北京海绵城市建设的若干新技术与新装备

The New Technology and New Equipment in Beijing Sponge City Construction

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一、海绵城市中欧合作概况

Ⅰ、Overview of China-Europe cooperation in Sponge Cities

1、悠久的中欧合作历史

China and Europe have a long history of cooperation

■ 北京市水务局和北京市水科学技术研究院非常注重对外合作

Beijing Water Authority and Beijing Water Science and Technology Institute attach great importance on foreign cooperation

- 1990's 中英合作开展乡村水环境治理研究

In 1990, China and the UK jointly conducted research on rural water environmental governance

- 2000's中德合作城市雨洪利用、官厅水库流域水生态环境综合治理、奥运工程水资源综合管理、密云水库流域水土流失与面源污染防治

2000's Sino-German Cooperation City rainwater and flood utilization, Guanting Reservoir watershed water ecological environment comprehensive treatment, Olympic project water resources comprehensive management, Miyun Reservoir watershed soil erosion and non-point source pollution prevention and control

- 2012~，中欧水平台支持下进一步开展了一系列合作。

Since 2012, a series of cooperation with the support of China and Europe Water Platform.

科技奥运中德合作项目技术论坛
Technical Forum of Sino-German Cooperation Project of Science and Technology Olympics

中德雨洪利用项目的信息通报会
Information briefing on Sino-German Rainwater and flood utilization project

2、中欧海绵城市合作

Sponge city cooperation between China and Europe

■ 中欧水平台成立前后国际交流合作持续不断

International exchanges and cooperation have continued since the establishment of the China-Europe water platform

- **2012，** 中丹国际合作交流-城市雨水管理利用

In 2012, China-Denmark International Cooperation and Exchange - Urban rainwater management and Utilization

- **2013，** 与荷兰、法国团队交流商议防洪排涝合作事宜

In 2013, discussed with the Netherlands and France on cooperation in flood control and drainage

- **2014，** 赴荷兰、法国考察交流城市雨洪管理

In 2014, went to Holland and France to investigate and exchange urban stormwater management

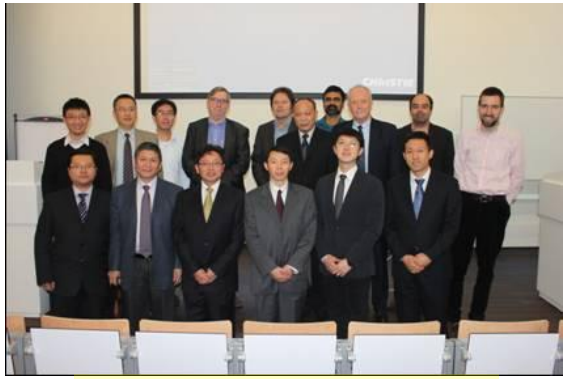
- **2015，** 中丹合作进行研究生培养

In 2015, China and Denmark cooperated in postgraduate training

- **2016，** 继续中丹、中荷合作，酝酿PI项目

In 2016, continue the cooperation between China and Denmark and China and the Netherlands, and brewing the PI project

在荷兰UNESCO-IHE交流
Exchange at UNESCO-IHE in the Netherlands



在荷兰UNESCO-IHE交流
Exchange at UNESCO-IHE in the Netherlands

2、中欧海绵城市合作

Sponge city cooperation between China and Europe

■ 中欧海绵城市国际合作

China-europe Sponge City International cooperation

- **2017， 协作完成欧方海绵城市合作项目立项**

In 2017, we cooperated with the European side to complete the project approval

- **2018.3，双方在京商议合作事宜**

2018.3, both sides discussed cooperation matters in Beijing

- **2018.5，中丹可持续城市发展合作交流**

2018.5, China-Denmark Sustainable urban development cooperation and exchange

- **2018.9，赴瑞典、芬兰参加合作项目研讨**

2018.9 Went to Sweden and Finland to participate in cooperation project discussion

- **2018.11，签订合作协议**

2018.11. Signed the cooperation agreemen

在瑞典商议PI项目合作事宜
Discuss the cooperation of PI project in Sweden

签订合作协议
Sign cooperation agreement

2、中欧海绵城市合作

Sponge city cooperation between China and Europe

■ 中欧海绵城市国际合作

China-europe Sponge City International cooperation

- 2019，全面开展合作交流

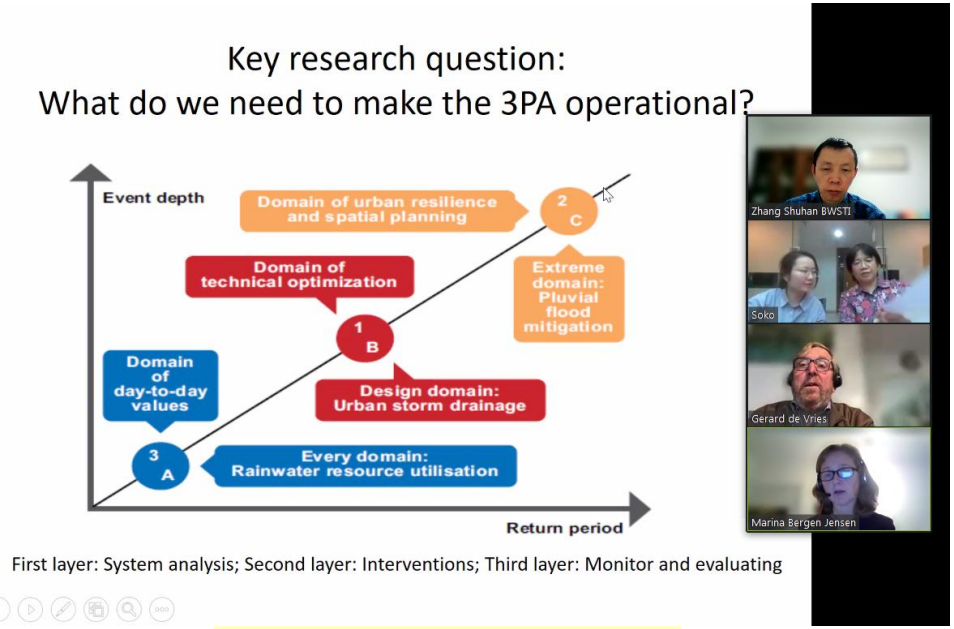
In 2019, we will carry out comprehensive cooperation and exchanges

- 2020，线上交流（8次），邮件来往

2020: Online communication (8 times) and email

- 2021，共商共议成果报告

2021, jointly discuss the outcome report



First layer: System analysis; Second layer: Interventions; Third layer: Monitor and evaluating

线上会议截图

Screenshot of online meeting

CHINA EUROPE Water Platform

1

Policy Guidance on China-Europe Cooperation on Sponge Cities

1.CEWP Policy Dialogue Process

The China-Europe Water Platform (CEWP) is designed around three strategic pillars - Policy Dialogue, Research and Innovation and Business Cooperation - with, at the same time, four thematic Focus Areas, namely Water Management and Ecological Security, Rural Water & Food Security, Water & Urbanization, Water & Energy Security.

Aiming to raise and to deepen the Policy Dialogue, there are ongoing activities between Chinese and European partners under each of these themes and in additional cross cutting issues as New Visions on Integrated Approaches, Business Cooperation and Climate Change.

And due to the fact that CEWP-EU has five Grant Contracts with EUDEL, this Policy Dialogue, being a key element for the EU Partnership Instrument, constitutes a major project output.

In the context of this water cooperation under CEWP, the Policy Dialogue can be described as the process of assisting and contributing to subnational, national and/or international decision making processes for water policies and their potential implementation, involving relevant stakeholders and key players.

Every CEWP project has developed a specific policy dialogue process, matching their own objectives and identifying or organizing the relevant arenas for this dialogue.

So, each output produced must trigger a dialogue process among the Focus Areas, resulting in a ***policy report***, that is the result of the work of each LOT at a project level. The outputs of this report, being under the responsability of the partners of each LOT, can be disseminated and, through a process of consultation with Secretariats, evaluated in order to proceed to a higher level of decision.

In case of agreement on an output merit, it should be converted into a ***policy guidance***, agreed between the two secretariats in order to be endorsed by the Joint Steering Committe (JSC). After endorsement, it can be disseminated or can be leveled up to the High-Level Dialogue Ministerial Meeting for decision. In case the High-Level Dialogue Ministerial Meeting agrees on its merit, it becomes a ***policy recommendation*** that will be integrated in the policy making of each region and it can be further disseminated.

Both secretariats must ensure the involvement of and uptake of policy guidance and recommendations by a wider range of stakeholders, such as relevant ministries or research institutes in China and Europe, that play a critical role in some of the Focus Areas' prioritized issues.

The Chinese and European CEWP secretariats have the role to manage and control the policy dialogue process at JSC Meetings, for CEWP conferences and at High Level Events, having in mind the need of sharing lessons and good practices aiming to improve the performance on every possible domain.

2. Key findings on Sponge cities

Co-funded by the European Union and P.R. China

Twitter @ChinaEUwater #CEWP
www.cewp.eu cewp.mwr.gov.cn

合作成果报告

Cooperation Results Report

二、海绵城市建设新技术

Ⅱ、new technology of sponge city construction

1、源头减排类（Source control）

■ 自灌溉雨养型屋顶绿化（Self-irrigated rainfed roof greening）

– 利用雨水满足屋顶绿化植物生长对水的需求。

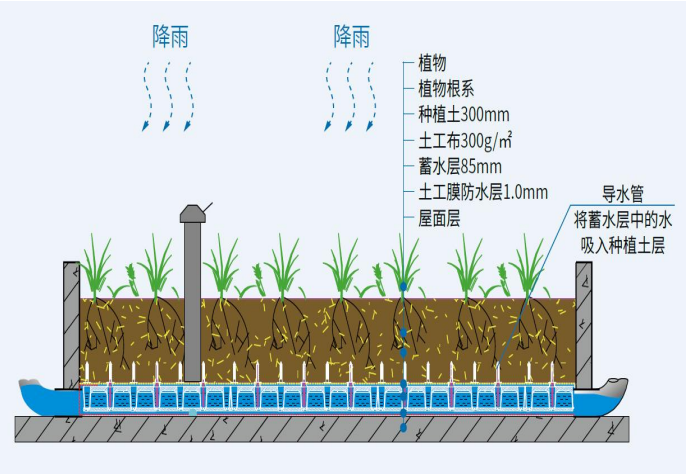
Rainwater is used to meet the water demand of roof greening plants

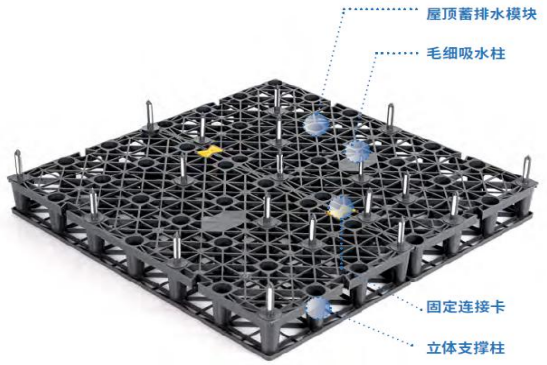
❖耐旱、耐寒、抗病虫害型植被，如景天科植物

Drought - resistant, cold - resistant, pest - resistant vegetation, such as sedum plants

❖种植层介质：轻质、透水、持水性好

Planting layer medium: light, permeable, good water holding capacity





雨养型屋顶储水模块

Rain-fed roof water storage module

1、源头减排类（Source control）

■ 雨养型屋顶绿化（Rainfed roof greening）

– 小雨，径流总量控制率达99.6%

With light rain, volume capture ratio of rainfall reached 99.6%

– 中雨，径流总量控制率达98.2%

In moderate rain, volume capture ratio of rainfall reached 98.2%

– 大雨，径流总量控制率达90.6%

Heavy rain, volume capture ratio of rainfall reached 90.6%

– 暴雨，径流总量控制率达65%

Rainstorm, volume capture ratio of rainfall reached 65%

– 特大暴雨，径流总量控制率达55.7%

Torrential rain, volume capture ratio of rainfall reached 55.7%

雨养型屋顶绿化

Rainfed roof greening

不同降雨等级下场次径流总量控制率

Volume capture ratio of rainfall under different rainfall grades

1、源头减排类（Source control）

■ 暗沟式透水硬路肩（Trench type permeable pavement shoulder）

能快速下渗收集道路地表径流和排除雨水

It can quickly seep down to collect road surface runoff and remove rainwater

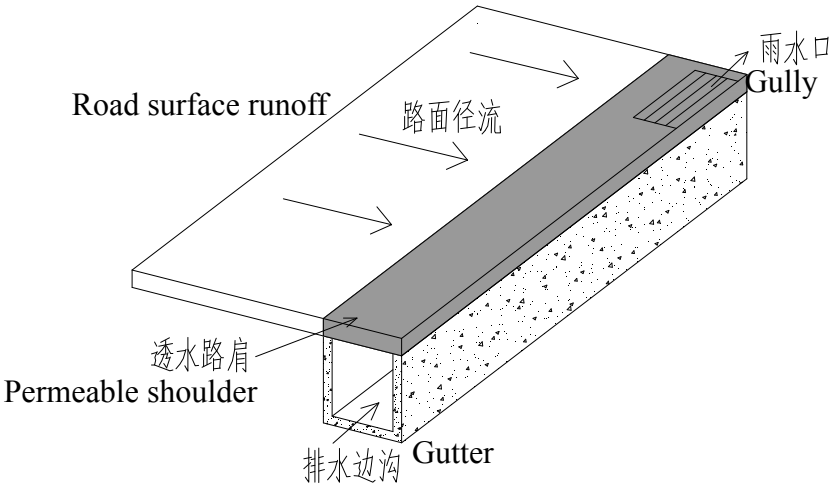


示意图
Schematic diagram

效果图
rendering

1、源头减排类（Source control）

- **屋面滞蓄控排技术（Roof storage control and drainage technology）**
  - 在具有足够承载和防渗能力的屋面，将降落的雨水临时滞留在屋面上，通过限流措施以较小流量排入雨水管道。

In the roof with enough bearing capacity and seepage prevention ability, the rain water will be temporarily suspended on the roof, through the flow limiting measures to drain into the rainwater pipe with a small flow.

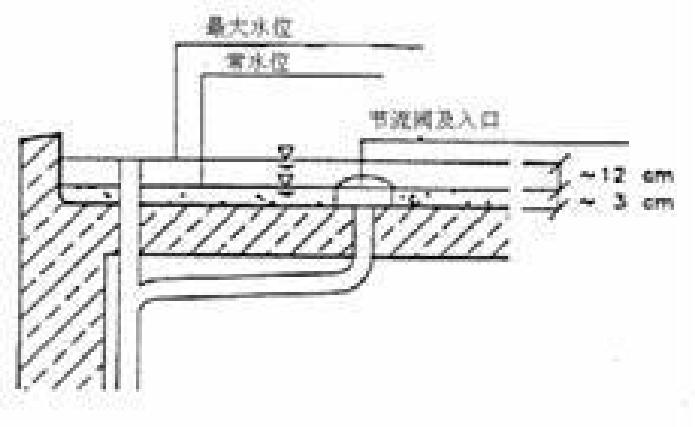


示意图
Schematic diagram

效果图
rendering

1、源头减排类（Source control）

■ 人行道雨水渗集自灌技术

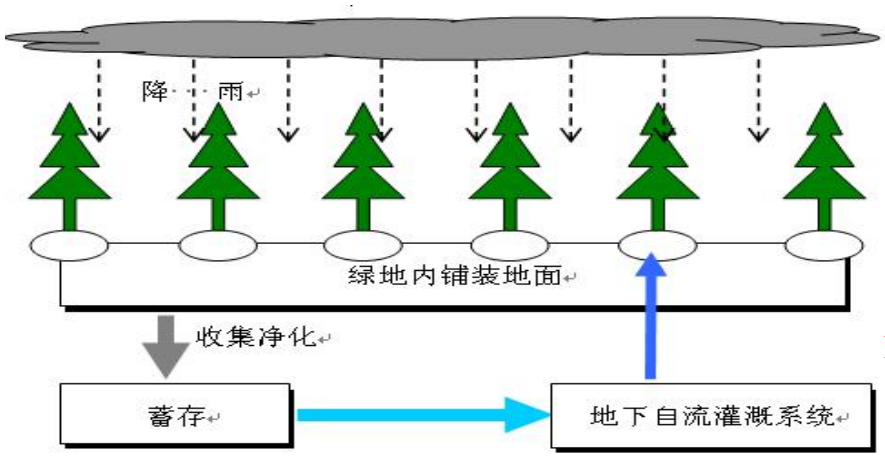
(Sidewalk rainwater infiltration collection self-irrigation technology)

- 由雨水收集、雨水储存、自动灌溉三部分组成。

It consists of three parts: rainwater collection, rainwater storage and automatic irrigation.

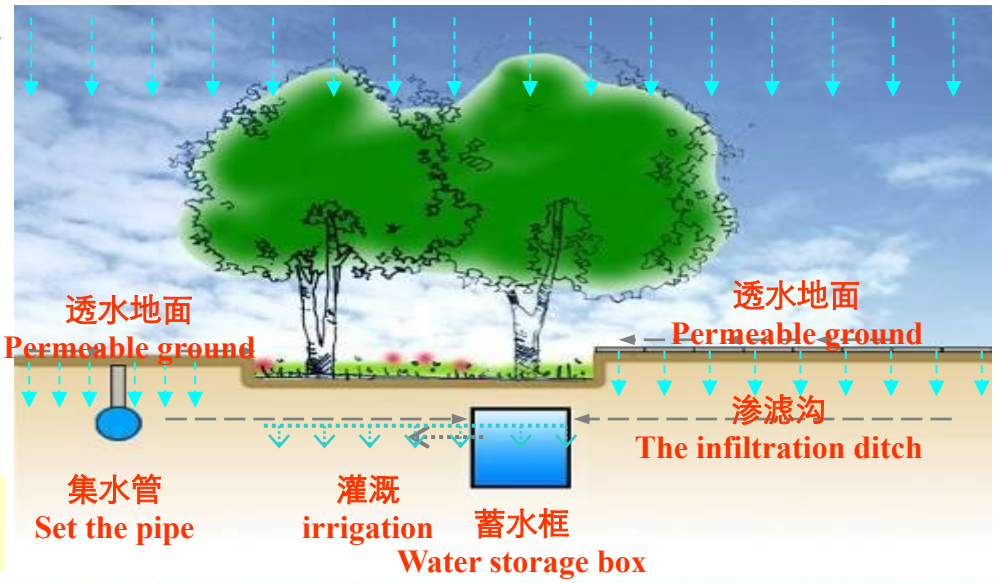
- 免灌溉维护

No irrigation maintenance required



铺装树阵雨水就地渗蓄自灌系统示意图

Pavement tree shower water in situ infiltration storage self irrigation system



1、源头减排类（Source control）

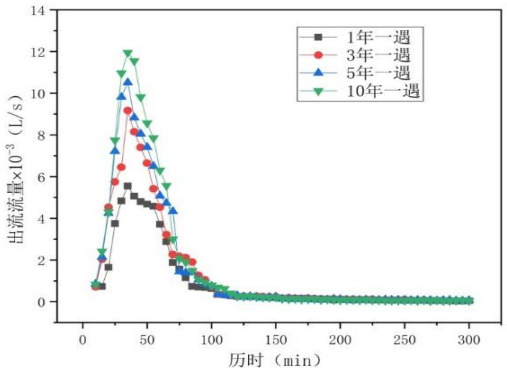
■ 结构透水铺装(Structural permeable pavement)

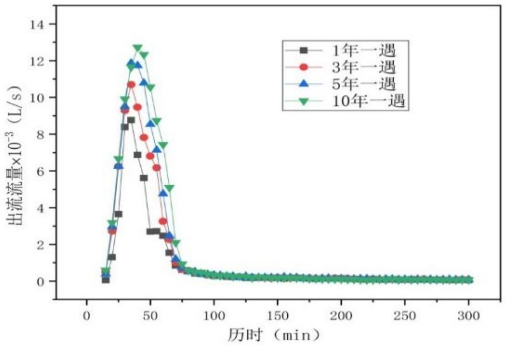
– 抗堵塞、强度高、耐冻融

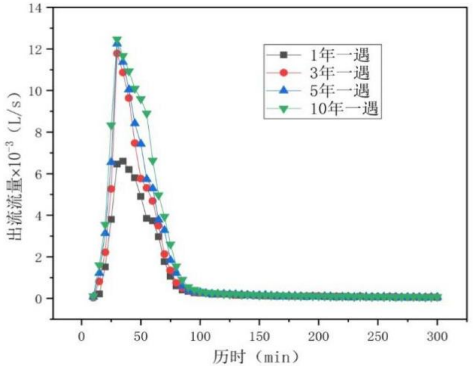
Blocking resistance, high strength, freeze-thaw resistance

– 比非结构透水铺装峰值削减率提高8.6%

Compared with the non-structural pervious pavement, the peak reduction rate is increased by 8.6%







1、源头减排类（Source control）

■ 倒置生物滞留设施(Inverted bio-retention facility)

- 将传统生物滞留池的结构层倒置

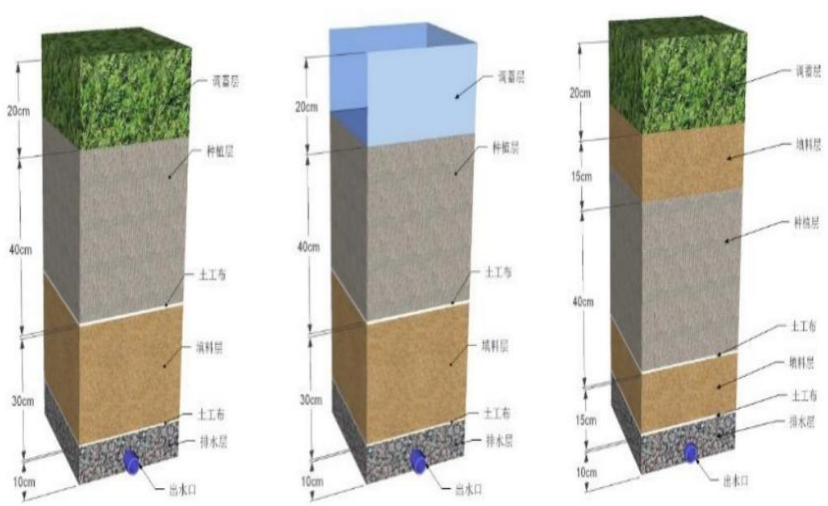
The structural layer of a conventional bioretention pond is inverted

- 径流总量控制率提高9%~21%

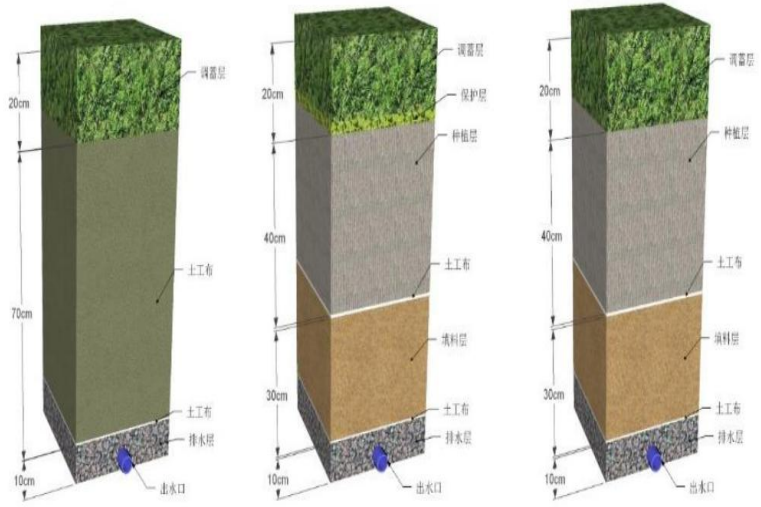
The total runoff control rate was increased by 9%~21%

- 浊度提升，水质更稳定

Turbidity increases, water quality is more stable



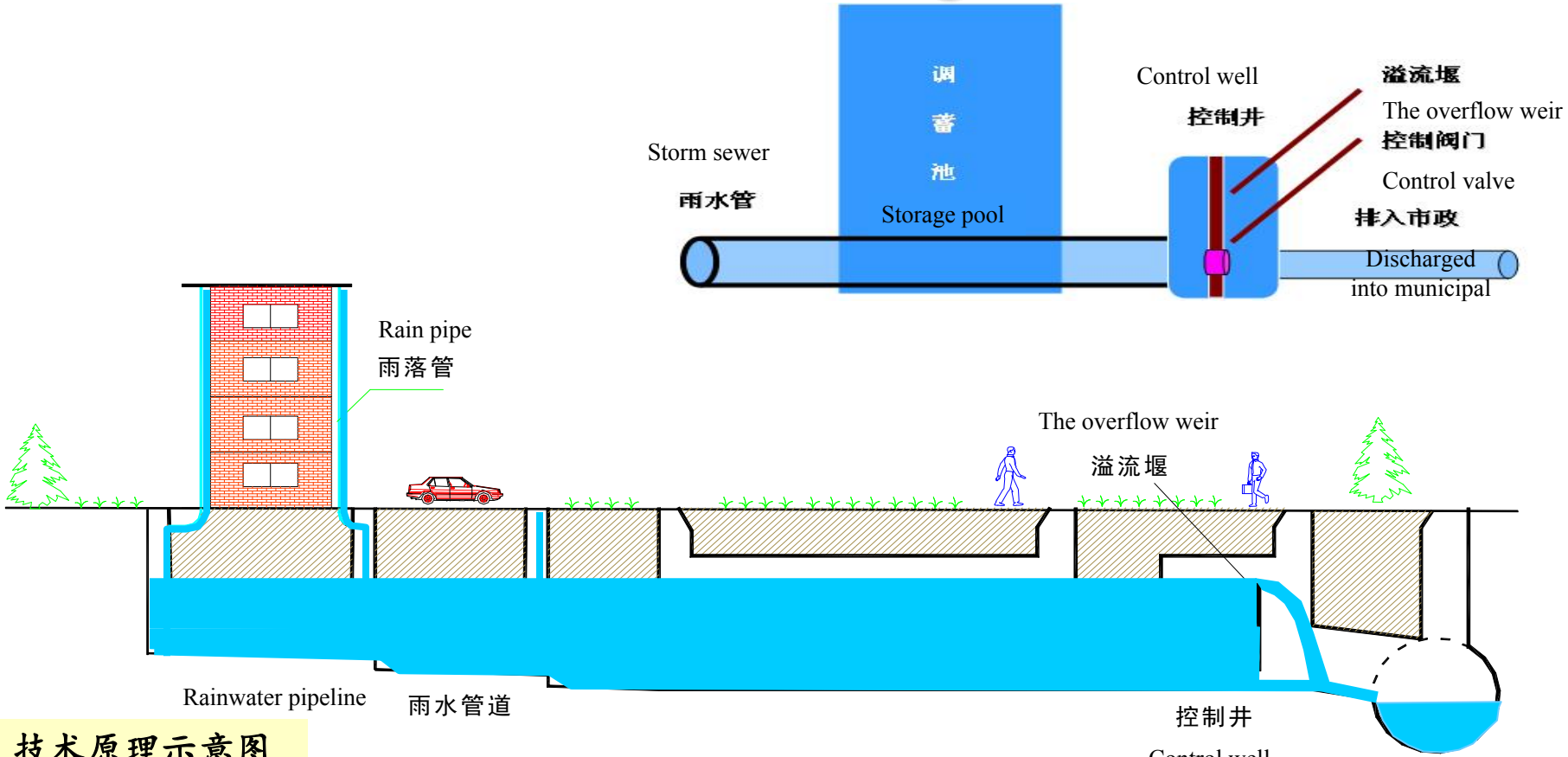
a)传统生物滞留 b)无植物生物滞留 c)倒置生物滞留
A) conventional bioretention b) no plant bioretention c) inverted bioretention



d)混合生物滞留e)覆盖层生物滞留f)小试实验装置
D) Mixed bioretention e) overlay bioretention f) pilot experimental setup

2、过程调控类(Process regulation class)

■ 调控排放
detention and controlled drainage



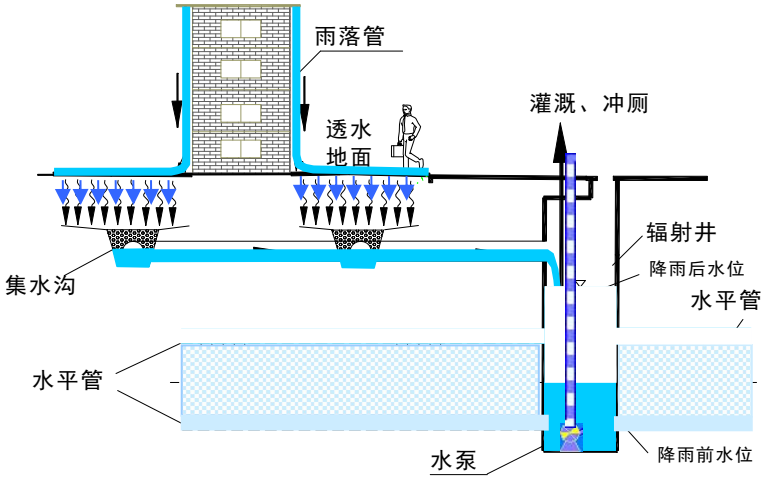
技术原理示意图
Schematic diagram

2、过程调控类(Process regulation class)

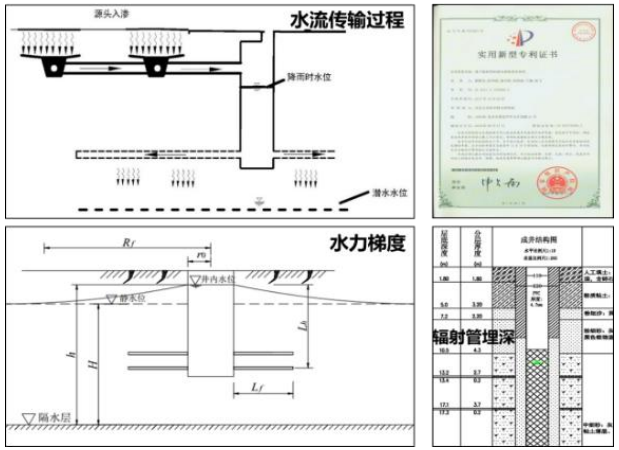
■ 辐射井强化渗透和利用雨水

Radiation Wells enhance infiltration and utilization of rainwater

- 通过竖井和水平辐射井，建立地表海绵设施与地下土壤调蓄空间的水力联系，集入渗、净化和调蓄功能于一体。(Through vertical Wells and horizontal radiation Wells, the hydraulic connection between surface sponge facilities and underground soil storage space is established, which integrates infiltration, purification and storage functions.)



技术原理示意图
Technical principle diagram

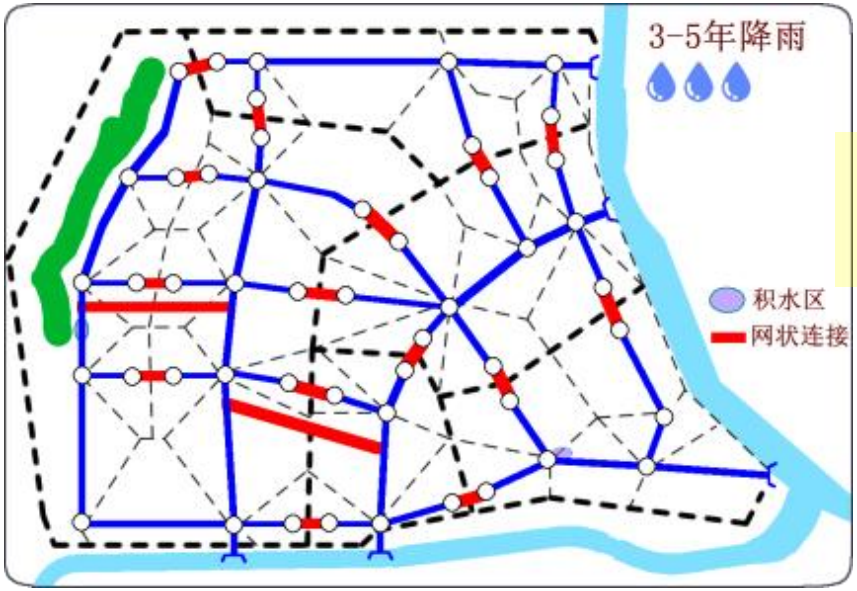


原理及专利
Technical principles and patents

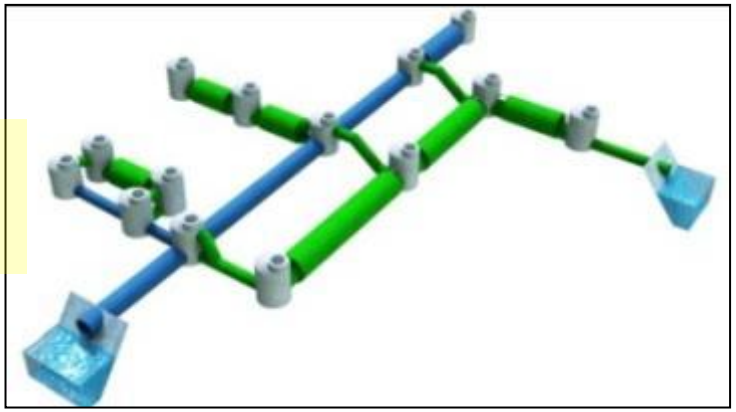
施工现场
The construction site

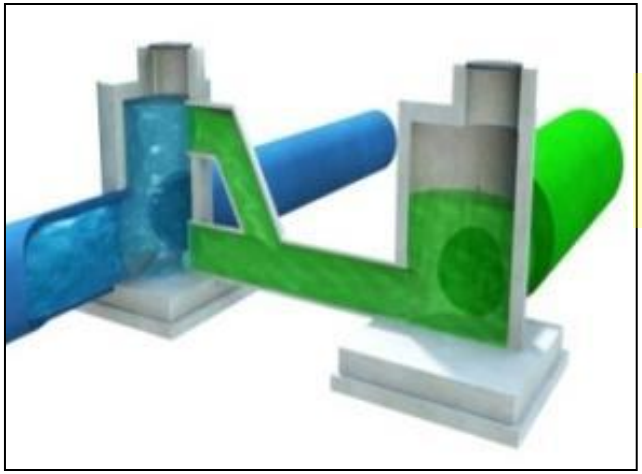
2、过程调控类(Process regulation class)

■ 网状雨水管排水技术(Reticulated stormwater drainage technology)



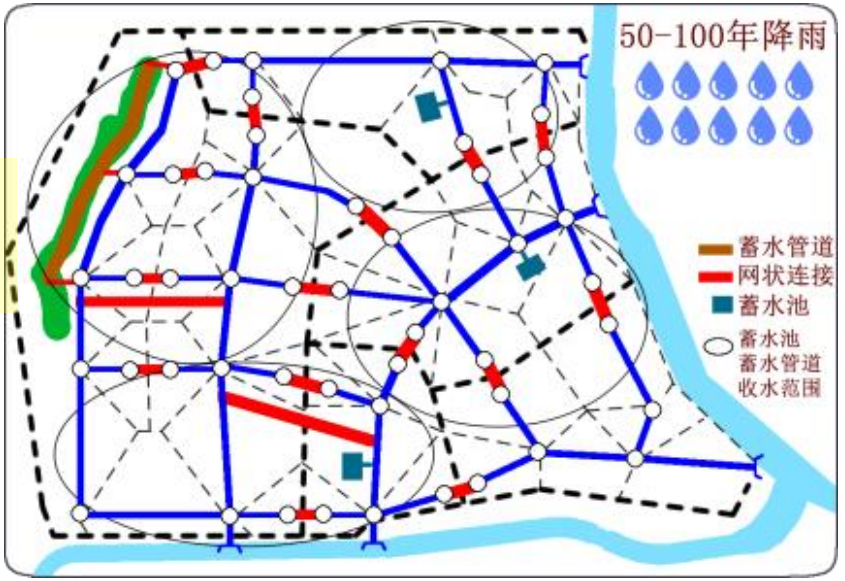
小排水网状图
Small drainage network diagram





超量雨水蓄排系统
Excess rainwater storage and drainage system

大排水网状图
Large drainage network diagram

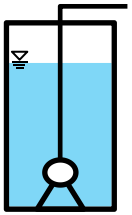


2、过程调控类(Process regulation class)

■ 大容量雨水管网蓄排技术

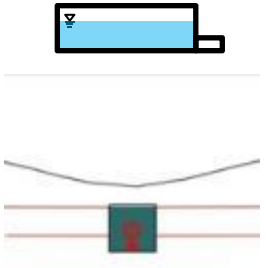
Storage and drainage technology of large capacity rainwater pipe network

收水管
Closed conduit



蓄水池
reservoir

泵站
The pump station



大容量蓄水管道
Large capacity water storage pipeline

3、综合减控类（Comprehensive reduction and control class）

■ 调蓄池智能进水控制技术

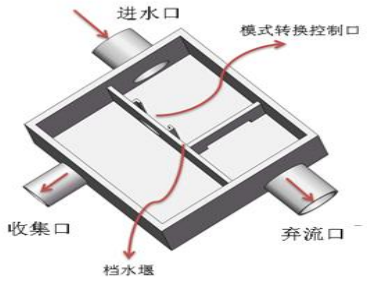
Intelligent inlet control technology for storage tank

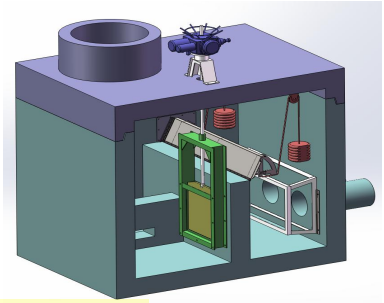
- 实现雨水调蓄池的智慧化管理

To realize the intelligent management of rainwater storage ponds

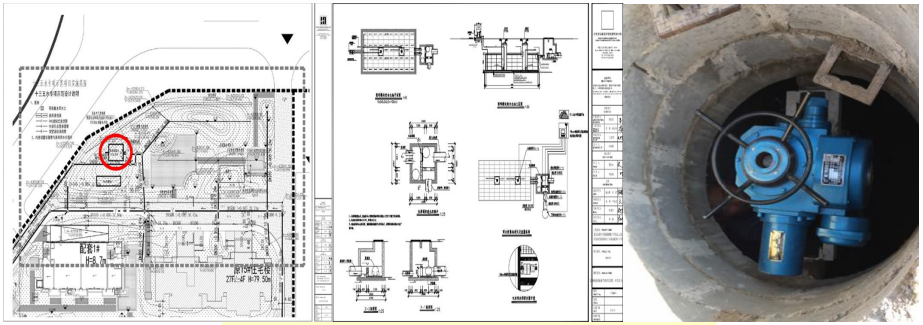
- 通常具有初雨弃流、雨水调蓄与洪峰削减等作用

It usually has the function of initial rain discard, rainwater storage and flood peak reduction

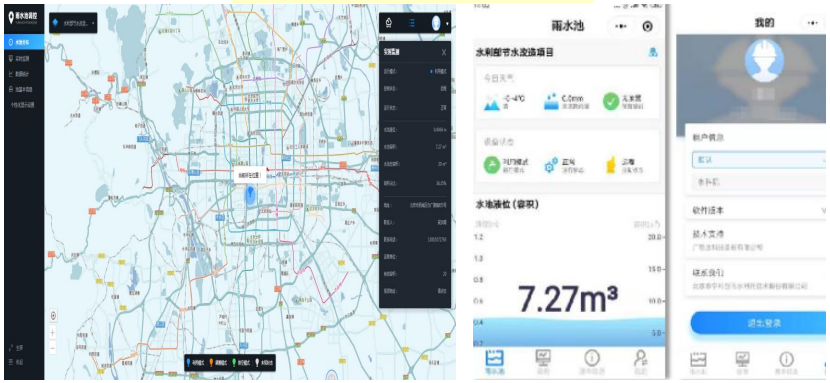




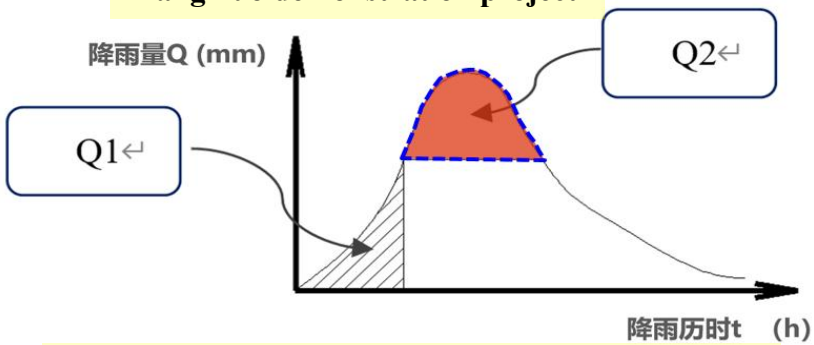
设备原理
Principle of equipment



杨坨示范工程
Yang Tuo demonstration project



管控系统
The control system

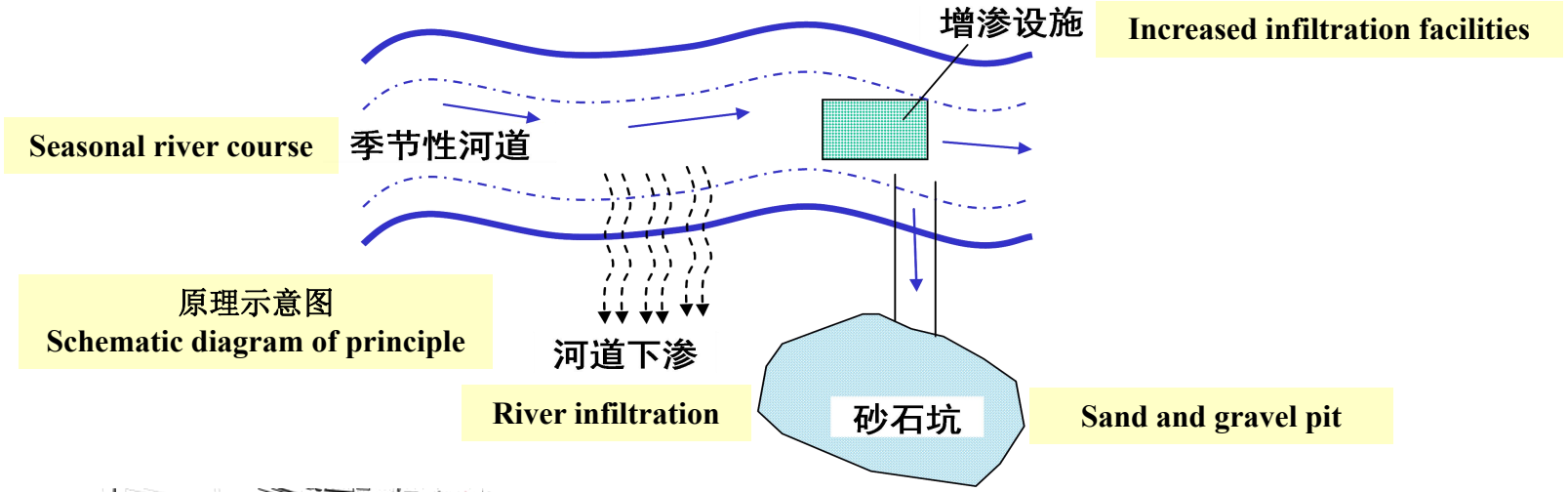


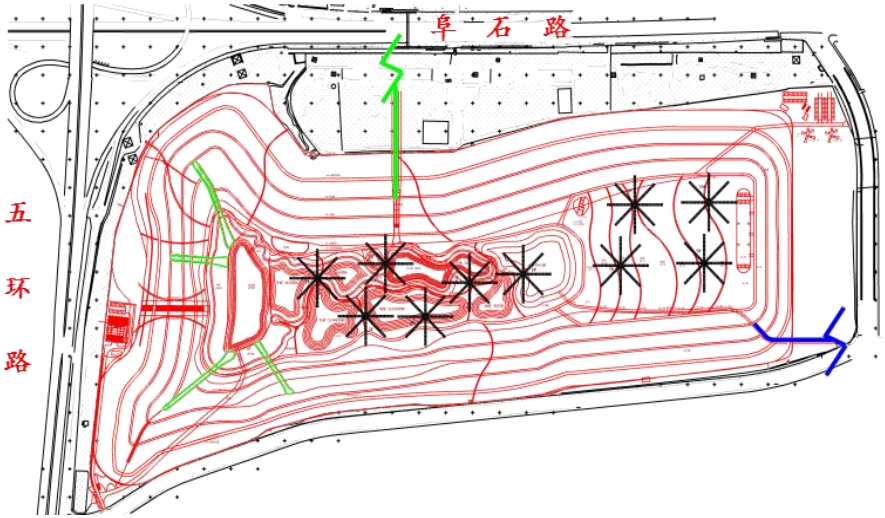
20年一遇不发生内涝，洪峰流量削减率73.21%
No waterlogging occurred in 20 years, and the reduction rate of flood peak discharge was 73.21%

3、综合减控类（Comprehensive reduction and control class）

■ 砂石坑调蓄下渗雨洪技术

Drainage and stormwater storage technology in Sand and gravel pit





西蓄雨洪利用工程

Sand and gravel pit in Westen Sub of Beijing

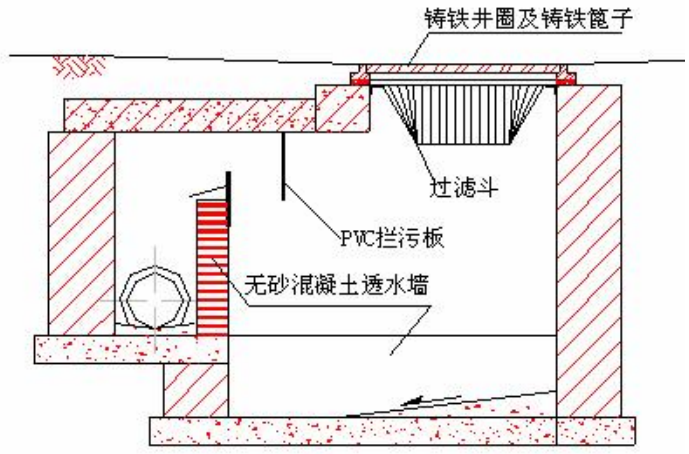
三、海绵城市建设新产品

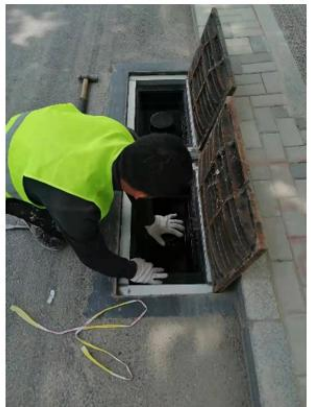
Ⅲ、sponge city construction of new products

1、海绵产品（Sponge products）

■ 环保型道路雨水口

Environmental protection road gully





1、海绵产品（Sponge products）

■ 雨水生物滞留槽填料

Rainwater biological retention tank filler

– 由砂质壤土、粗砂、蛭石、珍珠岩等组成

It consists of sandy loam, coarse sand, vermiculite, perlite and so on

– 具有较强的透水、持水、净水性能

It has better effect of permeable water, holding water and purifying water

1、海绵产品（Sponge products）

■ 自助雨水洗车设备 (Self-service car washing with rain water)

- 将屋面雨水进行收集，用于自助雨水洗车。

(The roof rainwater is collected for self-service rain water washing.)

- 按照100平米屋顶配1~2方水池，一套设备每年可利用雨水10~20方，洗车500~1000辆，效益2~5万元。
- (According to the 100 square meters of the roof with 1~2 square pools, a set of equipment can use 10~20 square rainwater every year, car wash 500~1000, the benefit of 20,000 ~ 50,000 yuan.)

自助雨水洗车装置1.0版
(Self-serve rainwater car wash version 1.0)

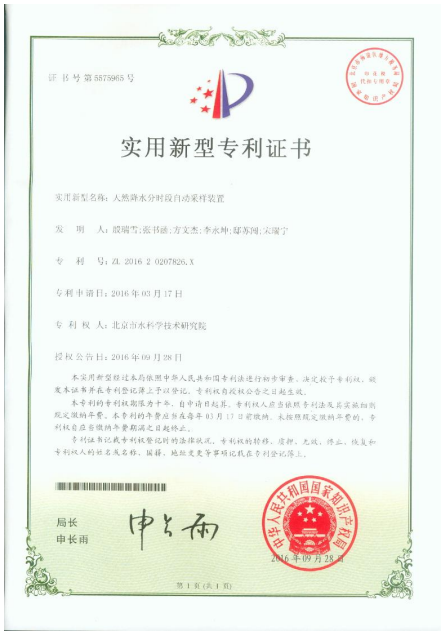
自助雨水洗车装置2.0版
(Self-serve rainwater car wash version 2.0)

2、监测设备（Monitoring equipment）

■ 天然降雨雨水采样器

Natural rainfall rainwater collector

- 无需耗电 Without electricity
- 自动全过程采样 Automatic whole process sampling
- 零点捕捉 Zero point capture



证书号第5575965号

实用新型专利证书

实用新型名称：人然降水分时段自动采样装置

发明人：殷瑞雪;张书函;方文杰;李永坤;郑苏阳;云瑞宁

专利号：ZL 2016 2 0207826.X

专利申请日：2016年03月17日

专利权人：北京市水科学技术研究院

授权公告日：2016年09月28日

局长
申长雨

2016年09月28日

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2、监测设备（Monitoring equipment）

■ 屋面雨水水质取样设备

Roof rainwater water quality sampling equipment

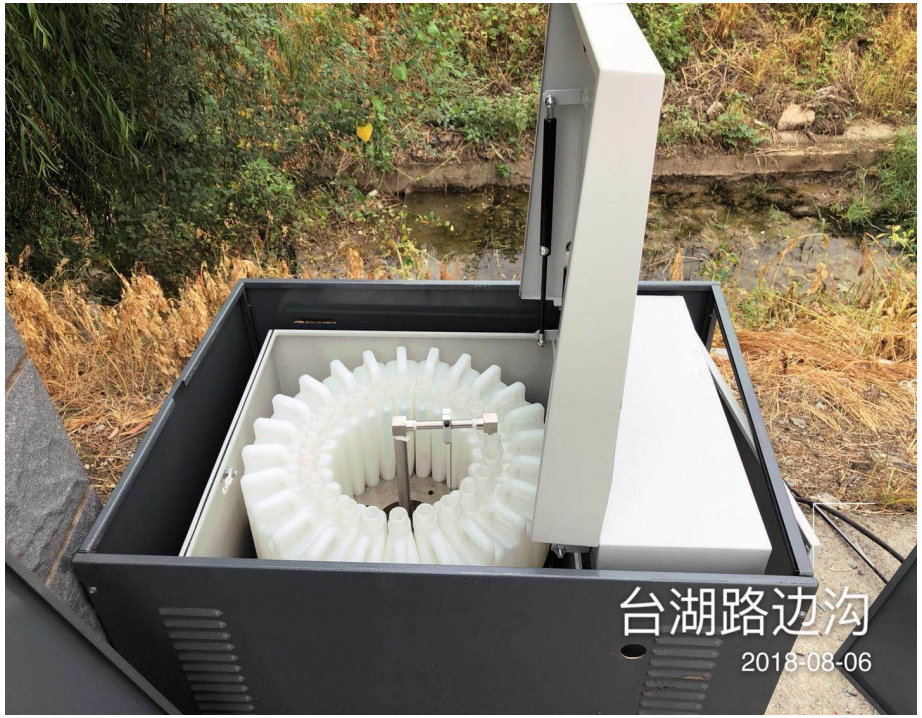
- 自动全过程采样（Automatic whole process sampling）
- 零点捕捉（Zero point capture）

2、监测设备（Monitoring equipment）

■ 智能雨水采样装置

Intelligent rainwater sampling device

分时段自动采样（Automatic sampling at different times）



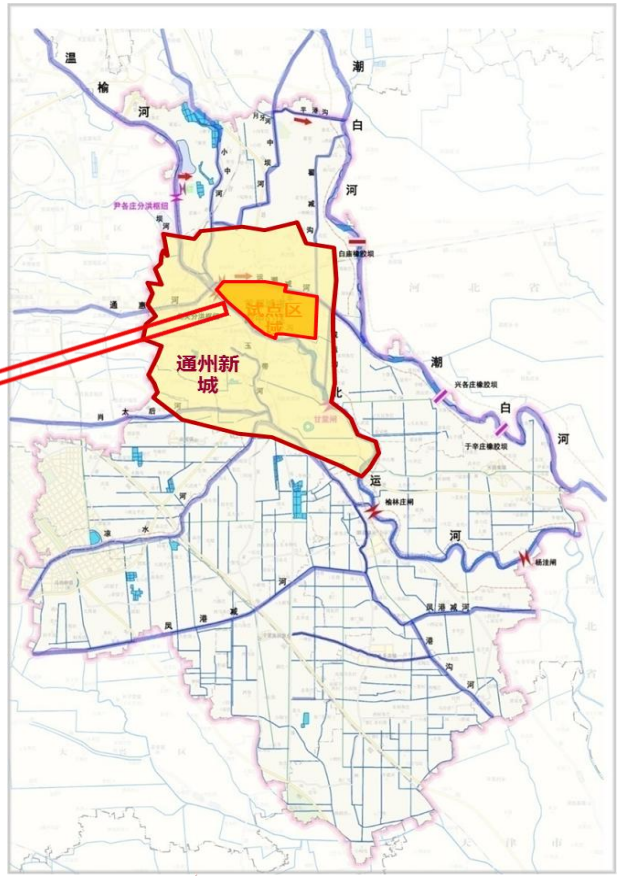
四、典型工程应用

Ⅳ、Typical engineering applications

■ 工程概况 Project summary

- 试点区位于北京城市副中心核心地带，总面积 19.36 平方公里。包含建成区、行政办公区、其他新建区三大部分

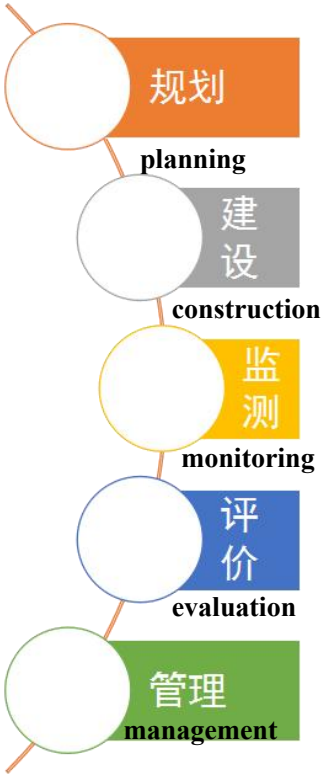
The pilot area is located in the core of Beijing's urban sub-center, with a total area of 19.36 square kilometers. It contains three parts: built-up area, administrative office area and other newly built areas.



城市副中心国家试点 National pilot in Beijing City Sub-center

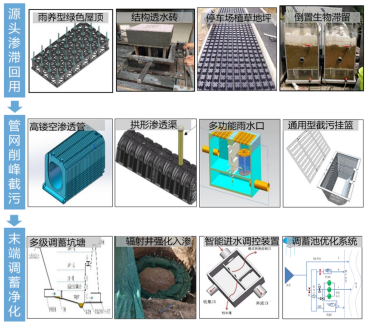
■ 工程建设思路

Ideas of engineering construction



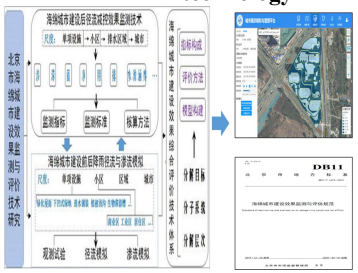
示范区存在问题梳理分析
Analysis of existing problems in the demonstration area

规划类技术应用
Application of planning technology

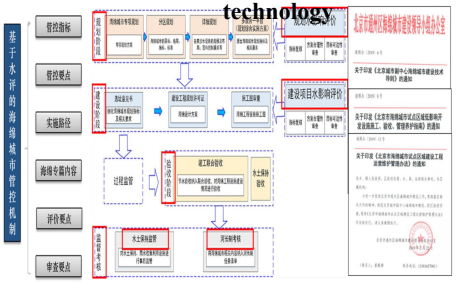


建设类技术应用
Application of construction technology

监测技术应用
Application of monitoring technology



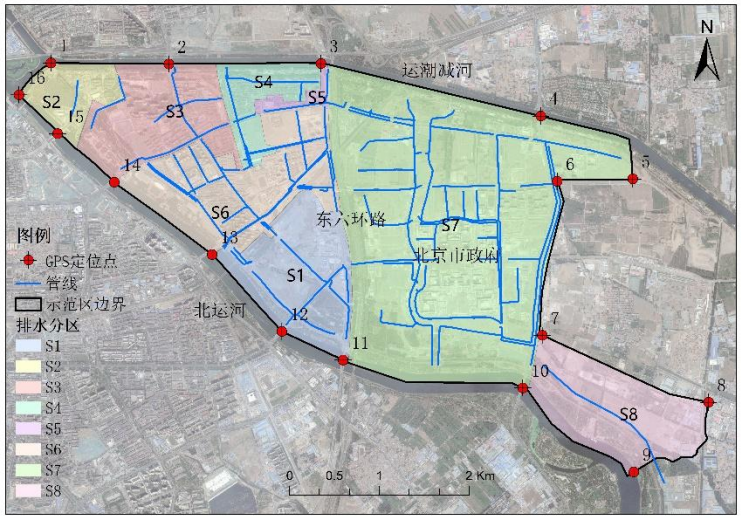
评估类技术应用
Application of evaluation techniques



管控类技术应用
Management and control technology application

■ 主要建设成效 Main construction achievements

- 共完成了3个片区包括海绵型小区、学校、道路等各类示范建设项目，主要涉及雨水花园、下凹式绿地、透水铺装、蓄水池等工程措施，示范区建成后，**多年平均年径流总量控制率86.54%，雨水径流污染物（SS计）总量去除率74.29%，**
- A total of 3 demonstration construction projects including sponge residential area, school and road were completed, which mainly involved rainwater garden, sunken green belt , permeable pavement, reservoir and other engineering measures, and played the role of sponge control at the drainage zoning scale. Tthe average annual runoff total amount control rate is 86.54%, and the total amount removal rate of rainwater runoff pollutants (SS) is 74.29%,



感谢倾听！

Thanks！

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