Case Study: Gwangju, Republic of Korea

Leading the Water Circulation Project

September 2020
1. Overview

Overview

Project Name: Gwangju Leading the Water Circulation Project
Duration: 2017. ~ 2021. (Now under development of working design)

Background, Purpose

- Background: Increase in surface of water permeability in the city causing flood, depletion of underground water, dried stream, degradation of water quality and water ecology, etc.
- Purpose: Applying Low Impact Development (LID), to recover city's capacity to contain water and to respond against climate change and secure soundness of water circulation system

Project Outline

<table>
<thead>
<tr>
<th>Location (Venue)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chipyeong-dong, Seo-gu, Gwangju (A=2.1km²)</td>
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</tbody>
</table>

Contents

- Reduce surfaces of water permeability (91%→65%)
- Key facilities applied LID
  - Public facilities: police office, elementary school, convention center, broadcasting system, community service center
  - parks
  - parts of main avenue, etc.

Timeline

2016.05. Gwangju selected as a leading city of water circulation (5 cities in the nation)
2018.08.~2020.09. Now developing working design
2019.01.~2019.08. Visit best practice site, public hearing

Expenses

29.5 bil. KRW (appr. 24.8 mil. US$)
- 70% from national govt., 30% from local govt.
2. Baseline Data Research

Calculation of water circulation target

1. Review on reduction target of rainfall

- Use management technologies of rainfall events (percentile rank)
- Analyze rainfall events using 10-year data since 2017

Target water circulation in the area is **14.5mm**, 80% of cumulative incidence frequency per year.
2. Baseline Data Research

2. Target setting of water circulation

- 91% (1,857,869 m²) of target area is impervious (water impermeable)
- Set target per zone

※ Zone A, B, C were categorized by water outlet

<table>
<thead>
<tr>
<th>Impervious areas</th>
<th>Set target amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entire area 2,065,562 m²</td>
<td>Target (Zone A) 9,046.9 m²</td>
</tr>
<tr>
<td>Impervious area 1,857,869 m²</td>
<td>Target (Zone B) 15,890.4 m²</td>
</tr>
<tr>
<td>Impermeability 90.6%</td>
<td>Total Amount 26,939.1 m²</td>
</tr>
</tbody>
</table>

Applying target rainfall 14.5mm

Impervious area x target rainfall = target amount
3. Working Design

How to apply LID (Low Impact Development) Facilities

1. Arrangement in the target area

<table>
<thead>
<tr>
<th>Gray Infrastructure → Green Infrastructure</th>
<th>Maximize LID</th>
<th>Inflow of rainfall into LID green space</th>
<th>Water circulation with multi-layered green space</th>
<th>Green &amp; Blue Network System</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Single purpose → Multiple purpose</td>
<td>- Various vegetation spaces: less impervious, more green</td>
<td>- Loss of rainwater and soil: clogged manholes/trenches</td>
<td>- High underground water level → evapotranspiration by vegetation is required</td>
<td>- Connection of all green spaces</td>
</tr>
<tr>
<td>- Urban infra. + green area + water circulation + ecology + landscape + leisure</td>
<td>- Expansion of ecosystem service</td>
<td>- Block-type green space → concave-type space</td>
<td>- Connection LID facilities and waterways</td>
<td>- Connect street trees with vegetation</td>
</tr>
</tbody>
</table>

- Inflow of rainwater to LID green space
  - (impervious) pavement: Discharge + stagnant water
  - (pervious) green area: infiltration + discharge

- Multi-layered vegetation

Structural change of Water Mgt. into green areas

- Water inflow (infiltration, filtration in a timely manner)
3. Working Design

2. Application of LID to public facilities

- Applied LID techniques to available areas considering feedback from stakeholders (education, public, etc.)

Example of standard LID facility in education

- Rainwater facility
- Vegetation
- Eco-water storage

Example of standard LID facility in public

- Rainwater facility
- Vegetation waterway
- Eco-water storage

Elementary School
- Building (Classrooms)
- Parking
- Gardening Area
- Vegetation waterway
- Pervious pavement
- Pervious trench
- Eco-water storage
- Pervious trench

Police Station
- Building
- Parking
- Gardening Area
- Vegetation waterway
- Pervious pavement
- Eco-water storage
- Pervious trench
- Pervious trench

Gwangju Leading Water Circulation Project
3. Working Design

3. Application of LID on road

- Applied LID techniques considering land use, etc. of the target area
- Road-focused design (street, pedestrian road), width of roads are considered to make a design plan

<table>
<thead>
<tr>
<th>Low</th>
<th>Nonpoint Source Pollution</th>
<th>High</th>
</tr>
</thead>
</table>

- More lanes → more traffic
  → higher nonpoint pollutant concentration

Street (for vehicles)
- Vegetation Facility – outstanding nonpoint pollutants reduction, average runoff reduction
- Pervious facility: outstanding runoff reduction, less nonpoint pollutant reduction
- Vegetation facility is recommended for roads with heavy traffic and/or many lanes

Pedestrian road
- Vegetation Facility – for enough spaces on pavement
- Pervious Facility – for narrow spaces on pavement or not enough space for vegetation facility

✓ Pedestrian road with 5 meters width or more: vegetation recommended
✓ Road for less than 5 meters width: pervious facility recommended

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3. Working Design

Plan to arrange LID (Draft)

1. General plan: on target area (draft)

- Applied LID techniques considering rain spill, land use, etc. of the target area
- Achieve the target amount by vegetation (22.3%) and pervious facilities (77.7%)

<table>
<thead>
<tr>
<th>LID Techniques</th>
<th>Amount (m³)</th>
<th>Rate(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>VEGETATION</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tree Pit</td>
<td>13.5</td>
<td>0.0</td>
</tr>
<tr>
<td>Bioswale</td>
<td>1,292.1</td>
<td>4.1</td>
</tr>
<tr>
<td>Rain Garden/Bio Retention</td>
<td>5,371.3</td>
<td>17.0</td>
</tr>
<tr>
<td>vegetation waterway</td>
<td>356.4</td>
<td>1.1</td>
</tr>
<tr>
<td><strong>Net Sum</strong></td>
<td>7,033.3</td>
<td>22.3</td>
</tr>
<tr>
<td><strong>PERVIOUS FACILITIES</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pervious gutter flow</td>
<td>1,777.8</td>
<td>5.6</td>
</tr>
<tr>
<td>pervious trench</td>
<td>105.7</td>
<td>0.3</td>
</tr>
<tr>
<td>grass-covered pavement</td>
<td>2,327.3</td>
<td>7.4</td>
</tr>
<tr>
<td>pervious blocks (collect &amp; save water)</td>
<td>6,805.4</td>
<td>31.1</td>
</tr>
<tr>
<td>pervious blocks</td>
<td>4,515.4</td>
<td>14.3</td>
</tr>
<tr>
<td>pervious blocks(parking lots)</td>
<td>424.6</td>
<td>1.3</td>
</tr>
<tr>
<td>bike lane (pervious paving blocks)</td>
<td>2,318.0</td>
<td>7.3</td>
</tr>
<tr>
<td>bike lane (pervious asphalt concrete)</td>
<td>3,257.1</td>
<td>10.3</td>
</tr>
<tr>
<td>pergola</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td><strong>Net Sum</strong></td>
<td>24,531.3</td>
<td>77.7</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>31,564.6</td>
<td>100.0</td>
</tr>
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</table>

Gwangju Leading Water Circulation Project
3. Working Design

Example of LID: pavement (pedestrian road)
After LID: Specialized block for vegetation

Before LID: Vegetation by block

Example of LID: pavement (pedestrian road)
3. Working Design

Example of LID: pavement (pedestrian road)

Before LID: soil runoff

After LID: Vegetation

Before LID: pathway + old bike lane

After LID: vegetation + swales + pervious pavement
3. Working Design

2. Example of LID: pavement (pedestrian road)

- Before LID: pathway
- After LID: linear green space

- Before LID: impervious pathway
- After LID: vegetation + pervious pavement
3. Working Design

2 Example of LID: commercial district

Before LID: impervious pathway

After LID: grass-block pavers + vegetation

Before LID: impervious pathway

After LID: Grass block pavers + pervious pavement
3. Working Design

2 Example of LID: commercial district

Before LID: pathway

After LID: vegetation + pervious pavement

Before LID: pathway (impervious)

After LID: vegetation + swales + pervious pavement

Gwangju Leading Water Circulation Project
3. Working Design

Maintenance Plan

1. Stakeholders for maintenance (Draft)

- General Management
- Water Circulation Dept.
- Gwangju
- Environment Corporation of Gwangju

Managed by

LID Facilities

- Roads / Pavements
- Parks
- Pavements
- Children Parks
- Public Facilities