UNITED NATIONS ESCAP
Economic and Social Commission for Asia and the Pacific

Regional meeting "Making innovation work for the SDG's" and 9th session of the SPECA working Group on Knowledge-based Development



한국기술사회
The Korean Professional Engineers Association

"Innovative technology applications for urban disaster risk management"

22 June, 2017

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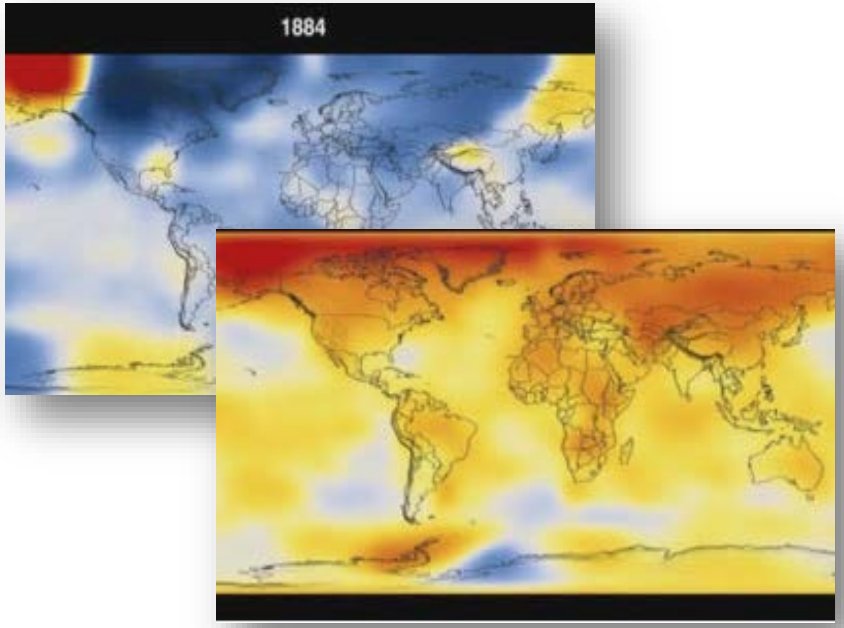
1 Why LID Stormwater Management is Needed?

1. Why rainwater management is needed?

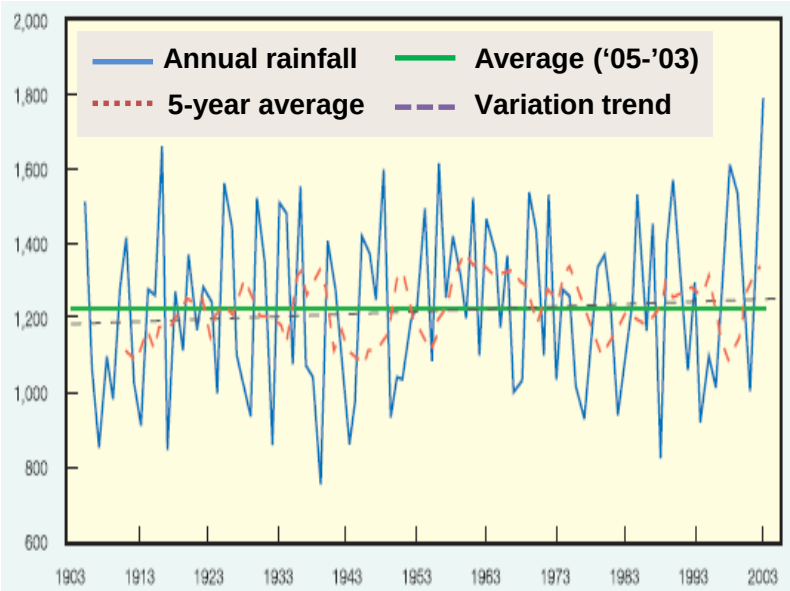
① Climate change

- Higher temperature
- More rain
- Extreme weather
- Sea-levels are rising



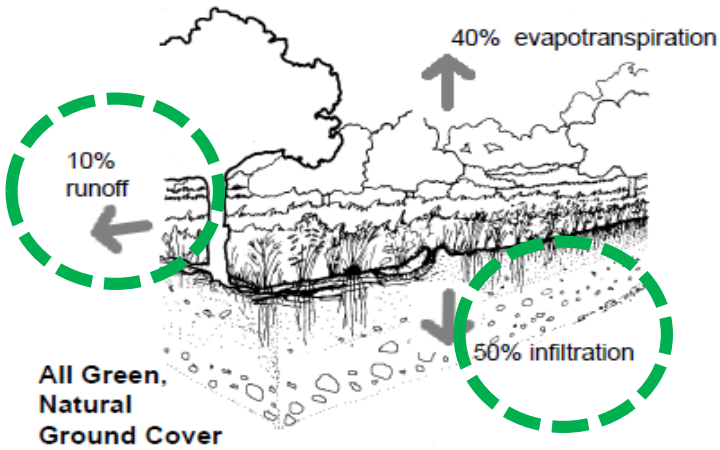
Source: http://geology.com/news/labels/Global-Warming.html

- Average annual rainfall has slightly increased over the last century
- Variations in annual rainfall have significantly increased

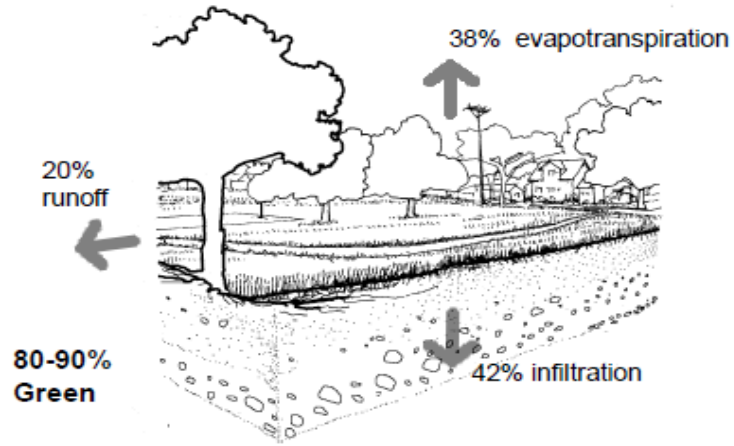


1. Why rainwater management is needed?

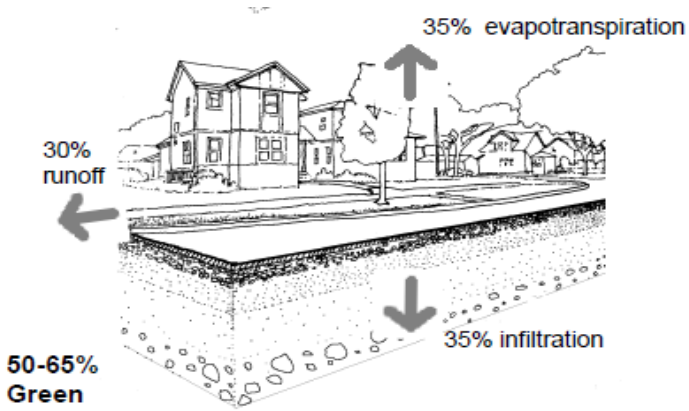
② Hydrologic characteristics



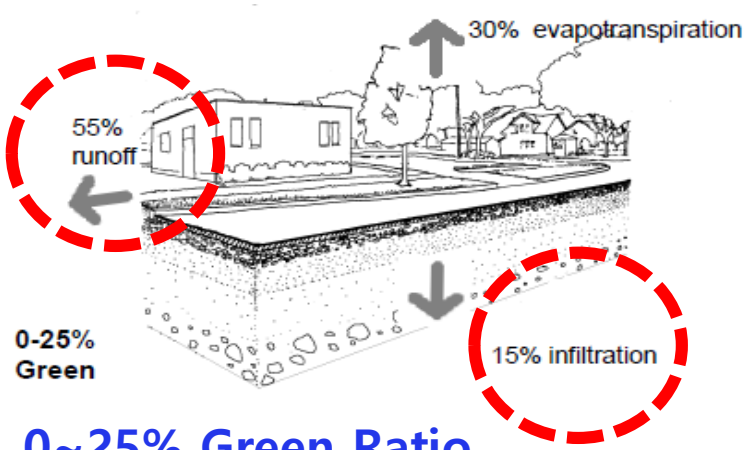
100% Green Ratio



80~90% Green Ratio



50~65% Green Ratio



0~25% Green Ratio

1. Why rainwater management is needed?

③ Urbanization

Flood

Non-point source pollution

Destruction in ecosystem

Distorted Water Cycle

Drought

Dry stream

Underground water level ↓

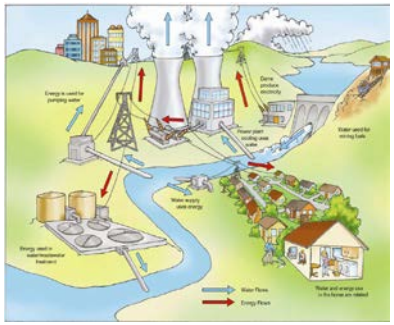
Water

Urbanization

Energy

Climate

Energy for water management ↑

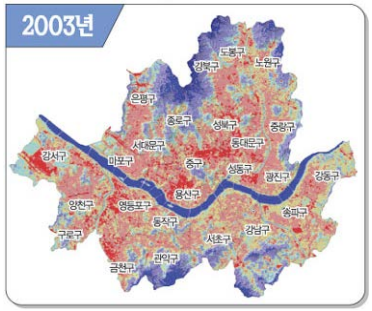


High Energy Consumption

Distorted Heat Cycle

Heat island

Tropical night



1. Why rainwater management is needed?

④ Examples of water-related problems

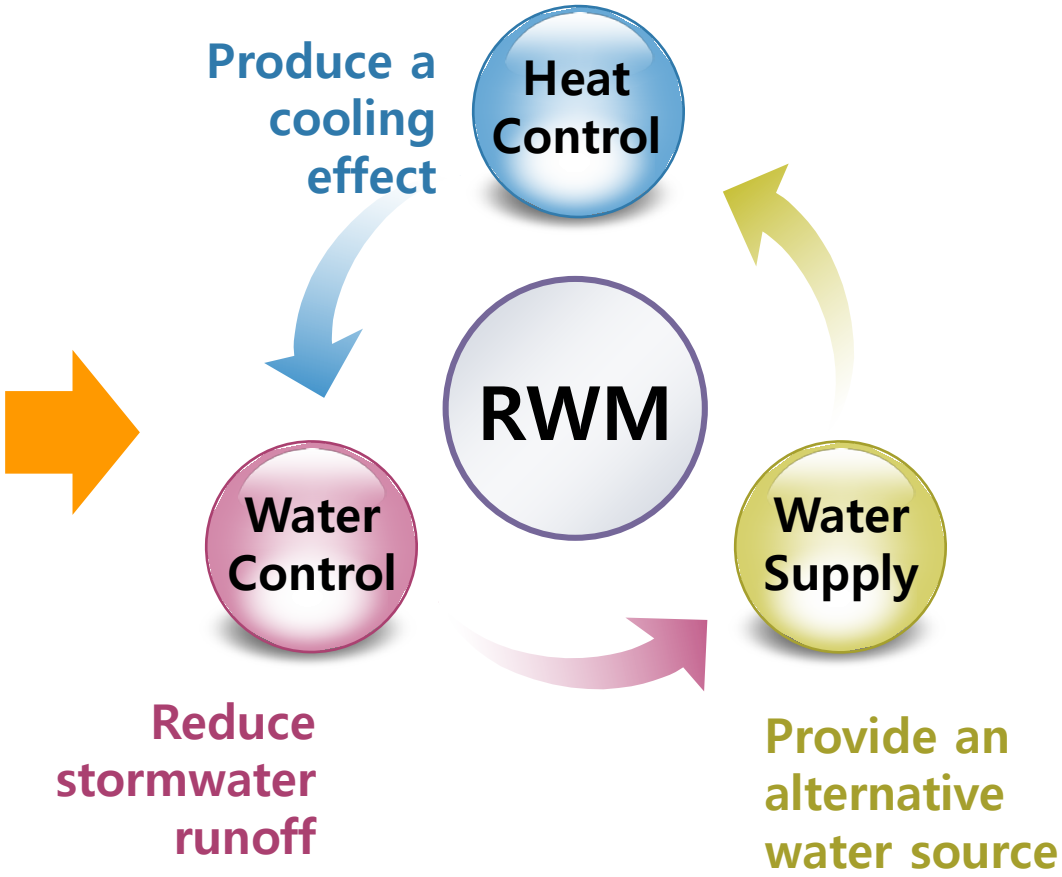
1. Why rainwater management is needed?

⑤ Adaptation of climate change

Impacts of Climate Change

- High Temperature
- Extreme Precipitation
- Shortage of Water
- Flash Flooding
- Heat Island
- Water Contamination

Impacts of Urbanization



2

Project description :
The Integrated Rainwater, Storm water and Wastewater Management Project in Cebu, Philippines

2. The Integrated Rainwater, Storm water & Wastewater Management Project in Cebu, Philippines

Introduction

◆ Project definition

- Pilot activity for the Philippines to develop and install in a public building a system capable of managing rainwater, stormwater and waste water treatment.

◆ International cooperation

- UN-ESCAP (Water Security Section of United Nations Economic and Social Commission for Asia and the Pacific),
- KOICA (The Korea International Cooperation Agency),
- KICT (The Korea Institute of Construction Technology),
- EREDE Co., Ltd.
- DOST7 (The Department of Science and Technology Region 7).

◆ Objectives of the project

- To strengthen the capacities of local government officials for the planning and management on the integrated rainwater and stormwater recycling system through the implementation of the pilot demonstration project
- To establish the model for integrated rainwater and stormwater recycling system in the selected building to demonstrate the eco-efficient approaches for water infrastructure
- To promote awareness and advocacy on eco- efficient water infrastructure development in the Philippines.

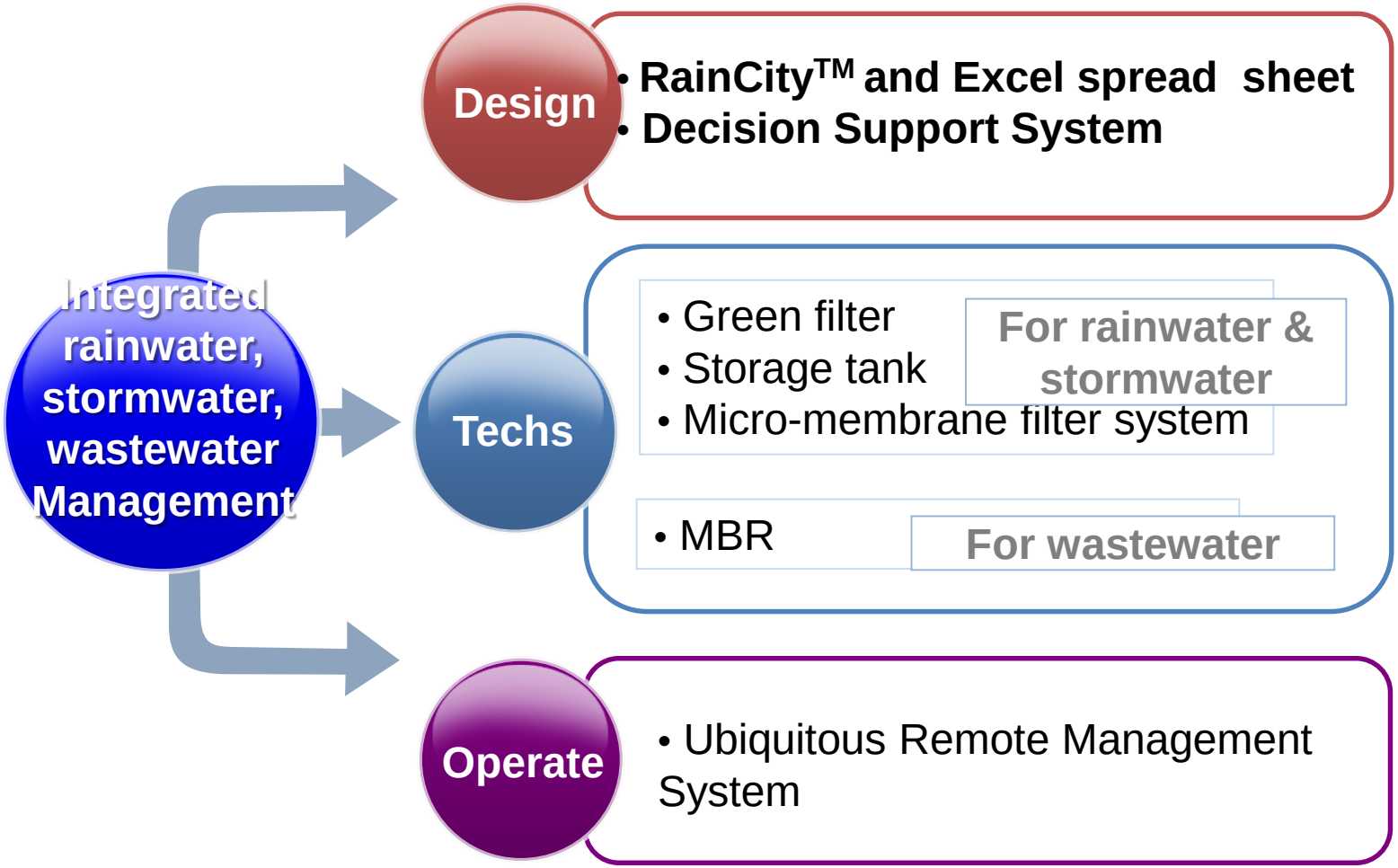
2. The Integrated Rainwater, Storm water & Wastewater Management Project in Cebu, Philippines

Outline of the project

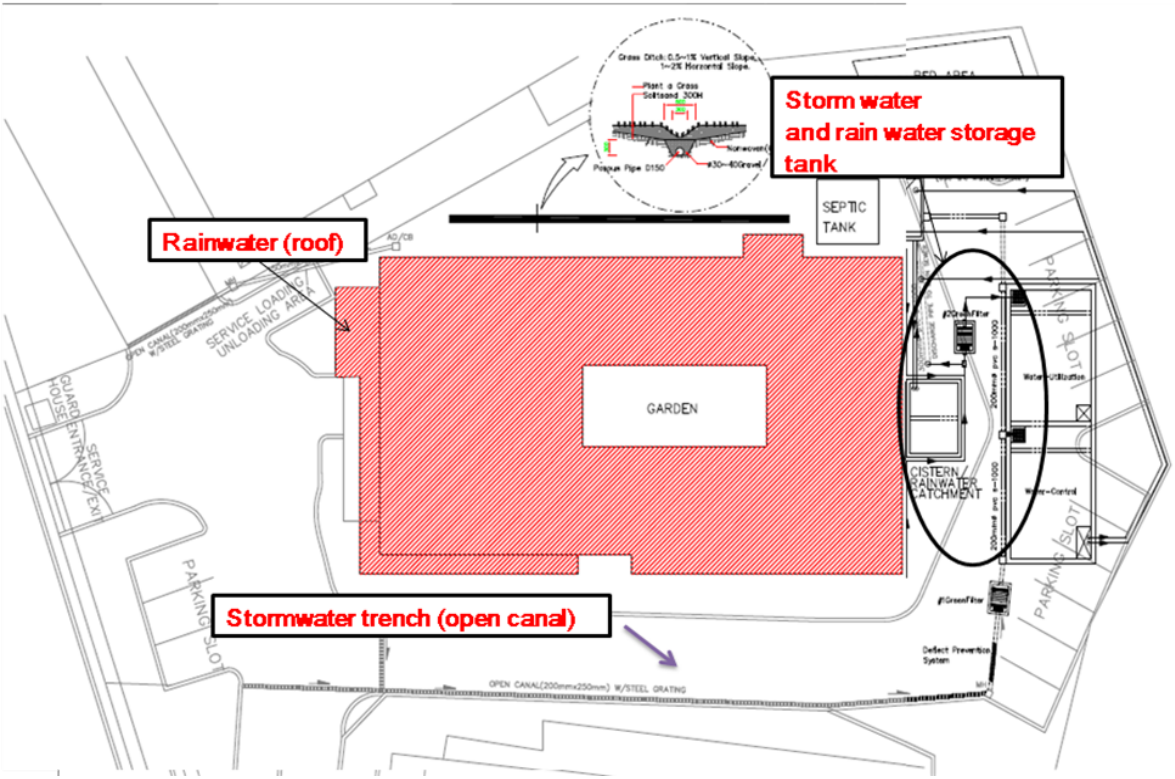
- Site: DOST 7 Office Building, Cebu City, Philippines
- Project cost: US$45,000 from ESCAP
  - Construction cost of the tanks supported by DOST 7
  - **MF system, MBR system, Remote controlling system donated by EREDE co. Ltd.**
- Project duration: 2009-2010 (12 months)
- Information Source: http://www.ro7.dost.gov.ph/

2. The Integrated Rainwater, Storm water & Wastewater Management Project in Cebu, Philippines

Application of Innovation Technology for the system construction



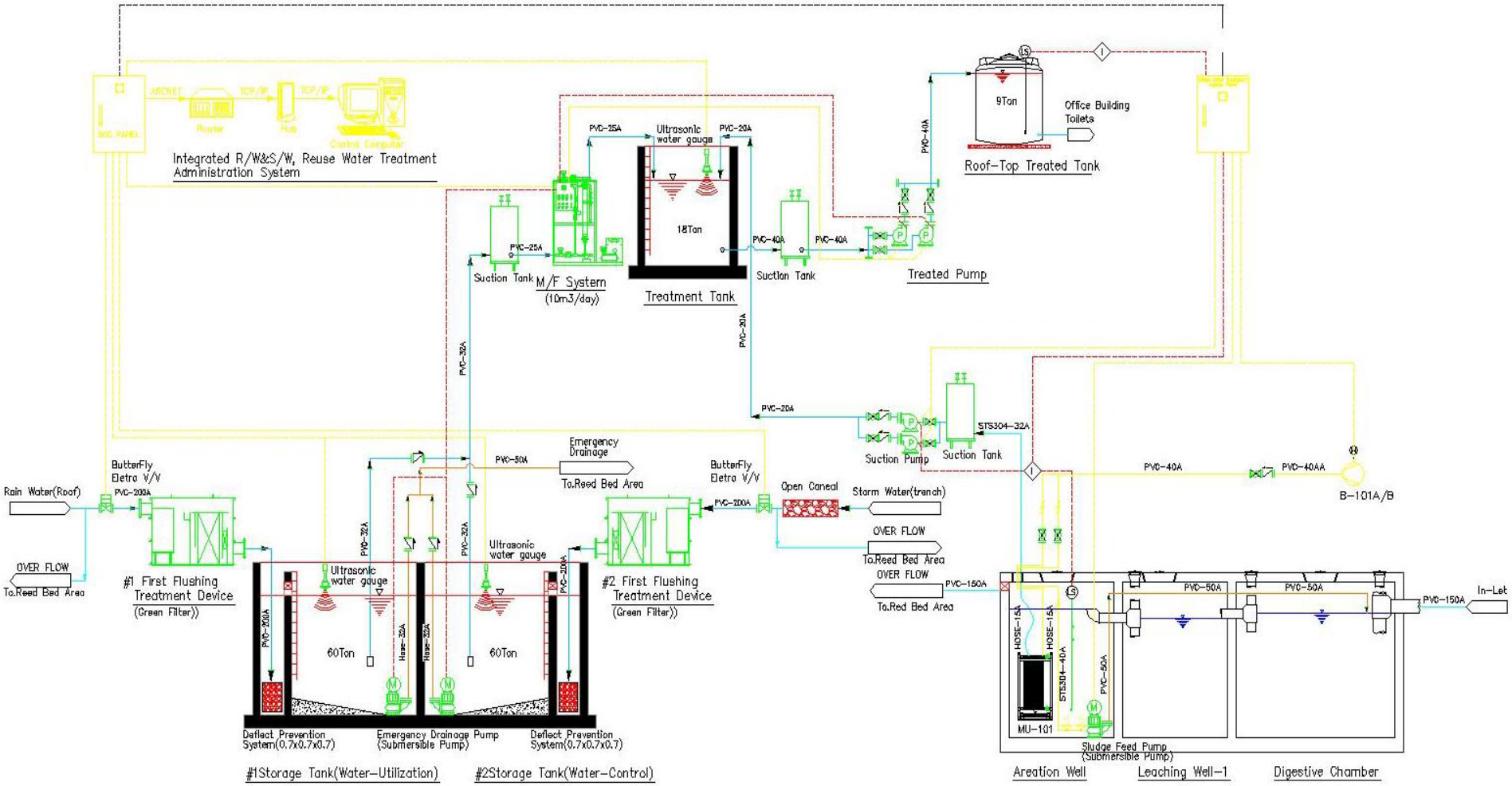
2. The Integrated Rainwater, Storm water & Wastewater Management Project in Cebu, Philippines



- Catchment area : 1,500 m^2
- Rainwater tank : 60 m^3
- Stormwater tank : 60 m^3
- Treated water tank : 40 m^3
- Supply tank on a roof : 9 m^3
- First flush treatment device: W1,000×L1,500×H1,000 (Total 2set)
- MF system : 1 m^3/hr (10 hr operation/day)
- Wastewater treatment(MBR) : 10 m^3/day (toilet flushing)

2. The Integrated Rainwater, Storm water & Wastewater Management Project in Cebu, Philippines

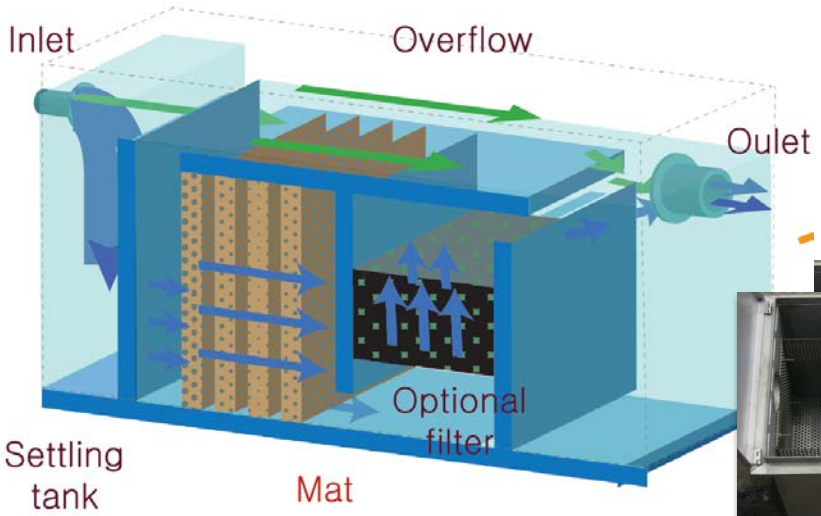
Pipe & Instrument Design(P&ID) of the system

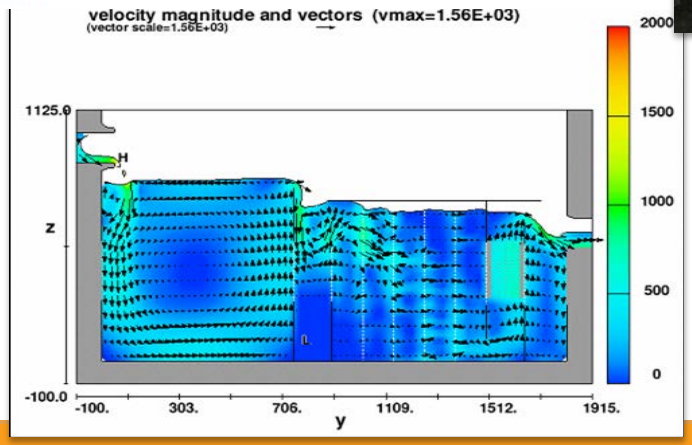


2. The Integrated Rainwater, Storm water & Wastewater Management Project in Cebu, Philippines

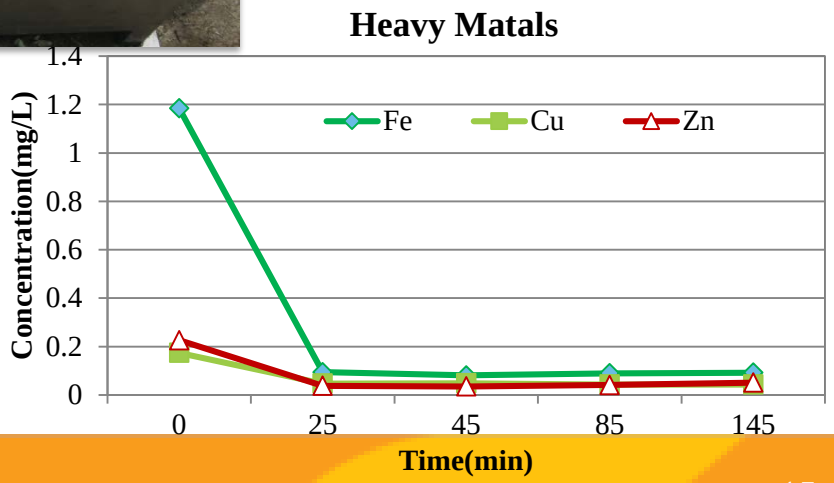
Rainwater & stormwater harvesting system

Green filter(Applying innovation technology)



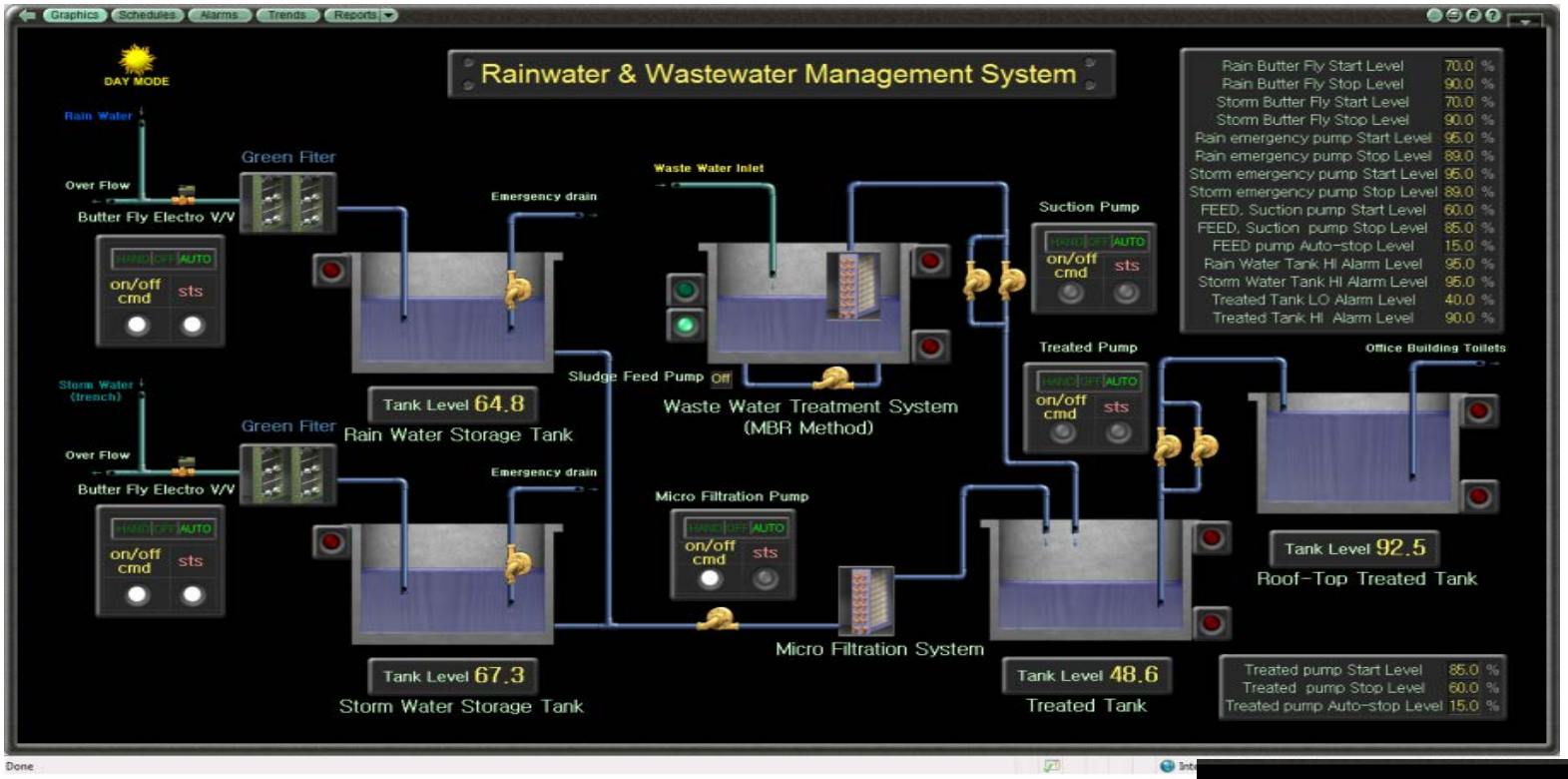


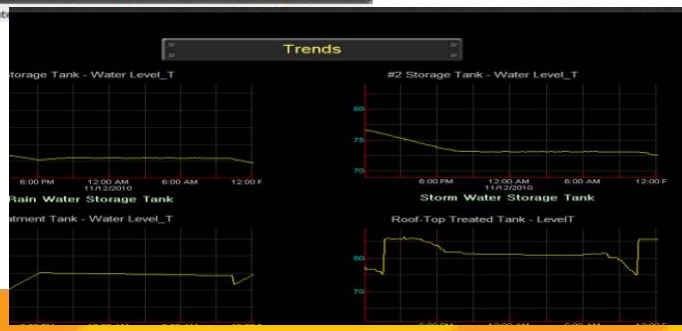
- Integrated system (Sedimentation and Filtration)
- No external power source is required
- Removal capability of nitrate, phosphate, and heavy metals as well as particles
- Filter media made of recycled wood : Environmentally friendly
- Patent No. 0516951 "Treatment facility and method for runoff from building rooftop"



2. The Integrated Rainwater, Storm water & Wastewater Management Project in Cebu, Philippines

Remote control and operating system(Applying innovation technology)

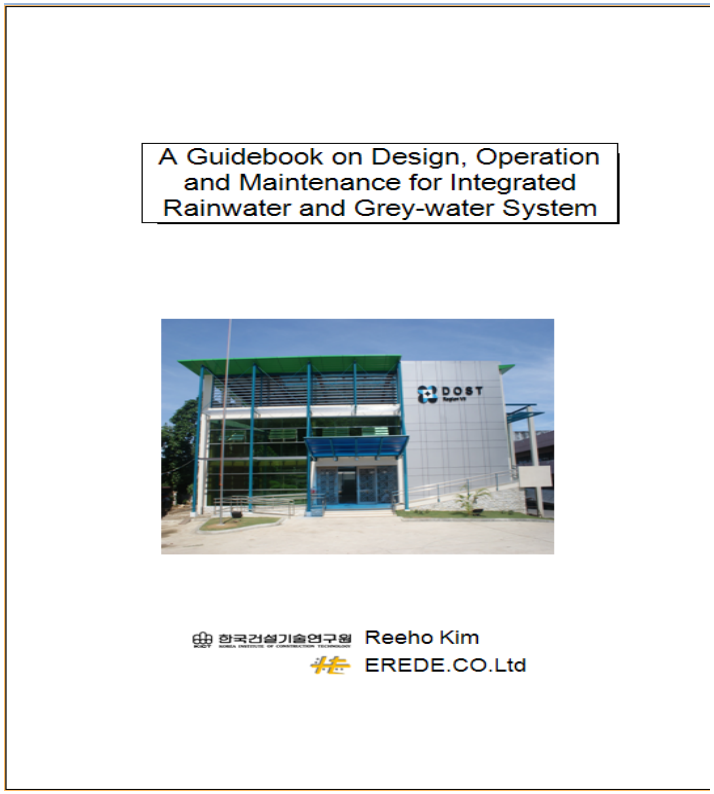




2. The Integrated Rainwater, Storm water & Wastewater Management Project in Cebu, Philippines

Reuse of stormwater and wastewater in the gardening of DOST 7

Plants and crops watered through the ISWM system.



Integrated Rainwater & waste water Treatment system Design & install in Department of Science and Technology regional 7 Office Guidebook

3 Low Impact Developement Technologies for Treatment of Stormwater Runoff

3. LID technologies for treatment of stormwater runoff

① Definitions of the LID

Low Impact Development (LID) is a stormwater management strategy designed to maintain site hydrology and mitigate the adverse impacts of stormwater runoff and nonpoint source pollution. (U.S. Department of Defense, 2010)

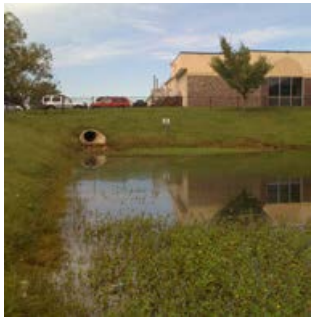
Low Impact Development (LID) is an ecologically-based stormwater management approach favoring soft engineering to manage rainfall on site through a vegetated treatment network. (UACDC, 2010)

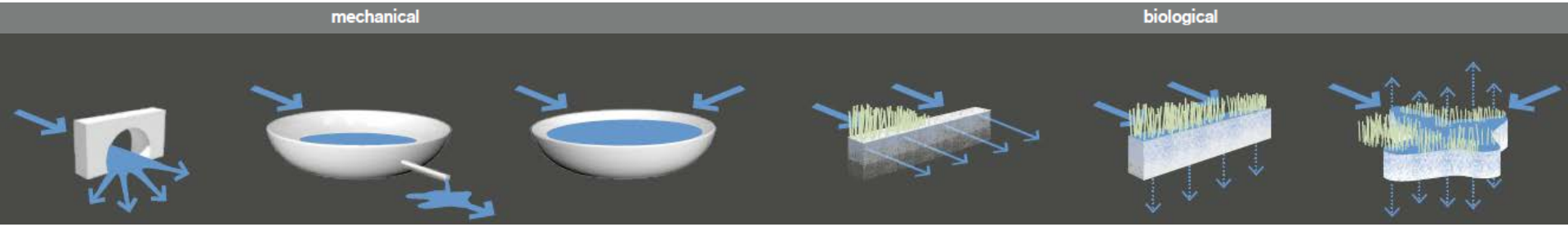
Low Impact Development (LID) is a land use planning approach to reduce flood and water pollution considering infiltration, storage and water cycle system of stormwater or rainwater. (Ministry of Land, Transport and Maritime Affairs, Guidelines on waterfront development, 2011. 11)

3. LID technologies for treatment of stormwater runoff

② Technologies of LID





Slow → Spread → Soak

flow control
The control of stormwater runoff flow rates

detention
The temporary storage of storm-water runoff to reduce peak flow rates

retention
The storage of stormwater runoff on site

filtration
The sequestration of sediment from stormwater runoff

infiltration
The vertical move-ment of stormwater runoff

treatment
Process that utilize phytoremediation or Bacterial colonies to metabolize contaminants in stormwater runoff

Ref. : UACDC(2010), LID a design manual for urban area

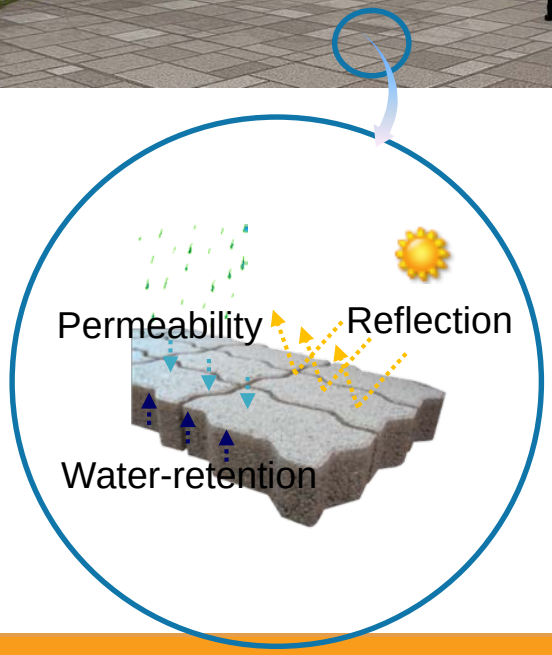
3. LID technologies for treatment of stormwater runoff

③ Facilities of LID

A : Vegetated filtration technologies
B : Infiltration technologies
C : Detention and retention technologies
D : Other technologies

3. LID technologies for treatment of stormwater runoff

④ Multi-function (permeable-retentive-reflective) block

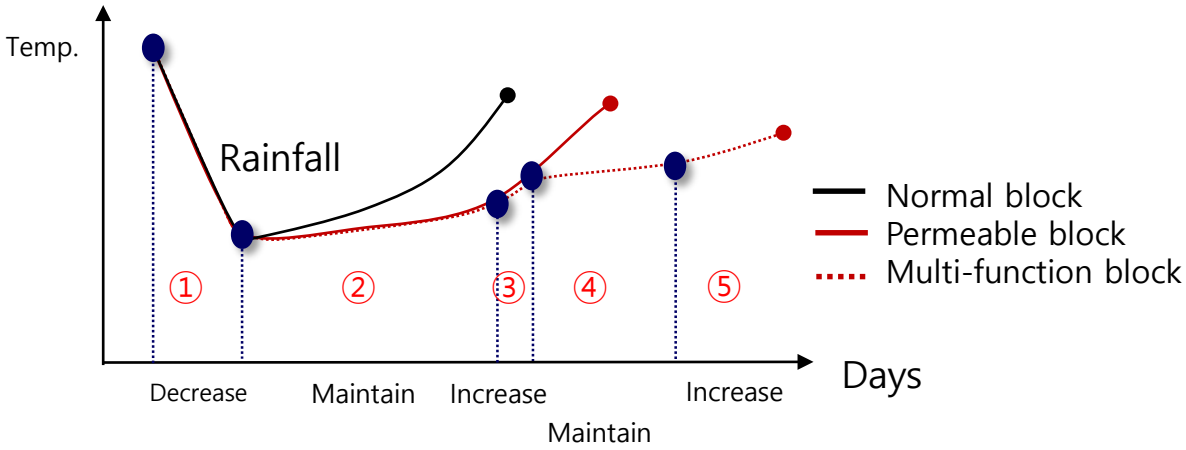


Rain
- Rainfall inflow to the block
- The material inside of block absorbed the rainwater

→ Runoff control

Fair
- Surface temperature control by evaporation and reflection of the block

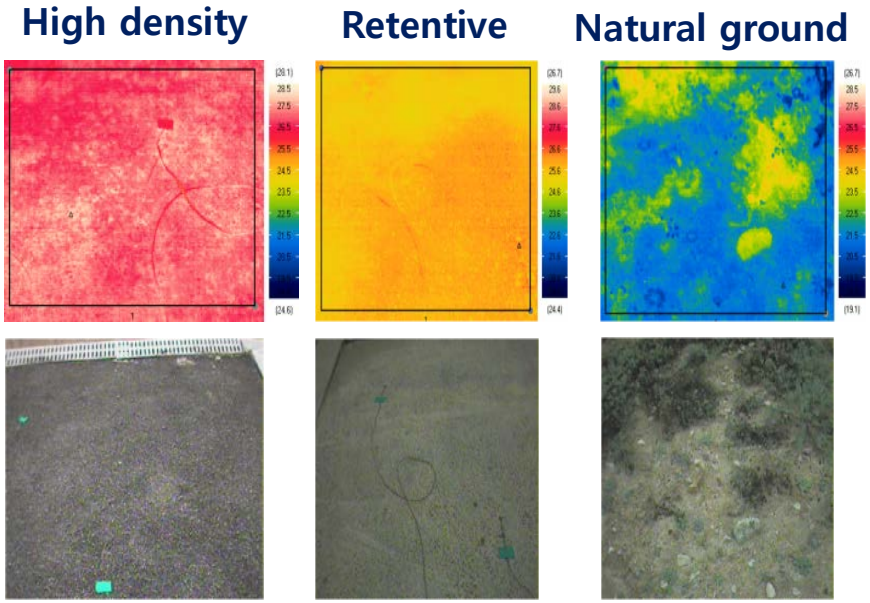
→ Surface temperature control



3. LID technologies for treatment of stormwater runoff

⑤ Water retentive asphalt pavement

- **Performance evaluation**

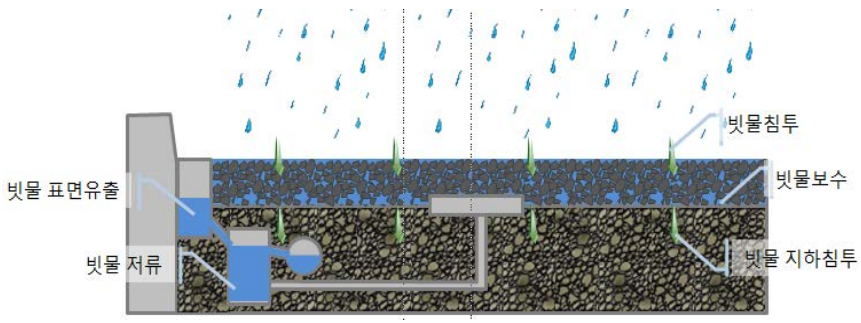


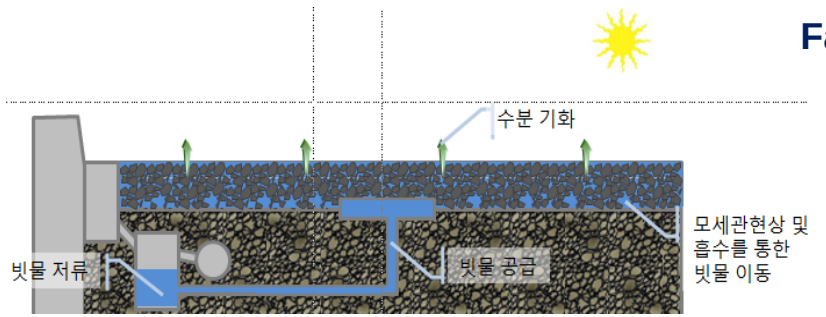
Pavement type	Daily Max. temp.	
	Summer (Aug)	Fall (Oct.)
Temperature	33.0℃	26.0℃
High density	62.3℃	30.1℃
Retentive	50.2℃	25.7℃
Natural ground	34.6℃	22.0℃

3. LID technologies for treatment of stormwater runoff

⑥ Water supply system for pavement

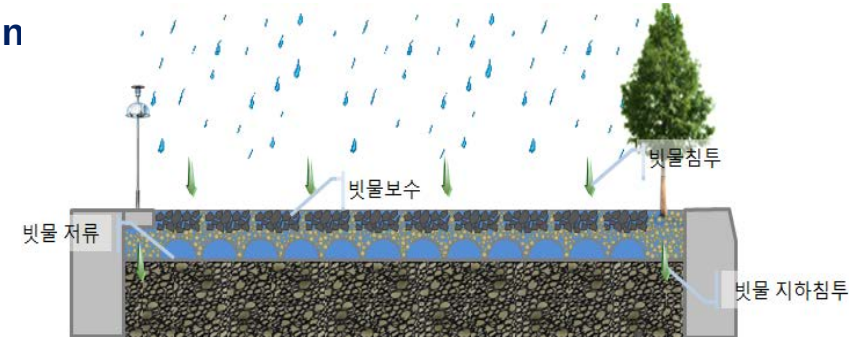
Water supply system for retentive asphalt road



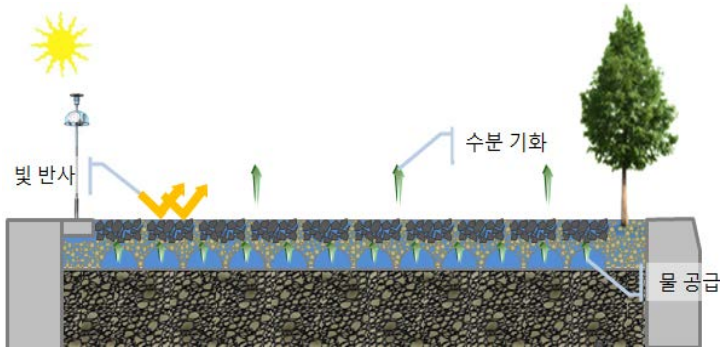


Water supply system for multi-function block

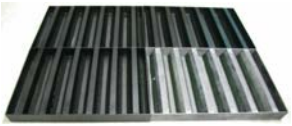
Rain



Fair



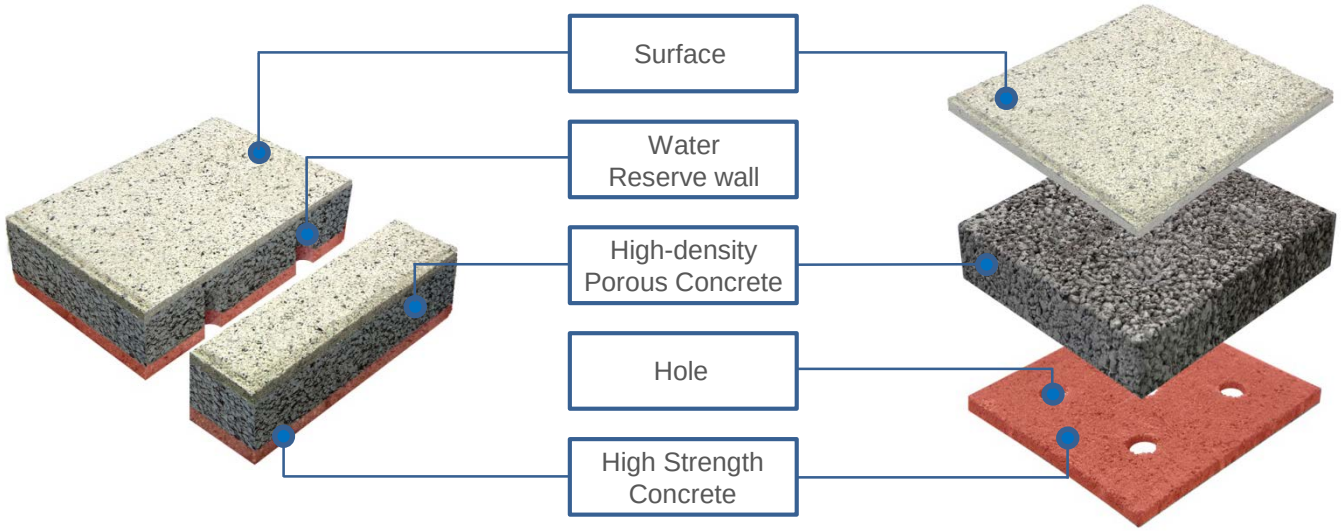
Type 1



Type 2

3. LID technologies for treatment of stormwater runoff

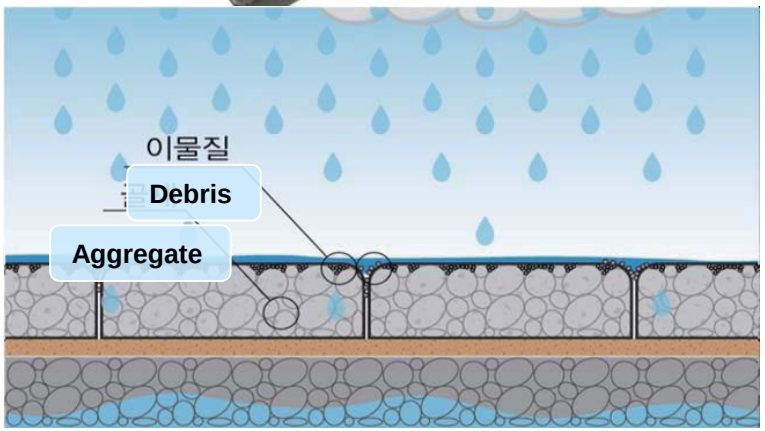
⑦ Permeable hole block

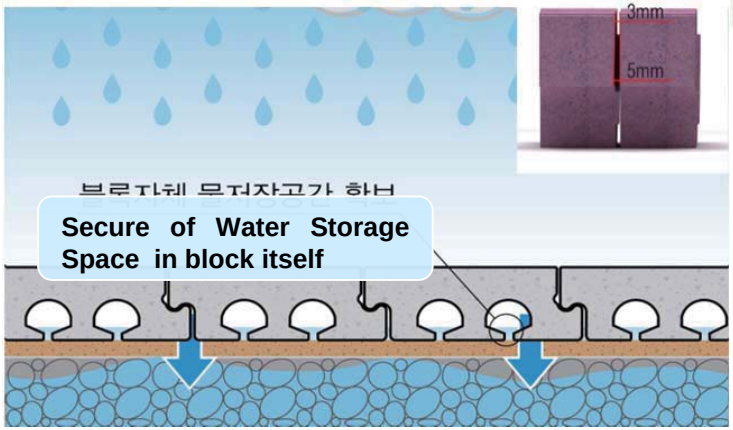


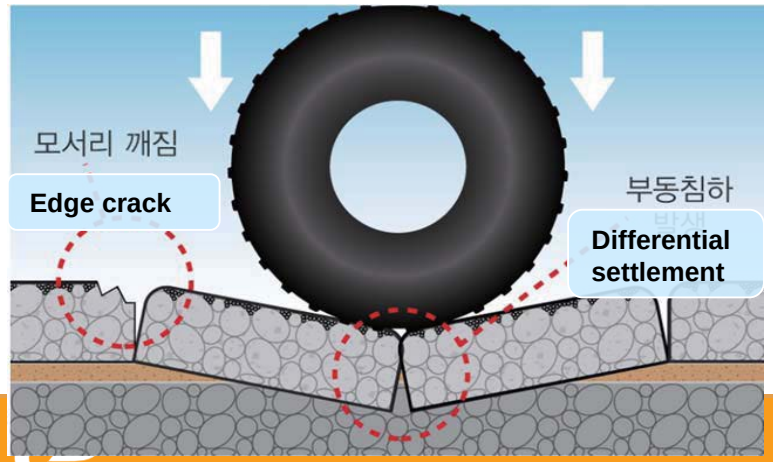
Source : Mr. Baek, Daeil Tec. Co., Ltd.

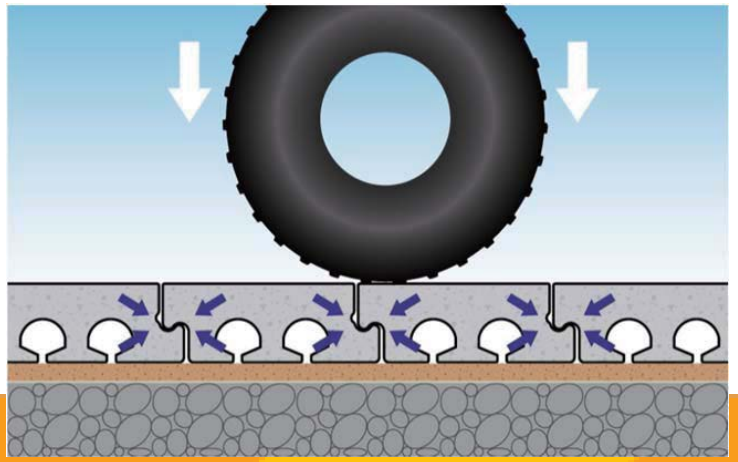
3. LID technologies for treatment of stormwater runoff

⑧ Storage block





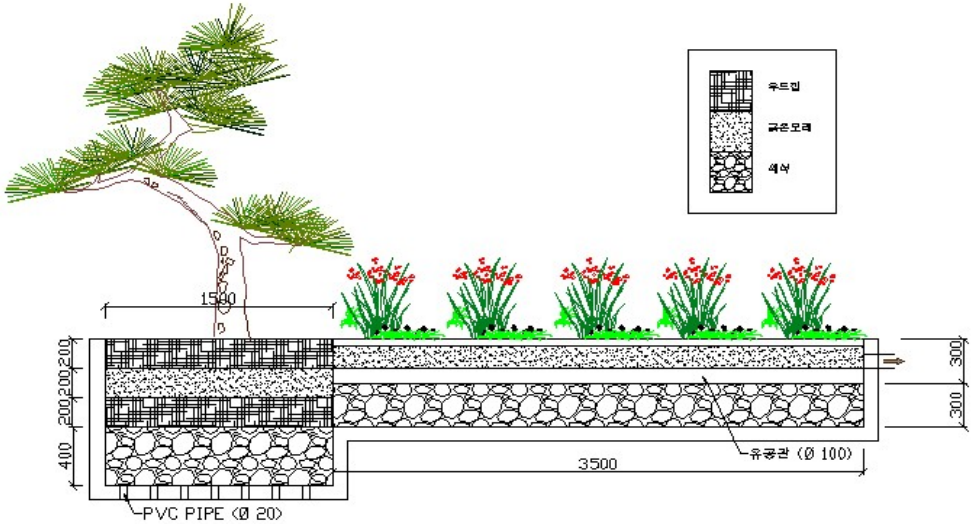


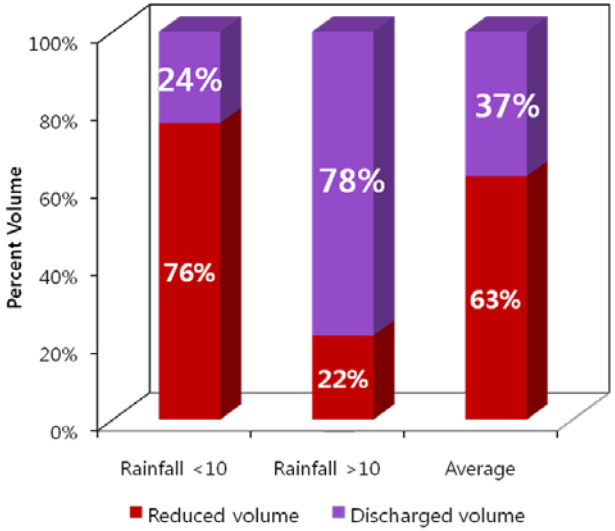


Source : Mr. Choi, EcoTop Co., Ltd.

3. LID technologies for treatment of stormwater runoff

⑨ Tree box filter

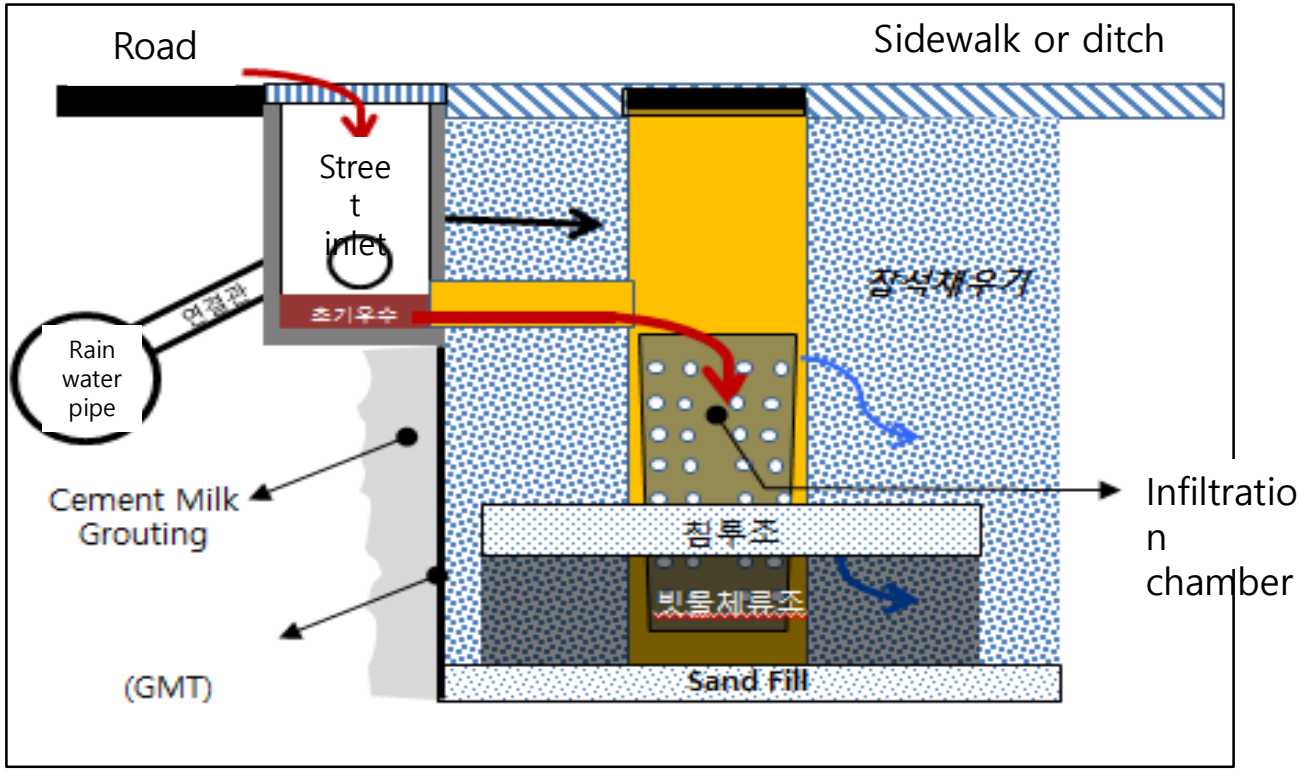




Source : Dr. Heo, LID Solution Co., Ltd.

3. LID technologies for treatment of stormwater runoff

⑩ Infiltration street inlets

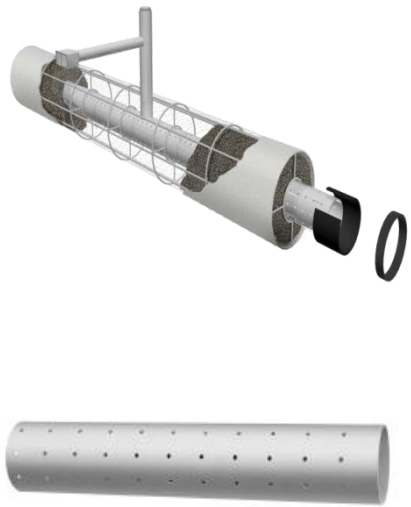


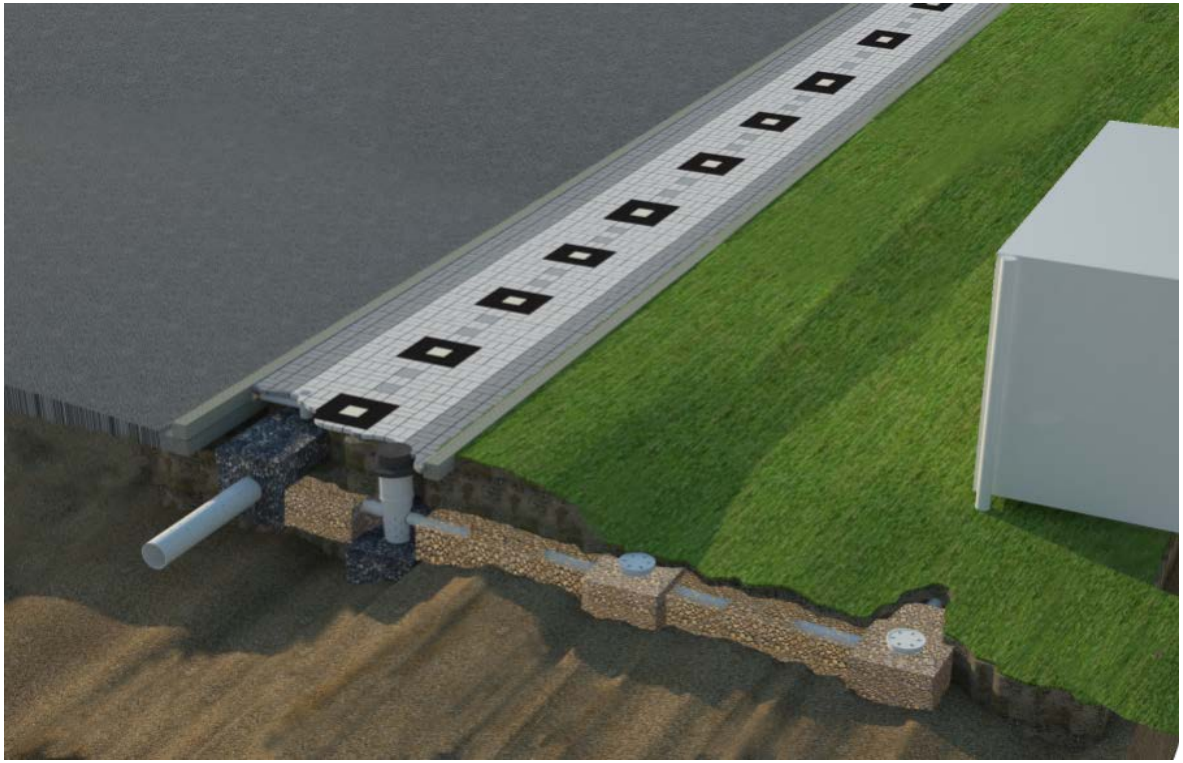
- Rainwater from the road ➡ street inlet ➡ infiltration chamber
- Overflow goes to the rainwater pipe
- The first flush inflow to the infiltration chamber and treated by materials

Source : Mr. Heo, LID Solution Co., Ltd.

3. LID technologies for treatment of stormwater runoff

⑪ Infiltration lateral ditch



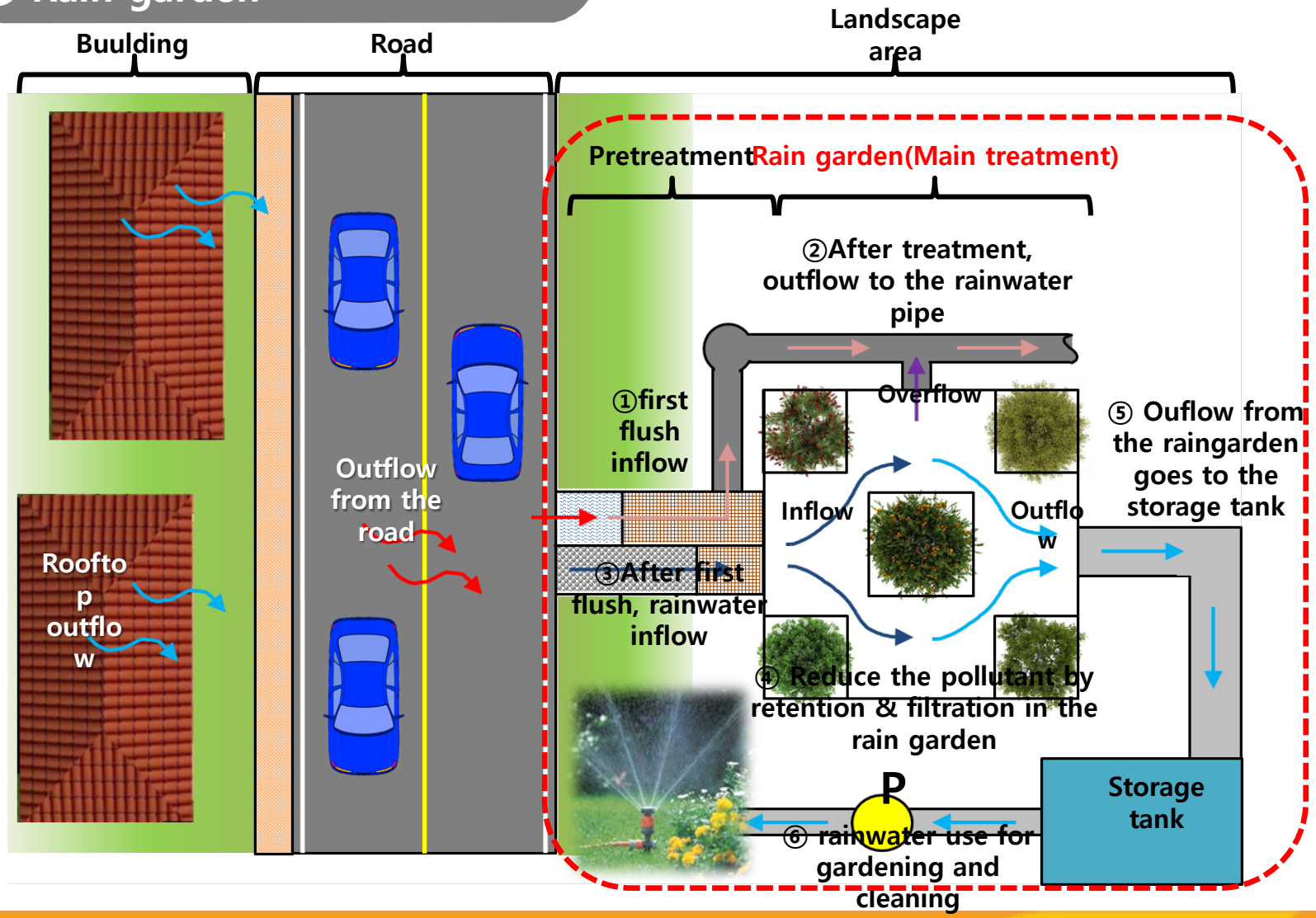


- Reduce the water flow rate and infiltrate rainwater
- Crushed stone is put around ditch, rainwater is infiltrated through the side and bottom

Source : Dr. Heo, LID Solution Co., Ltd.

3. LID technologies for treatment of stormwater runoff

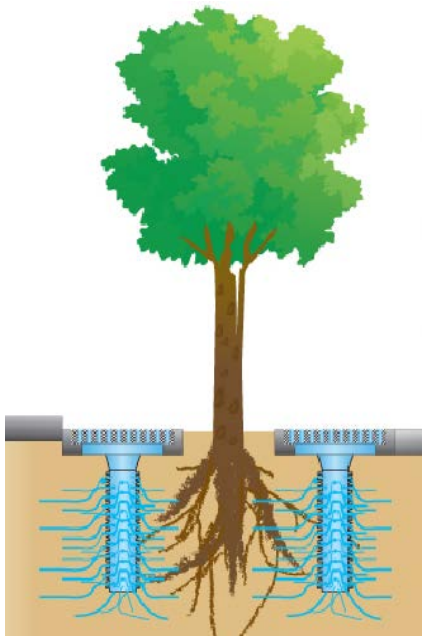
⑫ Rain garden



Source : Dr. Lee-Hyung Kim, Kongju National Univ

3. LID technologies for treatment of stormwater runoff

⑬ Tree protector & vertical infiltrators

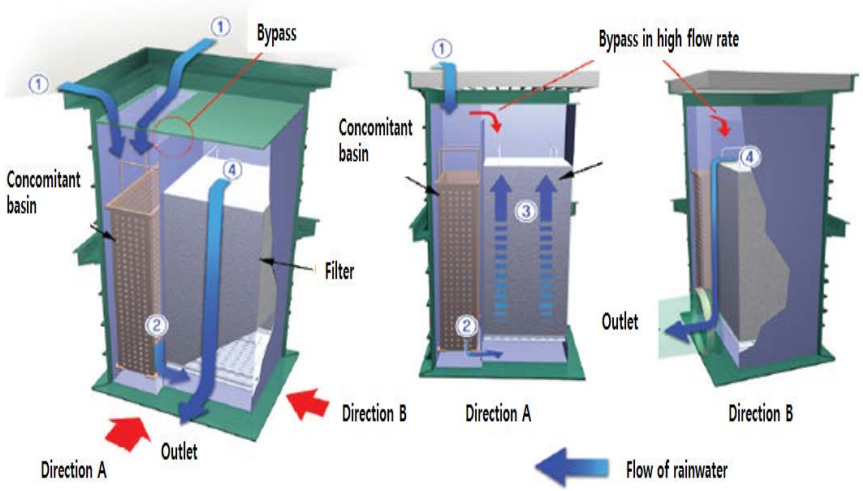


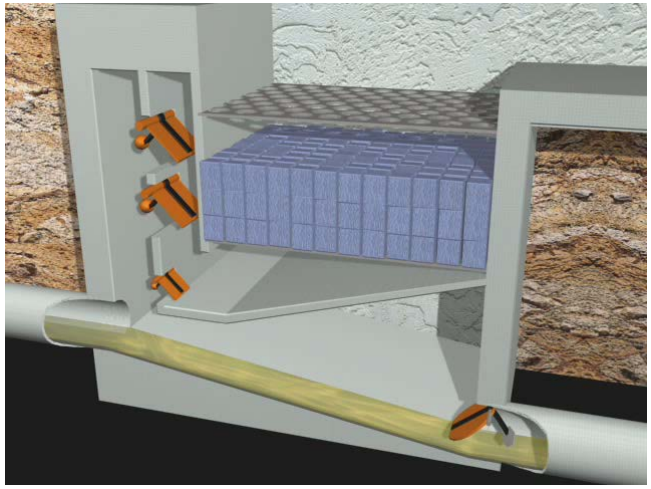
- Tree protector and vertical infiltrator
- Function : Stormwater infiltration, non-point sources and soil erosion control

Source : Mr. Han, Earth Green Korea Co., Ltd.

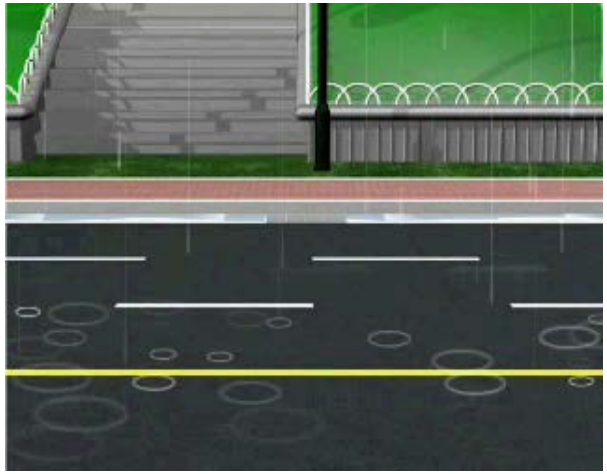
3. LID technologies for treatment of stormwater runoff

⑭ First-flush treatment system





Basic system



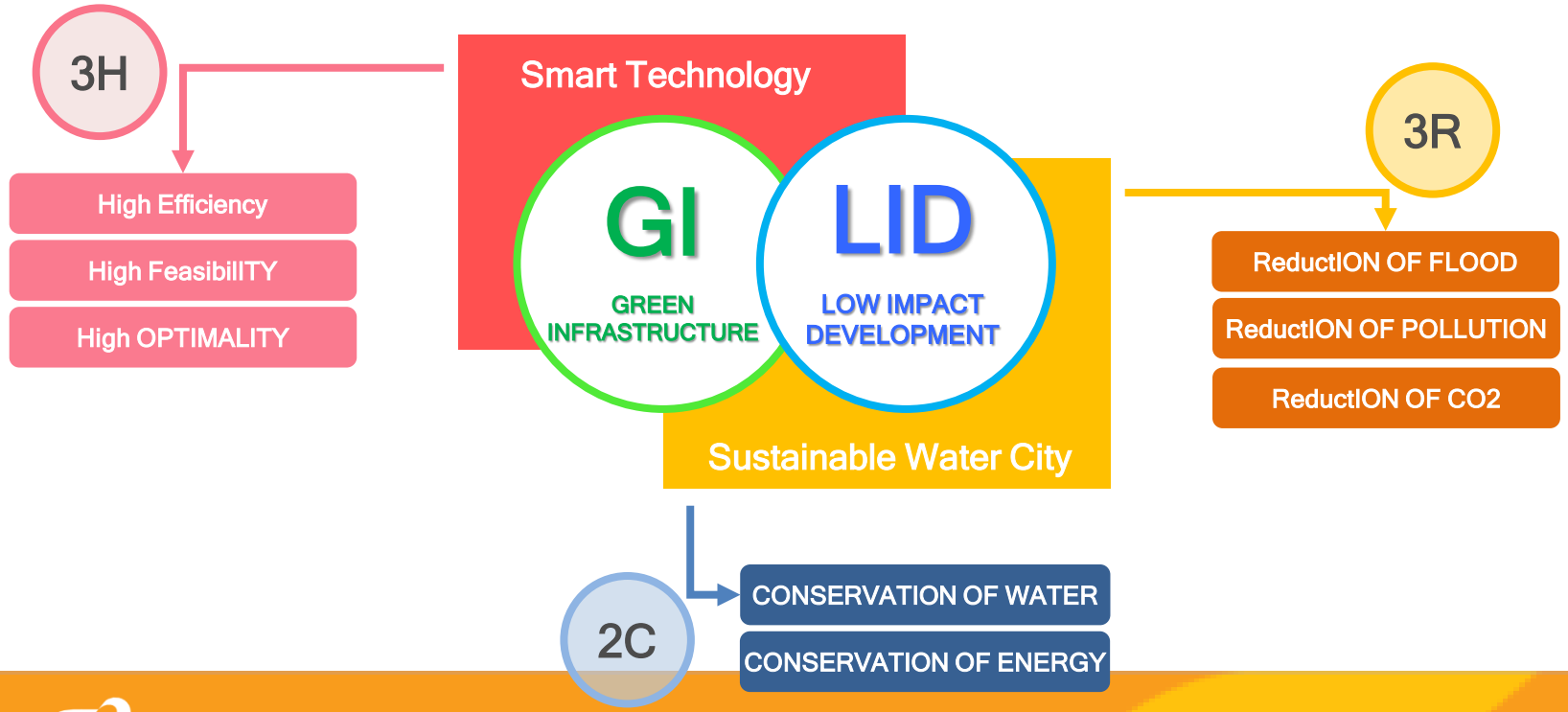
Advanced System for High contaminant treatment

4 Korea National Green Infrastructure & Low Impact Development Center

4. Korea National Green Infrastructure & Low impact Development Center

National Smart GI and LID Research Group

Urban Green Water-Cycle Infrastructure Technology for Sustainable Low Impact Development



4. Korea National Green Infrastructure & Low impact Development Center

"SITE" KOREA LID-VERIFICATION FACILITY

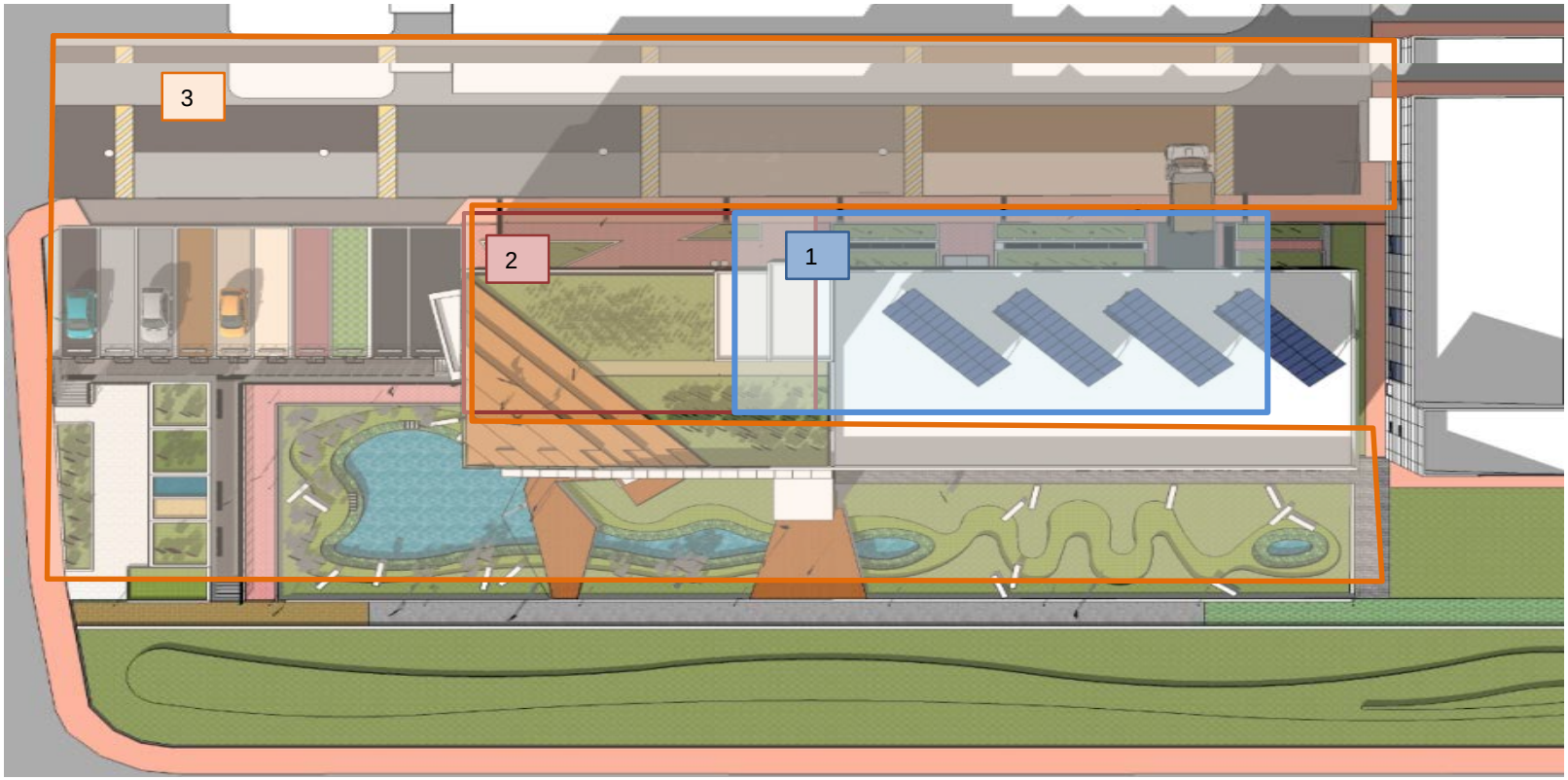
- Gyoungnam Yangsan-si 2nd Campus of Pusan National University
- The characteristics refelcting friendly water in Nakdong River

Site Condition

- Inside distributed national experimental facility complex
- Inside Pusan National University (offered by PNU)
- Completely furnished with infrastructure

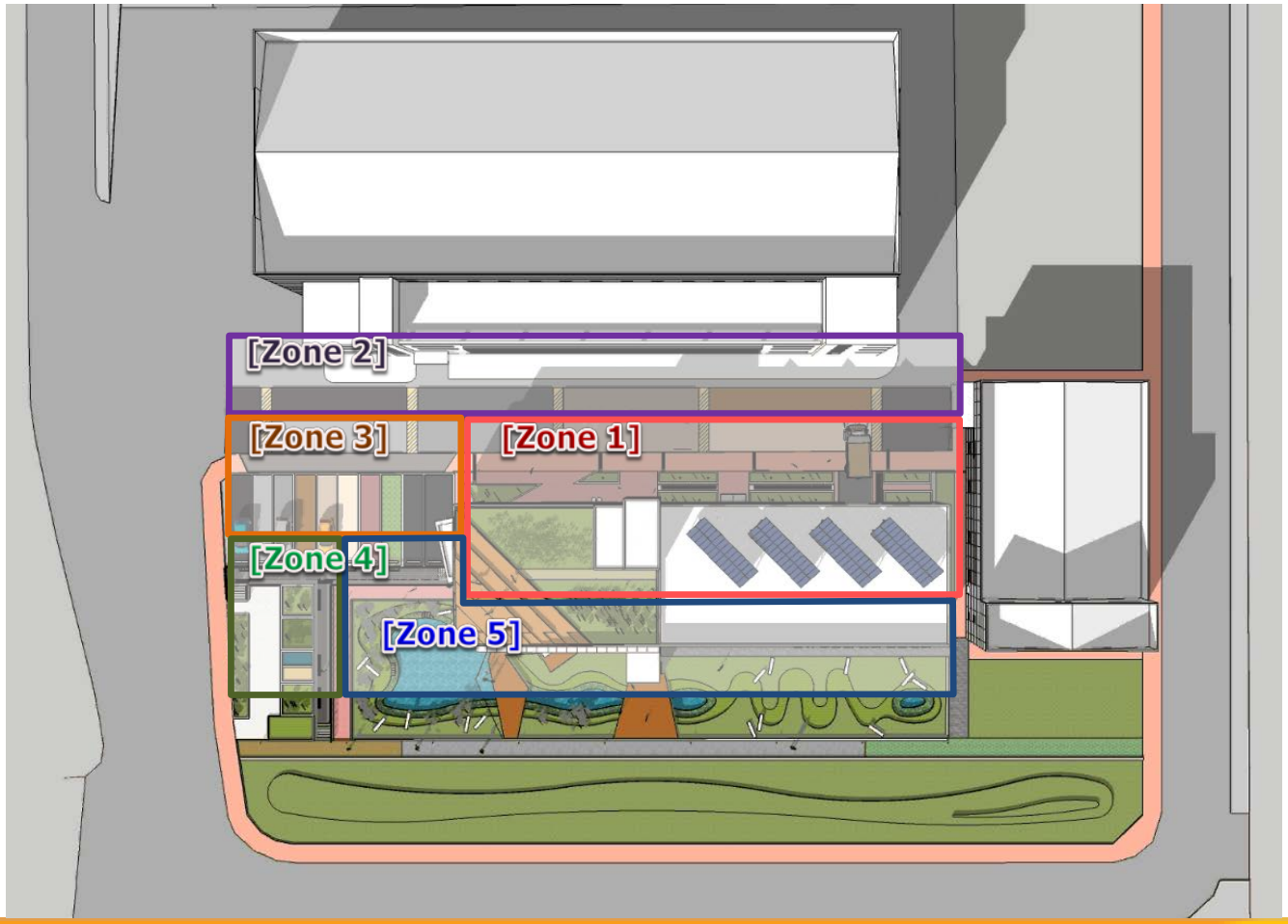
4. Korea National Green Infrastructure & Low impact Development Center

LOCATION AND SITE PLAN



4. Korea National Green Infrastructure & Low impact Development Center

LID OUTSIDE TEST-BED SITE(LID-TEST-BED)



[ARCH.-LID Area]

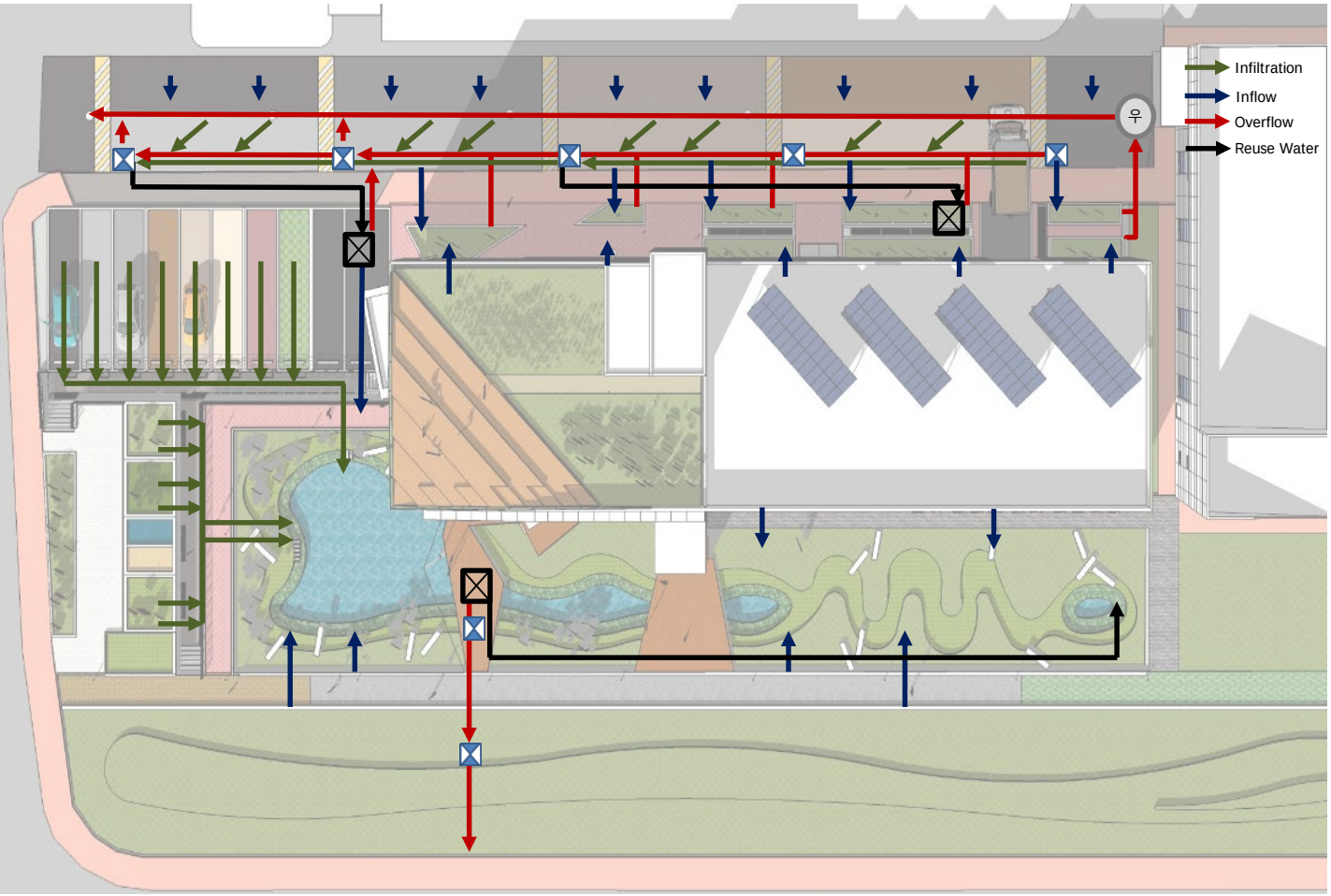
[PARKING-LID Area]

[IDT-LID

[BR-LID Area]

4. Korea National Green Infrastructure & Low impact Development Center (LID outside test-bed site)

SITE STORMWATER SYSTEM (SS)

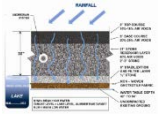


Outline

- Rainfall flow in test bed can be infiltrate and storage through LID or GI facilities.

LID technologies


Green Roof


Porous Pavement


Flow-Thorough Planter

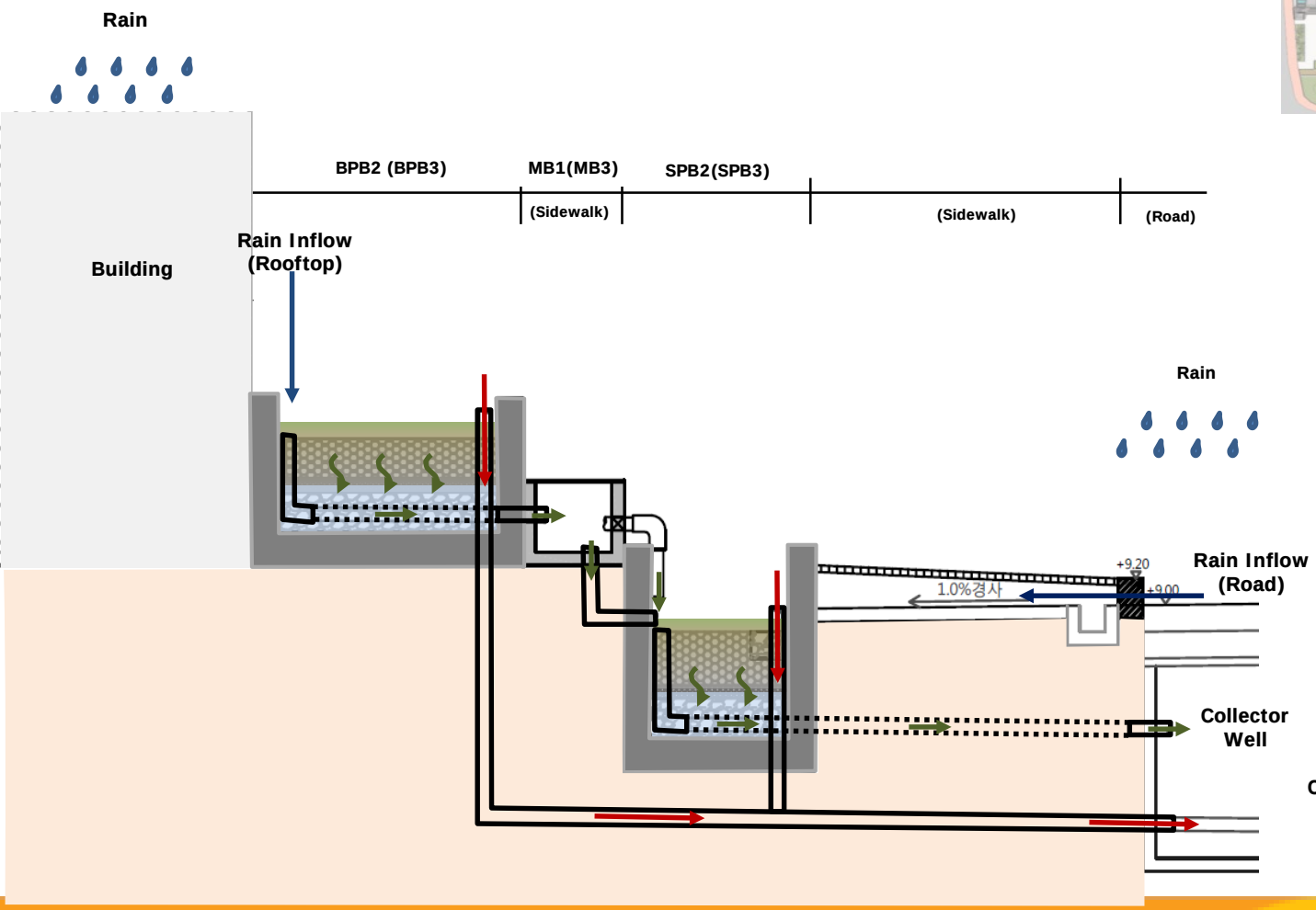

Vegetated Filter Strip


Rain Garden


Bioretention

4. Korea National Green Infrastructure & Low impact Development Center (LID outside test-bed site)

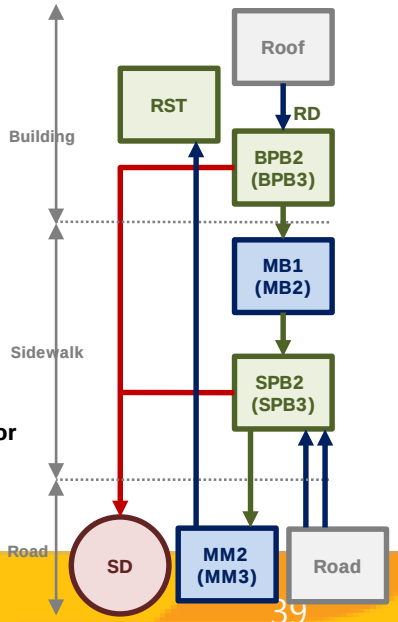
ARCHITECTURAL LID TYPE



Outline

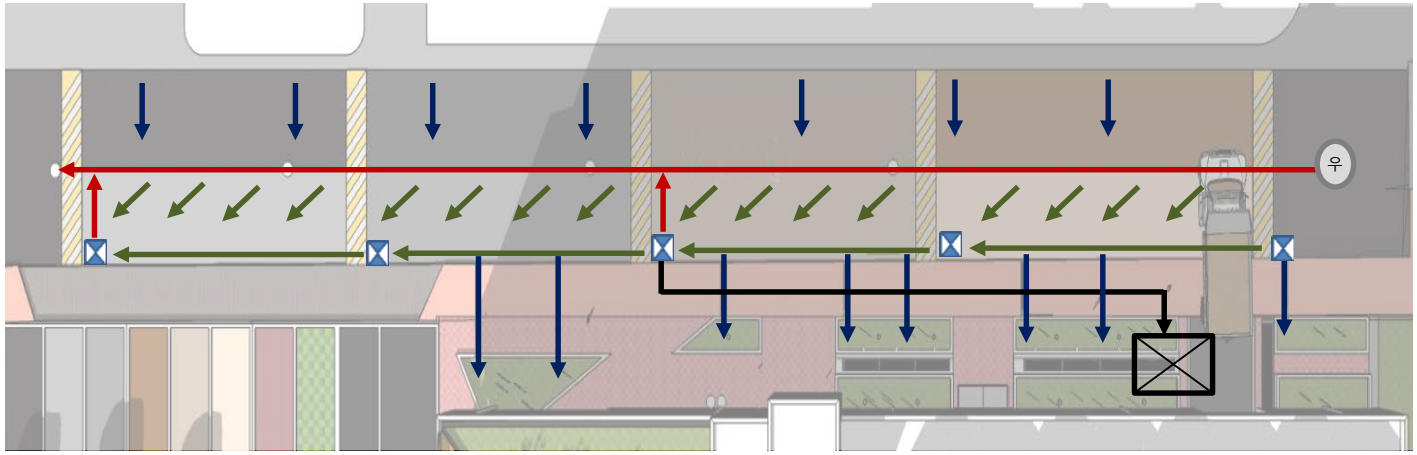
- Rain inflow : Rooftop, Road
- The rain inflow can be infiltrate and exclude through LID facilities.
- Infiltration water can be reuse

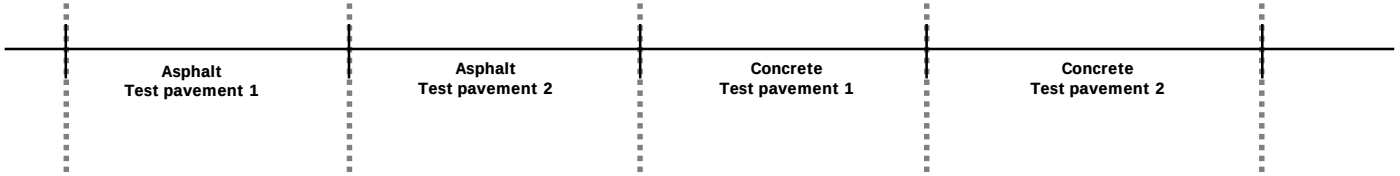
Stormwater schematic diagram

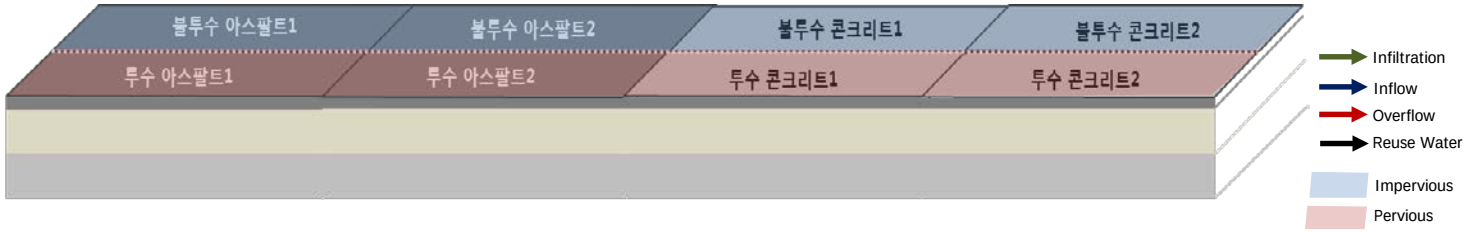


4. Korea National Green Infrastructure & Low impact Development Center (LID outside test-bed site)

ROAD-LID ZONE







Outline

- Road type LID facilities is to experiment for reduction effect of runoff, nonpoint source and heat island effect etc.
- The facilities is compsed of pervious and impervious asphalt and pervious and impervious concrete
- Collection water can be reuse

LID technologies

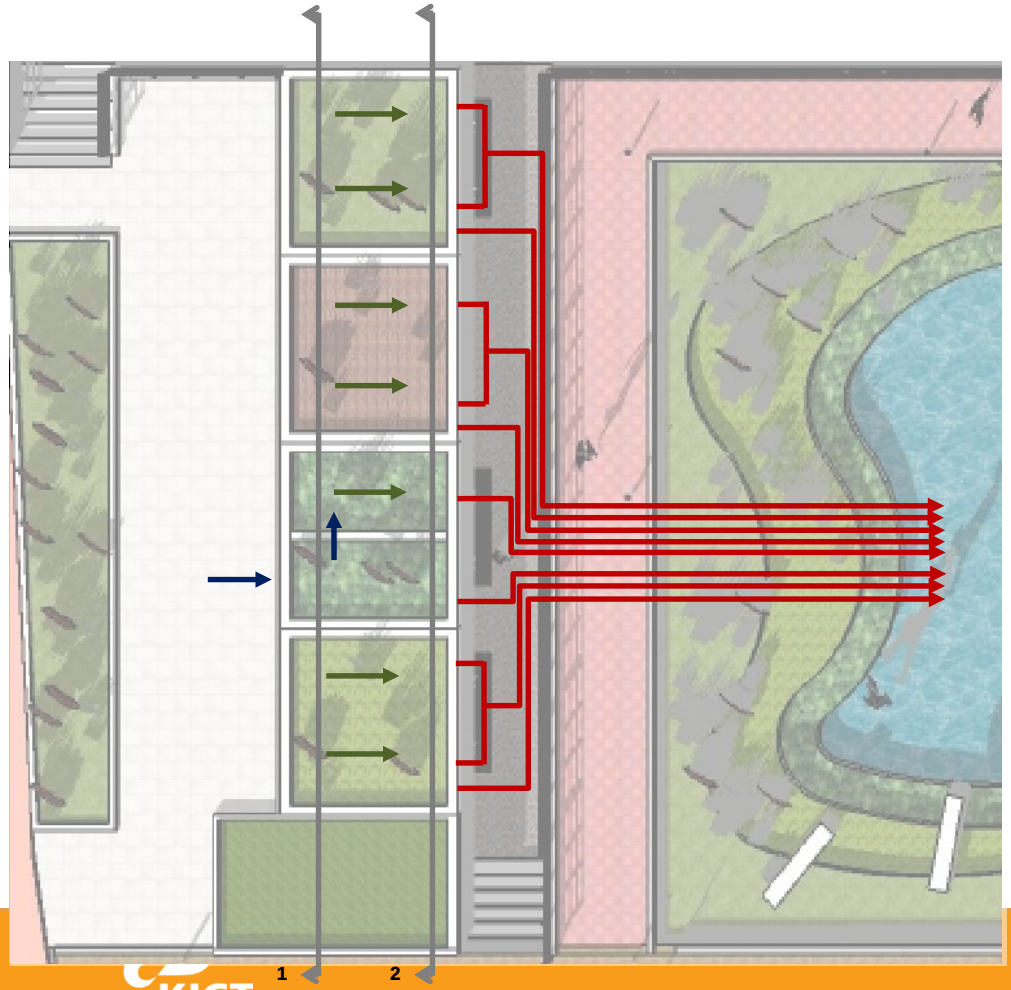
Pervious Concrete

Pervious Asphalt

www.perviouspavement.org
www.exteriorscapes.com

4. Korea National Green Infrastructure & Low impact Development Center (LID outside test-bed site)

INDUSTRIAL LID ZONE

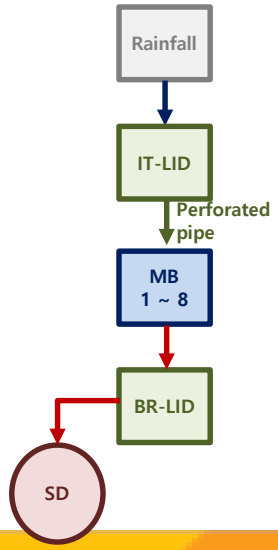


Infiltration
Inflow
Overflow

Outline

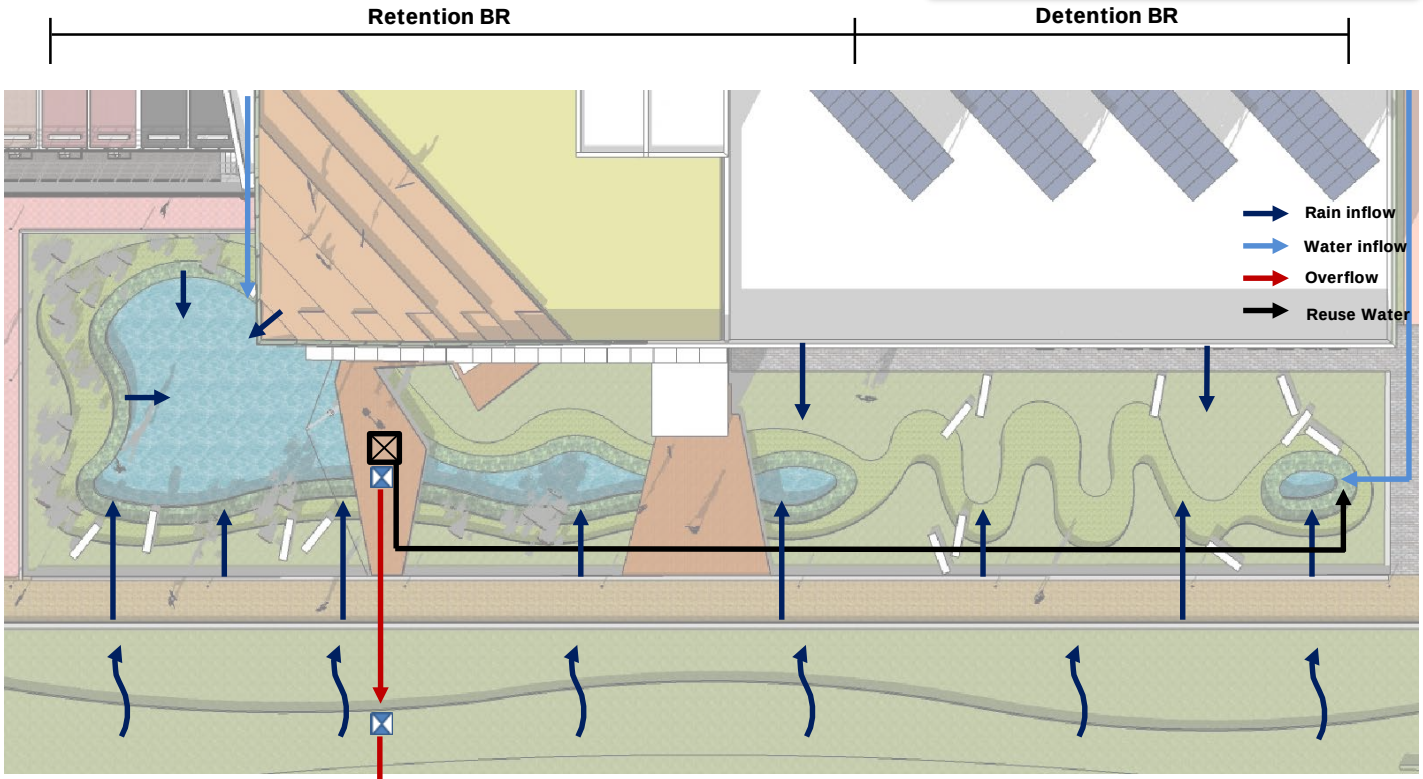
- Industrial LID facilities can be verify the effect of complex LID facilities
- Rain inflow in industrial LID facilities can be move to bioretetion LID zone

Stormwater schematic diagram



4. Korea National Green Infrastructure & Low impact Development Center (LID outside test-bed site)

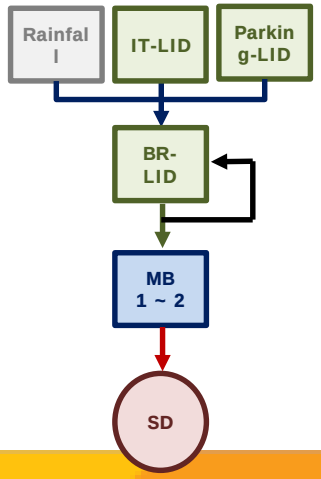
BIORETENTION-LID ZONE



Outline

- Bioretention LID zone collect the rain inflow from parking LID zone and industrial LID zone.
- Retention pond usually utilize landscape for park, but when the facility can be use exclude the rain inflow when it is raining.

Stormwater schematic diagram

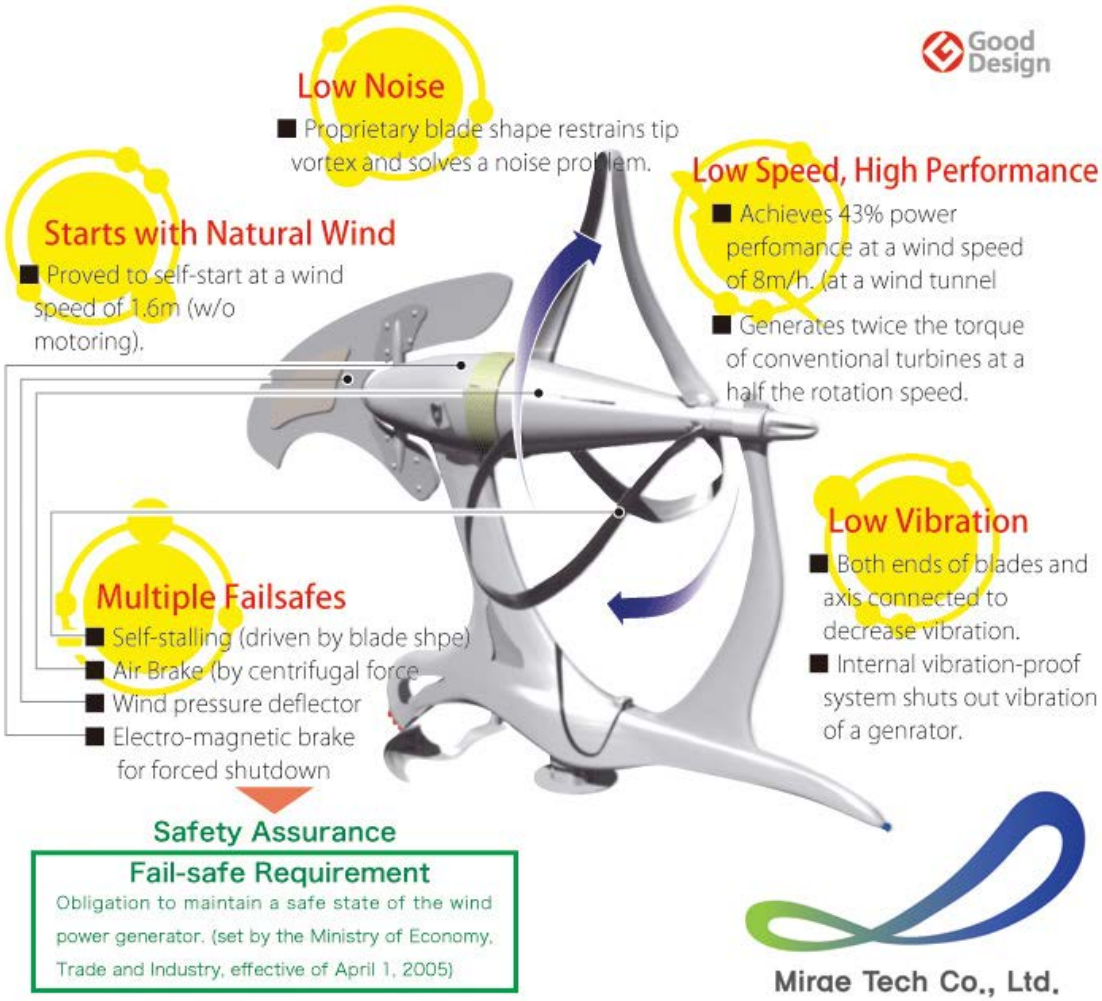


5 Wind generator capable of stable electric supply in case of disaster

KICT 한국건설기술연구원

5. Wind generator capable of stable electric supply in case of diasaster

Core Technology



5. Wind generator capable of stable electric supply in case of diasaster

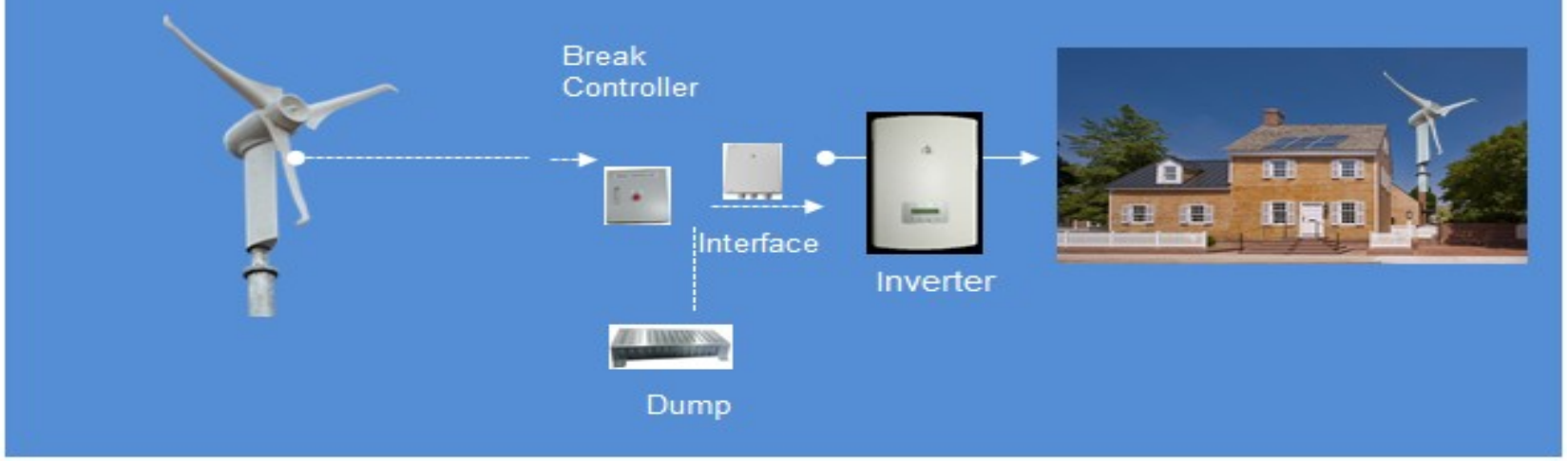
Content	Specification
Rated Output	**3 kw**
Rotor Diameter	3.18 m
Cut-In-Out Wind Speed	2.5 ~ 17 m/s
Voltage	220V /50. 60Hz
Rated Wind Speed	12 m/s
Rated output speed	350rpm
Blade material	Fiber Reinforced Plastics
Generator type	Synchronous . gearless
Brake methods	Electronic control brake
Endurance Wind Speed	60 m/s
Weight(kg)	125 Kg
Tower Height	**8 M**
Work temperature	-40 ~ +60˚c

Content	Specification
Rated power	**10kW**
Rotor diameter	7.1m
Cut-in-Out wind speed	3m/s - 25m/s
Grid tie type	Three phase 400v.50~60Hz.20A
Rated wind speed	10.5m/s
Rated output speed	180 RPM
Blade materal material	Carbon Fiber Composite
Blade Pitch Control	hydraulic pitch cylinder
Brake methods	Pitch and hydraulic disc brake
Weight (tower except)	1,850 Kg
rated frequency	50-60Hz
Total Tower height	**21m**
Work temperature	-40 ~ +60˚c

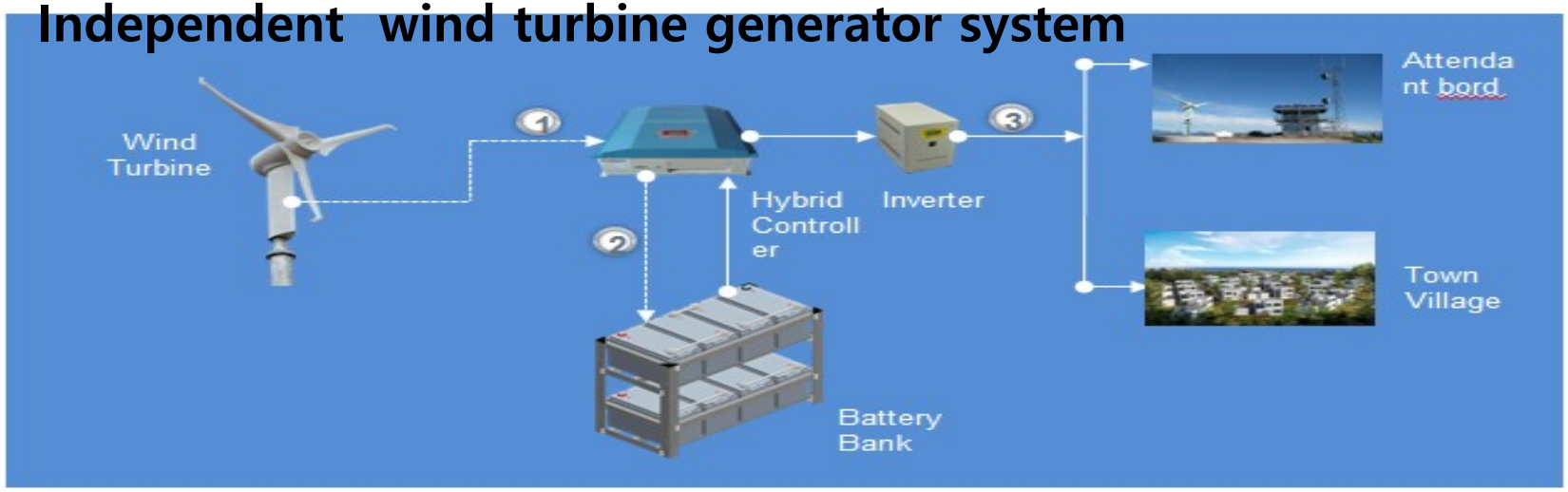
Content	Specification
Max. effect	**15 kW**
Rotor diameter	9,9 meter
Rotor area	77 m^2
Operating area	3 - 25 m/s
Output	3 x 400V / 50 Hz / 20 A
Full effect from	8,5 m/s
Blade material	Fiberglass
Brake methods	Pitch and disc brakes
Speed regulation	Pitch via hydraulic
Number of blades	3
Tower height	**20 meter**

5. Wind generator capable of stable electric supply in case of diasaster

Grid-connected wind turbine generator system



Independent wind turbine generator system



Thank you

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