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# 水工程概预算的原理与应用

叶 森 王业伟 华 夏 文 军 陈彦生 编著



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# 水工程概预算的原理与应用

Principles and  
Application of  
Water Works  
Estimation

叶 森 王业伟 华 夏 文 军 陈彦生 编著



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## 内 容 提 要

本书系“中国水工程安全与病害防治技术丛书”之一，以概念加固的新思维和整体性理论为导向，重点介绍了水工程概预算编制的基本原理与方法，在编著中力求体现行业的最新发展和编制要求。全书共分 14 章，主要内容包括：水工程造价的形成，水工程概预算简述，水工程定额及其制定，水工程费用，基础预算价格的确定，建筑及设备安装工程概预算编制，临时工程概预算与设计总概算编制，竞争性投标报价的编制，工程概预算计算机辅助系统，病险水工程除险加固概预算典型应用案例。

本书可供水工程概预算与投标报价编制人员应用，也可供土木工程等领域从事设计、施工、监理、维护与管理的人员，以及相关的中职、中专和高等院校的师生参考。

## Abstract

This book, is one of the Series of Safety and Disaster Prevention for Water Works in China, mainly introduces the basic principles and methodologies of water works cost estimation guided by the Integrity Theory and the Conceptual Reinforcement View. We try to reflect the latest sectorial development and estimation requirements during the preparation of this book.

It is divided into 14 chapters. Main contents include the brief introduction of water works cost estimation, water works quota and quota making, water works expenses, the confirmation of basic estimation price, preparation of cost estimation of construction and equipment installation projects, overall estimation preparation for provisional project estimation and design, preparation of tender quotation for competitive bidding, CAD system of engineering estimation, typical application cases of the cost estimation of risk removing and reinforcement for sick water works.

This book can be used not only for those who are engaged in the fields of water works cost estimation and tender quotation preparation, but also for those who are engaged in the fields of civil construction, as well as for teachers and students from technical secondary schools and universities.

## 编 著 者 的 话

江河湖海与地下水资源的开发、利用、控制、调配和保护水资源的各类建筑物，称为“水工程”。

水工程包括挡水建筑物诸如闸、坝、堤、海塘等；泄水建筑物诸如溢洪道、泄洪隧洞等；输水建筑物诸如渠道、输水隧洞、管道等；治导建筑物诸如丁坝、顺坝等；专用建筑物诸如水电站及扬水站的厂房、船闸及升船机、防波堤及码头、鱼道、筏道以及给水的过滤池等。

水工程的一个共同点，就是必须承受水的各种作用诸如静水压力、动水压力、渗流压力和水流冲刷等。

根据中华人民共和国水利部《2005年全国水利发展统计公报》，全国已建各类水闸39839座，其中大型水闸405座；各类水库大坝85108座，其中大型水库大坝470座；江河堤277500km；海塘10000余km，它们对国民经济的发展发挥了重要作用，为水文明进步作出了有益贡献。

由于水工程基础和建筑物本身存在地质缺陷和结构缺陷，设计欠妥、施工材料选择不当、施工质量不佳、运行条件变化、运行年限增加、运行管理存在问题以及地震等不利因素日益凸现，致使约占水工程总量30%~40%的水工混凝土建筑物存在不同程度的病害，有的已严重影响工程正常运行，威胁着人民生命与财产的安全，党中央国务院对此给予高度的重视。

2006年中央经济工作会议强调，集中力量用两三年的时间基本完成全国大中型和重点小型病险水工程的改造，以求“一定不能出现垮坝等重大安全事故”，确保“以人为本”构建和谐社

会的自然生态与人文环境的平衡。

“中国水工程安全与病害防治技术丛书”编写宗旨是密切配合党中央国务院这一重大战略部署进行的一项有意义的工作，旨在“十五”期间共 3259 座病险水工程除险加固总结的基础上，以“概念加固”新思维，采取集体讨论、分工合作的方式，编著了《水工程安全与病害防治技术概论》、《水工程安全检测与评估》、《水工程概预算的原理与应用》、《水工程结构缺陷一般加固技术》、《水工程地质缺陷常用加固技术》、《病险水工程碳纤维补强加固技术》、《病险水工程裂缝修补技术》和《病害水工程维护与管理》，共计 8 册一套系列丛书。

“中国水工程安全与病害防治技术丛书”分别介绍了除险加固技术的简史、现状、技术基础理论、设计计算经验公式、施工技术流程与工艺、安全、质量检测与评估、施工采用的材料与主要设备，以及病害水工程的技术维护与科学管理方法等。在每个分册前汇集了相应术语与符号；书尾载有相关工程应用典型案例。丛书内容简明新颖，文字通俗易懂，集知识性、实用性与可操作性于一体，可谓当今水工程安全与病害防治技术小百科。

“兴建容易修补难”，这是先人为我们总结出来的至理名言。“中国水工程安全与病害防治技术丛书”的出版发行，既有助于近期全国大范围除险加固水工程施工，又前瞻性地为“概念加固”理论发展提供了上升平台。

**编著者**

2007 年 5 月于武汉

## **Authors' Statement**

“Water works” is defined as all kinds of structures constructed for the development, utilization, control, operation and protection of water resources in rivers, lakes, and oceans and underground water head.

Water works include water retaining structures, such as sluice, dam, levee, seawall; water release structures, such as spillway, spillway tunnel; water conveyance structures, such as channel conveyance tunnel, pipeline; river control structures, such as groin, longitudinal dike; and special structures, such as power house, ship lock, ship lift, breakwater, dock, fish way, log chute, filter basin for water supply of hydropower station and pumping station.

A common feature of water works is that it has to endure all kinds of Water actions, such as hydrostatic pressure, hydrodynamic pressure, seepage pressure and current erosion.

According to the 2005 Statistic Bulletin about National Water Resources Development, 39839 water gates including 405 large ones; 85108 dams and reservoirs, including 470 large ones; levees of 277500km, seawalls of more than 10000km, have been constructed nationwide all those constructed structures have played an important role in the development of national economy, greatly contributing to the progress of water civilization.

As more and more unfavorable factors appear in the foundation of water works and structures gradually, including inherent geological and structural defects, faulty designs, inappropriate construction materials, low quality of construction, changes in

operation conditions, increased years of operation, problems in operation management and earthquake. some hydraulic concrete structures accounting for 30% ~ 40% of total amount of water works have various damages at different levels, which have seriously affected normal operations and threatened the safety of people's lives and properties. However, the Communist Party and the Government have attached great importance to those situations.

It was emphasized on 2006 Central Working Conference for Economy that we should concentrate ourselves to basically complete the reconstruction of medium, large and important small sick water works in 2 or 3 years' time in order to avoid fatal safety accidents with a firm hand, such as dam breach, ensuring a balance between natural ecology and culture environment for a harmonious and human oriented society.

The compiling of the Series of Safety and Disaster Prevention for Water Works in China is a significant task closely following the important strategy of the Central Government and the State Council. On the basis of the summarized experiences drawn from the risk removing and reinforcement of 3259 sick and risky water works during the "Tenth Five" program with the new view of "Conceptional reinforcement", through group discussions, assignment and cooperation, we compiled the series of 8 volumes, including the General of Water Works Safety and Damage Prevention Technologies, Detection and Assessment of Water Works Safety, Principles and Application of Water Works Estimation, General Reinforcement Technology for Hydraulic structural Defects, Common Reinforcement Technologies for Geological Defects of Water Works, Reinforcement Technologies by Carbon Fiber for Sick and Risky Water Works, Crack



Repairing Technologies for Sick and Risky Water Works, and Maintenance and Management of Sick Water Works.

In each volume, the authors respectively introduce risk removing and reinforcement technology, including its development history, current situation, technological foundation theory, calculation formulas, construction flow, technics, safety, quality test and assessment, materials and equipments during construction, as well as the methods of technical maintenance and scientific management for sick water works. The corresponding terms and symbols were listed at the beginning and typical application cases of relevant works was listed at the end of each book. The series is concise and easy to understand. At the same time, it combines technology with practice and the feature of operation. It can be regarded as a technical encyclopedia for the safety and damage prevention of water works.

“Easy to construct but difficult to repair” is wisdom that our ancestor summarized for us. The publication of the series is not only beneficial for the risk removing and reinforcement construction of water works nationwide recently, but also provides a rising platform in a forward—looking way for the development of conception reinforcement.

**Compilers**

May 2007 in Wuhan

## 前 言

人类为了改善自身的生存状态，谋求更大的时空发展，以及自然资源与人文教育的共享，从古至今，一直都通过运用资金、知识、工具和技术手段将自然界中的物质（诸如水），改造成可以为人类所用的“人工物”（诸如水工程）。水工程的建设，从其项目建议书、可行性研究、初步设计、施工图设计、开工准备、组织施工、生产准备到竣工验收这8个阶段的实践活动全过程，均贯穿了一个主线——价值（Value）。

价值的涵义源于经济，尤其是现代商品经济社会，价值工程（Value Engineering，简称VE）已在20世纪40年代应运而生。与此同时，价值分析（Value Analysis，简称VA）与价值管理（Value Management，简称VM）相伴而行，这为本书“价值水工程（Value Water Works，简称VWW）”的拓展提供了理论依据。

《水工程概预算的原理与应用》一书系“中国水工程安全与病害防治技术丛书”之一。它从管理学科角度以精确的融资计算来界定水工程建设和加固工程的安全性和技术先进性，以及水工程建设与加固工程的合理性和可靠性，从而达到维护健康江湖海与地下水源、促进人水和谐的目的。

水工程概预算，不仅涉及水工程技术，而且与国家方针政策、社会分配体制有着密切关系。水工程概预算编制对象，既有生产力方面的课题，也有生产关系方面的课题；概预算使用定额，既随地区不同而不同，又随生产力的发展和经济政策的变化

而变化。各地区、各部门均按照当地造价管理部门的规定执行，具有强烈的地区性、时效性和政策性。同时，费用的计算，贯穿于从水工程建设、加固项目筹备直至竣工验收、后评价全过程，又具有很强的实践性。尤其是水工程概预算编制的重要目标——招投标的标底和报价，始终遵循着“博弈理论 (Game Theory)”运作，并尽力寻求“帕累托最优 (Pareto Optimality)”而使参与者共赢。这些“游戏规则 (Game Rule)”又激起了水工程概预算编制者的兴趣和责任感，使得形似枯燥无味的数字，在欢快活泼的电脑屏幕上由“电子表格 (Excel)”显示出来。

《水工程概预算的原理与应用》一书采取集体讨论、分工合作的方式进行编著。全书共分14章，将职业要求的基本知识和技能走墨于字里行间，同时把行业科技发展前沿的新知识与新技术整合为书本内容，以适应水工程建设与加固实际的需要。编著者一个共同的愿望：中职、中专和高等院校的学生通过本书的学习，能够结合配套的定额及相关法律法规标准，分析与套用取费程序；对于从事水工程建设与加固的规划、咨询、设计、科研、监理、施工与管理的人员，以及相关领域的科技工作者，读过此书后，除娴熟掌握水工程概预算编制的原理、方法与步骤之外，祈望激发他们的创造性思维和创新潜能。

全书由叶森、王业伟、华夏、文军、郭玉、董建军和陈彦生共同编著。其中叶森撰写前言、术语、符号、第1~3章及附录，王业伟撰写第4~7章，华夏撰写第8~10章，文军撰写第11~14章，郭玉、董建军和陈彦生参加了部分章节的编写工作。全书由郭玉、董建军和陈彦生共同策划，由陈彦生统稿。

本书的英语文稿由周竹林翻译。

在本书的撰写中，引用了水利部、国家电力公司和中国长江三峡工程开发总公司及水利部下属流域机构、设计院、定额站，

湖北、湖南、安徽、江西、广东、广西、浙江、福建、河南、河北、陕西、山西、重庆、西藏、山东、辽宁、新疆等省、直辖市、自治区的信息资料，在此一并顺致谢意。

鉴于编著者的水平所限，书中难免有欠妥失误之处，恳请读者指正。

**编著者**

2007年8月于武汉

## Preface

In order to improve the living status, pursue better development in time and space and the share of natural resources and human education, in all ages, human has been using capital, knowledge, physical tools and technical measures to change the substance in nature, e. g. water, into those man-made substance that can be used by human, e. g. water works. The main line -- "Value" runs through the whole process of water works construction, including the eight phrases of project proposal, feasibility study, preliminary design, construction drawing design, start-up preparation, implementation, production preparation, project completion and acceptance.

The connotation of the word "Value" originates from economy. In modern commodity economic society, value engineering appeared in 1920s. At the same time, value analysis and value management were developed with value engineering, which provides theoretical foundation for the development of value water works-VWW of this book.

Principles and Application of Water Works Estimation is one of the Series of Safety and Disaster Prevention for Water Works in China. It defines the safety, technical advance, reasonability and reliability for water works construction and reinforcement so as to achieve the purpose of ensuring the health of rivers, lakes, oceans and underground waters and promoting the harmony between human and nature by accurate financial calculation from the perspective of management discipline.

Cost estimation of water works not only involves technology in water sector, but also has close relations with national policies and social distribution system. The objects of water works cost estimation cover the aspects of productive force as well and production relations. Quota, used in cost estimation, varies with different places, productive force development and economic policies. Different regions and departments follow different cost estimation regulations made by various local price management departments that have strong regional, time effective and policy characteristics. Cost estimation, running through the whole process of water works construction and reinforcement project, including preparation, completion acceptance and post evaluation, has a strong practicability. The most important targets of water works cost estimation—the bottom price of tender and tender quotation, are always operated following Game Theory towards Pareto Optimality to achieve mutual wins for stakeholders. Those Game Rules activate the budgeters' interests and responsibilities, who are trying to make those bald numbers more lively in Excel.

“Principles and Application of Water Works Estimation” was compiled through group discussions, separated work and cooperation. It is divided into 14 chapters, covering both the basic knowledge vocational and skills, integrating leading new knowledge and new technologies in industrial technical development so as to be in accord with actual needs of water works construction and reinforcement. It is a common wish of the compilers that students from secondary vocational schools, polytechnic high schools and universities will be able to analyze and apply cost procedures in combination with relevant quotas and related regulation standards by learning this book; those professionals

who are engaged in planning, consultation, design, scientific research, supervision, construction and management for water works construction and reinforcement will be able to grasp the principles, methods and process of water works cost estimation, and be stimulated to explore their creative ideas and potentials. It was written by Ye Sen, Wang Yewei, Hua Xia, Wen Jun, Guo Yu, Dong Jianjun and Chen Yansheng, in which Ye Sen wrote the preface, terms and symbols, Chapter 1 - 3 as well as appendix, Wang Yewei wrote Chapter 4 - 7, Hua Xia wrote Chapter 8 - 10, Wen Jun wrote Chapter 11 - 14. Guo Yu, Dong Jianjun and Chen Yansheng were involved in writing of some chapters. Guo Yu, Dong Jianjun and Chen Yansheng, were also planners of the series; Chen Yansheng was the organizer of the series. The abstract, authors' statement, preface and content list of this book was translated by Zhou Zhulin.

In the process of compiling the book, we cited and referred to related information from Ministry of Water Resources, China State Power Corporation, China Three Gorges Project Corporation, Subordinate river basin authorities, design institutes and quota stations under the Ministry of Water Resources, as well as from Hubei, Hunan, Anhui, Jiangsi, Guangdong, Guangxi, Zhejiang, Fujian, Henan, Hebei, Shanxi, Shanxi, Chongqing, Tibet, Shandong, Liaoning, and Xinjiang, etc. We sincerely appreciate all those people who gave us great support on this book.

Because of the authors' limited knowledge, there might be some incorrectness. We welcome any corrections by readers.

**Compilers**

June 2007

# 术 语 表

**概算** (Budgetary Estimate; Rough Estimation): 广义地指政府、机关、团体和事业单位编制一定时期预算的匡计数字。

**预算** (Budget): 广义地指经法定程序批准的政府、机关、团体和事业单位在一定期间的收支预计; 狭义地指对于建设工程项目而言, 预算是指根据工程施工图纸按照国家规定, 以一定的步骤和取费标准计算出的所需工程费用的预计值。

**工程造价** (Cost of Works; Project Cost): 指建筑安装工程的建造费用的总额, 即从工程项目确定建设意向直至竣工验收为止的整个建设期间所支付的总费用。

**工程投资** (Investment of Works; Project Investment): 指建设项目的建设成本。

**估算** (Projection; Estimate): 指对事物的价值、数目等大概的推断计算。

**定额** (Quota): 指从事生产活动时, 在人力、物力、财力利用方面所应遵守的标准。

**工程量清单** (Bill of Quantities, 简称 BOQ): 指表现招标工程的建设工程项目、安装工程项目、措施项目、其他项目名称和相应数量的明细清单。

**成本** (Cost): 指生产活动中所消耗的生产要素的费用, 亦称生产费用。

**价值工程** (Value Engineering, 简称 VE): 指设计过程中, 对设计对象 (诸如水工程项目、产品等) 的功能以及设计、用料、加工等方面进行分析研究, 寻求改进办法, 提供必要功能, 以最低的总成本, 获得最优价值的一种经营管理技术。

价值工程对象的价值 (V)、功能 (F)、成本 (C) 三者的关系为

$$V = F/C$$

**价值分析** (Value Analysis, 简称 VA): 指有组织、有步骤地分析研究一个建设项目、一件产品、一个系统或一种劳务的价值与其所能提供的功



能，谋求以最少耗费，提供必要的功能，从而获得最优价值的经营管理技术。

**价值管理** (Value Management, 简称 VM): 按照现代国际通行的概念，价值管理是价值规划、价值工程、价值分析的集合，即集中应用价值规划、价值工程、价值分析多种技术来保证项目“物有所值”。具体讲，在项目决策阶段和方案设计阶段，价值管理主要表现为价值规划，即应建造什么；在项目实施阶段，价值管理主要表现为价值工程，即应怎样建造；在项目投产运用阶段，价值管理主要表现为价值分析，即进行项目后评价。

**帕累托最优** (Pareto Optimality): 指资源分配的一种状态，在不使任何人境况变坏的情况下，而不可能再使某些人的处境变好。

**博弈** (Game): 指一些个人、团队或其他组织，面对一定的环境条件，在一定的规则下，同时或先后，一次或多次，从各自允许的行为和策略中进行选择并加以实施，各自取得相应结果的过程。