

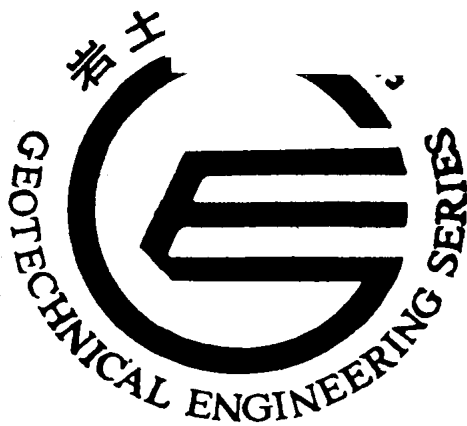


# 岩土工程 勘察设计 手册

GEOTECHNICAL  
INVESTIGATION  
AND DESIGN  
MANUAL

林宗元 主编

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## 内 容 提 要

本书共分 9 篇 90 章。第 1 篇总论,包括岩土工程的概念、业务范围、勘察基本要求和设计准则。第 2 篇基础地质,包括主要造岩矿物、岩石、构造地质、地史与第四纪地质、地貌、气象与水文以及地下水。第 3 篇岩土的工程性质,包括岩体(石)的结构、分级标准、工程性质和土的分类定名、静力与动力特性以及岩土参数取值标准和常用数理统计方法。第 4 篇工程地质测绘、遥感判释、勘探与取样,包括工程地质测绘、遥感判释、勘探、取样和勘探点的测定。第 5 篇地基基础工程分析设计,包括地基基础分类、地基承载力、应力分析、沉降计算、基坑回弹计算、地基稳定性、浅基础、箱形基础、筏板基础、壳体基础、锚杆基础、桩基础、扩底墩基础、动力地基与基础和基坑开挖与支护。第 6 篇各类岩土工程的勘察设计,包括低层、多层、高层及超高层建筑,市政、铁道、地铁、公路、机场、矿山、石油天然气、核电、电力、水利水电、近海、港工、地下工程、边坡和桥涵等工程的岩土工程勘察设计。第 7 篇特殊性岩土的工程勘察评价,包括膨胀岩土、盐渍岩土、湿陷性土、新近堆积土、软土、填土、污染土、冻土、风化岩、残积土、红土和混合土。第 8 篇环境岩土工程,包括地震环境和地震动、区域地壳稳定性、地裂缝、风沙、泥石流、地面沉降、岩溶、采空区、水库漫没、水库坍岸、斜坡与滑坡、崩塌与落石、废弃物处置、环境介质对建筑材料的腐蚀性和工业环境振动。第 9 篇岩土工程勘察设计常用计算机程序。

本书集国内外有关规范、经验资料和先进科研成果之大成,内容丰富,资料翔实,具有实用性、简明性、指导性、先进性和可靠性。

本书可作为从事各种工程的岩土工程(含勘察、设计、治理、监测、监理)生产、科研和教学科技人员的必备工具书,也可作为工程结构设计、施工科技人员以及岩土工程、土建、水利、道桥、港工、工程地质等专业研究生和高年级大学生的重要参考书。

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## 主 编 简 介

林宗元,1929年9月生,福建莆田人。1945年毕业于莆田砺青中学,1948年毕业于哲理中学,1953年3月毕业于上海同济大学结构系,从事工程勘察(及工程结构设计)已43年。中国北方工业公司勘察研究院原副总工程师、教授级高级工程师。历任原第二机械工业部设计处见习技术员、勘测处助理工程师、原第一、三、五机械工业部勘测公司副科长、工程师、大队长兼主任工程师、副总工程师、高级工程师、原兵器工业部、国家机械委、机械电子工业部勘察研究院副总工程师、教授级高级工程师。主持过国内外各类型(如国防工业工厂、机械工业工厂、化工厂、造纸厂、冷冻厂、机场、海上工程、天然洞室利用、人工洞室、市政工程、线路工程、高层、超高层建筑等)、各种地层(如一般岩土,湿陷性黄土与砂土、软土、膨胀土、盐渍土和红土等特殊土)、各种地质环境条件(如平原地区、山区、滨海地区、半沙漠地区等)、各种环境工程地质问题(如边坡和滑坡问题、隐伏岩溶地表塌陷问题、地下矿层采空问题、泥石流问题、地震工程问题等)的大中型工程勘察项目一百多项,曾获得国家级优质工程勘察银质奖2项,部级优质工程勘察奖或优秀论文奖5项。在国内外各种学术会议上及国家级刊物上发表过论著30多篇,对红土、膨胀土等特殊土、超高层建筑场地的岩土工程勘察、环境工程地质与环境岩土工程等有独特的研究。1989年被评为首批的中国工程勘察大师;1992年被国务院授予有突出贡献的享受政府特殊津贴的科技专家;1986年起担任首届中国工程勘察协会副理事长,1989年11月起兼任第二届秘书长,协助政府主管部门搞好行业管理,推动工程勘察技术的发展,参与工程勘察收费标准改革及原状取土器标准化、系列化等方面的工作。1980年起为国际地科联工程地质协会(I. A. E. G)会员。1979年起为中国兵工学会基本建设学会第一、二、三届的委员。

## Introduction To The Chief Editor

Lin Zongyuan, born in September, 1929 at Putian in Fujian Province, China. In 1945, graduated from Liqing Middle School and in 1948 graduated from Zheli Middle school, Putian. Graduated from the Department of Structure, Tongji University in Shanghai in 1953. As deputy engineer—in—chief and professor senior engineer of the Engineering Institute of Investigation and Surveying Company of NORINCO of China, he has engaged in geotechnical investigation and survey as well as civil engineering for more than 43 years.

He has successively held the posts of technician on probation at the Department of Design, assistant engineer at the Department of Investigation and Surveying of the late Second Ministry of Machinery Industry, Vice section Chief, engineer, team leader and concurrent chief resident engineer, vice engineer—in—chief, senior engineer of the Investigation and Surveying Company of the late First, Third and Fifth Ministry of Machinery Industry, Vice engineer—in—chief, Professor senior engineer at the Research Institute of Investigation and Surveying of the late Ministry of Ordnance, the Commission of Machinery Industry, the Ministry of Machinery and Electronics Industry of the People's Republic of China.

Among more than a hundreds of varieties of projects under his direction. e. g. factories of defence industry, machinery industry, chemical industry and paper mill, cold storage, airport, marine projects, usage of natural caves, man—made chambers, municipal engineering, pipelines, high rise buildings, in variety of forms of rock and soil like common rock, collapsible loess and sand, soft clay, expansive soil, saline soil and laterite, etc. in many kinds of geological environments like plain, mountaineous area, sea shore semidesert area, etc. in various sorts of environmental engineering geologic condition e. g. slide and slopes, ground subsidence at underlaid karst area, mining subsidence, debris flow, earthquake, etc. two of them were silver medals of the national prize in investigation and survey, five of them were Ministry Awards of investigation and surveying or Best Paper Awards. More than 30 papers have been published in international conference and national symposium. His unique devotion to special soils like laterite and expansive soil, research to geotechnical investigation of high rise building, environmental engineering geology and environmental geotechnology has won extensive recognition from the whole expertise and led to his highest reputation as the Master in Geotechnical Investigation and Survey of the People's Republic of China in 1989. In 1992, he was awarded The National Outstanding Scientist by the state council of P. R. C and began to enjoy the top grade Government's Particular Subsidy.

In 1986, Mr Lin Zongyuan began to hold the post of the first deputy President and in November 1989 held the concurrent post of General Secretary of the second Chinese Association of Geotechnical investigation and surveying and helps the organization responsible for the profession to fix the standards of fee collecting, to promote the standardization and seriation in soil sampling, etc. He has been the member of International Association of engineering Geology (I. A. E. G) from 1980, and also the committee member of the first, second and third Capital Construction Committee of the Chinese Association of Ordnance Industry from 1979.



## 序

党的十一届三中全会以来,我国工程勘察界在总结历史经验和吸收国外先进技术的基础上,应用现代化的探测技术进行了岩土工程的理论研究和实践探索,取得了可喜成绩。鉴于工程勘察单位和勘察人员最了解建设场地的岩土工程条件,而且能够充分利用岩土,把岩土做为一种结构物,从而提高了勘察工作的精度,优化了工程勘察方案,对保证工程质量、降低工程造价、缩短建设工期、提高投资效益起到了极好的作用。岩土工程的蓬勃发展,给我国建设事业带来了进步,给工程勘察界带来活力,给整个勘察事业带来兴旺发达。

这次由中国工程勘察协会组织编写的《岩土工程丛书》,集中中国勘察、设计、施工、科研、院校等三百多名专家、研究员和教授及青年工程师的智慧与经验,他们熟悉这一新兴学科的系统知识,了解这一学科国内外发展的历史和现状,不断丰富工程实践经验。这次编写出版的这套丛书,力图在体系、内容和风格等方面充分发挥自己的优势,突出岩土工程的特点,尽量避免与已出版的同类书在内容上的简单重复,从而保证了本丛书的完整性、实用性、指导性、科学性、可靠性和先进性,使其符合我国的国情,以适应从事岩土工程的广大工程技术人员、科研人员和大专院校有关师生的需要。

《岩土工程丛书》是我国勘察设计战线广大工程技术人员应用现代技术在工程实践中的结晶,它的出版发行,对我国工程勘察各级领导干部和广大技术人员正确认识和理解岩土工程,提高勘察队伍的整体素质和工程质量,使岩土工程更好地为国民经济建设服务,必将起到积极的作用。希望工程勘察设计行业的各级领导干部和技术人员认真阅读,从中汲取有益的东西,结合本地区、本部门的实际和工程实践,创造性地加以运用,并不断总结经验,逐步提高我国岩土工程技术水平,为实现具有中国特色的岩土工程,为早日赶上和超过世界先进水平而共同努力。

**建设部勘察设计司司长  
中国勘察设计协会常务副理事长 吴奕良<sup>①</sup>  
中国工程勘察协会理事长**

1991年8月

<sup>①</sup> 注:吴亦良同志自1995年12月起担任中国勘察设计协会第三届理事长。

## Preface

Since the third session of the eleventh conference of the Communist Party of China, great achievements have been obtained in the theory and practice of modern geotechnical engineering investigation. on the basis of history experiences and advanced technology absorbed from abroad. Having a good knowledge of site geotechnical conditions, investigation institutes and engineers can make full use of rock and subsoil as a structure, improve the work precision, optimize survey plan, ensure engineering quality, reduce cost, shorten construction period, increase investment benefit. The flourishing development of geotechnical engineering brings national construction the progress, contributes an active and brisk aspect in engineering investigations.

The Geotechnical Engineering Series edited by Chinese Association of Geotechnical Investigation and Survey collect intelligent knowledge and precious experience from more than 300 experts, researchers, professors and young engineers who are familiar with the past and present of this new area to enrich their practical experience.

The publication of this series tries to reflect its advantage in system, content and style indicating characters of geotechnical engineering to ensure this series entirely, practical, conductive, scientific, reliable and advantageous in accord with the national situation, meeting the requirements of technicians, researchers, teachers and students.

Geotechnical Engineering Series is the result of modern technology application on engineering investigation, Its publication takes a positive action in people's understanding of geotechnical engineering, improving the quality of engineering and its personnel to serve for the national economy, I sincerely hope cadres and technicians from all lines of investigation and design to read and absorb the series with the combination of local practice and experiences, to utilize them to bring Chinese Geotechnical Engineering to catch up with and exceed advanced world level.

Wu Yiliang

Director of Investigation and Design Bureau of the  
Ministry of Construction

Deputy Standing President of Chinese Association  
of Investigation and Design

President of C. A. G. I. S

August, 1991.

## 前 言

近十多年来,在国家主管部门的积极倡导和组织下,中国工程勘察行业一些有代表性的生产、科研单位和有关大专院校,为工程勘察向岩土工程延伸做了一系列有益的工作。中国工程勘察协会等社会团体在工程勘察技术人员(包括技术工人)知识更新与培训提高、技术经济立法、经验交流等方面,协助政府主管部门做了许多有成效的工作,为推行岩土工程起了积极的作用。为了适应进一步推行岩土工程的需要,在国家主管部门、辽宁科学技术出版社、广大参编单位和参编人员的大力支持下,中国工程勘察协会决定组织国内有关人员编写一套《岩土工程丛书》,包括《岩土工程勘察设计手册》、《岩土工程试验监测手册》、《岩土工程治理手册》、《岩土工程监理手册》和《国内外岩土工程实例和实录选编》等。从1991年3月28日在北京召开第一次编辑工作会议以来,参加编审工作的先后共有100多个工程勘察、工程设计、工程施工单位和有关院校与科研部门,计有有代表性的有关专家、教授、研究员以及有坚实理论基础与有一定实践经验的青年工程师、老师300多名,有关的中国工程勘察大师及中国工程设计大师基本上都参加了本丛书的编审工作,可谓具有老、中、青及勘察、设计、施工和生产、教学、科研三个三综合的特点。

本丛书编写的指导思想是,要力争成为从事岩土工程的广大工程技术人员、科研人员必备的工具书;大专院校有关专业师生的主要参考书;受土建结构设计技术人员与工程施工技术人员欢迎的参考书。在内容上尽可能体现指导性、简明性、实用性、可靠性与先进性,尽可能突出岩土工程的特点,注意充分体现本丛书的特色。

从内容上讲,岩土工程勘察、设计是岩土工程的基础,也可以说是核心部分。岩土工程勘察指以土力学、岩体力学、工程地质学及基础工程学等为理论基础,通过各种勘测技术和有关电子计算技术等方法,结合工程设计的特殊技术要求及场址的工程地质条件与环境工程地质条件,以及施工开挖、支护、降水等特殊要求,提出对岩土的论证评价,并指导岩土工程的设计与施工。岩土工程设计指以土力学、岩体力学、基础工程学、弹塑性力学与结构力学以及专门水文地质学等为理论基础,以岩土工程勘察成果、场地条件与设计技术要求等为依据,通过岩土工程分析计算和有关电子计算技术等方法,提出供岩土工程施工用的成果图件。从狭义理解,岩土工程设计主要指对特殊复杂的或深重大的地基基础(与基坑)、边坡加固、滑坡治理以及环境岩土工程问题治理的工程设计;从广

义理解,则泛指设计标高正负零零以下各种类型的地基基础及岩土工程治理(包括环境岩土工程问题的治理)的工程设计。从全局的观点和实施的现实可能性考虑,岩土工程设计应以狭义的理解为宜。

显然,根据上述的含义,本丛书的《岩土工程试验监测手册》中大部分内容实质上是属于岩土工程勘察的范畴,其中相当一部分技术方法当应用于岩土工程监测时,则同时又是后者的组成部分;而《岩土工程治理手册》中各种技术方法有关勘察设计的内容实际上是属于岩土工程勘察设计的范畴。出现这种情况主要是考虑到本丛书的系统性、整体性与各手册的分工,并为了便于读者查阅使用,同时也因为本手册篇幅所限,也可以说,本手册与上述其他二手册的相应部分有机地组成以有关岩土工程勘察设计为主题的整体。

本丛书涉及面广,特别是本手册中各类型工程的岩土工程勘察设计的特点、技术要求互不相同,各特殊性岩土的工程勘察技术要求与评价方法也各不一样,各种环境岩土工程问题的调查分析评价与治理更是差别很大,要在本手册有限的篇幅内反映诸方面的基本内容难度很大,只有简明地突出其核心部分,同时也注意到尽量体现指导性和实用性。

随着相关科学技术的迅速发展,岩土工程勘察、设计技术也日新月异,本丛书力求能反映国内外新水平、新经验和中国新近出版的有关规程、规范,其中有一些内容在中国是第一次被编入手册中的。

从本手册所包括的内容在本丛书中的序列来看,可以认为本手册是本丛书中的第一本。编写本手册的目的是:

- a. 作为岩土工程师(含岩土工程监理工程师)在编制勘察(或监理)纲要和进行现场与室内(含岩土工程设计)工作的指南;
- b. 作为土建结构设计技术人员提岩土工程勘察技术要求和进行工程设计的参考;
- c. 作为岩土工程施工技术人员进行现场工作的参考;
- d. 作为岩土工程科研人员工作中和大专院校有关专业师生教学的参考。

根据对本丛书规定的各专册之间既要有明确的分工,自成系统的独立性,又要保证整套丛书形成一个整体,防止不必要的重复的编写原则的要求,按照各篇的不同特点,一般尽可能突出本篇章所应有的基本内容。

由于各篇章的资料丰富程度不同等原因,各章节的篇幅有很大的差异,编写格式和实用程度也不尽一致,为此在编审修改中不强求统一,重点立足于尽可能体现如前所述的五性。

本手册计有 9 篇 90 章 479 节,插图 852 幅,表 1793 张,公式 1801 个,共约 310 万字。

由于受篇幅的限制,为了尽可能保留本手册必要的内容,对正文中部份内容(如实例、公式符号说明、参考文献目录等)用小一号的字(即 6 明)排,这在全

书版面的美观上可能有点影响,但为了实用和内容的完整性,只好如此,请读者和参编者见谅!

有的名词术语在已经或即将出版的有关的基本术语国家标准中作了修改,如含水量( $\omega$ )改为含水率、砂的相对密度改为相对密实度( $D_r$ )、比重( $G_s$ )改为相对密度  $d_s$ )等,为了便于读者对照采取加注或在索引中相应术语后加括号对照的形式处理。

参加本手册编审工作的共有 80 个单位,136 名专家、教授和研究员。先后于 1991 年 8 月和 9 月在北京召开第一次、第二次、第三次碰头会,初步确定编写的突出要点和篇章目次与分工及进度计划,1993 年 1 月在呼和浩特,同年 2 月在天津分别召开了第 6~8 篇和第 1~5 篇的审稿会,经过逐章逐节进行认真的互审,调整了篇章目和部分编审人员,然后编写人根据修改意见进行了修改。1993 年 6 月在北京召开了修改稿纂编碰头会,确定了纂编工作的主要任务和要求,分工由林宗元、汤福南、王长科、修本善、项勃、钟龙辉负责初步修改纂编,马兰也承担了部分章节的初步修改纂编,并由汤福南、王长科负责全稿的具体修改纂编工作,并负责索引和主要符号的编辑,王长科还负责全稿的编目、编附录、稿件的复核和图表公式的校改、有关内容的删改或补充,张文清、叶伟英负责主编简介、序、前言、目录等的英译,张满来负责校译,全稿最后由林宗元审定稿。

全面编纂这么一套岩土工程丛书,在中国尚属首次。虽然我们尽可能特邀了对各该章节有较深造诣、扎实的理论基础和丰富实践经验的专家、教授、研究员负责编审工作,经过各方面的大力支持,参加编审人员的无私奉献精神,对稿件反复进行审核修改,亟力想把本手册编成能反映国内国际先进水平的工具书。但由于编审时间和本人水平所限,错漏之处可能还会存在,欢迎读者批评指正,提出具体的建设性建议。来信请寄:邮编:100053,北京 573 信箱 7 分箱。

内蒙古有色勘察工程公司、天津地质工程勘察院分别承办了呼和浩特和天津审稿会,天津地质工程勘察院还派人完成了本手册的全部插图的清绘、植字工作,北京新丰印刷厂在印刷上给予大力支持,特在此致以衷心的感谢!

中国工程勘察协会副理事长兼秘书长  
中国工程勘察大师、教授级高级工程师 林宗元  
《岩土工程丛书》主编  
1995 年 3 月 北京

## Foreword

In order to extend engineering investigation to the line of geotechnical engineering, a series of beneficial work has been carried out in recent decade by some representatives of related institutes and universities under the active promotion and organization of the Ministry of Construction of China. Chinese Association of Geotechnical Investigation and Surveying (CAGIS) and other related societies have contributed a lot to training people, renewing technicians knowledge, making technical economy legislation and exchanging experience. Their work has been proven much helpful to the development of geotechnical engineering. With the support of Ministry of Construction, Liaoning Science and Technology Press, editorial units and Staff, CAGIS has decided to compile Geotechnical Engineering Series which will include Geotechnical Investigation and Design Manual, Geotechnical Testing and Monitoring Manual, Geotechnical Processing Manual, Geotechnical Supervision Manual, etc. On March 28, 1991, first meeting of editorial staff was held in Beijing. Since then, more than 100 institutes, universities and companies in geotechnical investigation, design, construction and research, and more than 300 experts, professors, researchers and excellent young engineers have been involved in compiling and editing. Experts with the title of masters in geotechnical investigation and surveying and in engineering design of P. R. China have also taken part in this job. Three trinities i. e. old, middle, and young in age, investigation, design and construction in communities, production, teaching and research in working style are the special characters of the editorial group.

The guiding ideology in editing the Series is to make it one of the required reference collection for technicians, researchers, teachers and students, civil engineer and constructor. The distinguished features of this Series are directive, explicit, practical, reliable and advanced, with the manifestation of the characteristics of geotechnical engineering.

In content, geotechnical investigation and design are the basis of geotechnical engineering, or the core of it. Geotechnical investigation is the subject that bases upon the theories of soil mechanics, rock mechanics, engineering geology and foundation engineering, and that utilizes surveying technics and related computer technics, in accordance with special technical requirements of engineering design, conditions of engineering geology and environmental engineering geology and requirements on excavation, supporting, dewatering, etc. to provide geotechnical proof and evaluation and to instruct geotechnical design and geotechnical construction. Geotechnical design is the subject that bases upon the theories of soil mechanics, rock mechanics, foundation engineering, elastic and plastic mechanics, structure mechanics, special hydrogeology, etc., and that utilizes geotechnical analysis, calculation and computer technology, in accordance with investigation results, site condition and design requirements, to put forward geotechnical construction drawing. In a narrow sense, geotechnical design refers to base and foundation design which is specially complicated or in large scale, slope supporting design,

landslide processing design and environmental engineering processing design. In a broad sense, geotechnical design is named for engineering design of various foundations and geotechnical processings that are below the assumed zero elevation (including environmental engineering processing). In a general point of view, the narrow concept is more practical and acceptable.

According to the above definition, it is obvious that much of the content in Geotechnical Testing and Monitoring Manual belongs to the Category of geotechnical investigation and quite a lot of technical methods in the Manual should be the component part of engineering investigation, and so is that various technical methods of designs in Geotechnical Processing Manual actually belongs to the category of geotechnical design. These arrangement contribute to the consideration of that the Series should be integrated, independent of each manual, and convenient to readers. This manual, in its limited space of pages, cannot cover everything, the other manuals have provided but incorporate itself with the others to form an entirety with geotechnical investigation and design as its theme.

This Series of Geotechnical Engineering have a broad coverage. Especially, this manual listed the features of various types of engineering, different technical requirements, special rock and soil investigation and evaluation methods, environmental engineering analysis and processing in geotechnical design and investigation. It is difficult to give a minute description to every corners of the field in a limited page, but a rather explicit stress is given to concrete the key part and make it instructive and practical.

With the rapid development of related science and technology, great changes have been taken place in geotechnical investigation and geotechnical design technology. The authors try to represent the latest development, newly published regulation, Standards and experience both at home and abroad. Some materials compiled in this manual are the first demonstration in a manual in China.

Geotechnical Investigation and Design Manual can be regarded as first book of the Series, its function are: (a) As a guide book for geotechnical engineers (including geotechnical supervisor) to make out outlines of geotechnical investigation and carry out in—Situ or laboratory test. (b) As a reference book for structure engineers to put forward requirements in geotechnical investigation and design. (c) As a reference book for geotechnical engineers to direct site work. (d) As a reference book for geotechnical researchers, college teachers and students.

Based on the editorial guide line that each book of the Series is not only clearly divided and independent but also incorporated with the others, editors try their best to highlight the content every parts should include and to avoid unnecessary duplication.

Due to difference in data richness, there exist differences in pages, writing style and practical levels in different chapters and sections.

This manual consists of 9 parts, 90 chapters, 479 sections, 852 drawings, 1793 tables, 1801 formula, Chinese letters in original.

Due to the limit space of the page, the author tries to keep the necessary content of this manual and to arrange smaller letters to illustrate certain part, e. g. case study, formulas, expressions and references, etc. It may possibly influence the artistic layout to do this way, but

could make this book practical and integrated. The author hopes to reach an understanding by his readers and editors.

A certain words and terms have been corrected in those having been and oncoming published national standards such as Water Content ( $w$ ) to Woisture Content ( $w$ ), Reletive Density ( $D_r$ ) of sand to Relative compactness ( $D_r$ ), Specific Gravity ( $G_s$ ) to Relative Density Index ( $d_s$ ), etc. . The author usee footnotes or parentheses behind terms in corresponding index so that readers can easily make their comparition.

About 80 units and 136 experts, professors and researchers have taken part in compiling this manual.

Three meetings were held in Beijing between August and September 1991 to make discussion on prominent key points, list of chapters, duty division and work schedule. In January and Feburary 1993, two meetings were held in Huhhot and Tianjin to check and modify each chapter, to adjust chapters and sections and to change part of editors. Modification was carried out after meeting according to corrected ideas made by editors. In June 1993, a meeting to modify draft was held in Beijing to further determine editorial tasks and requirements, divison of work. Preliminary compiling was directed by Lin Zongyuan, Tang Funan, Wang Changke, Xiu Benshan, Xiang Bo and Zhong Longhui. Several chapters were modified by Ma Lan. Tang Funan and Wang Changke are in Charge of overall examination and the compiling work of indexes and symbols. Wang Changke is also in charge of catalogue, appendix, draft checking, table and formula rectifying as well as deleting and amending. Zhang Wenging and Ye Weiyong are in charge of English translation to preface, foreword, introduction to the chief editor and table of content. Zhang Manlai is in charge of proof of English translation. Lin Zongyuan presides the final proof of the whole draft.

It is the first time to publish such a series of manuals on geotechnical engineering in China. Although leading experts, scientises, researchers have been invited to make much selfishless contribution to promote this book to be a modern, advanced one which reflects current levels in this field both at home and abroad, errors and mistakes may still be found some where. Thus any correction and constructive proposals from all sides are acceptble. please mail to the following address:

P. O. Box 573 (Branch 7), Beijing, 100053 P. R. China

The Chief editor wishes to express his honest thanks to the Ferrous Metal Investigation Company of Innermongolia in Huhhot and Tianjin Institute of Geological Engineering who had hosted editorial meetings there. The later also sent their experts to finish work of drawings, Copying, lettering, etc.

Lin Zongyuan

Deputy President and General Secretary of CAGIS

Master of Geotechnical Investigation and Surveying of P. R. China.

Professor and Senior Engineer

Chief Editor of Geotechnical Series



## 鸣 谢

向对本书给予大力支持的下列主管部门致以衷心的感谢!

建设部勘察设计司  
中国兵器工业总公司建设局  
中国有色金属工业总公司企业部  
中国有色金属工业总公司地质总局  
冶金工业部建设协调司  
交通部基建管理司  
交通部公路司  
电力工业部建设协调司  
水利部建设司  
化学工业部建设协调司  
电子工业部综合规划司  
铁道部建设司  
机械工业部行业发展司  
煤炭工业部规划发展司  
中国航天工业总公司固定资产投资部  
中国船舶工业总公司综合计划局  
中国石油化工总公司工程建设部  
中国石油天然气总公司基建工程局  
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中国勘察设计工程勘察协会  
计协会

1995年8月