Stormwater Treatment from the Road in Japan

Regional Workshop on Eco-Efficient Water Infrastructure towards Sustainable Urban Development and Green Economy in Asia and the Pacific

12-13 December 2013
Bangkok, Thailand

Masahiro IMBE
Association for Rainwater Storage and Infiltration Technology (ARSIT)
Today’s Presentation

1. Background
2. Typical Examples
3. Experimental Study
4. Experimental Results
5. Issues and Scope
Country-specific Approaches for Sound Water Cycle

**Japan**

- Well-balanced Hydrological System
  - Applied for a unit of River Basin
  - Well-balanced among Flood Control, Water Use and Aqua-environment
  - Promotion of Rainwater Storage and Infiltration Facilities and Rainwater Utilization

**Western Countries**

- Low Impact Development = LID【USA】
- Sustainable Urban Drainage Systems = SUDS【UK】
- Decentralized Urban Design = DUD【Germany】
- Water Sensitive Urban Design = WSUD【Australia】

- Applied for Specified Area, Community or Development Area
- Well-balanced among Water Quantity, Quality, and Amenity
- Source Control/Green Infrastructure = GI
Percentage of Cities in Japan by Size of Population where the Localized Torrential Rain ($\geq 100$mm/hr) occurred in the past

- $\geq 300,000$: 12.50%
- $\geq 200,000$: 7.50%
- $\geq 100,000$: 12.50%
- $\geq 50,000$: 10.00%
- $\geq 30,000$: 12.50%
- $\geq 10,000$: 42.50%
- $< 10,000$: 2.50%

Almost 30%
1. Background

Runoff % correspond to Land Utilization in Tokyo (assuming the precipitation to be 100mm for 1 hour)

- Road: 23%
- Water Surface: 17%
- Independence House: 20%
- Housing Complex: 15%
- Commerce & Industry: 16%
- School: 6%
Flood Control Plan for Kanda River located in Central Tokyo

1. Background

Required Storage Volume determined by Tokyo Metropolitan Government

Basic Principal: 10mm/hr for basin wide allotment
where, 75mm/hr for total measure

Large scale private facilities: 600m³/ha

Existing or newly constructed private facilities: 300m³/ha

Public facilities (Sidewalk): 200m³/ha

Public facilities (Building, Park): 600m³/ha

Public facilities (Roadway): 290m³/ha

No measure
1. Background

Cooling of Road Environment against Heat Island

1. The big tree is symbolic. Street trees provide shaded areas.

2. Coloration technique on the road surface is effective for the thermal insulation.

3. The conventional drainage system should not be applied. The rainwater is stored around the road and infiltrated. So this kind of drainage is called “Road of River” in our group.
1. Background

The image of “Road of River”

Sidewalk
The wet vegetation ditch under the sidewalk connected to the inclined gravel void storage under the roadway

Roadway
Surface: Permeable
Structure of Road Bed: Inclined gravel void storage

1. Purification by contact oxidation of gravel void storage
2. Huge volume of storage
3. The conventional drainage system is not necessary.
2. Typical Examples

2.1 Street Permeable Box

Street Permeable Box
2. Typical Examples
2.1 Street Permeable Box

Various Buckets for Removal

Bucket for Removal  Plastic Filter  Bucket Filter
2. Typical Examples
2.1 Street Permeable Box

Inlet Filter and Bottom Filter

The inlet filter is attached to the pipe inserted to the permeable trench which is connected to the permeable inlet.
2. Typical Examples

2.2 Combination of Permeable Box and Void Storage
2. Typical Examples

2.3 Rainwater Storage and Infiltration beside Road

(Implemented in Mitaka city)
2. Typical Examples

2.4 Permeable Pavement along Sidewalk

- Permeable Pavement along Sidewalk
- Sidewalk
- Crusher-run
- Asphalt Concrete
2. Typical Examples

2.4 Permeable Pavement along Sidewalk

Photo taken on Aug. 8 in 2012

Permeable Pavement along Sidewalk at Tsukuba
2. Typical Examples
2.5 EGSM Construction Method

EGSM:
- Easy
- Ground
- Speed
- Machine

Adjacent Land
Grating
Existing Connection Box
Filter
Attached Pipe
Sewer
Water Area
Permeable Cylinder
Sludge Pit

Permeable Structure
Permeable Sheet
Crushed Stone
2. Typical Examples
2.5 EGSM Construction Method

Filter is attached in the connection box.

Permeable pipe is installed under the bottom of the connection box.
2. Typical Examples
2.5 EGSM Construction Method

Borehole Machine to install the permeable pipe
2. Typical Examples

2.6 Utilization of Underpass no longer Required

(implemented in Gifu city)

1. Watering for plant
   - 2 times/week, 20 min./day : 0.64 m³/week
2. Infiltration into ground
3. Reduction of temperature on road surface

Water depth $\geq 25$ cm : Watering for plant
Water depth $\geq 60$ cm : Drain to street gutter
Water depth = 50 cm : Stop pumping
2. Typical Examples

2.7 Roadway Trench

Rain Cyclical Road Surface Drainage System: RACSUS

Image of New Drainage System applied for Road
2. Typical Examples
2.7 Roadway Trench

Experimental facility

Observed data in rainfall and runoff
3. Experimental Study

Pavement of Rainwater Cyclical System (PRaCS)
3. Experimental Study

Supporting Platform

Capillary Pillar inside Storage Tank
4. Experimental Results

Change in surface temperature of PRaCS

The surface temperature of PRaCS is cooler in max. 14°C than that of the ordinary asphalt pavement.

Ordinary Asphalt Pavement

Surface Temperature of PRaCS

Air Temperature

Daily Rainfall

Date

Temperature (°C)

Temperature (°C)

Daily Rainfall (mm)

Aug. 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23

in 2011

The surface temperature of PRaCS is cooler in max. 14°C than that of the ordinary asphalt pavement.
5. Issues and Scope

The followings are issues and scope to be solved for the future.

1. First flash containing non-point source should be cleared up.
2. The system should be cleaned regularly to remove the rubbish and leaves and so on.
3. Cleaning system should be operated easily and economically.
4. The coalition with the road administrator is necessary for both construction and maintenance.
5. The easy reconstruction method for the infiltration should be developed.
6. The sound water cycle related to flood control, water utilization and improvement of water quality should be considered.
Thank you for your attention

ARSIT Home Page: http://www.arsit.or.jp