【专题：海绵城市 / Sponge City】

特邀专题策划：刘建，任心欣

利用自然力量建设“海绵城市”专题研究序言

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关键词：海绵城市；低影响开发；创新；水环境；面源污染

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20世纪70年代以来，急速的工业化和城市化使得全球温暖化和城市暴雨问题日趋严重，城市“看海”现象时有发生。为了减轻暴雨危害和控制面源污染，美国提出最佳管理措施（best management practice, BMP）、低影响开发（low impact development, LID）、绿色基础设施（green infrastructure, GI）等。受美国的影响，英国提出了可持续城市排水系统（sustainable urban drainage systems, SUDS）、澳大利亚提出了水敏感城市设计（water sensitive urban design, WSUD）、日本提出了雨水滞留渗透计划，推行流域综合治理。

国外暴雨管理和雨水利用基本由地方政府或民间组织推动，形成一定规模后由中央政府在国内外推广。但中国是由中央政府推动的。为了解决城市环境恶化问题，2013年12月，习近平总书记在中央城镇化工作会议上发表了重要讲话，要求优先考虑更多利用自然力量排水，建设自然积存、自然渗透、自然净化的“海绵城市”。从此海绵城市的理念在国际上得以广泛传播。

为了贯彻落实习近平总书记海绵城市的重要讲话精神，国家财政部、住建部和水利部于2015年4月和2016年4月分两批在全国30个城市实施海绵城市建设试点工作，第1批试点城市14座，第2批试点城市16座。为了推进海绵城市建设，2015年10月11日，国务院办公厅发布了《关于推进海绵城市建设的指导意见》（国办发〔2015〕75号），要求通过海绵城市建设，综合采取“渗、滞、蓄、净、用、排”等措施，最大限度地减少城市开发建设

对生态环境的影响，将70%的降雨就地消纳和利用。到2020年，城市建成区20%以上的面积达到目标要求；到2030年，城市建成区80%以上的面积达到目标要求。经过5年多的建设，至2019年底，海绵城市建设试点工作结束，30座试点城市全部考核合格。

原理上，海绵城市与BMP、LID、GI、SUDS、WSUD和日本的流域综合治理等相似，通过源头控制、增加下垫面渗透滞蓄净化能力，对城市雨水进行综合管理，减少雨水径流和污染物排放。由于增加了黑臭水体治理的内容，所以，海绵城市设施的种类和功能要比LID和WSUD等雨水管理设施多。

深圳作为中国改革开放的重要窗口，经过40年的建设，已成为一座充满魅力、动力、活力、创新力的国际化创新型城市。2019年8月，中共中央、国务院发文支持深圳建设中国特色社会主义先行示范区，要求深圳践行“绿水青山就是金山银山”等理念，在“美丽湾区”建设中走在前列。今后深圳市的海绵城市建设应与先行示范区的要求相协调，为深圳成为竞争力、创新力、影响力卓越的全球标杆城市增添色彩。

自2016年4月深圳入选国家第2批海绵城市建设试点城市以来，努力探索海绵城市理念与深圳文化、气候、地形、地质条件相结合的实施方法，在圆满完成试点工作的同时，因地制宜地进行了创新，建造了一些新型海绵城市设施，提高了海绵城市设施效率，改善了城市生态环境。

为了总结海绵城市建设经验，尤其是深圳市的

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创新经验,《深圳大学学报理工版》推出了海绵城市专题,分两期刊登与海绵城市建设相关的研究成果.本期发表的5篇论文主要集中在海绵城市建设经验总结和实验研究方面,下一期将重点关注海绵城市监测和工程案例分析方面.

第1篇论文《深圳市海绵城市建设与创新》是一篇综述性文章,总结了深圳市海绵城市建设经验与教训,论述了深圳市海绵城市创新成果,展示了深圳市海绵城市研究水平和创新能力.

第2篇论文《深圳绿色屋顶雨水滞留效应变化及其影响因素》通过对深圳市4种不同植被覆盖的绿色屋顶进行连续水文监测,分析了绿色屋顶雨水滞留效应的波动规律及其影响要素.

第3篇论文《深圳典型道路原位模拟雨水生物毒性评价分析》通过对深圳市12条典型道路进行原位模拟检测,提出并分析了将污染物的毒性作为

雨水径流安全回用指标的必要性.

第4篇论文《校园低影响开发渗蓄性能及成因模拟分析》利用雨洪管理-地理信息系统模型对兰州市某校区绿色屋顶和透水铺装的雨水径流控制效果进行了研究.

第5篇论文《城市建成区河流生态功能评价及修复策略——以深圳市大沙河为例》构建了河段尺度下的河流生态功能评价指标体系,并对大沙河生态功能进行了评价.

最后,希望从事海绵城市领域的读者更加关注海绵城市的生物功能研究,更多地交流研究成果,使海绵城市设施既不滋生蚊虫、蚊子,又能吸附漂浮在空气中诸如新冠病毒等有害微生物,为改善城市宜居环境添砖加瓦,促进我国海绵城市良性发展.

Preface to the special research on building the sponge city by natural power

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Key words: sponge city; low impact development; innovation; water environment; non-point source pollution

Since 1970s, rapid industrialization and urbanization have made global warming and urban stormwater more and more serious, and the phenomenon of “sea views in city” has occurred from time to time. In order to reduce the negative effects of stormwater and control non-point source pollution, the United States of America has put forward some measures such as best management practice (BMP), low impact development (LID) and green infrastructure (GI); Britain proposed sustainable urban drainage system (SUDS); Australia presented water sensitive urban design (WSUD); and Japan made rainwater storage and infiltration plan and implemented integrated watershed management.

The stormwater management and rainwater utilization in foreign countries are basically promoted by local governments or non-governmental organizations, then they are implemented by the central government after forming a certain scale. However, they are promoted by the central government in China. In order to solve the problem of urban environment deterioration, General

Secretary of the Communist Party of China (CPC), Xi Jinping, proposed the great strategy of constructing the sponge city through natural storage, natural infiltration, natural purification and natural drainage in December 2013. Since then, the concept of sponge city has been widely spread in China and abroad.

In order to implement the spirit of Xi Jinping's important speech on sponge city, Ministry of Finance, Ministry of Housing and Urban-rural Development and Ministry of Water Resources selected a total of 30 pilot cities of sponge city construction in 2015 and 2016. To promote the construction of sponge city, the General Office of the State Council issued the *Guiding opinions on promoting the construction of sponge city* (Guofabao [2015] 75) on October 11, 2015, which required some comprehensive measures such as rainwater infiltration, retention, storage, purification, use and drainage should be taken to minimize the impact of urban construction on the ecological environment during the sponge city construction, and 70% of rainfall should be

treated and used locally. More than 20% of the urban built-up areas should achieve the objectives and requirements by 2020; and more than 80% of the urban built-up areas should achieve the objectives and requirements by 2030. After more than 5 years of construction, the sponge city construction pilot work was completed by the end of 2019, and all 30 pilot cities passed the national assessment.

The principle of sponge city is similar to BMP, LID, GI, SUDS and WSUD. By means of the source control and increasing of infiltration, retention, storage and purification capacity of urban underlying surface, the comprehensive management of urban rainwater is carried out to reduce rainwater runoff and pollutants. However, the sponge city has more types and functions than those of LID, WSUD etc., because it requires some facilities to treat the black and odorous water.

Shenzhen, as an important window of China's reform and opening up, has become an international innovative city full of charm, power, vitality and innovation after 40 years of construction. In August 2019, Shenzhen was supported to build a pilot demonstration area of socialism with Chinese characteristics by the Central Committee of CPC and the State Council, and has been becoming the leading city in the construction of the beautiful Guangdong-Hong Kong-Macao Greater Bay Area by implementing the "Two Mountains Theory" that lucid waters and lush mountains are invaluable assets. Therefore, the sponge city construction in Shenzhen should be coordinated with the requirements of the pilot demonstration area of socialism with Chinese characteristics to make Shenzhen colorful as a competitive, innovative and influential global benchmark city.

Since Shenzhen was selected as the second batch of sponge city construction pilot cities in April 2016, efforts have been made to explore the implementation approach to combine sponge city concept with Shenzhen's culture, climate, topography and geological conditions. As successfully completing the pilot work, a lot of technology and management innovation have been carried out, and innovative sponge city facilities have been built.

In order to summarize the experience of sponge city construction, especially the innovation experience in Shenzhen, *Journal of Shenzhen University Science and Engineering* plans to issue the sponge city features

and publish the research results of the sponge city construction in two issues. 5 papers are published in this issue, which focus on the experience summarization and experimental research of sponge city; the next issue will address the monitoring of sponge city facilities and case studies.

The paper "Sponge city construction and innovation in Shenzhen" summarizes the experience and lessons of the sponge city construction and introduces the innovative results in Shenzhen, which reflect the research level and innovation ability of sponge city in Shenzhen.

The paper "Variation and influencing factors of rainwater retention of green roofs in Shenzhen" analyzes the variation of the rainwater retention performance of green roof and its influencing factors by continuous monitoring of four different vegetation green roofs in Shenzhen.

The paper "Biotoxicity assessment of in-situ simulated stormwater runoff on typical urban roads in Shenzhen" analyzes the in-situ simulated runoff samples of 12 typical urban roads in Shenzhen, and proposes the combined toxicity is a preferred option whether the road stormwater can be reused safely in the process of sponge city construction.

The paper "Simulation analysis of infiltration performance and cause of low impact development in university campus" simulates the detention effects of green roofs and permeable pavement by storm water management model with geographic information system, taking a campus in Lanzhou as an example.

The paper "Ecological function evaluation and restoration strategy of river in urban built-up areas: a case study of the Dasha River in Shenzhen" builds the river ecosystem function evaluation index system at the reach scale and evaluates the ecological function of the Dasha River.

Finally, I hope that readers who engage in sponge city can pay much attention to the research on biological functions of sponge city, so that sponge city facilities will not breed ceratopogonids and mosquitoes, and absorb harmful microorganisms such as COVID-19, and exchange more research results to improve the urban environment and promote the sound development of sponge city in China.

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