Single Piles And Pile Groups Under Lateral Loading 2nd Edition Hardcover December 9 2010

Pile Foundations are an essential basis for many structures. It is vital that they be designed with the utmost reliability, because the cost of failure is potentially huge. Covering a whole range of design issues relating to pile design, this book presents economical and efficient design solutions and demonstrates them using real world examples. Coverage includes nonlinear response of single piles to vertical or torsional loading and to cyclic lateral loading, as well as prediction of nonlinear response of lateral pile groups, vertically loaded pile groups and the design of slope stabilising piles. Most solutions are provided as closed-form expressions. Theory and Practice of Pile Foundations is: illustrated with case studies accompanied by practical applications in Excel and MathCad the first book to incorporate nonlinear interaction into pile design. A valuable resource for students of geotechnical engineering taking courses in foundations and a vital tool for engineers designing pile foundations.

The determination of stiffness and damping of piles is an important step in the analysis of pile-supported structures subjected to dynamic loading.

Great strides have been made in the art of foundation design during the last two decades. In situ testing, site improvement techniques, the use of geogrids in the design of retaining walls, modified ACI codes, and ground deformation modeling using finite elements are but a few of the developments that have significantly advanced foundation engineering in recent years. What has been lacking, however, is a comprehensive reference for foundation engineers that incorporates these state-of-the-art concepts and techniques. The Foundation Engineering Handbook fills that void. It presents both classical and state-of-the-art design and analysis techniques for earthen structures, and covers basic soil mechanics and soil and groundwater modeling concepts along with the latest research results. It addresses isolated and shallow footings, retaining structures, and modern methods of pile construction monitoring, as well as stability analysis and ground improvement methods. The handbook also covers reliability-based design and LRFD (Load Resistance Factor Design)-concepts not addressed in most foundation engineering texts. Easy-to-follow numerical design examples illustrate each technique. Along with its unique, comprehensive coverage, the clear, concise discussions and logical organization of The Foundation Engineering Handbook make it the one quick reference every practitioner and student in the field needs.

Behaviour of Single Piles and Pile Groups in Calcareous Sediments

Recommendations on Piling (EA Pfähle)

Analysis of Laterally Loaded Piles in Multilayered Soil Deposits

Behaviour and Efficiency of Perimiter Pile Groups

Scour Effects on Lateral Behavior of Pile Foundations

Scour is a phenomenon of soil erosion around foundations under currents and waves. It is a major cause for the disruption to water-borne structures such as bridges and marine structures. Pile foundations supporting these structures are required to be designed against the scour damage. However, at present, there is no accepted method for the design of piles in scoured conditions probably due to an inadequate understanding of scour effects on foundations. Although numerous efforts have been made to evaluate the scour effects on single piles using numerical simulations and centrifuges tests, the scour susceptibility of piles in different soil properties is still not well understood. Furthermore, there is no study concerning scour effects on the lateral responses of pile groups. Therefore, a series of three-dimensional finite element (FE) parametric analyses were conducted to investigate scour effects on lateral behavior of both single piles and free-head pile groups by varying scour-hole dimensions, soil properties, pile properties, and pile group configurations. Moreover, to facilitate the routine design, a modified p-y method that was modified based on the widely used p-y method was proposed for both scoured single piles and pile groups, and was validated against the results from the FE analyses. The results show that scour induced lateral capacity loss to both single piles and pile groups, which was approximately 10% more in dense sands than that in loose sands. Simplification of local scour as a general scour that has been commonly used in general design practice resulted in a maximum of 17% underestimate of lateral capacity of pile foundations. Pile groups were more susceptible to scour than single piles under equivalent scour conditions. A pile group with smaller pile spacing or larger pile numbers tended to experience less lateral capacity loss due to scour.

The complexities of designing piles for lateral loads are manifold as there are many forces that are critical to the design of big structures such as bridges, offshore and waterfront structures and retaining walls. The loads on structures should be supported either horizontally or laterally or in both directions and most structures have in common that they are founded on piles. To create solid foundations, the pile designer is driven towards finding the critical load on a certain structure, either by causing overload or by causing too much lateral deflection. This second edition of Reese and Van Impe's course book explores and explains lateral load design and procedures for designing piles and pile groups, accounting for the soil resistance, as related to the lateral deflection of the pile. It addresses the analysis of piles of varying stiffness installed into soils with a variety of characteristics, accounting for the axial load at the top of the pile and for the rotational restraint of the pile head. The presented method using load-transfer functions is currently applied in practice by thousands of engineering offices in the world. Moreover, various experimental case design examples, including the design of an offshore platform pile foundation are given to complement theory. The rich list of relevant publications will serve the user into further reading. Designed as a textbook for senior undergraduate/graduate student courses in pile engineering, foundation engineering and related subjects, this set of book and CD-ROM will also benefit professionals in civil and mining engineering and in the applied earth sciences.

This book comprises chapters on scour and erosion related issues. It is an outcome of the International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE) Technical Committee 213 Workshop on Scour and Erosion that was held on December 16, 2020. The ISSMGE TC213 Workshop was attended by 368 participants from 12 different countries worldwide. The contents of this book reflect recent advances in the mechanics and countermeasures of scour and erosion, including coastal protection, erosion control, etc. Covering practical issues of geotechnical engineering with academic and research inputs, this volume will be a useful reference for academia and industry alike.

Theory and Practice of Pile Foundations

Soil Mechanics for Unsaturated Soils

Dynamic Analysis of Single Piles and Pile Groups [microform]

Simplified Procedure for Analysis of Laterally Loaded Single Piles and Pile Groups

Performance of Single Piles in Line Groups Installed in Sand

X, 62 leaves.

Guiding the professional through the complexities of lateral-load design, this book and CD-ROM combination introduces the procedures involved in piles and pile group design. This is a problem that can only be solved by accounting for the soil resistance as related to the lateral deflection of the pile. Intricate equations are derived and fully explained, enabling the designer to find the critical loads, either causing a pile to be overloaded or causing too much lateral deflection. The CD-ROM contains simplified versions of two required programs that allow the reader to check the solutions of some of the examples given in the book and to find answers to related problems.

Groups of piles are commonly used as high capacity foundations. It is recognised that the load distribution among piles in a group will vary and it is thought that the inner piles are likely to make a relatively small contribution to the total load carried. The essence of the research undertaken is to establish the relative effectiveness of pile groups with either no inner piles (perimeter group) or a single central pile (target group) when compared to the more commonly used grid group arrangement. Pile groups in which the central piles were omitted were used for the Cannon Place redevelopment in London and provided the impetus for the research project. The main research technique used is geotechnical centrifuge modelling. Samples of overconsolidated kaolin clay were prepared and tested on the centrifuge at City University London. This provided a firm clay into which pile groups could be installed in a wide variety of arrangements. Three or four different pile groups were located in each centrifuge model and loaded to failure using a strain-rate controlled load actuator. The individual model piles were made of 5 mm diameter aluminium rod placed in holes pre-drilled in the consolidated kaolin prior to the centrifuge test. All piles extended to a depth 250 mm in the clay giving an lid ratio of 50. The ranges of pile groups tested are linear, circular and square perimeter, circular and square target . and square grid. Single pile tests provided the reference pile capacities used to normalise the data from the 23 centrifuge models tested. The experimental work was complemented by a parametric numerical modelling study using the finite element programme Abaqus. This gave insight into the pile-soil interaction and permitted a more meticulous analysis of the soil stresses and displacements. In addition, the numerical modelling enabled extension to the original variables tested as part of the centrifuge experiments and the soil shear strength and lid ratio were varied. The pile groups failed in one of two ways: either as individual piles with the piles settling into the ground with no noticeable settlement of the soil surrounding a pile, or as a block with the soil contained within the outer ring of piles settling by the same or similar amount as the piles. The change from block failure to individual pile failure often occurred at a pile centre-to-centre spacing of about two pile diameters though variables such as number of piles, the presence of a target pile and the strength of the soil all had an effect. The efficiency of a pile group is defined as the load capacity of a pile group expressed as a ratio of the number of the piles in the group multiplied by the load capacity of a single isolated pile. It was demonstrated that a grid group arrangement was the least efficient of the groups tested, whereas a perimeter group arrangement could achieve higher efficiencies of greater than unity and the inclusion of a target pile could further enhance the group efficiency. It has been shown that a target group comprised of 17 piles (16 piles plus one central pile) has a significantly higher efficiency than a 5x5 grid group comprised of 25 piles, such that the capacity at lower settlements is the same for both groups.

Calibration of Settlement Analysis Models for Single Piles and Pile Groups

Proceedings of ISSMGE TC 213 Workshop

Three-dimensional Non-linear Finite Element Analysis of Laterally Loaded Piles in Clay

Dynamic Behaviour of Pile Foundations with Soil-pile Interaction

Single Piles and Pile Groups Under Lateral Loading

Single Piles and Pile Groups Under Lateral Loading, 2nd EditionCRC Press

This handbook provides a complete and detailed overview of piling systems and their application. The book and construction of piled foundations is based on Eurocode 7 and DIN 1054 edition 2010 as well as the European construction codes DIN EN 1536 (Bored piles), DIN EN 12699 (Displacement piles) and DIN EN 14199 (Micropiles). These recommendations also deal with - categorisation of piling systems, - actions on piles from structural loading, negative skin friction and side pressure, - pile resistances from static and dynamic pile test loading as well as extensive tables with the pile load-bearing capacity of nearly all piling systems based on values from practical experience, - pile groups, - performance of static and dynamic test loading and integrity tests, - load-bearing behaviour and verifications for piles under cyclical, dynamic and impact actions - quality assurance for construction. An appendix with numerous calculation examples completes the work. As part of the approval procedure for offshore wind energy structures, the Federal Office for Shipping and Hydrography (BSH) demands verifications according to the new Chapter 13 ("Load-bearing behaviour and verifications for piles under cyclical, dynamical and impact actions") of the EA Pfähle (the recommendations of the Piling working group - 2nd edition), which deals with external pile resistance for the foundations of offshore wind energy structures and the types of verifications to be provided under cyclical actions. The publication of the EA-Pfähle recommendations by the Piling working group of the German Society for Geotechnics (DGGT), which works with the same members as the piling standards committee NA 00-05-07, is intended to provide assistance for engineers active in the design, calculation and construction of piled foundations. The recommendations can thus be considered as rules of the technology and as a supplement to the available codes and standards.

Guiding the professional through the complexities of lateral-load design, this book and CD-ROM combination introduces the procedures involved in piles and pile group design. This is a problem that can only be solved by accounting for the soil resistance as related to the lateral deflection of the pile. Intricate equations are derived and fully explained, enabling the designer to find the critical loads, that will either cause a pile to be overloaded or cause too much lateral deflection. The CD-ROM contains simplified versions of two required programs that allow the reader to check the solutions of some of the examples given in the book and to find answers to related problems.

Scour- and Erosion-Related Issues

The Effect of Nonlinear Soil Response on the Behavior of Single Piles and Pile Groups in Clay

Single Piles and Pile Groups Under Lateral Loading, 2nd Edition

Analysis of Pile Foundations Subject to Static and Dynamic Loading

This report focuses on the development of a new method of analysis of laterally loaded piles embedded in a multi-layered soil deposit treated as a three-dimensional continuum. Assuming that soil behaves as a linear elastic material, the governing differential equations for the deflection of laterally loaded piles were obtained using energy principles and calculus of variations. The differential equations were solved using both the method of initial parameters and numerical techniques. Soil resistance, pile deflection, slope of the deflected pile, bending moment and shear force can be easily obtained at any depth along the entire analysis were in very good agreement with three-dimensional finite element analysis results. The analysis was further extended to account for soil nonlinearity. A few simple constitutive relationships that allow for modulus degradation with increasing strain were incorporated into the analysis. The interaction of piles in groups was also studied.

Pile group foundations are used in most foundation solutions for transportation structures. Rigorous and reliable pile design methods are required to produce designs whose level of safety (probability of failure) is known. By utilizing recently developed, advanced, two-surface plasticity constitutive models, rigorous finite element analyses are conducted. These analyses are for axially loaded single piles and pile groups with several pile-to-pile distances in various group configurations installed in sandy and clayey soil profiles. The analyses shed light on the relationships between the global response of the pile-soil system (deve resistances) and the behavior of local soil elements (e.g., shear band formation). The influence of the group configuration, pile-topile spacing, soil profile, and pile head settlement on the group effects are studied. Mechanisms of pile-soil-pile interactions in pile groups are revealed. Pile efficiencies for individual piles and the overall pile group are reported for use in pile group design. The instrumentation, installation, and static and dynamic testing of a closed-ended, driven pipe pile in Marshall County, Indiana is documented. The test results along with two other case histories are used to verify the new Purdue pile design meth performed to develop resistance factors for the load and resistance factor design, LRFD, of vii pile groups considering both displacement and non-displacement piles, various soil profiles, and two target probabilities of failure. The pile design equations, pile group efficiencies and resistance factors together form the LRFD pile design framework. Two step-by-step design examples are provided to demonstrate the LRFD pile design procedures for single piles and pile groups.

Pile Foundations are an essential basis for many structures. It is vital that they be designed with the utmost reliability, because the cost of failure is potentially huge. Covering a whole range of design issues relating to pile design, this book presents economical and efficient design solutions and demonstrates them using real world examples. Co

Static and Dynamic Lateral Loading of Pile Groups

The Design of Piled Foundations

Experiments with Instrumented Pile Groups in Sand

Basics of Foundation Design

Proceedings of the 5th International Symposium TC28. Amsterdam, the Netherlands, 15-17 June 2005

This book presents computational tools and design principles for piles used in a wide range of applications and for different loading conditions. The chapters provide a mixture of basic engineering solutions and latest research findings in a balanced manner. The chapters are written by top experts in the field. The materials are presented in a unified manner based on both simplified and rigorous numerical methods. The first four chapters present the basic elements and steps in analysis of piles under static and cyclic loading together with clear references to the appropriate design regulations in Eurocode 7 when relevant. The analysis techniques cover conventional code-based methods, solutions based on pile-soil interaction springs, and advanced 3D finite element methods. The applications range from conventional piles to large circular steel piles used as anchors or monopiles in offshore applications. Chapters 5 to 10 are devoted to dynamic and earthquake analyses and design. These chapters cover a range of solutions from dynamic pile-soil springs to elasto-dynamic solutions of large pile groups. Both linear and nonlinear soil behaviours are considered along with response due to dynamic loads and earthquake shaking including possible liquefaction. The book is unique in its unified treatment of the solutions used for static and dynamic analysis of piles with practical examples of application. The book is considered a valuable tool for practicing engineers, graduate students and researchers.

Behavior of laterally loaded single piles and pile groups in fine grained soils are investigated using a non-linear finite element methodology. The purpose is to gather behavioral information that would help improve our knowledge of pile behavior and enhance the applicability of some existing methods of analysis. A three-dimensional non-linear finite element program, PILE3D, has been developed. An anisotropically hardening bounding surface plasticity model is used to model soil behavior. Behavior of soil-pile interface is modeled using thin isoparametric elements. Various geotechnical loading and boundary conditions including drained and undrained loading, water table, in-situ stresses, preconsolidation and formation of gap at the soil-pile interface, have been implemented. Two full-scale laterally loaded pile tests are analyzed using two- and three-dimensional idealizations and results are compared with observed pile behavior. Good agreement is obtained between measured and computed bending moment, soil resistance and lateral deflection along the length of the pile, load-deflection response at the pile-head and p-y curves at different depths. Influence on the behavior of the pile-soil system of flexural rigidity and diameter of the pile, shear strength, lateral pressure coefficient, friction angle and preconsolidation of the soil, and gap formation behind the pile at the soil-pile interface are investigated. Results are compared with some existing criteria for the determination of p-y curves. Effect of interaction between the individual piles in a group is studied using three different configurations: (i) an $infty$ x 1 group, (ii) a 1 x $infty$ group and (iii) an $infty$ x $infty$ group. Influence of spacing between the piles in a group is investigated. Results are compared with some existing theoretical solutions and with results of full-scale and model-scale pile load tests. Interactions factors are developed to adjust single pile p-y curves to account for group interaction.

A valuable source of reference on the current practices of analysis, design and construction of tunnels and underground structures in soft ground. This collection of reviewed papers covers a wide range of tunnelling practice, from deep excavations in Singapore to the construction of a new metro line in Barcelona. The international scope of the contributors makes this a truly comprehensive collection of work on the geotechnical aspects of soft ground excavation.

The Behavior of Laterally Loaded Single Piles and Group Piles in Sand

Pile Foundation Analysis and Design

Experimental Research Into the Behavior of Piles and Pile Groups Subjected to Cyclic Lateral Loading

Piling and Deep Foundations

Pile groups under cyclic lateral loading

Single piles and pile groups are frequently subjected to high lateral forces. The safety and functionality of many structures depends on the ability of the supporting pile foundation to resist the resulting lateral forces. In the analysis and design of laterally loaded piles, two criterions usually govern. First, the deflection at the working load should not be so excessive as to impair the proper function of the supporting member. Second, the ultimate strength of the pile should be high enough to take the load imposed on it under the worst loading condition. Typically, pile length, pile section, soil type, and pile restraint dictate the analysis. This paper presents different methods, specifically Broms' method and the p-y method, for both the analysis and design of laterally loaded single piles. Both linear and nonlinear analyses are considered. The measured results of several full-scale field tests performed by Lymon Reese are compared to computed results using Broms' method of analysis and the p-y method of analysis. Observations are made as to the correlation between the results and recommendations are made as to the applicability of the accepted methods for the analysis and design of laterally loaded piles.

HKUST Call Number: Thesis CIVL 2006 XuY.

The "Red Book" presents a background to conventional foundation analysis and design. The text is not intended to replace the much more comprehensive 'standard' textbooks, but rather to support and augment these in a few important areas, supplying methods applicable to practical cases handled daily by practising engineers and providing the basic soil mechanics background to those methods. It concentrates on the static design for stationary foundation conditions. Although the topic is far from exhaustively treated, it does intend to present most of the basic material needed for a practising engineer involved in routine geotechnical design, as well as provide the tools for an engineering student to approach and solve common geotechnical design problems.

Piles and Pile Foundations

Geotechnical Aspects of Underground Construction in Soft Ground

Structures and Solid Body Mechanics

Dynamic Nonlinear Analysis of Pile Foundations Using Finite Element Method in the Time Domain

The Foundation Engineering Handbook

A paperback edition of this highly successful volume. Piling is a fast-moving field, and in recent years there have been major advances in theory, methods, testing procedures and equipment, all of which are covered here. This is a detailed manual with a marked emphasis on practice.

A research program to study the behavior of piles and pile groups subjected to cyclic lateral loading was conducted at a Houston, Texas site. A single pile and a nine-pile group situated in the natural clay were tested and then the upper several feet of clay were removed and replaced with sand and the tests were repeated. Following these tests, another study was undertaken to measure experimentally pile-head flexibility reduction (interaction) factors for the pile group in sand. Tests were made cyclically at varying magnitudes of applied groundline shear on single piles and two-pile and three-pile subgroups, and the response of unloaded piles in the group was measured. Concurrent with these studies, pressuremeter (PMT) and cone penetrometer (CPT) tests were performed in both the clay and the sand from which capacity predictions were made. Each of these studies generated a report with voluminous data. This report summarizes the major findings into one volume. Keywords: Cyclic lateral loading, Interaction factors, Piles, Pile groups, Scour, Pile structures. (SDW).

The principles and concepts for unsaturated soils are developed as extensions of saturated soils. Addresses problems where soils have a matric suction or where pore-water pressure is negative. Covers theory, measurement and use of the fundamental properties of unsaturated soils--permeability, shear strength and volume change. Includes a significant amount of case studies.

Proceedings of the International Conference on Piling and Deep Foundations, London, 15-18 May 1989

Load and Resistance Factor Design of Bridge Foundations Accounting for Pile Group-Soil Interaction

Piling Engineering

Behaviour of Single Batter Piles and Pile Groups Under Lateral Soil Movement in Sand

Seismic Response of Single Piles and Pile Groups

The Design of Piled Foundations, Second Edition focuses on the theories which have been advanced to predict the loads which piles will carry, both singly and when used in groups to form a piled foundation. Organized into 12 chapters, this book begins with an explanation of the utilization of piles. Subsequent chapters discuss the types of piles and their construction; pile driving by vibration; the calculation of the ultimate bearing capacity of a pile from soil properties; the settlement of single piles and the choice of a factor of safety; and piles in soft soils. Other chapters describe pile testing; piles in groups with vertical loading; horizontal forces on piles and pile group; and the durability of piles.

It is the aim of this research work is to investigate and to assess quatitatively as well as quantitatively the bearing behaviour of pile groups subjected to cyclic lateral loading. In this context, the influences of different boundary conditions, in particular the soil properties and the pile group geometry are to be analysed experimentally and numerically. Based on a brief literature review in chapter 2, model tests (centrifuge and small-scale at 1g) and numerical investigations have been carried out to contribute to a better understanding of the cyclic behaviour of pile groups. Chapter 3 describes the test procedure and summarises the results of centrifuge tests, which have been carried out at the Centre for Offshore Foundation Systems (COFS) in Perth, Australia. Further investigations have been carried out by means of smallscale model tests at 1g in the testing facilities at the University of Kassel, Germany, with the results as summarised in chapter 4. A comparison of individual results of both test series is provided in chapter 5. The numerical studies in chapter 6 have been carried out in order to analyse the general ability of numerical simulations to calculate the response of pile groups to cyclic lateral loading. Based on the previously derived results, chapter 7 provides equations that can be applied to estimate the cyclic accumulation of lateral displacements of pile groups as well as the cyclic changes of the load distribution within pile groups.

A quasi-three-dimensional method of analysis is presented for the nonlinear dynamic analysis of single piles and pile groups. The analysis is performed in the time domain using strain-dependent moduli and damping, yielding at failure, and a no-tension cutoff. The analysis has been incorporated into the computer program PILE-3D and has been validated using data from centrifuge tests on a single pile and a 2 X 2 pile group under simulated earthquake loading. Analyses of the centrifuge tests demonstrated a significant reduction in soil moduli around the piles during strong shaking and a corresponding reduction in pile stiffnesses. The time-dependent shear modulus distribution in soil around the pile is obtained as part of the output. This allows the time variation of dynamic impedances of pile foundationsduring shaking to be established and allows a realistic assessment of thesingle-valued stiffnesses and damping factors usually incorporated into commercial structural analysis programs for the seismic analysis of pile-supported structures. The analysis also demonstrates the importance of inertial interaction between foundation and structure.

An Investigation and Comparison of Accepted Design Methodologies for the Analysis of Laterally Loaded Foundations

"The field of lateral-load design is a very complex one. This book and CD-ROM not only provides the reader with an overview of procedures involved in the designing of piles and pile groups, but with a way of finding answers to related problems"--

Piled foundations are generally designed using empirical methods, in particular the traditional capacity based approach on which the majority of codes of practice are based. However in recent years the analysis of pile groups and piled rafts has undergone substantial development in the light of new research and the mechanisms for the interactions b