit Equilibrium Stress-Deformation Analysis for Unsaturated Soils Solving Stress-Deformation Problems with Unsaturated Soils Compressibility and Pore Pressure Parameters Consolidation and Swelling Processes in Unsaturated Soils Unsaturated Soil Mechanics in Engineering Practice is essential reading for geotechnical engineers, civil engineers, and undergraduate- and graduate-level civil engineering students with a focus on soil mechanics. Geosynthetics in Civil and Environmental Engineering presents contributions from the 4th Asian Regional Conference on Geosynthetics held in Shanghai, China. The book covers a broad range of topics, such as: fundamental principles and properties of geosynthetics, testing and standards, reinforcement, soil improvement and ground improvement, filter and drainage, landfill engineering, geosystem, transport, geosystem-killer support system and geocell, hydraulic application, and ecological techniques. Special case studies as well as selected government-sponsored projects such as the Three Gorges Dam, Qinghai-Tibet Railway, and Changi Land reclamation project are also discussed. The book will be an invaluable reference in this field. Engineering geologists face the task of addressing geological factors that can affect planning with little time and with few resources. A solution is using the right tools to save time searching for answers and devote attention to making critical engineering decisions. The Handbook of Research on Trends and Digital Advances in Engineering Geology is an essential reference source for the latest research on new trends, technology, and computational methods that can model engineering phenomena automatically. Featuring exhaustive coverage on a broad range of topics and perspectives such as acoustic energy, landslide mapping, and natural hazards, this publication is ideally designed for academic scientists, industry and applied researchers, and policy and decision makers seeking current research on new tools to aid in timely decision-making of critical engineering situations. Suction-controlled triaxial tests have been widely used to characterize unsaturated soils. However, this type of test requires sophisticated and therefore expensive equipment, and is very time consuming because of the low permeability of unsaturated soils. Only a few research universities can afford the equipment, which limits the advancement and implementation of unsaturated soil mechanics. This paper proposes a new triaxial testing system for
unsaturated soils based upon minor modifications on the conventional triaxial test apparatus for saturated soils. Instead of controlling suction, high-suction tensiometers are adopted to monitor matric suction variations during constant water content triaxial testing. Also, a photogrammetry-based method is used to measure volume changes of unsaturated soil specimens during triaxial testing. To evaluate the capabilities of the proposed testing system, a series of constant water content triaxial tests were performed on unsaturated soils with different moisture content. Matric suction and volume variations during testing were monitored by the high-suction tensiometers and the photogrammetry-based method, respectively. New methods were also proposed to analyze the test results. Analysis results showed that the proposed system is cost effective and efficient for unsaturated soil characterization. Soil-testing equipment, Test equipment, Soils, Specimen preparation, Reports, Soil testing, Mechanical testing, Soil strength tests, Construction, Compression testing, Testing conditions, Mathematical calculations, Triaxial test (soils), Shear testing, Vane test. Mechanical properties of frozen soils are invaluable input parameters when designing building foundations or infrastructure in perennial frost areas. Mechanical properties are also important for natural resource development in the north, such as for mining and petroleum-industry-related projects. One of these properties is the shear strength of frozen soil under varying temperatures and loading times. If these strengths are estimated instead of measured, risks for failure or overdesign exist. Therefore, it is important to accurately measure the strength of frozen soils. Two main methods exist for measuring the shear strength of soils: the direct shear test (ASTM D3080) and the triaxial compression test (ASTM D4767, ASTM D7181, and ASTM D2850). Although these tests are routinely used for unfrozen soils, not much published information exists regarding their use for frozen soils. Yet the industry needs this property for planning their operations in cold regions. Therefore, ASTM International Subcommittee D18.19 on Frozen Soils and Rock has started a process of developing new standards for mechanical properties of frozen soils. Of special interest is the dynamic triaxial testing of frozen soils. The purpose of the study reported here was to collect information and practices for the current usage of triaxial testing for frozen soil, under either static or dynamic loading conditions. According to the results of the literature review, researchers use various modified testing systems and sample configurations, and unfortunately they do not always describe them fully. So, standardization of the testing method would be beneficial for creating comparable results between laboratories. The measurement of small strains and deformations in dynamic tests was reported to be challenging. A Split-Hopkinson pressure bar is currently being developed as a means to overcome this problem. Another challenge under investigation is the accuracy of the strain rate control. The synthesized information can be used as a starting point in the development of a standard test method for the dynamic triaxial testing of frozen soils. This volume, the first in a set of three, is a vital working manual which covers the basics for the classification and compaction characteristics of engineering soils. It will therefore be an essential practical handbook for all engaged on the testing of soils in a laboratory for building and civil engineering purposes. Based on the author's experience over many years managing large soil testing laboratories, particular emphasis has been placed on ensuring that procedures are fully understood. Each test procedure has therefore been broken down into simple stages with each step being clearly described. The use of flow diagrams and the setting out of test data and calculations will be of great benefit, especially for the newcomer to soil testing. The book is complemented with many numerical examples which illustrate the methods of calculation and graphical presentation of typical results. The reporting of test data is also extended to include such topics as laboratory equipment and methods of testing, laboratory safety, calibration of measuring instruments, essential checks on equipment, and laboratory accreditation are all included. A basic knowledge of mathematics, physics and chemistry is assumed but some of the fundamental principles that are essential in soil testing are explained where appropriate. Professionals, academics and students in geotechnical engineering, consulting engineers, geotechnical laboratory supervisors and technicians will all find this book of great value. Book jacket:"Although the triaxial compression test is presently the most widely used procedure for determining strength and stress-deformation properties of soils, there have been no books published on triaxial testing since the 1962 second edition of the landmark work The Measurement of Soil Properties in the Triaxial Test by Bishop and Henkel. It is apparent there is a need to document advances made in triaxial testing since publication of Bishop and Henkel's book and to examine the current state of the art in a forum devoted solely to triaxial testing. Because of increasing versatility brought about by recent developments in testing techniques and equipment, it is also important that the geotechnical profession be provided with an up-to-date awareness of potential uses for the triaxial test."---Overview. The triaxial test has been extensively used to evaluate both saturated and unsaturated soil behaviors. The conventional triaxial test apparatus for saturated soils cannot be used to test unsaturated soils due to difficulties in soil volume and suction measurement. In 1961, a suction-controlled triaxial test apparatus was developed to investigate behavior of unsaturated soils. Since this development, the suction-controlled test has been widely used for unsaturated soil characterization. Most important concepts concerning unsaturated soil mechanics were developed based upon results from suction-controlled tests. However, the suction-controlled triaxial test on unsaturated soils, which is a drained test, is usually laborious, time-consuming, and costly, and may not be justifiable for routine engineering projects. The constant water content (undrained) test has been widely used to investigate saturated soil behaviors. However, for unsaturated soils, due to difficulties in direct, rapid, and reliable suction measurement, the constant water content test was rarely used for unsaturated soil behavior evaluation. In addition, accurate volume change measurement of unsaturated soils was a great challenge for researchers. Recently, the Modified State Surface Approach (MSSA) has been developed to calibrate unsaturated soil behaviors. According to MSSA, both results from suction-controlled and constant water content triaxial tests can be used for constitutive behavior calibration on unsaturated soils. In this study, a new triaxial test system was developed to investigate unsaturated soil behaviors through constant water content triaxial tests. To measure soil suction variation during testing, a new type of high-suction tensiometer was developed based on a commercial miniature pressure transducer. A 15 bar air-entry ceramic disc was used as the filter of the high-suction tensiometer. After saturation and calibration, this new type of high-suction tensiometer could be utilized for matric suction measurement on unsaturated soils with a maximum measurable suction up to 1100 kPa determined via a free evaporation test. To measure the volume change of unsaturated soils during triaxial testing, a photogrammetry-based method was developed by integrating photogrammetry, optical-ray tracing, and least-square estimation techniques. Through two validation tests on a stainless steel cylinder and a saturated sand specimen, the average point and total volume change measurement accuracy were determined to be approximately 0.065 mm and 0.05%, respectively. With this method, the conventional triaxial test apparatus for saturated soils can be used for triaxial testing on unsaturated soils.
soils without any modification. In addition to total volume change measurement, the newly developed photogrammetry-based method can also be used to investigate the deformation characteristics of soils during triaxial testing such as full-field deformation, volumetric strain non-uniformity, full-field strain distribution, and shear band evolution process. To evaluate the performance of the new triaxial testing system, a series of constant water content triaxial tests were carried out on unsaturated soils. New methods were proposed to characterize shear strength of the tested unsaturated soils. Also, an example was given to calibrate the constitutive behavior of an unsaturated soil based on results from the constant water content triaxial tests. Analysis results indicated that the proposed triaxial testing system is a cost effective and time efficient alternative to the suction-controlled triaxial testing system. In geotechnical and highway engineering, many projects involve unsaturated soils at shallow depths with low confining stresses (less than 100 kPa). To investigate the behavior of unsaturated soils at low confining stresses, the new triaxial testing system was simplified to a modified unconfined compression testing system. A study of triaxial testing under elevated cell pressure is presented. The influence of test conditions, namely end lubrication and slenderness ratio, on such tests is discussed. Results of a tomodensitometric investigation of internal homogeneity are given. The main results of the high pressure study are presented, including time effects on isotropic compression. Triaxial Testing of Soils explains how to carry out triaxial tests to demonstrate the effects of soil behaviour on engineering designs. An authoritative and comprehensive manual, it reflects current best practice and instrumentation. References are made throughout to easily accessible articles in the literature and the books focus is on how to obtain high quality experimental results. The paper first covers common problems with testing equipment and procedures that cause errors in the measured properties of the soil specimen, with emphasis on consolidated-undrained (CU) and consolidated-drained (CD) triaxial tests. These problems are divided into three categories: errors that can be handled via appropriate corrections; errors that must be avoided; and potential errors that must be evaluated when selecting test procedures or interpreting measured data, the most important being the nonuniform stresses and strains caused by frictional end caps. The paper then assesses the use of triaxial testing in practice to predict undrained stability and deformations for saturated cohesive deposits. Based on considerations of strain rate effects, soil anisotropy, disturbance from tube sampling, and results from case histories of failures, the authors make four recommendations. 1. UU compression tests should not be used as the principal means of estimating in situ undrained strengths because the values can be either significantly too high or too low. 2. CIU compression tests have little value because the measured undrained strength will be unsafe for stability analyses, and the stress-strain data do not simulate in situ behavior. 3. Therefore, more reliance should be placed on CKoU compression and extension tests, which would be aided by the availability of more reliable and less expensive automated "stress path" triaxial cells. 4. Oedometer tests should always be conducted to ascertain the stress history of the deposit. This paper describes a test method to measure the shear strength of unsaturated soils using standard triaxial equipment with minor, low-cost modifications. The method is based on using the axis translation technique in a standard triaxial testing apparatus with a base pedestal slightly modified to accommodate a high-air-entry ceramic disk. The testing apparatus and procedure are described. The aim of the proposed test setup was to limit the modifications of the standard triaxial setup within a reasonable budget to make the method accessible and attractive to researchers and practitioners that may otherwise not be able to afford the testing devices commonly used in the field of unsaturated soil mechanics. Thus, the paper discusses the effectiveness of the proposed test method, and also discusses the potential limitations that may exist due to some of the simplifications used in this methodology. The proposed methodology was used to evaluate the shear strength of residual soils at the Auburn National Geotechnical Experimentation Site. The shear strength parameters obtained for the Auburn unsaturated soils were compared to previous tests conducted in similar soils and proved to be reasonably accurate. A triaxial testing procedure is presented for measuring the increase in shear strength resulting from soil suction in an unsaturated soil. Necessary modifications on a conventional triaxial cell are described. A simple graphical method is presented to interpret the test data in accordance with the shear strength equation for unsaturated soils. Specimens of sedimented kaolinite were subjected to consolidated-undrained triaxial compression by means of a new electropneumatic control system that will apply any desired loading path in the axisymmetric stress space or any desired deformation path. Specimens were tested under ramp loading, ramp deformation and combined ramp loading?ramp deformation with both constant cell pressure and constant first invariant of the applied stress tensor. To determine the entire stress-strain-pore pressure relationship, it was necessary to perform the combined load rate-deformation rate test. It was found that while a unique principal stress difference-major principal strain relationship exists, a unique pore pressure-major principal strain relationship does not exist. The paper presents the 1986 practice at the Norwegian Geotechnical Institute (NGI) for triaxial testing of soils that are fully saturated in situ. The test procedures for specimen mounting, saturation, consolidation, and static and cyclic shearing are outlined. Sample disturbance, specimen height, end friction, and anisotropic consolidation are discussed at length. Simplified procedures for anisotropic consolidation according to soil types are proposed. Sources of error are mentioned. A new method to measure the initial shear modulus in triaxial soil specimens is described. The paper describes problems encountered in performing consolidated drained triaxial tests on Piedmont residual soil specimens trimmed from both Shelby tube samples and block samples. The micaceous silty soil has steeply dipping layers, planes of weakness, and granular seams. These characteristics complicate trimming and cause specimens to bend during consolidation and shearing. Because some specimens failed at strains of 14% to 20%, the nonuniformities influence the estimation of peak shear strength. To cope with variability, a multistage test on one specimen was compared to behavior measured on three single-stage tests performed on three specimens; all four specimen strains were trimmed from the same block. Comparative results were inconclusive. This is a collection of articles from the Asian conference UNSAT-ASIA 2000, covering topics such as: historical developments; numerical modelling; suction measurement techniques; permeability and flow; mass transport; and engineering applications.