水

中国建筑设计研究院　主编

Compiled by China Architecture Design & Research Group

建筑给水排水设计手册

第二版（上册）

Design Manual for Building Water Supply and Drainage

2nd Edition

(Volume 1)

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《建筑给水排水设计手册》于1992年首次发行到2008年的第二版，期间我国经济建设迅猛发展，城市及基础设施建设取得举世瞩目的成就，建筑给水排水相关技术基本上达到国际发达国家的水准，颁布了一些相关的建筑给水排水标准、规范，《建筑给水排水设计规范》也进行了修订。为全面体现当前建筑给水排水技术的发展，将新规范、新技术、新材料、新设备、新工艺反映到设计手册中来是本次再版的目的。本手册分上、下2册，主要内容包括：建筑给水、建筑排水、建筑雨水、建筑热水、管道直饮水、消防、建筑中水、水景、公共浴室、游泳池、洗衣房、医疗用高压蒸汽和用气系统及设备、厨房设备、地震区给水排水、湿陷性黄土地区给水排水、建筑给水处理、建筑排水处理、循环冷却水、建筑给水排水常用计算资料等。为使读者使用方便还汇集了常用设备及材料。力求本手册能充分体现技术先进、资料翔实、数据准确、内容丰富的大型实用工具书特色。

本书可供建筑给水排水专业的决策、规划、设计、施工安装、教学、科研、维护管理人员使用，也可供给水排水专业、环境工程专业大专院校师生参考。

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责任设计：赵明霞
责任校对：安　东　王雪竹

Design Manual for Building Water Supply and Drainage is reprinted in 2008 since issued for the first time in 1992. During this period, China's economy witnesses a rapid development, urban and infrastructure construction get great achievement attracting world attention, technologies related to building water supply and drainage have basically reached the levels of developed countries. Some standards and regulations related to buieding water supply and drainage have been issued. The "Design regulation for buieding water supply and drainage" has also been revised. The objective of reprinting this Design Manual is to have new regutalions, new techniques, new materials, new equipment and new technologies included in this manual to reflect all aspects of current development of technologies related to buieding water supply and drainage. The Manual falls into two volumes (volume 1 and volume 2), including building water supply, building drainage, building rainwater, building hot water, piped direct drinking water, fire control, building reclaimed water, waterscape, public baths, swimming pools, laundries, high pressure steam and gas-consuming systems & equipment for medical use, kitchen installations, water supply and drainage in seismic area, water supply and drainage in loess areas sensible to subsidence under wet conditions, treatment of building water supply, treatment of building drainage, circulation of cooling water, common calculation data for building water supply and drainage. In addition, common equipment and materials are collected for ease of use by readers. Effort is made to make this Manual fully reflecting the characteristics of a large practical tool book, i. e. a book with rich content introducing advanced technology with reliable information and accrate data.

The Manual is useful for reference for staff undertaking design, construction & installation, teaching, scientific research and maintenance & management, as well as decision makers and planners in building water supply and drainage sector, as well as to the students majored in water supply and drainage or environmental engineering.

主编单位：中国建筑设计研究院
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前　言（第2版）

中国建筑工业出版社于1992年出版的《建筑给水排水设计手册》自发行以来，17年中，共再版16次，发行70000册，是从事建筑给水排水设计工程师和注册公用设备工程师的必备工具书和设计资料，被广大建筑给水排水设计师亲切地称为“白皮书”。

建筑给水排水技术在这17年中得到了蓬勃发展，本手册的基础规范《建筑给水排水设计规范》GBJ 15—88也于2003年进行了全面修订。补充了居住小区建筑给水排水的设计内容；调整和补充了住宅、公共建筑用水定额；增加了管道连接防污染措施和新型管材应用技术；住宅给水秒流量计算采用概率修正公式；统一各种材质管道水力计算公式；新增了水上游乐池水循环处理和冷却塔及水循环设计内容；补充了屋面雨水压力流计算参数；调整了集中热水供应设计小时耗热量计算公式的适用范围；补充了新型热水机组、加热器的有关应用技术要点和参数以及饮用净水管道系统的有关内容。

建设资源节约型、环境友好型社会是我国经济建设的重心，大力发展节能省地型住宅、公共建筑，在工程建设中推行节能、节水、节材、节地的新技术、新设备、新材料，是设计人员都必须应对的。围绕国家的建设原则，建筑给水排水技术在以下几方面得到了发展、并于工程中得到应用。

1．在变频调速泵的基础上，无负压供水技术的应用

在建筑给水系统中，采用水池、变频调速泵组供水的方式是目前的主流，它解决了水池、水泵、屋顶水箱联合供水存在的弊病：屋顶水箱在建筑立面上不好处理、建筑物最高层的供水压力不足、屋顶水箱水质二次污染等。但水池水质的二次污染仍然存在，有压的市政水进入水池后，原有的压力得不到利用，在能量利用上是浪费；水池的占地面积大，建筑用地得不到充分的利用。为从根本上解决水池的污染问题、节省能源，在市政供水条件良好的地方，采用从市政管网上直接吸水的供水方式，即无负压供水技术，在北京、青岛、福州、广州、深圳等城市得到了应用。无负压供水设备由管道倒流防止器、稳流补偿罐、真空抑制器、变频加压泵组等组成。可避免对市政管网的倒流污染及过度抽吸，影响周边的其他用户正常用水。

2．管道直饮水技术的应用

目前国内传统净化工艺处理的自来水，可降低水源水中悬浮物、胶体、微生物等，但不能有效去除原水中微量有机污染物。出厂水经管道输送和水池、高位水箱后，均存在二次污染，居民饮用此水将会对健康造成一定影响，而这部分饮水量又只占供水量的2%～5%。因此在目前不可能对现有的全部市政自来水进行深度处理和对市政供水管网进行大规模改造的前提下，将饮水和生活用水分质供应，既避免了高质低用的浪费现象，又保证了饮水卫生安全。近几年来我国管道直饮水行业有了较快发展，管道直饮水系统已在许多建筑中投入运行。相应的国家城镇行业标准《管道直饮水系统技术规程》CJJ 110—2005、《饮用净水水质标准》CJ 94—2005也已颁布实施。

3. 新型给水排水管材在工程中的全面应用

为保证给水的水质，提高工程质量，满足居民健康用水的需求，降低输水过程中的能耗损失，各种新型管材在近几年的工程中得到了全面的应用。不同接口形式的薄壁不锈钢管、铜管、新型塑料管、钢塑复合管、金属复合管等，为工程师及业主提供了广泛的选择。

4. 绿色、可再生能源的推广应用

加快建设资源节约型、环境友好型社会，大力发展循环经济、保护生态环境绿色、可再生能源的推广应用成为近几年政府行政主管部门的重要工作，太阳能、热泵（水源热泵、空气源热泵、地源热泵）在工程中得到了越来越多的应用。太阳能集热器与建筑一体化的技术得到发展，为太阳能在建筑物尤其是住宅建筑的应用提供了技术支持。热泵技术的发展与完善，使得利用地下水的水源热泵在采暖与生活热水供应，利用空调冷凝水的水源热泵在生活热水的制备，空气源热泵在游泳池池水加热与除湿等方面应用实例不断增多。国家标准《民用建筑太阳能热水系统应用技术规范》GB 50364—2005 也已颁布实施。

5. 住宅生活热水水温的保证

住宅中采用集中热水供应系统或户内自成系统热水供应者越来越普遍，为保证供水温度，不浪费水资源，集中热水供应系统采取干、立管循环的方式，采用电子远传水表（或 IC 卡水表），将水表设置在户内的卫生间，减小支管的长度，在规定的时间内得到热水。户内自成系统热水供应采用在循环管道上设小热水循环泵，循环泵集成温度控制器、时间继电器等功能，自动控制水泵的运行。为解决小区室外热水干管难以用同程布置保证循环效果的问题，采取在单体建筑连接至小区热水回水总干管的回水管上设置分循环泵的措施。相应的中国工程建设标准化协会标准《小区集中生活热水供应设计规程》CECS 222:2007也已颁布实施。

6. 虹吸式屋面雨水排水系统

体育场、馆，会展中心，大剧院等公共功能的建筑，屋面的集水面积均很大，采用重力式屋面雨水排水系统，需要的雨水斗多，水平悬吊管道敷设的坡度占用建筑物空间多，管径大。采用虹吸式屋面雨水排水系统，系统设计计算精度较高、能充分利用雨水的动能、具有用料省、水平悬吊管道不需要坡度、所需要安装空间小等优点，在大型公共建筑中得到了普遍的应用。相应的中国工程建设标准化协会标准《虹吸式屋面雨水排水系统技术规程》CECS 183:2005 也已颁布实施。

7. 雨水利用工程

雨水利用包括雨水入渗系统、收集回用系统、调蓄排放系统之一或其组合。建筑区雨水利用是建筑水综合利用中的一种新系统工程，具有良好的节水效能和环境生态效益。目前我国城市缺水日益严重，与此同时，健康住宅、生态住区正迅猛发展，建筑区雨水利用系统，以其良好的节水效益和环境生态效益适应了城市的现状与需求，在具体工程中得到了应用。相应的国家标准《建筑与小区雨水利用工程技术规范》GB 50400—2006 已颁布实施。

8. 游泳池水处理技术

随着我国经济的发展与提高，大型国际游泳比赛越来越多地在我国举办，对游泳池水质标准的要求也在提高。为满足出水的水质要求、在运行中节约反冲洗用水、减少过滤设

备的占地面积，硅藻土过滤器在实际工程中得到了应用。同时，为解决我国《游泳场所卫生标准》GB 9667—1996 中“人工游泳池池水水质卫生标准”指标过低，不能满足大型游泳比赛的水质要求，与国外游泳池水质标准规定项目相差较大，无法与国际接轨的矛盾，新的城镇建设行业标准《游泳池水质标准》CJ 244—2007 颁布实施。《游泳池给水排水工程技术规程》CJJ 122—2008 也已颁布实施。

9．消防水炮、大空间智能型主动喷水及水喷雾等灭火技术

体育场、馆，会展中心，大剧院等公共功能的建筑中存在超过《自动喷水灭火系统设计规范》规定的自动喷水灭火系统能扑救地面火灾的高度，根据高度的不同、采用自动控制消防水炮、大空间智能型主动喷水灭火系统替代自动喷水系统的功能，满足超大空间的消防要求，保证人身和财产的安全。水喷雾是一种在锅炉房、柴油发电机房等取代气体消防而用水灭火的设施，目前在工程中普遍应用。相应的国家标准《固定消防炮灭火系统设计规范》GB 50338—2003、《水喷雾灭火系统设计规范》GB 50219—95 已颁布实施。

为体现上述新技术、新设备、新材料的发展与应用，满足广大给水排水工程设计人员的需求，由中国建筑设计研究院组织，成立编委会，赵锂（机电设计研究院院长、教授级高级工程师）担任编委会主任，王耀堂（机电设计研究院副总工程师、教授级高级工程师）担任编委会副主任，刘振印（顾问总工程师、教授级高级工程师）、赵世明（副总工程师、教授级高级工程师）、傅文华（顾问总工程师、高级工程师）、陈耀宗（教授级高级工程师）、陈光辉（总经理）、关兴旺（主编）、周蔚（高级工程师）、钱梅（总经理）担任编委会委员。在全国范围内组织行业内知名专家，对本手册进行全面的修编，修编后的手册分为上、下 2 册，内容更加翔实、全面。本手册得以再版，是时代的使命，是全体编写人员积极参与、勤奋工作、同心协力的成果。

由于编著者水平有限，手册中一定存在错误和不足之处，敬请读者给予批评指正。

谨以此手册作为中国建筑学会建筑给水排水研究分会成立的献礼。

Preface

Since released, the ***Design Manual for Building Water Supply and Drainage*** published by China Architecture & Building Press in 1992 has been reprinted for 16 times in 17 years with a total circulation of 70, 000. It has become an essential design tool for engineers undertaking building water supply and drainage design and registered utieity engineers. It is called by the designers in this sector of the industry a "white book".

Building water supply and drainage technology has been developing rapidly in these 17 years and the basic regulation referenced in this manual, the ***Design Regulation for Building Water Supply and Drainage*** **GBJ 15—88**, was also fully revised in 2003. The items in design of building water supply and drainage in residential quarters are added; the water duties for housing and public buildings are modified and supplemented; the anti-pollution measures for duct connections are added; the application techniques for new tubing are supplemented; the probabicistic revising formulas for calculation of flow per second of housing water supply are adopted; the hydraulic calculation formulas for the ducts of various materials are unified; the items in water circulation treatment of water recreation pools are added; the items in design of cooling towers and water circulation are supplemented; the parameters for calculation of pressurized flow of roof rainwater are added; the scope of applicability of the formula for calculation of designed heat consumption per hour of contralized hot water supply is modified; the key points and the parameters related to application of techniques of new hot water units and heaters are supplemented; and the topics related to pure drinking water piping are added.

To build a resource-saving and environment-friendly society is the focus of economic construction in China. All designers must respond to both the rapid development of energy and land saving housing and public buildings and the promotion of new energy, water, material and land saving techniques, equipment and materials in engineering construction. Following this state construction principle , the building water supply and drainage technology has been developed in the following aspects and applied to engineering.

Ⅰ. Application of Non – Vacuum Water Supply Technology Based on Variable-Frequency Speed Regulating Pump

In a building water supply system, water supply from pool with variable-frequency speed regulating pump set is the current dominating technology. It removes the troubles caused by combined water supply from pool and roof tank by water pump: the roof tank is difficult to be made up on buieding's elevation; water supply pressure for top floor of the building is deficient; and secondary pollution of water quality in roof tank is likely to occur, etc. However, secondary pollution of water quality in a pool is still a problem. As the pressurized municipal water enters into the

pool, the original pressure is not utilized thus causing waste in utilization of energy. In addition, the floor space of the pool is large, so that the building lot can not be fully utieiged. In order to remove the pollution trouble of the pool radically and save energy, water supply by directey conducting water from the municipal pipe network (i. e. non – vacuum water supply technology) can be adopted at the places where the municipal water supply conditions are favorable. This technology has been used in such cities as Beijing, Qingdao, Fuzhou, Guangzhou and Shenzhen. Consisting of a device preventing backflow from pipe, a compensation tank for flow stabilization, a vacuum controller, a variable-frequency speed regulating pump set, the nom – vacuum water supply equipment can avoid backflow pollution and excessive pumping from the municipal pipe network to prevent adverse effect on normal water use of other users around the area.

Ⅱ. Application of Piped Direct Drinking Water Technology

At present, after treated by the conventional purification process in China, the amount of suspended substances, colloid, and microorganism etc. in source water can be reduced, but the organic contaminants in minute quantities in source water can not be removed effectively. Secondary pollution occurs both during pipage of the finished water and after the water reaches the pool or the roof tank. Residents who drink the water are subject to health damage to a certain extent. However, the volume of this part of drinking water only takes up 2% ~ 5% of the water supply volume. Since at present it is impossible to perform deep treatment process for all municipal water and it is not practical to conduct large scale reconstruction of water supply network, it is reasonable to separate drinking water supply from domestic water supply with different qualities to prevent quality water being wasted in low level usage, at the same time to ensure sanitation and safety of drinking water. In recent years, the piped direct drinking water industry in China has been developing rapidly and the piped direct drinking water systems have been put into service in many buildings. The corresponding industry standards applicable in towns of China, such as the ***Technical Specification for Piped Direct Drinking Water*** **CJJ 110—2005** and the ***Water Quality Standard for Pure Drinking Water*** **CJ 94—2005**, have been issued and put into effect.

Ⅲ. Full scale Application of New Water Supply and Drainage Tubing in Engineering

In order to ensure good water quality in water supply system, improve construction quality, meet resident's demand for pure drinking water, and reduce energy loss in the process of water delivery, a great variety of new tubing has been widely used in projects in recent years. The thin-walled stainless steel tubes, copper tubes, new plastic pipes, steel-plastics composite pipes, and metallic composite pipes with different joints provide engineers and owners with a wide range of choices.

Ⅳ. Promotion and Application of Green and Renewable Sources of Energy

In order to speed up the construction of a resource-saving and environment-friendly society, and to develop a recyclable economy to protect ecological environment, promotion and application of green and renewable sources of energy has become a significant task of the governmental administration department in recent years and solar energy and heat pumps (water source heat pump, air source heat pump and ground source heat pump) have been used more and more in engineer-

ing. The technology that integrates solar energy collectors with building has been developed to provide technical support to application of solar energy to buildings, especially housing construction . The development and improvement of heat pump technology result in more and more applications, such as water source heat pump utilizing hot underground water in heating and domestic hot water supply, water source heat pump utilizing condensed water from air conditioner to prepare domestic hot water, and the air source heat pump for heating water and dehumidification in swimming pool, etc. The national standard ***Technical Code for Application in Solar Water Heating System in Civil Buildings*** **GB 50364—2005** has also been issued and put into effect.

Ⅴ. Guaranty of Temperature of Domestic Hot Water in Housing

Centraliged hot water supply systems or seef – contained systems of hot water supply in housing are becoming more and more popular. In order to ensure temperatare of supplied hot water without waste of water, measures are taken in centralized hot water supply systems, such as water circulation in main and stand pipes, use of electronic remote – reading water meters (or water meters with IC card) mounted in bathrooms, reduced length of branch pipes for hot water to be running out within a preset period of time. In self – contained systems of hot water supply, a small hot water circulating pump is set in circulation line, featuring integrated functions of temperature regulator and time relay. It can control operation of water pamp automatically. In order to solve the problem that it is difficult to ensure circulation effect of main out door hot water pipe in a residential quarter with one and the same course arrangement, a branch cirwlating pump is set for each single building at the backflow pipe connected to main backflow pipe of hot water supply system in the residemtial quarter. A corresponding standard issued by China Association for Engineering Construction Standardization, ***Design Specification for centraliged Domestic Hot Water Supply in Residential Quarters*** **CEC S222:2007**, has also been put into effect.

Ⅵ. Siphonic Roof Rainwater Drainage System

Any buildings with public functions, such as stadiums, gymnasiums, convention and exhibition centers, and grand theaters, have a large roof area for catchment and a gravity type roof rainwater drainage system which requires many rainwater funnels, and much of the building space for laying stoped horizontally suspended pipelines of large diameter. Having higher computational accuracy in system design, a siphonic roof rainwater drainage system can use the most of kinetic energy of rainwater. With such advantages as less material used, no slope needed for horizontally suspended pipelines, and smaller space required for installation, the system has been widely used in large-scale public buildings. A corresponding standard issued by China Association for Engineering Construction Standardization, ***Technical Specification for Siphonic Roof Rainwater Drainage Systems*** **CECS 183:2005**, has also been put into effect.

Ⅶ. Rainwater Utilization Engineering

Rainwater utilization includes any one of following systems or a combination of them: rainwater infietration system, rainwater collecting and recyceing system. rainwater reserving and draining system. Rainwater utilization in building areas is a kind of new system engineering in comprehensive utilization of water in buildings and it can bring favorable water-saving efficiency and

environmental and ecological benefits. Now, cities in China are encountering increasingly serious water shortage, at the same time, healthy housing and ecological residential quarters are being built up rapidly. With good water-saving efficiency and environmental and ecological benefits, rainwater utilization systems in building areas are suitable to current conditions and requirements of cities and have been used in specific projects. A corresponding national standard, ***Technical Code for Rainwater Utilization Engineering in Buildings and Residential Quarters*** **GB 50400—2006**, has also been issued and put into effect.

Ⅷ. Treatment Technology for Water in Swimming Pools

With development and enhancement of Chinese economy, more and more grand international swimming competitions are held in our country, which requires more strict water quality standard for swimming pooes. Diatomaceous-earth filters are used in practical projects to meet requirement to water quality, save water used for backwash during operation, and reduce floor space of filter plant. A new industry standard for urban construction, ***Water Quality Standard for Swimming Pools*** **CJ 244—2007**, has been issued and put into effect . This new standard is to replace the "Hygienic Standard for water Quacity in man – made swimming pools" included in "Hygienic Standard for swimming Places GB 9667—996, in which the requined water quality is set too low to meet the requirement to water quality for large swimming competitions. In addition, there are significant differences letween the "Hygienic Standard" and infernational standard of water quality for swimming pools in terms of specified cheek eist of water quality. So, a new standard is necessary to be in line with international standards. The ***Technical Code for Water Supply and Drainage Works of Swimming Pools*** **CJJ 122—2008** has also been issued and put into effect.

Ⅸ. Fire-fighting Water Gun, Fire – fighting intelligeut Active water & mist Sprinkling technology for Large Spaces

In the buildings of public functions, such as stadiums, gymnasiums, exhibition centers and grand theaters, there are the places with the heights exceeding the limit specified in ***Design Regulation for Automatic Sprinkler Systems*** that an automatic sprinkler system can reach when fighting a ground fire. Depending on height, auto matically controlled fire fighting water gun, fire fighting infelligent active water & mist sprinkeing system can be used to replace common automatic sprinkeing system to meet the requirement of fire confrol in super large spaces to ensure personal and property sapety. Mist spray is a kind of facility which uses water to put out fire in place of the fire fighting devices using gas in boiler houses and diesel generator rooms. It is also widely used in engineering. The corresponding national standards, ***Design Regnlation for Fixed Fire-Fighting water gun Systems*** **GB 50338—2003** and ***Design Regulation for Fire fighting Mist Sprinkeling Systems*** **GB 50219—95**, have also been issued and put into effect.

To embody the development and applications of abovė mentioned new techniques, facilities and materials and meet demands of the designers undertaking design of water supply and drainage works, China Architecture Design & Research Group organized and set up an editorial committee for compilation of this manual. Composition of the editorial committee-director: Zhao Li (president of Institute of Mechanical and Electrical Design, professor level senior engineer); deputy

director: Wang Yaotang (deputy chief engineer of Institute of Mechanical and Electrical Design, professor level senior engineer); members: Liu Zhenyin (advisory chief engineer, professor level senior engineer), Zhao Shiming (deputy chief engineer, professor level senior engineer), Fu Wenhua (advisory chief engineer, senior engineer), Chen Yaozong (professor level senior engineer), Chen Guanghui (managing director), Guan Xingwang (chief editor), and Qian Mei (managing director). This manual has been fully revised by the well-known experts in the sector organized countrywide. The manual revised falls into two volumes (volume 1 and volume 2), of which the content becomes more detailed, accurate and full. Reprint of this manual is an accomplishment obtained by active participation, industrious labor and teamwork of all compilers as a mission of the time.

Due to the compilers' knowledge limitation, it is unavoidable that some errors and inade quatenesses may exist in this manual. Your comment and correction are welcomed.

We dedicate this manual as an offering to foundation of Water Supply and Wastewater Association under Architectural Society of China.