Planning, Building and Designing with Water

Water-scapes Innova-tion.

水敏性创新设计

Herbert Dreiseitl & Dieter Grau | 赫伯特·德赖赛特尔和迪特尔·格劳 编著

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Preface

by Dieter Grau

Working with urban water presents one of the most fundamental and rewarding challenges in our cities today.

After realizing Asia is heavily in need of flood protection and improvement of water quality and urban quality, we feel delighted to present our ideas for those issues in this book. After the three editions of Waterscapes, we made a conscious decision to publish our most current work now in an English/Chinese bilingual version for Asia. As the urbanisation process has reached an enormous speed, the consideration of clean water, blue sky and quality of life for people in dense cities has reached utmost importance. This has to be seen also in the light of a harsh competition between cities and their abilities to attract investment and talent.

Creating a better systemic approach to resources in cities, where the local people and local authorities are integral part of the solution is one of the key directions, in simple words this could be recalled as a process "vision creation" instead of "problem solving". Low-tech urban innovations are necessary to enhance the performance of cities in the future but consider the underdeveloped knowledge of those systems maintenance with non educated people.

We have focused in this book on project samples which show a sustainable approach to new waterscapes for cities and even extending it to a regional scale. The core approach of all the work shown is the deep integration between city planning and infrastructure. But an ultimate component of liveable cities is the human scale quality, where water can play a fascination role and can provide beauty and aesthetical qualities.

Some samples address key issues of flood management and water quality, while seeking to create the greatest possible synergy with the urban environment. This new generation of urban waterscapes, or blue-green infrastructures addresses essential city services such as mobility, recreation, safety and biodiversity, creating a strategic and feasible approach to ensure long-term resilience and economic buoyancy. The networking of city public space as interactive, ecological infrastructure makes our cities more beautiful, functional, safe and comfortable. This means that parks, plazas, streetscapes and rivers are blue-green infrastructure. Every investment is rewarded by the social-economic synergies of this interdisciplinary approach.

Take, for example, Singapore. The Kallang River- Bishan-Ang Mo Kio Park project is a new vision for blue-green city infrastructure which addresses the dual needs of water supply and flood protection while creating spaces for people and nature in the city. Tianjin Cultural Park is the city's most significant urban redevelopment project which manages stormwater for microclimate improvement and flood protection, while creating a high quality civic stage for Tianjin City's new cultural center. Offenbach Harbour represents a pragmatic vision for how climate adaptation can be achieved in urban context creating attractive neighbourhoods through integrated engineering.

Thanks to the great support of all colleagues in the Atelier studios, special thanks to Dr. Gao Feng and her continued work on the translation and coordination. Many thanks also to all our friends and colleagues who took the effort and contribute with great passion. Special thanks to Dr. Eduard Kögel, Gerhard Hauber, Mr. Khoo Teng Chye, Prof. Wolfgang F. Geiger, Prof. Antje Stockmann, and Prof. Che Wu for their essays as an essential part of the book.

前言

迪特尔·格劳

应对城市水环境问题成为了当今城市之中最根本、最具挑战意义的课题之一。在了解到亚洲国家在抵御城市洪水侵袭、改善水质和提升城市品位的强烈需求之时，非常荣幸能够在这本书中介绍我们在面对这些问题方面的观点。在出版此书的前三个版本之后，我们决定在这本面向亚洲国家的中英双语的书籍中更新、发表最新的代表作品。在亚洲国家城市化进程正值高速行进之时，对于洁净的水体、蔚蓝的天空和改善人口密集城市之中生活质量的考虑已经极为重要。它们同样也被视为城市之间在吸引投资和引进人才方面激烈竞争的关键要素。

创造一个城市之中更加完备的资源系统解决方案，将地方居民和政府机构整合作为解决方案的组成部分，成为了解决方案的关键步骤。简单而言，这并非单一的“解决问题”的过程，而可以被重新定义为一个“视觉创造”的过程。当前较低技术含量的城市创新设计尽管在提高未来城市机能方面发挥作用，但仍需意识到在这些系统的设计和维护方面从业者知识和经验的欠缺。

在这本书中，我们专注于项目案例，展示了以可持续的方式设计城市以及城市区域范围的水敏性景观。而这些项目的核心则归结为城市规划与基础设施的深度整合。不过，宜居型城市的最基本内容仍为人性化尺度的设计质量。在那样的空间之中，水敏性设计可以成为一种极具吸引力的元素，提供美观、亮丽的城市环境。

在一些案例之中，明确提出了完善洪水管理、提升城市水质，并同时寻求创造水资源与城市环境协同作用的最大可能等关键性问题。这样一种新生代的城市水敏或蓝绿基础设施设计，满足了如流通、休闲娱乐、安全和生物多样性等方面的基本城市服务，能够创建以一种战略性、可行的方式保障长效城市弹性适应能力和经济增长浮力。互动、具备生态基础设施特征的城市公共空间网络，能够让我们的城市更美丽、功能齐备、安全和舒适。它也意味着公园、广场、街景和河流将共同组建成为城市之中的蓝绿基础设施。每一项投资都会从这种跨学科的经济、社会协同作用之中获益。

新加坡，加冷河碧山宏茂桥公园项目是一个全新的城市蓝绿基础设施的典型案例，满足了水资源供应和防洪保护的双重需求，同时为城市之中的人们创造了与自然接触的空间。天津文化中心作为天津市近十年来最重要的城区重建项目，管理雨洪、提升区域小气候、进行防洪保护，并为天津市新的文化中心区域创造了一个高品质的市政平台。德国奥芬巴赫港口区域的规划设计则展示了如何在城市背景下实现气候适应性设计，并通过设计与工程的整合、创造富有吸引力的邻里社区。

感谢德国戴水道设计公司全体员工的大力支持，特别感谢高枫博士和她一直以来的翻译和协调工作。同时十分感谢我们所有的朋友和同事们的努力和富有激情的工作。特别感谢为此书写作主旨文章的爱德华·科格尔博士，格哈德·豪博先生，邱登才先生，沃夫冈·F·盖格教授，安茱·斯托克曼教授，车伍教授。

Introduction

by Herbert Dreiseitl

Waterscapes have always been the driving component for structures in natural and urban environments. Without water there is simply no life. Never bound to strict limitations water fulfills in the long term the innovative character of transition, change, and development not only in the natural environment but also within urban settlements.

We have been active with integrated water-projects in cities all around the world for more than 30 years, combining contextual design with sustainable engineering. This was not a given standard, and waterscapes in cities were seen more as a challenge and danger instead of an opportunity. To drain and to get rid of water as fast as possible was a common practice. In the beginning of our work engineers were making jokes about our ambition to find better ways of environmentally responsive water management. Today this is a mega-trend and we can see this crucial topic is receiving more and more awareness in media, politics, and in the professional world, one we foresee increasing even more as an urgent topic in the future.

Natural water systems always combine functionality with a high aesthetic performance. There is a sense of logical balance, of "common sense" in these natural hydraulic systems that can create adaptable and flexible opportunities in dynamic landscapes where many vibrant life forms can exist and even depend upon the environment. It is a creative beauty that takes spaces and performs at the appropriate time, a motion we have often lost within industrialization, our artificial technology, and rising urbanization.

To bring us closer to this natural prototype it always comes back to a fundamental question: Can we create living systems that filter, clean and regulate water, balance temperature, produce good air, save natural resources, increase biodiversity - and what are the basic principles and processes to achieve this while integrating in space and time?

A significant amount of research and development today has gone into engineering. Not only are mathematic hydraulic models compiled or flood risk analysis and protection created but strategies for traffic control, energy efficiency, and other urban design and planning tools. Often we know about these methods, engineering tools, and instruments but we do not know how to implement this in the urban fabric. There is a competition for space usage especially in urbanized areas, and this conflict is dramatically rising in turn with increasing urban density. Traffic, industry, shopping, housing, parks, recreation, and leisure activities are growing - but in the near future we will simply run out of space. Each

of the aforementioned functions and services demanded its own rights and space needs, and tended to be located and treated separately without any relationship to context. With this attitude many cities were created and look today like old, inflexible, broken machines that need permanent reparation and demand expensive maintenance. Even with the best intentions in mind, this service draining our limited resources, deteriorating the environment, and destructing sustainable urbanization and livable cities.

Can we afford this in the future?

The key seems to be found within the urban performance and how to best integrate adaptable, flexible infrastructure. Cities will need to become more multifunctional with its allocation of shared spaces. Simultaneously cities will need to become more kinetic, utilizing spaces at different times with varying, different functions. Like space is needed for water after a rain event, the dynamic occurrence of multiple mobility at rush-hours and gatherings of immense crowds of people for a special cultural event is also in need of space. We have to invent cities that can handle these processes. The key lies then therefore in not just technology but meaningful and resilient solutions of the urban form by good governance, new forms of organization, and integrated aesthetically attractive design enhancing quality of life standards.

Combining high forms of aesthetics and efficient technical performance works best within the local cultural context. We have seen too many glittering, slick masterplans with a strong top down attitude that have in the end proven ineffective and have failed. Since our establishment in 1981 we have been constantly searching for opportunities to integrate participation and processes, to bring the local residents and stakeholders on board right from the beginning. Our projects were successful when we were able to find the right mix of a bottom-up-and-top-down approach, with centralized and decentralized organizational structures. Together we pushed the envelope and created, as pilot projects, many resilient shared spaces in cities. This resulted in a win-win situation for the local people and the natural environment.

Innovative Waterscapes influence modern lifestyles, increase better health conditions, and create more beauty in cities. Instead of the hard, inflexible, and old machines of the past, Cities of the Future can become resilient dynamic organisms supporting our modern urban life and society.

简介

赫伯特·德赖赛特尔

水敏性设计一直作为自然和城市环境结构之中的驱动组件。没有水就没有生命。水从不受限制，长期以来存在于自然以及城市居住环境之中，不停歇地转换、变化和发展，实践着自我的更新。

三十多年来，我们一直活跃在世界各地城市综合水务项目的设计活动之中：将可持续的工程实践与广阔背景下的概念设计结合。这里不存在一个既定的标准，现存城市之中的水敏性设计更多的是被看做一种挑战和危险，而非机遇。排放、尽快去除多余水体是一种常见的做法。在我们工作的初始阶段，工程师曾经对于我们寻找更好的环境适应型水管理方式的努力付之一笑。而今天，这已经成为了一种大趋势，我们可以看到这一至关重要的话题正在受到媒体、政界以及专业领域越来越多的关注，我们完全可以预见到关于水敏性设计的话题在未来会变得愈发的紧迫和关键。

自然水系总是能够将功能性与极高的审美表现结合起来。这里有一种逻辑上的平衡，一种自然水利系统之中的“常识”，它能够创建动态景观之中充满适应性和灵活性的机会，充满活力的生命形式便可能存活并与环境相互依存。它是一种创造性的美，能够在适当的时间出现并发挥作用；它也是一种在我们的工业化、人工技术迅猛发展以及不断浓重的城市化之中常常被丢失的一种态度。

为了使我们更接近这一自然的原型，又回到了一个基本问题：我们是否能够创造具备过滤、净化以及调节水量、平衡温度、制造清洁空气、节约自然资源、提高生物多样性的生命系统？而整合空间和时间，达成这些目标的基本原则和流程是什么？

如今的大量研究和发展已经进入工程领域，不仅在数学水力模型建造或是洪水风险分析和保护方面，而且在交通控制、能源效率以及城市设计和规划工具应用策略上都有所运用。通常情况下，我们也许仅仅了解这些方法、工程工具和仪器设备，但却并不知道如何将其在城市结构之中加以实践。在空间使用特别是城市地区空间使用方面存在着竞争，且随着不断增加的城市密度，这种竞争冲突变得愈发剧烈。交通、工业、商业、住房、公园、娱乐和休闲活动不断增加，在不久的将来，我们可用的空间将变得更加

紧张。上述的每一项功能和服务都有其自身的权利和空间需求，并且常常孤立分布、彼此与周围环境之间无任何关联。在这样的态度指导之下，许多城市被建造起来，在今天看来就如老旧、机械、破碎的机器，需要永久的修缮和昂贵的维护费用。即使拥有最美好的意愿，这种服务也在耗尽我们有限的资源、恶化环境、破坏可持续的城市化和宜居城市发展。

未来，我们是否能够担负?

问题的关键很大程度上在于城市的表现，以及如何最好地整合适应性强、灵活的基础设施。城市需要变得更加多功能，享有更多的公共空间。同时，城市需要变得更具动感，在不同的时间内利用空间发挥多样变化的功能。正如降雨之后所需要的雨水排放、城市峰值时刻发生的紧急事件以及特定的文化性集会时的人群快速聚集活动等，都需要城市里的缓冲空间。我们必须创造出能够应对这些状况的城市空间结构。因此，问题的关键不仅依赖技术层面，而且包含对于城市形式的富有意义的弹性解决方案。通过良好的管理，新型的组织形式，综合、美观、且具吸引力的设计，来提高生活质量标准。

综合高品质美学形态和高效的技术性能的作品最能与地方的文化背景完美结合。而相反，我们已经能够清楚地看到，太多被光环笼罩、目标宏伟远大、但却华而不实的规划项目最终被证明无效而失败。自德国戴水道设计公司于1981年成立以来，我们持续不断地寻找机会注重参与和过程，从初始阶段即寻求带给当地居民和项目业主们广泛的权益。我们总是能够找到由下至上以及自上而下的正确组合方式，运用集中和分散的组织结构，保证项目成功。我们以此为基准，创建众多的试点项目，组成了城市之中的弹性共享空间，如此便形成了当地居民和自然环境之间双赢的局面。

《水敏性创新设计》一书之中所介绍的设计准则和项目案例能够影响现代生活方式、提高环境卫生状况、创造城市之中更多的美景。取代坚硬、毫无活力、老式的城市机器，未来之城可以成为富有弹性的动态有机体，以支撑我们现代化的城市生活和社会发展需求。

Water – the Key Resource for China's Future

by Dr. Eduard Kögel

"Since 1991, 31 million hectares of drought-affected farmland are irrigated annually on average, saving 39.41 million tons of grain, and enabling 24.36 million people and 19.08 million livestock access to drinking water each year." This statement is taken from the website of the Ministry of Water Resources of the People's Republic of China and reveals one of the big water related problems the country is facing. Water consumption for agriculture is between sixty and seventy per cent of total consumption, whereas industry uses around twenty-five per cent, leaving only twelve per cent for domestic use. The national policy for food self-sufficiency in a rapid urbanization has significant effects on irrigation-based agricultural production. More than forty per cent of the population lives in the North China Plain with only eight per cent of the national water at their disposal.

The uneven distribution of water between North and South China with a still-expanding population, poor water related infrastructure and management, pollution of surface water and depletion of groundwater as well as regular floods and droughts, result in growing regional conflicts over water-allocation. Experts believe that the rapid economic development of China will be substantially effected by these challenges. Many of the problems have to be tackled on an administrative level, but others only can be changed by individual awareness and modification of behavior. Both aspects must be seriously considered in the future.

Traditional Aesthetic and Technical Concepts

In ancient times the treatment of water related issues was already a topic in intellectual discourse, and was used in different fields of artistic expression and religious practice. The heroic hydraulic engineer Li Bing and his son Li Er Lang built the Dujiangyan Irrigation System in Sichuan almost 2,300 years ago. Their weir system was ingenious and, over time, was further developed into a distribution network of water in the basin of Sichuan, which gave rise to a rich agricultural production. This ancient system is still in use today. No wonder that the two engineers were idealized and worshipped in temples dedicated to their name. Hydraulic engineering and irrigation became a key issue for the development of a complex agricultural society in ancient China.

Early on, the rice-growing regions of Asia developed communal management systems for the distribution of water. In the case of China and India, the historian Karl August Wittfogel spoke of "hydraulic empires". The natural phenomenon of the monsoon with its seasonal rainfall and the reliance on continual water supply for agricultural production made it necessary to base the management on a powerful bureaucracy. The centralized water administration was the structure for what Wittfogel called "Oriental Despotism".

In the 1930s, in his work "Climate and Culture", the Japanese philosopher Tetsuro Watsuji pointed out the interconnectedness between climate, environment and human culture, in order to understand the basis of regional Asian societies. In the case of central China he spoke of the "monsoon society", mainly depending on the regular seasonal rainfall with its specific need for management of water, which had the consequence of a less individual, but more communal society.

Throughout history, the danger of floods and droughts was always present and guided the general concept of water management, not only in agriculture but also for the layout of human settlements. The awareness of water as part of the manmade environment is preserved in the traditional aesthetic concept of Chinese culture. The ideal landscape is reflected in traditional garden design, with a harmonious relationship between rocks, plants, pavilions and water.

Today the balance and harmony is ousted by technical feasibility and maximizing agricultural production in a fast growing economy. After the foundation of the People's Republic in 1949, water management became a key task for the state. The building of dams and irrigation systems, river regulation and monumental transfer projects from water-rich regions to the arid north of the country, was a political issue right from the start. Technical feasibility became the guiding principle for the experts within the political system. Hu Jintao, General Secretary of the Communist Party and President of the People's Republic of China, is a trained hydraulic engineer.

Natural Conditions and Conflicts

The huge surface area of the People's Republic of China is drained into the sea by only a few river systems. By far the biggest is the Yangtze River system in central China, which drains one-fifth of the country's surface and carries almost half of its surface water. Its source lies in the Tibetan mountains, from where the river runs 6,300 kilometers before emptying into the sea near Shanghai. Half of the country's agricultural production comes from the drainage area of the Yangtze River.

The second longest river, the 5,400 kilometer long Yellow River, empties into the Bohai Sea. In the last hundred years it has caused many deadly floods with several million victims. Currently, the lower reaches and the river mouth in Shandong Province fall dry half the year, with the consequence of further lowering the ground water level of the region. From its source in the Tibetan Mountains, it winds through nine provinces, including Inner Mongolia, Shanxi and Shaanxi, where massive erosion tints the water yellow. The large amount of sediment causes problems in reservoirs and in hydroelectric power plants. In the lower regions, where the silt deposits, an elevated riverbed exacerbates the permanent danger of flooding.

In the southern border lands conflicts arise with neighboring countries like India, Bangladesh, Burma, Thailand, Laos and Vietnam surrounding water withdrawal in the upper reaches of the Mekong, Brahmaputra and Red Rivers, which all originate in Tibet or Yunnan. International negotiations about the amount of water used by China could not yet solve the problem to the satisfaction of all affected nations. With canal projects under discussion to divert the water from the named rivers towards China's arid regions, the conflicts could become more serious in the future.

A further international conflict looms with countries like Tajikistan, Kazakhstan and Kyrgyzstan about the water from Tienshan and Pamir Mountains in central Asia. In this region China needs more water for the development in the arid land of its western province Xinjiang.

Droughts and Floods

The climatic changes in recent years have caused droughts and floods in Asia with catastrophic impact on infrastructure and arable land, like 2010 in Pakistan, where a destructive flood affected twenty million people. Neighboring regions in India suffered severe drought at the same time, due to the monsoon's erratic timing. The People's Republic of China is likewise influenced by the changes in the natural climatic system. In spring 2010 severe droughts affected several Chinese provinces: Yunnan, Guizhou, Sichuan, Shaanxi and others, with serious effects in neighboring countries like Thailand and Vietnam. The droughts in these usually water-affluent regions have been called the worst in a century.

The traditionally dry northern Chinese provinces of Shandong, Shanxi, Shaanxi, Henan, Anhui and Gansu – the breadbasket of China – were hit by a severe drought in spring 2011, the worst in the region since record keeping began in 1950. Only about ten percent of the expected rainfall for the season was measured in Shandong. In June, in some of the regions, floods replaced the droughts. Even along the Yangtze River many areas were affected this spring by the worst drought in the last 50 years. But extreme rainfall downstream in the same period, threatens heavy floods.

Water Pollution and Wastewater Treatment

In 2005 a chemical plant in Jilin City, in the northeastern province of Jilin, exploded and an estimated 100 tons of toxic pollutants entered the Songhua River. The city of Harbin, with almost ten million inhabitants, depends on the Songhua River for its water supply, which was closed down for some time after the event. Other cities along the river were also affected. The long-term consequences for the inhabitants are unknown. The drinking water supply of the city of Wuxi in Jiangsu Province, with almost six million inhabitants, which relies on the water of Lake Taihu, was seriously affected by an algae bloom, caused by a combination of pollution, sinking water levels and high temperatures

in summer 2007. In both cases thousands of people left the cities, to stay in areas with a safe water supply.

In addition to such major events, the everyday practice of dumping chemical wastewater unfiltered into rivers, causes major conflicts in society. Along the Yangtze Basin alone, 10,000 chemical plants release their wastewater unfiltered or uncontrolled into the rivers. It is impossible to use the water for industrial or agricultural production without prior treatment. Under such circumstances it is impossible to think about water supply for human use. The contamination of surface water and groundwater in some regions is cataclysmic. The quality measured at more than 400 flowing water-monitoring stations indicates that they are ecologically degraded. Fertilizers seriously pollute half of all natural lakes and reservoirs.

The dramatic events are followed by an outcry in the media, but after smaller incidents the unrest among citizens is also growing in many towns and regions. Each year thousands of public protests about water issues occur across the country. The vulnerability of the water supply is increasingly becoming a political problem of significance. The administration is aware of the problem and many hundred purification plants are planned or under construction. But inadequate operation and management in existing plants indicate, that a further investment in soft skills like management and negotiation is needed.

Groundwater and Water Distribution

The depletion of groundwater in northern China is a serious problem and adequate water supply to the big cities is a constant challenge. Massive urbanization and industrialization demand much more water than the groundwater and natural water cycle can provide. The surface water in northern China is naturally extremely limited and today in many cases seriously polluted. Other alternatives have to be considered. The most effective policy would be to reduce its use, especially in agriculture. The simplest method however, appears to be drilling deeper wells and taking the groundwater from non-renewable aquifers. Many of these aquifers suffer from natural arsenic contamination and affect the health of millions of people. Due to the fact that many new deep groundwater resources are tapped, the danger of poisoning is on the rise, besides the effect of further lowering of the groundwater table.