Design Principles for Urban Heat Management

Presentation KvK 09-07-2009
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Urbanism - Urban Landscapes

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Research into the Urban Heat Island effect

Only one study in the Netherlands by Conrads in 1971, Utrecht.

Climate change: warmer and more weather extremes

Further research and measurements in Dutch cities is needed
Consequences of the UHI effect

Climate

Health

Energy

Organic

(Kravcik et al. 2007)
Consequences of the UHI effect

- Climate
- Health
- Energy
- Organic
Consequences of the UHI effect

- Climate
- Health
- Energy
- Organic

Rotterdam, by F van Jole
Consequences of the UHI effect

- **Climate**
  - warmer surface water
  - more need for cooling water

- **Health**
  - draught

- **Energy**
  - electrical energy peak

- **Organic**
  - warmer surface water
Consequences of the UHI effect

Climate

Health

Energy

Organic

Blue algae, Kardingerplas
Design principles

Vegetation up to 4.7°C

Materials

Water up to 3°C

Built form

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Design principles

Vegetation up to 4.7°C

Water up to 3°C

Materials

Light - Dark
Asphalt - Grass

Built form

Wind
Sun
Typological analyses

Utrecht

before 1870 - Oudegracht
1930 - Ondiep
1960 - Kanaleneiland

Den Haag

before 1870 - Voorhout
1930 - Transvaal
1960 - Moerwijk
Typological analyses

Old city centre

Big contrast between densely build area and monumental green areas with water.

Few natural ventilation by wind but not so much solar radiation warming up surface materials.

1930 neighbourhoods
(excl. garden cities)

Relatively narrow streets that are lacking small green and trees. The few front gardens are often paved. Also backgardens contain many sheds and pavement.

Squares are stoney.

Spacing between building blocks allow just minimal natural ventilation.

1960 neighbourhoods

The high buildings have large green spaces as common garden and in between the blocks large paved parking areas along the road.

The high buildings and large open spaces generate a lot of ventilation.
Criteria for a heat resistant neighbourhood

- Within 200m from green with a minimum size of 0.15 ha (1500m²)

- Preferred street orientation: perpendicular to green areas

- Green filter in streets with a high traffic pressure

- New dwellings ≥ demolished dwellings (but with a larger dwelling surface)

- Combinations of green with water

- Few green possibilities in streets should be compensated with superficial water, green facades and semi-pavement

- Green on flat roofs or a white and reflecting surface

- PV-T on slanted roofs or a white and reflecting surface
Two strategies for Ondiep and Transvaal

Ondiep:
5,620 inhabitants
44 dwellings/ha

Transvaal:
18,000 inhabitants
98 dwellings/ha
Introduction Ondiep Utrecht

Vecht route - foot and cycle

Berlage route - car and bus

Amsterdamsestraatweg - commercial street for cars, bikes and pedestrians
Introduction Ondiep

Fruitbuurt

Het Kleine Wijk

Witte Wijk

Bomenbuurt

Vecht quay

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Criteria - 200m from green

- Wijnbesplantsoen
- Kloosterlaan
- Sportvelden
Green plan

Sevilla, Spain

Caixa Forum, Madrid, Spain

Patrick Blanc
Current situation

New situation

Total extra dwellings: 13 (4%)
Total extra m²: 21,600 (68%)
Prototype street profile for the Berlage route

Acer cappadocicum 'Lobel'    Picea omorika    Acer cappadocicum 'Lobel'

50 meter
Prototype street profile for the Berlage route

Acer cappadocicum 'Lobel'

Picea omorika

Aquaflow BV
Coniferous and deciduous trees
Traffic plan

- standard traffic road
- low traffic zone (30km/h)
- car free zone
Parking solutions

- standard parking along the road
- parking under apartments
- parking under green roof

Actual parking place/dwelling: 0.9

With only parking lots in streets and under green roof: 0.5

Parking lots in combination with parking under all the new apartments: 0.95
Roof garden

Prinses Ireneplateau, Utrecht
Calculations for the water system

Water system supports evaporation of trees
Underground storage: 11,350 m³

Fluctuation for peak-showers: 800 mm

Water system supports evaporation of trees & grey water for toilet flush
Underground storage: 18,625 m³

Water system supports evaporation of trees, grey water for households & cleaning grey water
Underground storage: 7,600 m³
Water plan

- Shallow canal, Solana, Texas (Moore et al. 1994)
- Shallow canal, Italy, Carlo Scarpa (Moore et al. 1994)

Legend:
- Storage
- Infiltration
- Water pump
- Flow direction
- Helophyte filter
- Water in/out let
- Surface water
- Shallow canal
- Drainage canal
- Storage underground
Street profiles

Ondiep

Nieuwlichtstraat

Alnus subcordata 'Oberon'

Tilia Platyphyllos

15 meter

20 meter

15 meter

20 meter

- grass
- shrub (up to 30cm)
- shrub (up to 80cm)
- semi pavement
- pavement
- asphalt
- bicycle path
- water
- superficial water
- dwellings
Street profiles

Nieuwlichtstraat

Water playground, Culemborg, by P. van Dijk

Water playgrounds, Spereco
Boerhavelaan
Design plan
Design plan with 200m from green
Introduction Transvaal_Den Haag
Introduction Transvaal
Criteria - 200m from green
Building plan

- renovation of squares with green and water
- demolition and design cool areas
Building plan

- renovation of squares with green and water
- demolition and design cool areas

I'Hotel Pershing Hall
Paris, France
Patrick Blanc
Green roofs

- renovation of squares
- demolition and design
- green roofs
- slanted roofs

Rotterdam, A. van Capellen

Hundertwasser

Rotterdam
Re-design of the Wijkpark Transvaal

Small fountains (Bedriegertjes)

Fountain Palace, Dallas Texas
WETDesign

Existing green

Existing streaming water
Green plan

- Green street, alley or square
- Demolition and design
- Green on Wijkpark Transvaal
- Green roofs
- 8-10 storey buildings with vertical garden
Water plan

- Storage
- Water pump
- Flow direction
- Helophyte filter
- Surface water
- Shallow canal
- Drainage canal
- Connection underground

Amiens, France
Nijmegen, R. Berendsen
Freiburg, Germany
Schalk burgerstraat

Tilia cordata

17 meter

3,5 2 6 2 3,5

green = grass
light green = shrub (up to 30cm)
medium green = shrub (up to 80cm)
gray = semi pavement
light gray = pavement
gray = asphalt
yellow = bicycle path
blue = water
light blue = superficial water
black = dwellings

Water near tram Freiburg, Germany
Enjoying cool water Freiburg, Germany
Shopping street with water Freiburg, Germany
Water closed at passings Amiens, France
Calculations for the water system

Fluctuation for peak-showers: 700 mm

Water system supports evaporation of trees

Extra water in new area: 8,700 m³

Water system supports evaporation of trees & grey water for toilet flush

Extra water in new area: 23,800 m³

Water system supports evaporation of trees, grey water for households & cleaning grey water

Underground storage: 3,000 m³

computer model 'Waterbalance'
ir. Leo Gommans
Calculations for the water system

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Extra water in new area: 8,700 m³

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computer model ‘Waterbalance’
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Re-desining a neighbourhood

Pampushout, Almere
OKRA

‘Growing Building’,
Montpellier, France
Eduard Francois
Traffic plan
Scheepersstraat

Prunus Trailblazer
Pinus Sylvestris
Prunus Trailblazer

3.5  3  1.5  3  9.5  3  8  3  8  9.5  3  1.5  3  3.5
60 meter

grass
shrub (up to 30cm)
shrub (up to 80cm)
semi pavement
pavement
asphalt
bicycle path
water
superficial water
dwellings
Scheepersstraat impressie
Ondiep & Transvaal
Design plan

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