



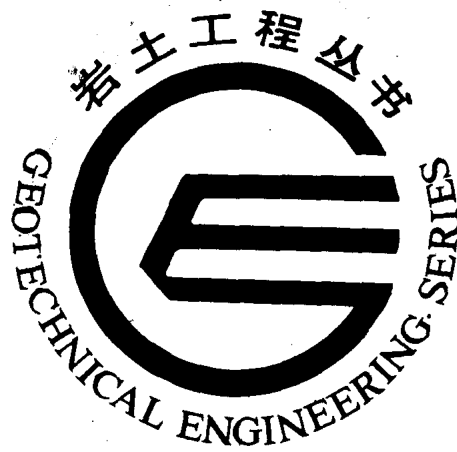
岩土工程 治理 手册

GEOTECHNICAL
PROCESSING MANUAL

林宗元 主编

辽宁科学技术出版社

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《岩土工程治理手册》编写人员

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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40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(一档); 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. 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 40 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 vice engineer—in—Chief, 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 semi—desert 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 interntional 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 concil of P. R. C and began to enjoy the top grade Governments Partcular 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 standarization 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。

建设部设计管理司司长
中国勘察设计协会常务副理事长 吴奕良
中国工程勘察协会理事长

1991年8月

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 collects 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 the Chinese Geotechnical Engineering to catch up with and exceed advanced world level.

Wu Yiliang

Director of Design Administration Bureau of the
Ministry of Construction

Deputy Standing President of Chinese Association
for 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,参加编审的共有100多个工程勘察、设计、施工单位和有关院校与科研部门,计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、科研三个三结合的特点。

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。

在中国,岩土工程治理是岩土工程的重要组成部分之一。从狭义理解,一般被认为是岩土工程施工的同义语;从广义理解,应该是包括与治理各类岩土工程问题有关的各种技术方法所特有的勘察、设计、施工与检测的全部内容。治理的对象——各类岩土工程问题包括诸如:某些特殊性土的地基处理与一般地基加固,边坡、滑坡治理与基坑壁加固,场地改造、工程施工中的岩土工程治理,以及环境岩土工程问题的治理等方面。每类岩土工程问题的治理往往可以有几种技术方法供选用,而每种技术方法有可能应用于几类岩土工程问题的治理,需要通过技术经济对比后选定。

实际上,岩土工程治理有着悠久的历史,在中国最原始的岩土工程治理的技术方法,甚至可以追溯到两千年以前就开始被应用了。岩土工程治

理的技术发展是适应整个土木工程领域技术发展的需要而推进,并且两者技术水平均与当时的国民经济及科学技术的发展水平相对应。岩土工程治理技术方法高速度的发展,真正形成一个系列,则仅是近40年,特别是近20年的事。

按本手册所涉及的内容在本丛书中的序列来看,可以说本手册是本丛书的第三本。编写本手册的目的是:

- a. 作为岩土工程师在进行岩土工程勘察中论证岩土工程治理方案的指南;
- b. 作为岩土工程师或土建结构设计工程师在进行岩土工程设计和确定监测、检测技术要求时的指南;
- c. 作为岩土工程施工技术人员现场工作的指南;
- d. 在一定程度上,本手册可说是《岩土工程勘察设计手册》和《岩土工程监理手册》等的辅助性工具书。

根据上述的编写目的,本手册是从广义角度来编审的。考虑到中国目前应用在岩土工程治理的技术方法很多,内容很丰富,为便于读者查阅使用,将有关岩土工程治理的内容单列一专册,其中有几种方法在国内是第一次编入专册的。根据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,本手册一般是以岩土工程治理各技术方法的设计和施工为重点,也适当的提出各该技术方法对工程勘察与监测、检测的特殊技术要求,对有关岩土工程勘察、试验、监测、检测的具体技术方法和常规要求则从略,必要时只交待需在本丛书某一专册的相应部分中查阅。本手册计有4篇36章230节,插图近一千幅、表七百多张、公式七百多个。共约190万字。

参加本手册编审工作的共有40多个单位,70多名专家。编写人员根据第一、二次丛书编辑工作会议要求的精神和分工,编写了本手册的章目细则,并于1991年8月13日至17日在丹东市召开的编写会议上进行了认真的审查讨论,提出了具体的修改意见,调整了部分章节细目和分工,规定了编审进度要求。1992年5月19日至26日在浙江绍兴市召开了本手册的初稿审查会,然后编写人员根据具体的修改意见进行了修改。修改稿由林宗元、修本善、龚主华负责审阅,并与常务编委王长科共同商定纂编的原则,由龚主华负责全稿的具体修改纂编工作,王长科负责全稿的编目、编附录、稿件的复核和图表公式的校改,张文清、叶伟英负责主编简介、序、前言等的英译,王正宏负责校译。全稿最后由林宗元审定。

由于各技术方法的技术发展水平和适用条件、范围不同等原因,各章节的篇幅有很大的差异,编写格式也不尽一致,为此在编审中不强求统一,重点立足于尽可能体现如前所述的五性。

全面编纂这么一套岩土工程丛书,在国内尚属首次。虽然我们尽可能特邀

了对各该章节有较深造诣、有丰富的理论基础和实践经验的专家、学者、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当前岩土工程先进水平的工具书,但由于编审时间短和本人水平所限,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 8 号分箱中国工程勘察协会收转。

辽宁有色勘察研究院承办了丹东本手册编写会议,有色金属南方岩土工程(联合)公司和浙江有色勘察研究院承办了绍兴初稿审查会议,并派专家积极参加本手册的编审工作,天津市地质工程勘察院派人完成了本手册的全部插图的清绘和植字、贴字工作,特在此表示衷心的感谢!

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

1993 年 3 月 北京

Foreward

In order to extend engineering investigation to geotechnical engineering, a series of beneficial work has been carried out in recent decade by some representatives of Chinese engineering investigation communities in production, research and relevant universities under the active promotion and organization of the Ministry of Construction of China, Chinese Association of Geotechnical Investigation and Surveying (C. A. G. I. S) and other societies have contributed a lot of effective work to teach and renew technician's knowledge, make technical economy legislation, exchange experience as well as help to improve the development of geotechnical engineering.

With support of The Ministry, Liao Ning Scientific and Technology Press, editing units and staff, C. A. G. I. S decides to compile Geotechnical Engineering Series including Geotechnical Investigation and Design Manual, Geotechnical Testing and Monitoring Manual, Geotechnical Processing Manual, Geotechnical Consultant Manual, etc. On March 28th 1991, the first meeting of editorial staff was held. More than 100 institutes and companies in Geotechnical investigation, design, construction, research and universities and more than 300 experts, professors, researchers and excellent young engineers have involved in compiling and editing. Masters in geotechnical investigation and surveying (and engineering design) of People's Republic of China have also taken part in this job. Three trinitities i. e. old, middle and young in age, investigation, design and construction in working Communities, production, teaching and research in working styles are the special characters of this Series of books.

The guiding ideology of this book is to try to become one of the required reference book to those of technicians, researchers, teachers and students, civil engineers and constructors. The distinguishing feature of this book is being directive, explicit, practical, reliable and advanced to manifest the characteristics of geotechnical engineering Series.

In China, geotechnical engineering processing is one of the important part of geotechnical engineering. In narrow sense, it is regarded as the synonym as geotechnical construction. In broad sense, it should include various technical methods in geotechnical improvement with the whole content of special investigation, design, construction and monitoring. Objectives of treatment are sorts of geotechnical problems including special and common ground stabilization, slope, landslide prevention, trench walls, site improvement, treatment during construction as well as environmental geotechnical engineering treatment. To one geotechnical problem, there exists several treatment methods. Nevertheless, one method can also be used as the answers to several geotechnical projects. It needs comparison on technology and economy base to those the final processing plan.

In fact, geotechnical engineering has a long history in China and the most ancient method of geotechnical construction could be traced back to two thousand years ago. It has been developed in accordance with the progress of civil engineering as well as that of national economic growth, science and technology. The geotechnical engineering in China has

a rapid development in last four decades especially two decades.

This is the third book of the series and it's aims are (a) A guidebook for geotechnical Engineers to propose optimum Geotechnical Processing plan in Geotechnical investigation report. (b) A guidebook for geotechnical or civil engineers to design and draft requirements on monitoring, testing. (c) A guidebook for geotechnicians to work at site. (d) In some degree, this book may be taken as an auxiliary reference to Geotechnical Investigation and Design Manual and Geotechnical Consultant Manual etc.

Based upon the above mentioned objectives, editing work has been extensively carried out. In consideration of rich and various geotechnical engineering processing methods, a separated edition of those methods is compiled, some of which appear the first time in China. Separate Manual should be independent but should also be continuous on the compiling principle of this series, avoiding unnecessary repeat. This Manual takes design and construction of geotechnical treatment methods as the key role and properly puts up their special requirements to investigation, monitoring and testing, omitting concrete techniques and routine requirements to investigation, monitoring, tests, which can be found in one of relevant books of the series when necessary. This Manual contains four sections, thirty—six chapters, with about 1000 drawings, 700 tables, 700 formulas.

More than forty units and seventy experts joined to compile the detail part of chapters according to the principle and work division Made at the first and second editorial meeting. A discussion was held from August 13 to August 17, 1991 in Dan Dong City, concreting ideas to modify chapters and divisions, stipulate editorial progress. From May 19 to May 26, 1992, revision meeting was held in ShaoXing, Zhe Jiang Province. Modification then was carried out and the approved draft was checked by Prof. Lin Zongyuan, senior Engineer Xiou Benshan and Gong Zhuhua. In the agreement with the standing editor Wang Chang ke's discussion, Senior Engr. Gong Zhuhua is in charge of modification and compiling. Engr. Wang Chang ke is in charge of draft checking, rectifying of drawings, tables and formulas. Zhang Wenqing and Ye Weiyang are in charge of English translation of preface and foreword, introduction to chief editor, English translation is checked by prof. Wang Zhenghong. Prof. Lin Zongyuan is in charge of final checking.

A rather big difference in space exists among chapters due to technical development, level, applicable condition and scope.

It is the first time to compile such a series of geotechnical engineering books in China. Although honourable experts, scientists, researchers were made selfishless contributions to promote this book to be a modern advanced one which reflects levels both at home and abroad, errors must exist, any correction and construction proposals from all sides are welcomed to mail to the following address:

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The Chief Editor wishes to express his thanks to Liao Ning Youse Institute of

Geotechnical Investigation and surveying who hosted the compiling meeting in Dan Dong; to Southern Geotechnical Engineering Company (united) of Ferrous Metal company and Zhejiang Youse Institute of Geotechnical Investigation and surveying who hosted first draft checking meeting, to Tianjin Geological Investigation Institute who sent their experts to make drawings.

Lin Zongyuan

Deputy president and general secretary of C. A. G. I. S.

Master of geotechnical Investigation and Surveying of P. R. C

Professor and senior engineer

Chief editor of geotechnical engineering series

Beijing, March, 1993

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!

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