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Improving perceived safety through spatial design in Pendrecht

# STRUCTURE

- 2 / Inquiry (theory and data)
- 3 / Design principles
- 4 / The experiment

1 / Problem introduction & analysis

5 / Neighborhood transformation design





## MOTIVATION

Growing population in cities





## Densifying the existing urban environment









UNSAFETY



## CONCEPTUAL FRAMEWORK





## PROJECT LOCATION





Urban plan Pendrecht, by Lotte Stam-Beese (1949)

source: www.metalocus.es



## PROBLEM INTRODUCTION





List and map of problem neighborhoods in the Netherlands (source: ministerie van vrom)

**UNSAFETY** 

## Problem neighborhoods in Rotterdam-Zuid

Included in the list of problem neighborhoods by minister Vogelaar



#### Income deviation from the average of Rotterdam

#### Percentage of social housing







UNSAFETY

0%

100%

Percentage of population with a non-western migration background









#### Physical index

#### Safety index









## NEIGHBORHOOD PROFILE



![](_page_9_Picture_5.jpeg)

## NEIGHBORHOOD PROFILE

![](_page_10_Figure_1.jpeg)

![](_page_10_Picture_5.jpeg)

# **RESEARCH QUESTION**

How can perceived safety be improved through neighborhood transformation in Pendrecht?

![](_page_11_Picture_4.jpeg)

![](_page_11_Picture_5.jpeg)

![](_page_11_Picture_10.jpeg)

## RESEARCH APPROACH

![](_page_12_Figure_1.jpeg)

![](_page_12_Figure_3.jpeg)

![](_page_12_Picture_5.jpeg)

## THEORETICAL FRAMEWORK

## CPTED

Assumes that crime and insecurity can be combatted through environment-oriented physical and social measures

## SOCIAL SAFE DESIGN

Assumes that a social safe environment is an environment in which people can move freely from the threat of or confrontation with violence.

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![](_page_13_Picture_7.jpeg)

- Visibility
- Legibility
- Accessibility
- Attractiveness

![](_page_14_Picture_8.jpeg)

- Visibility
- Legibility
- Accessibility
- Attractiveness

Clear overview

->

- Sightlines
- Lighting
- Social control

![](_page_15_Picture_13.jpeg)

- Visibility
- Legibility -
- Accessibility
- Attractiveness

Clear borders between territories

Recognizable ownership over the space

Continuity of the urban fabric

![](_page_16_Picture_10.jpeg)

- Visibility
- Legibility
- Accessibility ->
- Attractiveness

Accessible for everybody

Alternative routes

![](_page_17_Picture_10.jpeg)

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- Visibility
- Legibility
- Accessibility
- Attractiveness –

Quality of experience

Maintainance of public space and buildings

Esthetic quality

![](_page_18_Picture_11.jpeg)

## SPATIAL ANALYSIS

- Modernist neighborhood
- Light, air, space principles
- Open building blocks
- Variation in building height
- Open green spaces
- Cars dominate the streets

![](_page_19_Picture_7.jpeg)

![](_page_19_Picture_8.jpeg)

![](_page_19_Figure_10.jpeg)

![](_page_19_Picture_11.jpeg)

![](_page_19_Picture_12.jpeg)

source: author, 2019

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## SURVEY

#### **ISSUES MENTIONED BY THE PARTICIPANTS**

- Nuisance from waste
- Plein 1953 is unsafe during the night
- Route from metro station to main square is unsafe during the night
- Poor maintenance of the buildings
- Loitering groups

#### POSITIVE POINTS MENTIONED BY THE PARTICIPANTS

- Proximity of shops
- Proximity of public green
- Openness of the neighborhood
- The people: interaction and diversity
- Residents' initiatives

![](_page_20_Picture_13.jpeg)

## DESIGN PRINCIPLES

- 1 / Spatial diversity
- 2 / Adding front doors
- 3 / Adding front gardens
- 4 / Define territories
- 5 / Creating alternative routes

![](_page_21_Picture_7.jpeg)

![](_page_21_Picture_8.jpeg)

![](_page_21_Picture_9.jpeg)

![](_page_21_Picture_14.jpeg)

# OPEN GREEN SPACE

![](_page_22_Picture_1.jpeg)

source: Funda

![](_page_22_Picture_3.jpeg)

![](_page_22_Picture_4.jpeg)

source: Google Maps

## PARALLEL SHORT BUILDING BLOCKS

![](_page_23_Picture_1.jpeg)

![](_page_23_Picture_2.jpeg)

![](_page_23_Picture_3.jpeg)

## LONG BUILDING BLOCKS

![](_page_24_Picture_1.jpeg)

source: Google M

![](_page_24_Picture_3.jpeg)

![](_page_24_Picture_4.jpeg)

source: Google Maps

## DESIGN PRINCIPLES

# Common building configuration in Pendrecht

Alley houses

![](_page_25_Picture_3.jpeg)

source: Google Maps

Long building

![](_page_25_Picture_6.jpeg)

Specific location in Pendrecht

#### Apartment buildings

![](_page_25_Picture_10.jpeg)

#### Public greenery

![](_page_25_Picture_12.jpeg)

source: Google Maps

source: Google Maps

Public square

![](_page_25_Picture_16.jpeg)

![](_page_25_Picture_18.jpeg)

# 1 / ALLEY HOUSES

## 1. Current Situation

2. Rotate building block

narrow alley bordered by backyard fences

![](_page_26_Figure_4.jpeg)

![](_page_26_Figure_5.jpeg)

![](_page_26_Figure_6.jpeg)

![](_page_26_Picture_7.jpeg)

#### 3. Increase continuity

![](_page_26_Figure_11.jpeg)

![](_page_26_Figure_12.jpeg)

![](_page_26_Picture_13.jpeg)

![](_page_26_Picture_15.jpeg)

# 2 / APARTMENT BUILDINGS

## 1. Current Situation

![](_page_27_Figure_2.jpeg)

#### 2. Add Front doors

![](_page_27_Figure_5.jpeg)

![](_page_27_Picture_7.jpeg)

# 3 / PUBLIC GREENERY

#### 1. Current Situation

![](_page_28_Figure_2.jpeg)

![](_page_28_Figure_3.jpeg)

UNSAFETY

#### 2. Adding a function to the public space

- adding an entrance to the

![](_page_28_Picture_9.jpeg)

# 4 / LONG BUILDING

#### 1. Current Situation

![](_page_29_Figure_3.jpeg)

![](_page_29_Figure_5.jpeg)

![](_page_29_Figure_6.jpeg)

![](_page_29_Picture_8.jpeg)

## 5 / PUBLIC SQUARE

#### 1. Current Situation

![](_page_30_Picture_3.jpeg)

UNSAFETY

#### 2. Improve public square

![](_page_30_Picture_7.jpeg)

# SELECTED DESIGN PRINCIPLES

- Adding front gardens 1.
- 2. Increase continuity of building blocks
- 3. Adding front doors
- 4. Splitting long building blocks
- 5. Adding a path to an empty public space
- 6. Creating physical borders between territories
- 7. Adding building floors

![](_page_31_Picture_9.jpeg)

![](_page_31_Picture_10.jpeg)

![](_page_31_Picture_11.jpeg)

![](_page_31_Picture_16.jpeg)

## STATED CHOICE EXPERIMENT

The stated choice methodology assumes that when people have choice between two alternatives, they will choose the option that yields them the highest level op happiness.

(Louviere et al., 2000; Hensher et al., 2005)

![](_page_32_Picture_5.jpeg)

![](_page_32_Picture_6.jpeg)

![](_page_32_Picture_11.jpeg)

## STATED CHOICE EXPERIMENT

#### AIM

Validate selected design priniples that improve the perceived safety.

#### LAYOUT

#### Present a relatable narrative to the participants

"You have an appointment with someone at a location you have never been to. You have just got off the bus and walk into the neighborhood, but you are lost. The two streets shown below are the options you have to get to your destination, which option would you choose to arrive at the appointment while feeling safe?"

#### 7 choice tasks

- Adding front gardens
- 2. Increase continuity of building blocks
- 3. Adding front doors
- 4. Splitting long building blocks
- 5. Adding a path to an empty public space
- 6. Creating physical borders between territories
- 7. Adding building floors

#### SAMPLE

344 participants who are not residents of the neighborhood (to avoid familiarity with the environment)

![](_page_33_Picture_19.jpeg)

## Q1 / Adding front gardens

#### Hypothesis:

The participants prefer the situation in which the front gardens have been added.

#### Theory:

Front gardens make a street more attractive, lively, and softens the transition between public and private.

![](_page_34_Picture_5.jpeg)

#### Current situation

![](_page_34_Picture_7.jpeg)

![](_page_34_Picture_9.jpeg)

UNSAFETY

## Added front gardens

#### Preference results added front gardens

![](_page_34_Figure_13.jpeg)

## Q2 / Increase continuity of building blocks

#### Hypothesis:

The participants prefer the situation in which the building blocks are rotated.

#### Theory:

By rotating the building blocks there are more front doors on the street and there is a higher intervisibility between the front doors, which increases the social control.

![](_page_35_Picture_5.jpeg)

![](_page_35_Picture_7.jpeg)

![](_page_35_Picture_9.jpeg)

#### Current situation

# Preference results increase continuity of building blocks

![](_page_35_Figure_13.jpeg)

#### Increased continuity

64%

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#### Q3 / Adding front doors

#### Hypothesis:

The participants prefer the situation with the added front doors.

#### Theory:

By adding front doors the to buildings the street becomes more lively and there are more direct physical connections between the dwelling and the street, which increases the social control.

![](_page_36_Picture_5.jpeg)

#### Current situation

![](_page_36_Picture_7.jpeg)

![](_page_36_Picture_9.jpeg)

## Adding front doors

#### Preference results added front doors

![](_page_36_Figure_13.jpeg)

## Q4 / Split long building

#### Hypothesis:

The participants prefer the situation where the building is split in two shorter buildings

#### Theory:

Splitting the building creates an alternative route, which gives the observer the opportunity to avoid unwanted situations ahead. The alternative route is well lit, which reduces the chance of unwanted behavior.

![](_page_37_Picture_5.jpeg)

![](_page_37_Picture_7.jpeg)

![](_page_37_Picture_9.jpeg)

## Current situation

## Splitting long building

#### Preference results splitting long building

![](_page_37_Figure_14.jpeg)

![](_page_37_Picture_16.jpeg)

#### Q5 / Adding a path to an empty public space

#### Hypothesis:

The participants prefer to continue walking on the sidewalk

#### Theory:

The path that runs through the park is less well lit than the sidewalk. People can not see what is happening in the park, the reduces the perceived safety. In addition, surrounding residents also can not see what is happening in the park, as a results the social control is low

![](_page_38_Picture_5.jpeg)

#### Continue walking on the sidewalk

![](_page_38_Picture_7.jpeg)

![](_page_38_Picture_9.jpeg)

UNSAFETY

# Preference results from adding a path to an empty public space

![](_page_38_Figure_12.jpeg)

## Turn right on the park path

![](_page_38_Picture_16.jpeg)

## Q6 / Creating physical borders

#### Hypothesis:

The participant prefer the situation in which the hedge (a physical border) is added.

#### Theory:

By adding a physical border between territories the area becomes more legible and because the border is a hedge it also adds to the attractiveness of the street. Furthermore, an open field of grass can feel unsafe in the dark

![](_page_39_Picture_5.jpeg)

![](_page_39_Picture_7.jpeg)

![](_page_39_Picture_9.jpeg)

#### Current situation

#### Adding physical borders

# Preference results from adding physical borders

![](_page_39_Picture_14.jpeg)

## Q7 / Adding building floors

#### Hypothesis:

The participant prefer the situation where floors are added to the current buildings.

#### Theory:

By adding floors to the existing buildings there are more windows, and therefore eyes, directed to the public space. Eyes on the public space increases the social control.

![](_page_40_Picture_5.jpeg)

![](_page_40_Picture_7.jpeg)

![](_page_40_Picture_9.jpeg)

#### Current situation

## Adding building floors

#### Preference results from adding building floors

![](_page_40_Figure_14.jpeg)

![](_page_40_Picture_17.jpeg)

## EXPERIMENT RESULTS

#### Reject the null-hypothesis

 $H_0$ : There is no significant difference between the distributions.

 $H_1$ : There is a significant difference between the distributions.

#### **Binomial Test**

- Indicates whether or not there is a significant difference in the distribution of observations.
- Assumses a 50/50 distribution (in table Test. Prop.)
- Significant when p-value < 0.05 (in table Exact Sig. (2-tailed))

#### Conclusion

There is a difference in perceived safety between the two situations.

Binomial Test						
				Observed		Exact Sig. (2-
		Category	N	Prop.	Test Prop.	tailed)
Current situation or added frontgardens	Group 1	Adding Frontgardens	297	,86	,50	,00
	Group 2	Current	47	,14		
	Total		344	1,00		
Current situation or	Group 1	Continuity	123	,36	,50	,00
increase continuity	Group 2	Current	221	,64		
	Total		344	1,00		
Current situation or	Group 1	Frontdoors	273	,79	,50	.00
added front doors	Group 2	Current	71	,21		
	Total		344	1,00		
Current situation or	Group 1	Split	262	,76	,50	,00
splitting long building into	Group 2	Current	82	,24		
1440	Total		344	1,00		
Follow path straight ahead or enter park path	Group 1	Straight ahead	293	,85	,50	,00
	Group 2	Right to park path	51	,15		
	Total		344	1,00		
Current situation or added phsyical borders	Group 1	Current	118	,34	,50	.00
	Group 2	Adding physical border	226	,66		
	Total		344	1,00		
Current situation or	Group 1	Adding floors	295	,86	,50	.00
added building floors	Group 2	Current	49	,14		
	Total		344	1,00		

![](_page_41_Picture_14.jpeg)

## NEIGHBORHOOD TRANSFORMATION DESIGN

HOW CAN PERCEIVED SAFETY BE IMPROVED THROUGH NEIGHBORHOOD TRANSFORMATION IN PENDRECHT?

![](_page_42_Figure_4.jpeg)

![](_page_42_Figure_5.jpeg)

![](_page_42_Picture_9.jpeg)

![](_page_43_Picture_0.jpeg)

![](_page_43_Picture_3.jpeg)

![](_page_44_Picture_0.jpeg)

source: Google Maps

![](_page_44_Picture_3.jpeg)

source: Google Maps

![](_page_44_Picture_5.jpeg)

source: Google Maps

![](_page_44_Picture_8.jpeg)

![](_page_45_Picture_0.jpeg)

source. Google Maps

![](_page_45_Picture_3.jpeg)

![](_page_45_Picture_4.jpeg)

source. Google Maps

![](_page_45_Picture_7.jpeg)

![](_page_46_Picture_0.jpeg)

source. Google Maps

![](_page_46_Picture_3.jpeg)

![](_page_46_Picture_4.jpeg)

source: Author

![](_page_46_Picture_7.jpeg)

## VISION

![](_page_47_Picture_1.jpeg)

## MAIN DESIGN PRINCIPLES

1 / Optimize front door intervisibility

![](_page_47_Picture_6.jpeg)

![](_page_47_Picture_7.jpeg)

3 / Add front gardens where possible

![](_page_47_Picture_9.jpeg)

4 / Diversify the architecture and dwelling types

![](_page_47_Figure_11.jpeg)

6 / Maintain public green/blue structure

![](_page_47_Picture_13.jpeg)

![](_page_47_Picture_14.jpeg)

Legend

![](_page_47_Picture_15.jpeg)

5 / Physical borders between territories

![](_page_47_Picture_17.jpeg)

7 / Increase the sense of community

![](_page_47_Picture_19.jpeg)

![](_page_47_Picture_22.jpeg)

![](_page_48_Figure_0.jpeg)

# metro station

#### urban living

Number of dwellings: 730 Density: 138 dwellings per hectare

#### collective living

Number of dwellings: 440 Density: 109 dwellings per hectare

#### family living

Number of dwellings: 186 Density: 77,5 dwellings per hectare

#### Total number of dwellings included in masterplan: **1.356 dwellings**

LEGEND

![](_page_48_Figure_11.jpeg)

![](_page_48_Picture_13.jpeg)

# METRO STATION SQUARE

![](_page_49_Picture_1.jpeg)

![](_page_49_Picture_2.jpeg)

![](_page_49_Picture_5.jpeg)

![](_page_49_Picture_6.jpeg)

## URBAN BOULEVARD

![](_page_50_Picture_1.jpeg)

![](_page_50_Picture_2.jpeg)

![](_page_50_Picture_5.jpeg)

## **RESIDENTIAL STREET**

![](_page_51_Picture_1.jpeg)

![](_page_51_Picture_2.jpeg)

![](_page_51_Picture_4.jpeg)

![](_page_51_Picture_6.jpeg)

# COLLECTIVE GARDEN

![](_page_52_Picture_1.jpeg)

![](_page_52_Picture_2.jpeg)

![](_page_52_Picture_5.jpeg)

## URBAN LIVING

![](_page_53_Picture_1.jpeg)

![](_page_53_Picture_2.jpeg)

![](_page_54_Figure_0.jpeg)

![](_page_54_Picture_4.jpeg)

# LOCAL PARK

![](_page_55_Picture_1.jpeg)

![](_page_55_Picture_2.jpeg)

![](_page_55_Picture_5.jpeg)

# **RESIDENTIAL STREET**

![](_page_56_Picture_1.jpeg)

![](_page_56_Picture_2.jpeg)

![](_page_56_Picture_4.jpeg)

![](_page_56_Picture_6.jpeg)

# COLLECTIVE SPACE

![](_page_57_Picture_1.jpeg)

![](_page_57_Picture_3.jpeg)

![](_page_57_Picture_5.jpeg)

![](_page_58_Figure_0.jpeg)

![](_page_58_Picture_1.jpeg)

![](_page_59_Figure_0.jpeg)

Backyards which function as transition zones between private and collective sapce

pedestrian paths

![](_page_59_Figure_3.jpeg)

![](_page_59_Figure_4.jpeg)

![](_page_59_Picture_5.jpeg)

# RESIDENTIAL SQUARE

![](_page_60_Picture_1.jpeg)

![](_page_60_Picture_2.jpeg)

![](_page_60_Picture_5.jpeg)

# **RESIDENTIAL STREET**

![](_page_61_Picture_1.jpeg)

![](_page_61_Picture_2.jpeg)

![](_page_61_Picture_5.jpeg)

# COLLECTIVE GARDEN

![](_page_62_Picture_1.jpeg)

![](_page_62_Picture_2.jpeg)

![](_page_62_Picture_5.jpeg)

## FAMILY LIVING

![](_page_63_Picture_2.jpeg)

![](_page_64_Figure_0.jpeg)

garden

![](_page_64_Picture_7.jpeg)

## CONCLUSION

## HOW CAN PERCEIVED SAFETY BE IMPROVED THROUGH NEIGHBORHOOD TRANSFORMATION IN PENDRECHT?

- Analyze the physical environment and spatial elements that have a negative effect on the perceived safety
- Develop design priniples that aim to improve the perceived safety
- Validate the design principles through an experience based experiment
- Use the design principles as guidelines for the neighborhood transformation design
- And integrate the design principles in the neighborhood transformation design

![](_page_65_Figure_14.jpeg)

![](_page_65_Figure_15.jpeg)

a	

![](_page_65_Picture_19.jpeg)

![](_page_66_Picture_0.jpeg)