



# 海绵城市

## 理论与实践

# SPONGE CITY


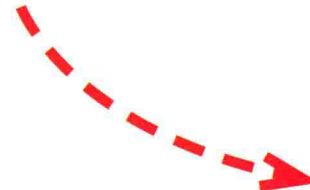

庞伟 编 李婵 杨莉 译

辽宁科学技术出版社



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· 沈阳 ·

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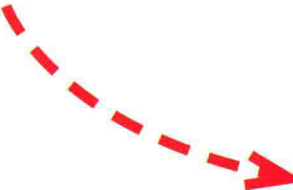

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## 序言

The Guide of Sponge City Construction, released in 2014 by Chinese Ministry of Housing Construction, becomes a key challenge in architecture and green urbanism design in China. As the different projects are perfectly illustrated in this book, there are world-wide solutions. These projects demonstrate that green spaces of different scales are capable to be innovative places to manage the flood risk and the presence of water in the city by multiple ways. This is one of the major themes of the book: to deal with the theme of water in the city in different scales: from the river and its watershed, to large landscaped parks, and to infrastructure and architecture. If in some way, the new extensive urbanisation with a higher density is created, even the risk of flooding in cities of today is strengthened, it is also possible to find out some new urban and environmental architectural forms which may also be used to manage this risk by transforming its technical constraints into new landscape and architectural vocabulary. This risk management in the city and architecture is also on the way of becoming the best expression of the overall management of environmental issues in search of new methods of more sustainable constructions.

But perhaps it is also the weak point of this new water management approach required by official policy in China, unified as 'Sponge City'. We must not, in fact, reduce green buildings of tomorrow to simple games of ditches and waterways. 'Sponge city' should actually be an opportunity to intervene and innovate on all ecological cycles of urban ecosystems, whether on the management of the water cycle, energy (refreshed energy supplied through recycled water) or urban soil. The next projects will not escape these global, ecological, integrated and transversal needs of methods.

This is certainly one of the reasons why these projects also demand a lot on the management of urban soils and new green spaces education in which the new ecological functions are also to be explained and to be put in the scene.

The presented achievements are deliberately started in steps as the answers are multiple, although mostly it always oriented towards more introduction of nature in our cities in order to finally manage flood risk through the most comprehensive natural ecosystems possible.

2014 年由中国住建部指导发表的《海绵城市建设技术指南》，如今在中国绿色建筑及城市规划中已经逐渐成为核心指导内容。正如本书中所介绍的项目及国际性方案所呈现的。绿色公共空间，通过不同尺度的处理，可以成为现今城市重要的新型雨洪管理系统。这正是本书的重点：以城市水管理问题为基础，讨论从城市及尺度之河流及其附属水系，到大型景观公园及水体，再到道路基建及街道小品等的小尺度问题。在高密度的新型城镇不断发展的现今，城市洪水风险日益加剧。而新型生态城市规划及生态建筑设计正好可以通过配合新的技术要求及新的建筑景观语境，解决新的城市雨洪问题。这种水文管理模式具有全局性及可持续性，在建筑及城市规划范畴都是一种更为优化的管理模式。

但这种管理模式在中国也有其薄弱之处，因其被单一命名为“海绵城市”。而事实上，我们不该将未来的生态设计简单化，而成为单纯的沟渠与水道的排列。“海绵城市”应该是一个整体的概念，其内容应涵盖水系统问题，能源问题（通过水循环提供新型能源），或者城市土壤问题。在未来的项目中，全局性的生态观及多领域的交叉及配合显得越来越重要。

正因如此，在这些项目中涉及了很多关于城市土壤管理以及生态科普宣传的设计及问题。

在实际问题中，方案的呈现方式是开放性的，因为问题的解决办法是多样的。但对于“海绵城市”，大都是基于将自然引入城市的理念，运用生态的方式，尽可能充分的使用城市水源，降低城市雨洪风险。



**Thierry Jacquet**

(法) 夏绮林

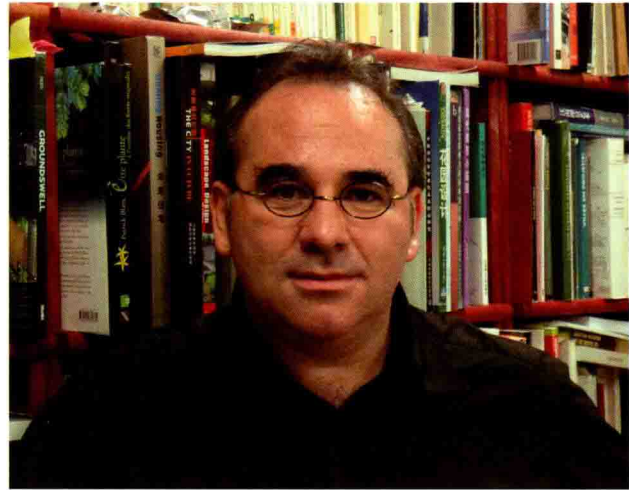
**Principal of Phytorestore**

法国滤园环境科技有限公司

董事长、主设计师

获环境规划硕士及城市规划师资格证书之后，夏绮林 (Thierry Jacquet, 生于 1965 年) 在 1990 年创立了他的第一所城市生态设计事务所，从事各种规模的项目：总体规划、城市局部规划、工厂生态重建、公共区域及工业区生态规划等。

Graduated from Paris VIII University, Thierry Jacquet (born in 1965) launched his first urban ecology agency, in 1990. He works on projects at different scales: master plan, local urbanism plan, ecological redevelopment of industrial sites, public spaces planning and business parks.



These varied and successful experiments in terms of diversity of techniques which work for the moment raise many questions. How to find solutions that will remain simple and sustainable in terms of operation and maintenance? How to make new urban space ecological and responsible for the flooding risks while remaining simple and enjoyable for residents and users in their daily life? Finally, in these processes, if the solutions are based mostly on nature like the artificially produced biomimetics, there's the risk of over-reproduction of nature. It is also the second risk that the 'sponge city' guide should overcome.

Finally, the third set of questions presented in the examples. Most of these projects show that they are from a design from several seemingly innovative technologies. But how to ensure that the objectives followed are the right ones? When we look at these projects precisely, many technical issues have arisen which clarify the complexity in front of us for controlling water cycles in the sponge city. Should we treat the quantitative question of water volumes which need to trap and thus achieve zero discharge of water outside in priority? But in this case, for what kind of storm? For exceptional storms which occur every ten, fifty or a hundred years?

This increased presence of water in the public space or to be released into the natural environment must also meet with quality objectives? Must it respond to the bathing quality to eliminate health risks? Should it just intercept the main organic pollutants and hydrocarbons to improve the quality of natural environments where the rejections happen?

The creation of a comprehensive guide for sponge cities therefore entails the creation of a guide of formal solutions at all levels of the city. However, it must also be accompanied by technical guides drafts which describe the methods and technologies for implementation.

This book just lays the groundwork in complete solutions that are to be invented to make a real sponge efficient city in terms of quantified objectives and pleasant in terms of living space.

这些不同的成功方案遇到的技术问题是多样的，并引发了多种问题。比如，如何找到维护简单且耐久的可持续解决方案？如何在对抗雨洪问题的同时为用户提供一个良好的生活环境？在这些设施方案中，如果该解决方案如大部分方案一样取材自自然界（比如仿生学），将会有对自然过分复制的风险。这也是“海绵城市”应该克服的第二个弱点。

最后，在实例中可以看到第三个弱点。这些项目大部分是基于他们的一些新技术。但如何确保目的的正确性？从一些项目的细节中可以看出，方案技术的重点是我们必须得到海绵城市的水循环系统的主导权。但是否必须首先处理径流的水体的流量问题高于将其收集并真正实现零排放？且在此情景下，应考虑何种级别降雨？十年一遇，五十年一遇还是一百年一遇强降雨？

排放的水体是否需要符合质量标准？是否必须达到生活用水标准？是否可以仅仅过滤掉主要的有机污染物及碳氢化合物，以改善排放地的生态环境？

因此，对于海绵城市参考用书的编纂，应该涉及城市的各种尺度。同时，也必须涉及详细的技术方法及实际应用范例。

本书仅是对于“海绵城市”理论研究的第一步，仍需从技术量化方面及在宜居环境方面加以补充完善。





# CHAPTER ONE

## 第一章

# SPONGE CITY THEORIES



海绵城市理论



# Sponge City Theories Review

By YU Kongjian

## 海绵城市理论简述

俞孔坚

### 1. Background

Today China is facing with various kinds of water crisis: water shortage, water pollution, flood, urban inland inundation, groundwater recession, lost of aquatic life habitats... These are all serious problems in China now.<sup>[1]</sup> This 'water crisis syndrome' is not caused by mismanagement of water conservancy administration department or other departments; rather, it is a comprehensive, systematic issue that needs a holistic approach to find an appropriate solution. Thus, 'Sponge City' theories came forth, based on the characteristics of the water situation in China.

#### 1.1 Geographic Location and Monsoon Climate

With the influence of southeast and southwest monsoon, China receives rainfalls with a great interannual and interseasonal variation. Rain comes mainly between June and September, accounting for 60%-80% of precipitation of the total year, even up to more than 90% in Northern China. In addition to that, the uncertainty in climate change across the country brings about the risks of a high frequency of storm and flood and an increase in peak flow, making summer a period of frequent occurrence of inland inundation. Meanwhile, due to the large amount of peak flood, most of which cannot be used or infiltrated, flow cutoff and flooding appear alternately, resulting in increasingly extreme risks.

#### 1.2 Rapid Urbanisation, Overdevelopment, and Serious Pollution

Water resources have been unprecedentedly overused in China, especially in the North, where we have seen flow cutoffs in the lower courses in Yellow River, Tarim River and Black River, and large areas of wetlands and lakes disappeared.<sup>[2]</sup> Moreover, exhaustive exploitation of groundwater is becoming an increasingly serious problem, with an over exploitation area totalling 190,000km<sup>2</sup>, and many northern regions suffer the serious crisis of groundwater depletion. At the same time, surface water contamination across the nation is a worrying issue.

#### 1.3 Unscientific Engineering

Urbanisation and construction of all kinds of grey infrastructure have caused serious results; vegetation damage, water and soil erosion, increase of impervious area, fragmentation of rivers and lakes, disconnection between surface water and groundwater... Water conditions such as flow convergence have been greatly altered, leading to a general tendency of confluence acceleration and high peak flow. Until now, we still pursue to solve complex, systematic water problems through grey infrastructure engineering targeted at single goals. As a result, we make the issues grow more and more serious and get into a vicious circle. Oversimplified engineering is reflected in (or derived from) the government's single-targeted decision-making and the water resources management system which segments departments, regions and functions. Water is a system on earth that should never be segmented, but now in our current engineering and managing systems we broke it up into fragmentations: the separation of water and soil; the separation of water and organism; the separation of water and urbanism; the separation of drainage and water supply; and the separation of flood control and drought resistance. The oversimplified engineering idea and the single-targeted decision-making directly brought about the outburst of the above-mentioned water crisis. Therefore, the solution to the 'water syndrome' in China is to return to the water ecosystem to find a comprehensive way to solve the problems.

### 一、“海绵城市”理论提出的背景

当今中国正面临着各种各样的水危机：水资源短缺，水质污染，洪水、城市内涝，地下水位下降，水生物栖息地丧失等，问题非常严重<sup>[1]</sup>。这些水问题的综合征带来的水危机并不是水利部门或者某一部门管理下发生的问题，而是一个系统性、综合的问题，我们亟需一个更为综合全面的解决方案。“海绵城市”理论的提出正是立足于我国的水情特征和水问题。

1.1 我国地理位置与季风气候决定了我国多水患，暴雨、洪涝、干旱等灾害同时并存

我国降水受东南季风和西南季风控制，年际变化大，年内季节分布不均，主要集中在6~9月，占到全年的60%~80%，北方甚至占到90%以上，同时，我国气候变化的不确定性带来了暴雨洪水频发、洪峰洪量加大等风险，导致每年夏季成为内涝多发时期。同时，由于汛期洪水峰高量大，绝大部分未得到利用和下渗，导致河流断流与洪水泛滥交替出现，且风险愈来愈极端。

1.2 快速城镇化过程伴随着水资源的过度开发和水质严重污染

我国对水资源的开发空前过度，特别是北方地区，黄河、塔里木河、黑河等河流下游出现断流局面，湿地和湖泊大面积消失<sup>[2]</sup>。地下水严重超采的问题也日益加剧，全国地下水超采区面积已达到19万平方千米，北方许多地下水降落漏斗区已面临地下水资源枯竭的严重危机。同时，我国的地表水水质污染状况不容乐观。

1.3 不科学的工程性措施导致水系统功能整体退化

城市化和各项灰色基础设施建设导致植被破坏、水土流失、不透水面增加，河湖水体破碎化，地表水与地下水连通中断，极大改变了径流汇流等水文条件，总体趋势呈现汇流加速、洪峰值高。直至今日，我们依然热衷于通过单一目标的工程措施，构建“灰色”的基础设施来解决复杂、系统的水问题，结果却使问题日益严重，进入一个恶性循环。狭隘的、简单的工程思维，也体现在（或起源于）政府的小决策的和部门分割、地区分割、功能分割的水资源管理方式。水本是地球上最不应该被分割的系统，可是我们目前的工程与管理体制中，却把水系统分解得支离破碎：水和土分离；水和生物分离；水和城市分离；排水和给水分离；防洪和抗旱分离。这些都是简单的工程思维和管理上的“小决策”，直接带来了上述综合性水问题的爆发。所以，解决诸多水问题的出路在于回归水生态系统来综合地解决问题。