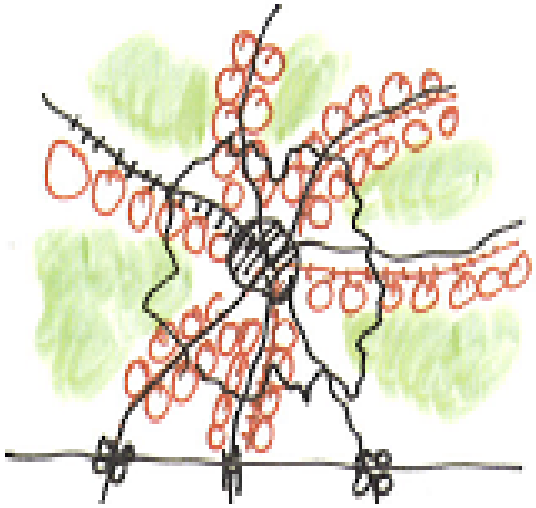
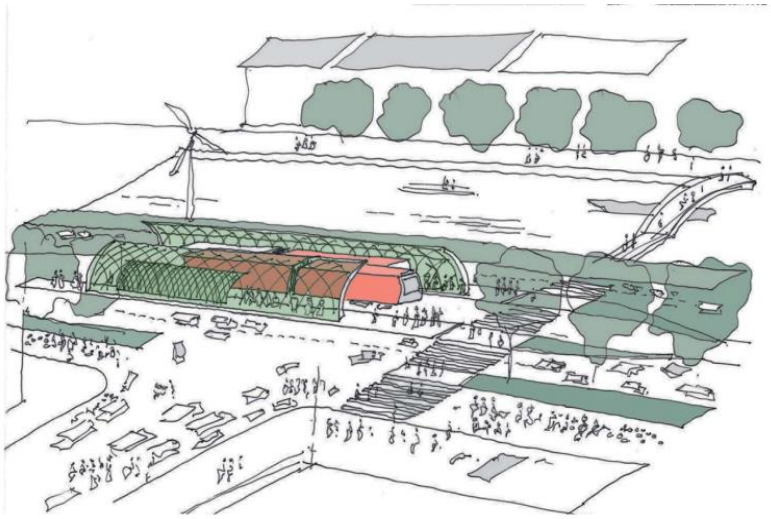
Innovation for Resilient and Smart Communities

Session 2: Improving Mobility, Improving Resilience

RESILIENT DESIGN FOR BRT PROJECTS





ADB, Manila
19 May 2015

ADB

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POSSIBLE MITIGATION MEASURES

1. Weather-protected “open” stations vs. “A/C stations”

2. Passive solar design for station climate control

3. Choice of materials for busways and stations

4. NMT integration as a resilience strategy for backup and redundancy

5. Fuel and vehicle technology

6. Energy-efficient street lighting

Station design:

Open design in Brisbane maximizes air flow for comfort

Open design in Guangzhou

Use of ventilators for customer comfort in Guangzhou


Station air conditioning in Bangkok BRT
สาทร
SATHORN

Customer comfort in extreme heat conditions:

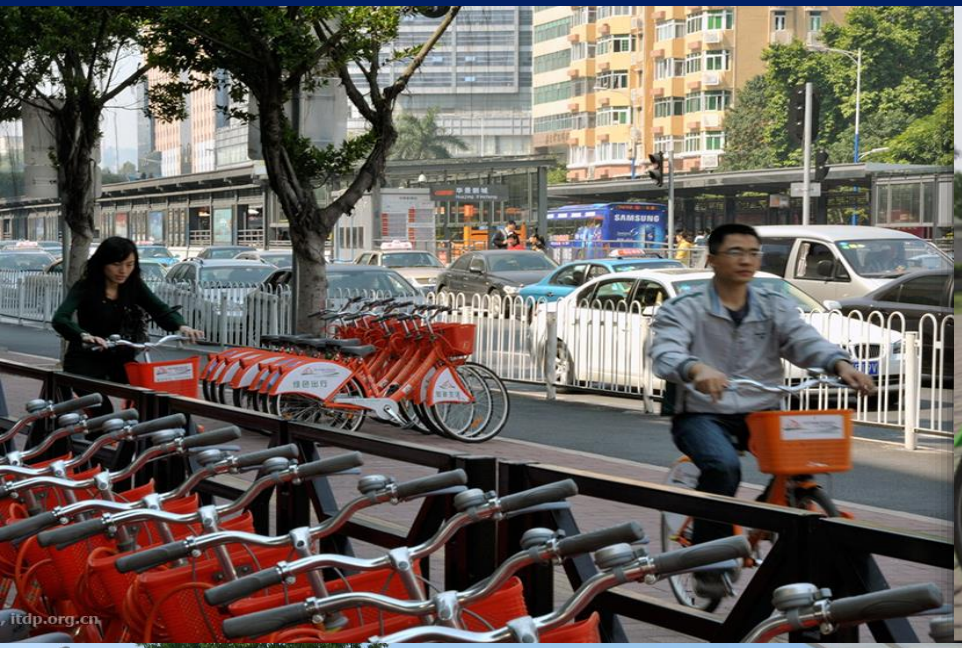
Design for less crowding


Station overhang as a passive solar design technique to cool temperatures and provide rain protection
Vegetation to reduce heat island effect
BRT
KING LONG
XMQ6127G
Xiamen

Vegetation inside Quito BRT station


Vegetation around
Cape Town BRT station
NMT integration

Public Bicycle and BRT Integration

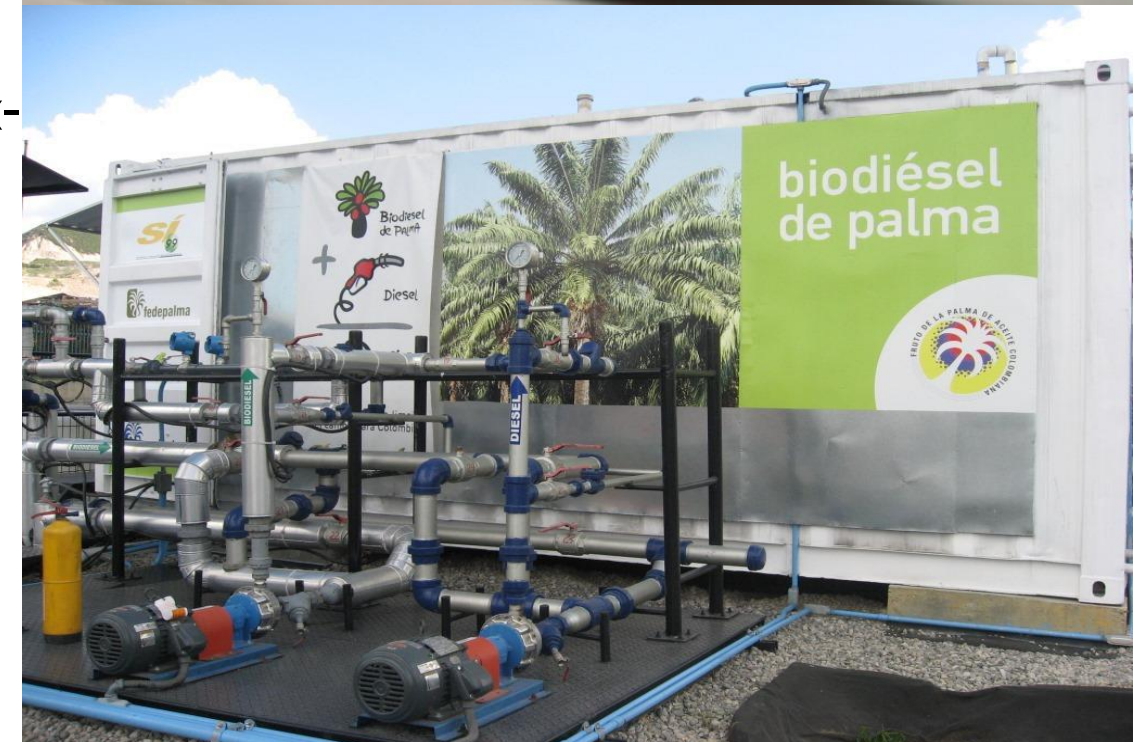


Alternative fuels and PT Fleet

Alternative fuels

Biofuels and Ethanol Buses

- Used for 20 yrs in Sweden
- BEST Project
- CO -60%
- PM -90%
- CO2 -80%
- Sao Paulo, 50 Scania buses. Expanding
- Nanyang, China, ethanol (flex-fuel) bus
- Biofuel plant at Transmilenio depot in Bogota



Waste to Fuel

Current “Waste to Biomethane” project in Wonju, Korea, to produce 5.5 million m^3 of biogas

Fuel will operate city bus and taxi fleets

Biomethane mandate in Korea

- As of 2012, the ocean dumping of sewage sludge has been banned
- Biomethane production has been developed as a major component of meeting the new mandate

Henan Province Biomethane Initiative

- Joint venture between Canadian biogas technology provider and Henan fuel provider
- Five biogas conversion systems put in place
- Biogas being delivered to CNG filling stations in Henan Province

Biomethane vs Conventional Air Pollutants

Biomethane produces similar reductions in conventional air pollutants as CNG

Delhi case study

Ambient reductions between 2000 and 2003

- CO – 75% reduction
- PM10 – 7% reduction
- SOx – 35% reduction

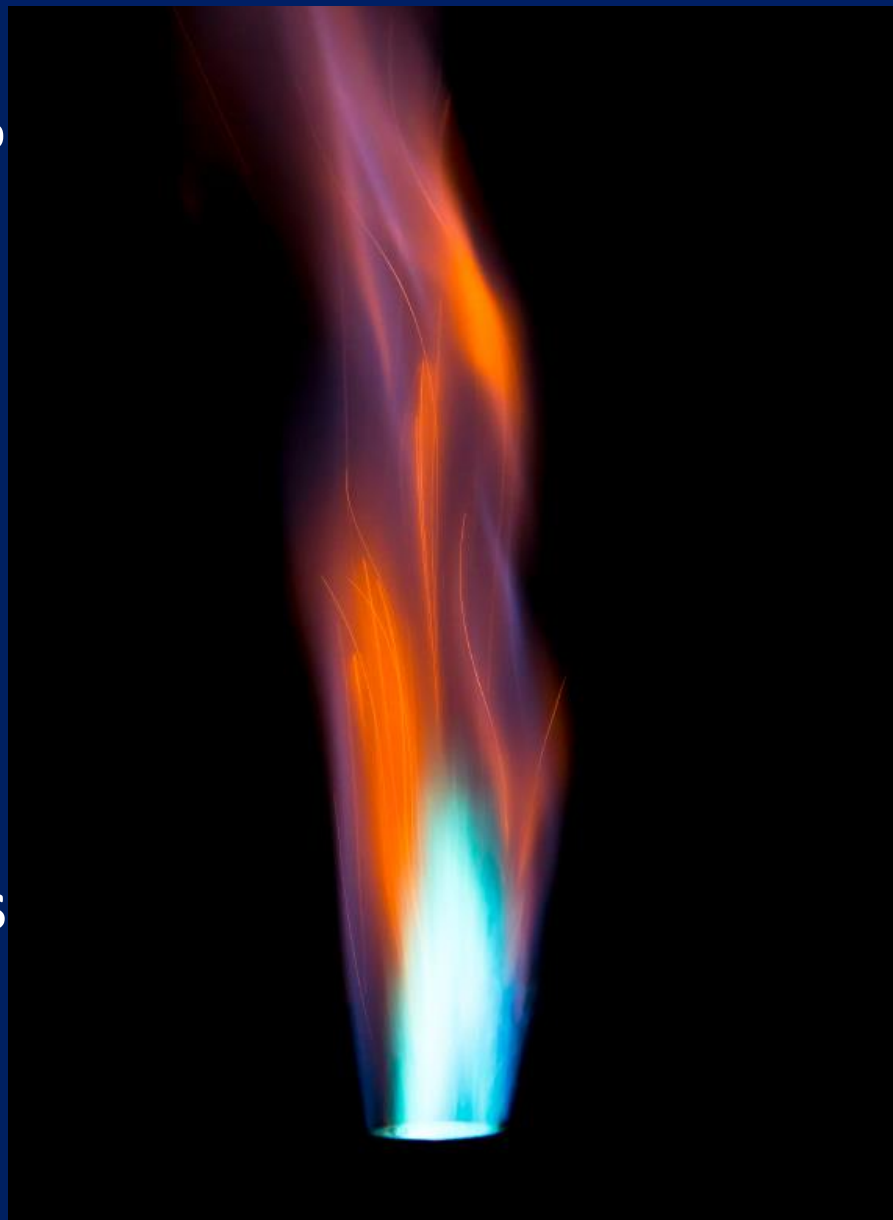
Source: Resources for the Future, 2007

Biomethane and Greenhouse Gas Reduction

"Biogas fuelled vehicles reduce CO2 emissions by between 75% and 200% compared with a fossil fuel baseline"
Source: NSCA, 2006 (UK)

Offsets both vehicle emissions and the release of methane from waste

Released methane has 25 times the GHG potential of CO_2



Biomethane Operational Experience

- Over four decades of biomethane vehicle operation in cities of Sweden
- Public transport fleets in most major Swedish cities are exclusively fueled by biomethane
- Extensive use in Germany and Switzerland as well

Biomethane Market Size

As demonstrated in Sweden, Germany, and elsewhere, the fuel requirements of an entire city's public transport and taxi fleets can be achieved from locally produced biomethane

Energy-Efficient Street Lighting

- Lighting accounts for more than **19% of the world's total electricity consumption**
- With conventional technologies, lighting comprises around **40% of** the local government's **energy bill**
- For road lighting, LED can **save up to 60%** of energy
- **BRT Projects** offer a good opportunity to introduce **energy-efficient street lighting along the corridor and in stations**.

POSSIBLE ADAPTATION MEASURES

1. Efficient drainage system

2. Bioswale

3. Permeable pavement

Flooding of Rio de Janeiro BRT station

TransJakarta:
Lack of effective drainage


Beijing BRT corridor


Beijing BRT station:
Lack of effective drainage

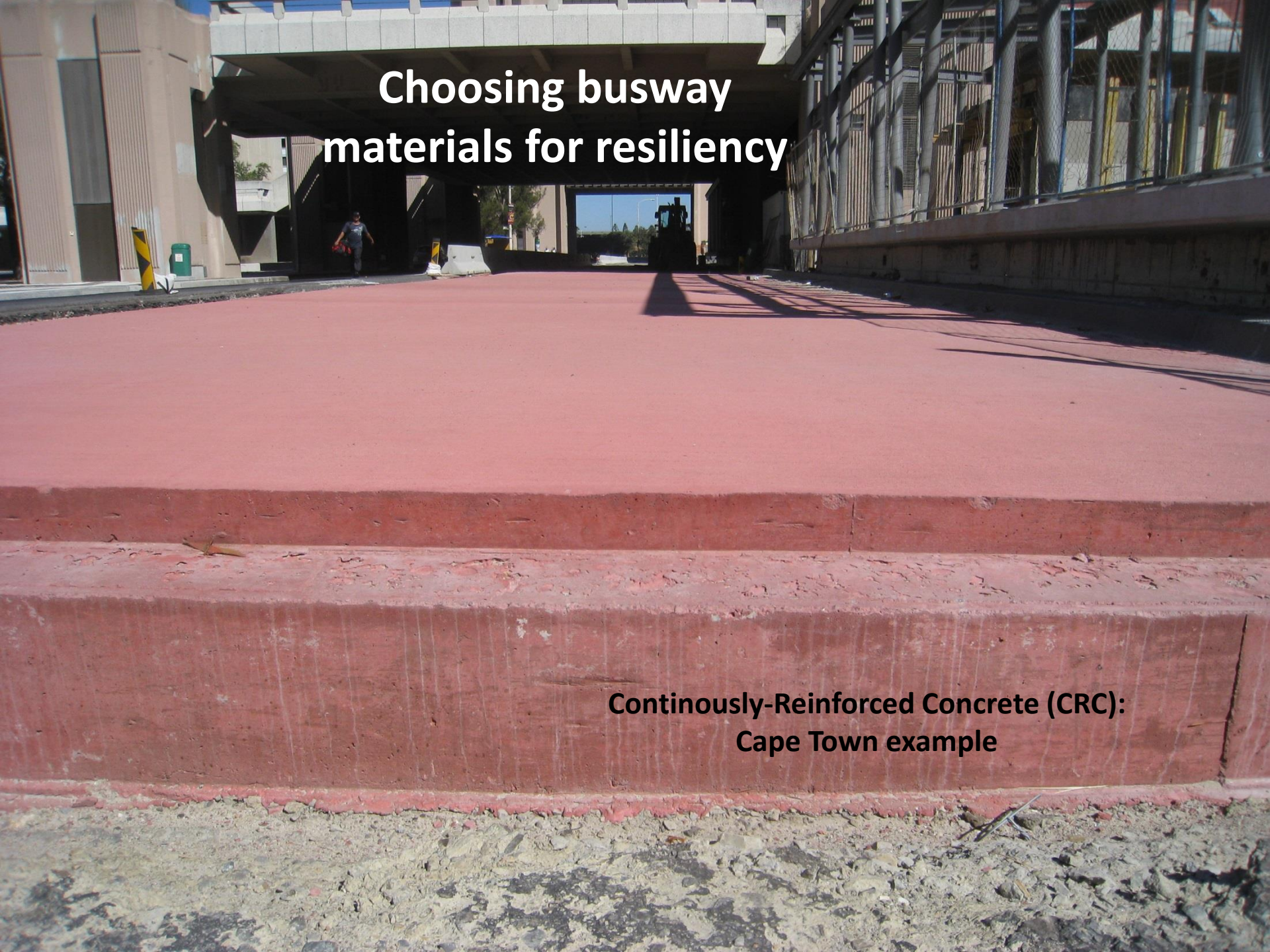
Accessibility infrastructure and resilience

Exit of Guangzhou BRT


Ortigas MRT pedestrian access

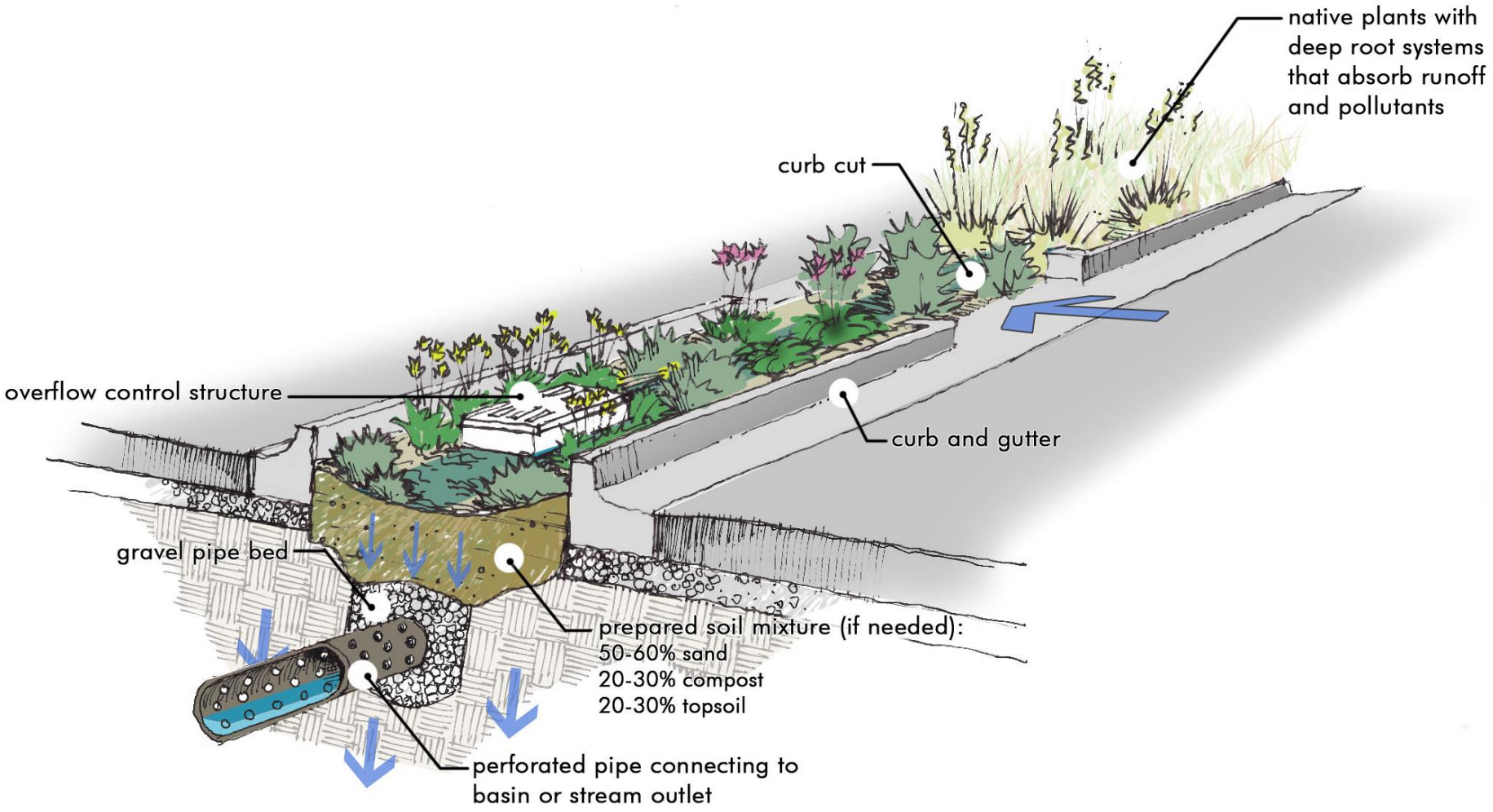
Flooding can contribute to premature degradation of busway surface


TransJakarta:
Deterioration of busway


Choosing busway materials for resiliency
Continously-Reinforced Concrete (CRC): Cape Town example


Properly size your drainage system for resiliency, and build it while building the BRT

Bioswale: Example Diagram



Bioswales

Urban Bioswale, New York City

Urban Bioswale, Toronto

Permeable Surfaces/Pavement

Permeable Surfaces/Pavement

D02. Paving: *Paving for Natural Drainage Systems*

Ecology

Types of Paving Materials

A

Permeable Asphalt Concrete

Fundamentally the same as regular asphalt, but it does not contain the fine particles that asphalt does, hence, creating porosity.

•**Need to be cleaned 2 to 4 times a year to avoid build-up of debris**. But some research has found that even with 99% clogging the infiltration rate can be up to 10 inches/hr.

•It **does not require special training** and can easily be supplied by conventional asphalt batch plants

B

Permeable Cement Concrete

This is a variation of traditional concrete, but without the fine particles in the mix.

•Installation is quite different from the traditional method, and **requires experienced installers** both in the mixing and laying of the product.

•Proper maintenance includes periodic vacuuming of the surface to **prevent clogging with sediment or organic material.** With proper maintenance it can last a minimum of 20 years.

C

Interlocking Concrete Pavers

Themselves are not always permeable, but they are typically installed with gaps between them to allow infiltration into the subsurface. The gaps, typically 10% of the surface area, are filled with a permeable material, usually small clean stone.

•**They have a long useable life, are relatively easy to install** and provide good infiltration.

•However, they are **sensitive to deformation** in the base and do require a thick base to prevent "heaving."

D

Open-Celled Paving Grid with Vegetation

Open-celled paving grids consist of a rigid grid composed of concrete or a durable plastic that is filled with a mix of sand, gravel, and topsoil for planting vegetation.

•The plastic grid pavers are also **flexible, allowing them to be used on uneven sites**.

•They do not require another drainage facility and are **competitively priced to asphalt and concrete paving**, when their required drainage costs are factored in.

E

Open-Celled Paving Grid with Gravel

The same open-celled grid structure is employed but the voids in the rings are filled with a mix of gravel.

•With the gravel in place this grid system does **provide additional structural support.** And since most grid-cell material is plastic, hence flexible, it can adapt well to shrink/swell and freeze/thaw conditions.

•Most commercially available geocell material is made from recycled material, an added environmental plus.

Source: Seattle Right of Way Improvement Manual and UC Davis Research

If LRT / Tramways can go green…







BRT can go green too !

Timeline for consideration of climate-resilient design features

- Preliminary engineering design / PPTA: Include as project components for cost estimates
- Detailed engineering design / Loan: Agree on technical specifications for choice of technology / provider
- Implementation: Select a provider with supply-install-maintain contracts

Thank you

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