

# HOT TOWN!

# SUMMER IN THE CITY

A research into the relation between Rotterdam's South socially deprived neighbourhoods and the urban **heat** island

ing. M.P. de Deckere

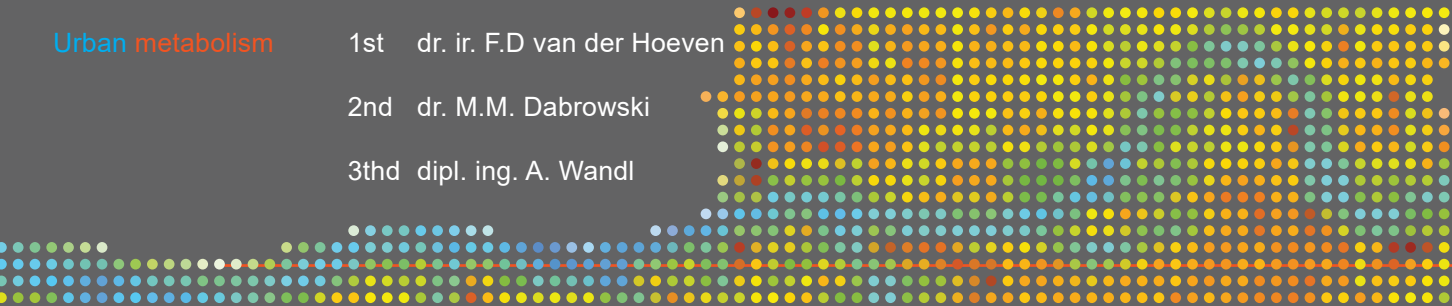
Mentors

Urban **metabolism**

1st dr. ir. F.D van der Hoeven

2nd dr. M.M. Dabrowski

3th dipl. ing. A. Wandl

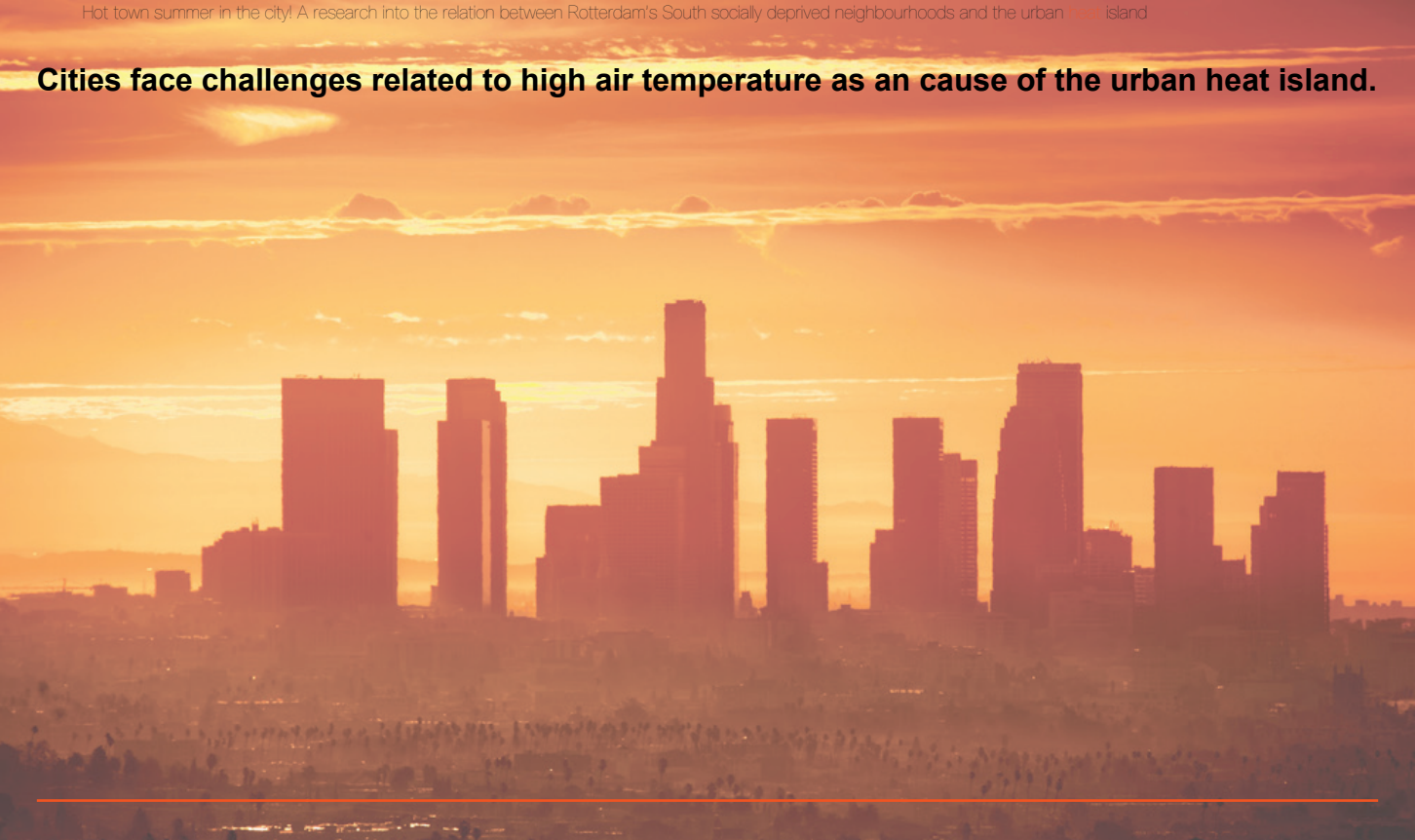


# Introduction





## **Cities face challenges related to high air temperature as an cause of the urban heat island.**



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**Climate change predictions of global temperature rise exacerbate the urban heat island.**

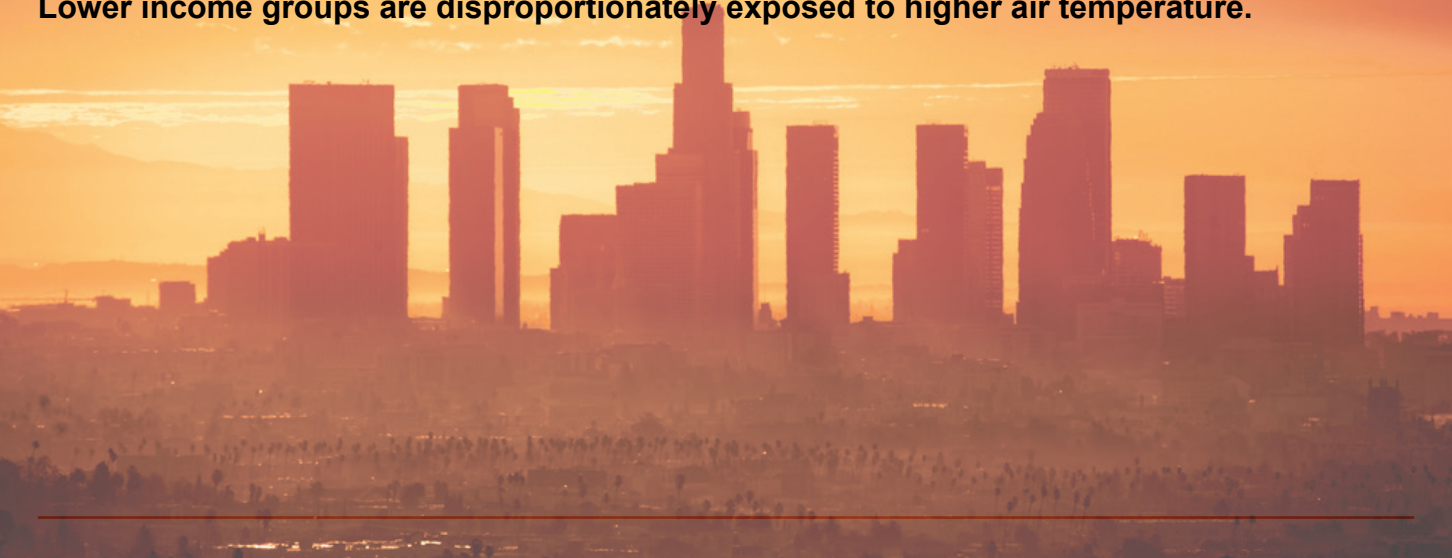


**Cities face challenges related to high air temperature as a cause of the urban heat island.**

**Climate change predictions of global temperature rise exacerbate the urban heat island.**

**Urban heat island is an issue of environmental justice on the city scale.**

**Lower income groups are disproportionately exposed to higher air temperature.**



**Cities face challenges related to high air temperature as a cause of the urban heat island.**

**Climate change predictions of global temperature rise exacerbate the urban heat island.**

**Urban heat island is an issue of environmental justice on the city scale.**

**Lower income groups are disproportionately exposed to higher air temperature.**

**However ...**

**Urban design can reduce exposure to high air temperature and adapt and mitigate to the urban heat island.**

How is the urban heat island related to social deprivation, why is this in the city of Rotterdam an issue and how urban design can mitigate and adapt to these effects?

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Theoretical framework

Statistical analyses

Observations and micro interviews

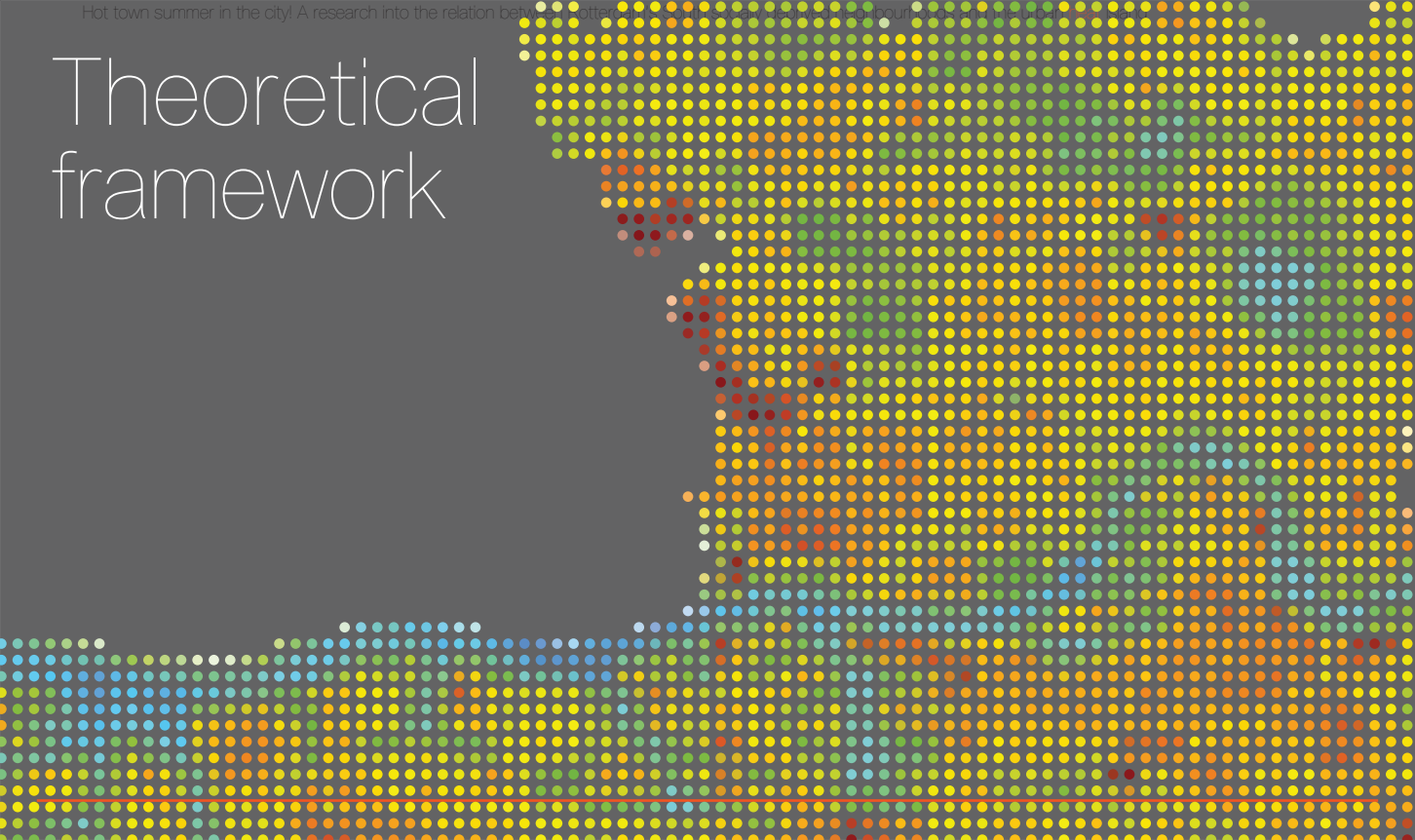
Neighbourhood analyses

Design interventions

Appendix

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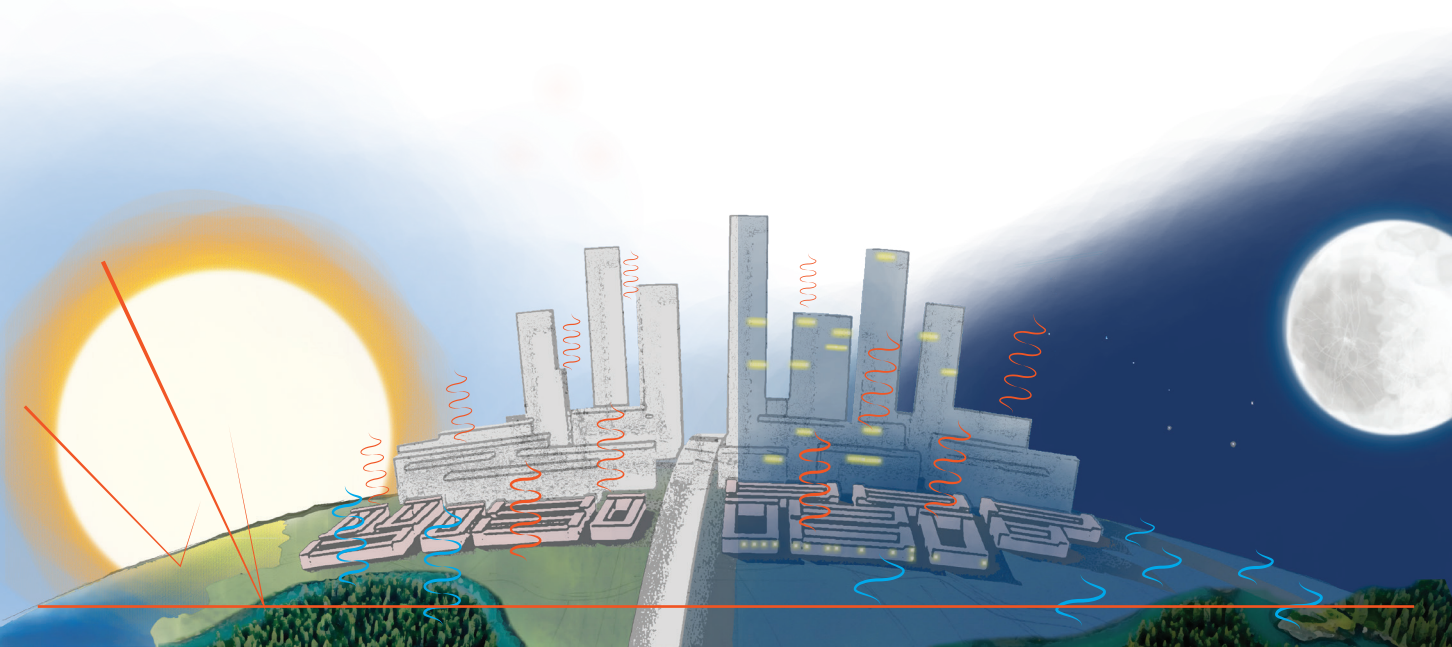
# Theoretical framework





## Urban heat island

**Net radiation + Anthropogenic Heat = Convection + Evapotranspiration + Heat storage**





## Characteristics contributing to the urban heat island

**Lack of vegetation**

**Widespread use of impermeable surfaces**

**High building mass**

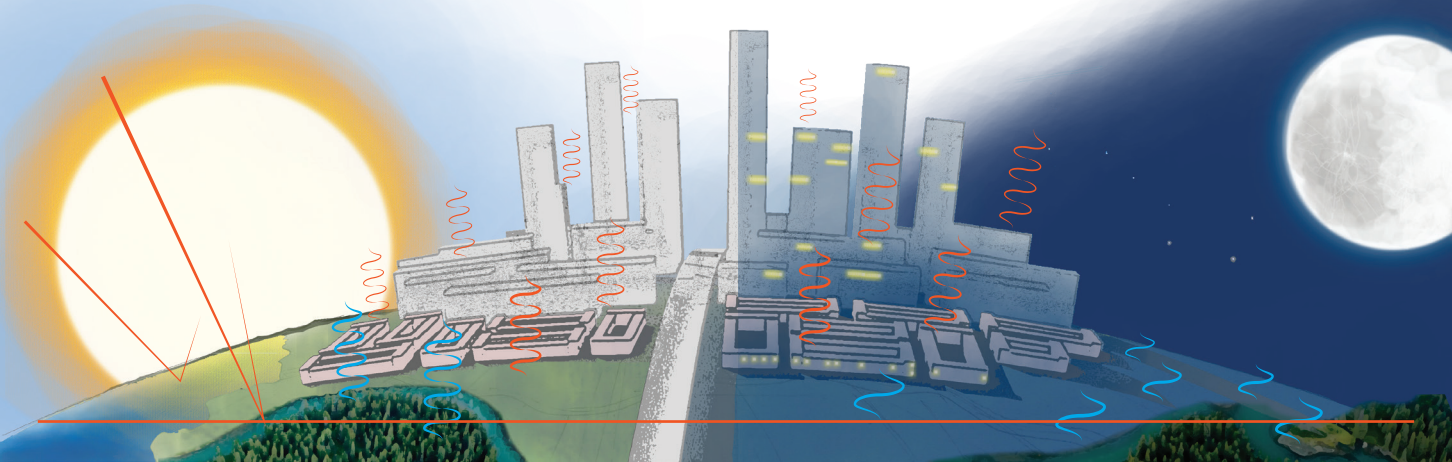
**Low Solar reflectance of urban materials**

**Urban geometries that trap heat**

**Lack of water for evaporation**

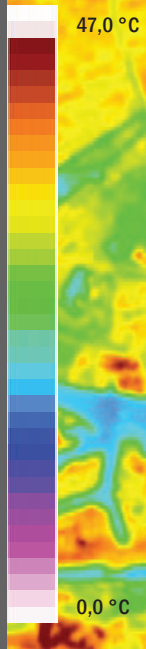
**Increased levels of air pollution**

**Increased energy use**



## LEGEND

Land surface temperature



47,0 °C

0,0 °C

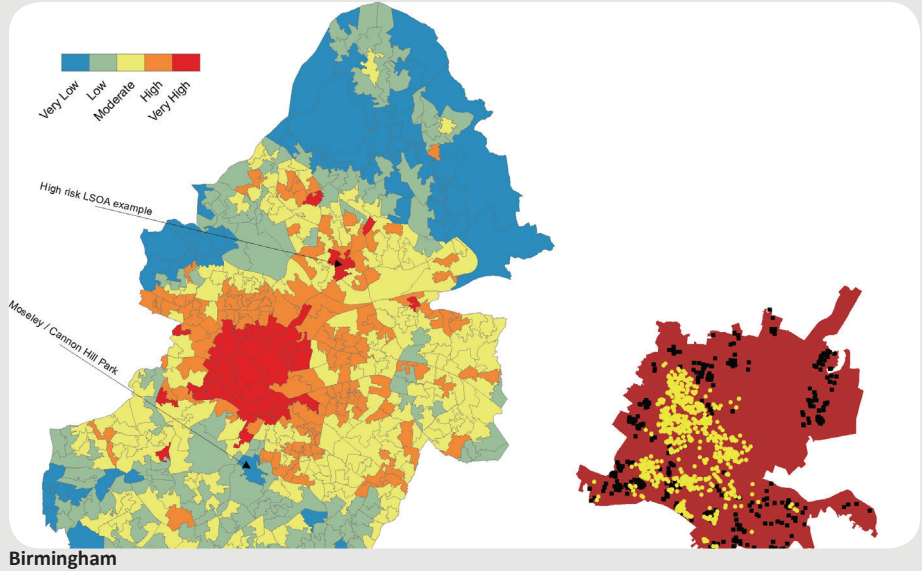
## Environmental justice: disproportionate exposure to an environmental hazard

Population characteristics

Environmental hazard

Urban characteristics

**MY NEIGHBORHOOD IS KILLING ME**

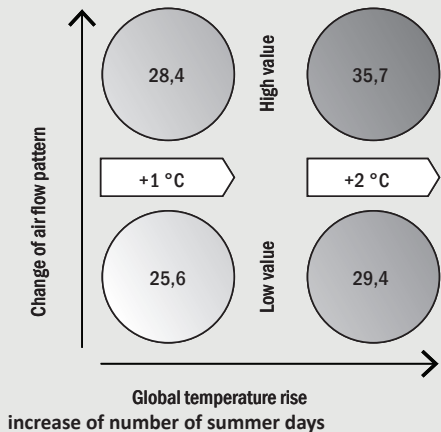


The urban heat island is often the most intense in neighbourhoods with urban characteristics of little to no vegetation, a high population density, high building mass, lack of shade and bad building quality.

Socially deprived neighborhoods share such characteristics and people, due to their social-economic and health status, are more vulnerable to effects of urban heat island and more exposed to high air temperature.

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## Climate change

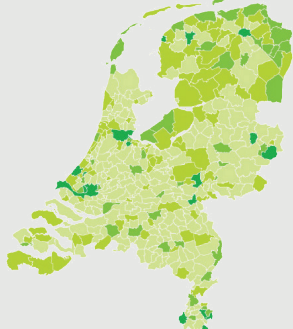


## Dutch context

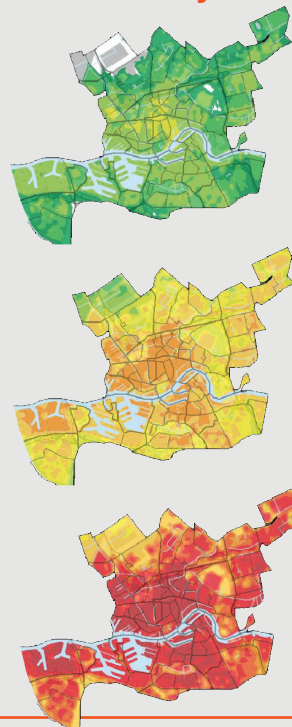
urban heat island



mean deviation of annual income



## Expected increase of hot summer days



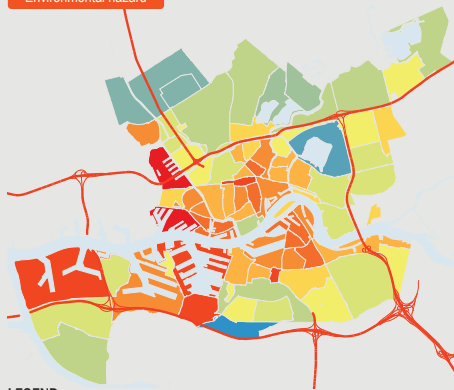
# Statistical analyses



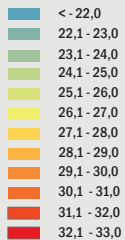


# Statistical analyses

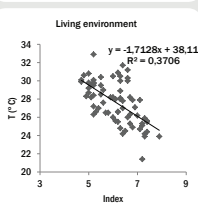
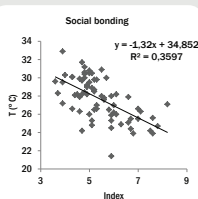
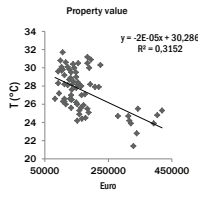
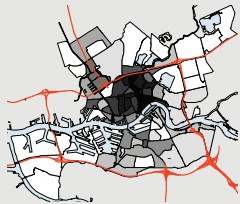
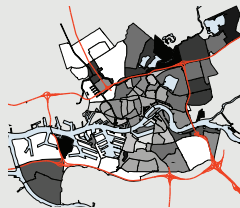
## Environmental hazard



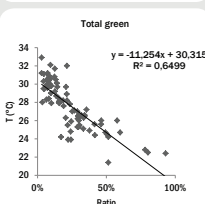
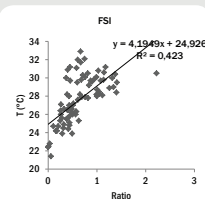
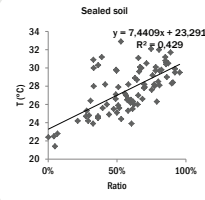
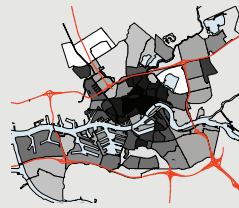
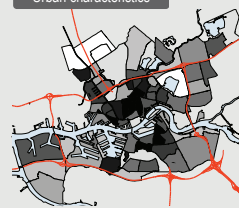
**LEGEND**  
Average summer day temperature



## Population characteristics



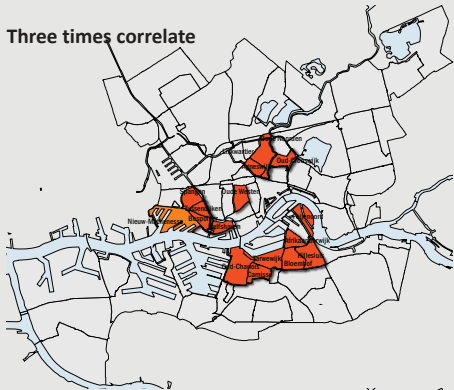
## Urban characteristics



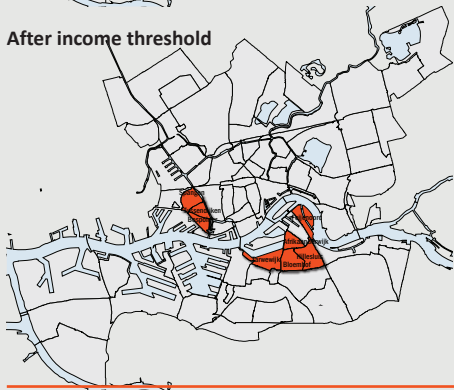




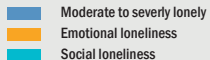
Three times correlate



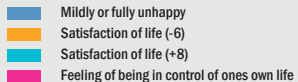
After income threshold



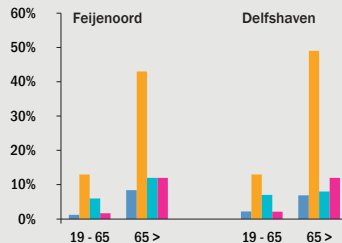
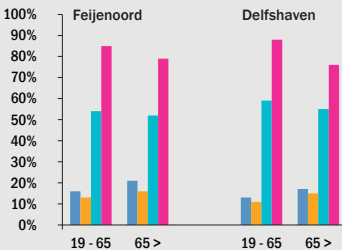
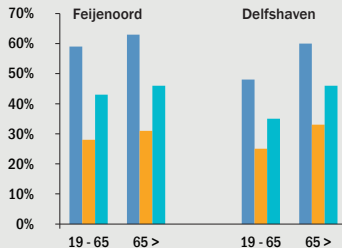
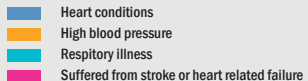
LEGEND  
Loneliness



LEGEND  
Quality of life



LEGEND  
Medical conditions



# Observations and micro interviews

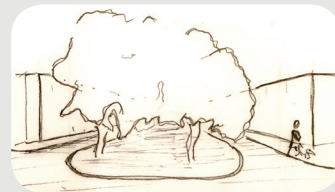
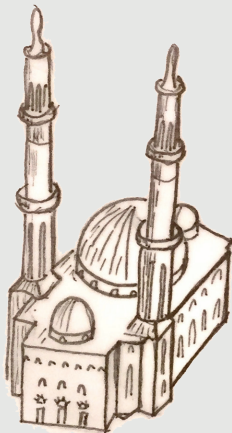
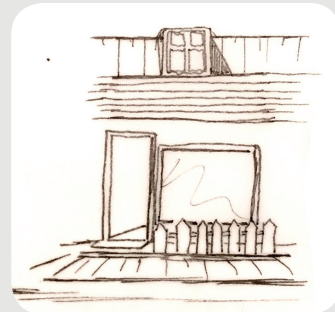


## Observations & micro interviews



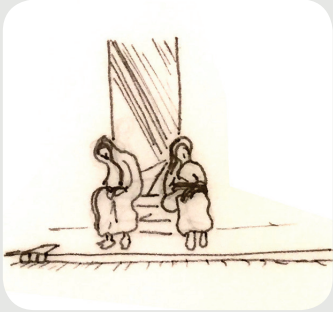
Micro interview retired Dutch man in the Roggestraat Tarwewijk:

- Life is good here in Tarwewijk.
- The postal code 3081 has a bad reputation.
- It gets quit hot in the summer, when I have the grand kids I let them sleep on the east side.
- A few weeks ago they rolled up a cannabis plantation.



Municipality Rotterdam: 'Elderly don't open the windows as they think the air draught makes them ill. Neither do they easily open the door as they are afraid they will be robbed'.

## Observations & micro interviews



Micro interview with Dutch-Hindustan

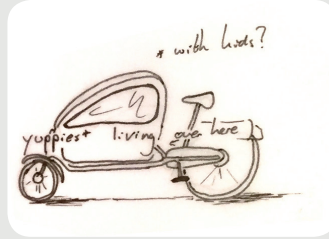
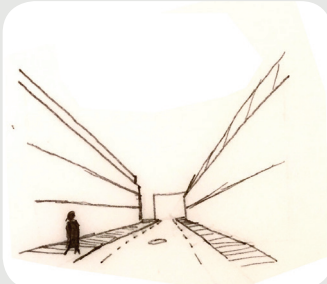
Woman (40+), lives in a apartment in Tarwewijk:

- During the summer it gets really warm or stuffy in the neighbourhood and my house.
- I keep the windows closed for the mosquito or drug addicted burglars.
- There has been some renovation of the inner-walls but it only helps for sound.

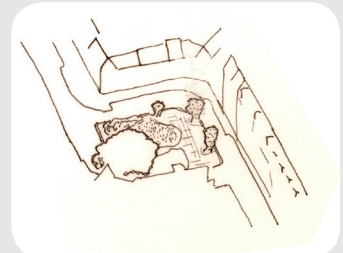
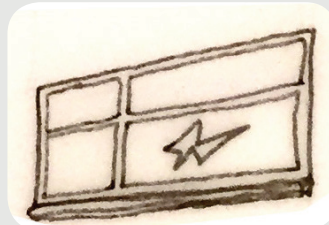


Micro interview with Moroccan women (40+), lives in a maisonette apartment in Tarwewijk:

- It gets really warm in my apartment, however the ground floor is much cooler.



Woonstad: The notion of the national program for Rotterdam South in terms of increase in number of houses we interpreted as adding more diversity to the neighbourhood. We are not considering increasing density.'

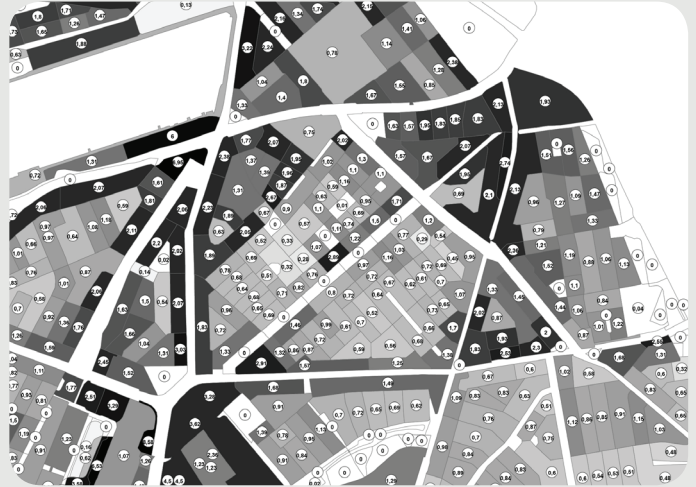


# Neighbourhood density and public spaces

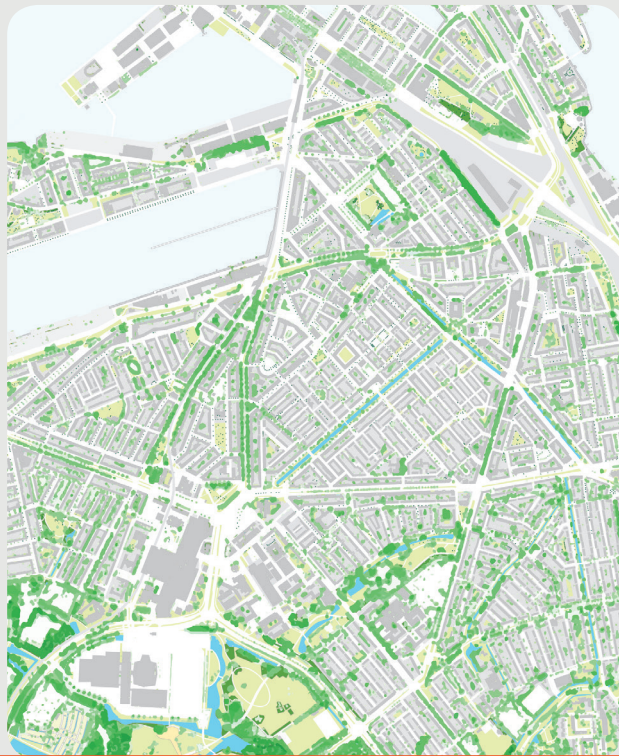
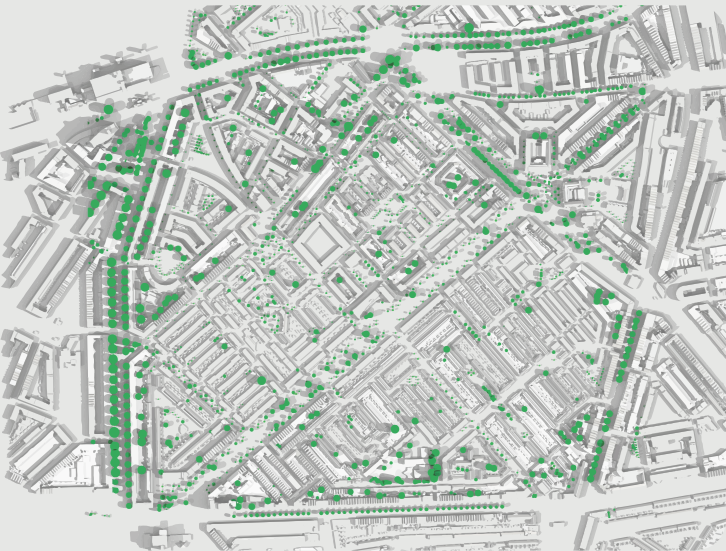




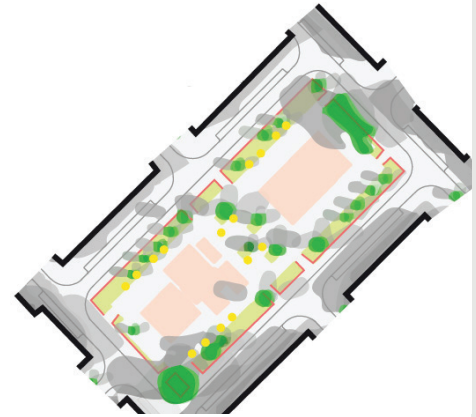
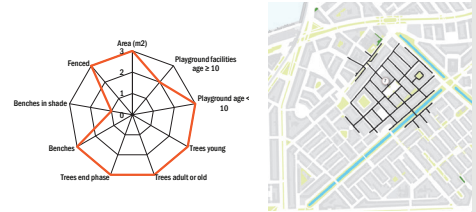
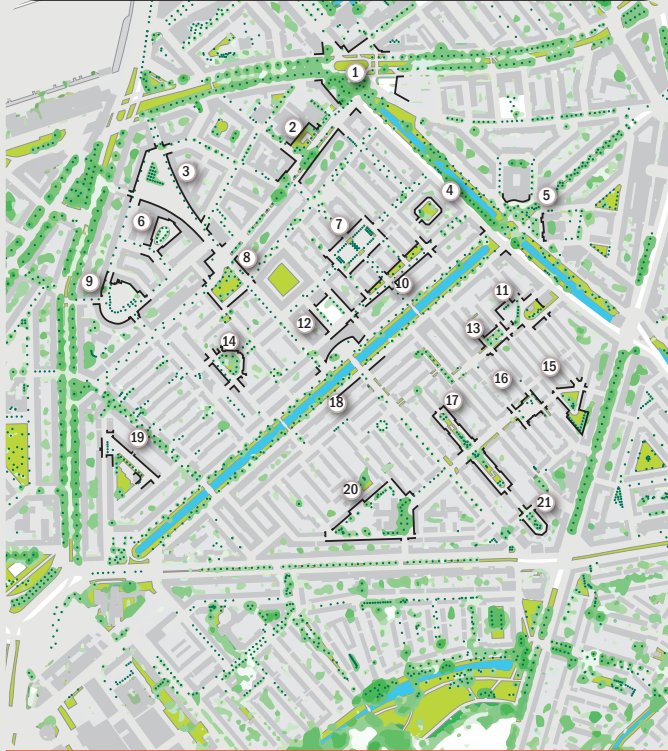
## Neighbourhood's analyses: ground and floor space



## Neighbourhood's analyses: sun study and green structure



## Neighbourhood's analyses: public spaces





## Neighbourhood's analyses: policy documents

**High burglar percentage**

**Small and bad insulated houses**

**Lack of green; no small parks or green with quality**

**Youth hang out at squares with nuisance**

**Need for more diversity of houses**

**Critical mass in housing and services for a diverse target audience.**

**Real quiet residential areas for more diversity to attract different groups.**

**Insufficient transport capacity**

**High percentage of paved surfaces and lack of green**

**Need for open water but not sufficient**

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Neighbourhood  
density and  
public spaces

# Design interventions



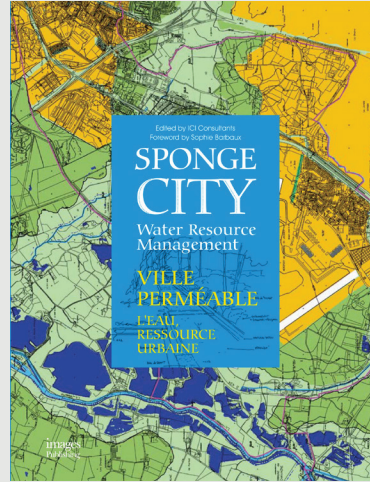
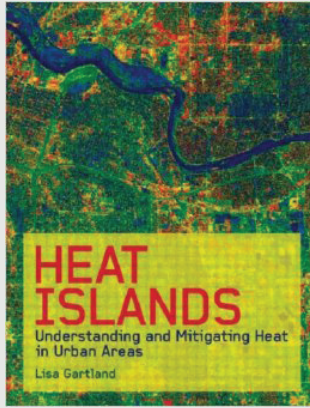
Improving density with new building blocks.

Improving the quantity and quality of vegetation in the public spaces and private space and the network.

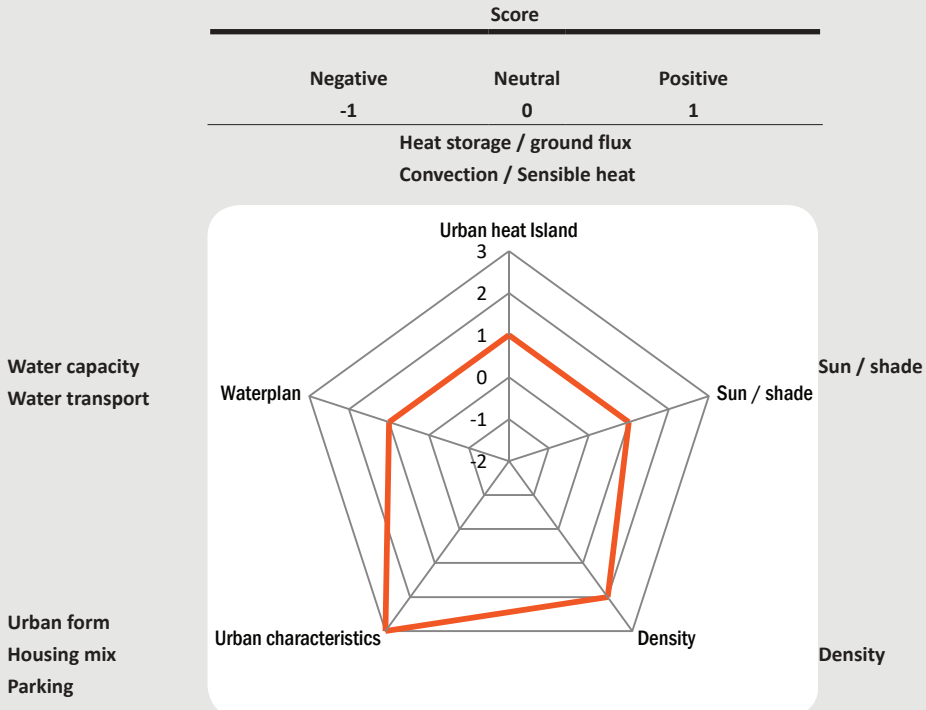
Adding water bodies.

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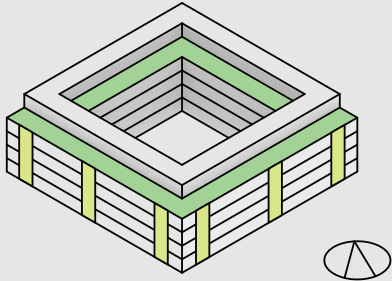
## Five main sources for design principles



## Valuation of design principles



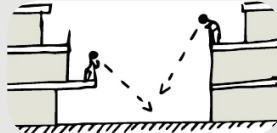
## Courtyard building block



Solar blinds (Huijbers & Dobbelsteen, 2012).



A pergola (Lenzholzer, 2013, p. 121).



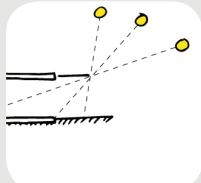
Eyes on the street (Polman, 2009; Teeuw & TU Delft Faculteit Bouwkunde SMART Architecture, 2010, p. 87).



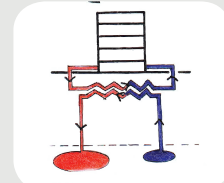
A green facade provides and water storage on roof (Lenzholzer, 2013, p. 123).



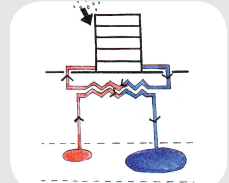
The principle of a loggia (Huijbers & Dobbelsteen, 2012, p. 84; Lenzholzer, 2013, p. 118).



Roofs with intensive green (Gartland, 2008; Lenzholzer, 2013, p. 162).









Heat and cold storage system (Climate Proof Cities consortium, 2014).

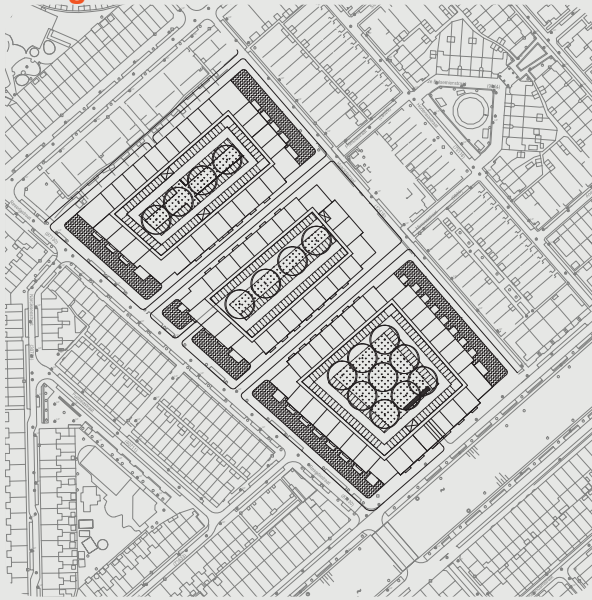


## Courtyard building block

### LEGEND

Terraced housing building block

-  Water
-  Balcony
-  Grass roof in combination with water and PV
-  Parking lot 2,30 m by 4,50 m
-  Tree 9 m diameter
-  Tree 12 m diameter

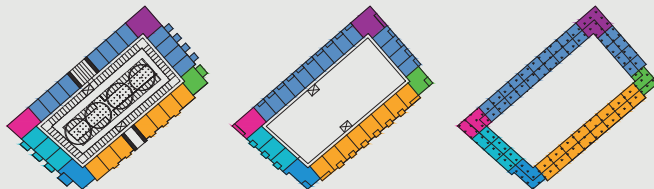


# Courtyard building block

## LEGEND

Building block I  
Total apartments 108  
Indoors (i.), Balcony (b.), Maisonette (m.)  
FSi: 1,17 GSI: 0,32  
Parking lots: 116

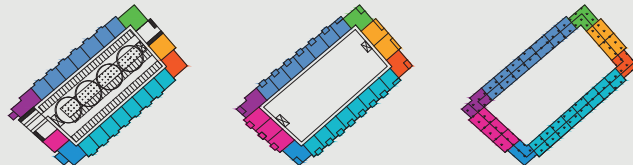
- |   |  |
|---|--|
| <span style="color: blue;">■</span> Type A: 86 - 96 m <sup>2</sup> (i.) 10 m <sup>2</sup> (b.) 134 m <sup>2</sup> (m.)      | <span style="color: blue;">■</span> Type E: 186 - 201 m <sup>2</sup> (i.) 15-38 m <sup>2</sup> (b.) 280 m <sup>2</sup> (m.)  |
| <span style="color: orange;">■</span> Type B: 112 - 124 m <sup>2</sup> (i.) 12 m <sup>2</sup> (b.) 172 m <sup>2</sup> (m.)  | <span style="color: purple;">■</span> Type F: 220 - 240 m <sup>2</sup> (i.) 20 m <sup>2</sup> (b.) 376 m <sup>2</sup> (m.)   |
| <span style="color: cyan;">■</span> Type C: 113 - 121 m <sup>2</sup> (i.) 12-18 m <sup>2</sup> (b.) 173 m <sup>2</sup> (m.) | <span style="color: green;">■</span> Type G: 137 - 152 m <sup>2</sup> (i.) 15-28 m <sup>2</sup> (b.) 221 m <sup>2</sup> (m.) |
| <span style="color: magenta;">■</span> Type D: 184 - 202 m <sup>2</sup> (i.) 18 m <sup>2</sup> (b.) 287 m <sup>2</sup> (m.) |  |



## LEGEND

Building block II  
Total apartments 90  
Indoors (i.), Balcony (b.), Maisonette (m.)  
FSi: 1,33 GSI: 0,30  
Parking lots: 90

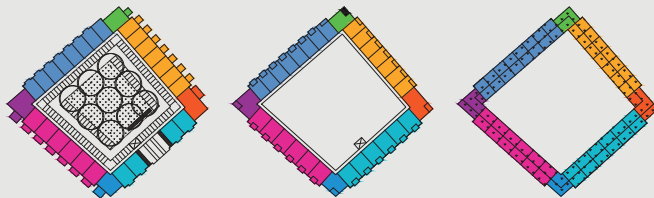
- |   |   |
|---|---|
| <span style="color: blue;">■</span> Type A: 92 - 104 m <sup>2</sup> (i.) 12 m <sup>2</sup> (b.) 130 - 142 m <sup>2</sup> (m.) | <span style="color: blue;">■</span> Type E: 129 - 144 m <sup>2</sup> (i.) 15 m <sup>2</sup> (b.) 189 m <sup>2</sup> (m.)        |
| <span style="color: orange;">■</span> Type B: 127 - 143 m <sup>2</sup> (i.) 16 m <sup>2</sup> (b.) 172 m <sup>2</sup> (m.)    | <span style="color: green;">■</span> Type F: 143 - 158 m <sup>2</sup> (i.) 15 - 16 m <sup>2</sup> (b.) 224 m <sup>2</sup> (m.)  |
| <span style="color: cyan;">■</span> Type C: 90 - 94 m <sup>2</sup> (i.) 10 - 12 m <sup>2</sup> (b.) 139 m <sup>2</sup> (m.)   | <span style="color: purple;">■</span> Type G: 143 - 158 m <sup>2</sup> (i.) 15 - 16 m <sup>2</sup> (b.) 233 m <sup>2</sup> (m.) |
| <span style="color: magenta;">■</span> Type D: 112 - 120 m <sup>2</sup> (i.) 12 m <sup>2</sup> (b.) 162 m <sup>2</sup> (m.)   | <span style="color: orange;">■</span> Type H: 143 - 158 m <sup>2</sup> (i.) 15 - 16 m <sup>2</sup> (b.) 233 m <sup>2</sup> (m.) |



## LEGEND

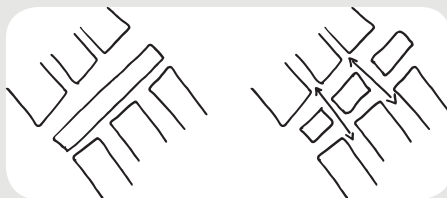
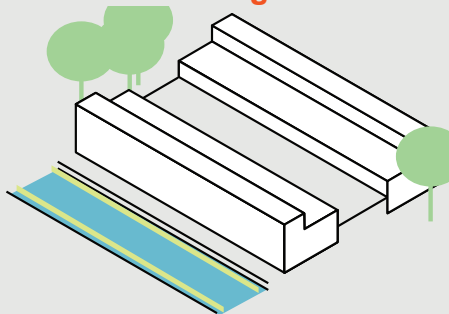
Building block III  
Total apartments 120  
Indoors (i.), Balcony (b.), Maisonette (m.)  
FSi: 1,20 GSI: 0,28  
Parking lots: 124

- |   |   |
|---|---|
| <span style="color: blue;">■</span> Type A: 86 - 100 m <sup>2</sup> (i.) 12 m <sup>2</sup> (b.) 134 - 136 m <sup>2</sup> (m.)       | <span style="color: blue;">■</span> Type E: 116 - 131 m <sup>2</sup> (i.) 15 - 30 m <sup>2</sup> (b.) 173 m <sup>2</sup> (m.)   |
| <span style="color: orange;">■</span> Type B: 86 - 96 m <sup>2</sup> (i.) 10 - 16 m <sup>2</sup> (b.) 134 - 136 m <sup>2</sup> (m.) | <span style="color: purple;">■</span> Type F: 160 - 175 m <sup>2</sup> (i.) 15 - 30 m <sup>2</sup> (b.) 257 m <sup>2</sup> (m.) |
| <span style="color: cyan;">■</span> Type C: 112 - 124 m <sup>2</sup> (i.) 12 m <sup>2</sup> (b.) 172 m <sup>2</sup> (m.)            | <span style="color: green;">■</span> Type G: 119 - 143 m <sup>2</sup> (i.) 15 - 16 m <sup>2</sup> (b.) 196 m <sup>2</sup> (m.)  |
| <span style="color: magenta;">■</span> Type D: 111 - 120 m <sup>2</sup> (i.) 12 - 18 m <sup>2</sup> (b.) 171 m <sup>2</sup> (m.)    | <span style="color: orange;">■</span> Type H: 177 - 191 m <sup>2</sup> (i.) 14 - 32 m <sup>2</sup> (b.) 276 m <sup>2</sup> (m.) |





## Terraced housing block



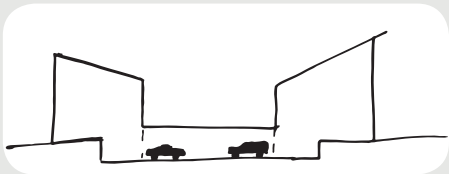
Improving network.



Large trees (Lenzholzer, 2013).



A mixture of bigger and smaller plants (Lenzholzer, 2013, pp. 134, 165).



Parking solution in where the parking garage is part of a terraced building block.



Water body (Meyer, 2012).









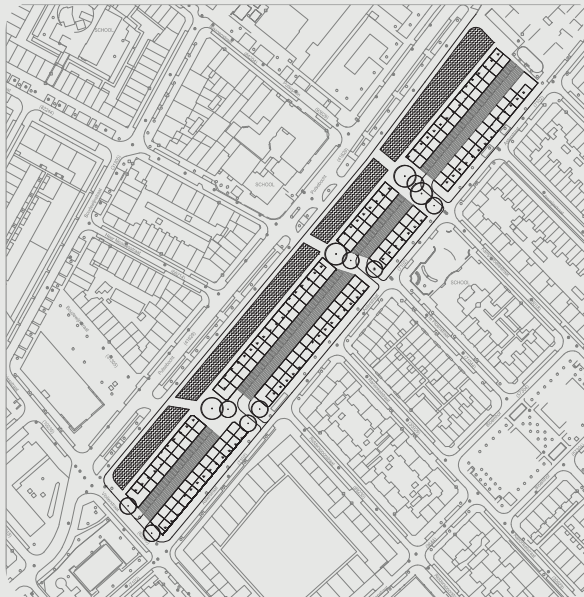
The effectively of the water body increases with vegetation (Lenzholzer, 2013, p. 169).

## Terraced housing block

### LEGEND

Courtyard building block

-  Water
-  Grass
-  Grass roof in combination with water and PV
-  Parking lot 2.30 m by 4.50 m
-  Tree 16 m diameter
-  Elevator and staircase

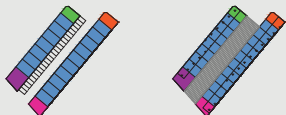


# Terraced housing block

## LEGEND

Building block I  
Total apartments 21  
Indoors (i.), Balcony (b.)  
FSI: 0,94 GSI: 0,29

Parking lots: 25  
Type A: 150 m<sup>2</sup> (i.) 60 m<sup>2</sup> (b.)  
Type B: 224 m<sup>2</sup> (i.) 130 m<sup>2</sup> (b.)  
Type C: 161 m<sup>2</sup> (i.) 77 m<sup>2</sup> (b.)



## LEGEND

Building block III  
Total apartments 13  
Indoors (i.), Balcony (b.)  
FSI: 0,82 GSI: 0,24

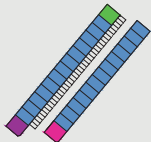
Parking lots: 18  
Type A: 150 m<sup>2</sup> (i.) 60 m<sup>2</sup> (b.)  
Type B: 275 m<sup>2</sup> (i.) 115 m<sup>2</sup> (b.)



## LEGEND

Building block II  
Total apartments 29  
Indoors (i.), Balcony (b.)  
FSI: 1,09 GSI: 0,30

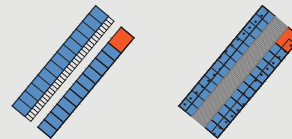
Parking lots: 37  
Type A: 150 m<sup>2</sup> (i.) 60 m<sup>2</sup> (b.)  
Type B: 201 m<sup>2</sup> (i.) 63 m<sup>2</sup> (b.)  
Type C: 185 m<sup>2</sup> (i.) 77 m<sup>2</sup> (b.)  
Type D: 205 m<sup>2</sup> (i.) 125 m<sup>2</sup> (b.)



## LEGEND

Building block IV  
Total apartments 25  
Indoors (i.), Balcony (b.)  
FSI: 1,00 GSI: 0,28

Parking lots: 34  
Type A: 150 m<sup>2</sup> (i.) 60 m<sup>2</sup> (b.)  
Type B: 195 m<sup>2</sup> (i.) 145 m<sup>2</sup> (b.)



# Greening private and public space

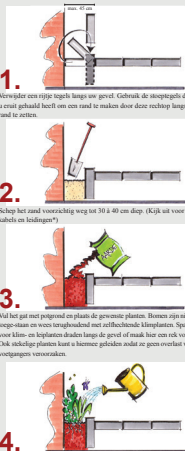


Gemeente  
Schiedam

## Een geveltuin aanleggen in vier stappen

### Aandachtspunten voor u begint:

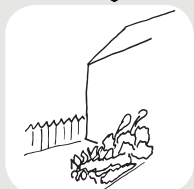
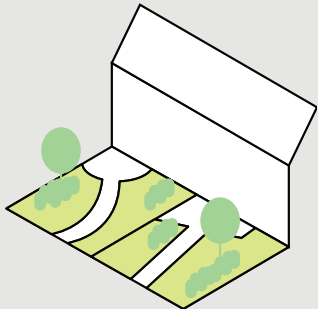
- Het tuintje mag niet breder zijn dan 45 centimeter;
- Na aanleg dient minimaal 1,50 meter trottoir vrij te blijven voor gebruikers;
- Een geveltuin legt u aan tegen de gevel van de woning, niet tegen een voortuin of in een winkelstraat.
- Gebruik de tegels die u verwijderd heeft als rand of bewaar ze;
- Houid goten en ontlastingsroosters in de gevel vrij.
- Als u een grotere geveltuin of bloembak wilt realiseren, neem dan even contact op met één van de wijktoezichhouders via telefoonnummer 14 010. Deze neemt dan de spelregels met u door aan de hand van een afsprakenlijstje dat beide partijen ondertekenen;
- Derselfde regels gelden voor het plaatsen van een smalle bloembak op het trottoir tegen de gevel.



\* Niet door een openbare school om lichte of ledingsen kunt u een openbare gevel



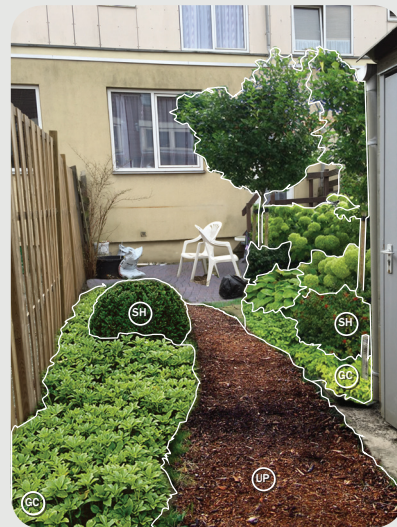
## Greening private space



Ground covering (Lenzholzer, 2013, p. 165).



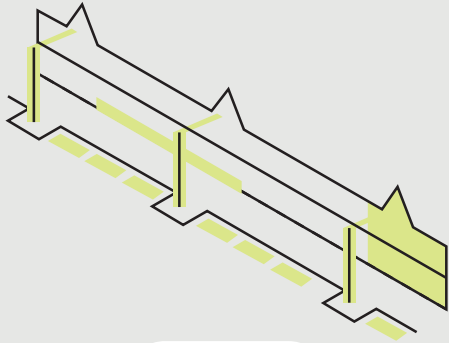
Small trees (Lenzholzer, 2013, p. 130).



LEGEND  
Description of plants

-  GC Ground covering plants
-  UP Unpaved path
-  SH Shubbery
-  NB Naturalizing bulbs
-  TR Trees

## Greening streets



Greening street lanterns (Lenzholzer, 2013, p. 172).



A green facade (Lenzholzer, 2013, p. 123).



Replacing the paved surfaces of parking spaces in the public space with semi paved tiles (Lenzholzer, 2013, p. 179, ICI Consultants, 2015, p. 154).



Conscious community (Teeuw & TU Delft Faculteit Bouwkunde SMART Architecture, 2010).



An interpretation of build shade elements (Lenzholzer, 2013, p. 140).



## Greening streets: Violierstraat



## Greening streets: Kamperfoeliestraat

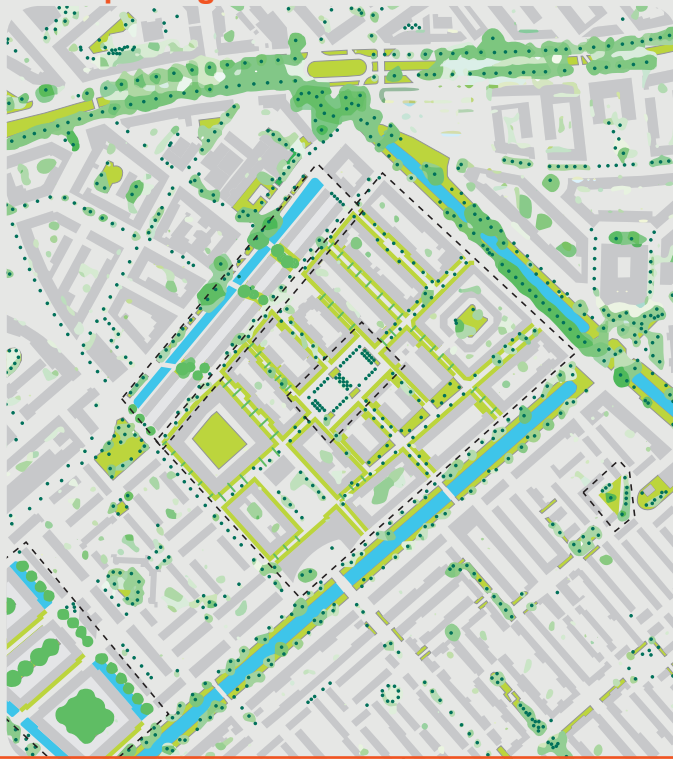


## Greening private and public space: green network

### LEGEND

#### Greenstructure

- Building
- Building island
- Grasland
- River
- Water
- Tree plantboxes
- Tree crowns
- Vegetation on and along side facade.  
Also represents semi-paved parking surfaces.
- Tree crowns
- Project borders



## Greening public squares

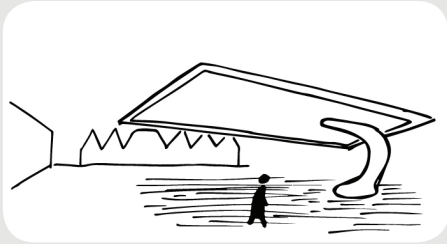




## Greening public squares



## Shading public squares





## Research conclusions

Rotterdam socially deprived neighbourhoods are disproportionately exposed to the urban heat island as they lack the means to escape from high air temperature both in the private and the public space.

Urban design can mitigate and adapt to the urban heat island and at the same time improve upon broader social issues, water and meet ambitions of growth.

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## Recommendations for further research

Research design with a broader relation of urban form and micro-climate.

Severity of high air temperature for people.

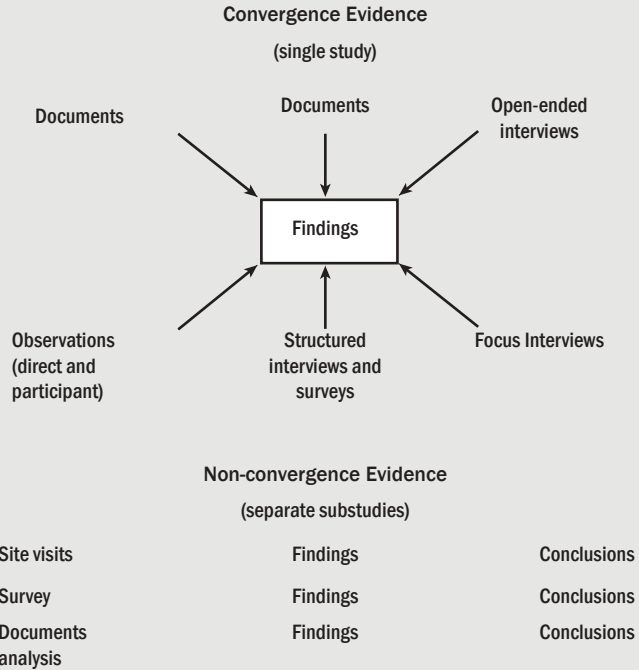
Higher resolution data of the nocturnal urban heat island phenomenon.

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# Questions and discussion



## Methodology









## Neighbourhood's analyses: functions, building year and typologies



LEGEND  
Functions

- Shops
- Offices
- Sport
- Education
- Health care
- Communal
- Industry
- Lodging



LEGEND  
Building year

- 1787 - 1900
- 1900 - 1910
- 1910 - 1920
- 1920 - 1930
- 1930 - 1940
- 1940 - 1945
- 1945 - 1955
- 1955 - 1965
- 1965 - 1975
- 1975 - 1985
- 1985 - 1995
- 1995 - 2005
- 1994 - 2014
- 2015



LEGEND  
Building typologies

- Appartments
- Duplex
- Terraced houses
- Maisonette

## Population characteristics

Age	Ethnicity	Education	Health	Income
The elderly and young are more vulnerable due to physical fragility because of young age or elderly often from diseases such as cardiovascular diseases, respiratory conditions and diabetes	Are more likely to live in warmer neighbourhoods with a greater exposure to heat stress.	Education is linked to socioeconomic status. Lower education limited the ability to understand or access warning or recovery information.	Physical fragile, particular those with renal & cardiovascular conditions and diabetes.	Physical fragile, particular those with renal & cardiovascular conditions and diabetes

(Cutter, Boruff, & W, 2003; Schauser et al., 2010, p. 33)

## Environmental Hazards

Pollution	Temperature
Environmental pollution is defined as the undesirable change in physical, chemical and biological characteristics of our air, land and water.	High temperature is considered hazards as it negatively influence thermic comfort resulting in misbalancing the thermal body management system also known as heat stress. Effects of heat stress our reduced concentration, learning capacity, labour productivity and sleep problems. Certain groups within a population are more vulnerable (see population characteristics).

## Population characteristics

(Lenzholzer, 2013; Sharma, 2009)

## Urban characteristics

### Density

High density in terms of dense building construction positively correlates with urban heat island.

### Vegetation

Vegetation positively relates to the evaporation of energy into the air and provides shade.

### Land use / Land cover

Correlation between daytime land surface temperature and land use / land cover.

### Urban fabric

Physical factors as building quality, canyon like configuration, high building mass, impervious cover or structures that hinder ventilation all correlates to the intensity of the urban heat island.

(EEA, 2012b; Gartland, 2008; Roth, Oke, & Emery, 1989)

Indicator	Applies to	Score			source
		Negative -1	Neutral 0	Positive 1	
Heat storage / ground flux	Heat storage or ground flux depends on the heat capacity of materials and is the biggest factor for the nocturnal urban heat island.	Increases the amount of impervious surfaces or mass that collects energy from the sun re-emitted during the evening or reduces the amount of evapotranspiration.	-	Reduces the amount of impervious surfaces or mass that collects energy from the sun re-emitted during the evening / or evapotranspiration.	(Gartland, 2008; FD van der Hoeven & Wandl, 2015)
Convection / Sensible heat	Convection is sensible heat where energy is transferred from a solid surface to a liquid or gas and as such heats the air.		-		(Gartland, 2008; FD van der Hoeven & Wandl, 2015).
Evapotranspiration / Latent heat	Evapotranspiration is the latent heat and the combination of energy transmitted away from the Earth's by water vapour and by plants.	Decreases the amount of greenery and shallow water available for evapotranspiration.	-	Increases the amount of greenery and shallow water for evapotranspiration.	(Gartland, 2008; FD van der Hoeven & Wandl, 2015).

Sun / shade	Direct radiation by the sun a strong influence on the experience of heat by the human body.	More exposure to direct sun light due to lack of shade.	-	Less exposure to direct sun light due to shade.	(Gartland, 2008; Havenith, 2005).
Density	Density of urban fabric in terms of FSI and GSI are beneficial as it provides critical mass in terms of inhabitants for services and the need for more dwelling because of expected growth.	Density decreases	-	Density increases	(Tillie, 2012;
Urban form	Urban form, defined by Taleghani, that is beneficial for providing thermal comfort at reference point.	Singular	Linear	Courtyard	(Taleghani, 2014)
Housing mix	The housing mix is perceived as problematic as its to homogeneous with houses of bad quality in terms of isolation, maintenance and size.				(Gebiedscomissie Feijenoord, 2014;
Parking	Reducing the parking pressure on the streets, as these are often narrow, as this is perceived as nuisance by the residents.	The parking pressure increases due to reasons of increased population density without providing sufficient parking places.		New parking solutions that reduce parking pressure on the street.	(Gebiedscomissie Feijenoord, 2014)

Public squares	The quality of public spaces in terms of greenery, playgrounds and benches.	The quality of a public space declines caused by reduction in one of the indicators as described in	The quality of a public increases as one of the indicators increases and or new public spaces are introduced.	(Gebiedscomissie Feijenoord, 2014)
Water storage capacity	The capacity of a neighbourhood to temporal store water as a cause of heavy rainfall.	The amount of water capacity reduces.	The amount of water capacity increases.	
Water transport	Transport capacity to water bodies like 'singels'.	The transport capacity to water bodies decreases.	The transport capacity to water bodies increases.	

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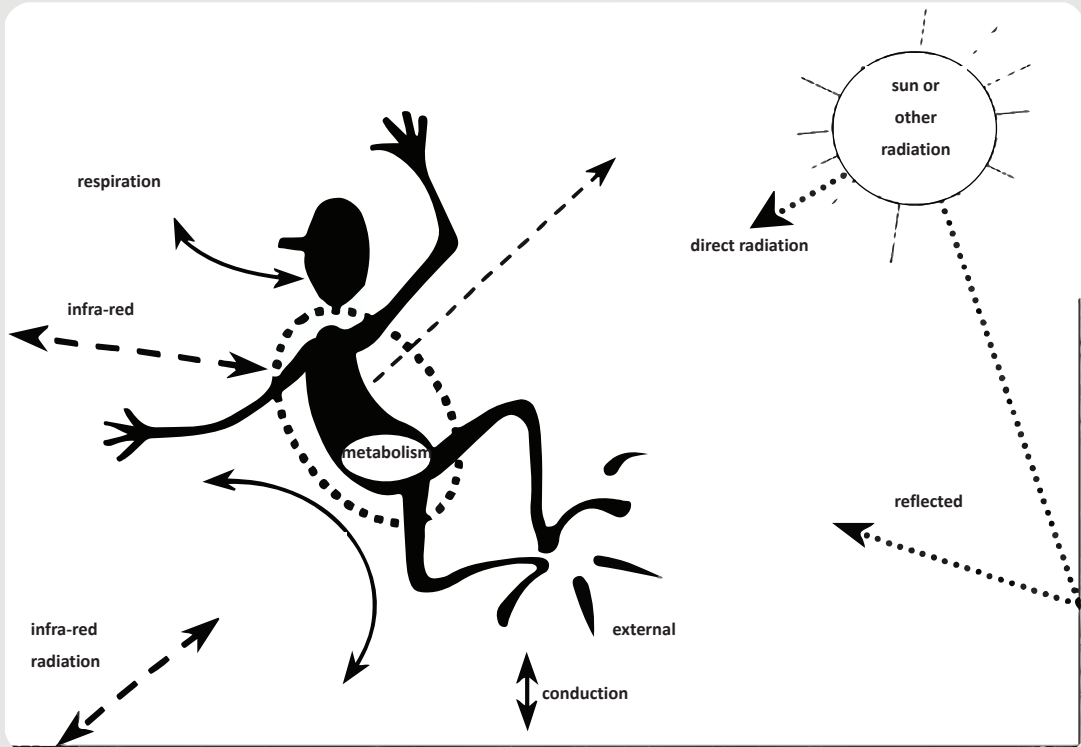


## Casualties during heat wave of 2003

Location	Additional casualties	Increase (%)
England and Wales	2091	17
France	14802	60
Germany	1410	-
Italy	3134	15
The Netherlands	1400-2200	-
Portugal	1854	40
Spain	4151	11
Switzerland	975	7

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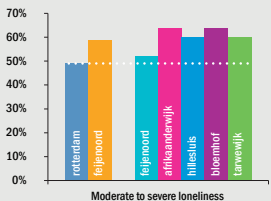
## Heat and the human body



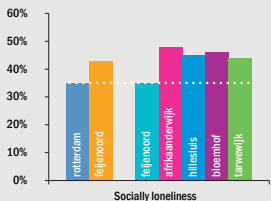
## Effects of heat

Effect	Symptoms	Mechanism
Nuisance	Irritable, lethargic, reduced alert, sleep disturbance, headache, dizziness, concentration problems , anxiety, muscle pain	Change of psychological functioning and social interaction with others
Sleep disturbance	Loss of concentration , tired, listless, irritable	Decrease in sleep quality that results insufficient recovery
Edema	Non painful swelling of ankles in which a well can be pushed	Withdrawal of fluid from the bloodstream by dilating blood vessels Blockage of sweat glands
Rash	Itchy blisters and redness	Blockage of sweat glands
Heat exhaustion, heat syncope , heat exhaustion	General: dry mouth, tired, dizziness , headache Skin: red , sweating Body temperature to 40 ° C	Moisture loss through transpiration and dilation of blood vessels
Heat Cramps / muscle Cramps	Skin warm and dry	Extreme loss of fluid and salts through sweating at effort
Heat stroke	General : confused, drowsy , Unconscious Body temperature above 40 ° C	Skin warm and dry Extreme loss of fluid and salts by perspiration

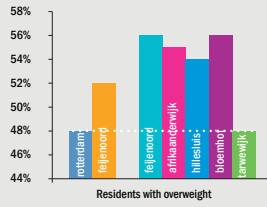
# Perceived quality of life



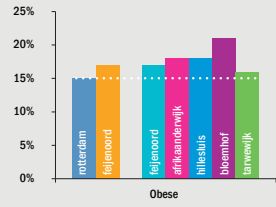
Moderate to severe loneliness



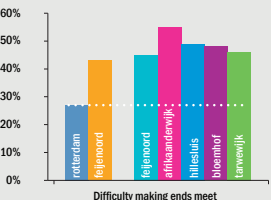
Socially loneliness



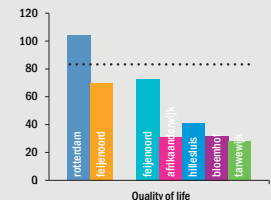
Residents with overweight



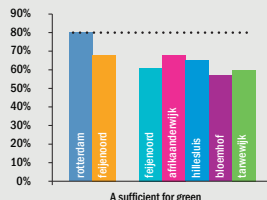
Obese



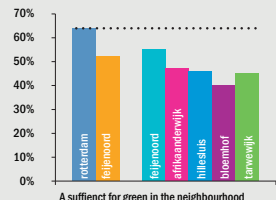
Difficulty making ends meet



Quality of life



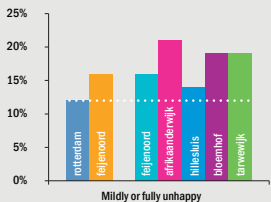
A sufficient for green



A sufficient for green in the neighbourhood

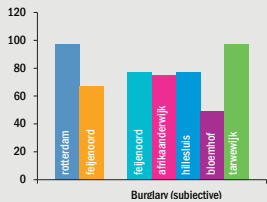
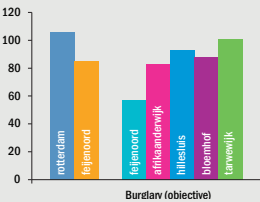
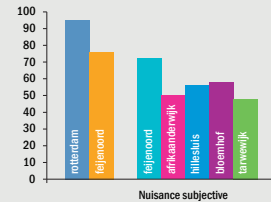
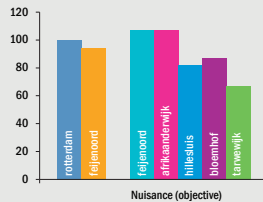
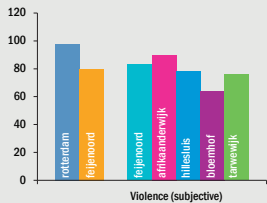
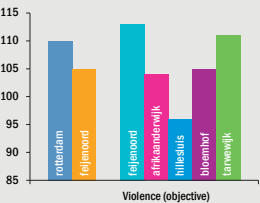
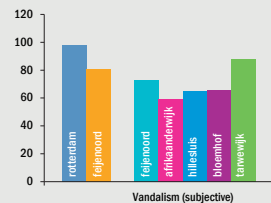
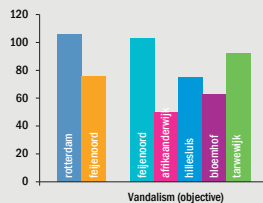
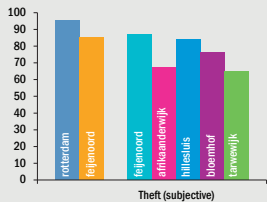
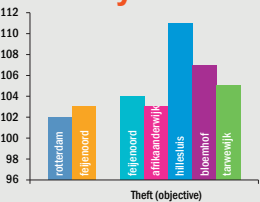


Experiences health as really good



Mildly or fully unhappy

## Safety index



## Income threshold

2013	single		couple		parent		average
	no children	1 child	1 child	2 children	1 child	2 children	
Lower income threshold 'not much but adequate'-threshold	10.100	13.900	16.900	19.000	13.500	15.000	14.800
	10.600	14.500	17.700	19.900	14.100	16.000	15.500

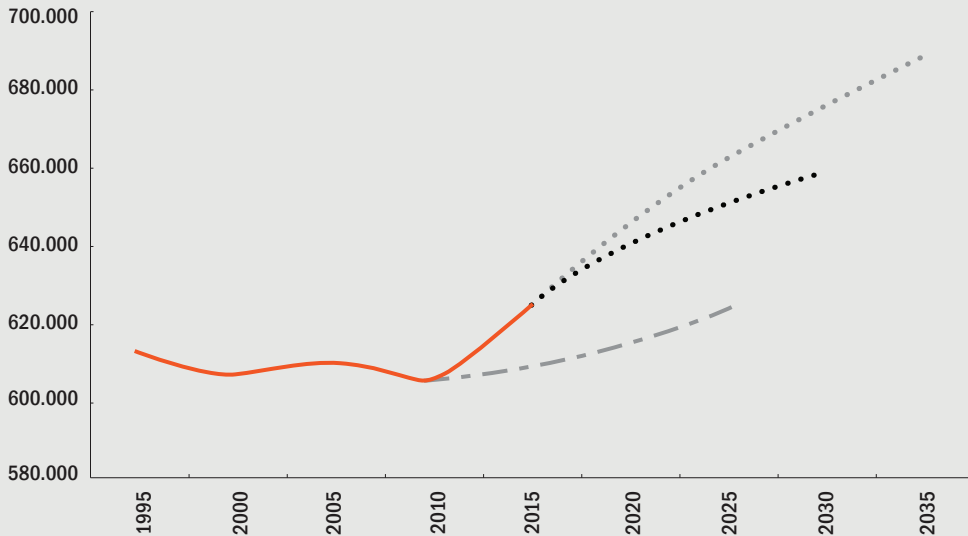
Neighbourhoods	Temperature	Income
Afrikaanderwijk	30,8	13000
Feijenoord	29,8	13100
Hillesluis	30,1	13300
Tussendijken	29,7	13400
Spangen	29,2	13600
Bloemhof	29,9	14100
Oud Crooswijk	28,7	14300
Bospolder	30,6	14600
Tarwewijk	29,6	14900
Oude Noorden	29,8	16100
Delfshaven	30,1	16400
Oude Westen	29,5	16800
Oud Charlois	28,2	17300
Agniesebuurt	30,4	17700
Carnisse	28,3	18100
Nieuw Mathenesse	32,9	-

## Population growth

### LEGEND

Municipal population growth compared

- Prognosis 2016-2035
- Prognosis 2013-2030
- Prognosis 2010-2025
- Realized 2015





## Policy documents

Topic	Scale	Policy document	Main points	Source
Housing	Rotterdam South	National program Rotterdam South	<ul style="list-style-type: none"> <li>• Need for critical mass in housing and services for a diverse target audience.</li> <li>• Need for quiet residential areas to create more diversity in housing to attract different groups.</li> <li>• Private owned small apartments are worrisome.</li> </ul>	(programmabureau NPRZ, 2015)
Population	Rotterdam	Chart of the city	<ul style="list-style-type: none"> <li>• Population of Rotterdam is growing with 40.000 more in 2025 according to the prognosis 2015-2035 then a previous prognosis of 2010-2015.</li> </ul>	(Stadsontwikkeling Rotterdam, 2015)
varied	Afrikaanderwijk	Area plan city district Feijenoord	<ul style="list-style-type: none"> <li>• Streets have high percentage of pavement.</li> <li>• Afrikaanderwijk needs improvement of its shopping street.</li> <li>• Improvement of the facades</li> </ul> <p>Parking pressure is high.</p>	(Gebiedscommissie Feijenoord, 2014)
varied	Bloemhof	Area plan city district Feijenoord	<ul style="list-style-type: none"> <li>• High burglar percentage.</li> <li>• Small and bad insulated houses.</li> <li>• Lack of green; no small parks or green with quality.</li> <li>• Youth hang out at squares with nuisance.</li> <li>• Diversity of houses.</li> </ul>	(Gebiedscommissie Feijenoord, 2014)

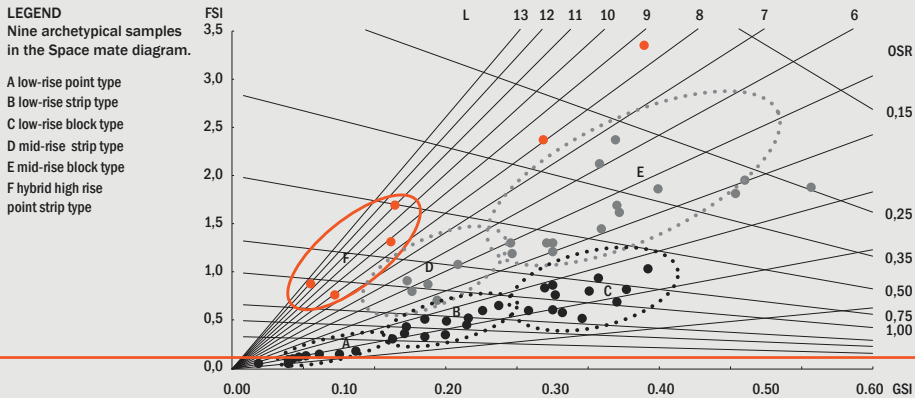
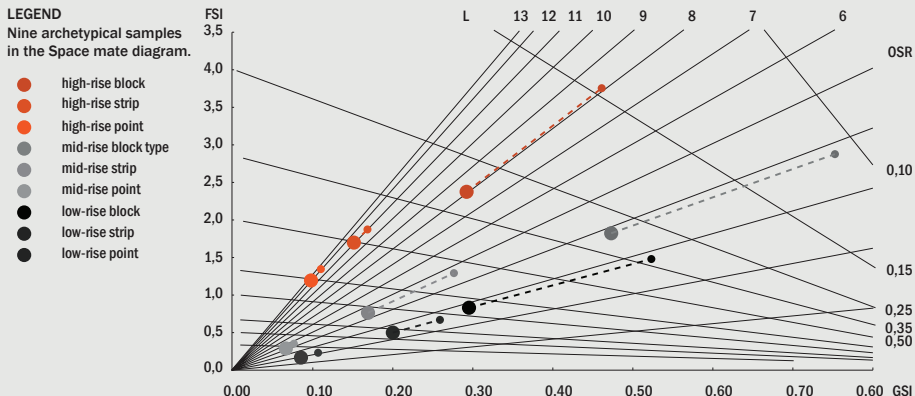
## Policy documents

Topic	Scale	Policy document	Main points	Source
varied	Hillesluis	Area plan city district Feijenoord	<ul style="list-style-type: none"><li>• Transition neighbourhood: people don't stay long.</li><li>• Homogenous type of housing.</li><li>• Create room for meeting, playing and relaxing.</li><li>• More diverse houses.</li><li>• Improvements public space and facade of the boulevard.</li></ul>	(Gebiedscommissie Feijenoord, 2014)
Water	City district Feijenoord	Waterplan 2013	Afrikaanderwijk, Bloemhof and Hillesluis do not meet the requirements for the norm for water nuisance.	(Gemeente Rotterdam, Waterschap Hollandse Delta, Hoogheemraadschap van Schieland en de Krimperenerwaard, & Hoogheemraadschap van Delfland, 2013)

## Policy documents

Topic	Scale	Policy document	Main points	Source
Water	Afrikaanderwijk, Tarwewijk, Hillesluis and Bloemhof	Waterplan Feijenoord and Charlois	With a high percentage of paved surfaces, lack of green and insufficient transport capacity there is a need for open water to give the water system a quantitative and qualitative new impulse. However due to a high density, a higher ground surface and limited capacity in its surrounding water system there is a need for innovative solutions.	(Gemeentewerken, 2010)
Density and greenery	Rotterdam	Rotterdammers maken stad verdichten + vergroenen = duurzame stad	<ul style="list-style-type: none"><li>• Higher density stimulates walking and cycling.</li><li>• Higher improves employment as the demand for services increase.</li><li>• Higher density intensifies the use of greenery.</li></ul>	(Tillie, 2012)

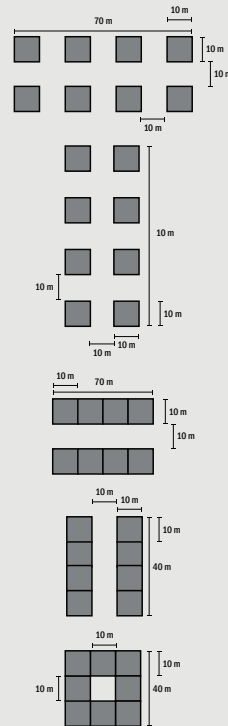
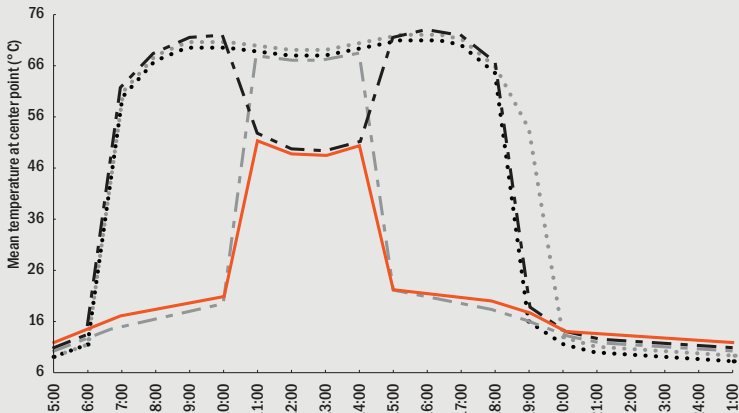
## Space matrix



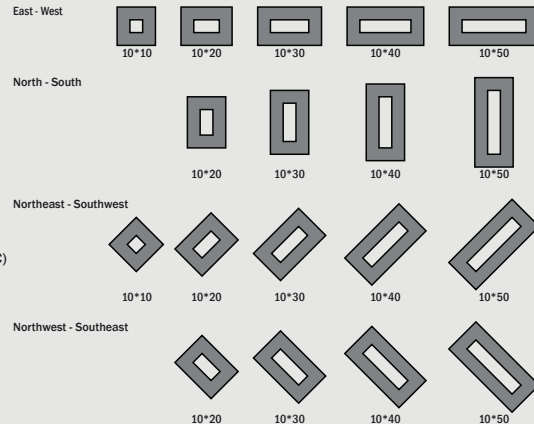
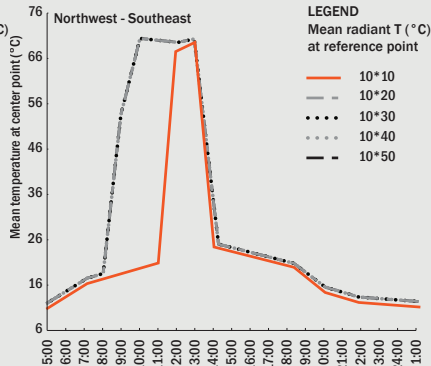
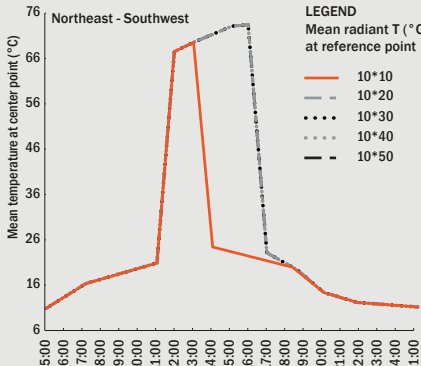
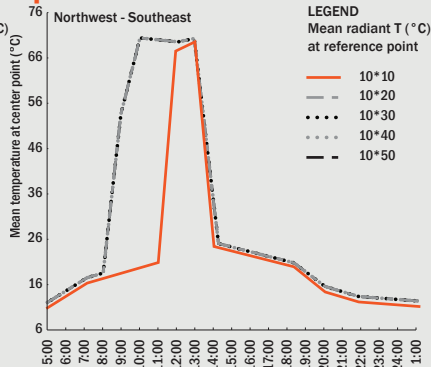
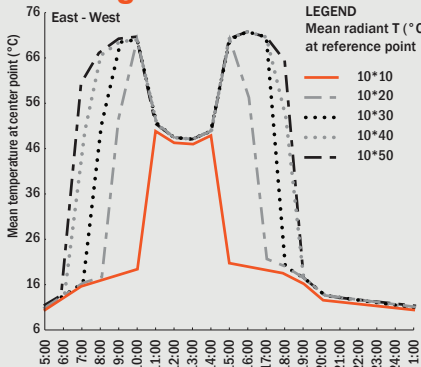
# Building block micro climate performance

**LEGEND**  
Mean radiant T (°C)  
at reference point

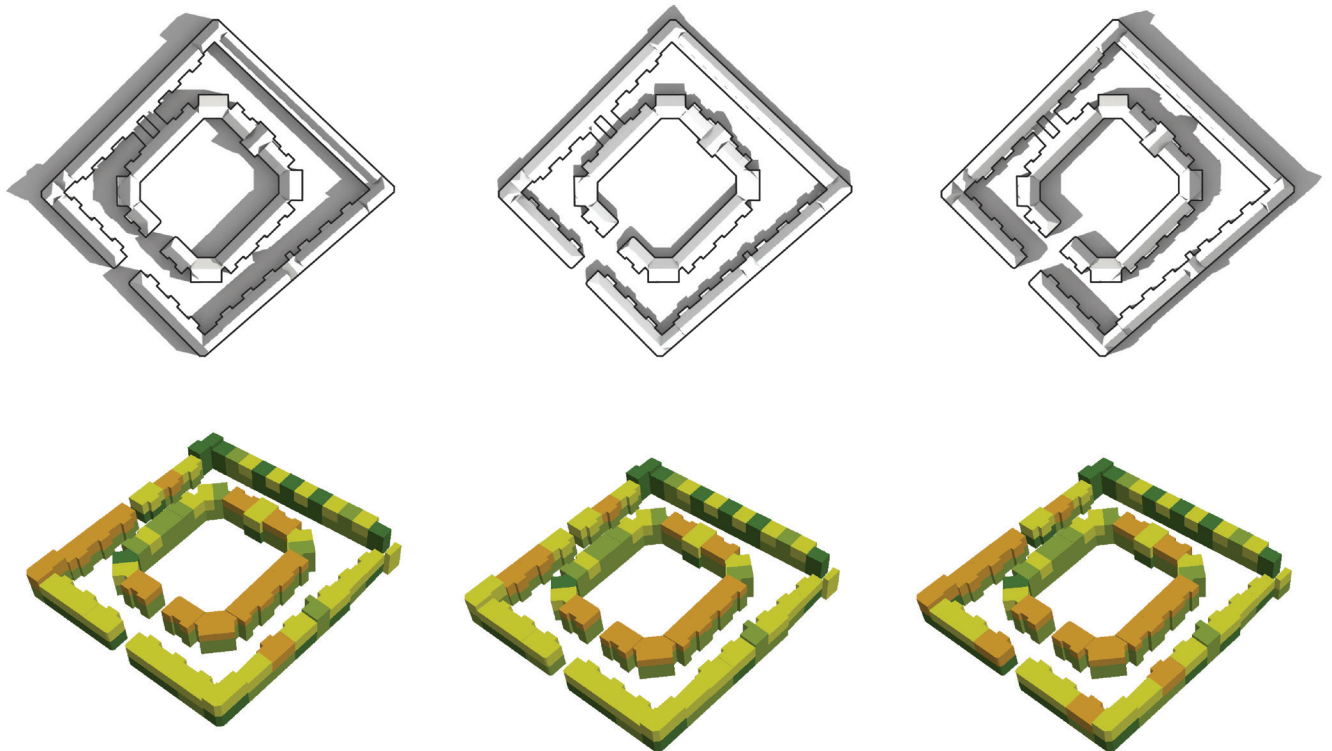
- Singular E-W
- Singular N-S
- Linear E-W
- Linear N-S
- Courtyard



# Building block micro climate performance

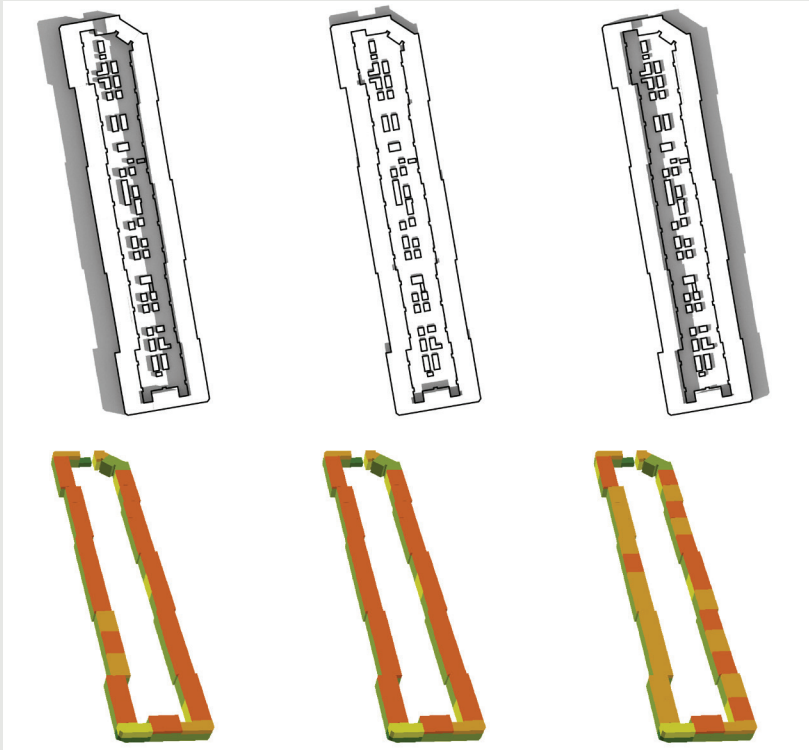


## Building block micro climate performance





## Building block micro climate performance



## Building block micro climate performance

