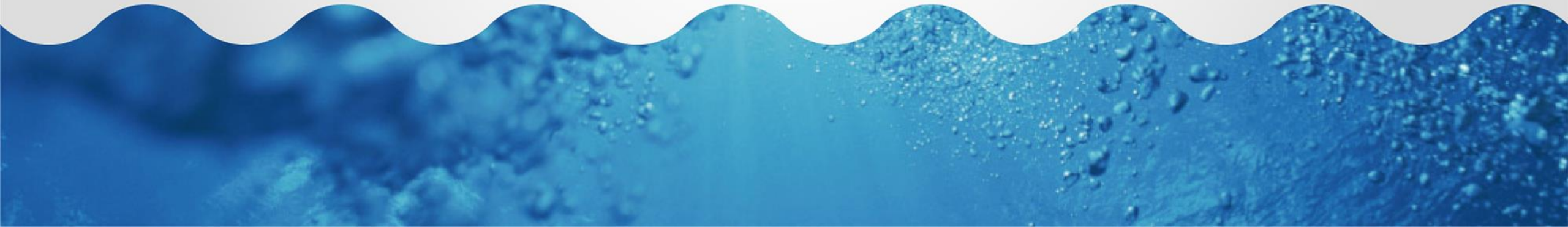
Analysis of Urban Flood-waterlogging and Design of Road Drainage System Based on Low-Impact-Development(LID)

Minghao Chen
Email: minghaochen@my.swjtu.edu.cn
Department of Civil Engineering,
Southwest Jiaotong University

Contents

- Backgrounds
- The potential flooding area evaluation model (PFAEM)
- Design of LID system
- Conclusions

Backgrounds



- Backgrounds

The issue of urban flood-waterlogging has become increasingly prominent!!!

Chengdu, China

10.7 million people were affected, 2 died and 1 was missing.

Wuhan, China

The direct economic loss of disaster is about 4.8 billion yuan.


BHUBANESWAR IS TALKING ABOUT

WATERLOGGING WOES OF A WANNABE SMART CITY

JAYADEV VIHAR

NAYAPALLI, NEAR CRP SQUARE

TEMPLES

AUTHORITIES SPEAK

RAJMAHAL SQUARE

LAXMI SAGAR

BOMIKHAL

Odisha, India

At least 600 people have died and thousands are stranded or missing on the edge of the Himalayas.

【DIRECTORY】

- Backgrounds

Reasons

Rapid development of the city

Lagging drainage system design

Conservative design concept: “Drainage-based”

“Sponge City” & LID

Weakness

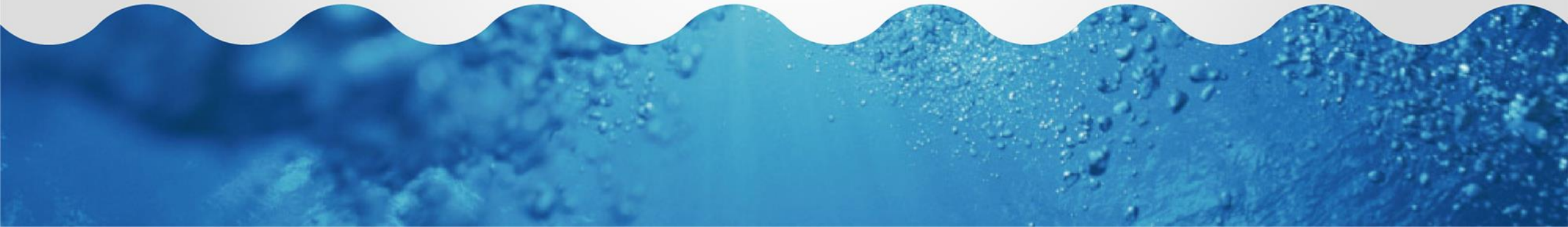
Hard to construct in the entire city

No comprehensive analytical methods

No BIM tech introduced

【DIRECTORY】

Potential Flooding Area Evaluation Model



- Establishment of PFAEM

  - Mathematic model:

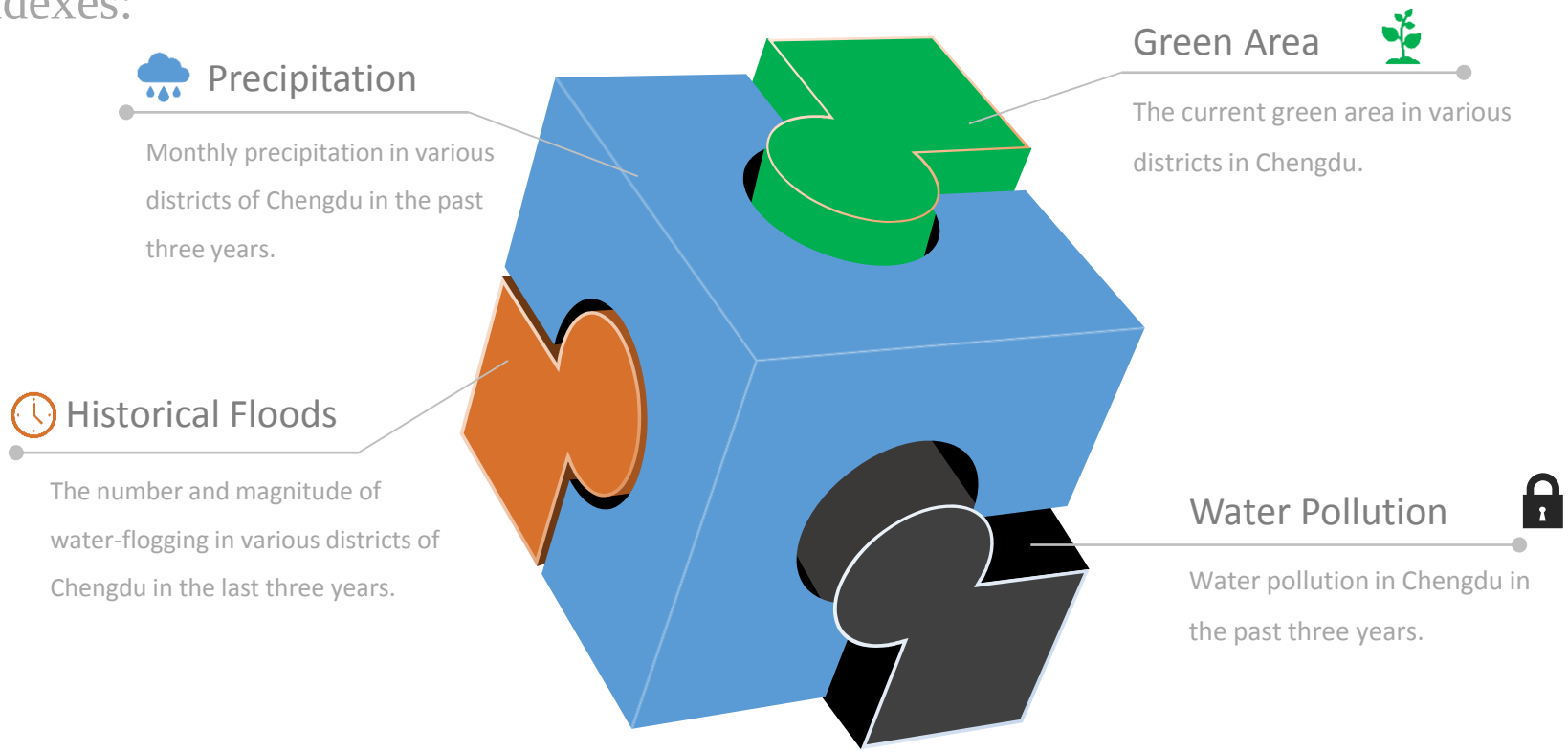
$$V_i = \frac{\sigma_i}{x_i} (i = 1, 2, \ldots, n)$$

$$W_i = \frac{V_i}{\sum_{i=1}^{n} V_i}$$

$$\xi_i(k) = \frac{\min\limits_s \min\limits_t \left|x_0(t) - x_s(t)\right| + \rho \max\limits_s \max\limits_t \left|x_0(t) - x_s(t)\right|}{\left|x_0(t) - x_i(t)\right| + \rho \max\limits_s \max\limits_t \left|x_0(t) - x_s(t)\right|}$$

$$r_i = \sum_{k=1}^{n} w_i \xi_i(k)$$

  - Indexes:



【DIRECTORY】

- Results

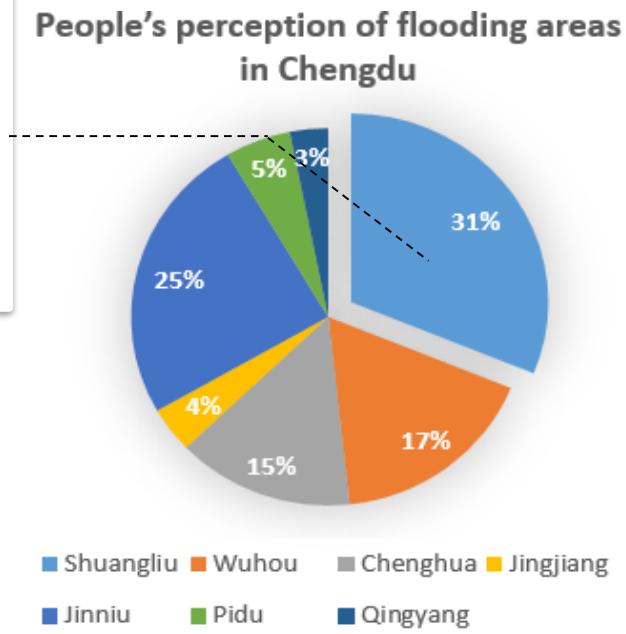
Ⅰ
Ⅱ
Ⅲ
Ⅳ
Ⅴ
Ⅵ
Ⅶ

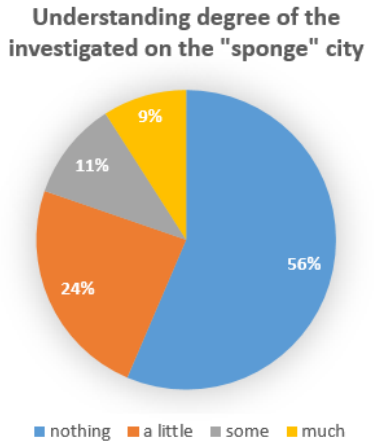
- According to the results of the correlation degree matrix obtained, the ranking of potential flood disaster hazards in various districts of Chengdu can be obtained as shown. The greater the degree of association, the higher the risk ranking of flood disasters.
- The "**Shuangliu**" is the **most likely** district for potential flood disasters in Chengdu.

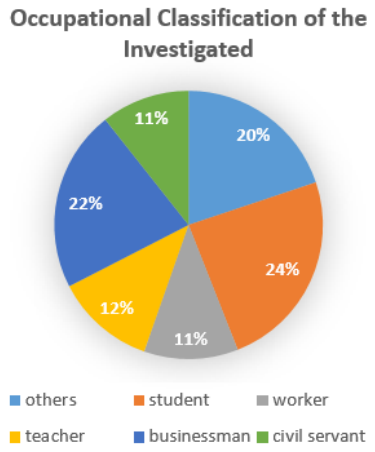
【DIRECTORY】

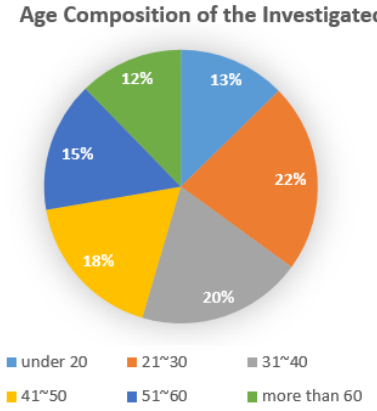
- Verification

- We made a questionnaire survey in Chengdu to provide reference and revised models for the results of the model. In our investigation, there are **31%** people think “Shuangliu” is the most likely district, and the PFAEM model results are similar to this.



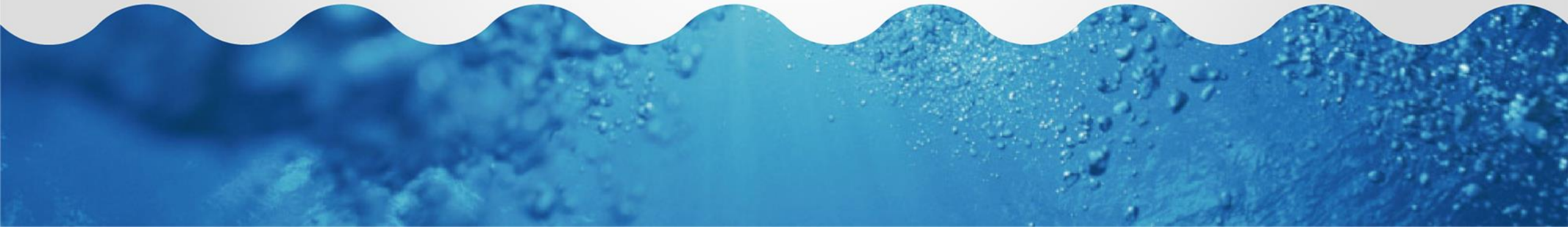




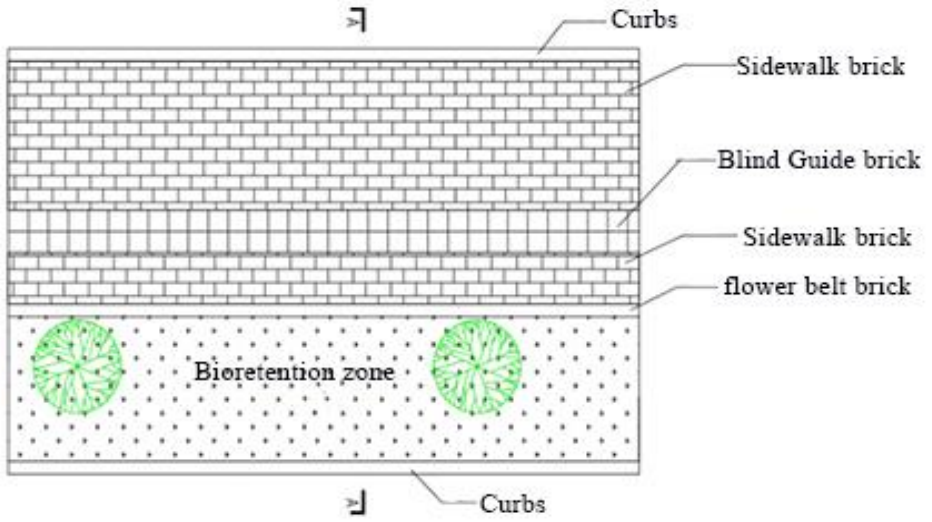


【DIRECTORY】

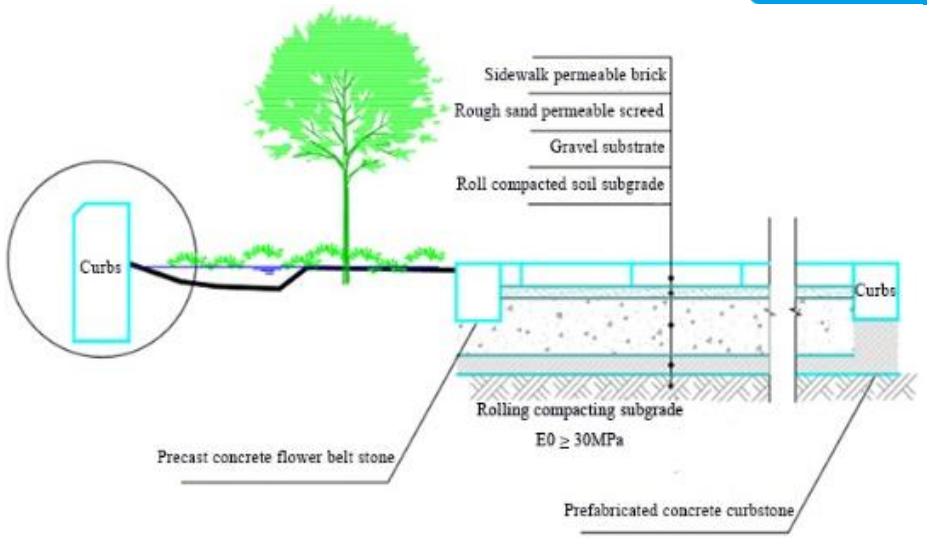
Design of LID system



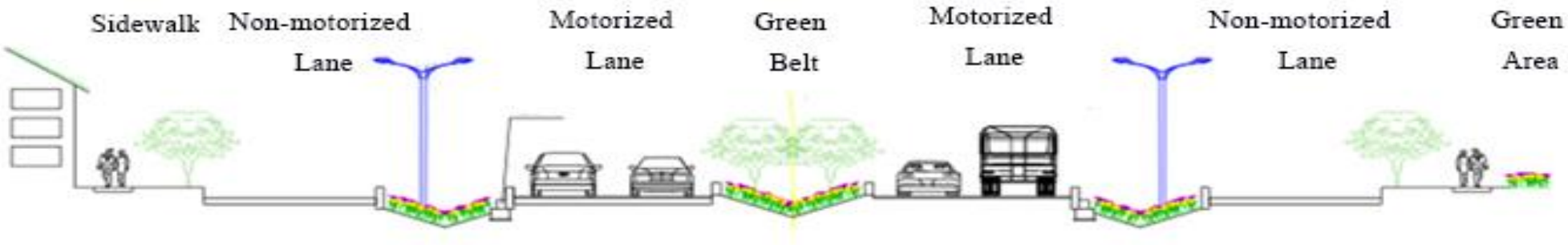
- AutoCAD design in road



PAVEMENT



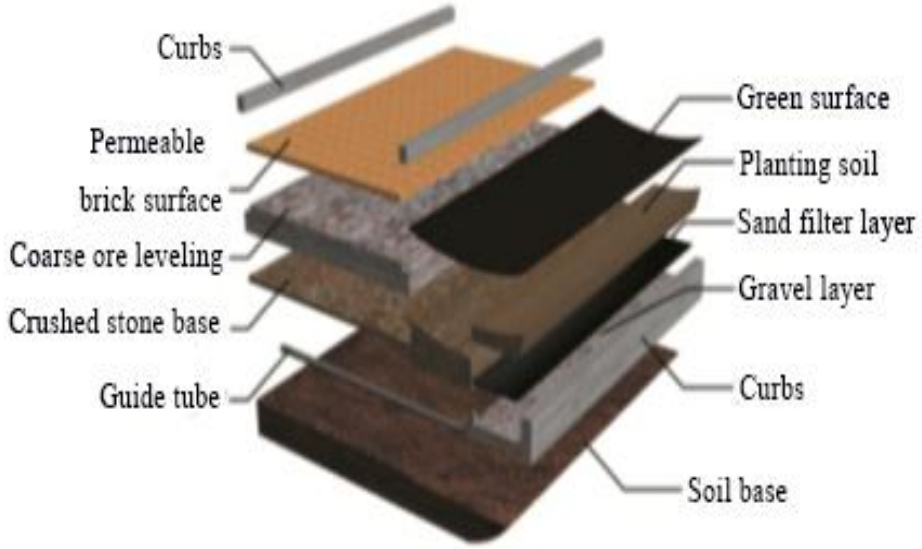
A - A SECTION



“Sponge” city four road cross-section arrangement type

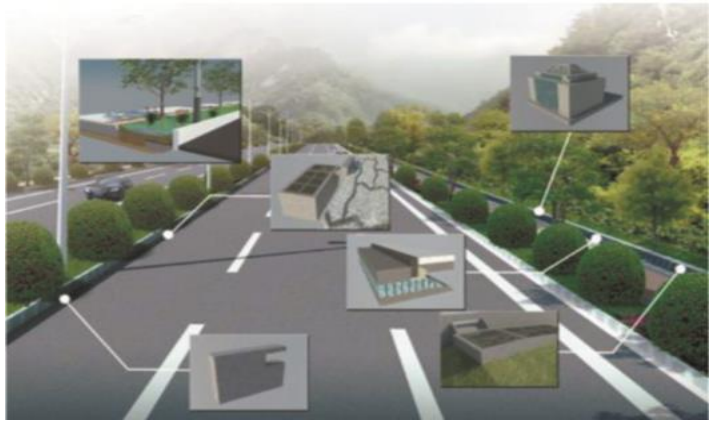
【DIRECTORY】

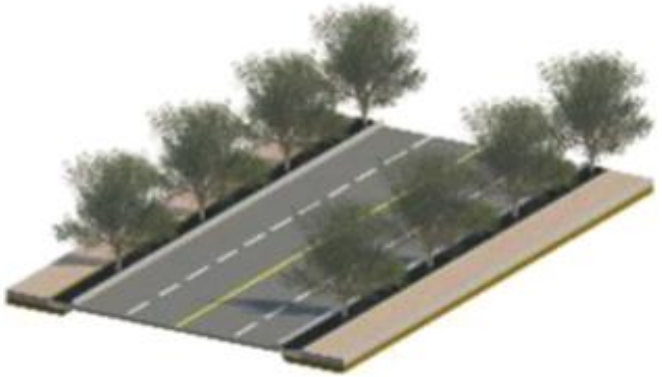
- Building information model design in road



BIM Road model for “sponge” city

With Revit, sweeping can create a 3D model of the road as shown. Using BIM technology to design, we can intuitively see the internal structure of the road, which is conducive to our design changes and construction.

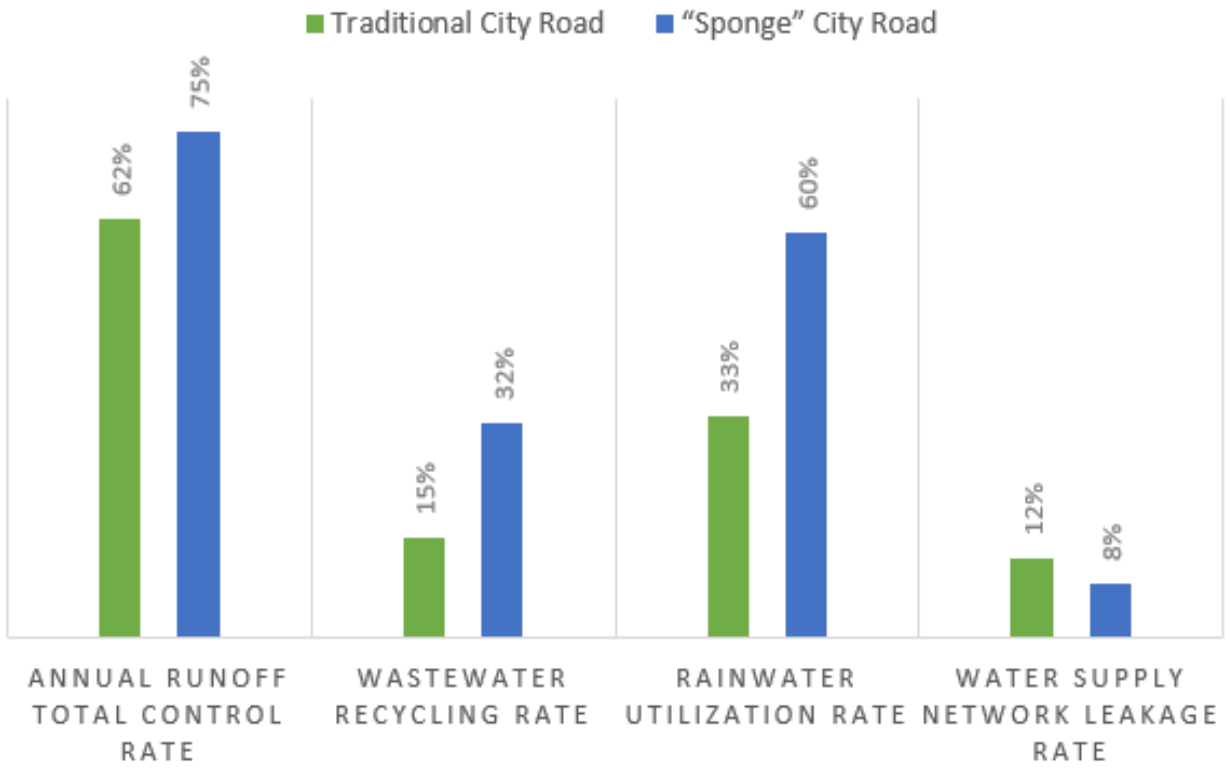




BIM Road internal structure for “sponge” city

【DIRECTORY】

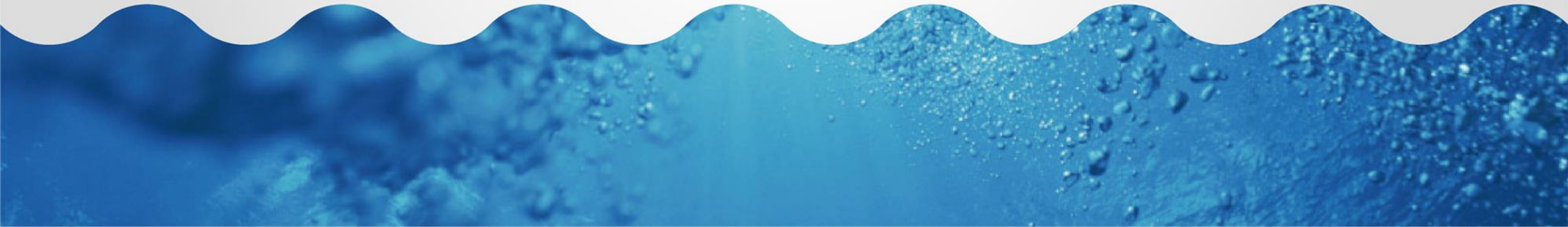
- Discussion



Use of “sponge” city roads designed in this paper can greatly reduce the risk of urban flood-waterlogging, while improving the utilization rate of rainwater resources and sewage regeneration and utilization.

【DIRECTORY】

Conclusions



• Conclusions

75%

By using numerical simulations, we can see that using our LID-based road model can achieve a total annual rate of 75% of annual runoff control, and all 3 positive rates are higher than before.

Shuangliu

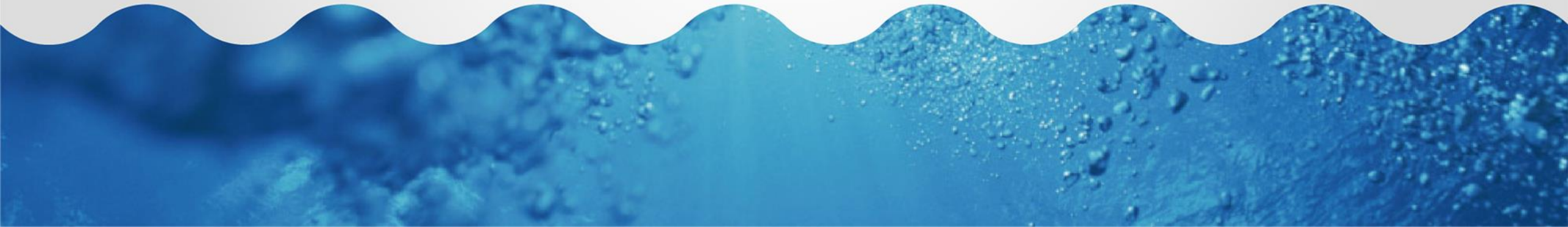
By using the PFAEM, we can find the “Shuangliu” should be the key construction district, which was consistent with the investigation results.

BIM design

By using BIM technology, we can better design and modify the model, and at the same time make the construction party more convenient. Compared with the traditional CAD design, the operability of the project is increased.

【DIRECTORY】

Credits



- Credits

Prof. Tao Huang,
Department of Earth Science and Environmental Engineering
Suggestions in research goal and paper.

Southwest Jiaotong University
Department of Civil Engineering

Support for research.

Dr. Wenbo Yang,
Department of Civil Engineering

Suggestions in paper and oral presentation.

【DIRECTORY】

THANKS

FOR WATCHING