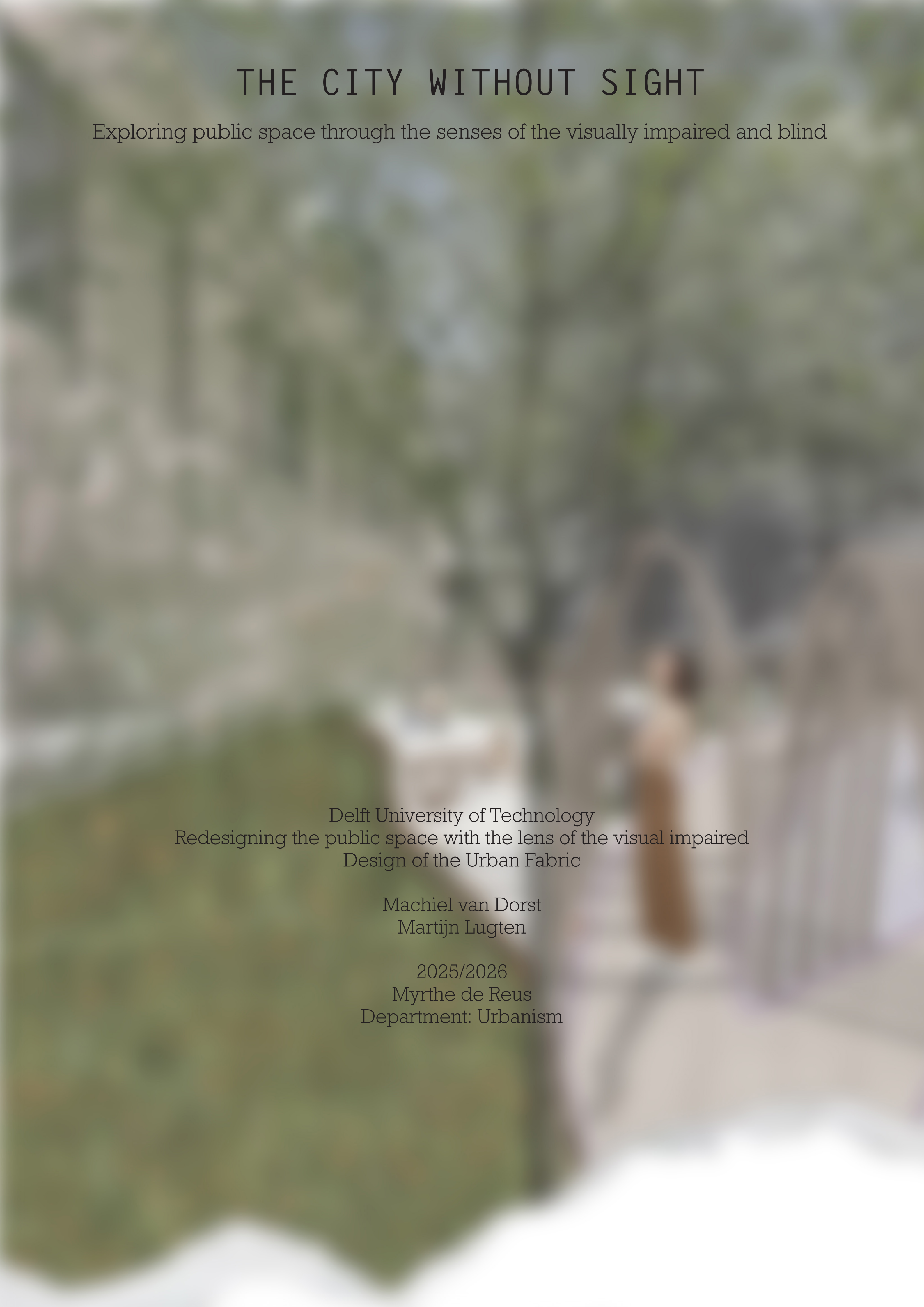

THE CITY WITHOUT SIGHT

Exploring public space through the senses of the visually impaired and blind

Delft University of Technology
Redesigning the public space with the lens of the visual impaired
Design of the Urban Fabric

Machiel van Dorst
Martijn Lugten

2025/2026
Myrthe de Reus
Department: Urbanism

Master Thesis – Final P5 Report
MSc Architecture, Urbanism and Building Sciences
Track Urbanism

Faculty of Architecture and the Built Environment
Delft University of Technology

Graduation Studio
Urban Fabrics

Project Team
Myrthe de Reus, author
Machiel van Dorst , first supervisor
Martijn van Lugten, second supervisor

This project was made possible with the support of the Oogvereniging and the contributions of interview participants and those involved in the pattern evaluation.

Delft, The Netherlands
09 January 2026

TU Delft
BK Bouwkunde

All figures, visuals and photographs are the author's own work, unless stated otherwise.

"It is not about pity, it is about quality design" - Gelly Sehat

ACKNOWLEDGMENT

During this graduation year, there are a few people whom I would like to thank.

First of all, I would like to thank my mentors, Machiel van Dorst and Martijn Lugten, who spent many hours reviewing my texts, guiding me through this subject, and sharing their insights on deteriorating sight as well as their own experiences.

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A special thanks goes to Estelle for lending me her laptop charger when mine mysteriously disappeared, and to Charlotte for lending me her iPad to create last-minute drawings before every deadline.

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Before concluding, I want to thank my parents for providing food and endless cups of tea whenever I studied at their house. I would also like to thank Bram for taking on the role of personal cheerleader and handling my mood swings like a pro. I know this could not have been easy, although it could have been worse as well ;). Thank you all.

Finally, I would like to thank my ON1 teacher, who kindly advised me to reconsider my study choice after the first design course of the bachelor. This thesis is for you as well.

ABSTRACT

Contemporary public spaces continue to be predominantly designed through a visual paradigm, resulting in environments that offer limited support for people who navigate the city primarily through non-visual means. Although accessibility has gained prominence as a design objective, this recognition has not translated into a substantive shift away from visually dominant design practices, resulting in limited and fragmented multisensory cues for wayfinding and perceptual comfort for visually impaired and blind individuals. This becomes particularly problematic in high-density urban contexts, where intensified sensory input increases cognitive demand and undermines non-visual legibility.

This research investigates how multisensory spatial design variables can support non-visual wayfinding and perceptual comfort in public space, and how these variables can be systematically translated into design strategies for plazas, parks and urban routes. The study employs qualitative walk-along interviews with visually impaired and blind participants conducted in The Hague, Rotterdam and Amsterdam, complemented by evaluations of spatial design principles with ten other visually impaired and blind participants.

The findings demonstrate that consistent auditory, tactile and material cues significantly enhance spatial legibility, reduce cognitive load and contribute to a more comfortable and predictable urban experience beyond vision alone. These insights are structured through a pattern-based framework that mediates between research and design, while a complementary maximization method is employed as an ordering and communicative tool within three spatial design proposals. By bridging experiential research and design practice, this study contributes to the development of more legible and coherent urban environments that acknowledge perception as fundamentally multisensory.

MOTIVATION

Going outside, looking at nature, reading maps to find the way and running around without worry because I could see what happened in front of me, these things were always so normal and natural to me as a kid. I remember seeing an episode of Sex and the City, as is shown in Figure 1, where one of the characters looks at a man with a cane and says, "Imagine being blind and not being able to see a beautiful day like today". However, I wondered if that was true. Even if he couldn't see his surroundings, he could hear the leaves crunching under his feet and smell the fresh-cut grass around him. It made me wonder: does being blind mean you can't enjoy the urban environment? Now that I am (a little bit) older, I still wondered the same thing, because even though we design for sight by default, so much of city life actually happens through sound, touch, scent and atmosphere, things we rarely design for intentionally. Over the years that question faded into the background, because you focus on your life and your responsibilities, as far as you can have them in your twenties of course. But when we started the graduation year and were asked what we wanted to work on, one thing was clear to me: I wanted to design something that would genuinely improve someone's daily life. I talked about it with our "godfather", as he called himself, and he started naming certain groups who could be in line with my idea. The second topic he said was "blind" and I just knew, that was it. I can't really explain it, it was just a feeling.
Maybe that feeling was already there because visually impaired and blind people are more noticeable in public space than, for example, people with autism or deafness. So perhaps the topic had already been simmering somewhere in my mind. And meanwhile, we're always talking about making inclusive cities, the 15-minute city, the inclusive city and this word inclusive started to annoy me a little. I kept wondering: is "inclusive" feasible and if not, should we still call something inclusive? That's what pushed me further towards this group as they are proof that concepts or designs that are labelled inclusive, aren't at all, at least not to them.
The last few years, I got intrigued by the idea of designing with senses rather than relying on vision alone, and I wanted to explore what that could mean in practice. It's funny to think that since I started this project, I've noticed more visually impaired and blind people than ever before, not because there are suddenly more, of course, but because once you start paying attention, you realise how many people with a visual impairment are around you.
My goal was never to design a city "for the blind", but to understand how public space can support people who navigate the world differently, without turning accessibility into an aesthetic afterthought. I wanted to explore how multisensory design could enrich public space for visually impaired and blind people, while at the same time making cities more legible and comfortable for everyone.

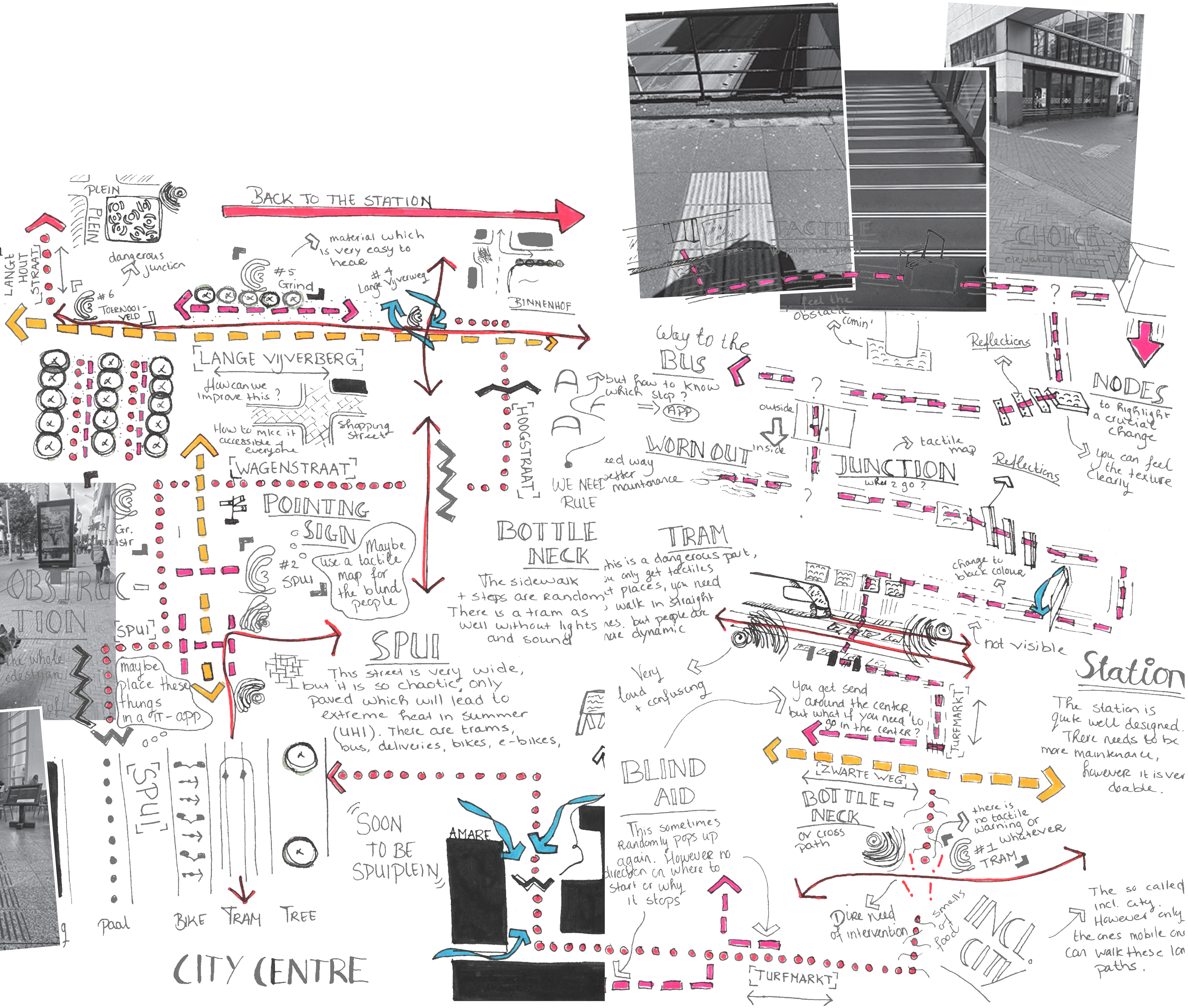
Figure 1

Note. Scene from *Sex and the City* (Season 6, Episode 13), created by Darren Star, HBO, 2004.

PROBLEM STATEMENT

CHAOS IN THE PUBLIC ENVIRONMENT

Visual perception is the dominant sense to experience the public space for most people. However, when this perception does not work accurately, different obstacles and challenges appear in the public space. Without sight, our familiar environment becomes unfamiliar, disorientated and unsafe. This page from my notebook presents a first walk through the centre of The Hague with its first challenges. How can we design a safe, comfortable and navigable environment for the visually impaired and blind.



LOCATION

DEN HAGUE - SOUTH HOLLAND

Figure 2
Abstracted National Scale Diagram of the Netherlands

Note. Adapted from GIS data and redrawn by the author.

To choose the right location to design for blind people, it must be easily accessible. The location should have interesting activities to attract people to come to this (un)familiar environment

central location

The city center of this location should be vibrant to make people want to go to this location. A mix of cyclists, pedestrians and motor-vehicles, especially if they share the same space, create a challenge for visually impaired and blind people to feel safe.

vibrant city center

One of the important aspects when looking into a location to design for visually impaired and blind people, is to choose a location with a rich built environment, parks and pleasant environments. Interesting landmarks, with many activities in the centre as well.

context

Every user uses his or her senses to understand their surroundings. Someone with visual impairment or blindness does this more intentionally. The other senses are more sensitive and developed. A city with a highly activated sensescape, creates a lot of information that has to be processed through the senses. The challenge becomes bigger. A location with different activated sensescapes is interesting to see how these can be adjusted to the wishes and needs of visually impaired and blind people.

activated sensescape

This location should be highly accessible by public transport, for visually impaired and blind people to be able to come to this place independently.

accessible by PT

DICTIONARY

accessibility

(n.) the ability to enter a public space and or building

average person

(n.) A person with good sight

blind

(n.) a person with 0% sight

built environment

(n.) A person with 0% sight

contrast

(n.) materials / colours next to each other stand out because of their difference

dwelling

(n.) refers to the act or state of lingering. physically, mentally, or sensorially, allowing one's attention or presence to settle in a place.

Inclusive

(n.) a person with 0% sight

inclusive design

(n.) A design that includes everyone according to the designer.

legibility

(n.) meaning of the clarity of the nature of a place through recognizable environmental cues

low-vision

(n.) A person with a decline in vision, but has the ability to differentiate light / contrast / shapes

night blindness

(v.) Difficulty to see at night because of the detoriation of rods

sensescape

(n.) A landscape that uses a particular sense to create direction and recognition

shared space

(n.) a design concept where the space has no differentiation between foot-, car- and bikepath.

sightless

(n.) visually impaired and blind people

spectrum

(n.) the wide range of a topic

tactile

(n.) Something with relief or nodes that can be felt through touch

ticker

(n.) the sound that a lamppost at a crossroad makes to determine safety

vi/b

(n.) an abbreviaton for visually impaired and blind

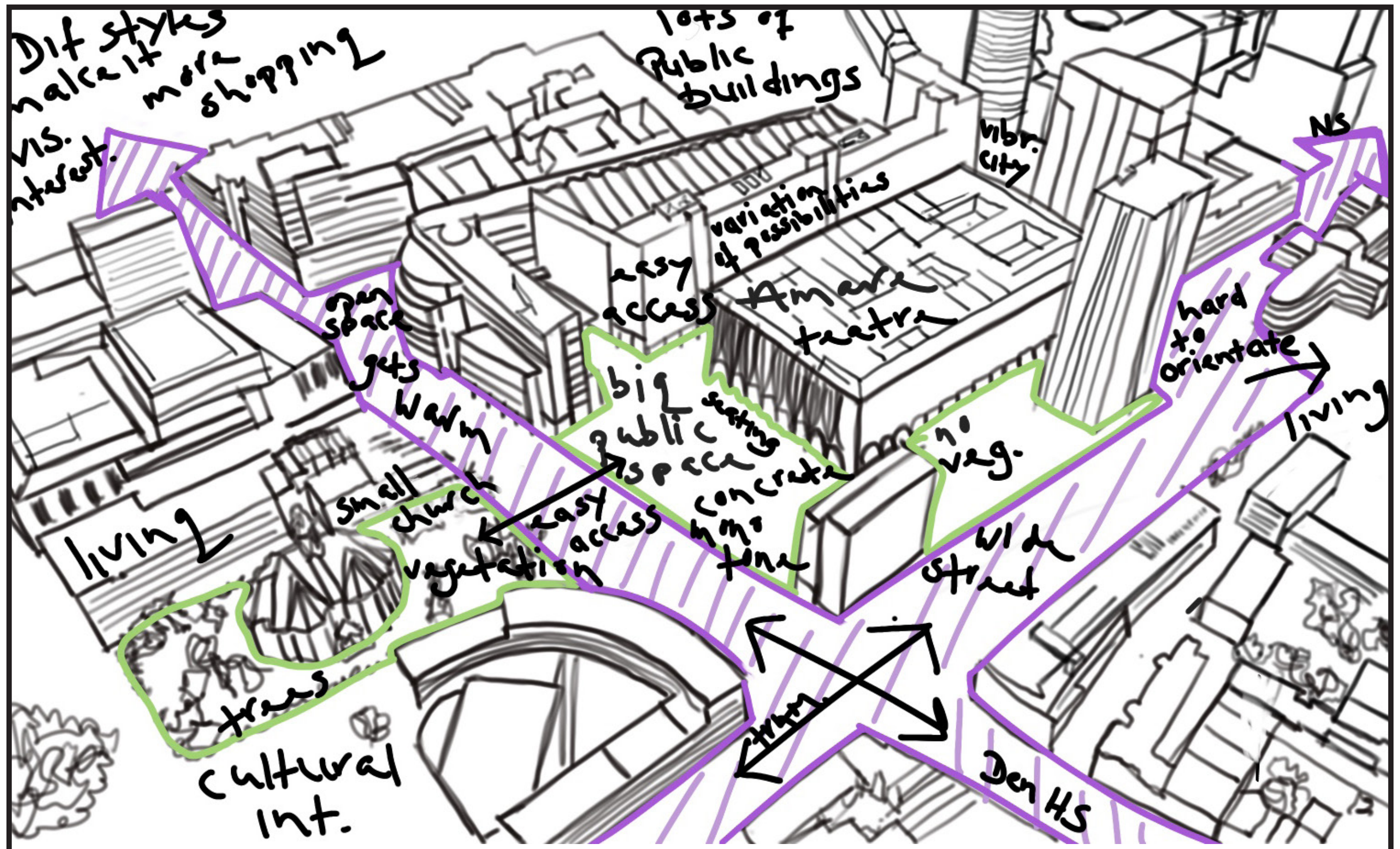
visually impared

(n.) Someone with low vision even after multiple operations.

wayfinding

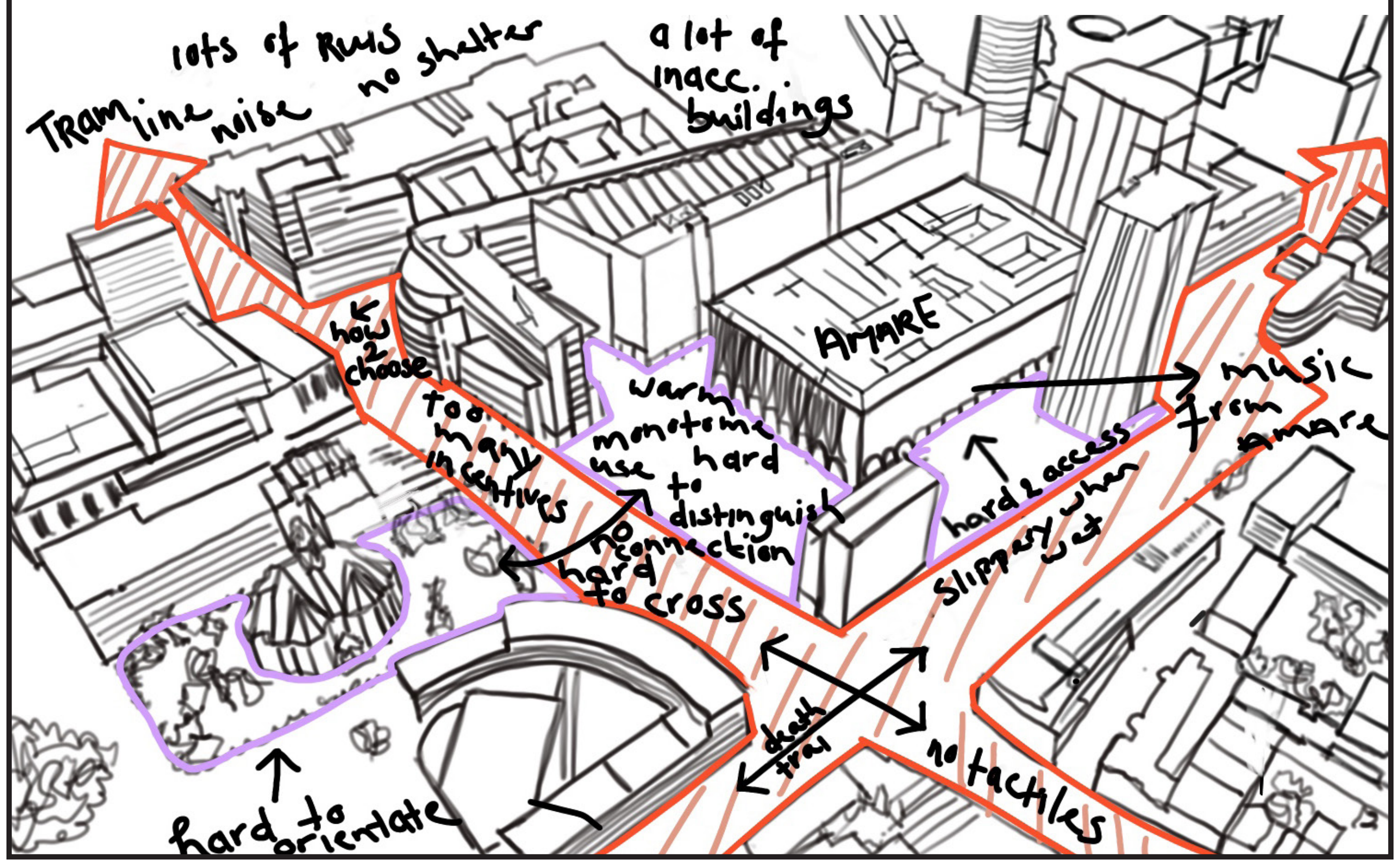
(n.) The process by which people orient themselves and navigate through space using environmental cues.

CONTENT



The lens of the "average man"

The lens of the visually impaired and blind



1.1.1 The first problems

According to a report from the World Health Organization (WHO) in 2003, the amount of blind people worldwide was approximately 45 million and 135 million people have been diagnosed with visual impairment. Although exact numbers for earlier centuries are scarce and often unreliable, more recent data suggest a dramatic increase: in 2019, the WHO estimated that at least 2.2 billion people globally have been diagnosed with blindness or visual impairment. This growth is driven by population ageing, increasing chronic diseases and improved detection and reporting of eye conditions (WHO, 2019). In 2008 in the Netherlands, 311,000 people were diagnosed with visual impairment, which has risen to 367,000 by 2020, reflecting similar demographic trends.

The growing prevalence of this diagnosis makes it essential for designers to examine how public spaces are experienced by this group, as current urban environments do not always meet the accessibility needs or requirements of visually impaired and blind people. This initiates the relevance of exploring multisensory design strategies that can make urban spaces more accessible and navigable for all users.

According to Carr (1992) "A public space can be defined as an open, publicly accessible places where people go for group or individual activities". Public space is an umbrella concept for various places in the city as playgrounds, malls, plazas, parks and streets. These places, by definition, should be accessible and legible to a wide variety of users (Carr, 1992). Legibility means that users can orient themselves and understand the nature of a place through recognizable environmental cues. Public space has developed through the centuries, starting in the Middle Ages, organically, without plan. The Renaissance times started planning and designing their squares and boulevards. In modern times, public spaces are evolving to accommodate heavy traffic, multifunctional use, safety and a diverse population. Carr (1992) argues that this evolution shows how design principles, user roles and the meaning of space are constantly shifting, making it essential to understand public space as something dynamic, shaped by time and context.

Contemporary urban design paradigms, such as the inclusive city, the 15-minute city and shared spaces claim to serve all users. On first glance, this might be true, however solely when you experience a public space as the "average man", someone who can rely on all their senses. As a result, these models provide streets, plazas and public spaces optimized for interaction, mobility and activities, but they frequently neglect the needs of people who do not fit this norm, like visually impaired and blind people.

A breakthrough for this group has been made by the implementation of tactile paving. Lu et al. (2008) define tactile paving as a system of textured ground surface indicators to assist visually impaired and blind persons to distinguish directions and identify potential hazards. It is widely implemented in many cities, there is criticism of its undesirable design by the visually impaired and blind users as well as other people. There is a lack of standard for tactile paving (Lu et al., 2008). Moreover, this tactile paving is often barricaded by tree roots, poles or advertisement as is shown in the picture, making a visually impaired or blind person feel trapped (Norgate, 2012).

This is a result due the lack or unawareness of how urban environments are designed, through a visual-centric lens, claiming to be inclusive, however limiting accessibility for those who navigate the world differently (Malekafzali, 2018). More of these "inclusive" factors can be taken under a loop when the city is viewed through the lens of a visually impaired or blind. Public spaces suddenly become less coherent and clear when experiencing the city through a different perspective. According to Chidiac et al. (2024) the built environment is primarily designed for sighted individuals, which leaves those with visual impairments struggling to gather the necessary sensory information to orient themselves. This makes the environment dangerous and can complicate the daily activities of this group. This would mean, the issue is not the loss of sight, but the inability of public space to provide alternative means of spatial understanding.

As Parkin & Smithies (2012) argue, not all users can perceive or respond to danger in the same way. They state that absence of supportive sensory infrastructure results in unsafe environments. However, if all the tactile paving routes were kept clear, would that be enough?

1.2.1 Problematisation
Low vision is defined as reduced visual acuity even when the individual is using the best possible optical correction; it is most often a consequence of untreatable ocular disease (Hernandez & Dickinsin, 2012). Visually impaired and blind people experience a lot of participation restriction. This refers to an individuals' perception of the barriers experienced in their life because of their impairment. This creates a complex interaction between their health condition, individual capacity and environmental structure (Stucki et al., 2002). This is a global experience for people with visual impairment and blindness. It has an impact on their daily system e.g. mobility, exchange of information, education, social relationships, work, leisure and their community life (Hernandez & Dickinsin, 2012). Part of this is due to negative reactions to their loss of vision like anger and denial, however it is also to be reflected in the quality of their life for physical, social and the wellbeing factors of an individual. This is evident in the reflection of visually impaired and blind people regarding the spatial form and material character of contemporary public spaces, often prioritizing visual legibility over multisensory accessibility (Parkin & Smithies, 2012).

According to Parkin and Smithies (2012), an urban area has two main functions; space to move and space to interact. Urban design policies often seek to balance high traffic efficiency with safety control, creating conflicting demands in public space, reducing predictability and safety for users (Hamilton-Baillie, 2008). Public spaces often fail to convey essential spatial information to visually impaired and blind people, due to their design from an ocular vision. As a result, orientation becomes difficult, and the overall layout of the urban environment is hard to understand. Highlighting the issue of public space and its lack of legibility, problems arise when visually oriented design solutions are assumed to be universally understandable but, in reality, remain inaccessible to VI/B people. This often happens at the expense of non-visual cues. Cities are designed mainly for people who rely on sight, leaving less room for other senses to understand the environment. (Heylighen & Herssens, 2014). Contemporary urban design (e.g. 15-minute city, inclusive city) also reflects a form of visual dominance: spaces are produced through sight but rarely tested through other senses.

Besides the physical layout of urban space, sensory overstimulation is a common experience that can turn everyday activities into an overwhelming experience. Overstimulation is a complex, full-body phenomenon that affects everyone to varying degrees, it is not merely sensitivity to loud sounds but a physiological response to an excess of sensory input (Overstimulation, n.d.). The brains of visually impaired and blind individuals, especially those who lost sight at an early age, often rewire itself to strengthen other senses such as hearing, touch and scent (National Eye Institute, 2017). However, this heightened sensitivity can also make them more vulnerable to sensory overload.

According to Zhang et al. (2022), visually impaired individuals frequently report feeling anxious, uncomfortable or unsafe in high-traffic areas. Bus stops, hospitals and markets, where complex and loud soundscapes, such as horns, construction noise and traffic, interfere with spatial orientation and navigation. In contrast, more quiet and organized environments, such as parks, residential streets and shopping areas, are perceived as safer and more comfortable (Zhang et al., 2022). These findings demonstrate that overstimulation does not arise merely from the presence of stimuli, but from the absence of deliberate sensory design, highlighting the need to move beyond visually dominant paradigms and consciously structure environments that consider all senses. The study by van der Ham et al. (2020) further emphasizes how sensory overstimulation can impair one's ability to interpret their surroundings and increase anxiety or disorientation, revealing the fragile balance between sensory activation and sensory overwhelm.

Besides the overstimulation, the clutter on top of urban spaces is often experienced as chaotic and dangerous by visually impaired and blind people. According to the study Mapping the Importance of Specific Physical Elements in Urban Space for Blind and Visually Impaired People (Kirtland et al., 2021), inconsistent physical elements such as obstacles, irregular pavement, misplaced furniture or unclear boundaries increase the difficulty of navigation and elevate the risk of accidents. The absence of a continuous tactile or auditory logic leads to what can be perceived as "spatial confusion" where environmental information becomes fragmented and unpredictable. These inconsistencies not only challenge orientation but can also evoke feelings of stress, insecurity and dependency, especially in high-density urban settings.

1.2.2 Framing the three problems
Across these layers, from illegibility to overstimulation and spatial confusion, it becomes evident that the problems faced by visually impaired and blind people in the city are not incidental, but systemic. They reflect the dominance of visual design paradigms and a lack of multisensory spatial coherence.
The recurring problems found across literature often refer to similar underlying barriers, though described through different vocabularies, legibility, sensory overload, disorientation etc. To bring coherence to these insights. This thesis identifies three central dimensions that illustrate how urban environments can disorient or pose risks to non-visual users: design blindness (the legibility and spatial layout of the urban environment), environmental overstimulation (the excessive activation of senses), and spatial chaos (the organisation of signs, street furniture, and other physical elements). These categories offer a framework for analysing the sensory and spatial challenges of the city and for reimagining urban design in ways that are friendly for visually impaired and blind people. Initiating a shift towards a more multisensory form of design.

1.2.3 Proposition
While many urban projects and policies are labelled as "inclusive," the term itself deserves closer inspection. True inclusivity is complex and often unattainable in absolute terms. A design that works well for one group may unintentionally exclude another. This calls for greater precision and awareness when labelling the concept: it is not a fixed goal, but a continuous process of recognizing and addressing exclusion where it occurs.

1.1 Initial Analysis

1.2 Theoretical Insights

↓

CONCLUSION

Public spaces in high-density cities are predominantly designed from a visual perspective, often resulting in environments that are confusing, exclusionary, or unsafe for blind and visually impaired individuals.

↓

PROBLEMSTATEMENT

Contemporary urban environments are still designed through a visual-centric lens, offering inconsistent and insufficient non-visual cues for navigation. As a result, visual impaired and blind people encounter spatial illegibility, sensory overload and environmental chaos that restrict independence and wellbeing. These challenges stem not from vision loss itself but from the inability of public spaces to provide alternative sensory pathways.

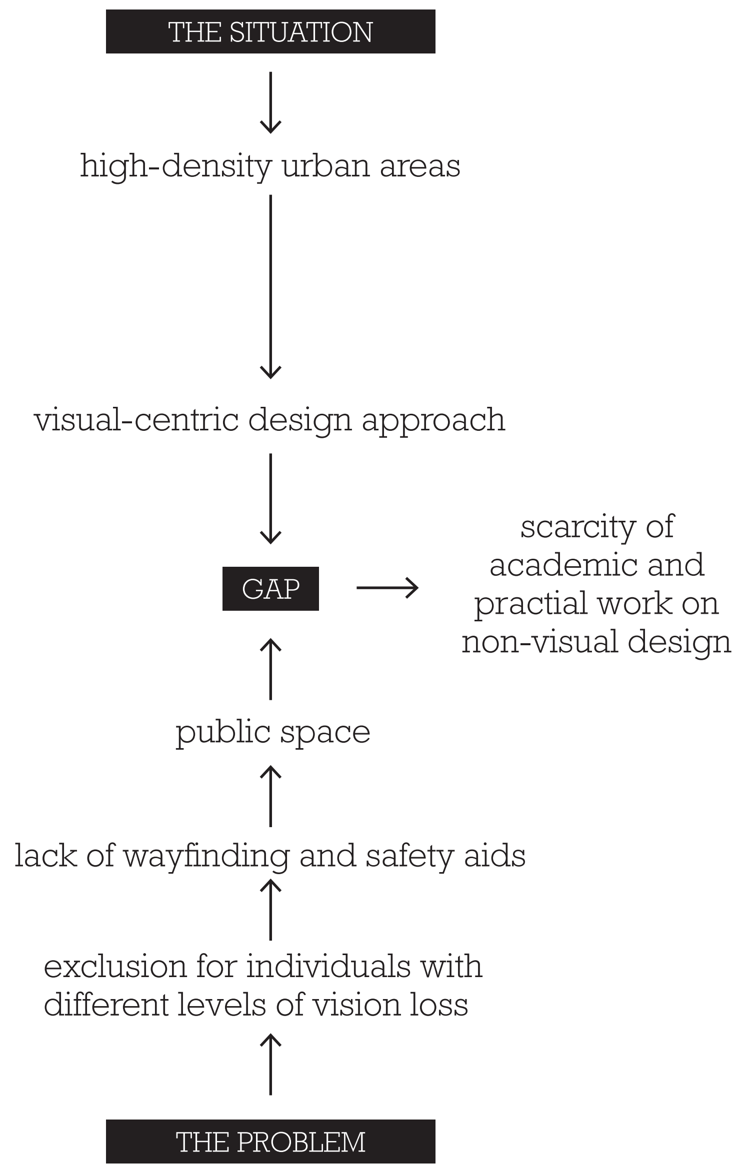
↓

HYPOTHESIS

Designing public spaces through a multi-sensory lens instead of just the visual one will lead to a more legible, safer and comfortable environment for visually impaired and blind people.

02 METHODOLOGY

Explaining the methodology of the thesis



2.1.1 knowledge gap

Existing literature acknowledges both the dominance of visual design and the need for justice-oriented urban frameworks (Marcuse, 2009), yet few studies fully integrate the lived sensory experience of blind individuals into spatial design methods. This research gap underpins the central aim of this study, how to implement sensory design in public spaces for visually impaired and blind people.

Contemporary urban public spaces are predominantly designed through a visual-centric paradigm that prioritizes clarity, aesthetics and navigation based on sight. This emphasis on vision implicitly marginalizes individuals who rely on non-visual modalities to perceive and navigate space, particularly visually impaired and blind people.

While existing literature addresses aspects of visual accessibility and touches upon multisensory approaches (e.g., Pallasmaa, 1996; Bakir et al., 2022), few design frameworks fully center the lived sensory experience of these individuals. Moreover, theoretical models such as communicative planning or the spatial justice theory (Marcuse, 2009) often acknowledge inequality, but rarely offer spatial tools or methods that respond to the embodied, sensorial challenges faced by non-visual users in urban environments.

Although inclusion is frequently invoked as a guiding principle in planning discourse, its practical application is often vague or superficial. This research takes a critical stance on the assumption that inclusion can be universally achieved, and instead explores how public spaces might become more responsive by activating a broader range of sensory cues, focusing on high-density contexts, where overstimulation and disorientation pose specific challenges to those with vision impairments.

In addition, a disconnect remains between objective sensory data collection and the spatial design process. While tools such as the Kestrel 5400 and Norsonic 140 are capable of measuring environmental variables like temperature, wind, humidity and sound, such data are rarely integrated into urban design strategies or tested through embodied fieldwork. Based on these observed gaps in both professional practice and academic literature, this research explores how a sensory-driven urban design approach, grounded in environment–behaviour theory and phenomenological inquiry, might inform more legible, comfortable, and safe public spaces for blind individuals. The investigation combines qualitative methods (interviews, soundwalks, tactile mapping), quantitative techniques (environmental monitoring) and research through design using different strategies, to assess how sensory conditions shape spatial awareness and orientation.

This research investigates to what extent the current design practices support or inhibit sensory accessibility. Despite the fact that urban experiences are the result of our interpretations and senses, research on multisensory dimensions in urban studies is still scarce (Quercia et al., 2015). By repositioning sensescapes as a critical design lens, this thesis aims to contribute to a broader understanding of how urban environments can engage different levels of vision, which could lead to enriching spatial quality for the wider public.

This research critically addresses the insufficient translation of non-visual sensory needs into spatial design strategies for high-density urban environments.

variables: auditory, odour, tactile and visual

spectrum of visual impairment

Which multisensory spatial design variables support wayfinding and perceptual comfort for people with different degrees of visual impairment, and how can these variables be translated into design strategies for high-density urban environments?

case study: The Hague

.2 RESEARCH QUESTION

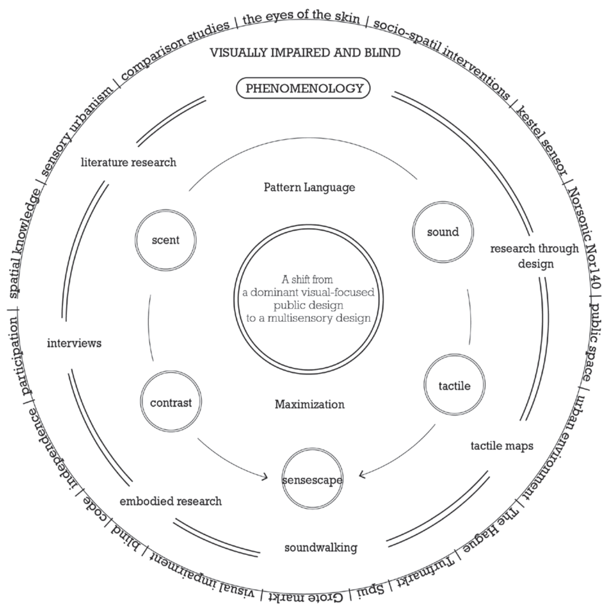
The Hague

Contemporary urban environments remain predominantly visually oriented, offering limited support for non-visual navigation. Existing measures such as tactile paving are applied inconsistently and are insufficient on their own, resulting in spatial illegibility, sensory overload and reduced safety for visually impaired and blind users, particularly in high-density contexts. Rather than stemming from visual impairment itself, these challenges reflect a systemic bias in urban design, which this research addresses by exploring multisensory design principles to improve legibility, orientation and everyday comfort.

Which multisensory spatial design variables support wayfinding and perceptual comfort for people with different degrees of visual impairment, and how can these variables be translated into design strategies for high-density urban environments?

analyse	user
expose	sensory
propose	site
execute	activation

literature review
walk along interview
tactile map
environmental monitoring
site analysis and mapping
research by design



2.3.1 Methodology

This chapter outlines the methodological approach used to investigate how multisensory urban design can improve spatial experience, autonomy and orientation for visually impaired and blind individuals in a high-density urban environment such as The Hague. While the project centres on the needs of non-visual users, it also examines how sensory strategies, sound, scent, touch and contrast, can enhance the overall clarity and experiential quality of public space for a wider public.

The methodology will be applied to a dense, vibrant, yet spatially fragmented environment, often characterised by three recurring problems identified in the problem analysis, design blindness, environmental overstimulation and spatial chaos. These systemic issues, in combination with the first literature reviews shapes the formulation of the central research question and its four sub-questions.

To address these questions, the methodology adopts an iterative structure inspired by Peter Marcuse's Critical Planning framework (2009), translated into four interrelated lenses: User, Sensory, Site and Activate. Each lens represents a different scale of inquiry where each phase informs the next through continuous reflection and design iteration. The approach and questions are directly linked through a mixed-method matrix that combines different methods to answer the question, which are explained in detail later in this chapter.

The chapter concludes with the conceptual framework, which synthesises the conceptual foundations guiding the research, and shows how these concepts collectively inform the three final outcomes of the thesis:

a set of multisensory design guidelines,
a redesigned public space
a city-scale wayfinding framework for visually impaired and blind people.

Together, these elements will create a renewed understanding and reimagining of sensory and spatial conditions of public environments.

design outcome #1
A set of implementable design guidelines
A clear list of practical principles for sensory-inclusive public space design, ready to be applied by urban designers and municipalities in any city.

design outcome #2
A redesigned public space with sensory features
An existing urban space adapted with sensory elements such as textured surfaces, ambient sounds, and spatial rhythm.

design outcome #3
A wayfinding route through The Hague
A clearly mapped walking route designed for blind and visually impaired users, using tactile paving, sound markers, and consistent spatial logic to enhance independent navigation.

outcomes

2.4.1 Research Aim

Figure 3 shows the aim of this research.
Currently the design strategies that are used in the urban environment only aid a part of the visually impaired people and the big part of the sighted user. The aim is to move this line on the x-as to involve more people in the urban environment. To achieve this, this research investigates how multisensory urban design can enhance spatial legibility, comfort and autonomy for visually impaired and blind individuals in high-density public environments.

Through integrating theoretical insights, empirical observation and research-through-design methods, the study explores how non-visual sensory cues can contribute to spatial understanding and orientation. This thesis will bridge the gap between knowledge on sensory perception and its spatial translation within urban design practice, moving beyond visual-centric approaches toward multisensory frameworks that support the broader range of users.

2.4.2 Research Objectives

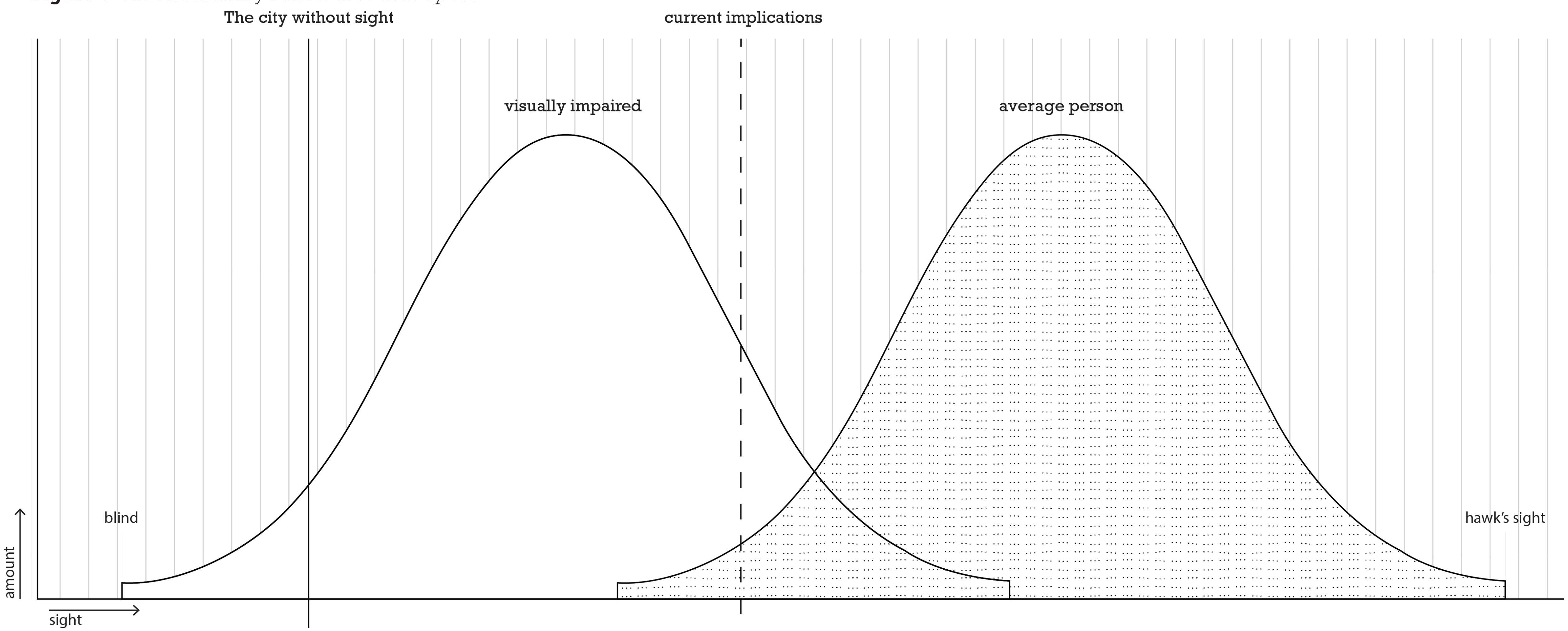
To achieve this aim, the study pursues the following objectives:

Understand user experience.
Investigate how visually impaired and blind individuals perceive, interpret, and navigate high-density public space, focusing on orientation, safety, stress, and comfort.
Identify sensory conditions.
Examine which non-visual sensory modalities (sound, touch, scent, contrast) support legibility and well-being, and how environmental factors influence their effectiveness.
Translate findings into design strategies.
Derive applicable principles from empirical insights to inform sensory-oriented design decisions in urban public space.
Develop and test design methods.
Use pattern language and maximization as complementary methods to generate and evaluate site-specific interventions that enhance sensory coherence and legibility.
Synthesize at the urban scale.
Combine local interventions into a coherent sensory framework for wayfinding and dwelling in The Hague's city centre, demonstrating how sensory logic can be scaled to the level of the city.

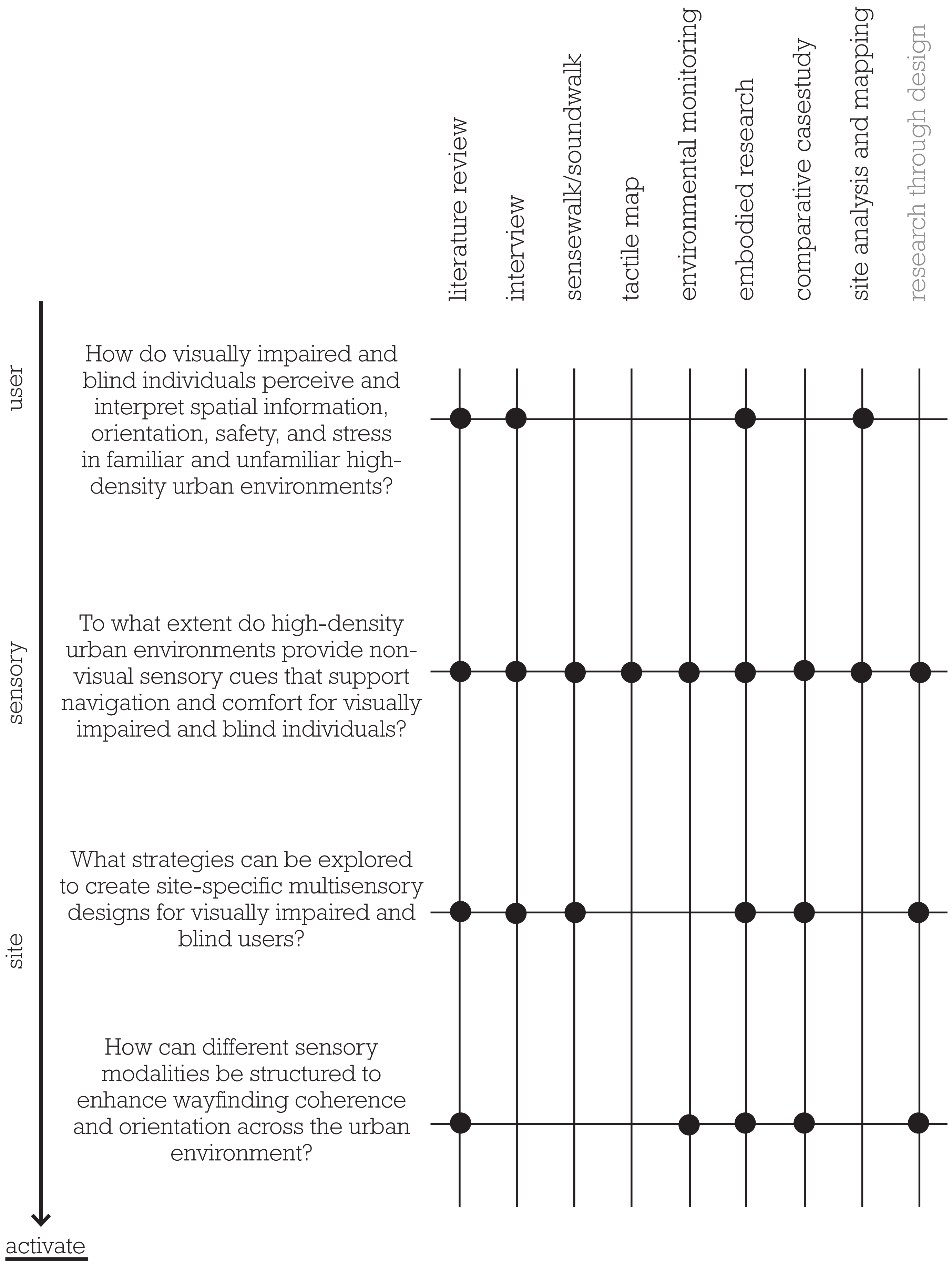
2.4.3 Structure of This Chapter

The following sections of this chapter detail the methodological implementation of this framework. Starting with a matrix that links each sub-question to the corresponding methods. Followed by a description of each method's process, and data output. Finally, this chapter concludes with an explanation of how the different insights are integrated through an iterative research-by-design process, ending with the conceptual framework and reading manual.

Figure 3. *The Accessibility Belt for the Public Space*



Note. Conceptually derived from discussions with Guus Jannsen, Municipality of The Hague, 2025.



Which multisensory spatial design variables support wayfinding and perceptual comfort for people with different degrees of visual impairment, and how can these variables be translated into design strategies for high-density urban environments?

2.5.1 Research framework and methods

To answer the research questions in this thesis, a mixed-methods approach was adopted, combining qualitative, quantitative, design-based and sensory-ethnographic techniques. Some methods were chosen at the beginning of the study based on approaches commonly used in related academic research, while others emerged during the course of the research to better fit the evolving insights. Together, these methods shape both the theoretical and experimental foundations of a sensory-oriented public-space design.

Each method is positioned within one of four interrelated lenses, User, Sensory, Site and Activate, that structure the research-through-design framework. As is mentioned, this structure is adapted by Marcuse's Critical Planning approach (2009). This approach analyses practice within current urban societies by researching the potential, and exposing the problems. At the same time, it informs future possibilities. To adapt it more to this thesis, the fases are renamed to the visually impaired and blind topic. These lenses are iterative and interdependent: findings from one phase inform the next, creating a continuous exchange between analysis, design exploration and reflection.

This section describes each subquestion with its purpose, methods and output. Each question starts with a groundwork that is established through multiple extensive literature reviews to define key concepts such as sensescapes, spatial justice and embodied navigation.

Literature reviews were conducted to establish the theoretical and conceptual foundation of the research. The review focused on three core themes: sensory experience in public space, wayfinding and navigation for visually impaired and blind people and urban accessibility.

Sources were retrieved from academic databases including ScienceDirect, Semantic Scholar, and Google Scholar. The search period ranged from February 10th to Novembre 15th 2025. Selection criteria included: relevance to non-visual spatial interaction, user experience of the blind and visual impaired, and cognitive mapping in (un)familiar environments. Initial screening was based on titles and abstracts, followed by full-text analysis and thematic clustering. Preference was given to peer-reviewed publications from the last ten years.

The literature review served a dual function. First, it provided a baseline for defining key concepts such as sensescapes, spatial justice and embodied navigation. Second, it helped to identify knowledge gaps that were addressed through empirical methods, including interviews, sensewalks and case study analysis. It also informed the design of research instruments, such as interview guides and the case selection framework. Furthermore, it shaped the theoretical positioning of the project, as described in the following subchapters.

User | Analyze (SQ1)

Sub-question
How do visually impaired and blind individuals perceive and interpret spatial information, orientation, safety, and stress in familiar and unfamiliar high-density urban environments?

Purpose
This first phase investigates the lived, first-person experience of navigating urban space without full reliance on vision. It explores how blind and partially sighted individuals develop spatial understanding through other senses, and how they emotionally and cognitively respond to disorientation, sensory overload, and insecurity.

Methods

Semi-structured walk-along interviews
Conducted with blind and partially sighted individuals, accessibility professionals, and sensory-design experts. The walk-along format enabled participants to describe sensory conditions in situ, combining guided reflection with spontaneous observations (Jackson, 1988).

Embodied research (blindfolded walkthroughs and observations)
Student peers performed walkthroughs under simulated low-vision conditions (blindfolds or tunnel-vision goggles) to examine disorientation and bodily orientation. Observations focused on movement, hesitation, and environmental feedback (Pallasmaa, 1996). Field observations during visits complemented these simulations.

Site analysis and mapping
Spatial features such as path hierarchy, material transitions, and obstacles were annotated on base maps to cross-reference experiential data with physical conditions.

Output
These methods revealed how orientation and awareness emerge from complex embodied interactions, exposing recurring challenges and intuitive strategies. The results form the qualitative foundation for defining design criteria in subsequent phases.

Sensory | Expose (SQ2)

Sub-question
To what extent do (inter)national high-density urban environments provide non-visual sensory cues that support navigation and comfort for visually impaired and blind individuals?

Purpose
This phase examines the presence, quality, and effectiveness of sensory cues, sound, scent, touch, and contrast, in contemporary urban public spaces.

The research incorporates comparative case studies from Barcelona and Tokyo, two contexts with contrasting yet complementary approaches to sensory accessibility.
Barcelona was selected for its accessibility initiatives and public spaces designed with tactile and auditory cues. Tokyo, by contrast, represents a society where tactile guidelines and social awareness are deeply embedded.

To address this question, the research applies both objective environmental monitoring and subjective experiential methods, enabling comparison between measurable environmental conditions and lived sensory perception.

Methods
Tactile Mapping
Tactile maps were designed and used as a tool to study spatial cognition and navigational logic. These maps incorporated elements such as raised patterns, Braille labeling, clear landmark positioning, and scaled proportionality. The format was inspired by work such as Petrovic (2025) and Davidson (2023), who emphasize the role of touch in spatial memory. Visually impaired and blind people can use this map to explore the theme sound in The Hague to determine their route, either avoiding or seeking out the sound of a city.

Environmental Monitoring (Kestrel 5400 & Norsonic Nor140)
These devices were selected for their ability to capture microclimatic and auditory variables relevant to sensory navigation, factors often overlooked in conventional spatial analysis. Quantitative data was collected on temperature, humidity, wind speed, radiant heat, and sound levels (Hz and dB), during both sensewalks and short fixed-point recordings across The Hague. This method provides an empirical foundation to evaluate how sensory environments fluctuate within dense urban settings. The Kestrel device has been linked with the KestrelLink app which monitored the found data. Moreover with the use of the MyTracks app, it is possible to place the data on the exact location.

Soundwalks and Sensory Mapping
Following the method of R. Murray Schafer and further developed in soundscape research (Adams et al., 2008), soundwalks allow for an embodied assessment of how public space is perceived acoustically. These were combined with spatial annotations on tactile cues, surface materials, and thermal zones, generating interpretive maps that represent the sensory legibility of space from a non-visual perspective.

Comparative Analysis of Objective and Subjective Data
The juxtaposition of sensor data and embodied impressions helps reveal mismatches between how a space measures and how it is experienced. This comparative approach is essential in phenomenological research, where quantitative metrics alone cannot capture affective or cognitive responses to space.

Site analysis and mapping
Environmental monitoring results were visualized through spatial mapping. Each measurement point was layered over base maps of The Hague to identify patterns in sensory comfort, noise distribution, thermal variation, and tactile features. These maps helped reveal sensory gaps and informed further site-specific interpretation.

comparative case study
To broaden the contextual understanding of sensory accessibility, the research includes a comparative reflection on Barcelona and Tokyo as reference cases. Both were examined through field observation, photographic documentation, providing insight into how different cultural and spatial contexts integrate sensory design principles. Barcelona served as a reference for urban accessibility that balances functionality with spatial quality. Tokyo, by contrast, illustrates how multisensory navigation cues, such as tactile paths, auditory signals, and material contrasts, are seamlessly embedded in daily urban life.

Output
Together, these methods generated a layered understanding of sensory comfort and environmental coherence. The findings exposed spatial blind spots in current design logic and established a baseline for developing more sensorially legible environments.

Site | Propose (SQ3)

Sub-question
How can empirical findings on sensory navigation and perception be translated into site-specific design interventions that enhance spatial legibility and dwelling?

Purpose
This phase marks a shift from analysis to design synthesis, translating insights from the first two phases into spatial tools and frameworks that enhance navigation and dwelling for visually impaired and blind individuals.

Methods
Site visits and field observation
Where possible, direct site visits were conducted to observe and map how sensory features are applied and experienced in practice. This included photographing elements, annotating material transitions, and recording ambient sound and environmental stimuli.

Output
The resulting design principles address both sensory and spatial needs, forming the foundation for site-specific interventions that reinforce legibility, safety, and emotional connection within dense urban environments.

Activate | Integrate (SQ4)

Sub-question
How do variations and patterns of sensory cues influence the coherence of wayfinding and orientation across the urban environment, and what principles can guide their integration at the city scale?

Purpose
This final phase investigates how site-based interventions can be woven into a coherent sensory framework for The Hague's city centre, enhancing continuity and recognisability across routes.
It links the Expose phase (uncovering gaps) with the Propose phase (developing strategies), distilling key design logics for future multisensory planning.

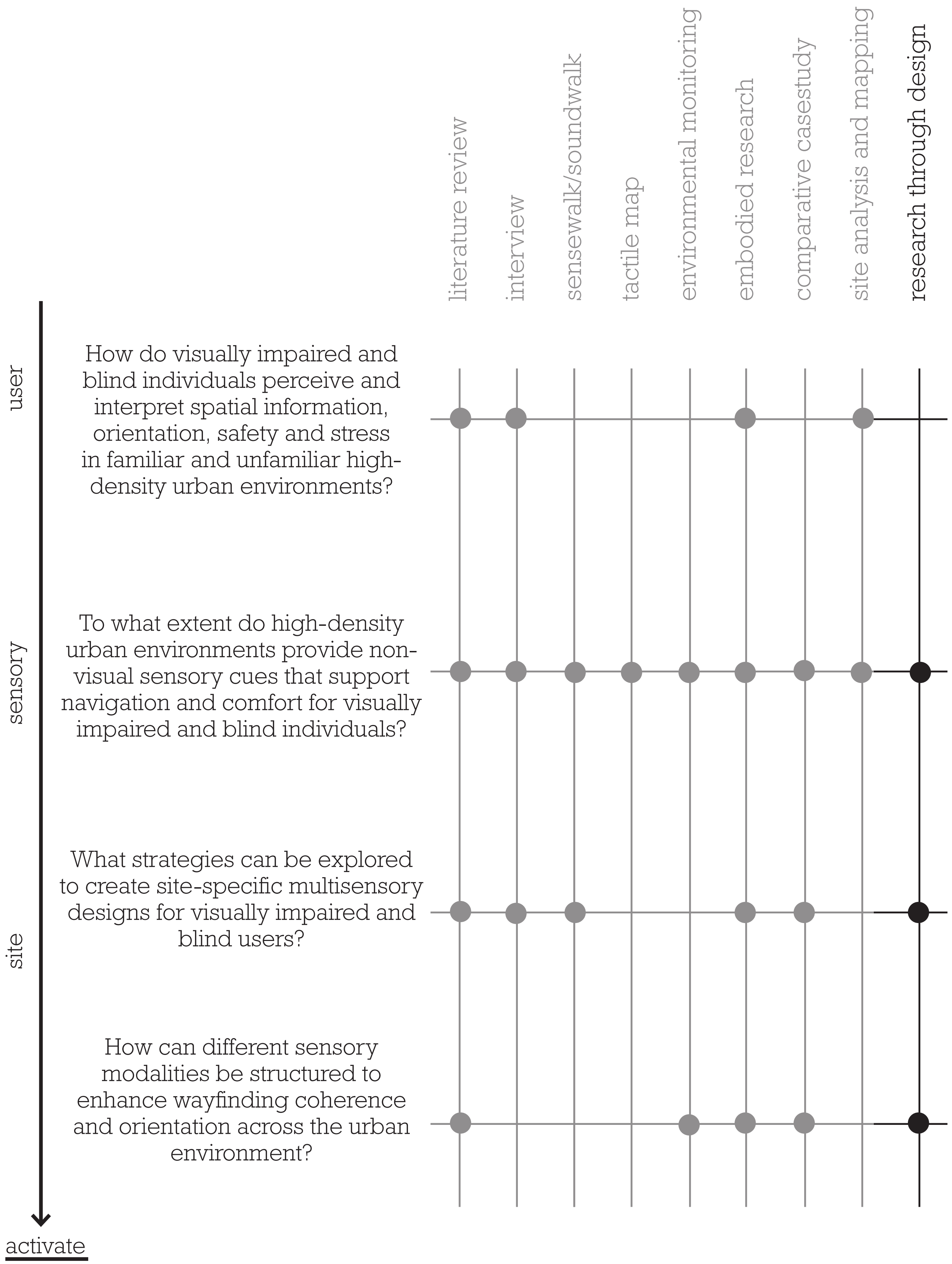
Methods
Embodied Research and Environmental Monitoring
Building on earlier fieldwork, embodied exploration was used to assess how sensory cues, such as tactile paving continuity, auditory signals, surface transitions, and spatial acoustics, can be experienced as a sequence rather than as isolated moments. These embodied routes were complemented with environmental monitoring data gathered through the Kestrel and Norsonic devices, revealing how sound, and wind interact with urban form along key mobility corridors in The Hague. This allowed for the identification of sensory thresholds and "breaks" in perceptual continuity, which are critical to designing legible wayfinding routes.

Spatial Mapping and Scenario Modelling
A spatial framework was developed for the city centre of The Hague in which each sensory modality, sound, touch, scent and contrast, was assigned to a thematic line. These sensory lines intersect and overlap throughout the urban fabric, creating a recognizable structure that supports orientation and wayfinding for both blind and visually impaired individuals. By introducing consistency and rhythm in sensory cues, the framework enhances familiarity and spatial memory across multiple routes.

Output
A city-scale sensory framework that demonstrates how multisensory cues can create coherent, legible, and inclusive wayfinding systems, enriching both functional navigation and experiential quality.

2.5.2 Method matrix
These different methods explain how each subquestion will be answered, using each input for the next phase to create a coherent and understandable story. All these interviews, observations, strategies and products will be able to answer the research question:

How can multisensory design strategies be developed, and to what extent can they address the spatial and perceptual needs of visually impaired and blind individuals in high-density urban environments?



Which multisensory spatial design variables support wayfinding and perceptual comfort for people with different degrees of visual impairment, and how can these variables be translated into design strategies for high-density urban environments?

2.6.1 The integration of research through design

The diverse methods applied in this research, from literature reviews, interviews, embodied observations to environmental measurements, sensory mapping, and comparative case studies, were not conducted in isolation, but were interwoven through an iterative research-by-design process. This integration enabled a continuous feedback loop between theory, lived experience, and spatial design.

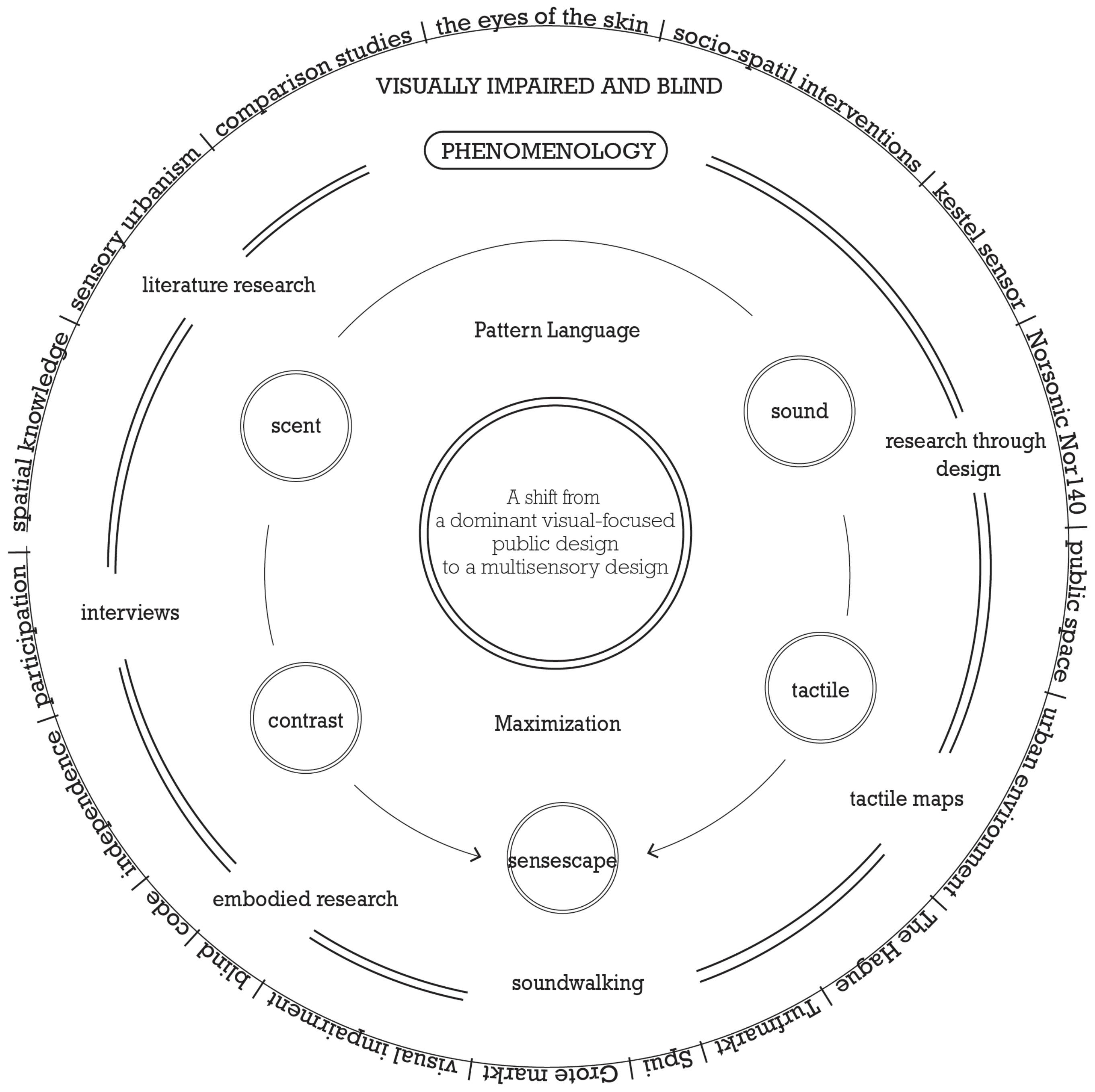
Rather than following a linear trajectory, the process evolved cyclically through the phases of User, Sensory, Site and Activate, where insights were repeatedly tested and translated into spatial form. Each stage informed the next: subjective experiences and qualitative findings were cross-referenced with objective environmental data, and both were synthesized through mapping, design testing, and pattern development.

Design was therefore not the endpoint of the research, but a tool, a way to critically examine existing spatial conditions, explore sensory alternatives, and visualize new possibilities. The iterative design process enabled the transformation of empirical insights into spatial propositions, using methods such as the Pattern language and Maximization framework to articulate and test how sensory principles could enhance legibility and comfort in public space.

The final design synthesis, represented through scenario modelling and sensory networks in The Hague's city centre, builds upon this foundation. These outcomes act as speculative yet evidence-based propositions that demonstrate how multisensory strategies can be embedded in the broader urban fabric, strengthening orientation, safety, and sensory richness for individuals with different levels of vision.

By embedding empirical findings and theoretical perspectives directly within the design process, this research translates sensory understanding into tangible urban strategies that challenge vision-dominant paradigms and advocate for a more experiential, human-centred city.

CONCEPTUAL FRAMEWORK



2. 7.1 The conceptual and problem framework

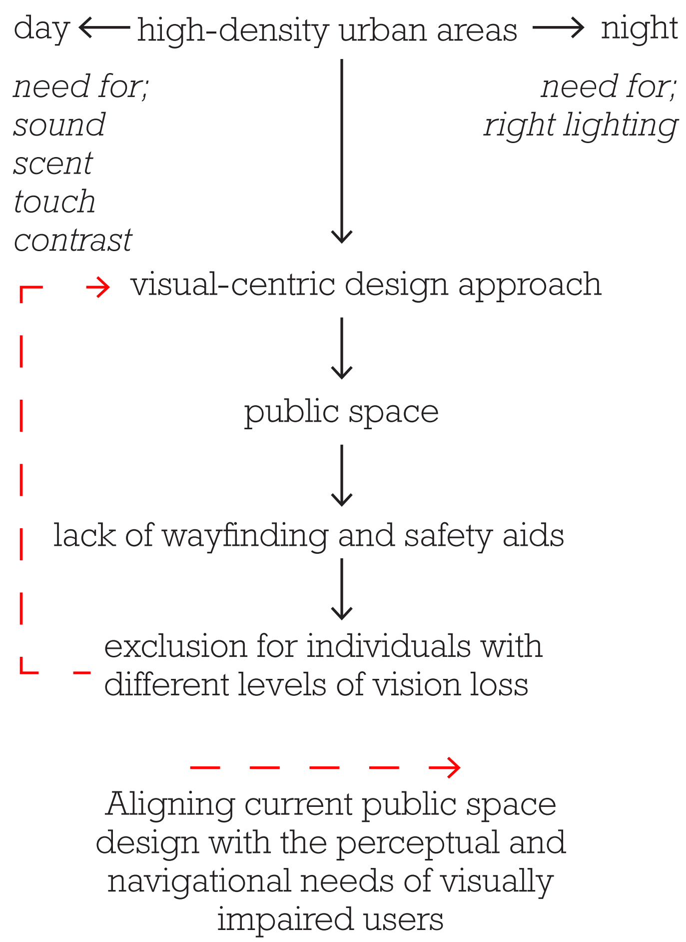
The conceptual framework outlines the logical and theoretical orientation that shapes the structure and direction of this research (Kivunja, 2018). At its core, the thesis centers on visually impaired and blind people and the role that senses can play in navigating and dwelling in public space. The central challenge is to reimagine urban environments in which the visually impaired and blind person becomes the starting point, not the afterthought. This involves crafting spaces that guide movement and perception through sensory cues like sound, scent, touch and contrast, rather than through visual hierarchy alone. The ultimate goal is to design urban environments that are clear, comfortable, and engaging for all, using the "eyes of the skin" (Pallasmaa, 1996) as a guiding metaphor.

The problem framework visualizes how a set of interconnected challenges, visual dominance in design, unawareness of designers and the gap on how to design with senses, shape the foundation of this study. These conditions are particularly pronounced in high-density urban areas, where many spaces are still designed by visual logic and aesthetic norms. In such environments, individuals with different levels of vision loss are not intentionally excluded, but often marginalized due to a lack of sensory variety and design awareness. The misapplication of the term "inclusive" further obscures the complexity of this issue. True inclusion is never absolute; instead, this research advocates for the sensorial enrichment of space, rather than attempting to design for everyone in the same way.

The conceptual framework diagram explains how this research is structured around the central concept of phenomenology, the first-person, lived experience of space. Surrounding this are the sensory modalities of sound, tactile interaction, and spatial sequencing, which together form what is referred to as the sensescape of urban space. These are informed by literature, interviews, environmental analysis, and embodied methods. This input will create the symbiosis between the pattern language x maximisation strategy to find a different approach for public space design, creating a shift from a dominant visual-focused public design to a multisensory design.

Each ring or methodological layer builds on the previous, starting from the theoretical framework to interviews to soundwalks to tactile prototyping, representing a cumulative process of inquiry and design. In this way, the conceptual framework integrates the core challenge (visual bias), the theoretical lens (phenomenology), and the methodological response (research-by-design).

The outcomes of this research are directly shaped by the lived experiences of blind individuals, as well as subjective and objective data collected through various methods. This progression, from conceptual analysis to empirical engagement, leads toward spatial interventions that stimulate legibility and enrich urban experience for people with different sensory realities.



PROBLEM FRAMEWORK

2.8.1 Reading guide

The first chapter 00 is the preface of this thesis. It gives a quick overview about the subjects of this report.

Chapter 1 and 2 are the problematization and the methodology where the methods and methodology are stated. Furthermore, in the methodology is the explanation on how this thesis will be illustrated and how the questions will be answered to conclude the research question. Moving on to the conceptual framework and the problem framework as well. This chapter will end with the planning of this graduation year.

Chapter 3 explains the theoretical framework. The problematization states the three folded problems in the current public design. The theoretical framework summaries the existing literature at this moment. This will be the groundwork of this thesis.

Chapter 4 is the case study: The Hague. Different analysis will be shown here and an explanation on how The Hague centrum looks like will be analyzed.

Chapter 5 starts with the run up to the research question, researching the user; visually impaired and blind person. It starts with the method interviews. How they were conducted and how they are coded. Then highlighting the most interesting aspects that came out of the interviews. This chapter will end with an answer to subquestion

Chapter 6 will use this input to investigate the sensory part, using the devices to collect data about the environment of the case study. It will then continue to subquestion 2. Both objective and subjective data will be compared to each other.

Chapter 7 and 8 will go into the possible design strategies that can be used to fill the knowledge gap answering the remaining subquestions.

Chapter 9 and 10 will answer the research question and reflect on this year.

Chapter 11 will entail the used literature alphabetically, closing this thesis with the appendix.

03 LITERATURE

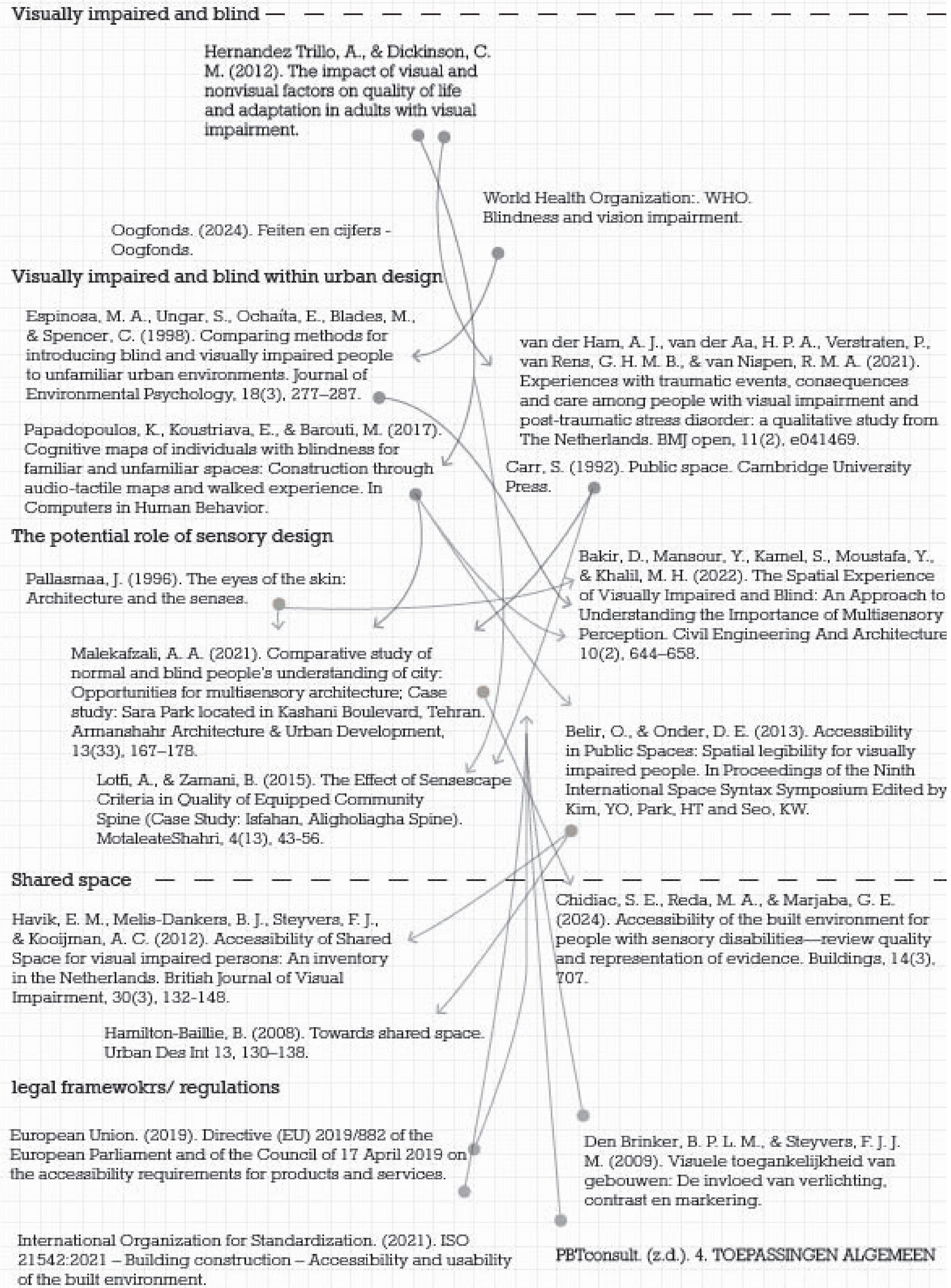
Laying down the groundwork, derived from literature, for the subjects of this thesis

This theoretical framework highlights the different themes and the key-literature for each segment. Some literature are intercorrelated with each other while other literature widens over some subjects that are mentioned in other literature.

Literature that dives more into topic

literature that is intercorrelated with each other

Figure 4. *The Connections within the theoretical background*



3.1.1 Theoretical Framework

This chapter establishes the theoretical foundation of the thesis. It brings key literature together that clarifies what visual impairment and blindness entail, how urban design theory and practice address this condition, how multisensory design principles can contribute to a more perceptible public environment and how urban concepts like *shared space* are complicated for VI/B people. Rather than presenting empirical findings, this chapter reviews and connects existing knowledge to position the research within the public space. It concludes by outlining relevant accessibility frameworks, such as the ISO and NEN standards, that translate theoretical principles into regulatory guidance. Together, these perspectives form the theoretical groundwork on which the subsequent methodological and analytical chapters build.

Literature Selection and Review Process

To construct this framework, a structured literature search was conducted to identify the most relevant academic and professional sources on visual impairment, sensory perception, and urban design. Searches were performed in Google Scholar, complemented by manual cross-referencing of citations (snowball method). The keywords used included: "visually impaired," "blind," "public (shared) space," "sensescape," "wayfinding," "urban accessibility," and "multisensory design."

The initial search results were screened by title and abstract to assess relevance and credibility. Peer-reviewed journal articles, conference papers, and authoritative books published between 1995 and 2025 were prioritized. The most influential and frequently cited publications were uploaded into Atlas.ai, a literature-analysis platform used to cluster and visualize relationships between key concepts and authors. This allowed the identification of common themes, theoretical overlaps, and contradictions within the body of literature. Each selected source was then read in full and annotated, with summaries and thematic connections documented in the theoretical Figure 4.

This process ensured that the framework is grounded in both classic theoretical works (e.g., Pallasmaa, Alexander) and recent empirical research on sensory accessibility. In doing so, it combines a systematic search strategy with an interpretative approach, ensuring both breadth and depth in the understanding of multisensory design theory.
This chapter is guided by the hypothesis that public space can become more secure, legible and emotionally engaging through multisensory design strategies. By combining theoretical, empirical, and regulatory insights, this framework provides a foundation for rethinking how urban environments can be designed and experienced beyond vision alone.

Figure 5. *Grade of Impairment*

Grade of Impairment	Snellen's visual acuity	Performance	Average visual field radius
0	Better than 20/70	Mild or no visual impairment	60° 50° 40°
1	20/70 to better than 20/200	Moderate visual impairment	30° 20°
2	20/200 to better than 20/400	Severe visual impairment (difficulty reading even with aids)	10° 8°
3	20/400 to better than 20/1200	Blindness	6° 4°
4	20/1200 to light perception	Blindness	2°
5	No light perception	Blindness	0°

Note. Adopted from WHO, 2015

Figure 6. *Examples of the Spectrum*

Note. Adapted from Perkins School for the Blind, z.d.

3.1.2 Visually impaired and blind (VI/B)

To understand the aim of this project, it is essential to clarify what visual impairment entails. Visual impairment refers to a spectrum ranging from low vision or partial sight to complete blindness, even after corrective measures that should improve one's eyesight (WHO, 2011). Each country applies different criteria to define visual impairment and blindness; for this thesis, the World Health Organization (WHO, n.d.), as is shown in Figure 5, definition is used as an international standard.

In the Netherlands, a person is considered socially blind (maatschappelijk blind) when their visual acuity is below 5% (Trillo & Dickinson, 2012; WHO, 2025). Although there is no precise figure for the total number of visually impaired or blind individuals in the Netherlands, more than 300,000 people are estimated to have some form of visual impairment (Oogfonds, 2024). Research by Rosenberg and Sperazza (2008) shows that the prevalence of eye diseases increases significantly with age, particularly among individuals over 40 years old. People with visual impairments are also more likely to experience social isolation, depression, and a higher risk of falls (Rosenberg & Sperazza, 2008).
The spectrum of visual impairment encompasses a wide range of experiences and degrees of sight loss, as illustrated in Figure 6. Only a small percentage of people are completely blind.

3.1.3 Visually impaired and blind within urban design

According to Carr (1992), public spaces are designed to serve human needs, from passive relaxation to active social engagement. These spaces can take many forms, such as plazas, malls, playgrounds etc. as long as they contain both physical and visual elements that support activities like pathways, seating, vegetation, water features, or other environmental components. The essential characteristic of a public space is its accessibility, it should, in general, be open to the public.

Carr (1992) also critically observes that while public spaces are intended to serve people's needs, they often fail to do so due to shortcomings in design and management. One crucial factor in successful public space design is legibility: the clarity and recognizability of a space through environmental cues that help users understand where they are and how to move through it. These cues, however, are not always equally perceivable to everyone.

Espinosa et al. (1998) explain that orienting oneself in an environment involves complex cognitive processes, including perception, encoding, learning and the ability to recall spatial information. For people with visual impairments, these processes are particularly challenging due to the limited availability of non-visual spatial information in most public environments. This often leads to such spaces being inaccessible.

Malekafzali (2021) argues that this inaccessibility is rooted in the predominance of an ocular-centric approach to urban design, one that prioritizes visual aesthetics and assumes vision as the primary means of perceiving and understanding space. Consequently, visual cues dominate orientation and mobility (the act of moving safely), making independent movement a significant challenge for people who cannot rely on sight (Belir & Onder, 2013).

This visual bias in urban design has tangible psychological and physical consequences. As Hernández and Dickinson (2012) note, the lack of perceptible spatial information can contribute to heightened stress and a reduced well-being among visually impaired and blind individuals. Van der Ham et al. (2020) further report that around 80% of people with visual impairments have experienced traumatic events, such as disorientation, falling or abuse, with the possibility that it will lead to chronic stress and social isolation.

Spatial understanding is commonly supported through cognitive maps, these are mental representations of spatial knowledge that enable people to navigate and recall places (Papadopoulos et al., 2017). Although visually impaired individuals construct these maps differently, research shows they are capable of developing equally complex spatial representations. They do so through alternative modalities such as tactile or audio-tactile maps, direct movement, sound, scent, and touch. This multisensory engagement can foster a rich and nuanced spatial understanding, provided that public space design actively integrates these non-visual sensory cues (Papadopoulos et al., 2017).

3.1.4 The potential role of sensory design

The potential of sensory design lies in its ability to transform urban environments from visually oriented systems into multisensory landscapes that engage the full human body. Phenomenology reminds us that the experience of space is not merely optical but embodied and temporal, it unfolds through movement, sound, texture, temperature, and scent. Within urban design, this shift calls for an understanding of public space as a sensory field rather than a visual composition.

The book "The Eyes of the Skin", Pallasmaa (1996) argues that architecture has lost its sensory depth by prioritizing sight above all other forms of perception. He emphasizes that "the body knows and remembers," suggesting that spatial experience depends as much on sound, scent, touch and temperature as on visual form. Similarly, Malekafzali (2021) critiques the ocular-centric approach in contemporary cities, which entails that the input is dependent on the eye of the human, pointing out that design decisions often neglect the multisensory ways in which people perceive and orient themselves, particularly those who cannot rely on sight.

Recent empirical research strengthens these arguments. Studies by Shahcheraghi and Bandarabad (2017) and Bakir et al. (2022) demonstrate that multisensory cues, auditory, tactile, and olfactory (scent), enhance spatial cognition and legibility. They state that the stimulation of multiple senses leads to a more vivid and structured experience of place, strengthening cognitive maps that are crucial for navigation and orientation. For visually impaired and blind people, whose non-visual senses are often more developed than those of sighted individuals, these cues are not merely supportive but essential. They allow users to interpret spatial qualities, such as openings, layout, orientation, materials, and textures, that sighted individuals might overlook. In doing so, they positively influence legibility and foster a sense of position and belonging within space.

Bakir et al. (2022) further argue that sensory landmarks like auditory, olfactory or tactile help to create mental images of environments and to recognize different atmospheres, thus enriching spatial understanding. While their research primarily focuses on the experiences of visually impaired and blind individuals within built environments, their conclusions are equally applicable to outdoor public spaces. The activation of senses such as touch, hearing, and smell occurs in both contexts: the sound of footsteps and echoes in enclosed squares, the texture of pavements, or the scent of vegetation and food stalls all contribute to spatial awareness. Similarly, Lessard et al. (1998) demonstrate how environmental sounds, such as footsteps, conversations, or background noise, enable spatial localization, while Zhang et al. (2022) note that consistent auditory cues, like a soft bell near a road edge, can signal spatial orientation. These cues allow blind pedestrians to construct reliable mental maps and anticipate upcoming transitions.
In this way, the insights from indoor studies can inform the design of accessible and legible public spaces through sensory cues that enhance navigation and comfort. Ultimately, the holistic experience of space, whether indoors or outdoors, is shaped by the interplay of sensory perceptions, offering a valuable framework for improving spatial experiences in public settings.

Belir and Onder (2013) also highlight how tactile and auditory cues can fundamentally shape spatial perception and mobility. Their research shows that the careful consideration of material contrasts, surface textures, and acoustic feedback can improve spatial comprehension for visually impaired users. Building on this, Ottink et al. (2022) found that sculptures and tactile maps provide valuable reference points, allowing individuals to explore spatial form with their hands and gain orientation through texture. Similarly, Reinhardt et al. (2022) observed that material sensations, such as feeling water droplets or temperature shifts, enhance situational awareness, subtly signalling one's location within a space.
Sound plays a particularly important role.
Environmental acoustics such as echoes from walls, the rhythm of footsteps, or the sound of running water provide a sense of spatial structure and enclosure (INCE, 1998). Afrooz et al. (2012) further show that everyday urban sounds, like crowd murmurs or shop activity, help blind individuals recognize distinct atmospheres and make decisions about where they are within a city sequence.

Natural sounds are often processed more pleasantly than mechanical ones, offering emotional grounding and helping people locate themselves (Nijmeijer, 2022). Lessard et al. (1998) confirm that musical tones can also function as navigational stimuli, supporting orientation when combined with spatial echo. In soundscape research, the soundscape is defined as the acoustic environment as perceived and understood by an individual in a specific time and place (Fan et al., 2015). It moves beyond objective measurements such as decibels or frequencies to consider the subjective quality of sound and how it influences spatial experience. According to Erfanian et al. (2021), two key perceptual dimensions determine how a soundscape is evaluated: pleasantness and eventfulness.

Pleasantness describes the emotional valence of a soundscape, how comfortable, appealing, or agreeable the sound environment is perceived to be, whereas eventfulness refers to the level of liveliness or sensory stimulation within that environment. Together, these two attributes are crucial for multisensory urban design, since it can change the emotional wellbeing of a person to e.g. calm, nervous, excited, depressed (Erfenian et al., 2021).

For visually impaired individuals, pleasant and moderately eventful soundscapes, such as rustling leaves, running water, or human conversation, provide orientation cues that are intuitive and emotionally supportive. Conversely, environments dominated by unpleasant or chaotic sounds, like traffic noise or construction, can cause stress, disorientation, and avoidance. Integrating soundscape theory into spatial design therefore helps to evaluate and enhance the sensory legibility of public spaces.

Similarly, olfactory cues such as flowers, food, or soil scents anchor emotion and spatial memory, supporting a feeling of belonging (Huang & Yuan, 2023). The use of living aromatic plants, such as lavender, rosemary, or mint, is particularly effective in creating recognizable natural smellscapes (Huang & Yuan, 2023). Çeven and Belkayali (2023) found that the scent of water can act as a spatial landmark, as many blind individuals intuitively associate it with open areas like plazas or fountains. Afrooz et al. (2012) add that localized scents, such as those from bakeries or flower shops, help individuals situate themselves relative to other elements in the urban environment.

Tactile information, the roughness of a handrail, the warmth of a material, or the texture underfoot, allows users to sense direction, identify transitions, and establish embodied connections with their surroundings. Arthur and Passini (1992) emphasize that tactile and auditory reference points, like the start or end of a canopy, should be perceivable through touch or sound. Dalke and Corso (2013) highlight that contrasting floor materials and bright landmarks improve visibility and orientation, while Lauria (2017) stresses the importance of floor contrast for following specific paths. Ottink et al. (2022) additionally note that continuous paving and frequent tactile markers, such as arches or texture shifts, enhance clarity along a route.

Together, these sensory inputs create what can be described as urban sensescapes, layered environments in which perception, memory, and movement merge into a cohesive spatial experience. Within these sensescapes, navigation becomes not only functional but also emotional and atmospheric. As Lofti and Zamano (2015) and Salehiniya and Niroumand (2018) observe, spaces that fail to engage multiple senses can cause alienation and disorientation, whereas multisensory spaces invite awareness, comfort, and orientation.

3.1.5 The difficulty of the shared space

Shared space emerged as a traffic design concept aimed at reducing signage and eliminating rigid separations between pedestrian and vehicular zones. By relying on social cues, such as eye contact and negotiated behavior, it was intended to humanize streets and promote coexistence (Hamilton-Baillie, 2008). The concept has been widely implemented, particularly in the Netherlands, Denmark, and Sweden (Havik et al., 2012).

However, these environments often fail to accommodate the needs of the most vulnerable users, particularly individuals with visual impairments, mobility challenges, or those accompanied by running children or strollers. The absence of tactile guidance, auditory signals, and clear spatial boundaries results in spaces that are perceived as confusing, disorienting, or even unsafe (Parkin & Smithies, 2012). What may feel "liberating" to sighted individuals becomes inaccessible for others. Eye contact, a cornerstone of shared space logic, cannot serve as a universal communication tool when vision is impaired. Moreover, continuous surfaces without height differentiation hinder the orientation of guide dogs and their users.

As Havik et al. (2012) note, guide dogs and their users are trained to navigate environments using specific spatial elements, kerbs, tactile paving, audible crossings, many of which are deliberately removed in shared spaces. This erasure creates ambiguity that undermines spatial clarity and safety.

Although shared space is often marketed as an inclusive design strategy, where pedestrians, cyclists, and vehicles can freely coexist on a uniform surface, it remains a contentious concept, especially among people with disabilities (Parkin & Smithies, 2012). The absence of tactile and visual navigation aids led her to feel disoriented throughout her journey in such spaces.

This has been confirmed by the study of Chidiac et al. (2014). They have stated that through extensive research with visually impaired and blind participants, the conclusion is that shared space is one of the more difficult concepts. During an experiment where the visually impaired had to evaluate shared space, ratings were consistently low, stating that it felt unsafe with most participants not wanting to finish this experience.

This sense of insecurity stems from three main shortcomings: a lack of spatial segregation, insufficient sensory navigation cues, and obstructive urban furniture. As a result, shared spaces often prioritize visual freedom over multisensory accessibility, leaving many users behind.

3.1.6 Translating Legal Frameworks into Multisensory Urban Design

Designing for blind and visually impaired individuals begins with understanding the legal and normative landscape shaping accessibility. Regulatory frameworks, from international to national levels, form the basis for embedding multisensory cues such as tactile paving, auditory signals, and visual contrast into public environments.

At the international level, ISO 21542:2021 outlines general accessibility and usability standards for buildings and surrounding environments (International Organization for Standardization [ISO], 2021). It emphasizes perceivability through multiple sensory channels, recommending tactile and high-contrast signage, audible navigation aids, even lighting, and barrier-free circulation.

Within the European context, the European Accessibility Act (Directive EU 2019/882) promotes similar multisensory inclusion by requiring that information be accessible through tactile, auditory, and visual means, and that spaces support assistive technologies and adaptable contrast settings (European Union, 2019).

The Dutch standard NEN 9120:2025 translates these broader principles into concrete and measurable design guidelines for urban environments (Nederlands Normalisatieinstituut [NEN], 2025). It specifies:

- Lighting: Minimum 100 lux in access routes, with higher levels in orientation zones
- Contrast: At least 60% luminance contrast between floor and vertical surfaces
- Tactile paving: Standardized guiding (ribbed) and warning (dotted) tiles near crossings, entrances, or hazards
- Auditory signals: Used to complement tactile and visual information, particularly in transport nodes or intersections

These requirements are further supported by Den Brinker et al. (2011) in Zicht op Ruimte, a Dutch manual on visual accessibility. It expands on optimal lighting levels, reflection control, and text placement, providing practical guidance on how to create environments that are perceptually clear, safe, and inclusive (den Brinker, Appituley, & Smeets, 2011). Further practical guidance comes from tactile paving protocols (PBTconsult, n.d.):

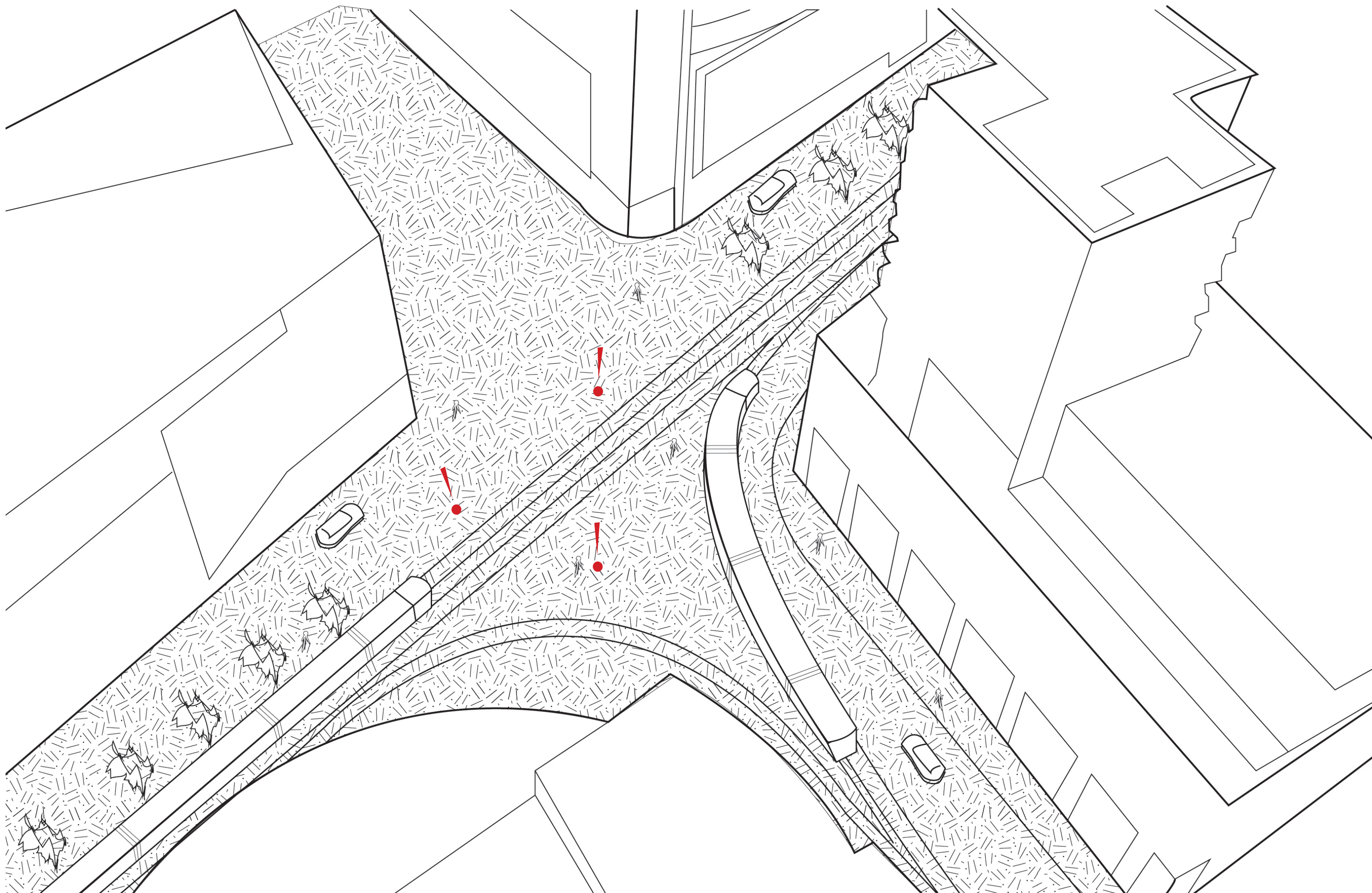
- Guide lines must be 30 cm wide, tactile and visually distinguishable
- They must follow safe, obstacle-free routes (e.g., transit hubs), and are not permitted on roads or bike paths
- Warning surfaces should be applied at crossings, stairs, or other danger points
- Tiles must visually contrast with the surrounding surface

Looking internationally, the Americans with Disabilities Act (ADA), enacted in 1990, remains a benchmark in accessibility legislation (Americans with Disabilities Act [ADA], 1990). It mandates:

- Clear, unobstructed paths with tactile warnings at hazardous areas
- High-contrast, tactile signage (including braille)
- Adequate lighting to ensure visibility
- Auxiliary aids, such as assistive listening systems or support personnel

All these laws, acts and/or rules create frameworks that provide a comprehensive basis for multisensory design strategies. These key points are legal standards that offer necessary direction, however they often emphasize technical compliance over experiential quality. This thesis critically reflects on these standards, reinterpreting them through urban design practice to promote autonomy, sensory richness, and dignity for blind and visually impaired individuals navigating public space, bridging the gap between regulatory compliance and genuine spatial empowerment.

A drawing of shared space (own image, 2025)



3.1.7 Synthesis

This chapter highlights the complex interplay between visual impairment, urban design, sensory perception and regulatory frameworks. Visually impaired and blind individuals experience space differently, relying on a combination of residual vision and non-visual senses to navigate and understand their surroundings. The spectrum of visual impairment entails diverse abilities and challenges, emphasizing the need to account for individual differences in designing public environments.

Urban design, traditionally shaped through an ocular-centric lens, often overlooks the spatial and emotional needs of visually impaired users. As Carr (1992) and Malekafzali (2021) demonstrate, conventional public spaces prioritize visual cues, making orientation and mobility difficult for those who rely on touch, sound, or scent. This lack of accessibility can impact well-being, contributing to stress, social isolation, and limited independent movement.

The potential of sensory design offers a pathway to address these gaps. While visual elements such as contrast and lighting remain important for spatial orientation, non-visual cues, sound, scent, touch, contrast, offer equally vital pathways for perception, memory, and comfort, particularly for those with visual impairment. Empirical studies by Bakir et al. (2022) show that multisensory cues enhance cognitive mapping, spatial awareness, and emotional engagement, applicable both indoors and outdoors. Belir and Onder (2013) further highlight how tactile and auditory information structures spatial comprehension and mobility, demonstrating that interior-based findings can inform outdoor urban design. Phenomenological perspectives (Pallasmaa, 1996; Shahcheraghi & Bandarabad, 2017) reinforce the embodied nature of these experiences, emphasizing the importance of designing spaces as multisensory landscapes rather than purely visual compositions.

Shared space is a concept that both touches upon the need of a well defined urban design and the missing cues of sensories. Which leads to a dangerous crossing while Denmark, Sweden and the Netherlands implement this often in their cities. Leaving a question on the consequences for those who are not able to make eye contact.

Regulatory frameworks, ranging from ISO standards to national accessibility codes, offer practical guidance for embedding multisensory accessibility within urban design. While these regulations often prioritise technical compliance, such as auditory signals, tactile paving, and visual contrast, they provide a vital bridge between theoretical perspectives and empirical insights, translating them into tangible design strategies. Together with the literature, this suggests that thoughtfully layered sensory cues, aligned with legal standards, can foster urban environments that are not only navigable but also rich in experiential and emotional depth for visually impaired users.

04 CASE STUDY

Introducing the case study

the Hague, the Netherlands

Note. based on GIS base data

4.1.1 Introducing the case study

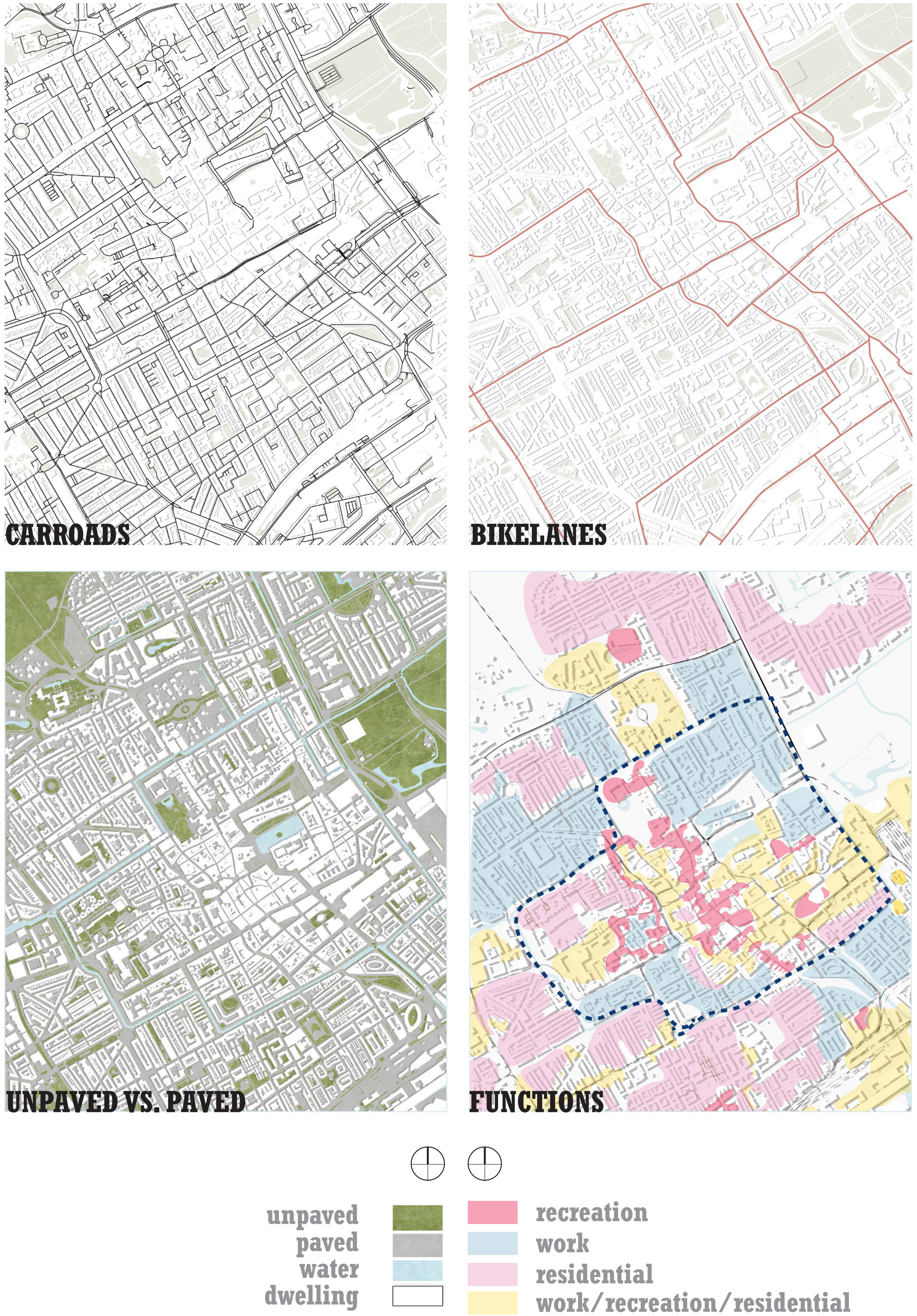
The Hague serves as the primary case study for this research because of its accessibility and use of shared space that relate to the challenges faced by visually impaired and blind people. As the national seat of government and home to major international institutions, the city carries a responsibility to ensure that its public spaces are perceptible and navigable for all citizens. At the same time, The Hague's implements shared spaces zones where the use for visually impaired and blind people lowers, making it a relevant environment to examine how multisensory strategies can support spatial understanding and comfort.

The first reason is its accessibility and connectivity. The Hague is deeply embedded within the national transport network, with two major train stations, an extensive tram system and dense cycling and car lanes. These multimodal connections reflect the movement patterns that visually impaired and blind people encounter in daily life. A city with this level of infrastructural intensity requires clear non-visual cues, making it a fitting setting to study how sensory strategies can improve orientation and safety.

The second reason relates to its implementation of the shared space. This space is centered around one plaza with the same material and no height differences. All modes of transport can drive, bike or walk here. Due to the accessibility, the tramlines are widely implemented in the city centre, placing another mode of transport on this shared space than the general shared space has. The overlapping mobility systems, heavy pedestrian flows and fragmented spatial organisation, often challenges safe situations for the sighted and VI/B. This tension between responsibility and experience forms a meaningful basis for investigating how multisensory strategies can enhance legibility within complex public spaces.

Several central areas, such as the intersection of Spui, Grote Marktstraat and Kalvermarkt, illustrate these challenges clearly. The city's density and sensory intensity therefore makes The Hague a relevant testing ground for exploring how design can better support non-visual navigation.

In this chapter, the case study is approached through two complementary steps. First, a spatial analysis outlines the structure, mobility patterns and physical organisation of the city centre, providing a factual understanding of the urban conditions that shape movement and orientation. This is followed by an exploratory fieldwork observation, in which the city is examined through a sensory lens to understand how sound, texture, scent and temperature unfold in practice for visually impaired and blind people. Together, these two components form the basis for identifying locations that reveal both structural and perceptual challenges, which will be proposed for further exploration in the next phase.



Note. based on GIS base data

4.2.1 A quick history of The Hague

This study focuses on the city centre of The Hague rather than the wider municipality. This area hosts the highest concentration of movement, functions and public attractions, and it is where most residents, workers and visitors converge. For visually impaired and blind people, these dense and activity-rich environments are the places where orientation challenges become most acute. Prioritising the city centre therefore allows this research to examine the most complex and high-pressure public spaces, where sensory navigation is most directly tested.

This brief history of The Hague outlines how the city's current spatial characteristics, particularly its fragmented layout and reliance on trams, came to be.

The Hague originated as the village Die Haghe. When the legal distinction between cities and villages was abolished, The Hague was formally recognized as the Royal Residence. Its administrative role attracted embassies and international institutions, establishing its identity as a governmental and diplomatic city (The Hague, 2024).

Unlike other Dutch cities, The Hague never developed a compact urban core. Its open grounds and dispersed growth created several civic plazas, such as Binnenhof and Plein, rather than a single central square. Rapid industrial expansion and population growth in the nineteenth century led to new development beyond the original centre, forming The Hague New Centre (The Hague, 2024). This diffuse urban structure continues to shape the city's spatial legibility today.

In 1864, The Hague made history by introducing the first horse-drawn tram in the Netherlands. More than 150 years later, HTM trams remain an inseparable part of the city's identity and urban rhythm, giving rise to its nickname, the tram city (HTM, n.d.).

During the 1970s and 1980s, car traffic became central to urban planning, leading to the construction of broad roads and large intersections. Since the 1990s, restructuring and densification have introduced a diverse mix of functions into the city centre, attracting millions of tourists each year. Today, The Hague places strong emphasis on accessibility, with a growing number of initiatives aimed at improving the experience for visually impaired and blind individuals, such as the recent installation of new tactile guiding lines (Nieuwe Blindegeleidelijnen Maken Den Haag Toegankelijker, 2024).

These developments make The Hague an intriguing case study: a city full of attractions and cultural energy, but one where the central area still struggles with spatial legibility and a sense of safety.

4.3.1 Observations in the centre of The Hague

This study focuses on the city centre of The Hague, where most residents, workers and visitors converge. For visually impaired and blind people, these dense and activity-rich areas are the places where orientation challenges become most acute. The observations presented here are based on multiple visits conducted throughout the year, involving sighted participants who navigated either blindfolded with a cane or with full vision. This exploratory approach helped reveal what is easily noticed, overlooked or misinterpreted according to people who are used to relying on their sight, before moving on to visually impaired and blind participants in later stages of the research.

The selected observation route, from Central Station through Turfmarkt, Spui, Grote Marktstraat and Buitenhof, captures the essence of the city centre and comes across multiple shared spaces. It represents a continuous sequence of spaces where different transport modes, pedestrian flows and sensory conditions converge. Focusing on this fragment clarifies why this route was prioritised: it exposes both the structural complexity and the perceptual challenges that shape non-visual navigation in The Hague.

When the city is entered from The Hague Central Station, multiple tactile paving is placed that guides towards the exits of the hall (1). For someone unfamiliar with the city, these routes are helpful, as they lead directly to the centre, though maintenance is crucial as signs of erosion are visible (2). Depending on which side one enters the hall, the smell of food stalls signals the central zone (3). A clear thermal shift marks the transition from the indoor hall to the outdoor wind and sunlight, as the overall soundscape becomes louder and more reverberant (4).

The Turfmarkt is the first street to enter after leaving the station. Several tram tracks cross this area, and the soundscape is dominated by trams coming from multiple directions (4), as well as cyclists and vans for logistic purposes. While these mechanical sounds can signal where tracks are located, the overlapping noises from trams, cyclists and pedestrians heighten stress levels. Tactile paving marks safe zones, however is sometimes placed in the same colour as the surrounding tiles.

Along the Turfmarkt, scents from restaurants mix with less pleasant odours from drains. At certain points, tactile paving leads directly toward parked scooters or bicycles (5), reducing reliability. Tram tracks appear suddenly (6), without tactile indication, and although the sound of an approaching tram eventually warns the pedestrian, this often occurs too late for comfort. The shared use of this street by vehicles, cyclists and pedestrians creates an unpredictable environment filled with sound and movement from all sides.

Tactile paving reappears at irregular intervals, breaking continuity. Moving toward the Spui (8), the spatial character shifts into a wide street with little vegetation, resulting in thermal discomfort during summer. Multiple modes of transport converge here, creating a noisy and restless atmosphere.

Crossing the Spui requires locating traffic lights, which is difficult to the blind. A construction area (9) forced pedestrians onto the roadway, posing significant risks for visually impaired or blind individuals who cannot detect such changes until contact. The shared space and intersection (10) between Spui, Kalvermarkt and Grote Marktstraat is especially challenging: traffic moves from four directions, trams cross frequently, and horns fill the space. For someone navigating non-visually, the scale and agitation of this junction make it extremely difficult to manage.

Continuing onto the Grote Marktstraat (11), the street remains wide but visually and acoustically overwhelming. A subtle bicycle lane runs through the pedestrian zone, often unnoticed until near collision. The air carries shifting scents, while visual signage dominates orientation (12), though illegible to visually impaired or blind users. Few tactile or auditory cues define boundaries or direction. Advertising boards placed in the walkway obstruct movement (7, 14). A wide junction nearby (15) lacks tactile or audible crossings.

At the Buitenhof, orientation remains difficult as trams once again dominate the soundscape, and non-locals struggle to determine direction without visual landmarks. The Lange Vijverberg (16) offers brief relief: quieter conditions, different pavement material, and soft acoustic feedback from the granite surface, along with vegetation. The Toernooiveld (17) that follows is a wide, car-dominated street that is difficult to cross safely to reach a small park (18) on the other side. Many entrances along this stretch are hard to recognise, due to the use of glass. Natural guidelines such as façades or vegetation are often absent.

Overall, The Hague reveals itself as a city that has much to offer yet remains loud and intense, where overlapping flows of transport, sound and people create constant sensory activation. These conditions expose the challenges of navigating dense environments shaped largely by visual design logic. The selected route touches several key axes that structure movement and public life, and together these observations clarify why this part of the city was prioritised: it forms one of the most complex and high-pressure sequences of public space, making it a fitting setting to investigate sensory navigation and non-visual perception.

04 CASE STUDY

CONCLUSION

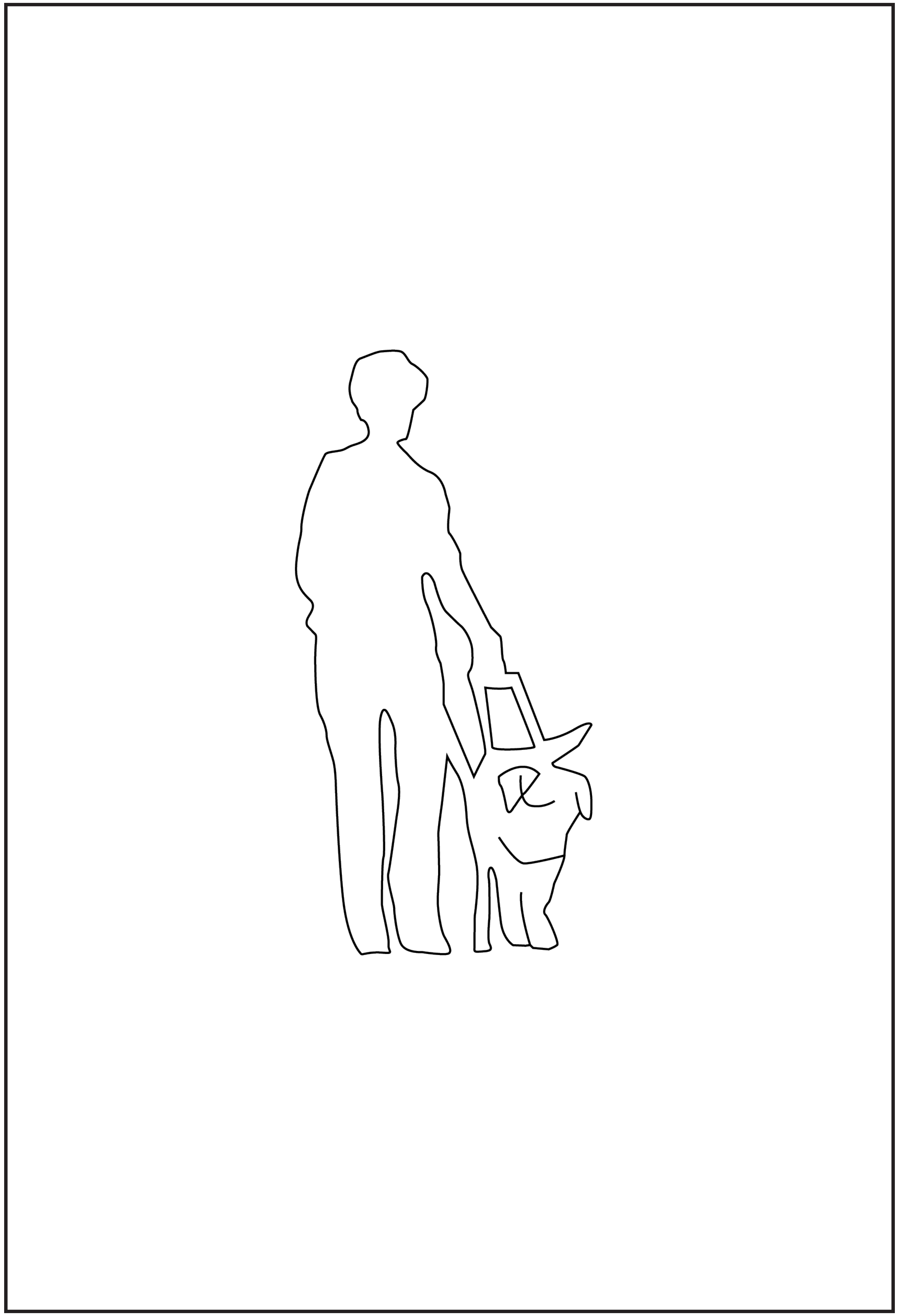
The Hague's active, wide use of the concept of shared space and culturally diverse centre creates a challenging environment for those who navigate without sight. Although tactile paving is implemented throughout the city, it is often insufficient: lines appear arbitrary, lack continuity or blend into the surrounding paving. Blindfolded observations confirmed that vibrancy and activity alone do not create a perceptible urban environment. Additional cues and a stronger sense of legibility are required. The city's layered soundscapes, material contrasts and overlapping flows of movement stimulate the senses but seldom guide them. This lack of guidance is partly rooted in The Hague's historical development: rather than emerging from a single coherent core, the city expanded through multiple plazas and axes, resulting in a dispersed spatial structure in which orientation depends heavily on visual references.

While these spatial and sensory conditions make The Hague a valuable site for exploration, they also expose the limits of urban ideals that prioritise openness and flexibility over perceptibility and safety. For visually impaired and blind people, such environments can feel less accessible and less predictable than intended, a tension that leads directly into the next phase of this research.

From here, the focus shifts to the User phase, in which the experiences of visually impaired and blind people themselves become central. Unlike the exploratory observations presented in this chapter, conducted with sighted participants navigating either blindfolded or with full vision, the User phase draws directly on lived experiences gathered through walk-along interviews across multiple cities. These encounters reveal how popular urban design concepts can unintentionally create unsafe or disorienting situations, but also uncover overlooked spatial elements that quietly support navigation and comfort. Together, these insights form the basis for the Sensory, Site and Activate phases, where the environmental, spatial and design potentials of a multisensory city will be further explored.

05 USER

Understanding the visually impaired and blind person begins with acknowledging that there is no single experience of vision loss. Yet, across this diversity, shared patterns often emerge in how they perceive, interpret, and navigate the urban environment.



5.1.1 Visually impaired and blind people
Even though visual impairment exists on a broad spectrum, visually impaired and blind people often encounter similar barriers and moments of disorientation in the way cities are organised. Urban environments are largely shaped by visual assumptions, expecting users to read spatial cues, detect contrast, recognise boundaries and negotiate movement primarily through sight. As a result, people who navigate through auditory, tactile or memory-based strategies are quickly overlooked, leaving fundamental gaps in how public space supports independence and comfort.

This chapter brings together insights from the methods literature and interviews to understand how individuals with limited or no vision construct spatial understanding in high-density environments. The literature provides essential context: definitions of visual impairment, historical developments in mobility support and research on non-visual wayfinding and issues related to dynamic urban environments, resulting into the base of the interview questions.

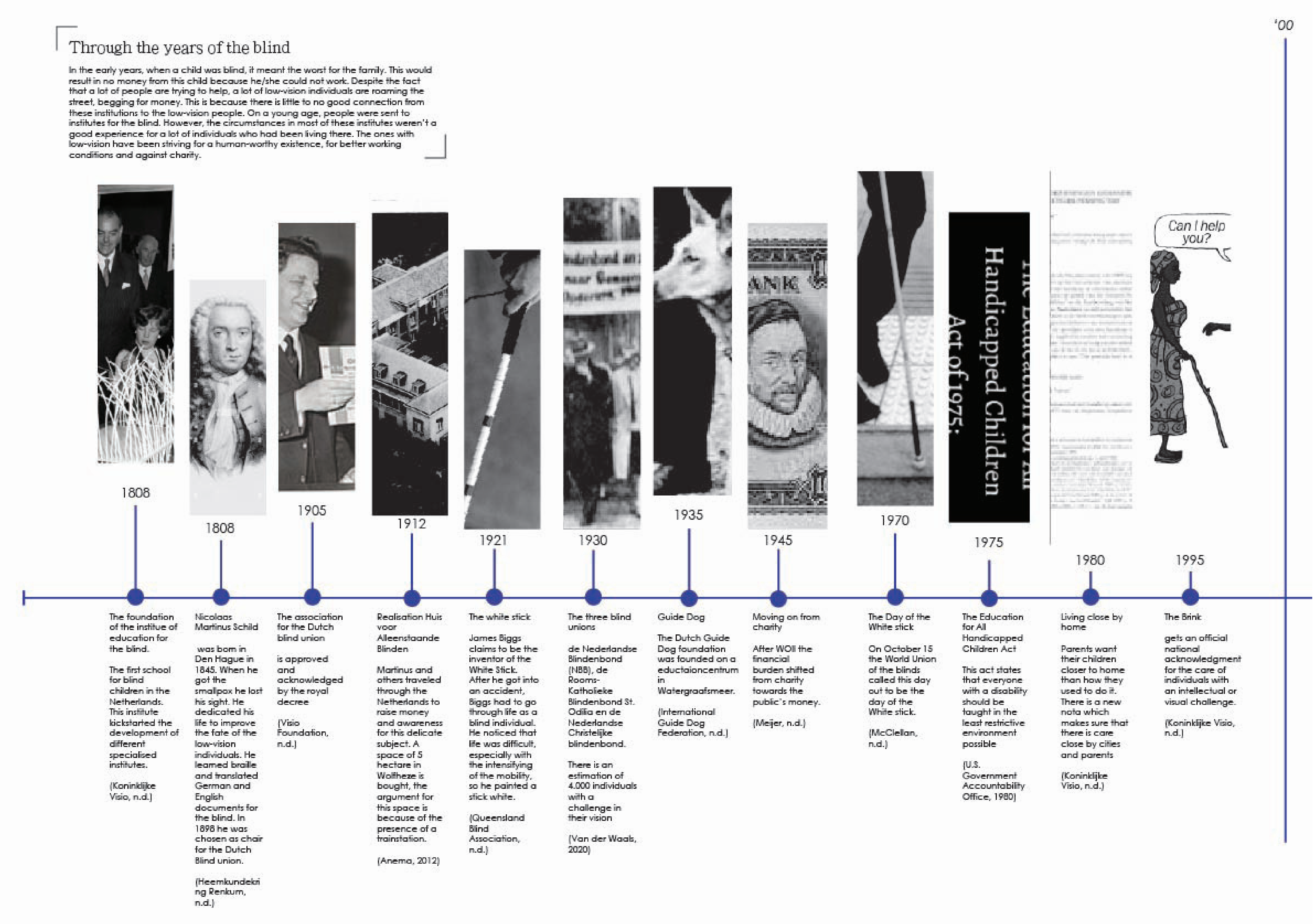
Building on the literature foundation, the second part of the chapter presents the outcomes of eight semi-structured interviews, including four walk-alongs.

The interview protocol was therefore partly derived from the literature (e.g., questions on wayfinding through sensory cues, cognitive mapping, obstacles, material changes and orientation strategies), partly shaped by issues that were mentioned frequently in the first few interviews (such as shared space, rhythm and the surprising preference for cycling over walking) and partly informed by design-driven questions needed for this thesis (the Needs & Wishes section, including questions on comfort, boundaries, lighting, and the overuse of the word "inclusive"). This layered approach allowed the interviews to both test observations from existing research and explore everyday experiences that are underrepresented in the literature.

Together, these insights form the foundation for answering the following subquestion:

How do visually impaired and blind individuals perceive and interpret spatial information, orientation, safety, and stress in familiar and unfamiliar high-density urban environments?

Figure 7. *Historical Timeline of Visually Impaired and Blind People*



Note. Images sourced from various online archives; full references are provided in the reference list.

5.2.1 The history

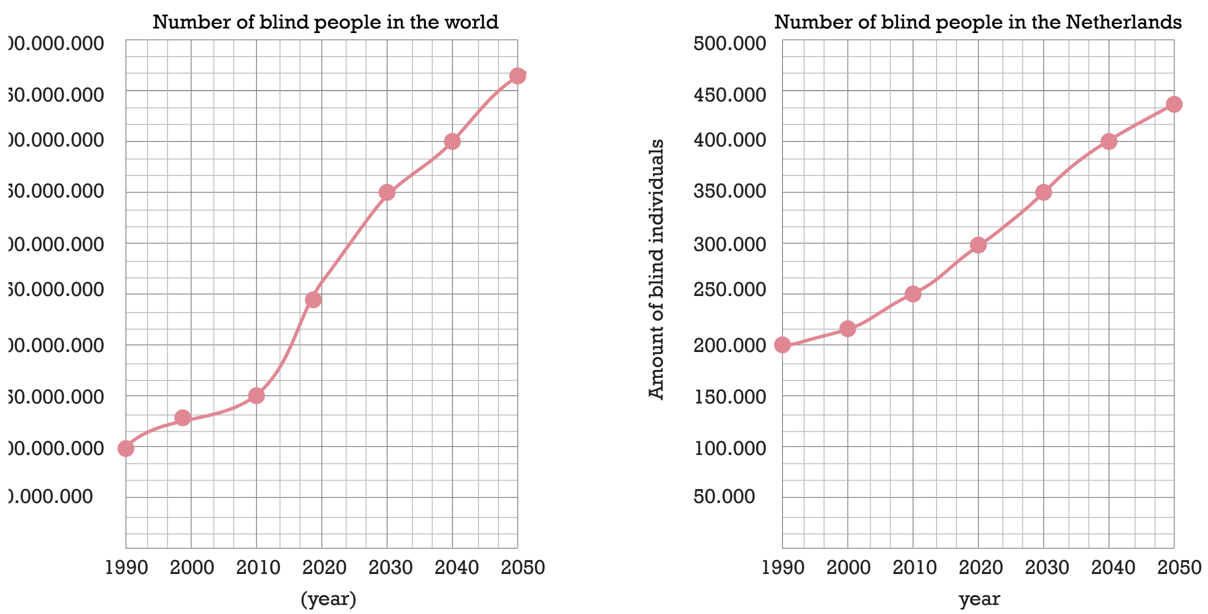
The history of visual impairment in the Netherlands shows a gradual shift from exclusion and charity toward rights, autonomy, and public responsibility. The foundation of the first institute for blind education in 1808 marked the beginning of formal support structures, soon followed by specialised schools and training programmes. Advocates such as Nicolaas Martinus Schild were instrumental in strengthening the social position of blind individuals, campaigning for dignity, education, and better living conditions.

During the early 20th century, key mobility tools and institutions emerged, including the white cane and the establishment of guide dog training centres. These developments offered visually impaired and blind individuals new forms of independence within increasingly complex urban environments. After the Second World War, financial responsibility shifted from charity to national funding, reinforcing the idea that accessibility is a public duty rather than voluntary goodwill.

Later legislation, such as the 1975 Education for All Handicapped Children Act, further emphasized the right to participate in society within the least restrictive environment. Over time, these changes laid the foundation for today's support systems, including mobility training, guide dogs, tactile tools, and advocacy organisations.

Yet despite these advancements, the physical environment has not progressed at the same pace. Many urban spaces still rely heavily on visual cues, limiting independence for those who navigate through sound, touch, or spatial memory. This historical overview therefore highlights not only societal progress, but also the persistent gap between institutional recognition and the lived reality of navigating public space, a gap that becomes clear in the interviews presented next.

Figure 8. *Amount of Blind People in the World and the Netherlands*



Note. Adapted from WHO, 2025.

5.3.1 Visual impaired and blindness

Approximately 400,000 people in the Netherlands live with some form of visual impairment or blindness, forming a significant and highly diverse group within society. Someone is considered visually impaired when they have substantial visual loss even with optimal correction (Trillo & Dickinson, 2012). In the Netherlands, we call someone socially blind (maatschappelijk blind) when the visual acuity falls below 5%.

Visual impairment therefore encompasses a wide range of abilities and needs. Some individuals rely on contrast or residual vision, while others navigate primarily through sound, touch, or spatial memory. Despite this diversity, visually impaired and blind individuals often face similar barriers in daily urban life, especially in environments that lack predictability, sensory structure, or clear spatial cues.

Beyond the practical challenges of navigation, visual impairment has emotional and social implications. Research shows that people with visual impairments are twice as likely to experience anxiety or depression (Hernandez & Dickinson, 2012), often linked to reduced independence and environmental uncertainty. Many individuals describe navigating the city as a process that requires significant preparation, concentration, and recovery time, far more than for sighted users.

These challenges arise not from the impairment itself but from the way public space is designed. Many urban environments assume that users can rely on visual cues, signage, material contrast, sightlines, or eye contact, to navigate safely. For those with limited vision, however, these cues are often unreadable or inconsistent. Irregular obstacles, unclear boundaries, and sudden shifts in street layout can quickly lead to confusion or unsafe conditions.

As the number of visually impaired individuals is projected to rise in the coming decades (WHO, 2025), the urgency to create public spaces that support non-visual orientation becomes greater. This requires moving beyond isolated accessibility measures toward a broader understanding of how spatial clarity, multisensory cues, and environmental consistency influence movement, safety, and autonomy.

These shared challenges are explored further in the following section, which introduces the interviews conducted for this research and examines how visually impaired and blind individuals describe their own ways of perceiving, navigating, and interpreting public space.

5.3.2 Wayfinding strategies

Research by Afrooz et al. (2012) has shown how visually impaired pedestrians navigate urban environments, their findings align closely with more recent insights from Kan-Kılıç et al. (2020). Together, these studies describe a highly multisensory, cognitively structured wayfinding process shaped by the degree of visual impairment, the environment, and the user's familiarity with it.

Across both studies, visually impaired pedestrians rely on chains of sensory reference points, such as the scent of a bakery, the sound of children in a schoolyard, the echo of a façade, the texture of a pavement, or the presence of a tactile wall, to create mental images of their surroundings. These reference points function as anchors in their cognitive maps, supporting the construction and recall of route sequences (Afrooz et al., 2012; Kan-Kılıç et al., 2020).

5.3.3 Blind pedestrians

Totally blind individuals depend on auditory, tactile and olfactory cues, drawing on subtle environmental information that sighted people often overlook. Both studies note that:

Auditory cues are the dominant source of spatial information. Sounds from traffic, footsteps, crowd movement, or the acoustic "signature" of a space provide orientation, help identify intersections and indicate the approach to an open or enclosed area (Kan-Kılıç et al., 2020; Afrooz et al., 2012).

Feeling of enclosure is a key navigational tool. Changes in echo, resonance and reverberation help blind pedestrians detect façades, building edges, underpasses, or plazas. This "acoustic enclosure" acts as a spatial frame, allowing users to infer width, openness or proximity to walls (Kan-Kılıç et al., 2020).

Tactile cues structure path-following. Blind users frequently follow walls, railings or building edges, also known as natural guidelines. They recognise smooth painted surfaces, rough brick or slight material changes underfoot as spatial markers (Afrooz et al., 2012).

Olfactory cues support localisation. Smells from bakeries, fruit shops, vegetation or soil function as stable spatial anchors, especially in familiar environments (Afrooz et al., 2012; Kan-Kılıç et al., 2020).

Cognitive maps are built through repetition. Blind individuals develop internal representations of landmark sequences, textures, sounds and smells. Familiarity greatly strengthens performance, allowing them to anticipate transitions and confirm their position without visual feedback (Afrooz et al., 2012; Kan-Kılıç et al., 2020).

Both studies confirm that auditory deprivation creates major disruption: when hearing was blocked experimentally, participants shifted to slower, more tactile strategies and relied heavily on memory, revealing how central sound is to non-visual navigation (Kan-Kılıç et al., 2020).

5.3.4 Low-vision pedestrians

Low-vision participants relied on a hybrid strategy, combining residual vision with auditory and tactile information:
They used high buildings, shadows, colour contrasts and signage as far as their vision permitted (Afrooz et al., 2012). Relaying more on visual landmarks, such as shops or building outlines. The visually impaired participants told that they were somewhat more comfortable taking alternative routes or exploring curvilinear paths, however, they still depended heavily on smell and sound, especially when light levels were low or visual cues were ambiguous.

Low-vision respondents frequently mentioned the need for high-contrast pavement markings, readable signage, and surfaces distinguishable even in twilight, reinforcing that spatial variables like contrast and lighting matter significantly more to this group (Afrooz et al., 2012).

5.3.5 Shared patterns across both groups

Despite differences, both blind and low-vision respondents demonstrated:

Heavy reliance on auditory structure, particularly crowd sounds, distant traffic, or pedestrian crossings. Use of olfactory reference points (bakeries, fruit shops, vegetation).

Dependence on predictable, straight street patterns, which simplify cognitive mapping (Afrooz et al., 2012).

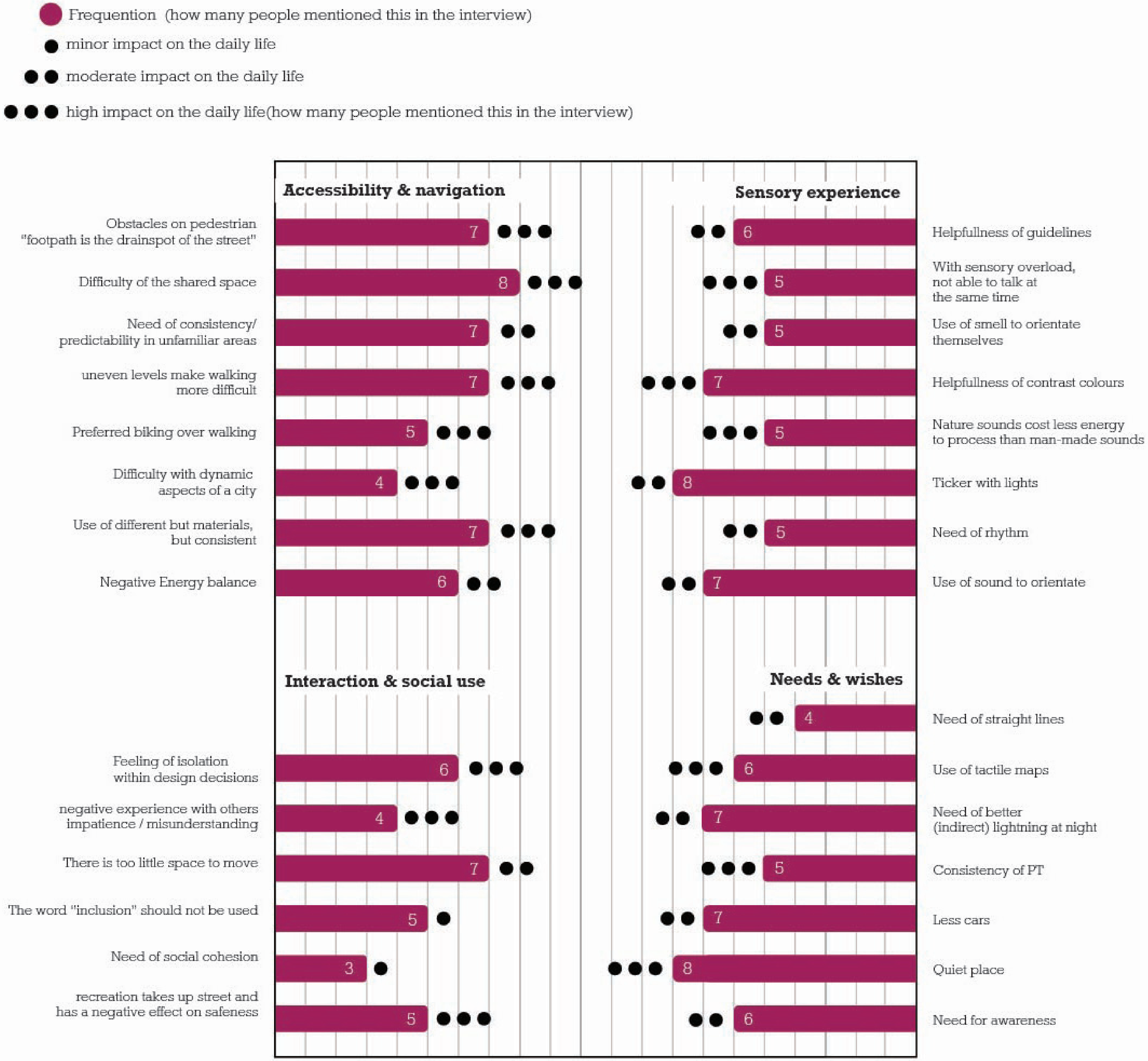
Recognition of surface textures as meaningful spatial information, both groups used material changes to identify junctions, entrances or boundaries (Kan-Kılıç et al., 2020).

Significant challenges arising from noise overload, temporary obstacles, poor maintenance, and lack of tactile continuity.

Together, Afrooz et al. (2012) and Kan-Kılıç et al. (2020) reveal that wayfinding without full vision is not defined by any single sense, but by the integration of sound, touch, smell and memory into a coherent spatial strategy. These multisensory cues allow visually impaired individuals to track their position, maintain orientation, and construct the cognitive maps necessary for safe, confident mobility.

These findings are the base for the structure of the walk-along interviews. The participants were questions about the cues that they use for wayfinding, what urban areas they prefer and what they don't like about the current design of the general public space.

Assessment of interviews



5.4.1 Talking with visually impaired and blind people

To understand how visually impaired and blind individuals experience public space, eight semi-structured interviews were conducted with participants aged 27 to 79. The group consisted of four women and four men: five blind participants (three with late-onset blindness), one person with low vision and two accessibility and mobility specialists. Four interviews were held as walk-alongs in The Hague, Amsterdam and Rotterdam; the remaining four took place at participants' workplaces or homes. Together, these settings captured a wide range of spatial, sensory and experiential perspectives.

Although several studies on non-visual navigation use methods such as walk-alongs, situated interviews, soundwalks or sensory mapping, no standardised interview protocol exists for visually impaired and blind individuals in complex urban contexts. The interview questions in this research were therefore self-constructed: partly informed by themes identified in literature, partly shaped by issues that emerged during early interviews, and partly guided by design-oriented questions relevant to this thesis. This flexible approach aligns with qualitative best practices in sensory and mobility research, allowing participants to emphasise the aspects most relevant to their lived experience.

All interviews were audio-recorded with consent. The material was transcribed, summarised and then thematically coded. Keywords and recurring issues were identified directly from the transcripts and clustered into four categories: Accessibility & Navigation, Sensory Experience, Interaction & Social Use and Needs & Wishes. These categories reflect how participants themselves framed their challenges and priorities, and the placement of topics in the diagram follows the way they articulated these issues during the interviews.

The *Assessment of Interview* visualises the coded results. Each bar represents the mention count, the number of participants who raised a particular issue. To reflect its qualitative weight, each theme is accompanied by one to three dots indicating its impact on daily experience, based on how strongly participants described it as affecting their orientation, safety or stress. For example, dynamic pedestrian behaviour was mentioned by only a few participants but described as highly impactful, whereas the overuse of the word "inclusion" was mentioned frequently but had little influence on daily navigation. This combination of frequency and impact distinguishes issues that are commonplace from those that are consequential.

The assessment provides an overview of the interview material; the following subsections expand on these themes with direct insights, quotes and situational examples gathered during the walk-alongs and conversations.

transcripts are availabe

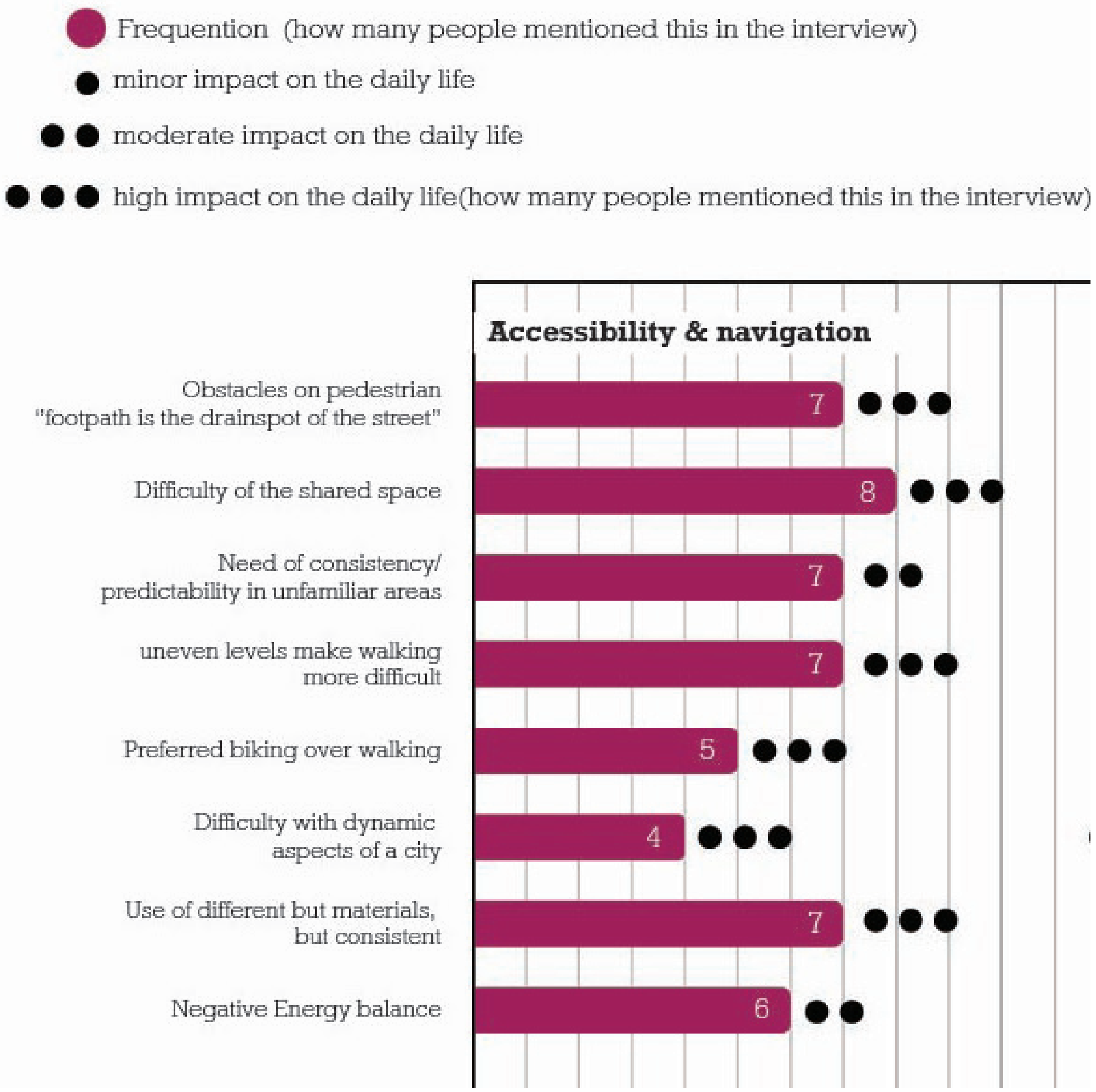
pathway as the drain of the street

5.5.1 accessibility & navigation

The interviews reveal that navigating high-density urban environments requires visually impaired and blind individuals to constantly negotiate obstacles, inconsistencies, and unpredictable spatial conditions. Participants described the pedestrian zone as ***"the drain of the street,"*** (M. Smit, personal communication, April 2025) a place where objects are routinely deposited: bicycles, advertisement boards, delivery packages, café furniture, and other temporary barriers. Many noted that such elements would be considered unacceptable if placed in the car lane or bicycle lane, ***"highlighting an implicit hierarchy that privileges vehicle-based mobility over pedestrian safety"*** (G. Janssen, personal communication, April 2025).

Because of this, several participants reported feeling safer walking on bicycle lanes than on sidewalks, as these lanes typically contain fewer unexpected obstacles. Although counterintuitive to sighted individuals, some visually impaired participants even preferred cycling over walking, as cycling offered a continuous path and fewer physical interruptions. Walking along building façades was described as especially reassuring because it provides a natural guideline, When a natural facade can be followed along a route, the placement of tactile paving becomes too much, Dunker (personal communication, 2025) said ***"it would be nice if the tactile paving ends where the natural guideline begins, both are unnecessary'***.

Shared spaces was a topic that every participant had a clear opinion about. It has been experienced as alienating with almost every participant. The concept relies on eye contact and visual negotiation, behaviours that are unavailable to those who cannot rely on sight, with one participant stating ***"This works in small villages in Sweden, but not in big cities, read the *** manual"*** (Janssen, 2025). Participants questioned how such environments could be framed as inclusive when the fundamental logic excludes them by design. Many described feeling "invisible" in shared spaces, as if their presence was not fully considered in the assumptions guiding movement. Strategies for orientation varied widely but shared common patterns.



Unfamiliar areas amplified disorientation. Several participants preferred visiting a new place first with a sighted companion to develop a cognitive map. The lack of consistency between cities, especially regarding auditory signals at crossings, tactile placements, or curb design, made independent navigation significantly more difficult. Participants expressed a desire for a "basic layer" of spatial logic across the city, something predictable that would reduce cognitive strain.

High-density environments also introduce dynamic elements, fast-moving crowds, cyclists, tourists, and people distracted by phones, that make navigation unpredictable. Participants explained that they often cannot anticipate the movements of others, leading to collisions or near-collisions. Large intersections, particularly those without clear tactile or visual contrast, were described as stressful and difficult to interpret: participants could not tell where crossings began or ended, whether they were standing safely, or whether a vehicle was approaching from an unexpected direction.

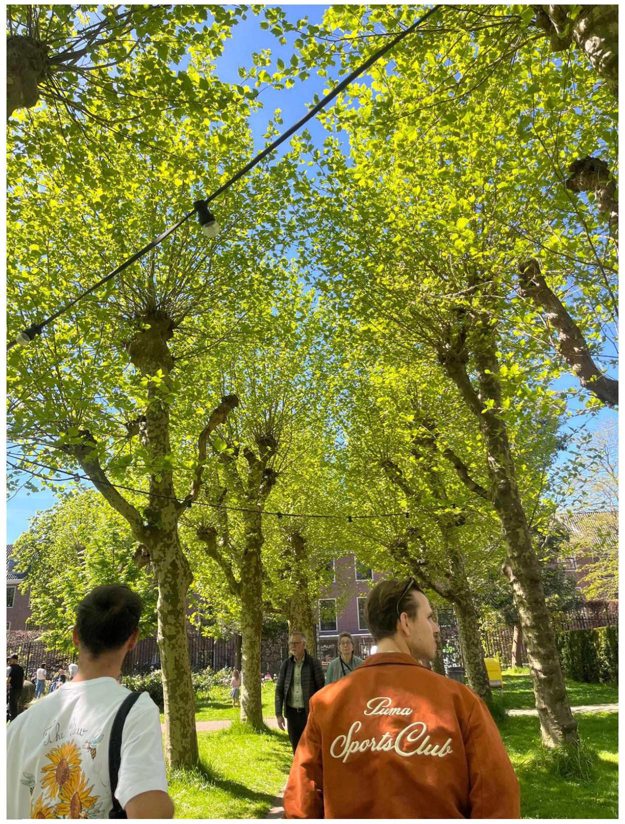
A recurring concern was the visual uniformity of some streets in The Hague, where identical materials are used across sidewalks, tram lanes, and pedestrian zones, a character of shared space. This made it difficult to determine where one function ended and another began. Construction sites posed similar challenges: without clear detours or sensory cues indicating a change, participants felt disoriented and unsafe. Many avoided areas like Spui, Grote Marktstraat, and their intersection altogether, describing them as overwhelming and chaotic. One participant stated, ***"There is not a single place in The Hague where I feel safe."*** (Spaans, personal communications, 2025).

Positive experiences were linked to quieter spaces with clear acoustic structure, such as the small park near the Buitenhof or intimate urban pockets in Amsterdam where water sounds and low-level background noise provided calming orientation cues Smit (2025) said ***"this is my favourite place, I can stay here, listen to the water, it is enclosed and calm but with a nice white noise of people"***.

The findings of this category show that accessibility and navigation are shaped not only by the presence of tactile guidance or crossings, but by the overall coherence, predictability, and sensory legibility of the environment. Nowadays, many take a friend or partner with them to examine an unfamiliar place. But when this is not possible, they are reliant on themselves. Predictability is something that almost every participant stated as a demand to go to an unfamiliar place.

When these elements are missing, or scattered inconsistently, visually impaired and blind individuals expend significantly more energy, experience higher stress levels, and navigate with reduced autonomy.

urban pocket | Amsterdam

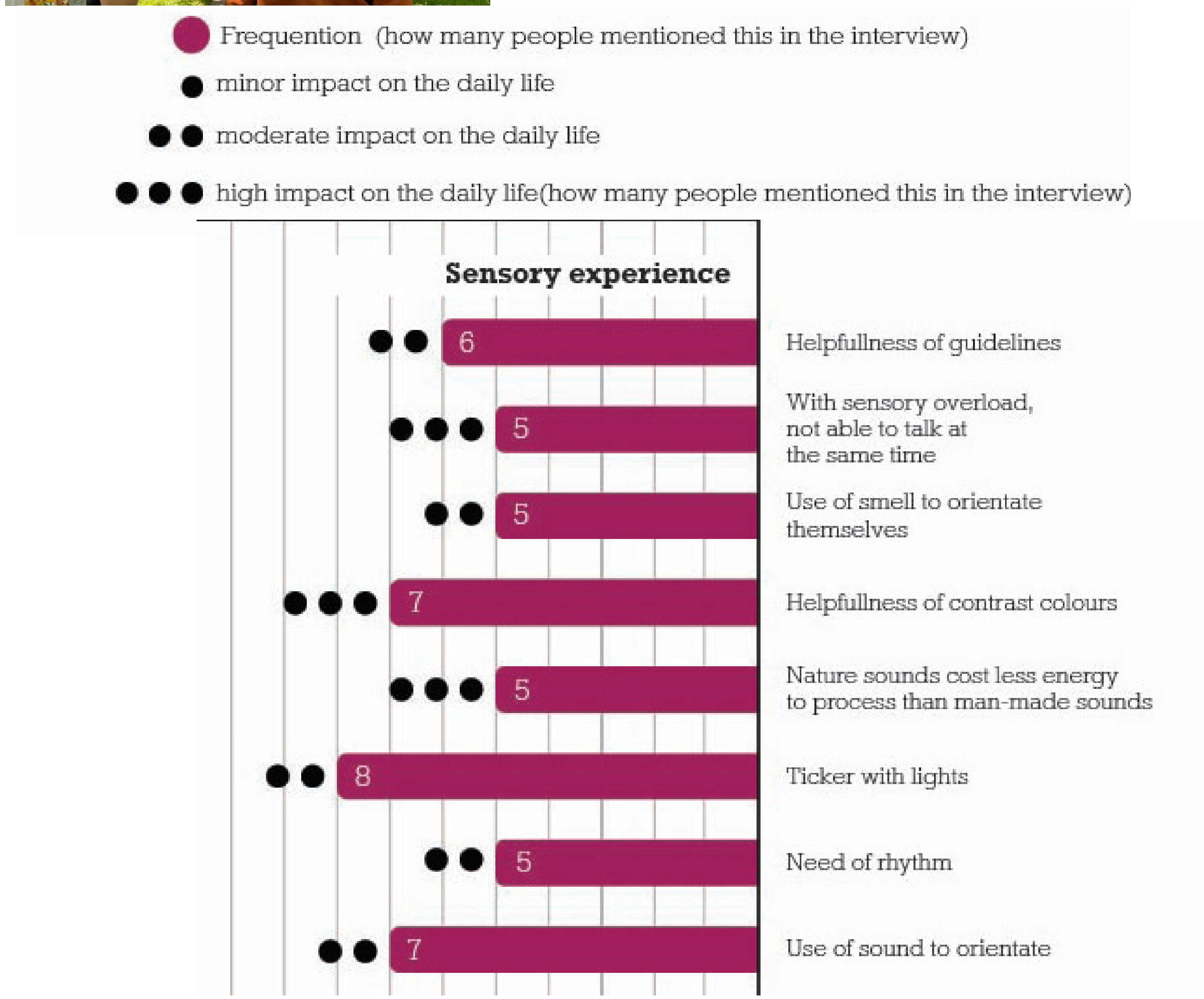

quiet place with white background noise

5.5.2 Sensory experience

Sensory cues play a central role in how visually impaired and blind individuals understand and navigate urban environments. Participants described a continuous process of listening, feeling, and subconsciously smelling their surroundings to create a sense of orientation, comfort, and safety. These cues, however, vary greatly in reliability and availability across different parts of the city, particularly in high-density areas.

Many participants listened for the presence of other people as a form of social security, or used the low hum of car traffic to understand their spatial position. However, this dependency on volume: soft traffic noise provided orientation, while loud traffic made concentration nearly impossible. During one walk-along, a participant from Amsterdam had to physically step away from the road because the noise overloaded her senses and prevented normal conversation.

Tactile paving was described as difficult to locate and inconsistent across cities. While it was helpful at crossings, particularly when other pedestrians were seen standing on it, it was often not installed continuously enough to support navigation. Participants noted that tactile guidance works relatively well in metro and train stations, where it provides coherent routes to exits, and where even sighted individuals subconsciously follow it when unfamiliar with the environment. However, participants explained that their guide dogs as well as themselves avoid tactile paving when they are walking in a continuous line, because the surface is uncomfortable, causing them to ignore the tactile paving lines entirely.



Natural sounds, such as rustling leaves, birds, or soft water noise, were consistently perceived as pleasant and grounding. Participants explained that these sounds help them form a mental picture of the space, offering subtle orientation cues without overwhelming their senses. The white background noise of people talking or moving also contributed positively to spatial awareness, serving as a quiet reminder that they were in a social and safe environment. In contrast, sharp or chaotic man-made sounds were described as stressful and disorienting. Tram bells, for example, were perceived as coming "from everywhere," making it difficult to understand directionality. Loud traffic created similar confusion: soft traffic noise was helpful for orientation, but high volumes made concentration nearly impossible.

Echoes and reverberation also offered important navigational information. Participants could hear whether a space was narrow or wide based on how sound bounced off surrounding façades. This ability made transitions, such as moving from an enclosed street to an open square, instantly noticeable through acoustics alone. However, wide open spaces with surrounding façades were often experienced as difficult to interpret, as echoes became diffuse and no longer provided clear spatial direction. But smaller details with sound like tickers with traffic lights were important as well. Pelleboer (personal communication, 2025) said ***"I don't like these types of junctions, the ticking sound is usually missing and there is no clear buffer between me and traffic. Then I have to rely on my dog and the sound of the environment while standing on the Spui"***.

Scent contributed more subtly to spatial understanding. Several participants initially claimed scent did not influence their navigation, but later realised, during walk-along interviews, that they subconsciously used it more than expected. Smells from shops, food stands, or flowers helped them locate themselves and understand where they were along a route. One participant noted, ***"I know it's corny, but I really do smell the HEMA worst and it helps."*** (Spaans, personal communication, 2025) However, this cue largely disappears at night when shops close, reducing yet another sensory anchor.

Tactile experiences varied widely depending on surface materials. Some participants wore thin-soled shoes specifically to feel subtle changes in the ground. Hard materials such as granite were often appreciated because they produced clear auditory and tactile feedback.


the distinctive scnet of the hema sausage

Lighting and contrast played an especially important role for individuals with residual vision. High-contrast colour combinations, ***"such as yellow, magenta, black, and white are easy to identify"*** (Nijkamp, personal communication, 2025), she further explained "along the doors of the public transport would make it easier to detect the entrance for me". Lighting needed to be indirect: overly bright or direct lighting created glare and made the environment harder to interpret. At night, the loss of contrast led many participants to become effectively blind, increasing stress, dependency, and uncertainty about where paths, entrances, or transitions were located. Many stressed the urgent need for consistent, ***"indirect lights that won't shine directly in my eye, or diffused would be very helpful to find the way in the dark"*** (Nijkamp, 2025).

Sensory overload occurred frequently in crowded, high-density areas where numerous man-made noises, movements, and visual stimuli coincided. Places with excessive "bells and whistles", such as the area around Spui and Grote Marktstraat, were described as chaotic and disorienting, especially when crossing or navigating through constantly moving streams of people. Participants noted that sound and tactile cues worked best in combination at critical decision points, such as crossings, while scent and subtle material transitions were more helpful on continuous routes.

Overall, sensory experiences shaped navigation as much as physical elements. When sensory cues were coherent, and placed in a rhythm, soft background noise, recognisable scents, clear echoes, helpful material textures, participants felt more grounded and confident. When cues were unpredictable or overwhelming, movement became stressful, cognitively demanding and unsafe.

a woman with her guide dog and cane

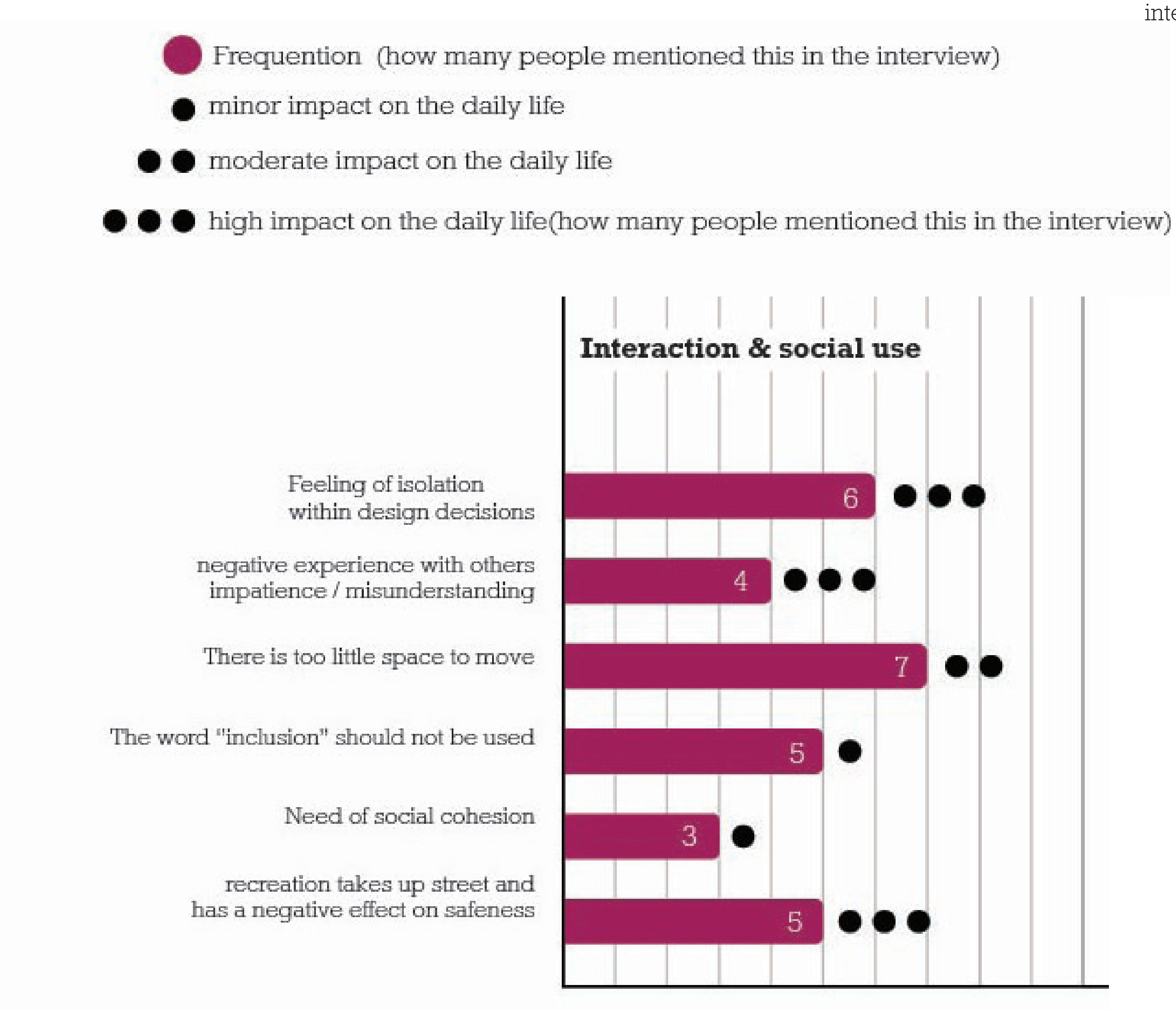
5.5.3 Interaction & social use

Social dynamics strongly shape how visually impaired and blind individuals experience public space. Participants explained that everyday interaction becomes more complex in environments where communication relies heavily on visual cues, particularly eye contact. Without the ability to meet someone's gaze or anticipate their movement visually, collisions frequently occurred. Several participants described situations where people reacted with frustration or irritation, reactions that shifted only once they realised the individual was visually impaired. This reliance on visual communication reinforces feelings of exclusion, especially when environments are labelled as "inclusive" while remaining inaccessible in practice. ***"People throw around the word inclusive too easily. It is fine if your design is not accessible for everyone, but don't call it inclusive"*** (Smit, 2025)

Unpredictable behaviour from sighted people was a significant source of stress. Many pedestrians walk while looking at their phones, change direction abruptly, or move erratically, making it difficult for visually impaired individuals to anticipate their path. Participants noted that fast-moving cyclists, scooters, and especially fatbikes created sudden moments of panic. Electric cars were described as particularly dangerous because they are so quiet that they often go unnoticed until they pass very closely. Several participants reported near-accidents with scooters or vehicles exiting parking garages, situations where sound provided insufficient warning.

Public awareness of visual impairment was described as mixed. When people recognise the white cane or guide dog, they often make space or react more calmly during accidental contact. However, many participants felt that awareness is inconsistent. Tactile paving is frequently blocked by shop signs, temporary advertisements, or even lampposts positioned directly in the guidance strip, all of which undermine navigation and demonstrate limited understanding of its function. Several participants expressed frustration that essential guidance routes are treated as secondary space, despite their importance for safe mobility.

Crowded spaces brought both comfort and difficulty. Moderate activity made participants feel socially safe, offering a sense of presence and shared environment. Yet beyond a certain threshold, crowds became an obstacle: canes struck people's legs, movement paths became unclear, and social interaction shifted into negotiation rather than comfort. Feelings of loneliness varied among participants, but the interviews suggested that the emotional experience depended more on environmental clarity than on the number of people present.



Guide dog users highlighted additional social dimensions. While public awareness of not petting guide dogs has improved, participants still encountered situations where people treated them with pity or excessive concern. Many stressed that they do not want special treatment or "designs made specifically for the blind," but rather environments that improve public space for everyone while supporting non-visual navigation. The goal is not segregation but shared usability.

Asking for help varied widely among participants. Some felt comfortable seeking assistance, while others preferred to avoid it, expressing frustration at the dependency this created, particularly when navigating unfamiliar environments that lacked sensory clarity. This emotional tension between autonomy and necessary assistance shaped many interactions in high-density public spaces.

Taken together, these findings show that social interaction and spatial design are deeply intertwined. When environments defer to visual communication, rely on unpredictable behaviour from others, or obscure essential guidance cues, visually impaired and blind individuals experience heightened stress, reduced autonomy, and a sense of invisibility in the urban landscape.

no regard for tactile paving

tactile paving at a crossing

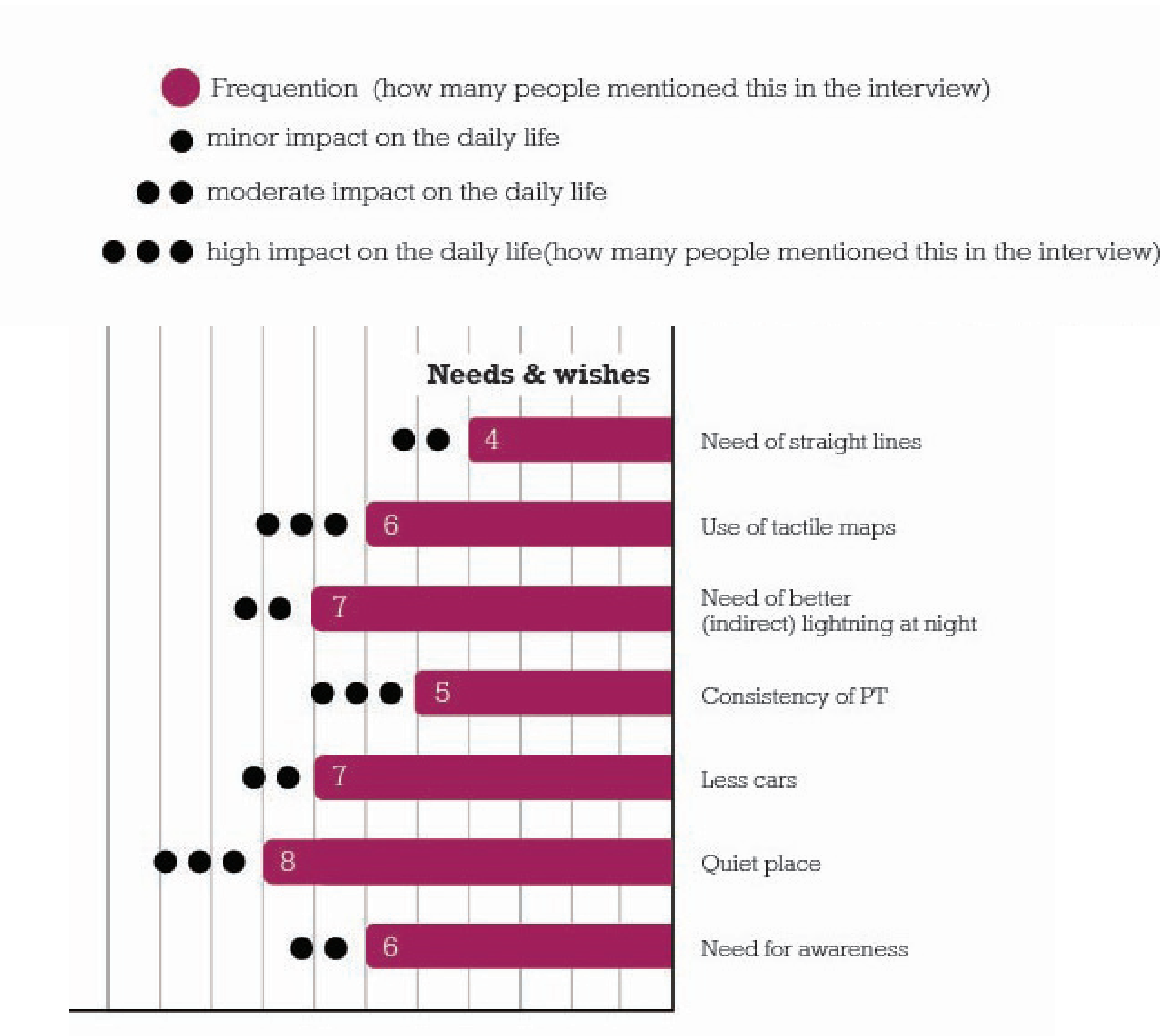
5.5.4 Needs & wishes

Across all interviews, participants expressed a clear desire for public spaces that offer predictability, clarity, and sensory support. Their needs were not focused on specialised or segregated environments, but on cities that integrate non-visual cues into good spatial design, design that enhances the public realm for everyone while enabling independent mobility for visually impaired and blind individuals.

A central theme was the need for consistent spatial logic, particularly regarding tactile paving. Participants explained that tactile cues should appear in predictable situations, at crossings, at subway entrances, and along key transition lines, rather than in fragmented or unexpected configurations. Consistency across the city was described as "a base layer" for safe navigation. Unclear boundaries between pedestrian areas and motorised traffic intensified feelings of uncertainty, particularly in shared spaces where roles and responsibilities relied almost entirely on visual negotiation. Most participants preferred to avoid such environments altogether and expressed a strong wish for their redesign.

Another topic that every visually impaired participant had an opinion about was the night. When the sun sets and the urban environment becomes dark. Lighting emerged as one of the most urgent needs, especially for those with residual vision. Participants emphasised the importance of indirect or diffused lighting, which clarifies edges and contrasts without creating glare. In the absence of daylight, many became effectively blind, making subtle cues disappear. Entrances to buildings, especially glass-heavy façades, were difficult to detect without proper illumination. Crossings also required clearer lighting, as participants relied heavily on visible contrast to understand where safe movement paths began and ended.

Ground textures played a significant role in spatial comfort. Many participants preferred stomped, fine-grained granite, which offered both tactile feedback underfoot and audible clarity when tapped by a cane Max (April, 2025) mentioned granite as a very pleasant material ***"it is a good indicator to know if you are standing on the right path".*** Sand-like or loose materials were considered unfavourable, as they made cane movement difficult and disrupted the rhythmic feedback essential for orientation. Raised curbs were appreciated for indicating transitions between pedestrian and vehicular zones, while white tactile paving provided helpful visual contrast where available.



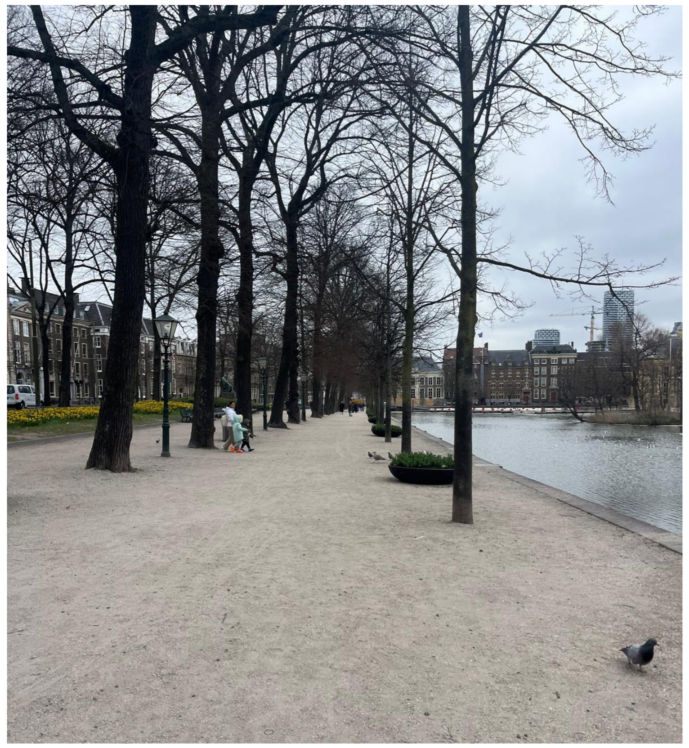
Auditory cues were another essential need. Participants wished for reliable, consistent, and functional audible signals at crossings, noting that these signals must be loud enough to hear above ambient noise but not overwhelming. Broken or absent signals created significant stress and could lead to unsafe crossings. At crossings and intersections, participants stressed that sound and tactile cues work best in combination.

Scent and natural soundscapes also shaped their preferences. Quiet natural sounds, such as water, leaves, or soft wind, were described as grounding and pleasant. Subtle scents from vegetation or nearby shops provided orientation cues and emotional comfort. Participants appreciated environments with quiet edges or soft "white noise," where overstimulation was reduced and movement felt manageable.

Clutter-free pedestrian space was a major wish. Participants called for logical placement of street furniture and advertisements, ideally in clearly defined zones. They especially stressed that tactile paving must remain unobstructed, as its blockage by boards, signage, or lampposts disrupts essential navigational routes and introduces preventable hazards.

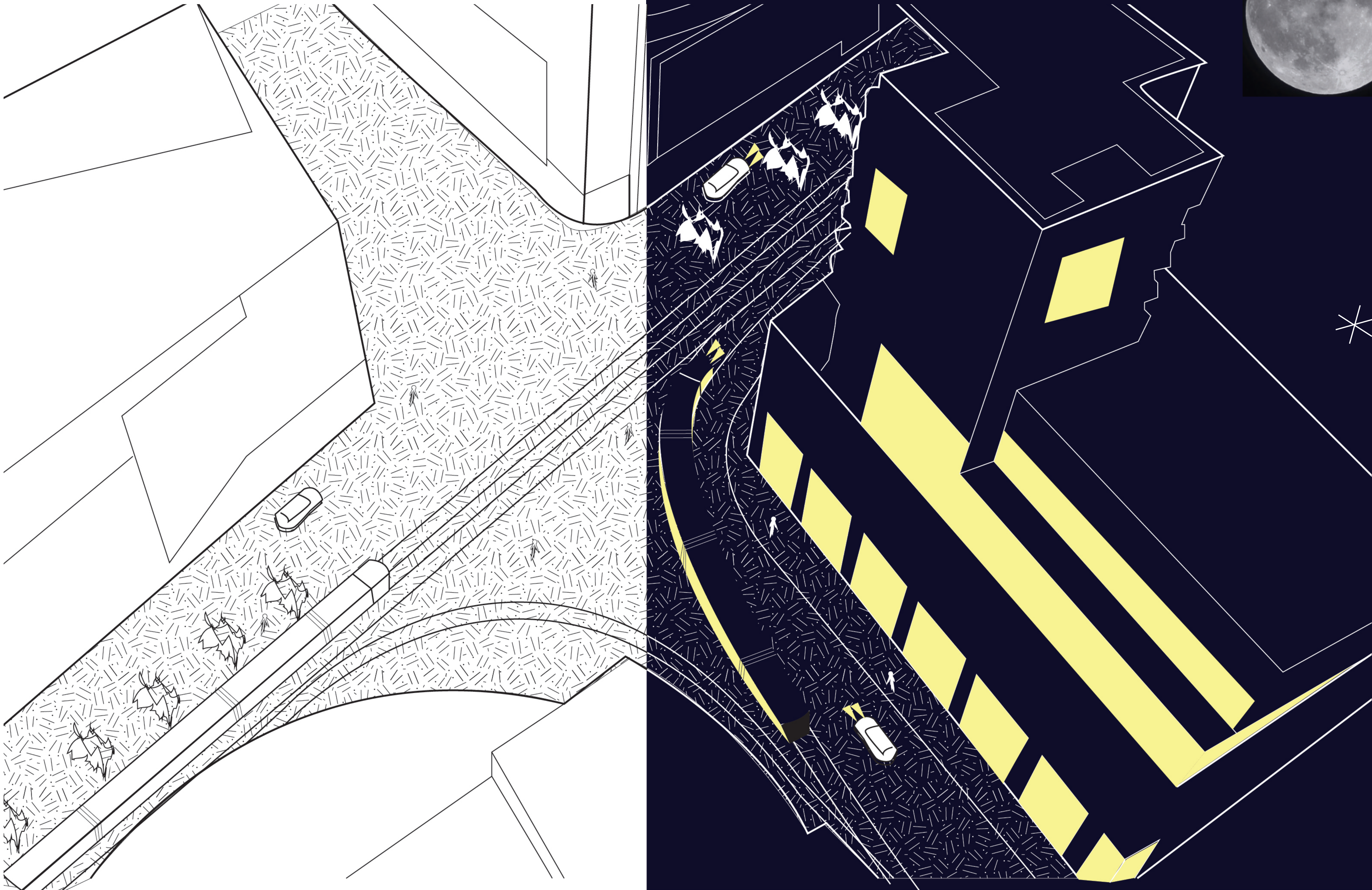
Beyond physical and sensory conditions, participants voiced deeper emotional needs: independence, dignity, and equal belonging. Many expressed frustration when designs were marketed as "inclusive" while remaining inaccessible in practice. They emphasised that they do not want spaces made "for the blind," but environments that genuinely support varied sensory strategies without reducing them to a special case. Improved lighting at night, reduced sidewalk clutter, and the rethinking of shared space were the most frequently and passionately expressed wishes.

Pleasant environments were consistently described as those that combined quiet edges, soft natural sound, subtle scent, and clear physical boundaries, spaces where sensory information formed a coherent whole rather than a chaotic mix. These preferences highlight that the needs of visually impaired and blind individuals are not about adding more stimuli, but about organising sensory cues in ways that support orientation, comfort, and autonomy.



granite as a helpful cue

5.6.1 Shared space and night time
Two major problems in the contemporary urban environment where participants where very opinionated about were shared space and nighttime navigation. Although connected to the broader themes discussed in this chapter, participants described these situations as uniquely disorienting and increasingly urgent to address, shared space because it is being implemented more widely, and nighttime because it affects daily life every single day. Both represent moments when the urban environment provides the least reliable sensory information: visual cues fades, boundaries become difficult to detect, and non-visual strategies no longer offer enough support for confident movement. These findings shed clearer light on the types of spaces where visually impaired and blind individuals feel most vulnerable within high-density urban settings. Importantly, they also played a decisive role in determining the zoom-in locations for the case study in The Hague, where these conditions are most strongly present.



05 USER

SYNTHESIS

QUESTION 01

How do visually impaired and blind individuals perceive and interpret spatial information, orientation, safety, and stress in familiar and unfamiliar high-density urban environments?

Perception, orientation & spatial understanding
Research on spatial cognition shows that orientation relies on perceiving, encoding and recalling environmental information (Espinosa et al., 1998). For visually impaired and blind individuals, these processes are challenged by the limited availability of non-visual cues in most public environments, which often remain visually dominant in their design (Pallasmaa, 1996; Malekafzali, 2021). Empirical studies demonstrate that multisensory cues, particularly tactile continuity, auditory structure, scent, echoes and material transitions, strengthen legibility and support the formation of reliable cognitive maps (Shahcheraghi & Bandarabad, 2017; Bakir et al., 2022; Kan-Kılıç et al., 2020). These insights align with long-standing principles of environmental legibility (Carr, 1992; Arthur & Passini, 1992), underscoring the need for public spaces that provide consistent, perceivable and interpretable guidance beyond visual information.

Theory and empirical findings
The interview results strongly reinforced and nuanced these theoretical expectations. Literature emphasises that orientation depends on multisensory perception, cognitive mapping and environmental predictability; the interviews confirmed these principles with concrete, lived examples. Participants described relying on echoes from façades to understand distance, material transitions to recognise route changes, soft natural sounds to confirm orientation and predictable edges to stay aligned, directly mirroring findings from Espinosa et al. (1998), Lessard et al. (1998), Afrooz et al. (2012) and Kan-Kılıç et al. (2020).

Interviews also confirmed literature on multisensory integration: both blind and low-vision participants used combinations of sound, touch, scent and temperature to maintain orientation, similar to the sensory strategies described by Afrooz et al. (2012). Several participants specifically noted how feelings of enclosure, created by echo patterns between buildings, helped them understand street width and location, aligning closely with Kan-Kılıç et al. (2020).

At the same time, the interviews exposed gaps that literature often treats only abstractly: the unreliability of tactile paving when blocked or inconsistently placed, guide dogs actively avoiding rough guidance tiles, the disappearance of scent cues at night, and the overwhelming effect of dense acoustic environments such as the Spui–Grote Markt crossing. The strong rejection of shared space and the sudden loss of navigational ability after sunset further demonstrated how spatial variables behave differently in real-world high-density conditions than theoretical descriptions alone suggest. In this way, the interviews both confirmed the multisensory principles identified in literature and expanded them, translating abstract concepts into concrete spatial design variables that determine non-visual legibility in practice.

multisensory spatial design variables
Integrating literature and interview findings reveals a set of spatial design variables that strongly influence orientation, safety and perceptual comfort across different degrees of visual impairment.

Variables relevant to both blind and low-vision users
Tactile continuity (predictable paving logic marking routes, steps, ramps, obstructions)
Boundary legibility (edges, kerbs, façades, walls, important for detecting enclosure)
Auditory structure (echoes, stable sound sources, recognisable transitions; key for blind users)
Material transitions (granite, rough–smooth changes, detectable by cane or foot)
Rhythmic spatial sequencing (façade rhythm, tree alignments, benches, lamppost spacing)
Absence of clutter (clear footpaths, grouping of obstacles on the car lane)

Variables primarily relevant to low-vision users
Contrast (colour contrast where perceivable, black, white, yellow, magenta)
Lighting quality (indirect, non-glare lighting enabling residual vision at night)
Visual clutter reduction (avoiding reflective materials or chaotic signage)

Variables that disproportionately disrupt both groups
Shared space (loss of edges, flat surfaces, reliance on eye contact)
Nighttime (loss of contrast, fading scent cues, quiet traffic noise)
Dynamic flows (fast bicycles, scooters, inattentive pedestrians)
Irregular tactile paving (blocked tiles, inconsistent logic, guide dogs avoiding harsh textures)

Cognitive mapping
Literature identifies cognitive mapping as a core component of spatial understanding (Espinosa et al., 1998; Afrooz et al., 2012). Interviews confirmed that participants construct mental maps through repetition, stable sensory anchors (sound, scent, texture and material contrast) and recognisable spatial sequences. Kan-Kılıç et al. (2020) similarly found that auditory cues, olfactory markers and tactile textures provide the "anchor points" needed to maintain route memory.

However, these cognitive maps proved fragile in unfamiliar or inconsistent environments. In cities where tactile systems differed, where boundaries were unclear or where soundscapes changed abruptly, participants reported losing orientation rapidly. This shows that cognitive mapping is not only sensory but structural: rhythm, repetition and environmental coherence are essential for spatial understanding.

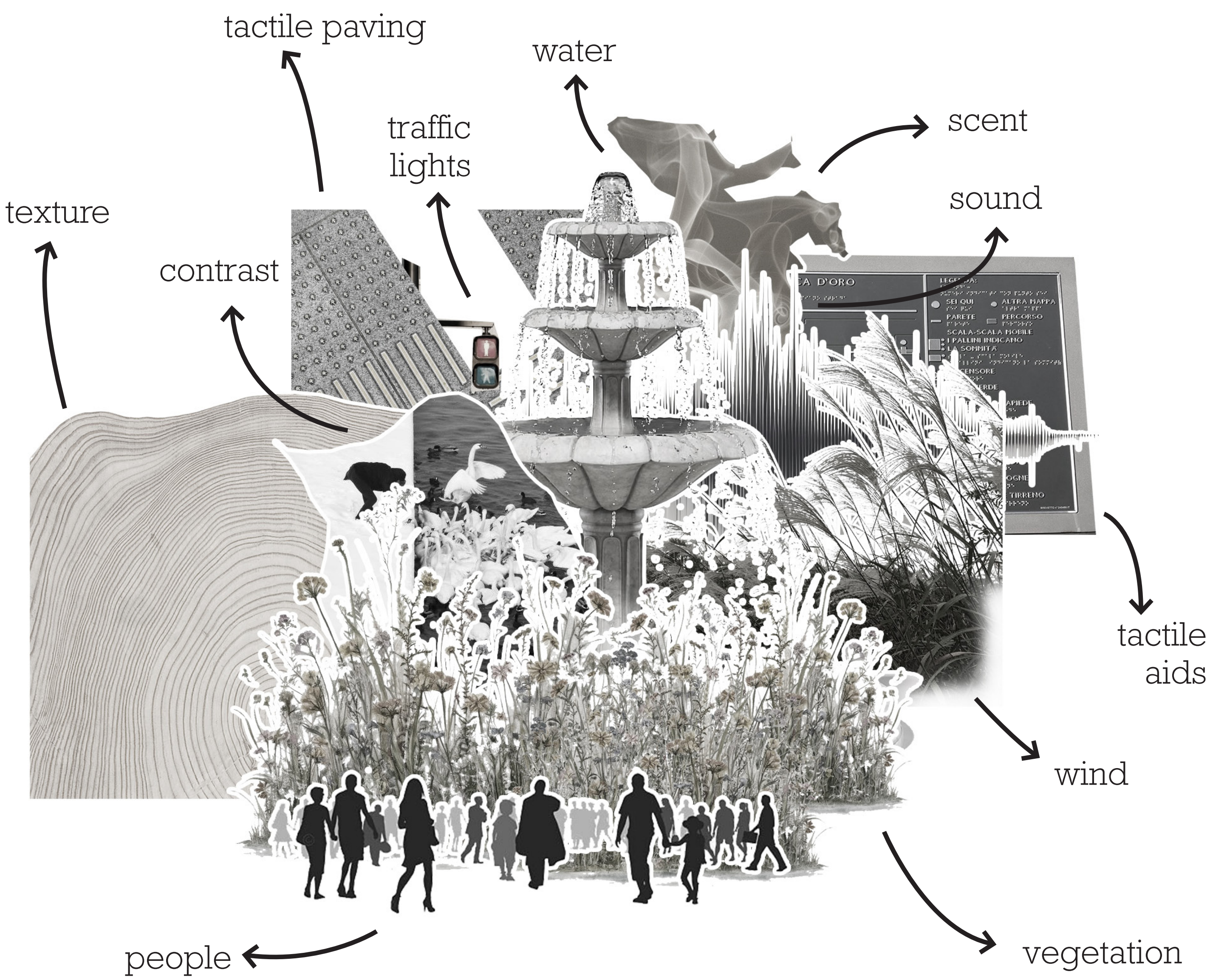
How visually impaired and blind users interpret public space
Visually impaired and blind individuals interpret spatial information through the integration of multisensory spatial design variables, supported by cognitive mapping and environmental coherence. Their ability to orient themselves, manage stress and feel safe depends on the consistency and reliability of these variables and the degree to which they can be perceived (for blind users) or visually interpreted (for low-vision users).

When cues align, continuous tactile lines, indirect lighting, calm sound pockets, stable smells and predictable boundaries, high-density environments become navigable even when unfamiliar. When cues contradict or disappear, blocked tiles, broken contrasts, reflective façades, chaotic soundscapes, shared spaces or nighttime conditions, spatial understanding breaks down.

These findings identify the spatial variables that guide this thesis' towards the phases sensory, site and activate phases, forming an empirical foundation for multisensory strategies in urban environments.

06 SENSORY

The exploration of different sensecapes in The Hague right now and the research on how to turn these into pleasant and helpful sensecapes for the user



6.1.1 Sensescapes in cities
Cities are far more sensory than we tend to recognise. Cities continuously produce layers of sound, scent, texture, microclimate and movement, yet most of these cues emerge unintentionally, as by-products of infrastructure, materials and urban density. While planning and design traditionally focus on geometry, visibility and circulation, the lived experience of public space unfolds through multisensory perception. This is especially true in high-density contexts, where sensory conditions become amplified by tall buildings, narrow corridors, intersecting mobility systems and constant activity.

The user insights revealed how auditory structure, tactile continuity and predictable materials support navigation, whereas irregular paving, shared-space logic, visual negotiation and nighttime environments create uncertainty or stress. The case study of The Hague further illustrated this: sound reflections between tall façades, shifting surface types, overlapping mobility flows and strong wind corridors result in sensory conditions that are rich but rarely legible. There are many helpful cues, such as enclosed quieter edges or vegetation, yet these are often inconsistent, overwhelming or poorly aligned with non-visual wayfinding.

This chapter examines these sensescapes more closely. It explains what sensescapes are, introduces a diagram that illustrates sensory variability and accessibility, and analyses how non-visual cues are currently present in The Hague and how they influence navigation and comfort. The chapter also reflects on lessons from outside the Netherlands, such as Barcelona and Tokyo, where tactile and auditory systems are more coherently embedded and consistent.

These insights address the following sub-question:

To what extent do high-density urban environments provide non-visual sensory cues that support navigation and comfort for visually impaired and blind individuals?

Understanding the strengths and shortcomings of the existing sensescape forms the basis for the design chapters that follow, where all input is translated into design strategies and outcomes that intentionally shape and reconfigure perceptual legibility and spatial independence.

6.2.1 The different sensescapes

Urban environments can be understood as sensescapes: dynamic fields of sound, scent, texture and microclimatic conditions that shape how space is perceived and navigated. Rather than functioning as visual compositions alone, sensescapes emerge through embodied interaction with the built environment, influenced by movement, materiality and spatial form. Authors such as Pallasmaa (1996) emphasise that urban experience is fundamentally multisensory, unfolding through the body long before it is processed through sight. Studies on multisensory cognition similarly show that auditory, tactile and olfactory cues contribute strongly to spatial understanding for visually impaired and blind individuals (Papadopoulos et al., 2017; Bakir et al., 2022).

Each individual experiences sensescapes differently, which makes designing with sensory cues inherently complex. The quality of a sensescape can be understood through its pleasantness. Research on environmental perception shows that pleasantness influences comfort, stress, memory and the willingness to dwell or move through a space. In soundscape studies, it refers to the emotional valence of auditory environments (Nijmeijer, 2022; INCE, 1998), but the concept extends naturally to scent, touch and microclimate. Pleasant smells, smooth tactile transitions or comfortable temperatures can make environments feel supportive, while unpleasant cues create tension or hesitation.

The following subsections introduce the four components of sensescapes that are most relevant for visually impaired and blind users in high-density environments: sound, scent, touch and microclimate.

6.2.2 Soundscape

A soundscape refers to the acoustic environment as it is perceived, experienced and interpreted by an individual. It encompasses all audible components in a space, natural, mechanical and human-made and how these elements interact with the built form to create patterns, rhythms and atmospheres (INCE, 1998; Nijmeijer, 2022). Soundscapes therefore extend beyond mere noise levels: they represent the spatial, emotional and functional qualities of sound within the environment.

Natural sounds are often processed as more intuitive and pleasant than mechanical ones (Nijmeijer, 2022), and consistent auditory cues strengthen cognitive mapping. However, high-density environments often produce overlapping or conflicting sound layers; dense streets, tall façades and constant movement cause sounds to overlap or echo, making it harder to distinguish meaningful auditory cues.

6.2.3 Scentscape

The concept of the smellscape was first introduced by geographer Porteous (1985) to describe the olfactory dimension of the environment and its relationship with human perception. Drawing an analogy with the soundscape, Porteous argued that smells form their own spatial and atmospheric layer, shaping how people interpret and emotionally respond to places. In this thesis, the term scentscape is used to refer to this olfactory environment, as it emphasises the broader sensory and atmospheric qualities of scent in urban space.

Scentscapes consist of the range of smells present in an area and how these are perceived, recognised and interpreted by individuals. They are influenced by vegetation, soil, food, human activity and airflow, and they contribute to atmosphere, memory and emotional comfort. Research shows that olfactory cues can support spatial understanding by anchoring memories or signalling transitions between zones (Huang & Yuan, 2023; Bakir et al., 2022).

For visually impaired and blind individuals, scent is not usually a primary navigational tool, but it provides meaningful contextual information. Distinctive or pleasant scents can make environments feel calmer or more identifiable, while unpleasant or inconsistent cues may increase discomfort or confusion. In dense urban settings, scentscapes often fluctuate quickly due to airflow and mixed land uses, making them atmospheric rather than reliably directional.

6.2.4 Materiality and tactile experience

Materiality forms the tactile layer of the sensescape. It includes ground textures, surface transitions, edges, and the way materials respond to touch, sound and movement. Tactile information is perceived both underfoot and through mobility aids such as the white cane, and it strongly shapes how visually impaired and blind individuals construct spatial understanding. Research shows that spatial cognition for non-visual users relies heavily on haptic exploration, audio-tactile cues and movement-based perception (Papadopoulos et al., 2017; Belir & Onder, 2013).

Contrast also plays an important role within this material layer. For individuals with residual vision, luminance contrast between surfaces, edges or objects helps distinguish pathways, identify hazards and recognise vertical elements such as steps or curbs. When contrast is used consistently, it reinforces the tactile logic of the environment by making transitions more legible. However, inconsistent or overly subtle contrast reduces clarity, especially in low-light conditions or at night, an issue repeatedly raised by visually impaired users in the earlier chapters.

Together, tactile information and contrast form a multisensory framework that supports orientation, reduces cognitive load and increases confidence in movement. Where this framework is clear, spatial legibility strengthens; where it becomes fragmented or unpredictable, navigation becomes more difficult, stressful or unsafe.

6.2.5 Microclimate: wind and temperature

Microclimate refers to the small-scale climatic conditions within urban space, such as wind, humidity, radiant heat and surface temperature. These conditions vary strongly across dense streets due to building height, street orientation, materials and vegetation, and they influence how comfortable or exposed a place feels.

For visually impaired and blind individuals, microclimate is not a primary navigational cue, but it does affect the overall pleasantness of the sensescape. Sudden wind corridors can make sounds harder to interpret, while warm or cool patches help signal shaded, open or enclosed areas. Wind also affects how scents travel and how clearly auditory cues can be perceived.

Although microclimate is less reliable than sound or touch for orientation, it contributes to the emotional and physical comfort of public space. From a design perspective, this means noticing conditions that support or hinder comfort: providing cooler areas in summer, creating sheltered spots in windy locations and offering protection against rain.

In this thesis, microclimate is included primarily as a contextual layer of the sensescape. While it informs the understanding of urban comfort, it does not form a direct basis for the design strategies developed later in the report.

6.2.6 Sensory Variability and Design Thresholds

As said before, pleasantness is inherently subjective. Individuals respond very differently to sound, scent, touch and microclimate: what feels calming or helpful to one person may be overwhelming, unpleasant or even inaccessible to another. For instance, some people enjoy the smell of vegetation while others dislike it, and sound can be a reliable cue for many visually impaired individuals, yet someone who is hard of hearing cannot depend on it at all. This diversity in perception makes it impossible to optimise a sensescape for every possible user.

This variation is not random but follows a familiar pattern found throughout nature. Many physical and behavioural traits , body size, strength, sensory sensitivity, walking ability , tend to distribute around an average, with a smaller group at both extremes. This creates a shape similar to a bell curve: a large middle group whose needs overlap, and smaller groups with very high or very low requirements.

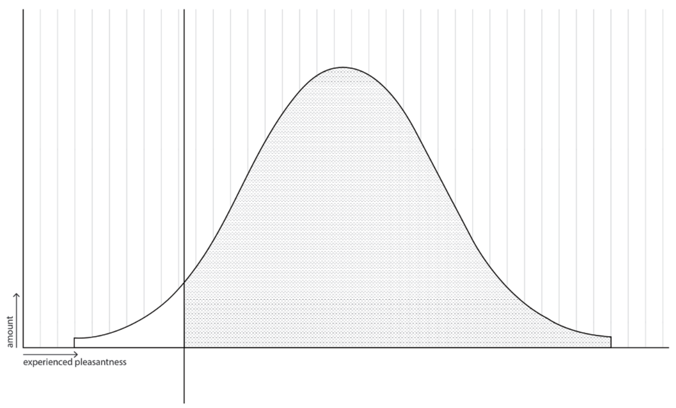
Figure 9 visualises this distribution. The curve represents how many people experience a sensory condition as accessible or pleasant. The vertical black line indicates the design threshold: the point at which an intervention meaningfully supports the majority of users. Those to the left or right of this threshold fall outside the primary design range, not because their needs are unimportant, but because designing for every extreme simultaneously is not feasible without compromising the entire system.

This logic is comparable to accessibility decisions in other fields, for example the placing of benches.

Olympic athletes may not need rest points, while some individuals need a bench every 30 metres. Designing a bench every 30 metres is not realistic city-wide, but placing them every few hundred metres supports the majority while alternative support is provided for those with greater needs. Choosing a design threshold does not exclude those outside the curve, it acknowledges that they may require additional support through assistive technologies, personal mobility aids or specialised interventions.

This diagram is therefore not only a conceptual illustration but a design tool. It makes explicit where decisions in this thesis are positioned and clarifies why sensory strategies focus on the central, functional range: the zone where interventions benefit the largest group while avoiding sensory overload, confusion or harm. Understanding this distribution ensures that the design proposals that follow are pragmatic, intentional and grounded in the reality of human diversity.

Figure 9. *Sensory Variability and Design Threshold*



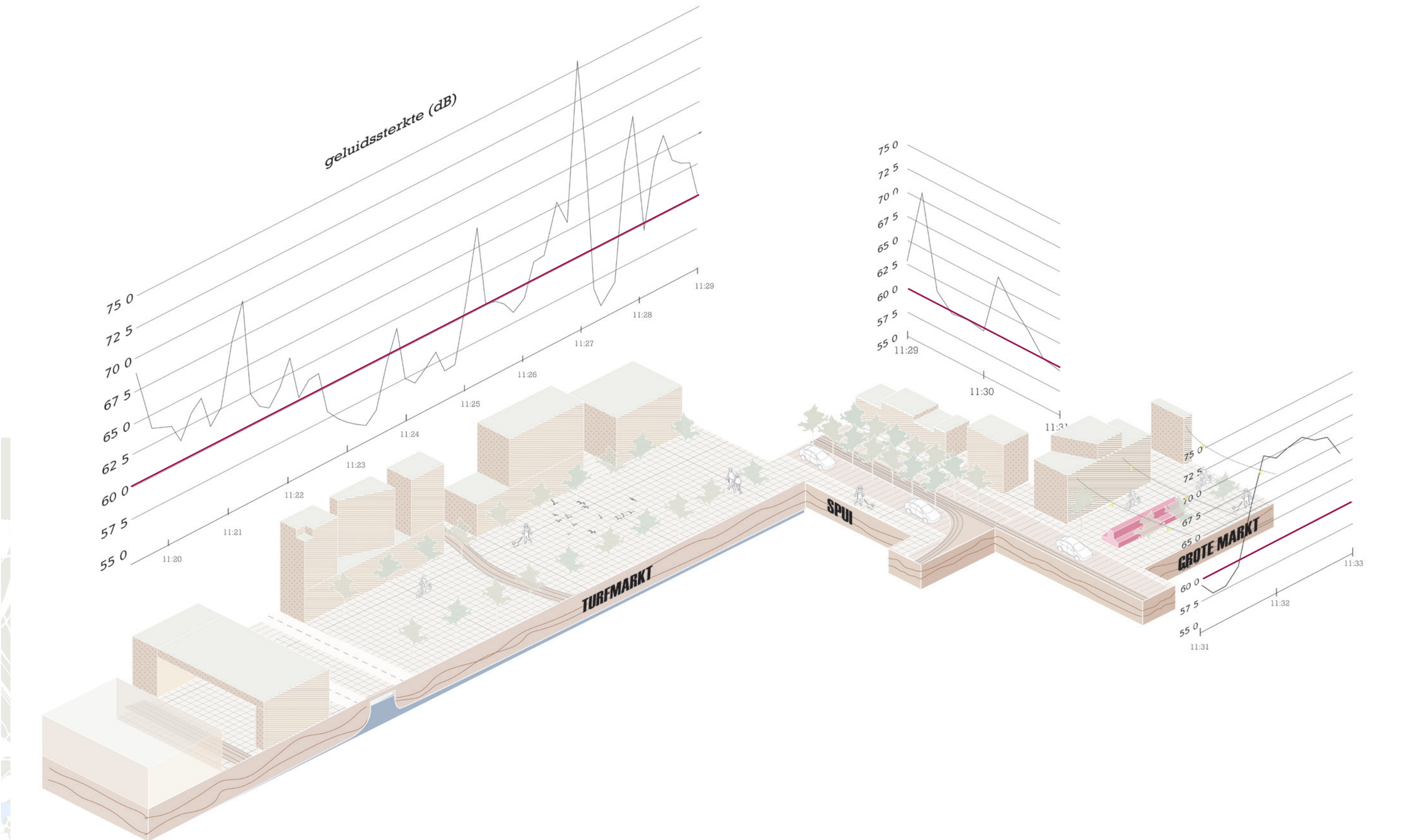
Note. Adapted from insights shared by Guus Janssen (Municipality of The Hague, 2025).

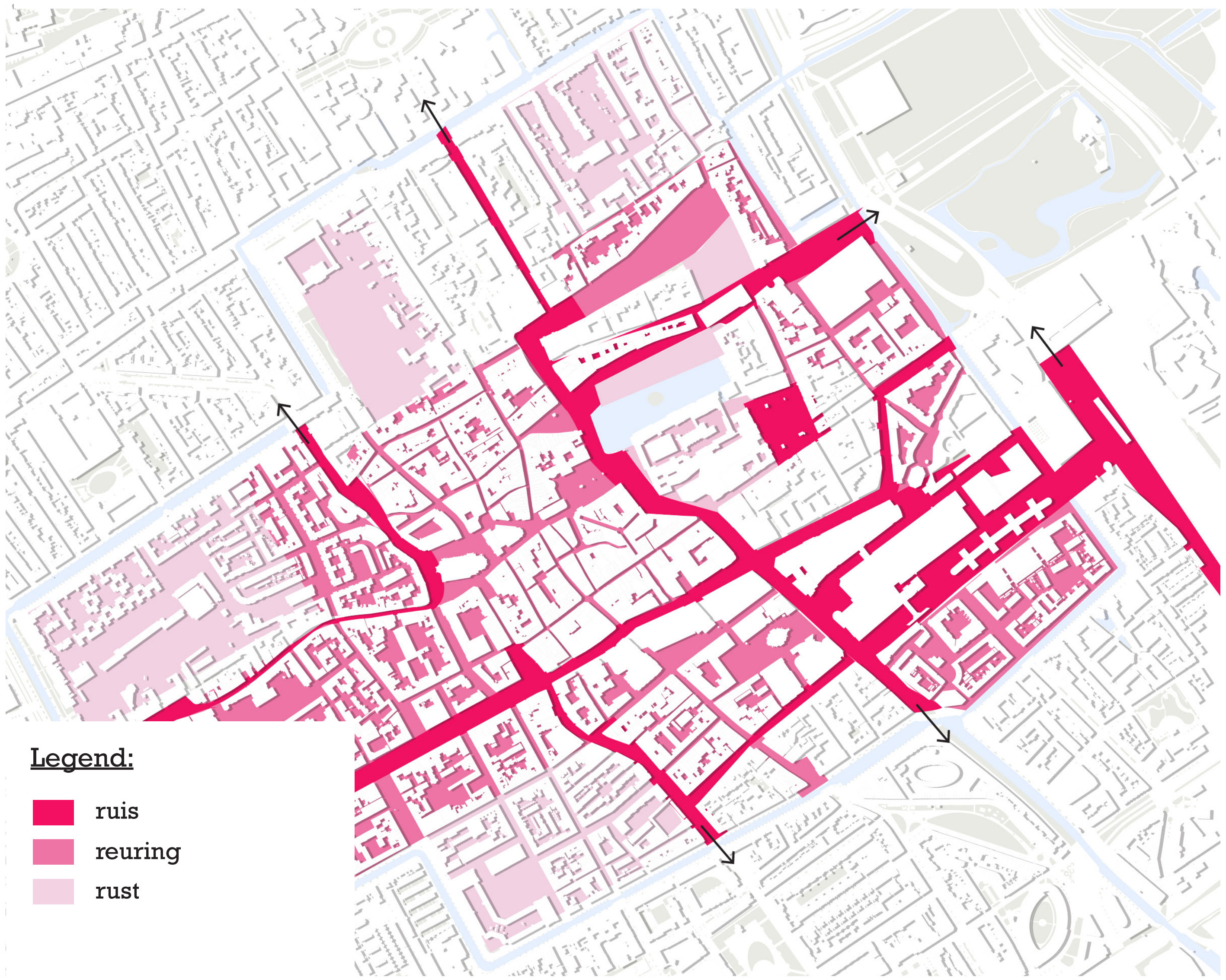
6.3.1 Norsonic Nor 140 and the Kestrel

The sensory findings presented in this chapter draw on a combination of subjective and objective data. Walk-along interviews, blindfolded tests and repeated field visits provided insight into how visually impaired and blind individuals perceive sound, scent, materiality and microclimate in real time. These lived experiences were complemented by objective measurements collected with two instruments: the Norsonic Nor140 and the Kestrel.

The Norsonic Nor140 recorded high-precision sound levels (LAeq) and short audio samples along the route from The Hague Central Station via Turfmarkt, Spui and Grote Marktstraat. A windscreen was used to minimise interference and ensure reliable outdoor recordings. The Kestrel measured air temperature, relative humidity, wind speed and barometric pressure, factors that influence environmental comfort. Mobile measurements were supplemented with stationary readings at key points for 1–5 minutes to capture localised conditions.

Together, these methods form the basis for the sound and microclimate maps presented in the following sections. The combination of subjective impressions and environmental measurements allows the sensescapes of The Hague to be interpreted with greater depth and precision.





Note. based on GIS base data

6.4.1 The sound in The Hague

Sound is one of the most important non-visual cues for visually impaired and blind individuals. It provides orientation, reveals distance and enclosure, and compensates for missing visual information (Zhang et al., 2022; Jianxi & Xinren, 2022). During walk-along interviews, participants repeatedly emphasised that sound strongly shapes their sense of safety, comfort and clarity in urban space. Natural or soft sounds, such as footsteps, rustling leaves and quiet conversations, were described as pleasant and supportive, while mechanical sounds such as trams, engines and construction noise were experienced as stressful and disruptive to concentration (Nijmeijer, 2022; Interview data, 2025).

In line with soundscape research, these experiences indicate that pleasant and unpleasant sound in urban contexts cannot be understood solely through quantitative noise levels. Rather, sound quality is shaped by meaning, context and the balance between wanted and unwanted sounds (Van Kempen et al., 2014). Pleasant sound quality does not equate to silence, but emerges from sounds that are appropriate to the place and activity, and that allow variation without domination. Nevertheless, sound levels above approximately 60 dB(A) are generally perceived as too loud, reducing comfort and restorative potential regardless of sound type. Below this threshold, perceived sound quality is influenced less by absolute sound levels and more by the nature of the sounds present, their relative levels, and the spatial and visual context in which they occur (Van Kempen et al., 2014).

For this analysis, the soundscape of The Hague is categorised into three perceptual groups: Rust (calm), Reuring (liveliness) and Ruis (noise). These terms are occasionally used within Dutch design practice, for example by De Zwarte Hond, and were adopted here because they closely reflect how participants described acoustic atmospheres during the soundwalks.

This map categorises the city centre of The Hague into Rust, Reuring and Ruis, based on subjective impressions recorded during soundwalks, complemented by objective sound measurements.

Rust (calm) areas have low sound pressure levels and often include trees, canals or sheltered side streets. These zones offer acoustic clarity and moments of rest, which all interview participants stated they actively seek when navigating the city centre.

Reuring (liveliness) describes areas with moderate sound activity, such as chatter, footsteps and movement. Participants experienced these areas as lively but not overwhelming, and often helpful, as they provide a sense of "life" without masking essential auditory cues.

Ruis (noise) indicates high-intensity, overlapping sound layers, typically dominated by traffic, trams, deliveries and construction activity.

The map shows that Ruis dominates most major streets, particularly around Turfmarkt, Grote Marktstraat and Spui. These corridors amplify sound due to tall façades, creating echoes and noise canopies that blend and distort auditory cues. Interview participants described these spaces as "exhausting", "hard to follow", and "difficult to interpret", especially when trams, cars and crowds overlap. According to Zhang et al. (2022), such environments can trigger anxiety and reduce spatial clarity for visually impaired users.

Reuring areas appear mainly in narrower commercial streets, where footsteps and conversations create a sense of activity and safety without overwhelming the listener. These environments allow people to orient themselves through the rhythm of movement, speech and acoustic feedback from surrounding buildings.

Rust, however, is almost entirely absent from the central network. Quiet places are essential for visually impaired users to pause, regain focus, meet someone, or reduce sensory overload. As one participant noted, "you cannot turn your ears off." The lack of calm zones in the inner city contributes to cognitive fatigue and reduces comfort during longer journeys.

Soundscapes also include subtle auditory feedback, such as the sound of footsteps on gravel or leaves, which participants described as pleasant and grounding. These cues help distinguish materials, transition zones and spatial rhythm, yet are largely absent in the highly paved and acoustically uniform centre of The Hague.

Overall, the soundscape analysis reveals that while high-density environments such as The Hague provide many auditory cues, these are unevenly distributed and rarely intentionally designed. Supportive sounds, such as footsteps, vegetation and soft acoustics, exist only in isolated pockets, while most major routes are dominated by noise levels that overwhelm or mask essential information. This imbalance directly affects the comfort, orientation and navigational confidence of visually impaired and blind users.

Note. based on GIS base data

6.5.1 The scent

Scent forms the atmospheric layer of the sensescape. While not a primary navigational tool for most visually impaired and blind individuals, it contributes meaningfully to orientation, memory and emotional comfort. Pleasant or recognisable scents can anchor certain locations, while unpleasant ones trigger avoidance or discomfort. Research confirms that smell strongly influences wellbeing, memory and place attachment. Moreover natural or familiar scents are often experienced as calming (Huang & Yuan, 2024; Çeven & Belkayali, 2023). Because scent is directly connected to the hippocampus and amygdala, it can evoke strong memories, sometimes more powerful than visual or auditory cues (Zhou et al., 2021).

This scentscape map is based on walk-along interviews, blindfolded routes, repeated field visits and GIS data identifying vegetation and water. Along each route, scents were noted and classified into categories of emissions, vegetation, horeca/food, local shops scent (Etos, van Haren etc), neutral areas and water-related odours.

The findings show that pleasant scents are present but unevenly distributed. Vegetation, although very limited in the city centre, was consistently described as calming. During the walk-along interviews, several participants expressed a preference for prolonging their route along greenery. In The Hague, the few places that this is possible is near the water at Buitenhof, which, not coincidentally, was also where one participant wanted to sit down to talk, describing it as "a calm and quiet piece of the centre." Food-related scents were useful when subtle and recognisable: the distinct smell of Asian cuisine acted as a strong anchor in Chinatown, and the smell of HEMA sausage helped participants pinpoint part of the Grote Marktstraat. Even the characteristic scent of drugstores functioned as a recognisable location cue, not necessarily pleasant, but spatially informative.

The map also highlights unpleasant but potentially spatially meaningful odours. Emissions from traffic, cigarette smoke, sewage drains and waste points were consistently described as unpleasant or even nauseating. Although these smells are not intentionally used today as spatial markers, they could function as boundary cues, especially since participants explicitly stated that they wanted to move away from these kinds of odours. While such smells do not support comfort, their strong influence on behaviour suggests that scent, even unpleasant scent, contributes to the sensory structure of the city and may hold unexplored design potential.

For visually impaired and blind individuals, scent is most effective when it is subtle, repeated and spatially consistent. This is difficult to achieve for scentscapes: shop scents disappear when doors close, restaurant smells fluctuate throughout the day, the afternoon food smells were often stronger, while morning routes were more neutral. Moreover wind and street geometry disperse odours unpredictably, making scent unreliable as a continuous guide. As a result, scent rarely functions as a stable navigational cue, but it does serve as a memory anchor, helping users recognise or recall places once they have experienced them. This aligns with findings from Huang & Yuan (2024), who show that smell can trigger deep memory responses and influence emotional states, even in people with cognitive decline.

The city centre of The Hague provides few intentional scent cues, and this appears to be a broader pattern in contemporary urban design. Scent is inherently volatile, hard to control and easily influenced by weather, mobility flows and daily rhythms, factors that may explain why cities rarely design with scent as a core layer. Parks, however, remain an exception: they consistently produce identifiable scents from vegetation, soil and water, which is why they stand out so clearly in both this analysis and in the experiences of participants. Çeven & Belkayali (2023) similarly highlight how natural scents and culturally recognisable smells can strengthen identity and comfort within urban environments.

Overall, the scentscape of The Hague shows that scent plays a modest but meaningful role in how people experience the city. Pleasant scent, whether from vegetation, food or recognisable shops, create moments of calm, recognition and groundedness in an otherwise dense environment. Unpleasant smells, such as sewage or emissions, shape behaviour in the opposite direction, prompting avoidance or discomfort and informing how people choose to move through space. Because scent shifts with wind, time of day and activity patterns, it is less suited to provide consistent wayfinding cues, yet it remains powerful in other ways: scentscapes can help trigger memories and create pleasant places.

Note. based on GIS base data

6.6.1 Tactile

Touch and materiality form one of the most reliable non-visual cues for visually impaired and blind individuals. Through the cane, feet or other aids, visually impaired and blind people gather continuous information about surface types, transitions, edges and level differences. Unlike sound or scent, tactile cues do not shift with time of day, making them essential for stable orientation in high-density environments. Research highlights that spatial cognition for non-visual users relies heavily on predictable material logic, audio-tactile feedback and clear transitions (Papadopoulos et al., 2017; Belir & Onder, 2013).

The materiality map is based on repeated field visits and GIS data identifying paved areas, water and vegetation. During walk-along interviews and blindfolded tests, participants actively stepped onto different materials to understand their tactile quality, acoustic feedback and overall pleasantness.

The findings show that The Hague relies predominantly on klinkers (paving pavers) in the city centre. While the sound of cars driving over them was appreciated, creating a recognisable "texture of traffic", participants found klinkers less helpful for personal orientation. Because the surface is relatively uniform and visually busy, it provided limited tactile guidance. Asphalt offered even less support, described as "dead," "silent," and giving no audio feedback underfoot.

In contrast, granite surfaces around the Toernooiveld were experienced as pleasant and informative. Participants noted that stepping onto granite produced a clear change in both sound and feel, creating a small but reliable moment of orientation. Similarly, rougher natural textures such as leaves are described as enjoyable acoustic cues, though their presence is seasonal and therefore inconsistent. Surfaces made from elongated harbour-style tiles were considered difficult, as cane tips frequently caught between the grooves, interrupting safe movement.

Different materials can be extremely helpful in structuring orientation, but only when applied intentionally and consistently. A material palette that is too limited, where nearly everything is paved with the same klinkers, reduces legibility. Conversely, a palette with dozens of materials becomes impossible to interpret and maintain for the municipality. Participants repeatedly emphasised the importance of material differences that are clear, predictable and meaningful, rather than decorative or overly varied.

Tactile paving shows a similar challenge. While guidelines are applied well inside The Hague Central Station, tactile strips in the public realm appear and disappear abruptly. In several places the tactile paving matches the colour of the surrounding pavement, removing the contrast needed by visually impaired users. Guide dogs tend to avoid the bumpy surface and cane users only detect it if they strike it by chance. Participants mentioned white, yellow, and magenta as effective contrast colours, while cautioning that black can look like a hole.

Shared-space concepts amplify these issues. Since shared spaces often use a single material, they remove kerbs, boundaries and surface shifts, creating environments described by participants as "endless" or "directionless." When sidewalks and roadways use identical materials, crossings become difficult to detect, leading several users to report uncertainty about whether they were still on the footpath or had entered the road. Although cities often use uniform materials to create a coherent visual identity, this approach unintentionally reduces tactile and acoustic legibility for non-visual users. Material diversity does not require sacrificing identity; clearer differences between pedestrian routes, cycle paths and roadways would significantly improve orientation.

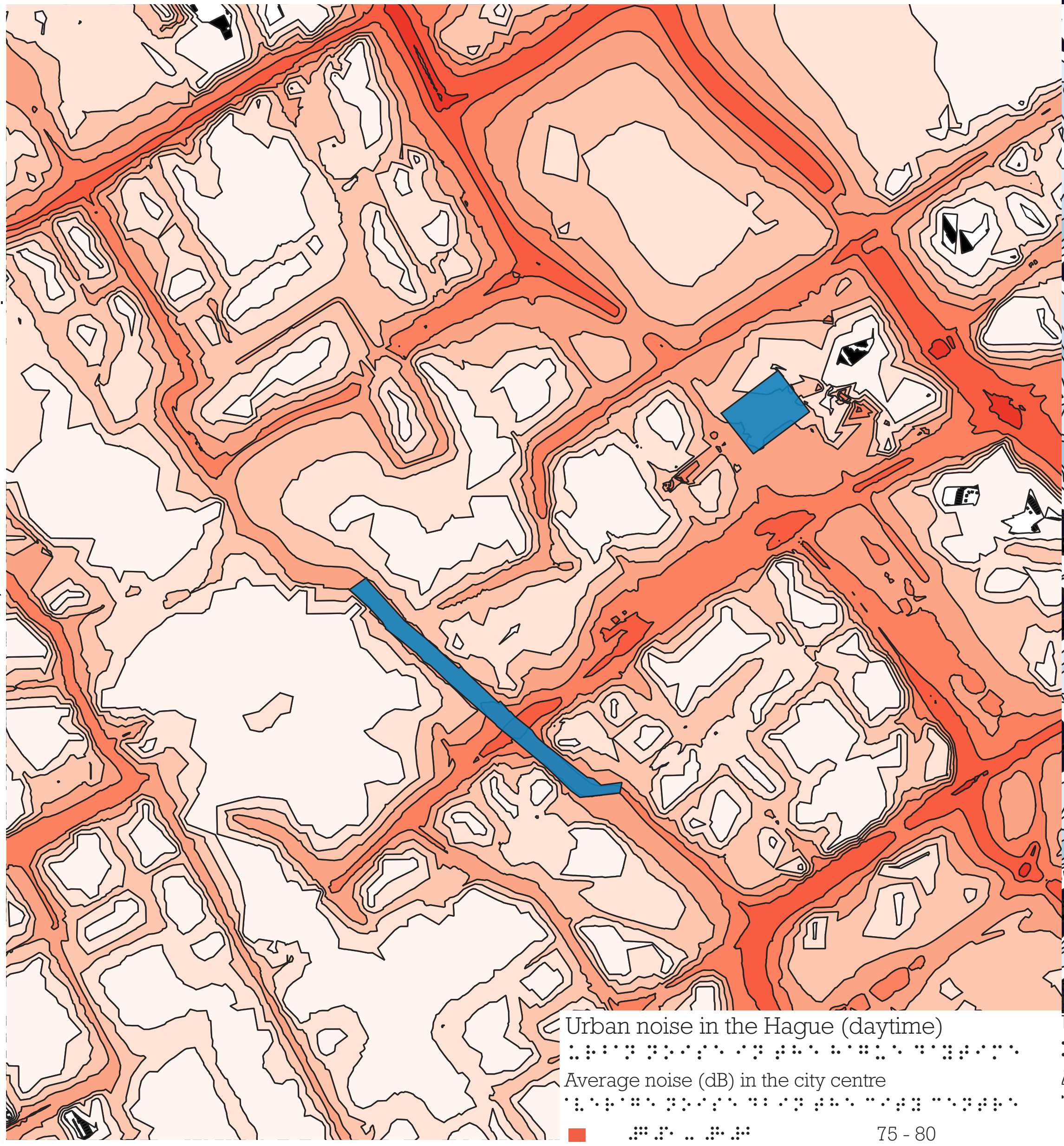
Preferences for navigation varied: some participants walked close to façades to anchor themselves, while others preferred walking centrally to avoid collisions with obstacles like café boards or trees. Level differences consistently presented challenges; the stairs at The Hague Central were highlighted as a positive example due to their tactile clarity.

Overall, the ground material of The Hague offers some tactile and material cues, but these are fragmented, inconsistent and rarely intentional. While certain materials support orientation, many spaces, especially those relying on uniform paving, asphalt or shared-space principles, undermine navigational clarity. A more structured material strategy, supported by a manageable palette that differentiates key functions, would enhance both comfort and legibility for visually impaired and blind people in the dense urban environment of The Hague.

6.7.1 Tactile cartography

In addition to the experiential and measured soundscapes, the noise conditions of The Hague were also explored through tactile cartography. These maps do not represent findings from the walk-along interviews but serve as an example of how complex sensory information, such as urban noise levels, can be made accessible through non-visual means. They demonstrate how auditory data can be transformed into a tactile and spatial format that supports orientation and environmental understanding for blind and visually impaired users.

The value of these maps lies in demonstrating how sensory information, often inaccessible, can be translated into stable, interpretable non-visual cues. Ottink et al. (2022) distinguish between two types of tactile maps: route-like maps, which guide users along a specific path and allow them to feel the exact sequence of turns, crossings and landmarks; and characteristic maps, which provide a broader spatial overview and communicate the qualities of an area rather than a single route. The tactile sound maps presented here fall into this second category. They enable users to understand the acoustic character of the city, where noise concentrates, where calmer pockets exist, and, in doing so, help inform which route someone may choose before entering the environment. Rather than prescribing an exact pathway, characteristic maps support anticipatory wayfinding, memory-building and decision-making for visually impaired and blind individuals by making sensory contexts physically interpretable.



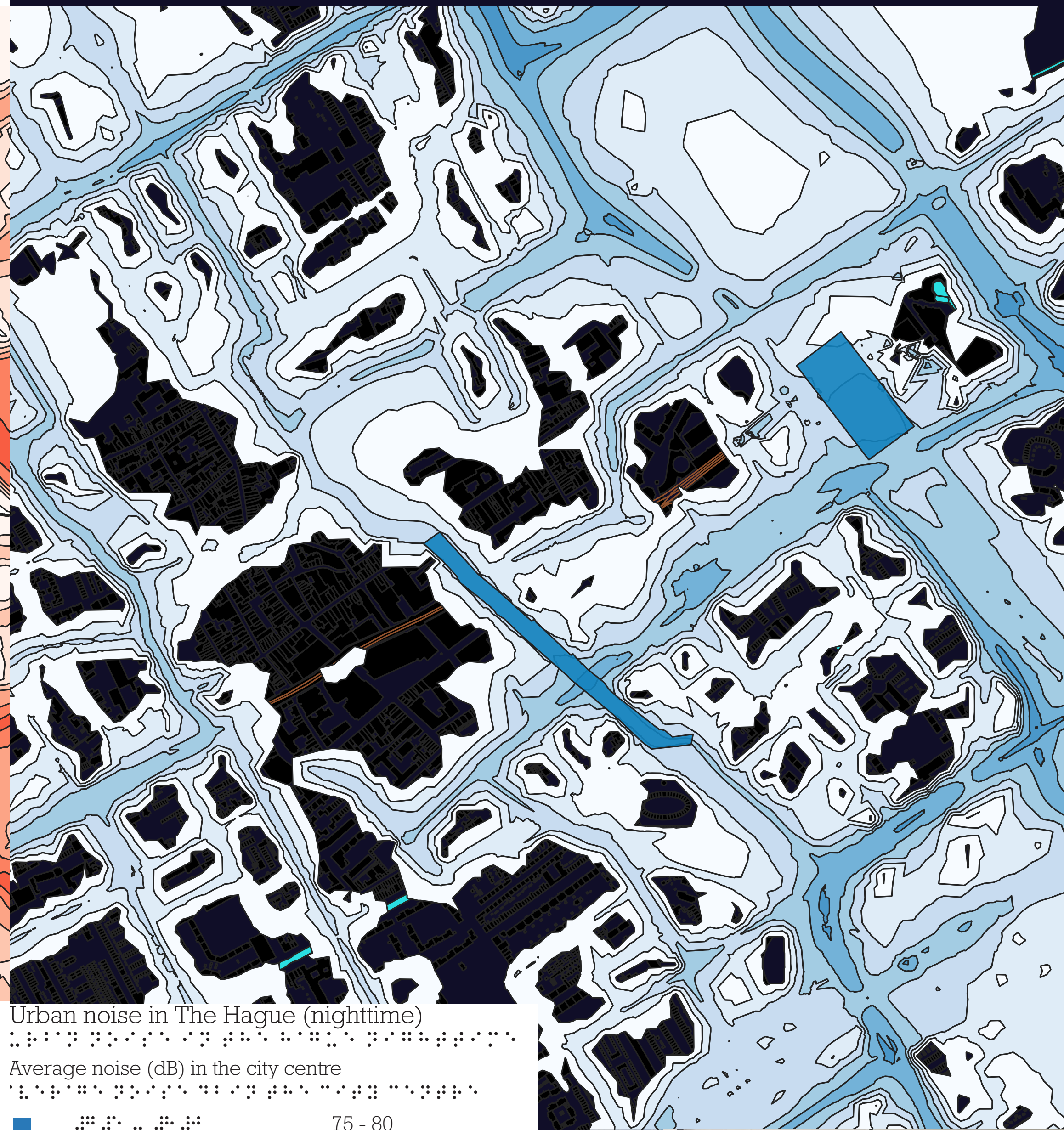
Urban noise in the Hague (daytime)

Average noise (dB) in the city centre

- 75 - 80
- 70 - 75
- 65 - 70
- 60 - 65
- 55 - 60
- 50 - 55
- Less than 50
- The Hague station
- Spui
- Dwellings

0 m — 500 m — 1000 m

The tactile maps are based on municipal noise datasets measured at façade height and translated into 3D-printed surfaces. Higher decibel levels correspond to taller extrusions, creating a landscape of sound that can be explored through touch. Landmarks such as Den Haag Centraal and the Spui corridor are added as tactile anchors, enabling users to position themselves within the map. Braille descriptions and high-contrast legends offer an additional layer of readability, creating a multisensory representation that can be interpreted without sight.

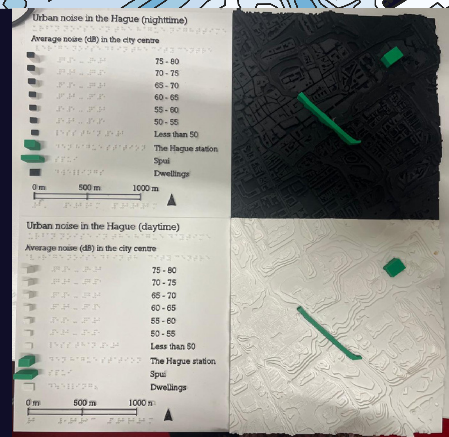


Urban noise in The Hague (nighttime)

Average noise (dB) in the city centre

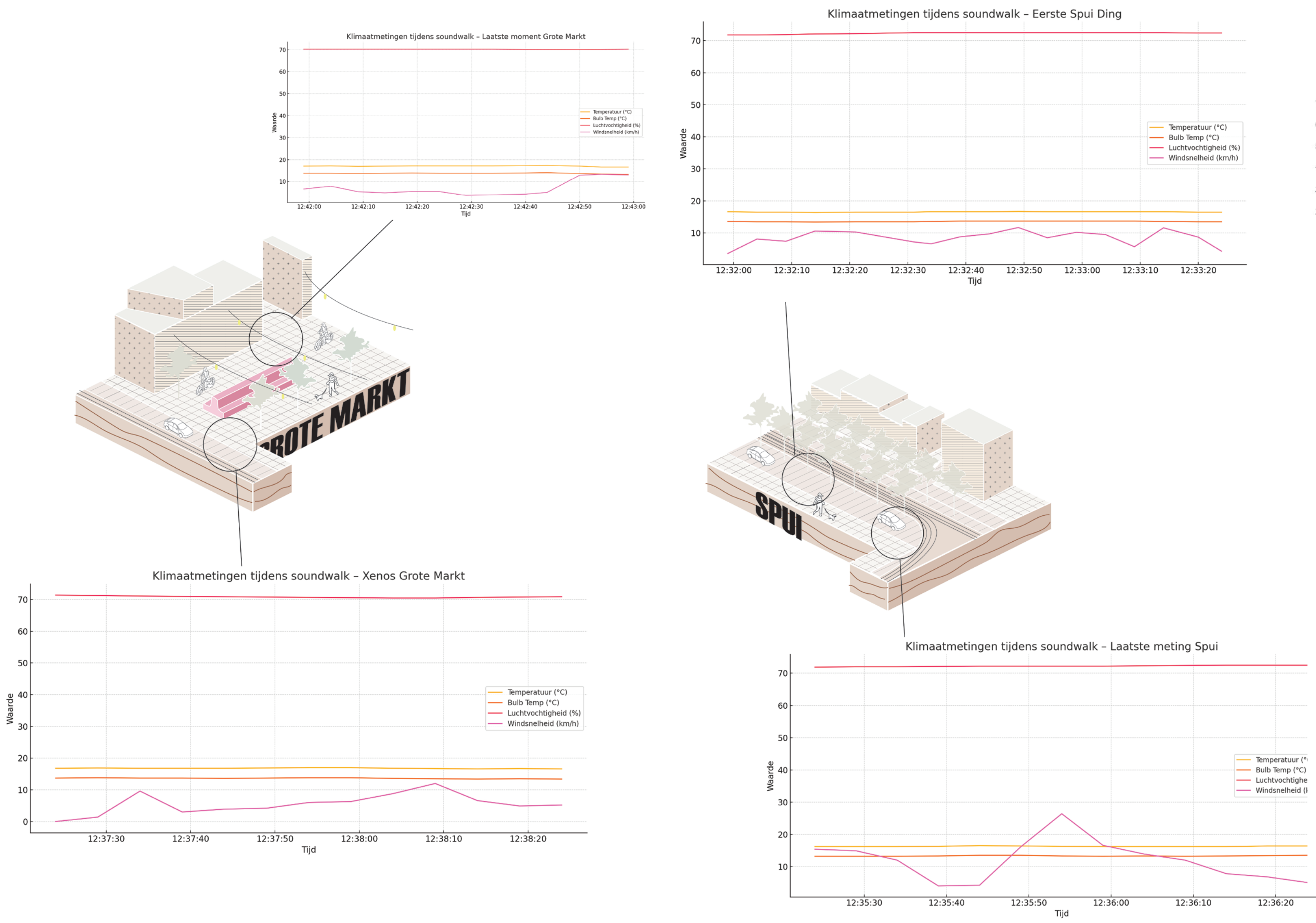
- 75 - 80
- 70 - 75
- 65 - 70
- 60 - 65
- 55 - 60
- 50 - 55
- Less than 50
- The Hague station
- Spui
- Dwellings

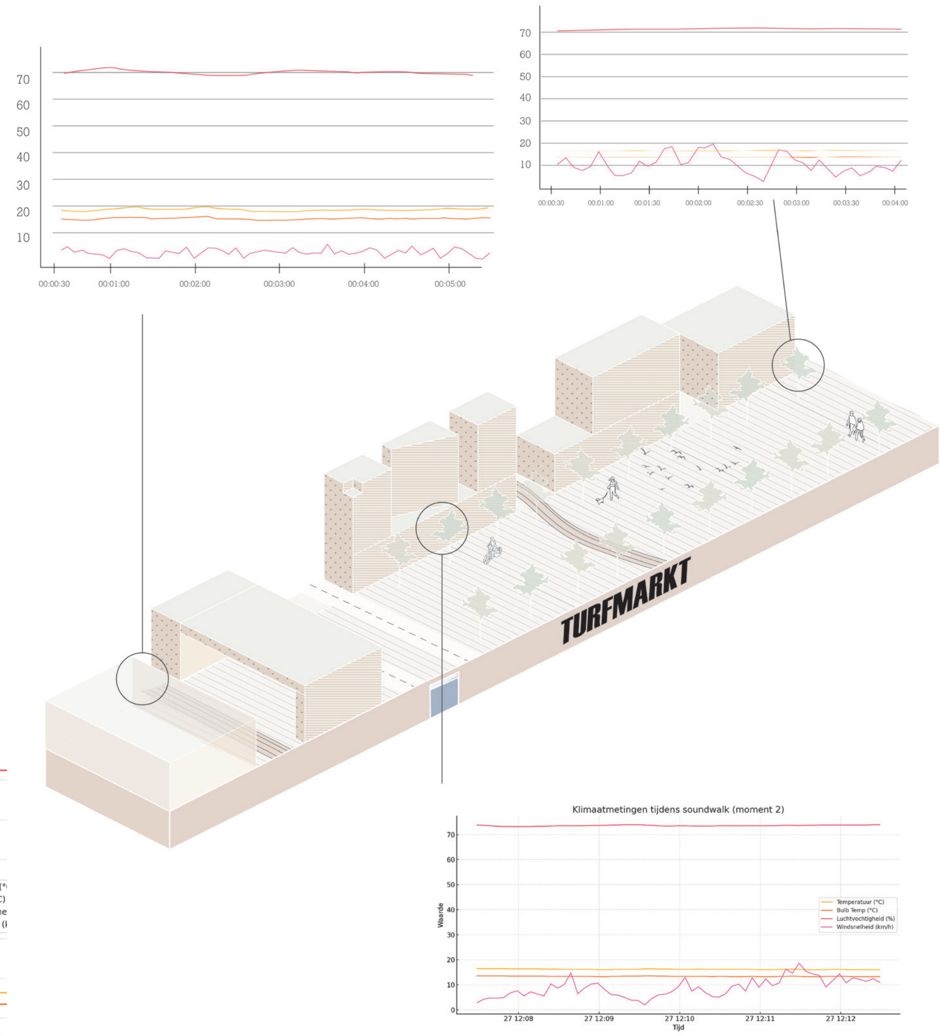
0 m — 500 m — 1000 m



same Interestingly, the tactile maps reflect the same spatial patterns found in the subjective soundwalks and the rust–reuring–ruis categorisation. During daytime, noise concentrations align with the major traffic corridors and the wide urban axes such as Turfmarkt and Kalvermarkt, while quieter pockets appear deeper inside the urban blocks. At night, the tactile maps shift: residential areas become almost silent, while pockets of nightlife activity remain noticeable. This reinforces the observation that The Hague's soundscape is not static but changes throughout the day, influencing how auditory cues function for non-visual navigation.

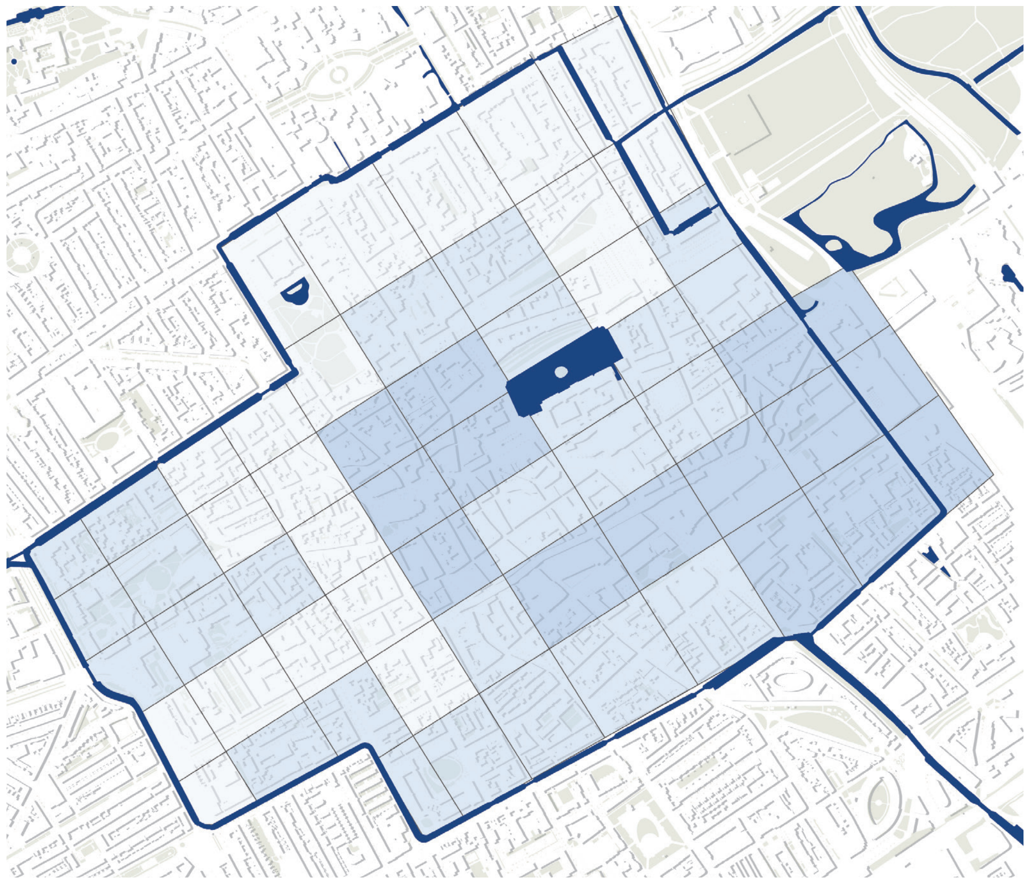
More broadly, these tactile sound maps illustrate a method that could extend to other sensory layers, such as smell or materiality, opening possibilities for future accessible mapping systems. Their correspondence with both the subjective and objective findings in this chapter indicates that tactile cartography can provide an additional non-visual cue that cities currently underutilise.





Legend:

- high wind exposure
- moderate wind exposure
- low wind exposure



correspond closely with both the wind-exposure map and the lived experience of the participants.

- Turfmarkt, identified on the map as a high-wind corridor, showed the strongest and most irregular fluctuations.
- Spui, mapped as a moderate zone, displayed medium but noticeable peaks.
- Grote Marktstraat, shown as predominantly sheltered, registered the lowest and most stable wind speeds.

This alignment reinforces that the spatial form of these streets directly shapes their microclimatic behaviour: enclosed pockets produce calmer air, while open or elongated corridors amplify turbulence. The agreement between the measurements, the map and the subjective impressions strengthens the reliability of the microclimate analysis.

6.8.1 microclimate

Wind and microclimate shape the ambient conditions in which other sensory cues are perceived. While they do not function as primary navigational tools for visually impaired and blind individuals, they strongly influence comfort, sound clarity and the overall experience of moving through a dense urban environment. Microclimate therefore acts as a supportive layer, affecting how long people wish to stay in a place and how easily other cues can be interpreted.

This analysis combines walk-along impressions with objective Kestrel measurements collected along the route from The Hague Central to Turfmarkt, Spui and Grote Marktstraat. Temperature, humidity and barometric pressure remained stable throughout the walk, confirming that wind was the only microclimatic variable that noticeably influenced comfort, whereas the other factors remained constant. Participants commented on the wind, however not in too much depth. The wind was clearly felt, especially around tall buildings, where gusts created discomfort and a sense of confusion about the orientation. Turfmarkt in particular was described as a corridor "where the wind always comes from somewhere."

6.8.2 Objective and subjective data in relation to the wind-exposure map

Across the three locations, the objective wind peaks

6.8.3 wind

Wind also interacts with other sensory layers, particularly sound. Several participants found it harder to interpret auditory cues in windy conditions: gusts scattered noise, blurred directional information and made it more difficult to locate traffic. This corresponds with the Norsonic data, which shows more erratic acoustic behaviour in exposed zones and steadier soundscapes in sheltered areas. In this sense, wind indirectly shapes auditory legibility, even though it does not provide stable cues on its own.

Overall, the microclimate of the city centre supports comfort rather than navigation. Wind highlights open versus enclosed spaces and influences how pleasant or stressful routes feel, but it does not offer continuous non-visual cues. At the same time, many high-density cities, including The Hague, struggle with persistent wind discomfort around tall buildings. These wind corridors act as a negative constant in contemporary urban environments, shaping how people experience public space whether they rely on vision or not. Recognising where wind tunnels occur and where sheltered pockets emerge remains valuable for design, as these microclimatic conditions influence sensory clarity, comfort and the lived experience of visually impaired and blind individuals in dense urban settings.


01. tactile paving to facade


02. disruption


03. different material


04. buffer

6.9.1 Barcelona - Catalonia
Barcelona provides a useful contrast to The Hague because it is internationally regarded, both in policy and reputation, as an accessible region for visually impaired and blind individuals. Catalonia has an established legal framework for disability-inclusive mobility and tourism, and studies note that the region actively works to remove barriers for VI/B users (Fernández & Ubach, 2018). This creates an expectation of a clarity and continuity design in public space. The field observations partially confirm this reputation: Barcelona offers strong material contrasts, consistent tactile logic in principle, and intuitive metro navigation. At the same time, disruptions in the tactile system and the absence of auditory cues reveal important limitations and design opportunities.

6.9.2 Tactile
Barcelona uses the same tactile paving patterns as the Netherlands (longitudinal stripes for guidance, dot patterns for warning), probably because of the European norm. In many locations, Barcelona uses this system is applied clearly (01): tactile routes lead from crossings to the building façade, enabling visually impaired and blind users to arrive at a predictable, safe natural guide. This consistency matches what one participant described during an interview, referring to Barcelona as a city known for accessibility.

However, the system is frequently disrupted. In several places, tactile paths continued directly into obstacles such as trees, street furniture or bicycle stands, undermining the very function of the cue (02). Colour contrast was also an issue (02): tactile paving was often the same colour as surrounding tiles, making it nearly invisible for visually impaired individuals. These inconsistencies show that while the tactile system is conceptually strong, it is not always executed with the precision required for reliable non-visual navigation, a thing many cities apparently struggle with.

6.9.3 Material
One of Barcelona's clearest strengths is the material logic between road, cycle path and pavement. In the Superilla (superblock) areas of Eixample, the car-zone and pedestrian areas are clearly distinguished through shifts in material (03). This helps users immediately recognise when they are drifting off-path. The cane feedback of these materials differs, not overly dramatic, but enough to detect a change underfoot or through sound reflection.

Curbs are present throughout the city, which preserves edge clarity and prevents the ambiguity often created by shared space. Compared with The Hague, where the repetitive use of similar materials creates ambiguity, Barcelona's consistent differentiation supports intuitive route-finding.

6.9.4 Soundscape
Barcelona's soundscape is characterised by moderate traffic noise and calmer pedestrian avenues. Narrow alleys in the Gothic Quarter create echo effects, but these reflections did not appear to support orientation; nor were they overwhelming. Traffic noise was present but generally not dominant, meaning it did not hinder perception the way turbulent soundscapes do in high-density Dutch corridors like Turfmarkt.
But, on the contrary, Barcelona does not use sound beacons or auditory guidance in crossings or public transport.

6.9.5 Scentscape
Barcelona's city centre is filled with bakeries and food shops that produce recognisable, pleasant scents as well as unpleasant scents. The presence of these scents are helpful for wayfinding as they act as subtle spatial anchors, especially in dense areas with limited visual overview. In the Gothic Quarter, where streets are narrow, scents became more reliable as cues because they lingered and were easier to locate.

However, like any large city, Barcelona also contains unpleasant smells such as garbage or sewage. These shaped behaviour: users tended to move away from them immediately. Overall, scent was more useful in Barcelona with the interaction between pleasant and unpleasant scents. However, scent is not consistent enough to serve as a foundational navigational cue on its own.

6.9.6 Microclimate
Unlike The Hague, where wind is the dominant microclimatic variable influencing experience, Barcelona's comfort is shaped primarily by heat. Shaded promenades lined with trees created highly comfortable walking routes (02, 04), while unshaded streets became overwhelmingly warm. In this sense, tree corridors acted as "comfort routes," guiding behaviour through preference rather than navigational clarity. Wind was present but mild and generally perceived as pleasant, far from the strong wind canyons observed in the Turfmarkt area.

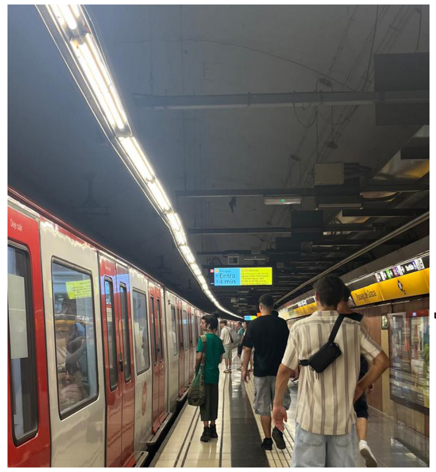
6.9.7 Modes of transport
The metro system was very clear (05): large signs with countdown timers, strong visual contrast, and intuitive platform layouts made navigation straightforward. Interesting sociocultural cues also reinforced accessibility, signage in trains reminding passengers to give up seats for visually impaired people, for example.

However, Barcelona lacked auditory guidance in stations, escalators or crossings. The absence of structured sound cues makes it harder for visually impaired users to navigate independently.

6.9.8 The pedestrian space
Another notable aspect of Barcelona's streetscape is the way pedestrian space is prioritised through the organisation of clutter. Bicycle parking is typically placed on the roadway rather than the pavement (06), which preserves a clear, unobstructed walking line and reduces the likelihood of encountering unexpected obstacles. Similarly, the geometry of the bicycle lane adapts to the pavement (07), its width and orientation shift to respect the continuity of the pedestrian path. This contrasts with Dutch practice, where the pavement often narrows or bends to accommodate cycling infrastructure. In Barcelona, the pedestrian route remains the stable element, while mobility flows adjust around it, resulting in a more predictable and comfortable environment for visually impaired and blind users.

6.9.9 Barcelona
In summary, Barcelona demonstrates how clear material differentiation, consistent kerb logic and a generally coherent tactile strategy can strengthen non-visual legibility in a dense urban environment. Its pedestrian-first organisation, such as bicycle parking placed on the roadway and cycle lanes adapting to the pavement, creates uncluttered, predictable walking lines that benefit visually impaired and blind users. Combined with Catalonia's reputation for accessibility (Pujol Fernández & Vergés Ubach, 2018), the city offers valuable inspiration for shaping multisensory design.

At the same time, Barcelona also exposes important limitations: tactile paths are regularly disrupted, colour contrast is often insufficient, and auditory guidance is almost entirely absent. These gaps reduce the reliability of otherwise strong design intentions. As a comparative case, Barcelona therefore shows both the potential of clear spatial structuring and the importance of maintaining and reinforcing non-visual cues to support fully independent navigation.

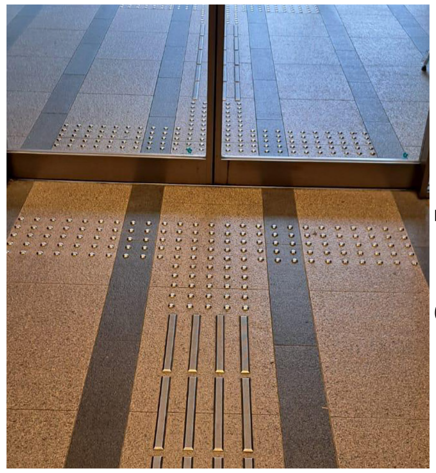

05. subway


06. different material


07. bike adapts to street


01. tactile paving outside


02. tactile paving in malls


03. tactile paving inside


04. buffer

6.9.10 Japan

Japan offers one of the most developed and recognisable tactile infrastructures in the world. Observations from Tokyo and Osaka show a city where accessibility is deeply embedded into public space, transport systems and building interiors. At the same time, the Japanese approach demonstrates the limits of relying too heavily on one sensory strategy, most notably tactile paving, revealing key considerations for designing multisensory environments in high-density cities.

6.9.11 Tactile

Japan's tactile paving (Tenji blocks) was present everywhere(01, 02): in streets, malls, train stations, platforms and building interiors. Directional stripes and warning nodes were used consistently and in accordance with national norms, making the system instantly recognisable and easy to interpret. Outdoors, tactile paving was almost always bright yellow, ensuring strong contrast; indoors, metal-coloured tactile tiles stood out against light flooring (03), guiding users from elevators to exits with remarkable clarity.

Japan is widely recognised as the pioneer of tactile paving systems. The first Tenji blocks were developed in the late 1960s by Seiichi Miyake and were rapidly adopted nationwide, long before tactile paving became standard in Europe. Dixon (1948) notes how tactile paving in Japan developed not only as a warning system but as a comprehensive guidance network, embedded into stations, street crossings and public facilities. This early and holistic adoption has shaped Japan's leadership in non-visual navigation.

However, the ubiquity of tactile paving also introduced drawbacks. Participants in interviews noted, echoed by direct observation, that too much tactile paving becomes disruptive rather than supportive. The Japanese context therefore highlights an important insight: tactile cues need clarity and continuity, but not saturation.

Japan's long history of embedding tactile and auditory cues into complex environments is one of the key reasons it is included as an inspiration in this thesis. As Dixon (1948) describes in his comparison of Tokyo and London, visually impaired commuters in Japan can navigate multi-level metro systems independently using only their cane and the tactile network, something that remains challenging in many Western cities. This demonstrates how non-visual wayfinding can be systematically integrated at the scale of an entire metropolis.

Japanese streets show a strong and reliable material logic. Pathways made of granite or semi-paved materials create crisp audio-tactile feedback, while asphalt bicycle lanes and vehicular roads contrast clearly through sound and texture (04). Curbs were consistently present or replaced by low fences or vegetation strips, both easily detectable with a cane (05).

Clutter was notably minimal. Japan's absence of public trash cans, limited number of parked bicycles and tendency to place shop signage above head height created unusually clean pedestrian zones, allowing independent movement along tactile routes and natural guides. During the night, these elevated signs gained an additional sensory function: many small local shops illuminated their signage, creating a continuous band of light above eye level (06). This produced an effective night-time visual guideline, making it possible for visually impaired people to track the direction of the street without the risk of colliding with obstacles.

6.9.12 Soundscape

Japan's soundscape is considerably calmer than in Dutch cities, shaped by cultural norms of quietness in public space. Sound cues were subtle and structured: shops emitted small entrance sounds and stations used melodic tones and clear announcements to distinguish platforms. Most importantly, audible beacons at street crossings, often in the form of bird-like signals, were present almost everywhere. These cues were pleasant, consistent and effective without contributing to noise pollution.

Combined with predictable train stopping positions and well-aligned tactile paving, these auditory elements enabled confident non-visual navigation in both small streets and large transit hubs.

6.9.13 Scentscape

Tokyo's scentscape provided occasional yet meaningful cues. Local food shops produced recognisable smells, offering spatial anchors along commercial routes. During blossom season, floral scents created atmospheric and location-specific experiences. Unpleasant smells were rare, reinforcing that scent supported comfort more than avoidance.

6.9.14 Microclimate

Tokyo's microclimate fell between Barcelona and The Hague: occasional wind, more than Barcelona, but far less than the extreme corridors observed in the Turfmarkt. Arcades, covered shopping streets and narrow alleys created sheltered, comfortable walking routes. Wind did not significantly hinder orientation, allowing sound cues to remain stable.

6.9.15 public transport

Train stations in Tokyo were particularly clear. Tactile paving reliably connected entrances, the train always stopped at the same location (07), ticket gates, platforms and elevators. Braille on stair rails (08) and elevator buttons improved interior navigation, though this effectiveness depends on the user's braille literacy. Trains stopped consistently in the same positions, aligning with tactile platform markers. Priority seating signage for visually impaired users, women and older adults also reflected a culturally embedded respect for accessibility.

6.9.16 Japan

Japan, and in this case specifically Tokyo offers an exceptionally coherent multisensory environment, characterised by consistent tactile systems, integrated auditory signals at crossings and in public transport, and remarkably uncluttered pedestrian zones. Its mobility network demonstrates how non-visual cues can be embedded at every scale when tactile and auditory information is continuous, predictable and culturally reinforced. At the same time, Tokyo's approach also shows the limitations of relying too heavily on a single sensory strategy, as the extensive presence of tactile paving can become overwhelming rather than supportive. Overall, Tokyo serves both as an inspirational model and a critical reference point, illustrating how dense cities can achieve strong non-visual legibility while underscoring the importance of balancing cues rather than saturating them.


05. fence

06. night lights


08. braille on handrail


07. train stops at same place

06 SENSORY SYNTHESIS

QUESTION 02

To what extent do high-density urban environments provide non-visual sensory cues that support navigation and comfort for visually impaired and blind individuals?

Sensory
High-density urban environments naturally generate layered sensescapes consisting of sound, scent, touch and microclimate. The key question is not whether these cues exist, but whether they are structured in ways that support navigation, comfort and independence for visually impaired and blind (VI/B) individuals. The findings from The Hague show that while all sensory dimensions are present, they seldom align as a coherent system. Instead, cues fluctuate, compete or disappear, creating a sensescape that is abundant yet not consistently harmonious.

Sound is the most pervasive cue in dense environments, but hard to rely on. In The Hague, the rust–reuring–ruis mapping demonstrates that the city centre is dominated by ruis: mechanical noise, overlapping mobility flows and amplified reflections between tall façades. Calm acoustic pockets ("rust"), which interview participants strongly desired, are scarce. This imbalance means that sound conveys atmosphere and movement but rarely provides stable directional information. The tactile sound maps reinforce this: the highest extrusions appear exactly where auditory stress was felt most intensely.

Tactile cartographic maps, however, offer a clear layer of non-visual potential. These physical maps translate sensory information into shapes that can be felt and interpreted before entering the city. In accessibility theory, they function in two ways:
• route-like maps, which show the exact paths to follow, and
• characteristic maps, which can influence the route a person will take.
The maps developed for this research demonstrate how multisensory data, normally intangible, can become preparation tools that strengthen orientation, memory-building and confidence for VI/B users before they enter the area.

Scent is present in every urban environment and contributes importantly to comfort, memory and recognition. In The Hague, vegetation, bakeries and characteristic shop scents provided momentary anchors. However, scent is strongly affected by wind, time of day, shop openings, food preparation cycles and seasons. These fluctuations make scent too inconsistent for navigation, but can definitely aid with the experienced pleasantness and spatial memory.

Materiality and tactile cues are the sensory elements most frequently used in cities to support non-visual navigation and orientation. Because materials change minimally over time, they are stable components of the sensescape. Yet, The Hague demonstrates how their effectiveness depends on consistent contrast, continuity and placement. Granite and façade lines offer clarity, but widespread use of pavers and asphalt reduces distinction between functional zones. There is a fine line between too many materials and too little that it becomes confusing. Tactile paving outside stations is inconsistent in colour contrast and often interrupted; however, stations themselves (e.g., The Hague Central) offer some of the clearest and most coherent tactile environments in the entire city, showing that continuity is achievable. Participants relied heavily on curbs, predictable edges and gentle material shifts, elements that were often more dependable than the formal tactile system.

Microclimate, especially wind, plays an indirect yet influential role. Temperature, radiant heat and humidity remained stable throughout measurements, but wind emerged as the one microclimatic variable that directly alters comfort and sensory perception. High wind levels around tall buildings made it harder to interpret sound, carried scent irregularly, and reduced the overall comfort of exposed streets. While not a navigational cue on its own, microclimate shapes how users experience and decode other sensory information, and can be intentionally designed to create sheltered, comfortable pockets.

Reading these sensescape layers together reveals a clear pattern: they are present, but they operate independently rather than reinforcing one another. This separation reduces their navigational value and increases the likelihood of sensory overload, something participants explicitly mentioned, especially in dense urban corridors like the Turfmarkt. In multiple segments along the main route from The Hague Central to Grote Marktstraat, all senses compete together, creating environments that feel overwhelming rather than legible.

When exploring places outside the Netherlands, it becomes evident how certain design cultures have integrated non-visual cues far more intentionally. Barcelona demonstrates the value of clear kerb logic, strong material differentiation and a pedestrian-first layout, which together create a legible street structure even in dense areas. Its Superilla zones show how reorganising mobility flows can enhance non-visual clarity, while its tree-lined promenades offer microclimatic comfort that subtly guides behaviour. At the same time, disrupted tactile paths and limited auditory cues reveal that even well-intended systems require maintenance, contrast and consistency to truly support VI/B navigation.

Tokyo, in contrast, offers a fully embedded multisensory framework that permeates public space, transit systems and building interiors. Continuous tactile paving, audible signals at crossings, predictable train stopping positions and uncluttered pedestrian zones form a coherent, intuitive network that VI/B individuals can navigate independently. Yet the Japanese case also highlights the importance of balance: overuse of tactile paving can become overwhelming, demonstrating that even the most advanced systems require careful calibration.

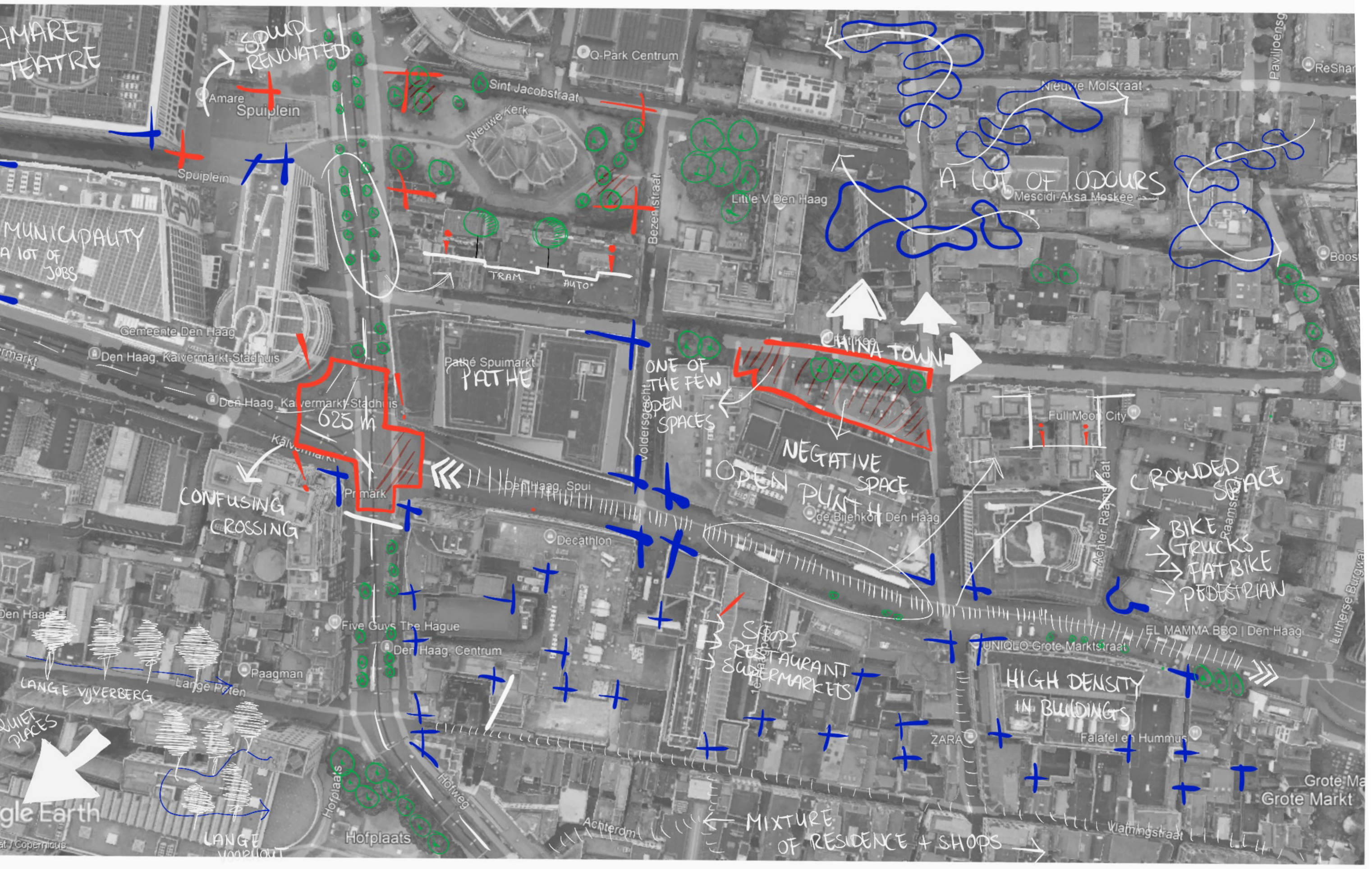
Together, these cities offer meaningful inspiration for the design phase that follows. They illustrate how multisensory cues can become structural elements of urban form rather than incidental by-products. Barcelona shows how material clarity and pedestrian organisation can strengthen orientation; Tokyo shows how tactile and auditory coherence can create predictable, supportive environments at metropolitan scale. These insights inform the design strategies explored in the next chapter, demonstrating how The Hague, too, can evolve toward a more legible and comfortable sensescape for visually impaired and blind individuals.

Overall, high-density cities do provide non-visual sensory cues, but their ability to support navigation and comfort depends on coherence, contrast and intentionality. In their current form, most cues in The Hague, and in many similar cities, act more as atmospheric enrichments than as reliable navigational tools. To meaningfully support VI/B independence, non-visual cues must be designed as interlocking layers rather than isolated elements. The sensescape analysis in this chapter therefore identifies where these layers fail, where they perform well, and where future design interventions can strengthen the non-visual legibility of The Hague's dense urban fabric

07 SITE

This chapter explores how design strategies can establish a predictable structure for cities and develop context-specific multisensory design.

Figure 10. *A Quick Analysis of the City Centre*



Note. Base from Google Earth satellite imagery

7.1.1 Analysis to design

This chapter translates the insights from the previous chapters into tangible design strategies. Two fundamental conditions shape the experience of visually impaired and blind (VI/B) individuals in a city: the need for a predictable spatial structure at the city scale, and the need for pleasant, coherent multisensory moments throughout the urban environment.

Interviews highlighted that navigation depends on recognisable transitions and a city-wide logic that reduces uncertainty. While The Hague offers a rich mixture of sound, scent, touch and microclimatic conditions, these cues are largely uncoordinated and frequently overwhelming. Together, these findings indicate that the city centre lacks both the structural continuity and the sensory intentionality required for confident non-visual navigation.

The analysis shown in Figure 10 synthesises these insights by illustrating the central spatial and sensory conditions of the city centre, from large, confusing intersections and fragmented tactile cues to high-density sound corridors, pockets of calm, distinctive odours, and residual "negative spaces." Based on this analysis, three locations were selected as design test sites in this chapter, each representing a specific challenge identified in the city: structural ambiguity, sensory overload, or the absence of atmospheric or tactile differentiation.

This leads to the central subquestion guiding this chapter:

What strategies can be explored to create site-specific multisensory designs for visually impaired and blind users?

To explore this question, the chapter introduces two complementary design approaches that build directly on the needs revealed in the earlier chapters:
A pattern language, addressing the need for legibility, predictability and structural coherence.

Sensory maximisation, examining how multisensory cues can reinforce rather than weaken one another.

In this chapter, the pattern language is developed first to establish the foundational spatial clarity needed across the city. The sensory maximization follows, testing how environmental stimuli can be intentionally shaped to support non-visual navigation and introduce sensory richness without causing overload. Together, these methods explore how predictable structure and context-specific multisensory strategies can work in tandem to create more supportive, legible and comfortable environments for visually impaired and blind individuals.

7.2.1 The language

A pattern language offers a structured way to translate recurring spatial problems into adaptable design principles. Originally introduced by Christopher Alexander, patterns describe situations in the built environment in which a specific challenge repeatedly emerges and propose a spatial response that can be tailored to different contexts. Each pattern holds both a problem and a hypothesis: an informed assumption about what type of spatial configuration may address that problem effectively. As Alexander emphasizes, patterns are not rigid prescriptions, but evolving tools that mature through repeated application, observation and refinement (Alexander et al., 1977).

In this thesis, the pattern language builds on this adaptive logic. It translates insights from interviews with visually impaired and blind individuals, fieldwork in The Hague, Barcelona and Tokyo, and relevant literature into a set of spatial strategies that respond to the challenges identified in the User and Sensory chapters. Following Alexander's principle that a pattern represents "our current best guess" of how to address a given problem, these patterns function as provisional hypotheses that remain open to adjustment as new experiences or environments are examined.

For visually impaired and blind people in particular, experiential knowledge is central. Participants in the interviews and walk-alongs articulated precisely how spatial arrangements either supported or hindered their orientation, safety and comfort. These lived experiences often reveal needs that visually oriented design methods overlook. Because research on non-visual navigation in urbanism remains limited, a Pattern language is especially valuable: it provides an adaptable design vocabulary that can respond to a range of urban conditions while remaining grounded in user experience.

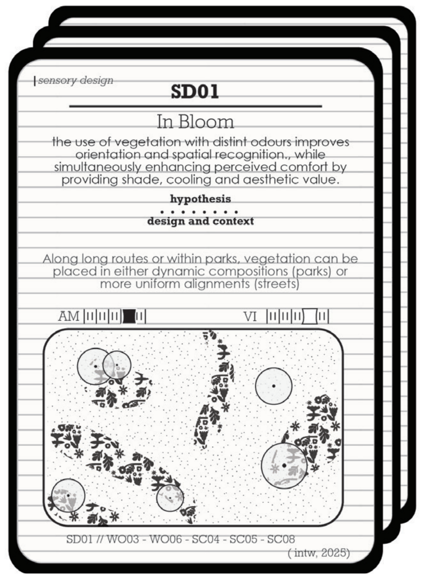
Patterns operate not as isolated elements but as a network. They reinforce, complement or occasionally contradict one another. This web of interconnections is what allows them to function as a "language": a coherent set of design cues that guides decision-making at different scales and situations. Taken together, the patterns in this thesis are organised into three problem domains that emerged from the research: design blindness, environmental overstimulation, and spatial chaos. These form the basis for three corresponding categories: Wayfinding & Orientation, Sensory Design, and Safety & Comfort.

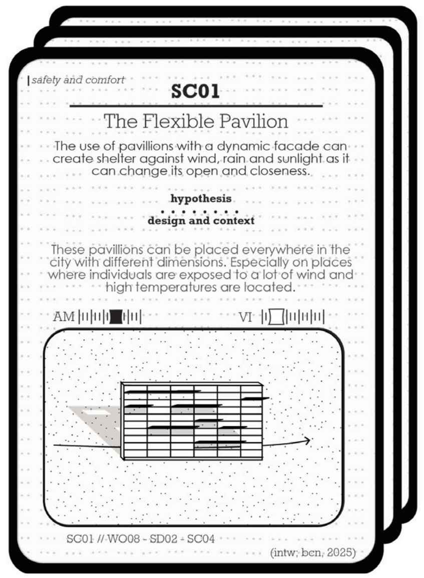
7.2.2 Role in this thesis

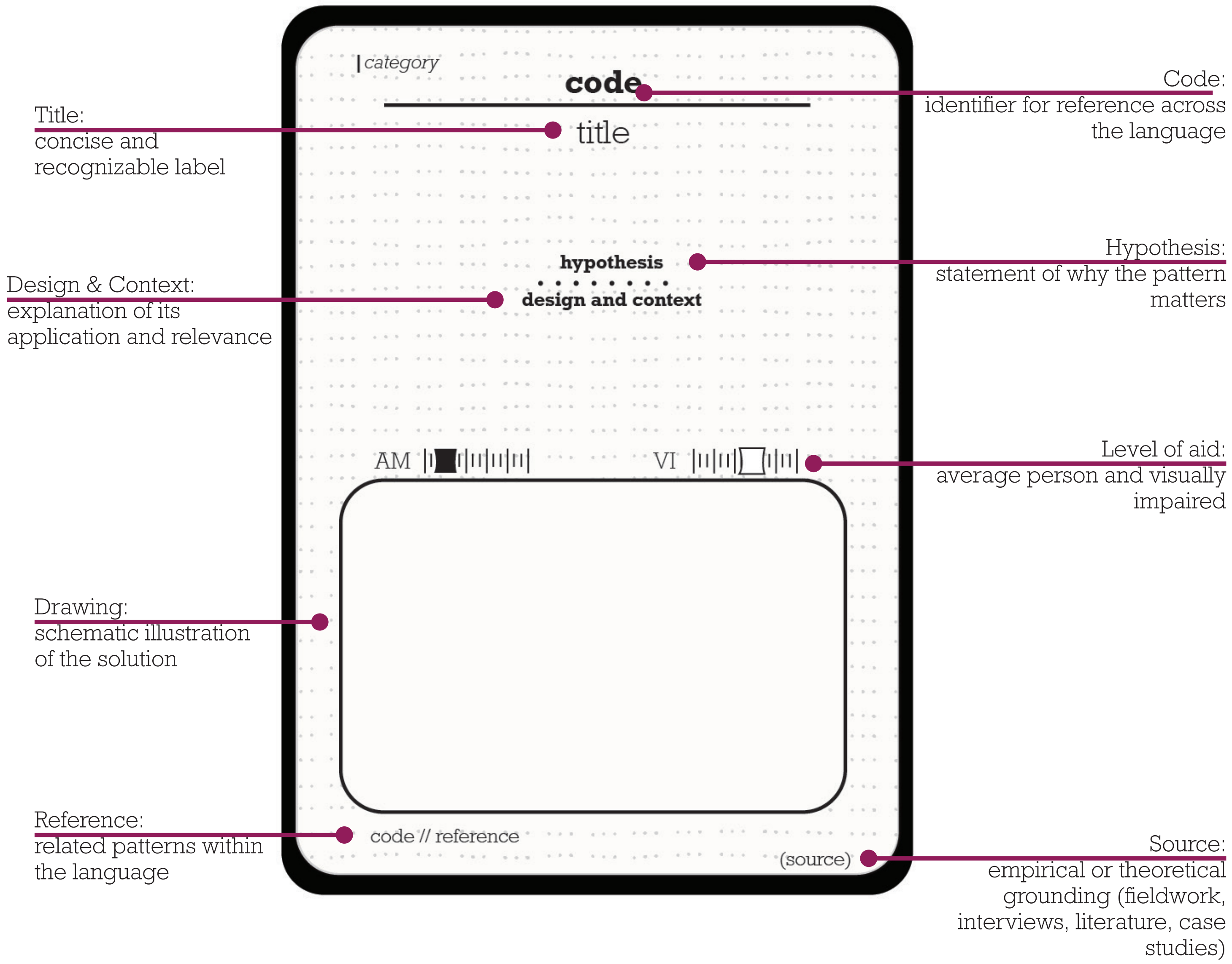
Enhancing the experience of visually impaired and blind individuals requires more than isolated interventions. It demands a layered approach that works across scales, from the street profile to the tactile detail. The pattern language serves as a design tool that offers structure within this complexity. The patterns propose spatial and social interventions that can be adapted to The Hague while also being transferable to other urban contexts.

In practice, these patterns establish the foundational layer of predictability and legibility across the city. They address the structural gaps identified earlier and propose ways to reduce ambiguity, improve continuity and support confident navigation.

In the next pages, the patterns are introduced with their logic, background and shown how they can be used as a design strategy in public space design.







7.3.1 The categories

The patterns in this thesis respond to three recurring problems identified in the User and Sensory chapters: design blindness, environmental overstimulation, and spatial chaos. These problem domains form the basis for three categories in which the patterns are organised. Although each category has its own focus, together they create a coherent framework for understanding and improving public space for visually impaired and blind users.

<u>Wayfinding and Orientation</u>
Core principle: Establish continuous, understandable, and legible routes.
Goal: Support spatial orientation and route definition.
Focus: Structural clarity of paths and junctions.

<u>Sensory Design</u>
<u>Core principle</u>: Activate sensory cues strategically to enhance recognition and place attachment.
<u>Goal</u>: Employ non-visual sensory inputs (sound, texture, smell) not only for navigation but also for multisensory accessibility and qualitative experience.
<u>Focus</u>: Material contrasts, vegetation, sound cues, and wind or acoustic modulation.

<u>Safety and Comfort</u>
<u>Core principle</u>: Create safe, stress-free, and socially inviting environments.
<u>Goal</u>: Foster both physical safety (traffic, obstacles) and psychological comfort (predictability, social cues, atmosphere).
<u>Focus</u>: Safe crossings, lighting, resting points, noise buffers and landmarks.

To enhance readability and clarity, each pattern is presented with a distinct background texture. These textures serve as a visual layer of information, signaling the category to which the pattern belongs. In addition, a coding system is applied to each pattern, allowing readers to immediately recognize and compare categories across the full set.

7.3.2 The Pattern

Each pattern is presented in a card-based layout designed to foster interactivity and clarity. The structure of the card is shown on the left page. At the top left, the category is indicated; in the center, the bold code is displayed with the title directly below. A concise hypothesis follows, formulated in a few sentences and then complemented by design guidelines and contextual notes on how the pattern can be applied.

Two evaluation sliders are included: one representing the experience of the average person (sighted users) and one representing visually impaired users. The latter is based on the input of 10 (4 VI, 6B) participants, aged 18 to 65, who evaluated each pattern using a five-point scale:

1 - Not helpful at all

2 - Interesting idea, but not workable in practice

3 - Promising, but needs refinement

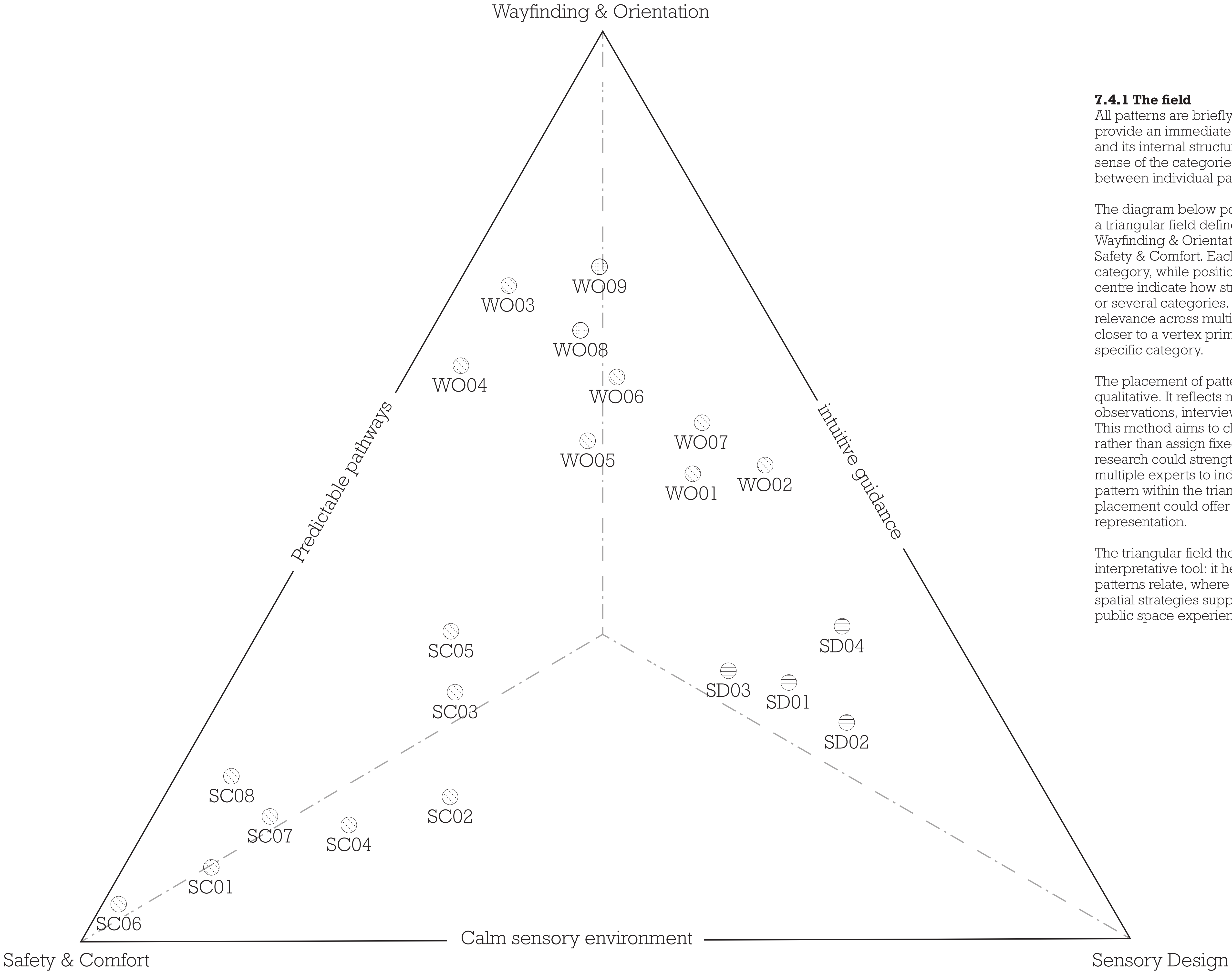
4 - Helpful in most situations

5 - Very helpful; would significantly improve public space experience

The averages of these scores are displayed in the slider. All qualitative comments and detailed reflections from the participants are included in the appendix, providing further insight into how each pattern was interpreted and assessed.

The further the slider is positioned to the right, the more favorable the pattern is for the respective group.

Each card also features a drawing that symbolically represents the code or title. Below the drawing, cross-references to other related patterns are listed, while the bottom right corner cites the source of inspiration. These sources often stem from direct field observations or precedents in urban practice, they are reinterpreted, adapted, and refined to address the specific needs of visually impaired individuals, ensuring originality while remaining grounded in empirical insight, on the back of each pattern, the source is elaborated.



7.4.1 The field

All patterns are briefly presented on the left page to provide an immediate overview of the full language and its internal structure. This offers a quick visual sense of the categories and the relationships between individual patterns.

The diagram below positions each pattern within a triangular field defined by the three categories: Wayfinding & Orientation, Sensory Design, and Safety & Comfort. Each vertex represents one category, while positions closer to the edges or centre indicate how strongly a pattern relates to one or several categories. Patterns near the centre hold relevance across multiple domains, whereas patterns closer to a vertex primarily address the needs of that specific category.

The placement of patterns in this diagram is qualitative. It reflects my interpretation based on field observations, interviews, and theoretical insights. This method aims to clarify dominant tendencies rather than assign fixed numerical values. Future research could strengthen this diagram by asking multiple experts to independently place each pattern within the triangle, after which an averaged placement could offer a more empirically grounded representation.

The triangular field therefore serves as an interpretative tool: it helps readers understand how patterns relate, where categories intersect, and which spatial strategies support multiple dimensions of the public space experience.

7.5.1 The scale-experience diagram

The diagram below positions the patterns along two axes: the scale of intervention and the degree of experiential presence. Together, these axes illustrate how patterns operate within the urban environment and how they contribute to legibility, sensory clarity and comfort. Compared to the previous overview, this diagram offers a deeper analytical layer by showing how each pattern functions across different spatial scales and levels of perceptual intensity, clarifying the internal logic that connects structural legibility with sensory experience. In addition, the connecting lines reveal how patterns relate to one another, indicating which strategies naturally reinforce or follow each other within the broader language.

Horizontal Axis | Scale of Intervention

The horizontal axis moves from large-scale urban structures on the left to small-scale object interactions on the right.
At the large scale, patterns work within the spatial ordering of the city, such as street profiles, rhythms, buffers or roundabout structures. These interventions structure movement flows and define the broader framework of public space.
At the medium scale, patterns shape the configuration of streets and intersections, influencing how users perceive transitions, edges and spatial sequences.
At the small scale, patterns operate directly at the level of touch and bodily interaction, such as entrances, tactile details, benches or sensory screens.

Vertical Axis | Degree of Experiential Presence

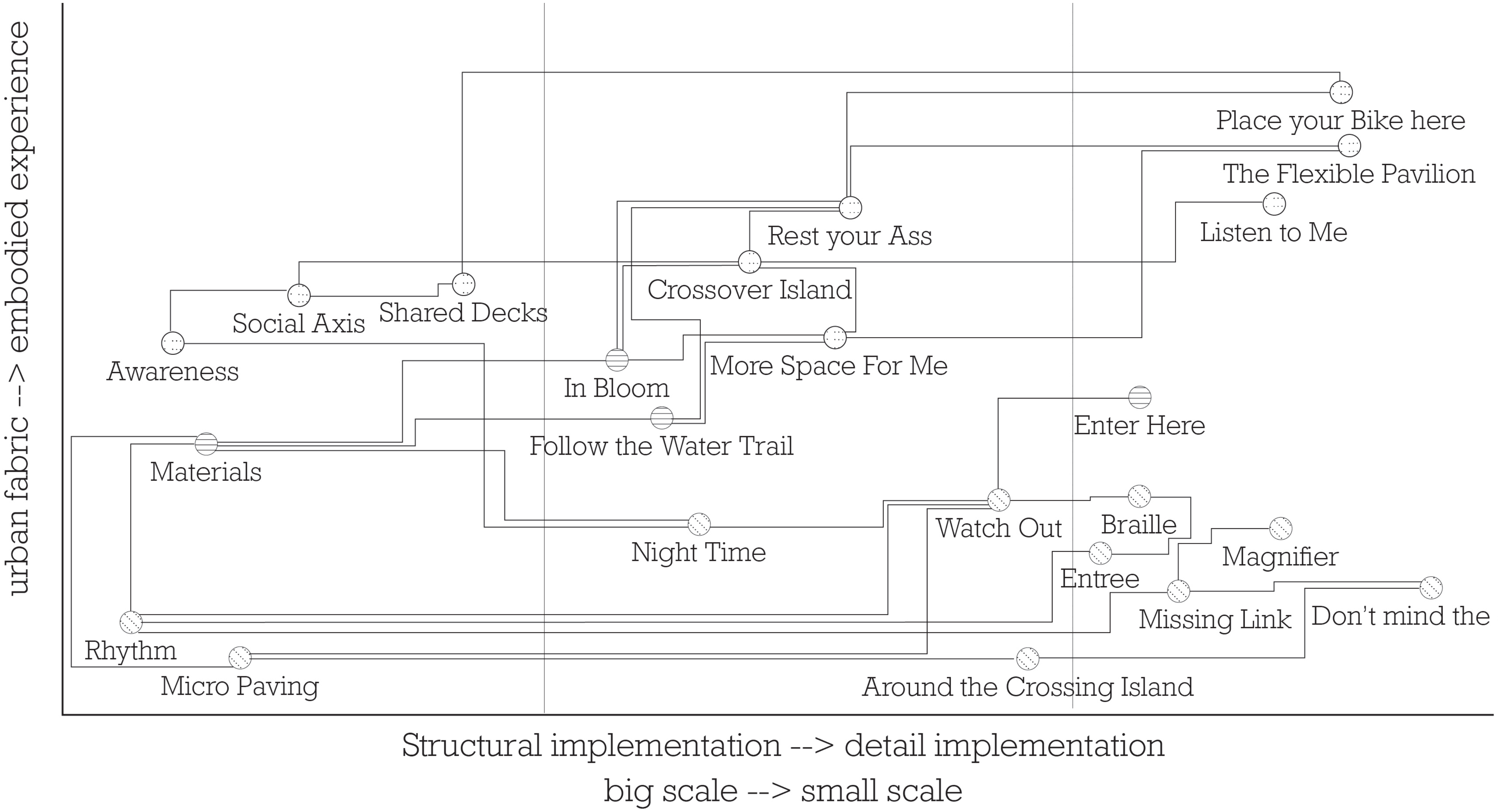
The vertical axis reflects how strongly a pattern is felt, noticed or perceived in daily use.
Patterns near the lower part of the diagram function as background systems embedded in the spatial logic of the street.

Moving upward, patterns become increasingly perceptible: they introduce sensory or atmospheric cues that actively support orientation, recognition or comfort.
At the highest level, patterns contribute directly to safety and immediate sensory feedback, addressing conditions that must be understood instantly by visually impaired and blind users.

The large-scale patterns are represented by awareness, materials, rhythm, and micro-paving. Each of these operates as a structural layer of legibility within the city. Rhythm is about predictability and foreshadowing the rest of the urban environment. Using the same type of aid to address entrees, public transport or guidelines in the street adding up to a legible environment. Furthermore, the large-scale patterns are dependent on materials. Materials provide another layer, capable of dividing paths or activities without barriers, and can range from vegetation or water to the reflective and indirect lights under sunset Micro Paving addresses the lay-out and use of materials in public spaces. It should show, feel and tell how to follow roads, it highlights obstacles and creates the same legibility throughout the city. Finally, awareness patterns extend across the urban scale, ranging from signage to lighting strategies, and contribute not only to accessibility for visually impaired people but also to the general legibility of the city for all

However it is important to note that, even though each pattern is created as an aid to orientation and safety, when all patterns would be placed at the same location they woudl undermine one another or are able to create hazards.
The diagram should not be understood as a rigid classification. Each large-scale pattern inevitably contains smaller-scale dimensions, and the layering of scales ensures that interventions reinforce rather than isolate one another. Not all categories intersect directly, yet this does not imply incompatibility.

This is why the diagram traces lines of complementarity: to emphasize that patterns must be composed in ways that extend, reinforce, and balance each other, rather than being applied indiscriminately.



7.6.1 wayfinding and orientation

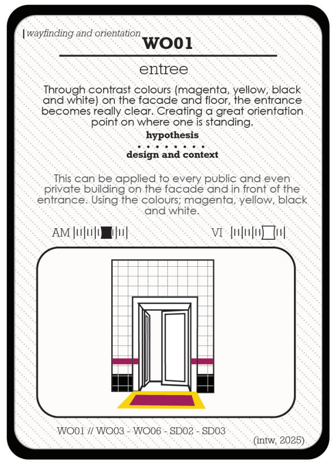
Wayfinding and orientation form the structural foundation of public space. The quality of this layer directly affects how users move through the city, but for visually impaired and blind individuals it is especially critical. Interviews and walk-along studies showed that navigation depends on predictable sequences, recognisable transitions and a continuous spatial logic that reduces uncertainty. When this logic breaks, through inconsistent materials, confusing street profiles or unclear crossings, orientation becomes challenging and stress levels increase.

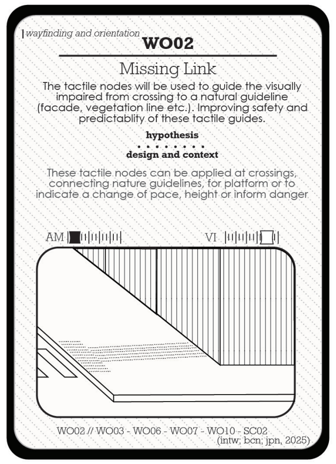
Research reinforces these findings. Bredmose et al. (2022) demonstrate that more than 60% of visually impaired adults select destinations based primarily on ease of access, highlighting the importance of environments that minimise ambiguity and support independent mobility. Physical cues embedded in the street, such as tactile guidelines, kerbs, edges and consistent rhythms, remain indispensable, particularly since digital navigation tools can introduce additional barriers related to accessibility, interface limitations or reliance on battery power (Prandi et al., 2021).

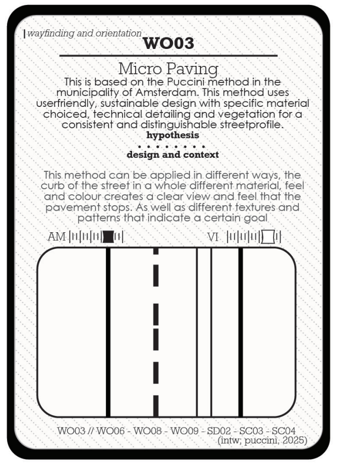
The patterns in this category translate these insights into spatial strategies that strengthen legibility. They focus on clear edges, rhythmic placement, continuous tactile lines and identifiable junctions, elements that help users anticipate what comes next and form a coherent mental map. Dalke et al. (2013) highlight how colour and contrast at entrances and façades can support recognition, while interviews confirmed the need for consistent cues at crossing points and building access.

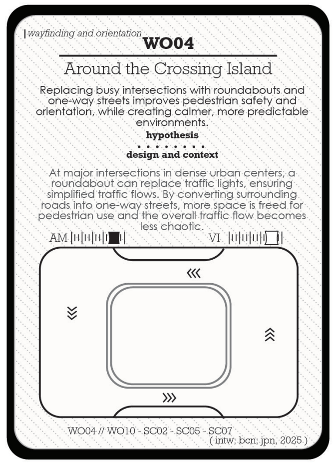
Lighting is another crucial component. Participants emphasised that continuous, indirect lighting improves recognition after sunset, whereas isolated points of light or strong glare often create confusion. Visual fragmentation at night can disrupt spatial anchoring, a point echoed by Kavee and Flanigan (2025), who argue that inconsistent lighting impairs the formation of a stable cognitive map.

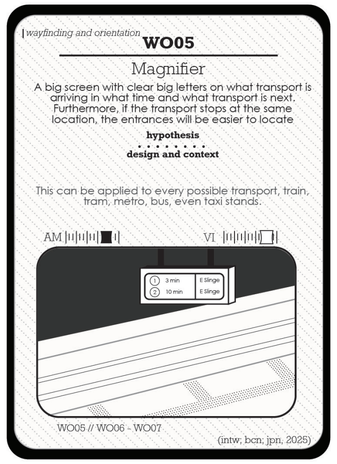
Together, the Wayfinding & Orientation patterns strengthen the underlying structure of the city. They establish a stable spatial rhythm that supports confident movement for visually impaired and blind users, while simultaneously enhancing clarity for all pedestrians.

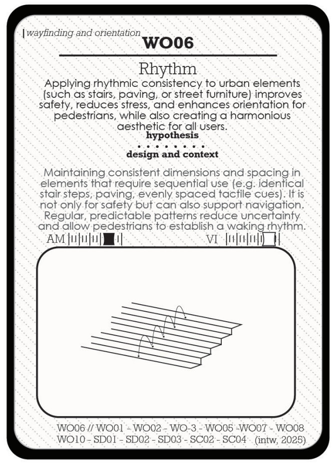


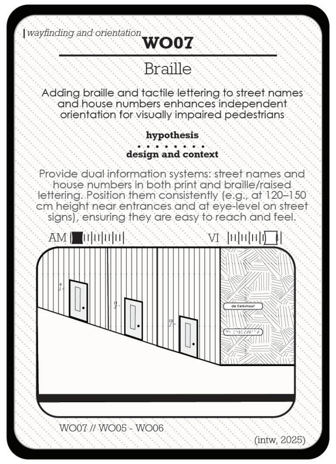


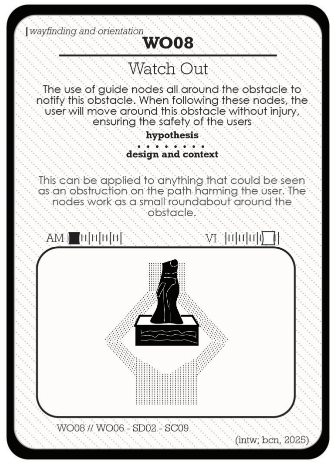


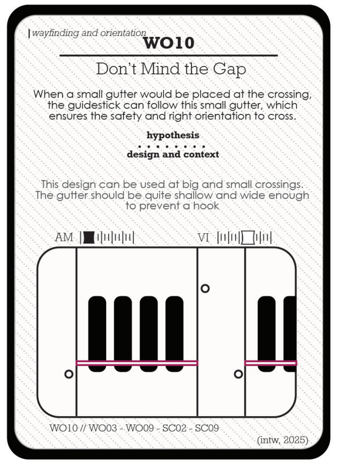


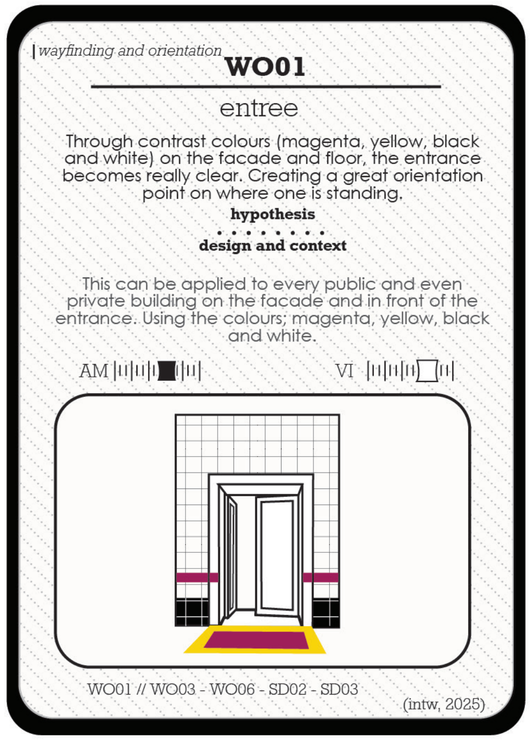








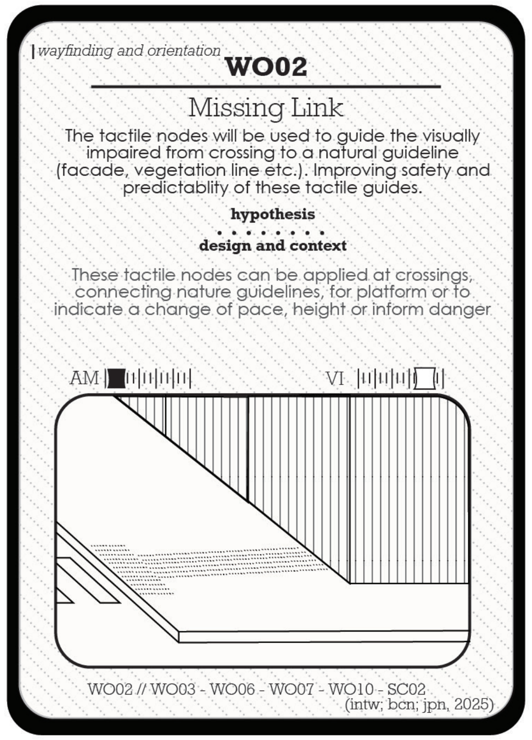




The entrances of buildings, parks and other public spaces are often hard to locate. Creating frustration and even accidents, especially when facades are made out of glass.

Entree

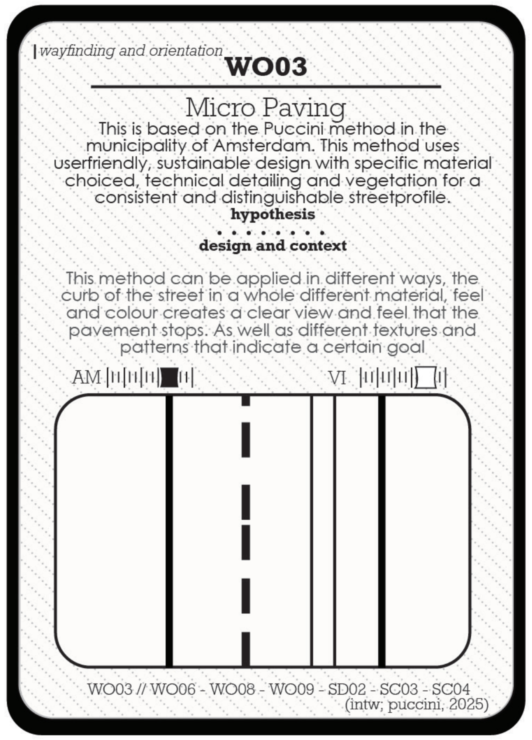
Multiple interviews confirmed this challenge, which is experienced by both visually impaired and sighted users. Literature, such as Zicht op Ruimte (Den Brinker et al., 2014), emphasizes that contrast can aid in identifying entrances. In this pattern, a magenta line along the facade, chosen for its distinctiveness, provides a visual cue, complemented by a thick black line at ground level and a doormat-shaped marker in contrasting colors to further indicate the entrance. These colours have been validated by visually impaired to be recongisable.



The gaps between guides are at times too big, resulting in confusion and disorientation. When visually impaired pedestrians are unsure of their direction, the risk of accidents increases..

Missing Link

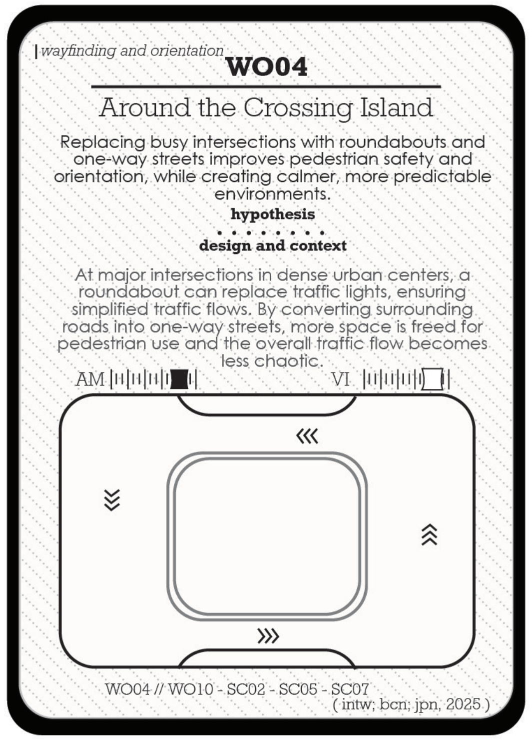
The concept of guide nodes in these nodes have been validated and inspired by cities such as Barcelona, where nodes connect gaps in tactile pathways. Interviews highlighted that many visually impaired participants experience disorientation after crossings. In Tokyo, extensive use of guide nodes is common, though overuse can be perceived as intrusive. Applying nodes only in critical locations creates a balance between these markers and natural guidelines, such as facades or vegetation, supporting safe and predictable navigation.



In many public spaces, it is difficult to distinguish between different pathways or vehicle zones. This can lead to confusion and disorientation for all users.

Micro Paving

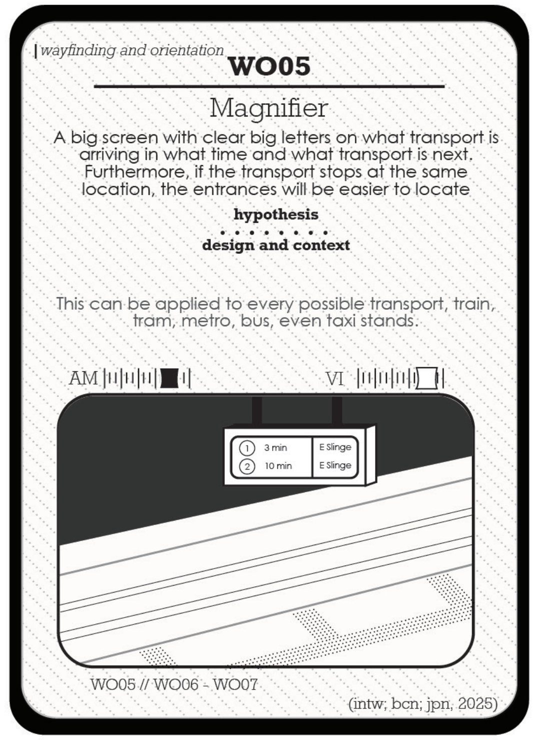
This idea emerged from an interviewee in Amsterdam, who highlighted the Puccini method as a highly effective strategy used by the municipality in Amsterdam. Field observations and literature confirm that varying textures, materials, and paving patterns can help visually impaired and the average man perceive boundaries between different pathways by implementing micro-paving techniques. This method allows visually impaired users to detect and follow the correct path, enhancing predictability and reducing the risk of accidents.



Large junctions or street crossings can be hazardous, as crossing times are often too long and multiple types of users must navigate simultaneously, creating dangerous situations.

Around the Crossing island

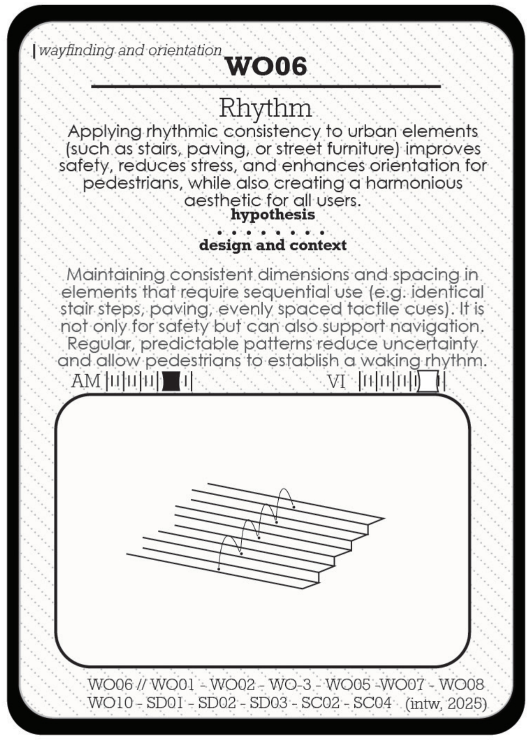
This pattern addresses the problem of prolonged crossing durations. Field observations and interviews indicate that providing a safe island between streets allows pedestrians to pause and separate flows, reducing congestion and potential accidents. Such intermediate zones improve both safety and predictability at busy crossings, benefiting all users. These so-called islands have been confirmed in literature to be a place to pause as well, when designed properly, creating a more diverse urban environment in a dense city.



Public transport is often inconsistent and confusing when one has no sight, entry points vary and it is not always clear where the transport is headed, especially with bus, tram, or subway.

Magnifier

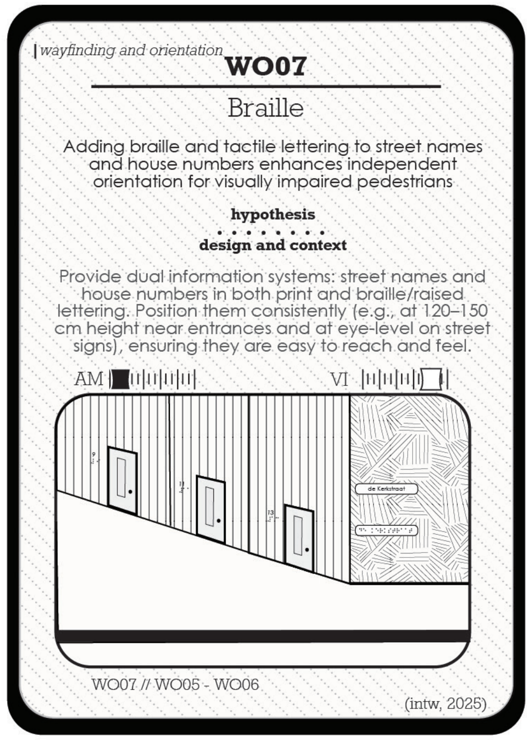
This problem has been highly mentioned with multiple interviewees. Especially with the bus, tram and subway. In Tokyo, the entrances of the train are always located on the same spot, creating a clear indication for the users on where to stand to wait for the train. Using contrast colours or guide nodes help visually impaired by understanding where they have to be situated. Using magnified letters, a countdown for the next train with letters that inform you which train comes and also a speaker that vocalises it, can minimize the confusion on what bus, tram or subway to take.



A lot of street furniture, stairs, crossing or other urban elements are placed arbitrarily. This creates unpredictability which results with many visually impaired in insecurity.

Rhythm

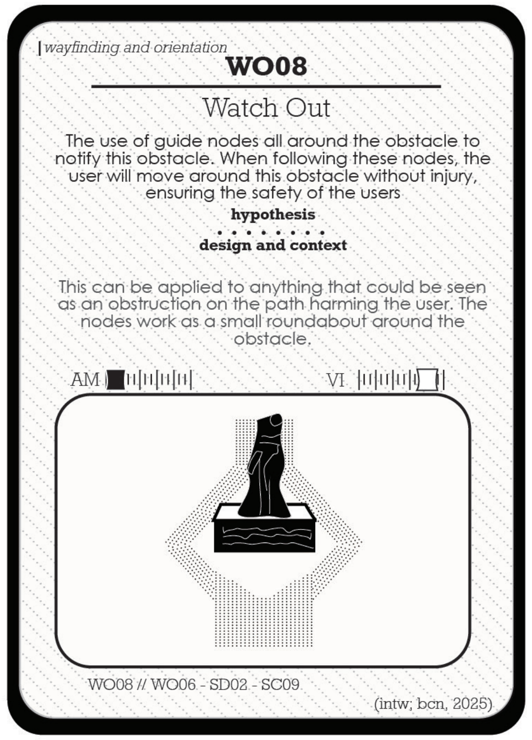
Interviews and literature highlight unpredictability and confusion as recurring challenges in urban environments. Introducing rhythm e.g. consistent step lengths, tree placement or benches every few meters, creates clarity in wayfinding at a larger scale. Participants emphasized that predictability and consistency are essential in public spaces to support independence. Field observations further confirmed that environments with a steady rhythm reduce stress and allow users to navigate with greater confidence.



Orientation in a city is difficult for visually impaired people. While technology can indicate one's location, it is important to be able to determine this directly in the physical environment as well.

Braille

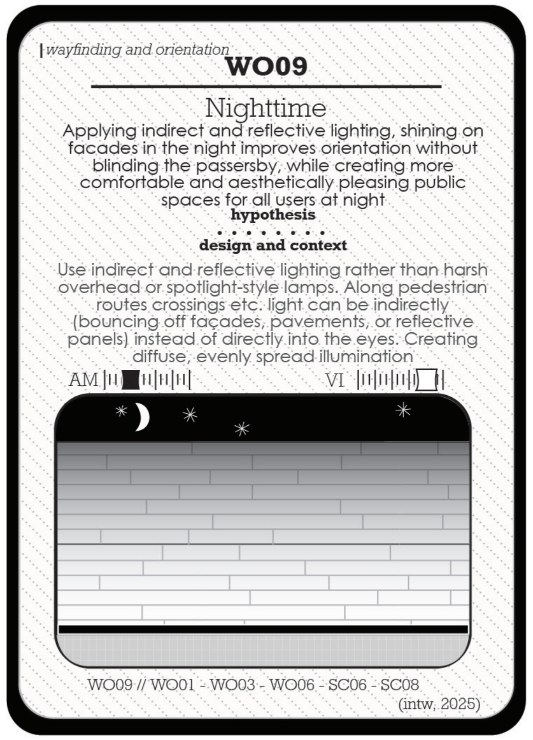
Tactile maps are used as braille maps to understand a specific situation. This principle can also be applied in the physical world. When signs with braille are placed at a human height, they become accessible to everyone and allow users to understand where they are standing. Such interventions have been validated in interviews, where participants stressed the importance of independent orientation without reliance on digital tools. Field observations further confirmed that clear, well-placed braille signs strengthen both confidence and autonomy in public space



Many objects in public spaces, such as advertisements, urban furniture, monuments, or statues, are placed arbitrarily, causing disruption and confusion in navigation and orientation.

Watch Out

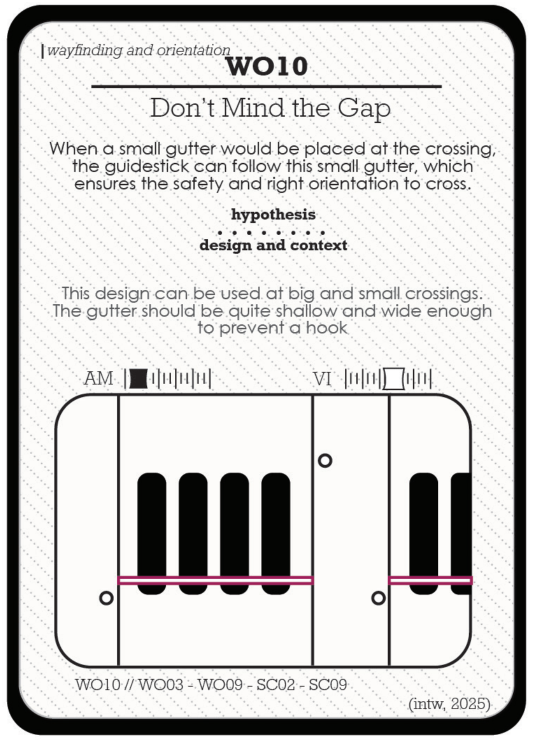
Through observation in the field of The Hague and other dense urban environments, it has been concluded that various elements e.g. boards, advertisements, chairs, benches, statues, and other street objects, are often positioned randomly and in the middle of the pedestrian pathway. Interviews highlighted participants' dire need for clear cues to navigate around such obstacles. Observations validated that guide nodes can indicate this function, attracting attention to changes in path and helping users move safely around obstacles.



When the sun sets, visually impaired people lose the contrast needed to distinguish elements in the environment. Even sighted individuals can struggle to recognize urban features in the dark.

Nighttime

Participants validated that indirect or diffused lighting is preferred over direct lighting, which can create glare and hinder orientation. Reflective surfaces and illuminated facades serve as clear navigational cues. Several visually impaired participants emphasized that continuous lighting is more effective than isolated spots, as dark areas can be misinterpreted as gaps or shaded zones. Field observations in cities like Barcelona and Rome which have their facades illuminated showed that the environment is better to distinguish than places without these light indicators.



Long or poorly defined crossings can create confusion and stress, as pedestrians often lack cues to determine whether they are walking straight or when the crossing ends.

Don't Mind the Gap

Interviews revealed that many visually impaired participants find crossings challenging and scary. Field observations and validation with participants suggest that incorporating a small gutter or guide path along the crossing, where a guiding stick or cane can follow could significantly improve orientation and walking pace. This subtle tactile cue provides a continuous reference line, reducing uncertainty and increasing confidence while crossing. Implementing such guidance allows users to navigate urban crossings with greater predictability and ease.

7.6.2 Sensory design

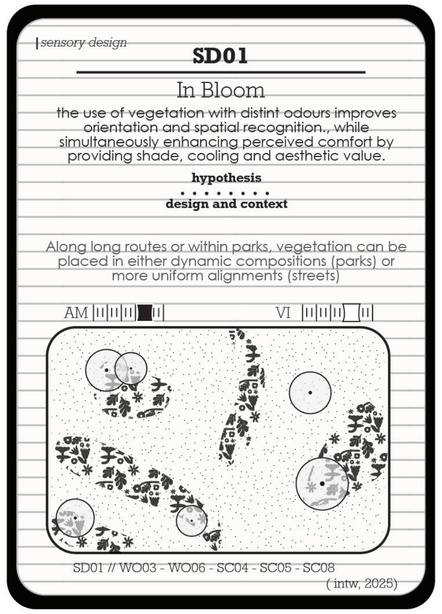
Sensory Design focuses on how non-visual cues can support orientation, recognition and comfort within the urban environment. While the Wayfinding patterns establish the structural logic of movement, this category introduces the qualitative layer that helps users understand and feel a place through sound, touch, scent and microclimate. For visually impaired and blind individuals, these cues often function as primary anchors in navigation and place awareness.

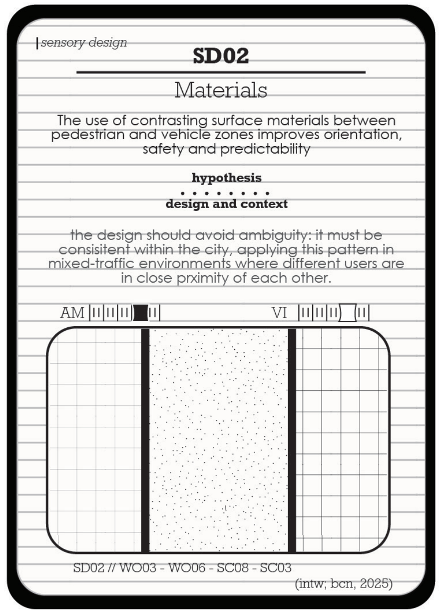
Findings from the Sensory chapter revealed that many sensory cues in The Hague are present yet uncoordinated. Participants frequently described difficulties in interpreting wide plazas, uniform pavements and spaces with limited acoustic definition. As Jenkins et al. (2015) note, these issues often stem not from a lack of sensory information, but from environments that provide insufficient cues to understand spatial form without relying on vision. Chidiac et al. (2024) similarly highlight that the absence of tactile and auditory information in open spaces leads to hesitation and reduced comfort.

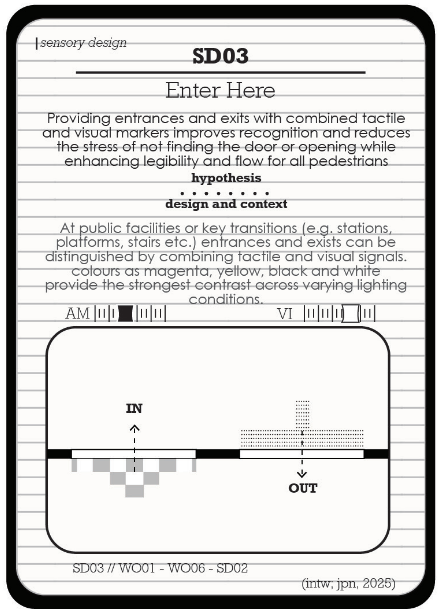
The patterns in this category respond to these challenges by making sensory cues intentional and legible. They use materials, textures, vegetation and characteristic sound sources to create distinctive spatial moments. Natural cues, such as water sounds, textured ground surfaces or recognizable vegetation, are especially valuable: according to Nijmeijer (2022), natural stimuli are cognitively easier to process and support emotional grounding. Research by Huang and Yuan (2023) further shows that natural odours can enhance wellbeing and memory, making them effective as both navigational markers and atmospheric elements.

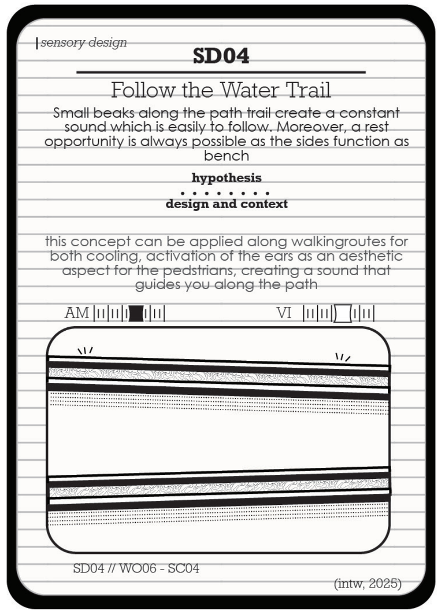
This category only has four patterns, this limited number reflects the inherent complexity of sensory experience in urban space. Unlike spatial structure, sensory conditions do not naturally organise themselves into repeatable, generalisable patterns: sound, scent, touch and contrast perception fluctuate across time, season, density and activity. As multiple scholars point out, sensory environments can be both meaningful and overwhelming simultaneously, and their effects are often contextual, resisting straightforward codification.

For this reason, a Pattern language can only partially address the sensory dimension of public space. While it can identify strategic principles, it cannot fully capture the dynamic, situational and sometimes contradictory nature of sensory experience. Designing with and balancing sensory cues therefore requires an additional approach, one that is able to work with variation, intensity and overlap rather than fixed problem–solution relationships.









sensory design

SD01

In Bloom

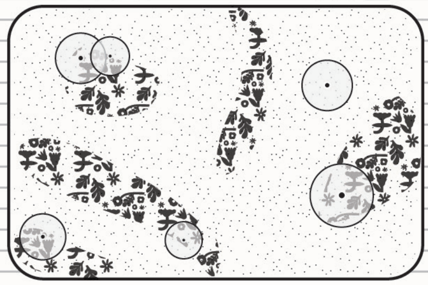
the use of vegetation with distint odours improves orientation and spatial recognition., while simultaneously enhancing perceived comfort by providing shade, cooling and aesthetic value.

hypothesis

design and context

Along long routes or within parks, vegetation can be placed in either dynamic compositions (parks) or more uniform alignments (streets)

AM VI



SD01 // WO03 - WO06 - SC04 - SC05 - SC08

(intw, 2025)

sensory design

SD02

Materials

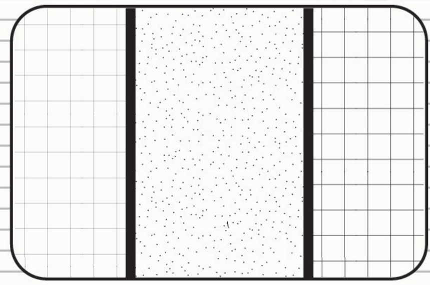
The use of contrasting surface materials between pedestrian and vehicle zones improves orientation, safety and predictability

hypothesis

design and context

the design should avoid ambiguity: it must be consisitent within the city, applying this pattern in mixed-traffic environments where different users are in close prximity of each other.

AM VI



SD02 // WO03 - WO06 - SC08 - SC03

(intw, bcn, 2025)

sensory design

SD03

Enter Here

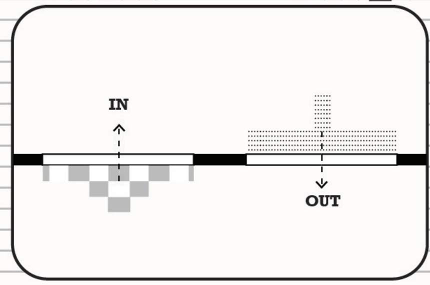
Providing entrances and exits with combined tactile and visual markers improves recognition and reduces the stress of not finding the door or opening while enhancing legibility and flow for all pedestrians

hypothesis

design and context

At public facilities or key transitions (e.g. stations, platforms, stairs etc.) entrances and exists can be distinguished by combining tactile and visual signals. colours as magenta, yellow, black and white provide the strongest contrast across varying lighting conditions.

AM VI



SD03 // WO01 - WO06 - SD02

(intw, jpn, 2025)

sensory design

SD04

Follow the Water Trail

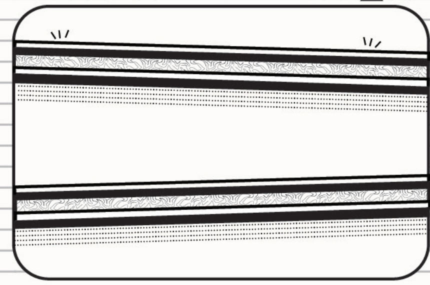
Small beaks along the path trail create a constant sound which is easily to follow. Moreover, a rest opportunity is always possible as the sides function as bench

hypothesis

design and context

this concept can be applied along walkingroutes for both cooling, activation of the ears as an aesthetic aspect for the pedstrians, creating a sound that guides you along the path

AM VI



SD04 // WO06 - SC04

(intw, 2025)

Urban routes are typically designed around visual cues, the absence of other cues make it difficult for visually impaired or blind people to understand the route / situation.

In Bloom

Deliberate placement of scent sources, such as specific vegetation, flowering plants, or fragrant materials, can make routes seasonally distinct. Characteristic smells along a street or around a square serve as reference points, similar to visual landmarks, as an extra cue besides the local shops. Individuals with both sight or not sight indicate that a flower path activates their way of route. As the smell can be really pleasant as well as nice to look at. Huang & Yuan (2023) conclude in their research that scentgardens can unlock memories are improve the wellbeing of people with dementia.

Large plazas, much like shared space environments, often rely on a uniform use of materials. While this creates a visually coherent design, it simultaneously makes orientation difficult.

Materials

The strategic use of different surface materials has been repeatedly validated by interviewees as highly supportive for orientation and ease. This principle is broadly applicable to plazas and other public spaces, where clear tactile and material contrasts can guide users more effectively. Field observations and embodied research indicate that materials such as gravel, cobblestones, and concrete create distinct and comfortable underground, allowing pedestrians to recognize spatial boundaries and a more legible environment.

Entrances and exits can be difficult to locate in buildings, due to confusing material choices, architectural complexity, or the scale of the structure. This causes confusion when attempting to enter or exit a space.

Enter Here

Multiple interview participants , both with visually impaired and no impairment at sight, reported difficulties in locating building entrances, a challenge that is also well-documented in literature on accessibility for visually impaired individuals. Frequently, aesthetic or design choices inadvertently compromise ease of access. Discussions with visually impaired users highlighted that clearly indicated entrances are needed. Establishing predictable and recognizable entrance cues is therefore critical for user-friendly design, helping the average man as well.

Urban routes are typically designed around visual cues, the absence of other cues make it difficult for visually impaired or blind people to understand the route / situation.

Follow the Water Trail

Placing elements that emit both subtle scents and natural sounds along a route can enhance spatial orientation and walking confidence. Such cues help users stay aligned with the intended path and reinforce directional understanding. According to Nijmeijer (2024), sounds originating from natural elements are easier for the mind to process and are inherently soothing compared to man-made noises like traffic. Field observations suggest that these integrated cues are particularly effective when they are consistent and spaced rhythmically along a route.

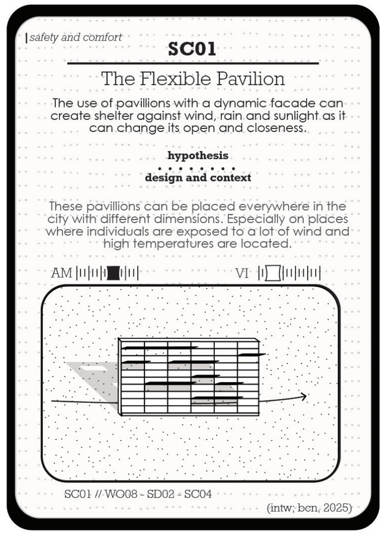
7.6.3 Safety and comfort

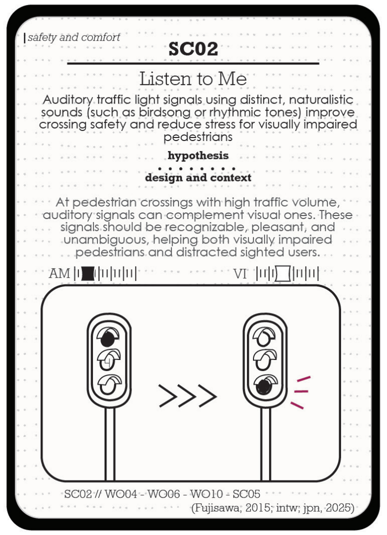
Safety and comfort form an essential dimension of public space, shaping not only how people move through the environment but also how long they are willing to stay there. For visually impaired and blind individuals, this dimension is closely tied to both physical security and psychological ease. Interviews revealed recurring issues such as unpredictable obstacles, inconsistent lighting, complex crossings and environments where multiple modes of transport overlap without clear structure. These conditions create stress, hesitation and, in some cases, dangerous situations.

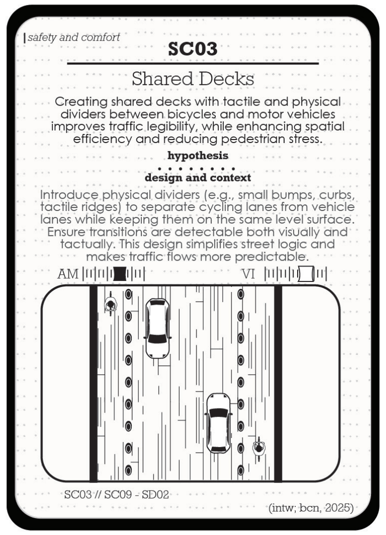
Recent studies confirm these experiences. Chidiac et al. (2024) and Nuzzi et al. (2024) show that visually impaired users frequently associate public space with discomfort and a reliance on sighted guides, largely due to the absence of accessible information or predictable spatial cues. Everyday elements, chairs, bicycles, advertisements, temporary stands, often become significant barriers when placed without clear logic. Parkin and Smithies (2012) further highlight how inconsistent street furniture arrangements reduce clarity and obstruct circulation, particularly for those who depend on tactile or auditory information.

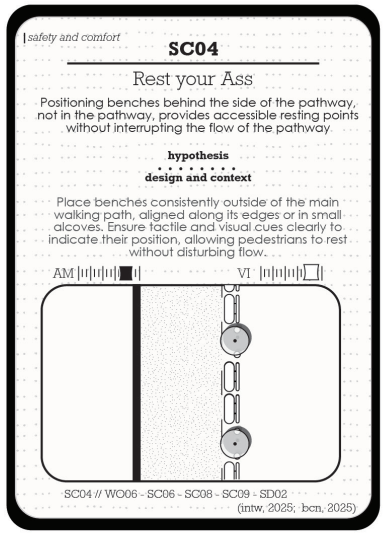
The patterns in this category respond to these issues by focusing on the organisation of clutter, the arrangement of furniture, and the structuring of pedestrian and traffic flows. They aim to create calm, predictable public spaces where movement feels secure and resting moments are accessible. Lighting plays an important role as well: continuous, diffused illumination supports recognition and reduces glare, while well-defined crossings and buffers ensure clarity at the edges between traffic and pedestrian zones.

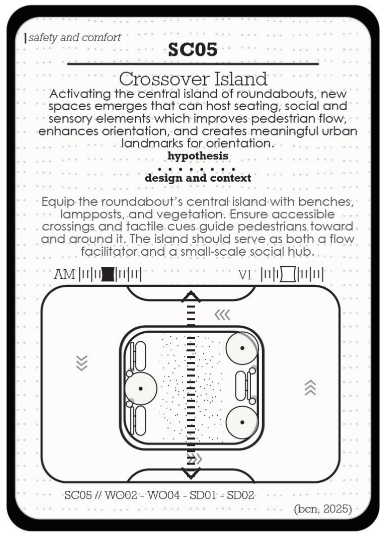
Beyond physical safety, these patterns also address psychological comfort. Well-placed seating, adequate shade, and areas that feel socially inviting can reduce stress and support longer, more meaningful use of public space. By ensuring clear routes, removing unexpected obstacles and organising street elements coherently, the Safety & Comfort patterns help create environments that are both supportive and reassuring for visually impaired and blind individuals.

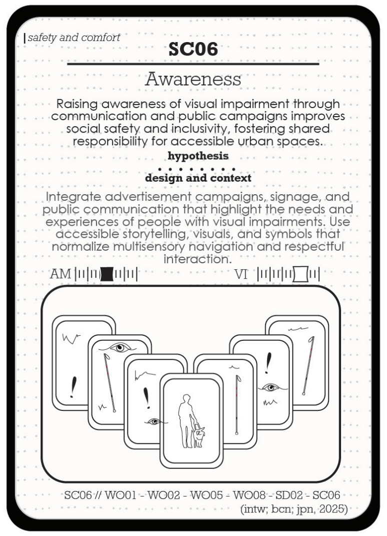


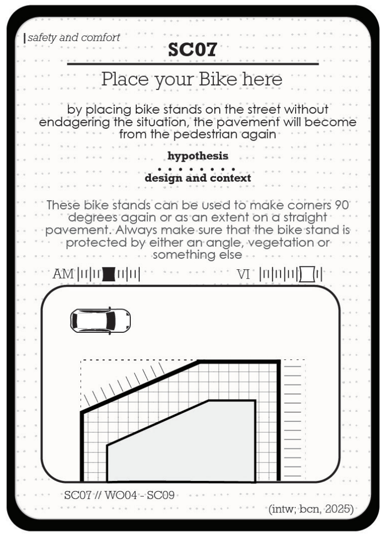


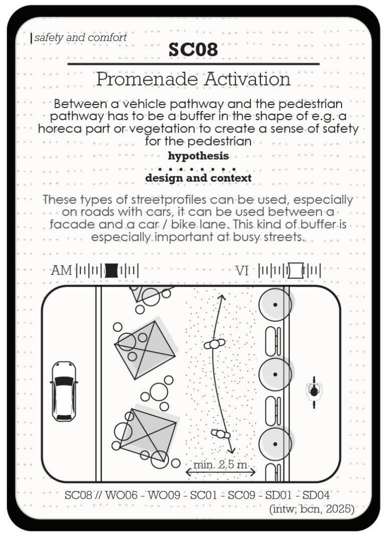


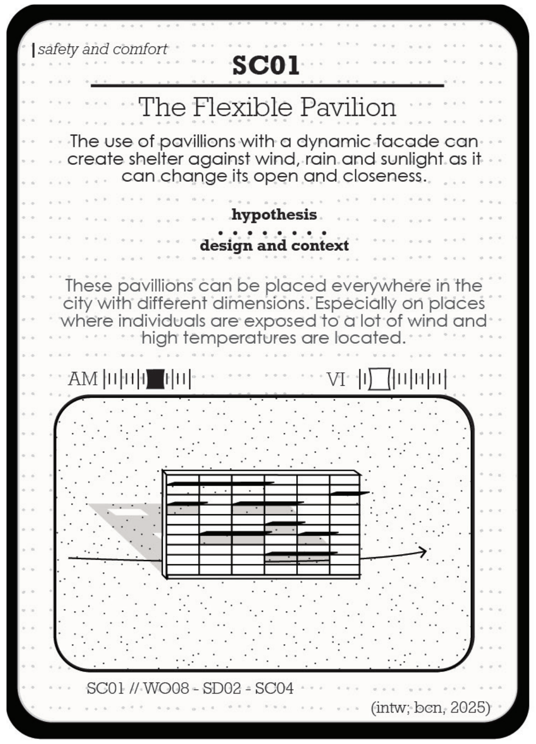


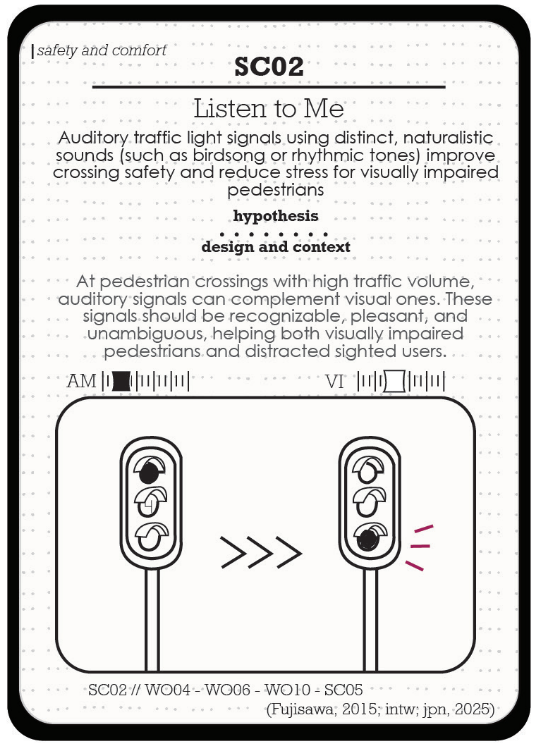


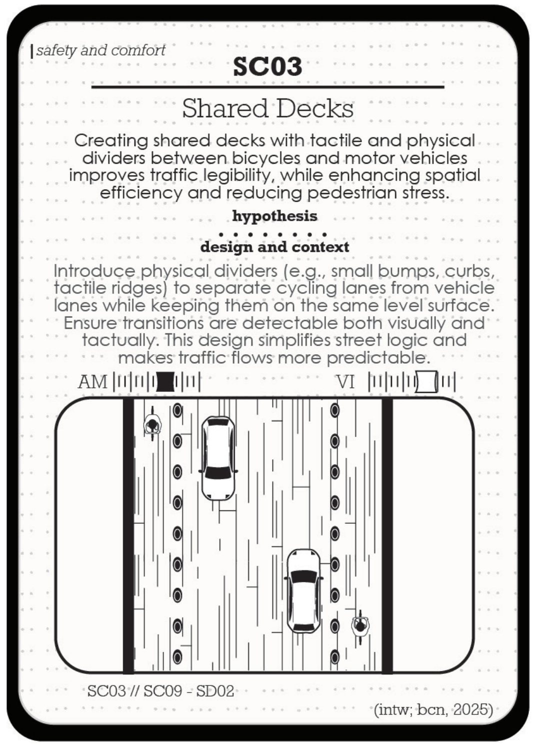


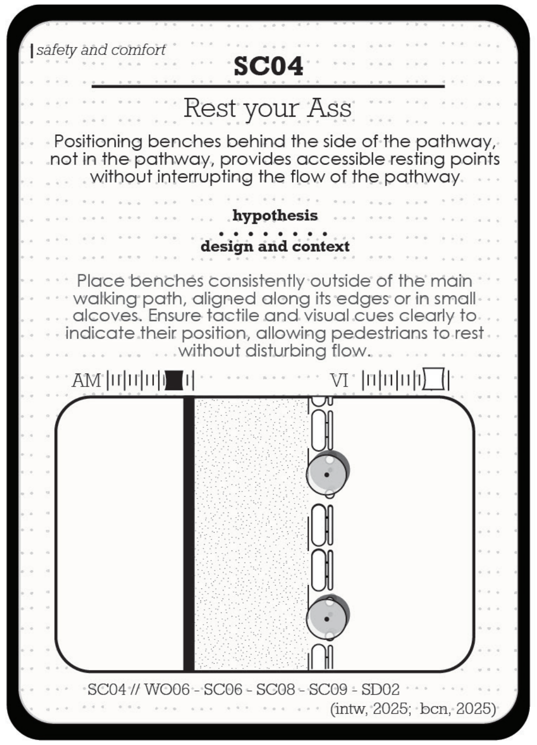


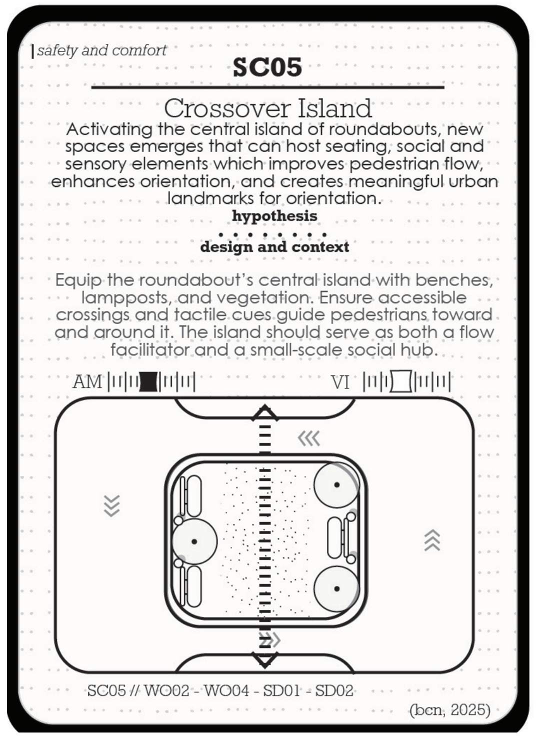












Public spaces are exposed to a wide range of weather conditions, from rain and hail to strong winds and sunlight. These environmental factors reduce comfort and usability of urban areas.

The Flexible Pavilion

In the Netherlands, where weather can change rapidly and dense urban areas amplify wind and sunlight effects, pedestrians frequently seek shelter. Field observations confirm that such shelters provide effective physical protection. Implementing a pavilion with an adjustable facade allows adaptation to varying weather conditions, offering short-term shelter that enhances comfort for all users. Beyond protection from the elements, these structures can serve as landmarks, meeting points, or sensory reference points, contributing to orientation and comfort.

Traffic lights are primarily designed as visual signals, relying on color to indicate when it is safe to cross. Leaving the visually impaired and blind behind, as they have to guess whether to cross.

Listen to Me

The use of auditory signals at traffic crossings has been validated in multiple cities and by various municipalities as a means to improve pedestrian safety and comfort. Interviews revealed that the sounds emitted by some traffic posts can be absent, inconsistent, or even agitating for users. In Tokyo, traffic lights are paired with natural sounds such as bird calls, which, according to Nijmeijer (2024), are more relaxing and easier for the brain to process. Field observations indicate that traffic lights, combined with natural sound should be a big aid in the urban environment.

In many city centers, roadways occupy a disproportionate amount of space, encouraging vehicles to drive faster than intended, this dominance of cars reduces safety and limits usable space.

Divide Us

Reallocating roadway space to accommodate bike lanes can reduce vehicle speed and create additional pedestrian areas. By placing dividers between cars and bicycles, a clear and safe boundary is established, preventing conflicts between different modes of transport. Using distinct materials for pedestrian and vehicle paths further enhances legibility, particularly for visually impaired users. By differentiating the surfaces, it becomes easier to perceive boundaries, while minimizing the need for additional materials or visual markers.

Benches and other street furniture are essential, especially in busy urban environments, but they are often placed in ways that obstruct movement rather than support it.

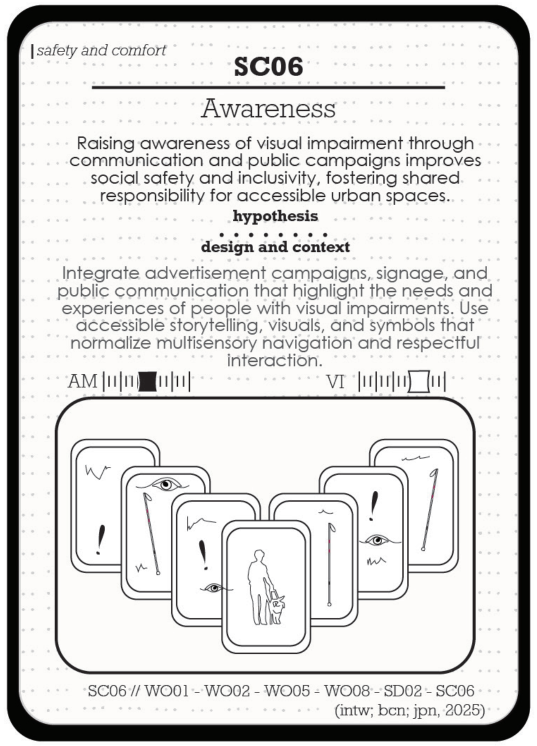
Rest Your Ass

Multiple interviews highlighted the importance of maintaining clear pedestrian pathways, particularly for visually impaired and blind individuals. Positioning benches and other street furniture along the sides of pavements, rather than in the middle or along pedestrian edges, preserves an unobstructed route while providing regular resting points every few meters. Field observations confirm that well-placed furniture not only supports safe and independent navigation, but also encourages social interaction and comfort.

Crossover islands at intersections often occupy significant space, yet this space, in dense urban environments, have to be designed thoughtfully to serve the pedestrian need.

Crossover Island

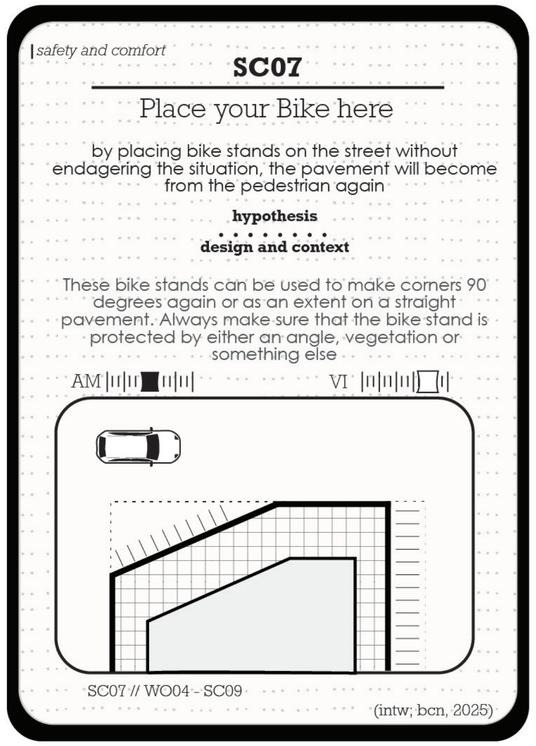
Integrating positive urban elements, such as benches, lampposts, or trees, into crossover islands can greatly enhance the pedestrian experience. Field observations in cities like Barcelona, demonstrate that well-designed islands serve as functional rest areas, visible landmarks, and social meeting points. Their central location at intersections makes them highly recognizable, providing orientation cues along stretches of streets. By strategically placing urban elements, the crossover islands can be safe and, moreover, comfortable.



Many people do not fully understand the significance of a white cane. This lack of awareness can lead to misunderstandings, impatience, or unsafe interactions in public spaces.

Awareness

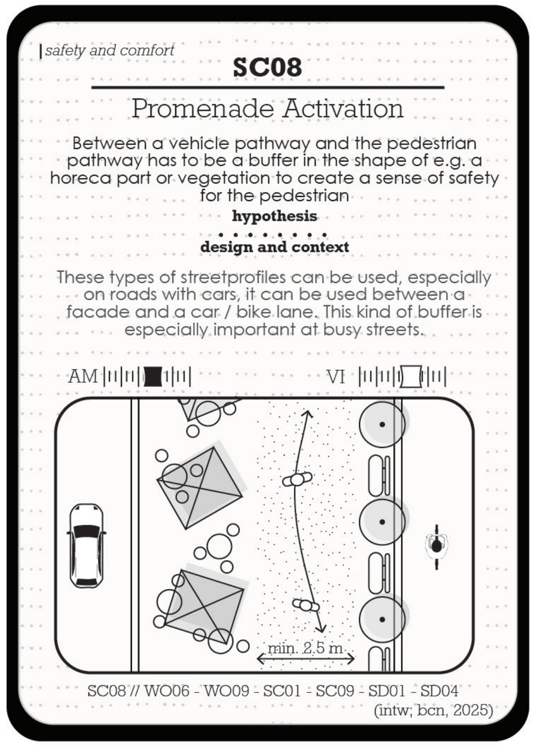
Promoting awareness through public campaigns, such as advertisements in public transport or visible signage in urban spaces, can foster greater understanding and empathy toward visually impaired pedestrians. Interviews indicate that when people are informed about someone's visual impairment, they are more patient and responsive. Tokyo shows a heightened public awareness, creating a more considerate and supportive atmosphere for visually impaired and blind individuals. Integrating awareness can cultivate a more understanding urban environment.



Pavements are often used simultaneously as drainage and informal storage for clutter like bikes, lampposts, garbage etc. This creates a tiring slalom-like environment for the visually impaired.

Place Your Bike Here

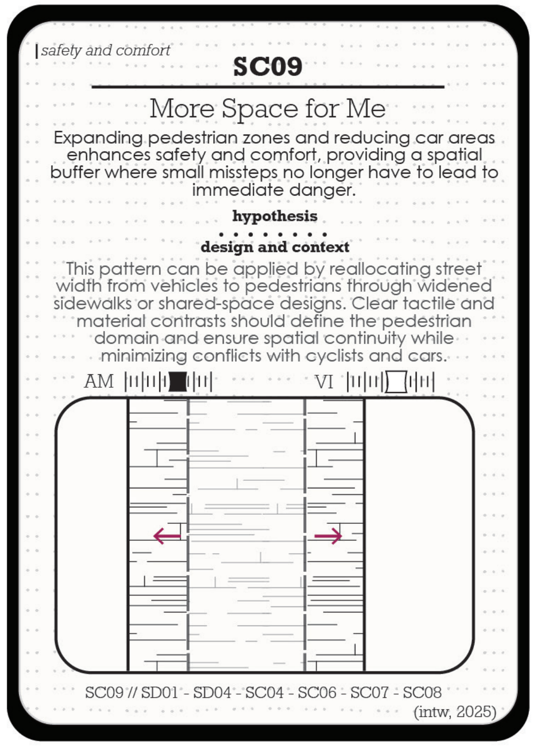
Relocating bike racks to designated areas on the street, rather than on pavements, frees up pedestrian pathways. Pedestrians typically occupy the narrowest portion of the street, so it is logical to reserve this space exclusively for walking. This approach has been successfully implemented in cities such as Barcelona, where bike racks are positioned safely in areas outside of vehicular traffic. Field observations indicate that this strategy not only improves comfort for visually impaired users but also reduces potential conflicts with other street users.



In dense urban areas, multiple modes of transportation often share the same space, creating potentially hazardous situations for pedestrians and reducing their feeling of safety.

Promenade Activation

Interviews revealed that many participants experience heightened anxiety when vehicles are nearby or approach unexpectedly. Observations from Barcelona show that integrating distance between pedestrian paths and vehicle lanes increases comfort. Inspired by this, creating dedicated buffer zones, with seating areas, trees or anything else, can improve the safety and comfort of pedestrians from vehicles while maintaining accessibility and flow. Validation with participants confirmed that buffers provide a sense of safety and reassurance.

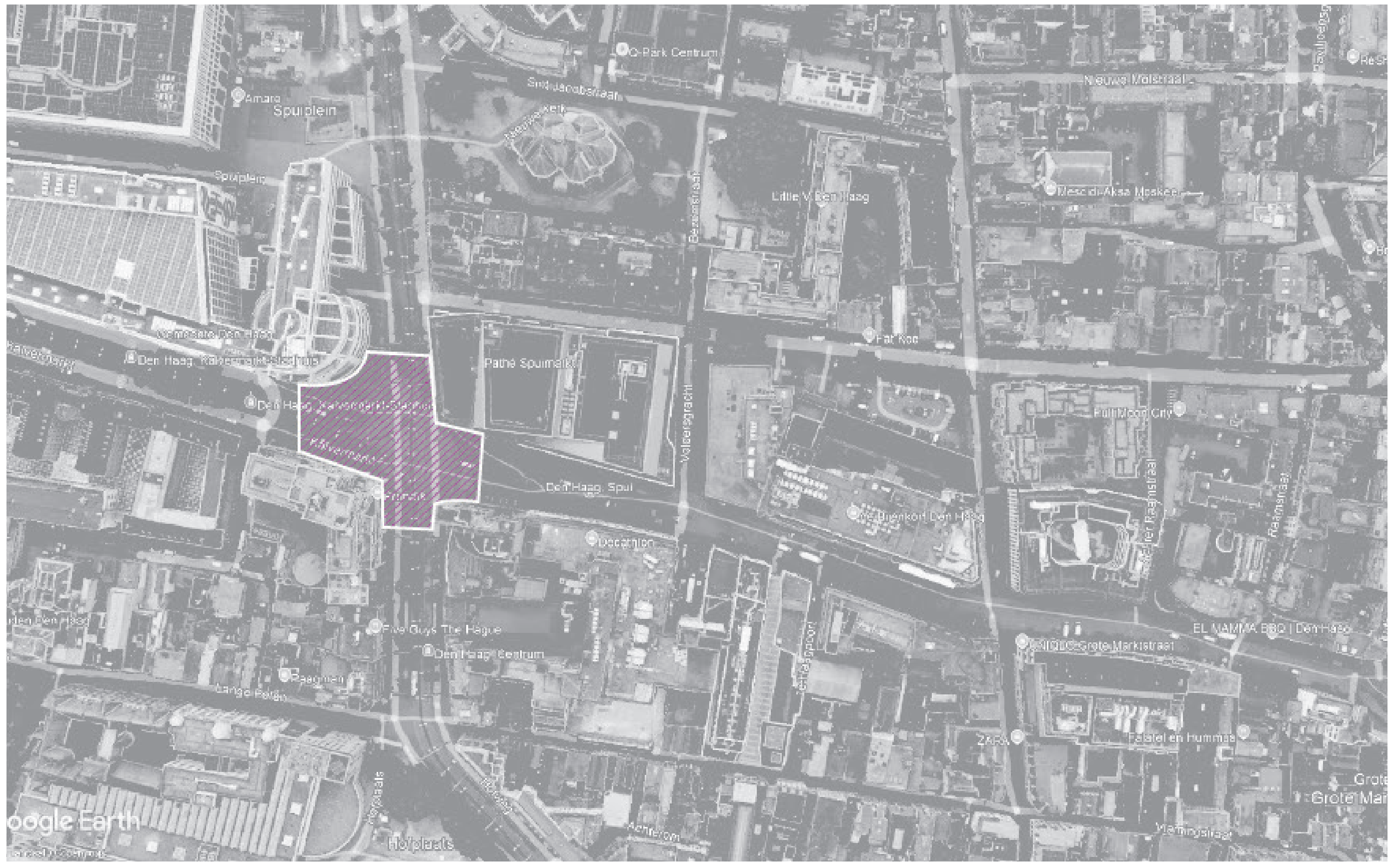


Cities provide too little space for their primary user: the pedestrian. Narrow sidewalks, cluttered layouts, and competing functions create a daily obstacle course.

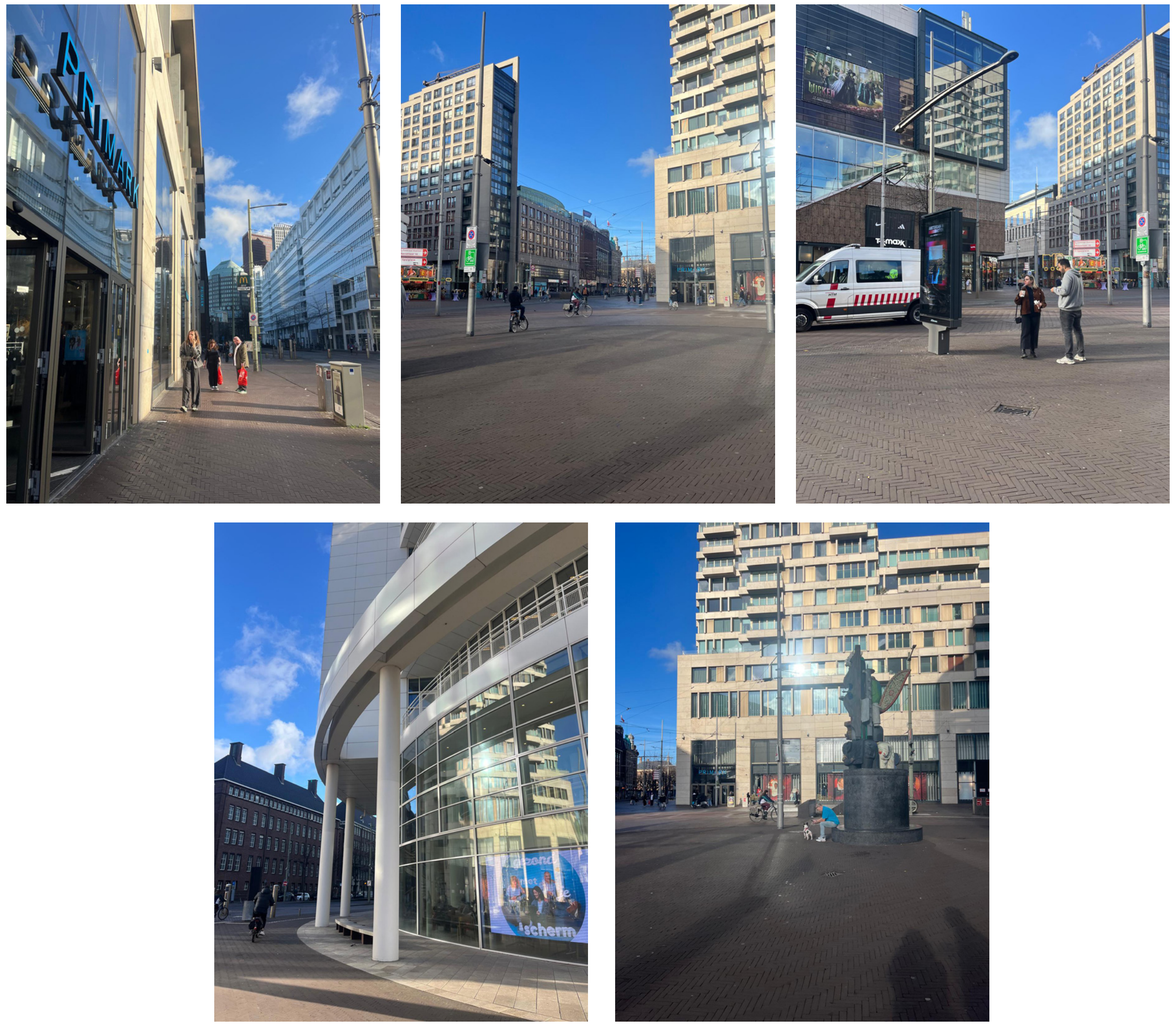
More Space For Me

In many cities, the pedestrian realm has been compressed to its minimum. Cars, signs and street clutter dominate, leaving pedestrians to navigate narrow, maze-like pavements that hinder flow and accessibility. Field observations and interviews reveal that limited sidewalk width and clutter increase stress and disorientation, particularly for visually impaired users. By redistributing space in favor of walking and tactile legibility, streets can regain their human-centered purpose, where movement feels intuitive, errors are non-fatal, and urban rhythm can unfold naturally.

Figure 11. *Location for the First Design Proposal*



Note. Base from Google Earth satellite imagery



7.7.1 Het Spui
The location to test the pattern language is the section between The Spui and the Grote Marktstraat. This part has been highlighted multiple times by participants and bystanders to be experienced as a terrible place. All modes of transport cross here make a lot of noise. Moreover, there is no clear crossing. The distance to cross is quite big, making it more confusing and hard.

This location is a shared space, one of the most horrible concepts according to multiple participants. This makes it interesting to test the pattern language in an area like this. To test how the results of the research can be translated into design proposals.

07 SITE

.8 OPERATION

7.8.1 From patterns to practice

To understand how the pattern language operates in practice, this section applies the patterns to one of the complex and challenging sites in The Hague: the junction with Spui, Grote Marktstraat and Kalvermarkt. Participants repeatedly identified this shared-space intersection as one of the most stressful and confusing locations in the city, largely due to its overlapping transport modes, inconsistent cues and sensory overload. As such, it is the clearest example of urban chaos within the case-study area: a space where design blindness, spatial fragmentation and high levels of noise converge, creating an extremely difficult place to navigate for visually impaired and blind people.

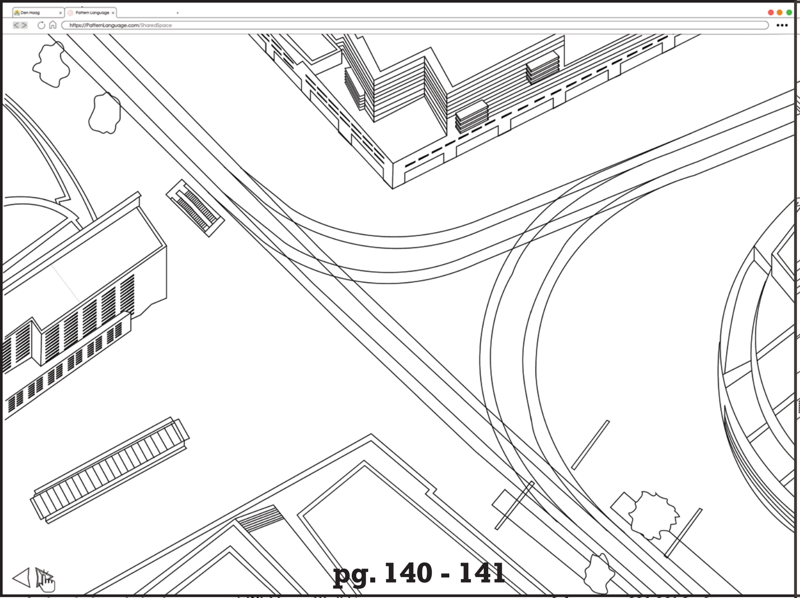
This location therefore serves as a deliberate "stress test" for the pattern language. The aim is not to present a final design solution, but to demonstrate how patterns interact, reinforce one another and collectively transform a difficult public space into one that is more legible, predictable and comfortable. By applying the patterns to a site with such a high density of behavioural and infrastructural demands, the demonstration reveals the capacity of the pattern language to operate within real urban complexity while remaining sensitive to the perceptual needs of VI/B users.

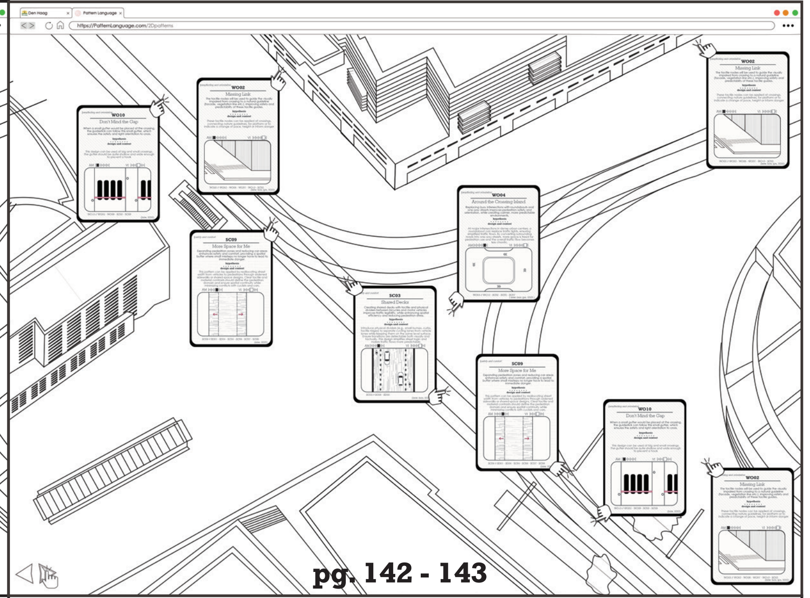
The transformation process begins with the lower patterns on the Y-axis of the Scale–Experience Diagram (urban fabric) (pg. 124–125), which shape the underlying structure and layout of the public space. These patterns establish legibility, reduce ambiguity and create a predictable base from which users can understand the space. Each step with patterns can produce several possible spatial variations; as Alexander et al. (1977) note, a pattern language can generate "a million different versions without ever doing it the same way twice." The variations shown here illustrate this generative potential. For clarity and continuity, one of these variations is elaborated further in the subsequent phases, demonstrating how the patterns can be developed into a coherent and context-specific spatial configuration. Without this structural foundation, any sensory or atmospheric layer would lack coherence or anchor.

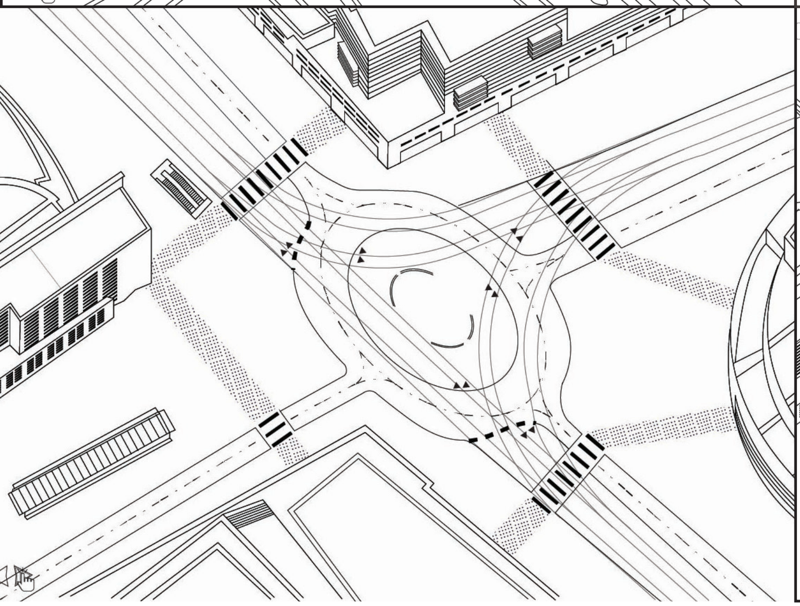
Once these patterns create a clear spatial framework, the patterns, higher on the y-as of the diagram are introduced (embodied experiment). they influence atmosphere, sensory clarity and comfort. They strengthen the character of the space through material contrasts, vegetation, light, tactile nodes etc. They help users recognise where they are, understand transitions and feel anchored within the environment, especially critical in shared spaces where visual dominance is reduced by design.

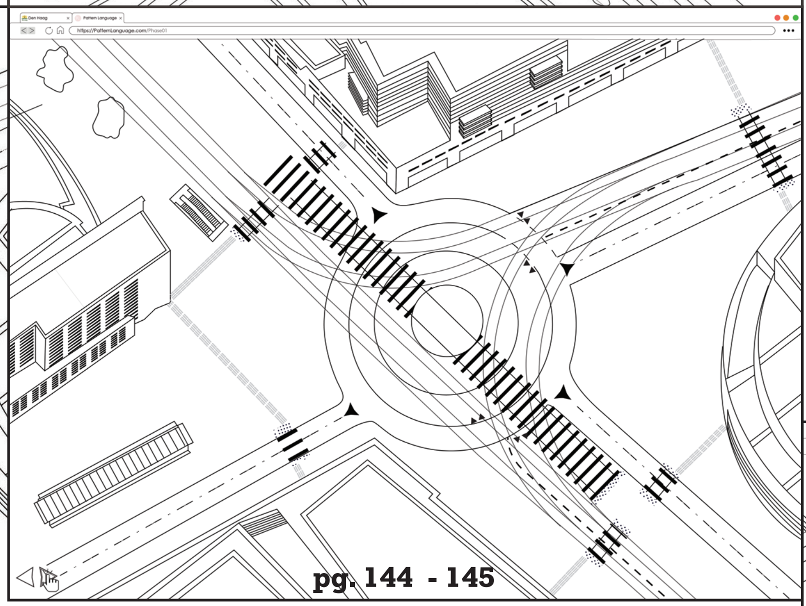
The relationship between these two layers is reciprocal. Horizontal-wise patterns provide the structure; vertical-wise patterns enrich that structure with sensory information and ambiance. Together, they allow the space to become predictable, readable and context-specific, responding both to the spatial problems of the junction and to the perceptual needs of VI/B users. The variations in the diagrams show the flexibility of the Pattern language: the same set of patterns can produce multiple spatial outcomes, each tailored to the local context. This adaptability is essential, as the intention of this pattern language is not to generate hundreds of prescriptive rules, but to propose a clear and transferable way to design better public spaces from the perspective of visually impaired and blind individuals, without disadvantageous sighted users.

The following phase-by-phase drawings illustrate how these layers work together. Starting from the existing condition, followed by placing the structural patterns on the shared space and moving on to experience and urban furniture, which introduce sensory and atmospheric depth. Finishing with the combined result which produces a more coherent, safer and navigable environment. The demonstration highlights the potential of the pattern language as a foundation for designing more informed, accessible and context-responsive urban spaces.


pg. 140 - 141

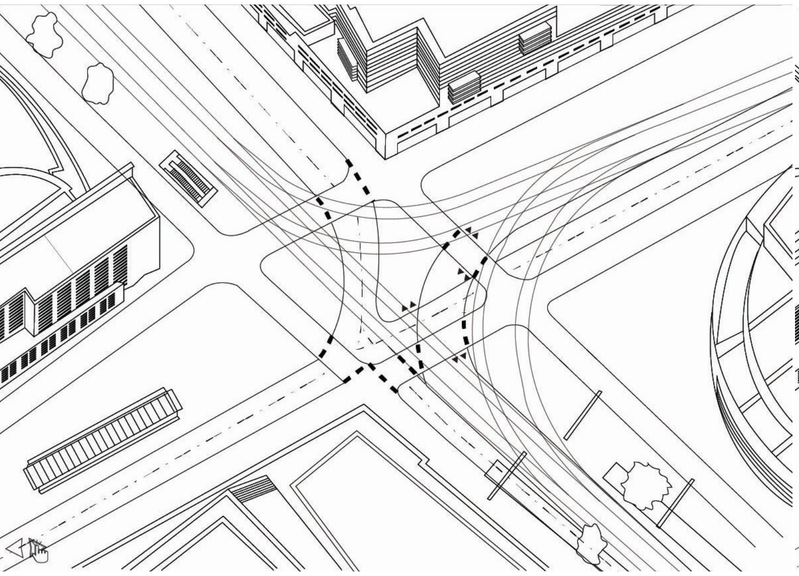

pg. 142 - 143


variation 02

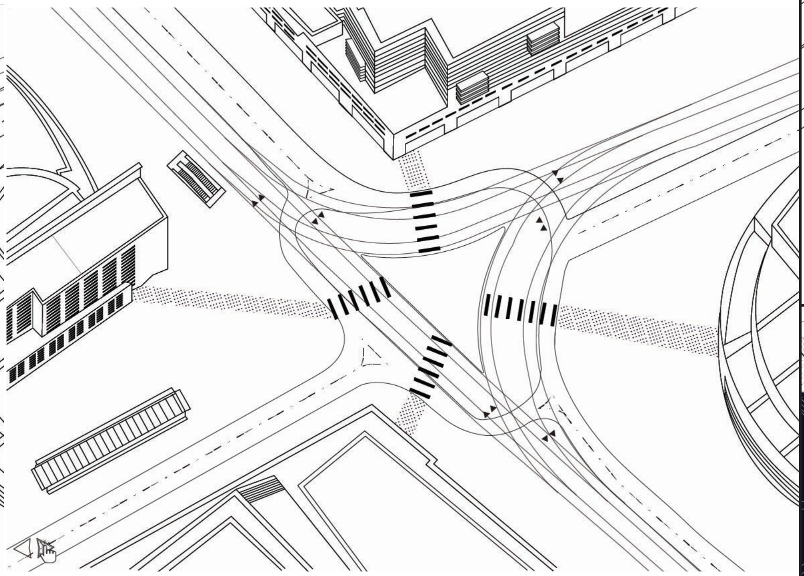

pg. 144 - 145

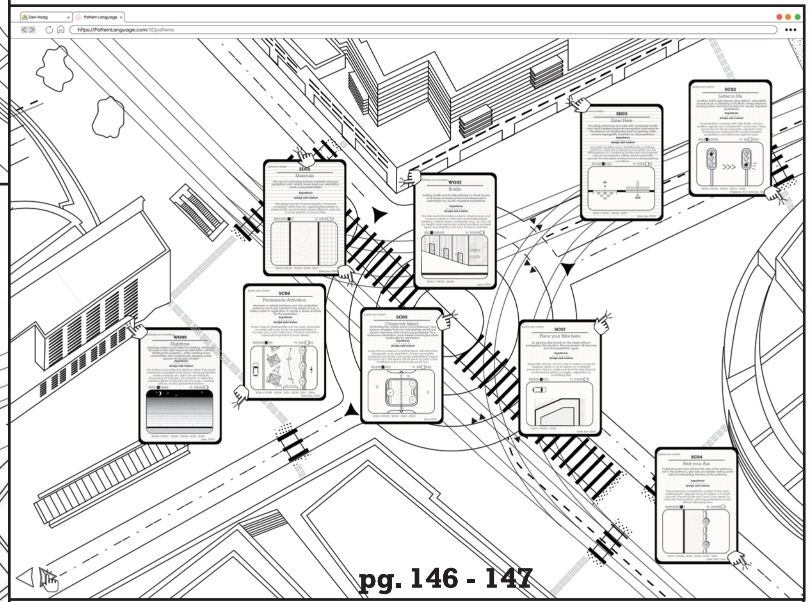
variation 01

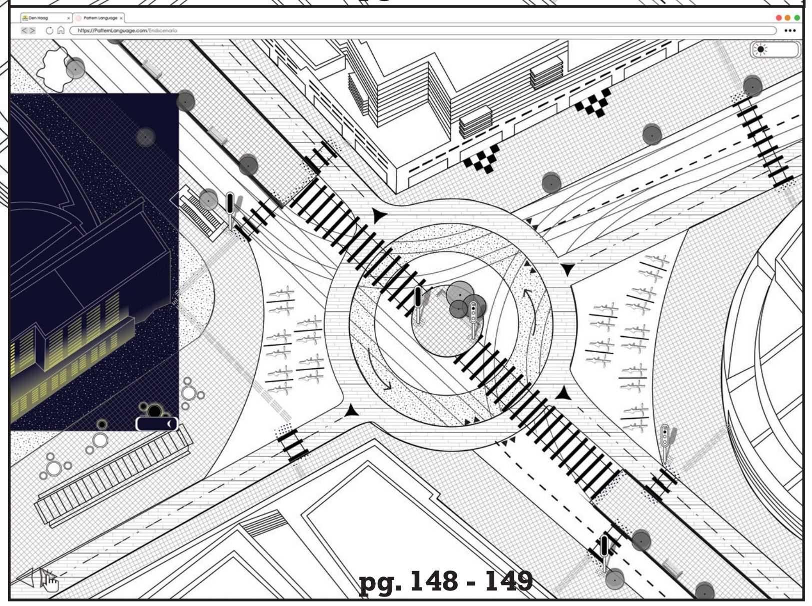
variation 03



variation 04

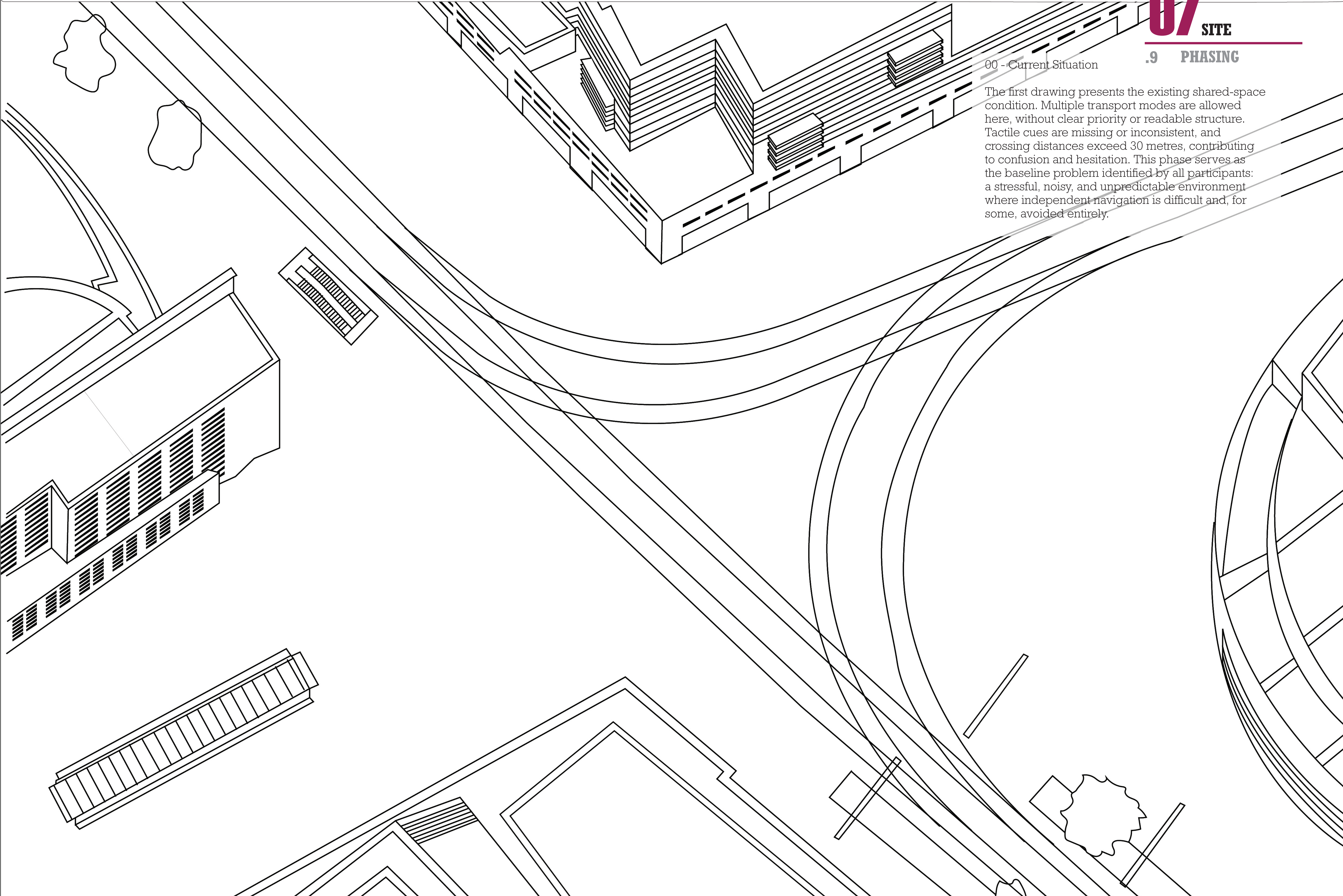



pg. 146 - 147


pg. 148 - 149

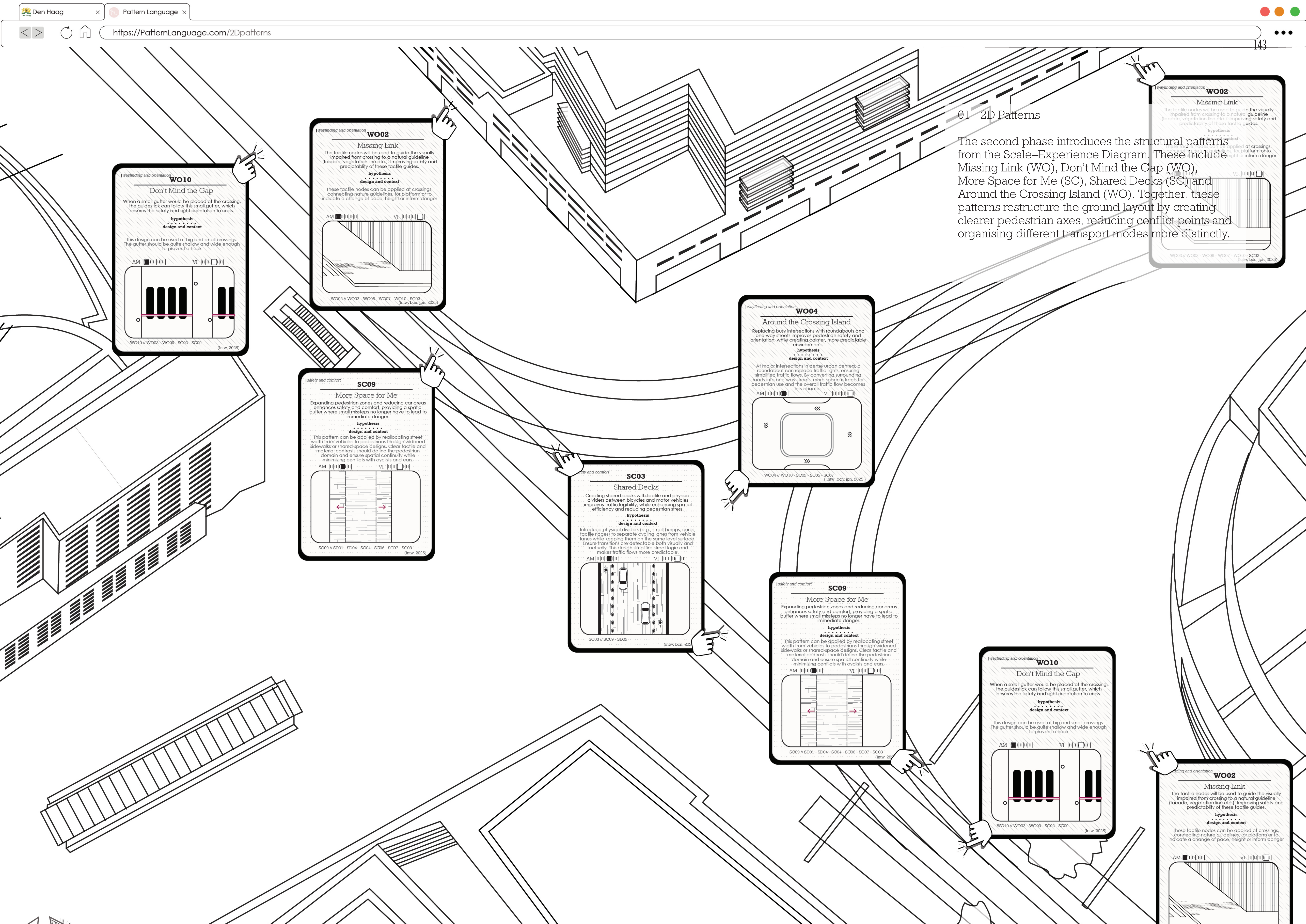
07 SITE

.9 PHASING



00 - Current Situation

The first drawing presents the existing shared-space condition. Multiple transport modes are allowed here, without clear priority or readable structure. Tactile cues are missing or inconsistent, and crossing distances exceed 30 metres, contributing to confusion and hesitation. This phase serves as the baseline problem identified by all participants: a stressful, noisy, and unpredictable environment where independent navigation is difficult and, for some, avoided entirely.

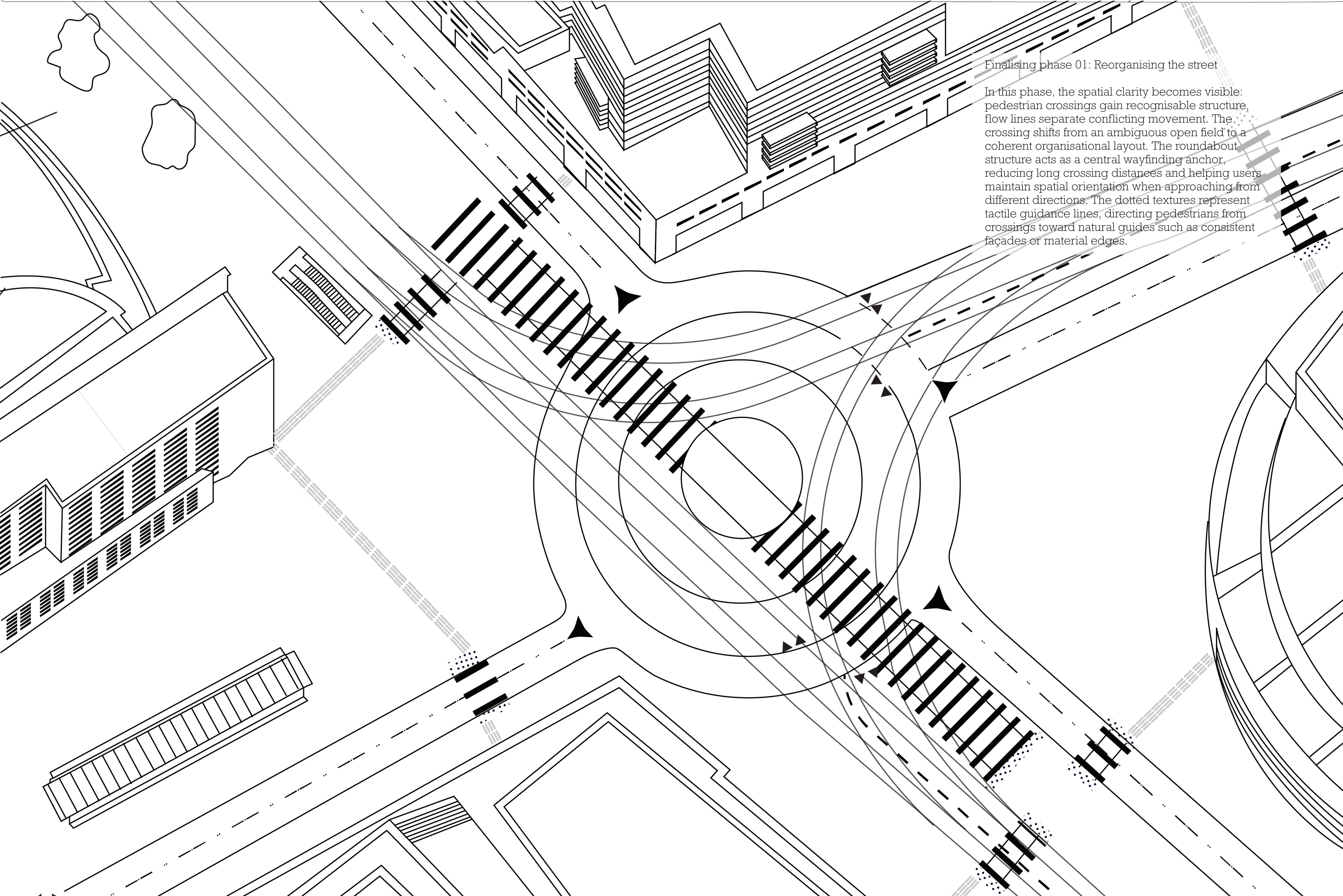


01 - 2D Patterns

The second phase introduces the structural patterns from the Scale–Experience Diagram. These include Missing Link (WO), Don't Mind the Gap (WO), More Space for Me (SC), Shared Decks (SC) and Around the Crossing Island (WO). Together, these patterns restructure the ground layout by creating clearer pedestrian axes, reducing conflict points and organising different transport modes more distinctly.

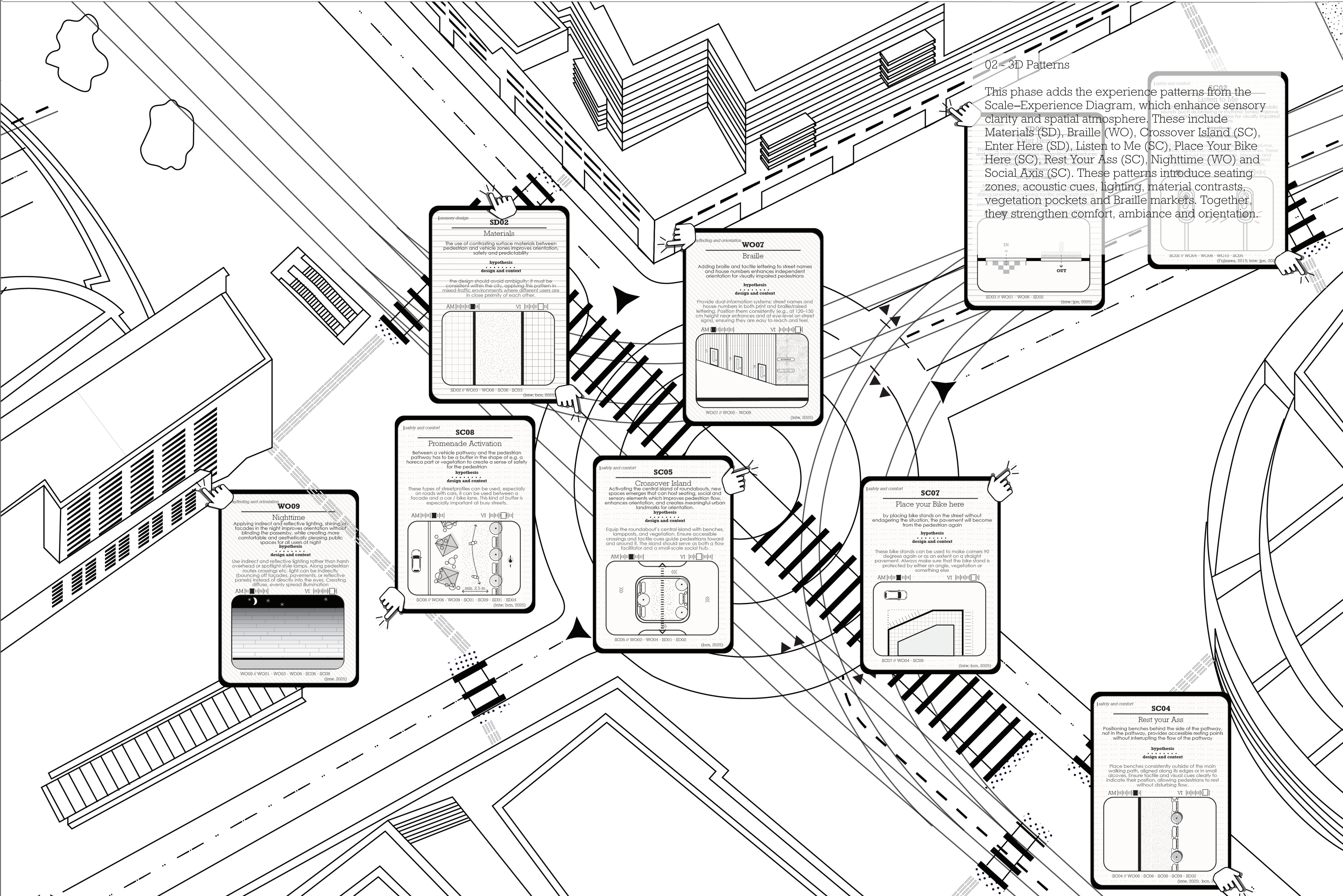
Finalising phase 01: Reorganising the street

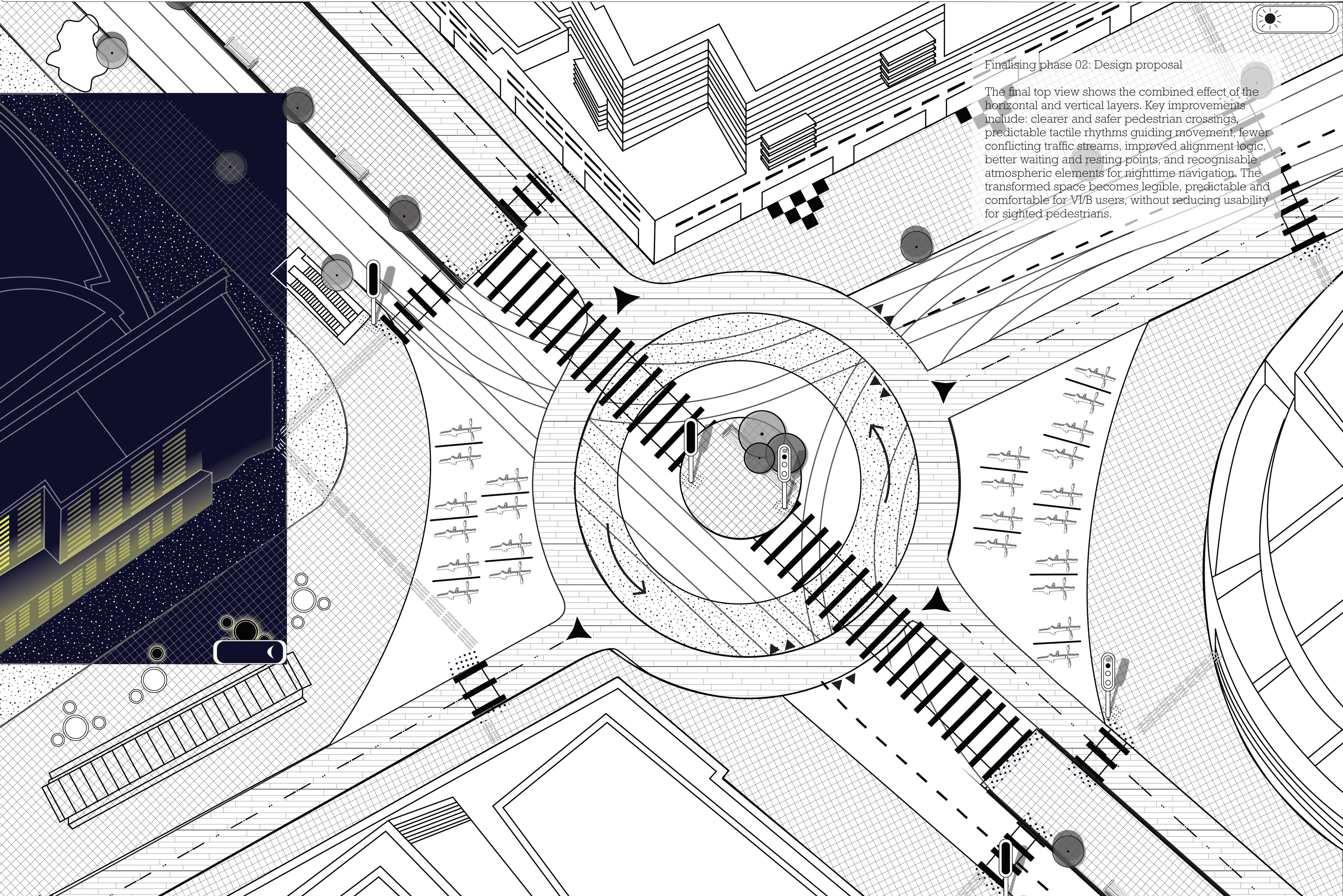
In this phase, the spatial clarity becomes visible: pedestrian crossings gain recognisable structure, flow lines separate conflicting movement. The crossing shifts from an ambiguous open field to a coherent organisational layout. The roundabout structure acts as a central wayfinding anchor, reducing long crossing distances and helping users maintain spatial orientation when approaching from different directions. The dotted textures represent tactile guidance lines, directing pedestrians from crossings toward natural guides such as consistent façades or material edges.



02 - 3D Patterns

This phase adds the experience patterns from the Scale–Experience Diagram, which enhance sensory clarity and spatial atmosphere. These include Materials (SD), Braille (WO), Crossover Island (SC), Enter Here (SD), Listen to Me (SC), Place Your Bike Here (SC), Rest Your Ass (SC), Nighttime (WO) and Social Axis (SC). These patterns introduce seating zones, acoustic cues, lighting, material contrasts, vegetation pockets and Braille markers. Together, they strengthen comfort, ambiance and orientation.





Finalising phase 02: Design proposal

The final top view shows the combined effect of the horizontal and vertical layers. Key improvements include: clearer and safer pedestrian crossings, predictable tactile rhythms guiding movement, fewer conflicting traffic streams, improved alignment logic, better waiting and resting points, and recognisable atmospheric elements for nighttime navigation. The transformed space becomes legible, predictable and comfortable for VI/B users, without reducing usability for sighted pedestrians.

7.10.1 Conclusion
The perspective drawing illustrates how the different layers of the Pattern language come together in a coherent spatial composition. The 2D (structure) patterns establish the structural clarity of the junction, legible crossings, predictable alignments, reduced conflict zones and a roundabout that functions as both a central orientation anchor and a safe haven. By breaking the former 30-meter crossing distance into shorter, manageable segments, the roundabout provides a place to pause, reorient and continue safely, which is especially crucial for visually impaired and blind pedestrians navigating a multimodal environment.

Built upon this foundation, the 3D (experience) patterns introduce material contrasts, tactile rhythms, vegetation, seating and subtle sound cues that enrich the spatial experience. Lighting plays a significant role here: in the nighttime configuration, continuous low-glare illumination, facade glow and gentle contrast gradients maintain orientation without creating glare or fragmentation. This supports spatial recognition after dark, ensuring that legibility and comfort are preserved even when visual information is naturally reduced.

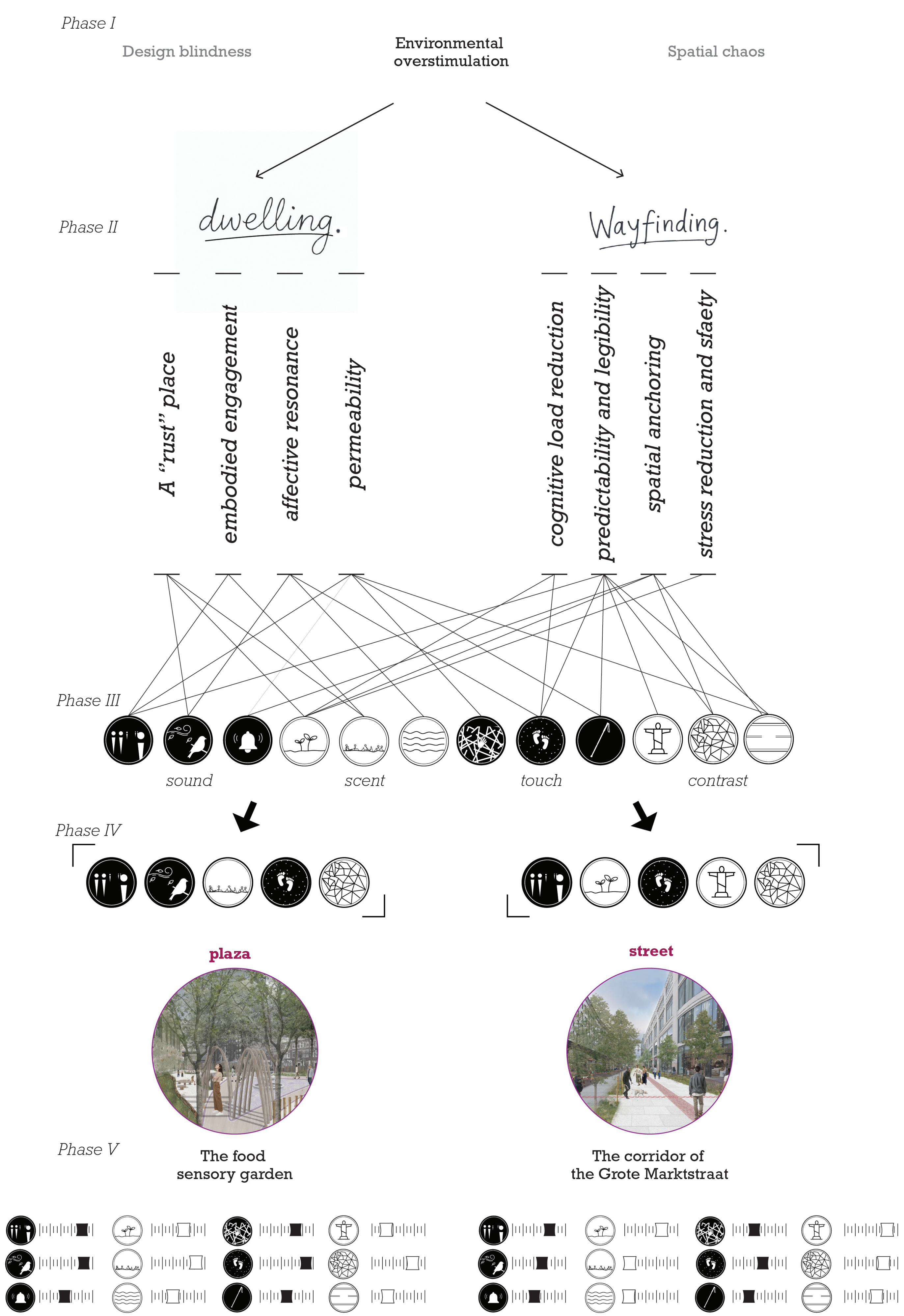
Together, these layers demonstrate how the results of the research can be translated into a pattern language. This chapter shows that patterns are able to, among other things, be used to transform a complex shared space into a legible environment without compromising its multimodal character. When structure and atmosphere reinforce one another, public space can support greater independence, lower stress levels and a more intuitive understanding of spatial form. More importantly, the same interventions that clarify the environment for visually impaired and blind individuals also benefit sighted pedestrians, cyclists and other users by reducing conflict, improving flow and strengthening the coherence of the junction as a whole.

It is important to note that the pattern language is not presented as a prescriptive design solution, but as a research-through-design and communication tool. In this chapter, it functions as a connecting framework between analytical insights and spatial design decisions, allowing complex findings from literature, interviews and observations to be translated into spatially readable and discussable principles. The patterns do not define a final form, but structure design thinking, support comparison and make underlying design logic explicit for both designers and non-designers.

The transformation also clarifies the scope of the pattern language within this chapter. While it is effective in structuring spatial relationships and translating research insights into communicable design principles, sensory experience itself remains dynamic, temporal and context-dependent. Sound, scent, microclimate and tactile perception shift across time of day, seasons, density and use, and cannot be fully stabilised through patterns alone. The pattern language can position sensory anchors and define spatial conditions, but it does not allow for an in-depth exploration of sensory intensity, interaction and threshold.

7.10.2 The maximization
For this reason, the following part of this chapter introduces sensory maximizationas a complementary design tool. Rather than replacing the pattern language, maximization is used as an ordering and exploratory method within the design process, enabling sensory cues to be isolated, intensified and compared across specific sites. This approach allows sensory knowledge, including insights from literature, interviews and expert understanding of the senses, to be tested spatially and critically reflected upon. While the pattern language operates across multiple locations as a connecting framework between research and design, maximization is applied more site-specifically, offering room to investigate how sensory environments behave under different conditions. Together, these methods support a layered design inquiry in which structure and sensory experience are explored in parallel rather than as a fixed means–end relationship.

maximization



7.11.1 Design strategy: maximalisation

The pattern language developed in the previous section demonstrates how spatial structure and organisation can support visually impaired and blind individuals by reducing ambiguity and strengthening legibility. It translates research insights into spatial principles that clarify movement, alignment and junction logic, and functions as a connecting framework between analysis and design. At the same time, the pattern language also reveals the limits of structuring sensory experience through stable patterns alone. While spatial relationships can be articulated and communicated with clarity, sensory experience itself remains dynamic, temporal and context-dependent.

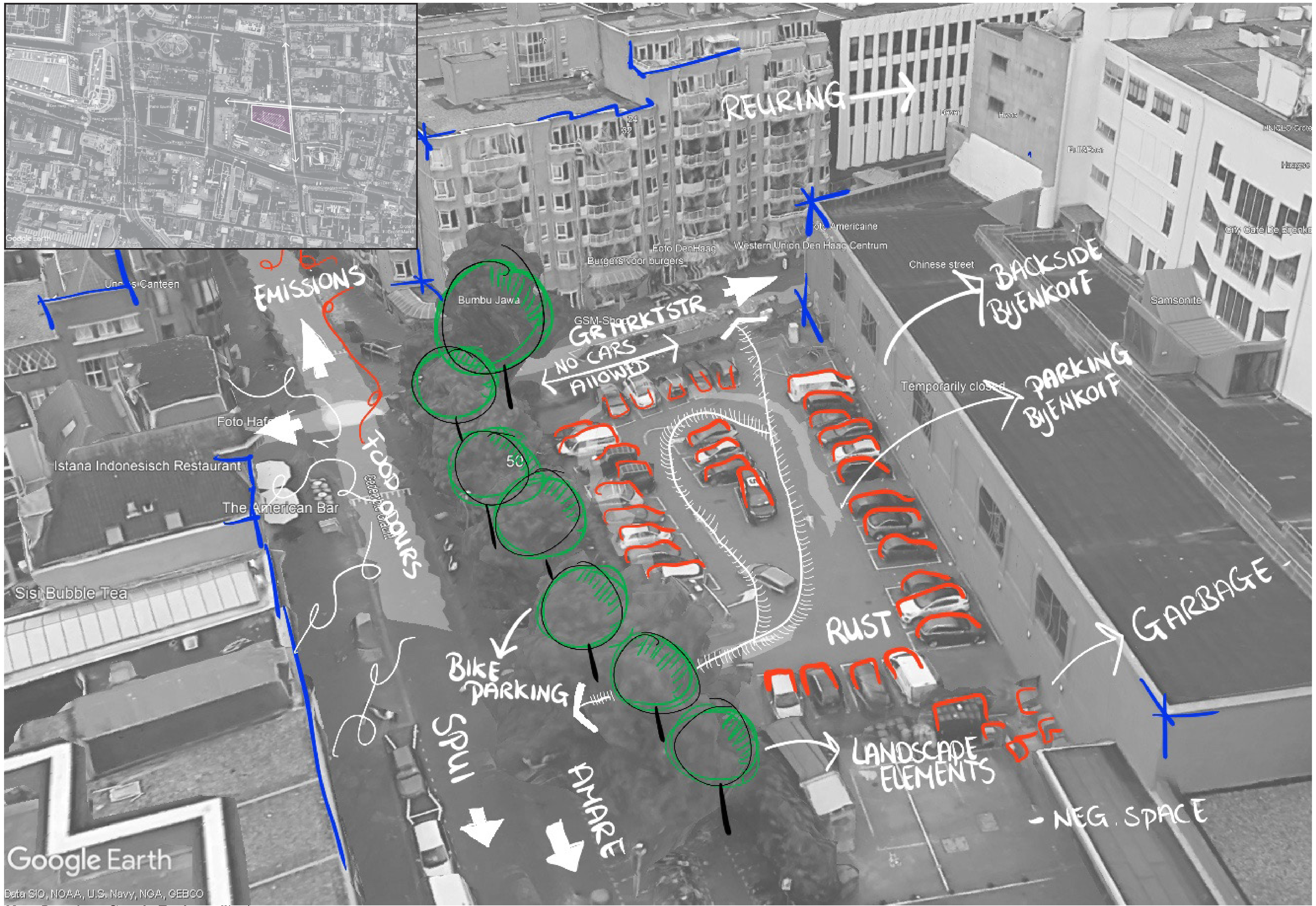
Sound, scent, microclimate and tactile perception continuously shift across the day, seasons, weather conditions and patterns of use. Their intensity, interaction and perceptual relevance cannot be fully captured through static spatial principles. Rather than indicating a shortcoming of the pattern language, this highlights the need for an additional design lens that allows these sensory dimensions to be explored, ordered and tested more explicitly within the design process.

For this reason, this chapter introduces sensory maximization as a complementary research-through-design and communication tool. Sensory Maximization is used to explore how individual sensory modalities behave when intensified, combined or moderated in specific spatial contexts. In contrast to the pattern language, which operates across multiple locations as a connective framework between research and spatial design, maximization is applied more site-specifically as an ordering method. It enables sensory cues to be isolated, compared and critically reflected upon, making sensory design decisions explicit and discussable.
Rooted in the problem of environmental overstimulation, the method distinguishes between two experiential domains: dwelling and wayfinding. By analysing these domains separately, each sensory modality, sound, scent, touch (including texture) and visual contrast, can first be maximised in isolation. This deliberate exaggeration reveals the full spatial potential of each sense, as well as its limitations, and exposes how sensory cues reinforce, compete with or depend on one another. In subsequent phases, these maximised scenarios are refined and optimised, allowing sensory elements to work together rather than compete, and shifting multisensory design from an accidental outcome to an intentional strategy.

The relevance of this approach is supported by research showing that the built environment significantly shapes people's ability to engage in everyday activities (Jenkins et al., 2015). For visually impaired individuals, decoding multisensory interactions is essential for both navigation and participation. However, limited spatial information, inconsistent signage and unreliable tactile or auditory cues often restrict access (Pigeon et al., 2019). Complex routes, in particular, increase cognitive load, leading to disorientation, misjudgement of distances and unsafe situations. These findings underline the need for environments that do not rely on a single sensory channel, but instead deliberately orchestrate multiple cues.

The maximization process begins with dwelling, focusing on how multisensory engagement can create spaces of comfort, rest and affective resonance. Research shows that reducing background traffic noise improves perceived comfort for both visually impaired and sighted users (Zhang et al., 2022), while scents, vegetation and microclimatic cues contribute to emotional grounding and memory. Dwelling therefore concerns not only safety, but also the creation of atmospheres that support presence, social interaction and belonging.

Wayfinding follows, addressing movement and orientation through space. Here, the emphasis shifts toward reducing cognitive load and uncertainty. Inconsistent or absent cues often hinder navigation, while natural sensory anchors such as tactile transitions, soundmarks or characteristic scents can significantly enhance spatial clarity and independence (Chidiac et al., 2014). Through maximization, this phase explores how sensory cues can clarify direction, establish landmarks and support continuous orientation along routes.
By distinguishing between dwelling and wayfinding, Sensory Maximization extends design inquiry beyond efficiency and safety toward the experiential richness of urban life. It provides a framework for understanding how sensory environments can be shaped to remain legible, engaging and resilient against overstimulation.
Because sensory conditions change across time, season and weather, the method concludes with a series of what-if scenarios. These scenarios test how maximised and optimised sensory configurations perform under varying environmental conditions, offering insight into how multisensory design strategies can remain robust, adaptable and supportive for visually impaired and blind users.



Note. Base from Google Earth satellite imagery

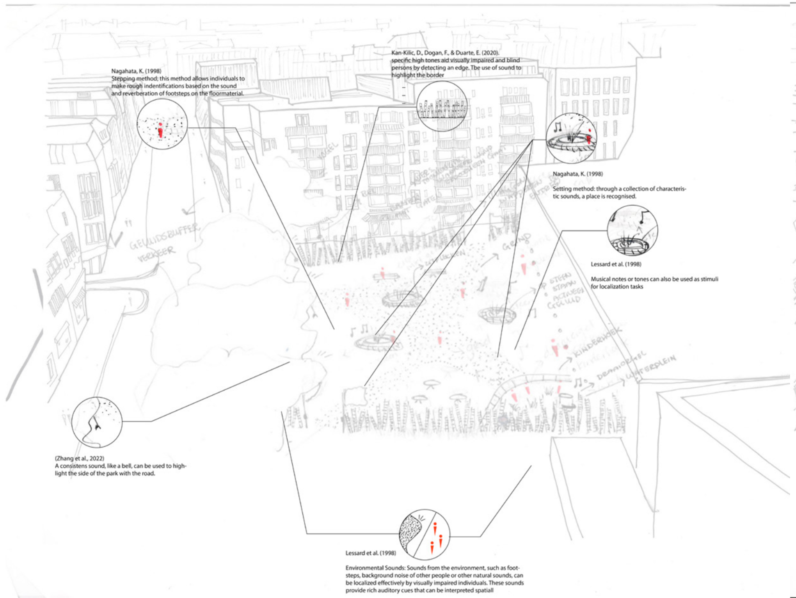
Figure 12. *Location for the Second Design Proposal*
Figure 13. *Analysis Location Design Proposal*

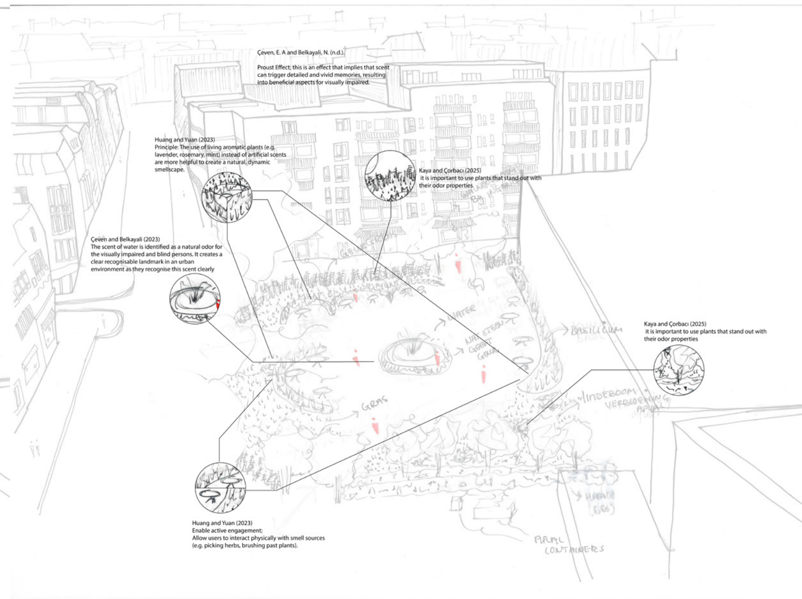
7.12.1 maximization | dwelling

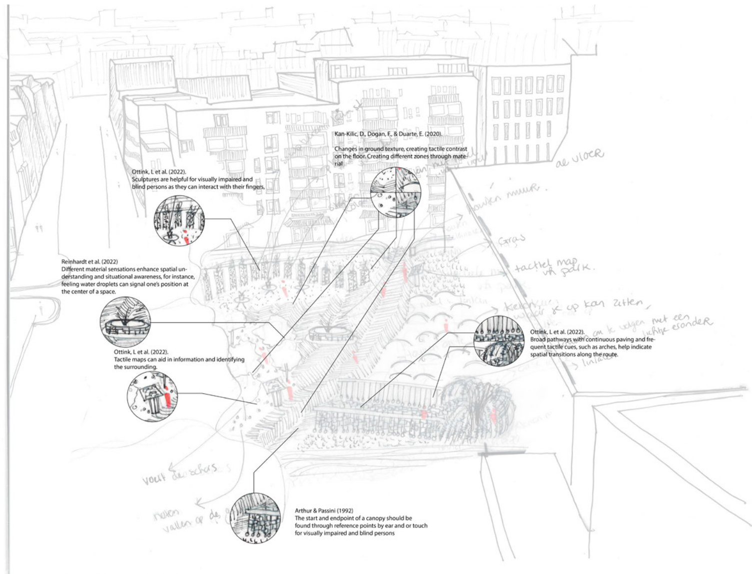
For the dwelling maximization, the site behind De Bijenkorf was selected, a centrally located but underused pocket within The Hague. Unlike other areas of the city centre, which lack accessible green and sensory-rich public spaces, most open areas lie further toward the Toernooiveld, leaving the inner core underrepresented. Today, this location functions almost entirely as a parking area: a classic urban "negative space" that serves cars rather than people. Its current condition makes it an instructive site for exploring how sensory design can transform a non-place into a meaningful, inclusive public environment. This place is between two busy and vibrant (reuring) environments in the city, the Grote Marktstraat and Chinatown, making it an ideal 'rustplek' where sensory calm can mediate between these high-stimulus zones. The site's immediate surroundings reinforce this potential. One edge is defined by the paving back wall of De Bijenkorf, while the other sides form part of Chinatown, with its dense collection of Asian supermarkets, eateries and food shops. Food odours and cultural cues characterise the streetscape, yet the interior of the parking lot remains atmospherically empty, an abrupt sensory gap within a highly expressive neighbourhood.

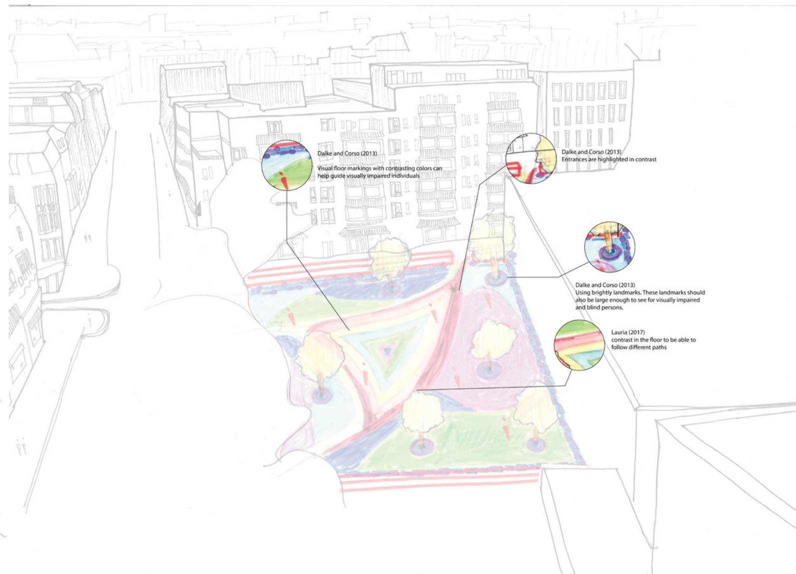
Research supports the relevance of choosing such a site. Visually impaired individuals report the highest levels of comfort, safety and spatial clarity in environments with calmer soundscapes and reduced traffic intrusion, such as parks, residential areas and shopping streets (Zhang et al., 2022). Conversely, artificial or unpredictable noises tend to evoke stress and disorientation. The area behind De Bijenkorf, positioned away from heavy traffic yet centrally located, offers an opportunity to create a sheltered, multisensory space that aligns with these preferences.

Reimagining this location as a dwelling-focused place, for resting, eating, or simply being present, allows an exploration of how natural sound, tactile ground textures, vegetation and microclimate can strengthen comfort and orientation. Its current emptiness becomes an asset: a spatial and sensory blank slate on which a calm, multisensory landscape can be constructed to support dwelling and offer a counterbalance to the city centre's intensity.









7.13.1 input maximization

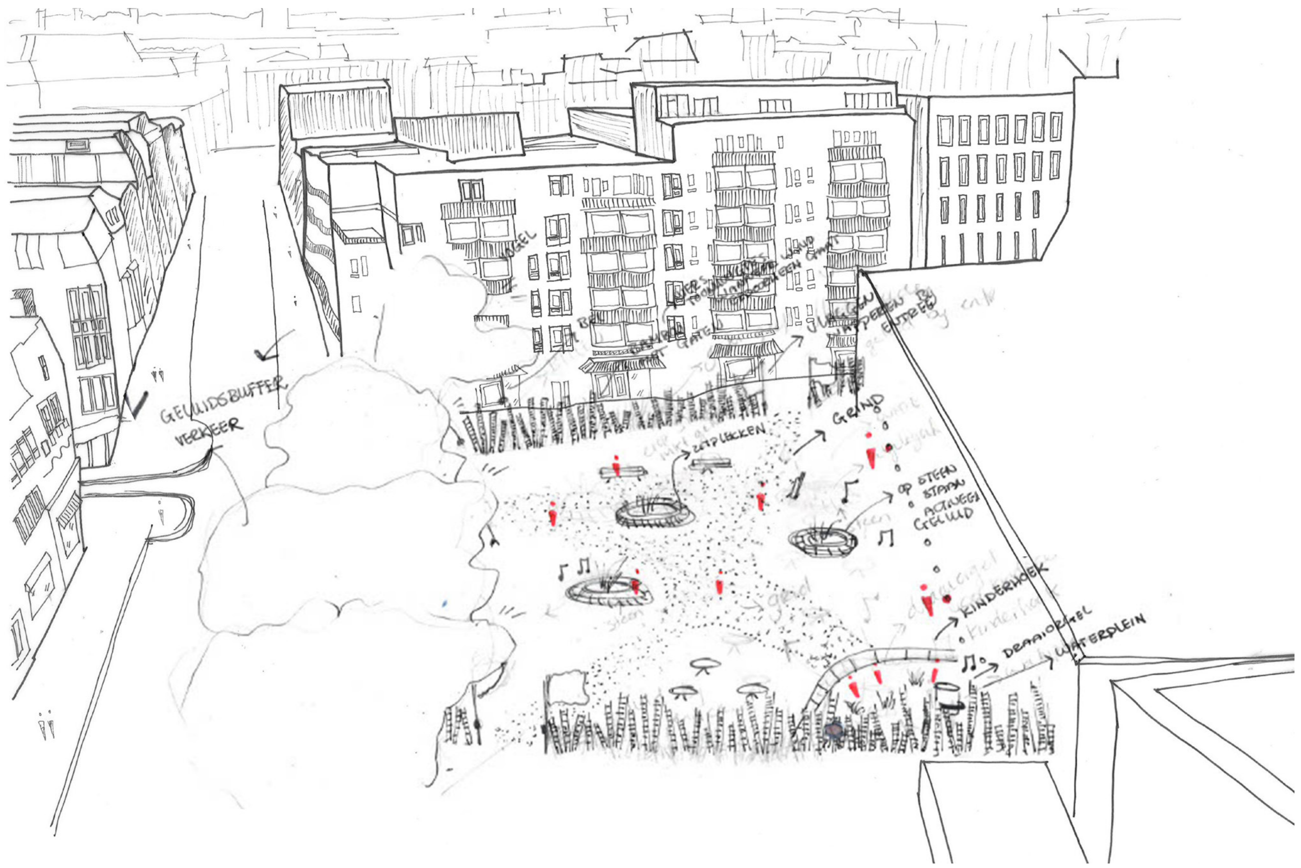
Phase I of the maximization method explores each sensory modality in isolation to understand its full spatial potential. By deliberately amplifying sound, scent, touch and visual contrast to their highest plausible intensity, the method tests how each sense can shape orientation, atmosphere and comfort when pushed to its spatial extreme.

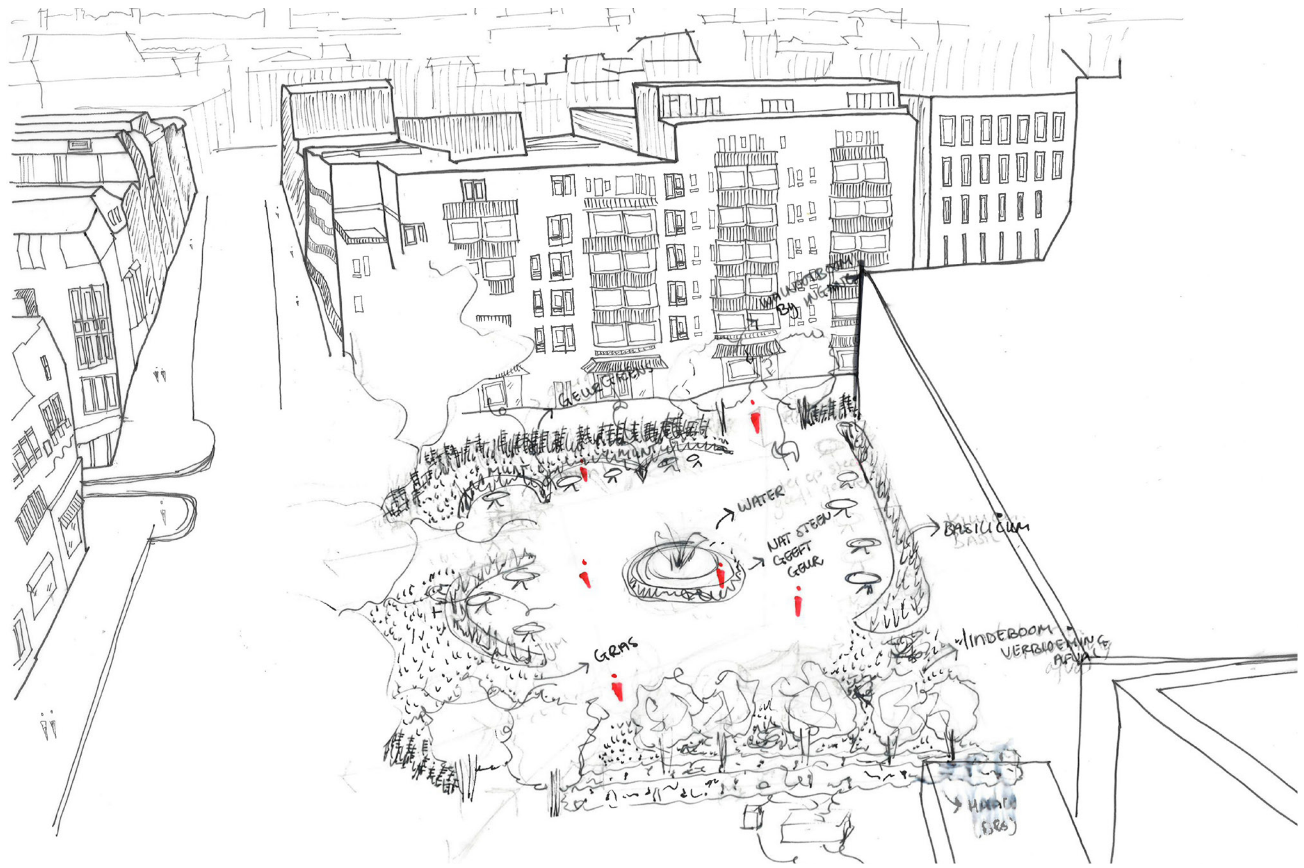
These scenarios are not design proposals but research-through-design experiments. They exaggerate sensory conditions to reveal boundaries, dependencies and conflicts that would remain hidden under normal circumstances. By reading these maximised situations side by side, it becomes possible to see where senses reinforce one another, where they begin to compete and where careful optimisation will later be required. The following pages present each maximised sensory scenario for the dwelling location behind De Bijenkorf.

The maximised scenarios are grounded in both literature and empirical fieldwork. Each drawing incorporates sensory elements identified in research as meaningful for orientation, emotional grounding or environmental comfort, such as natural soundmarks, fragrant vegetation, textural transitions or contrast-based wayfinding. These components are complemented by insights from interviews and on-site observations, where visually impaired participants describe the cues they rely on, avoid or struggle to interpret in similar environments. Together, the drawings visualise a synthesis of academic evidence and lived experience, forming an exploratory basis for understanding how each sense might operate when amplified to its fullest spatial expression.

The surrounding context further shapes the logic of this exploration. The site sits directly between two highly animated urban zones: the vibrant Asian food court area of Chinatown and the lively commercial spine of the Grote Marktstraat. Positioned between these reuring places, the parking lot behind De Bijenkorf offers a rare opportunity to create a calm, sheltered buffer, a pocket space where sensory softness can mediate between the intensity of the surrounding streets. This makes it a fitting location for a dwelling-oriented environment such as a small food court or "snoezelgarden," where people can sit, rest, eat food brought from home or purchased nearby, or simply enjoy a quieter atmosphere within the centre of the city.

This underlying intention, to create a place of sensory rest and gentle engagement between two high-stimulus areas, guides the experiments in the maximization method. It provides the conceptual foundation for exploring how different sensory cues might shape an environment that supports comfort, orientation and meaningful dwelling.



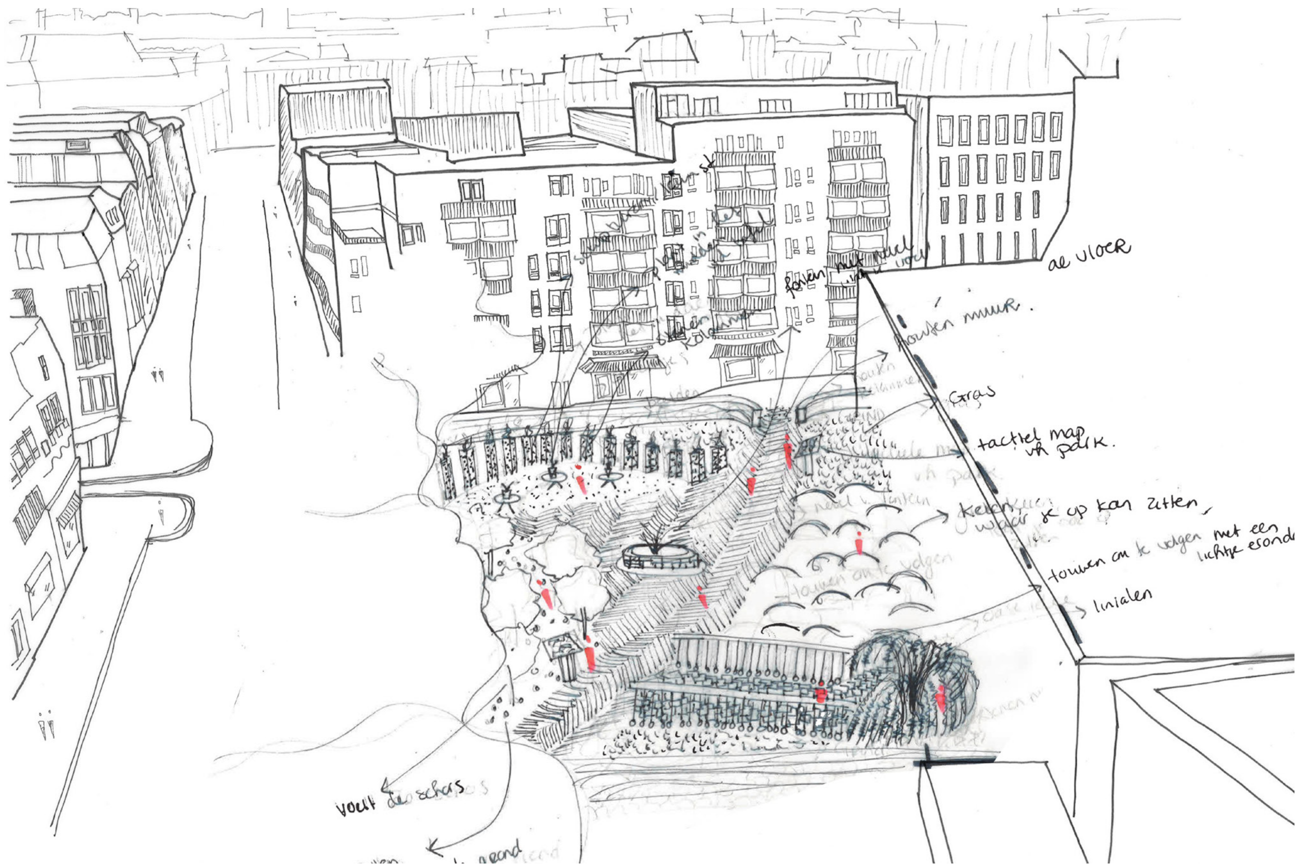


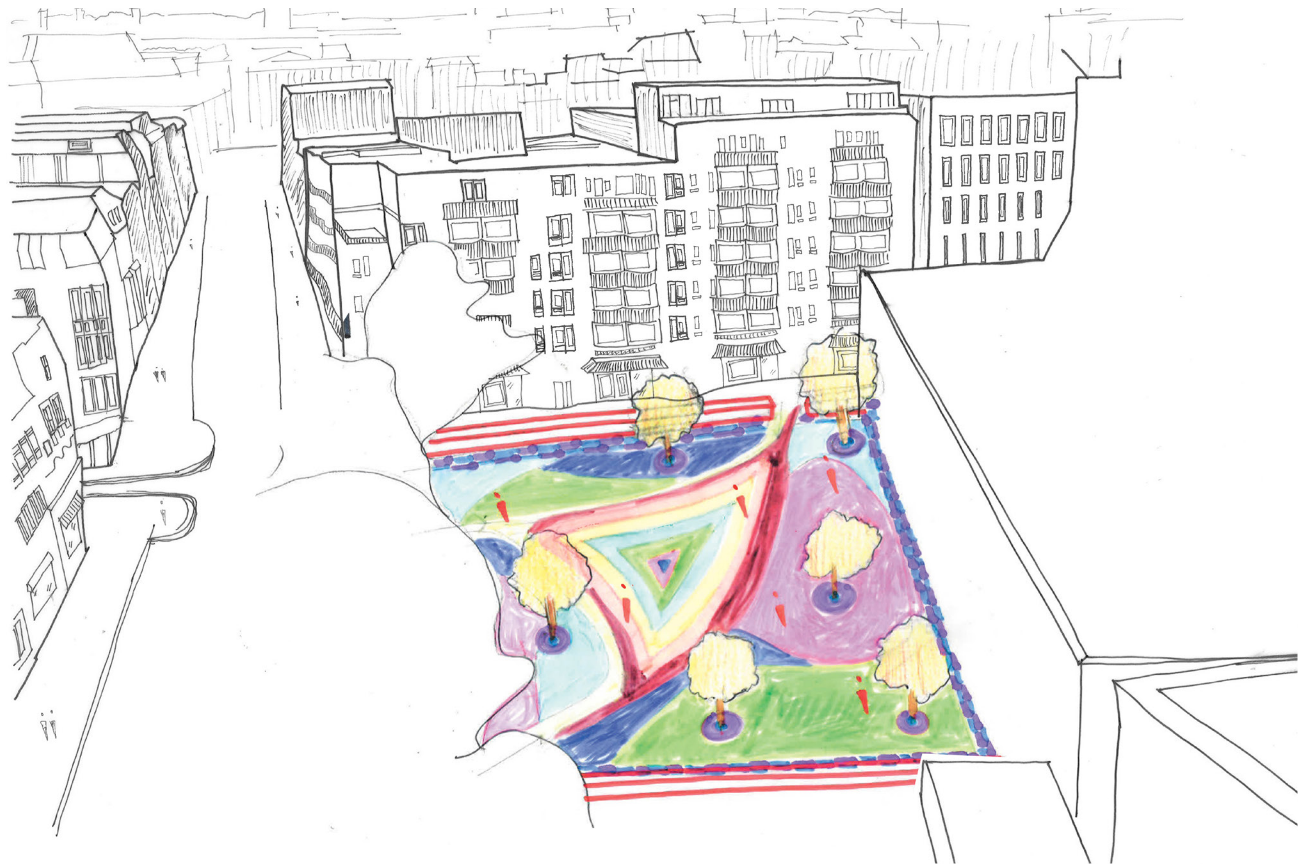
SOUND

In this scenario, sound becomes the primary organising element of the space. Highlighting the entrance with flags that make sound when the wind is present. Without wind, the bells on the flag will make sure the entrance is highlighted. Water features, rustling vegetation, and soft acoustic walls create a calm and readable soundscape that replaces the mechanical noise typically found in the city centre. The three different fountains act as soundmarks that define the different zones, support spatial orientation and create a sense of enclosure that visually impaired users rely on to interpret distance and boundary. The corner has a place for children with a toy that makes sound when it is played with. By maximising sound, this scenario exposes how auditory cues can structure movement and atmosphere, but also highlights the risk of sensory saturation if too many sound sources converge.

SCENT

Here, scent becomes the dominant driver of spatial experience. Fragrant vegetation, aromatic planting pockets and distinct smell zones create an olfactory map that guides users through the space. Each zone has its own natural scent which makes it recognisable without a visual cue. Because the site is adjacent to Chinatown, existing food odours interact with added natural scents. The center has a fountain that leaves a subtle water scent behind in the middle of the site. The maximization shows how scent can anchor memory, define atmosphere and help users distinguish different zones, but also demonstrates how powerful smells may overwhelm or conflict if not carefully calibrated.



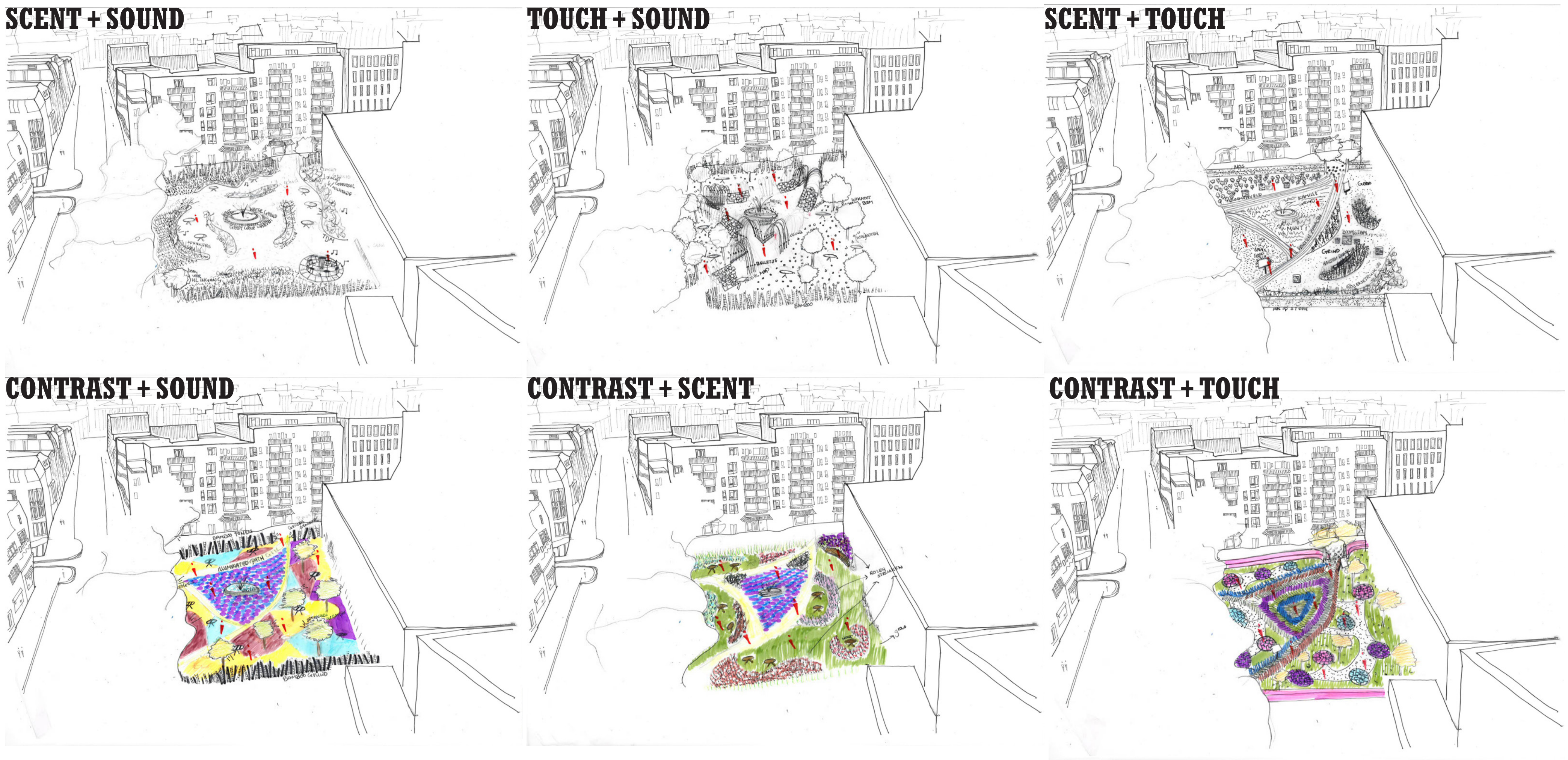


TOUCH

In the tactile maximization, ground textures, tactile furniture, surface transitions and hand-level materials become the primary cues for understanding the space. Each zone has different ground material. Besides the variation in ground material, someone can also feel his or her way to different zones. A tactile map is placed at each entrance to give an overview of the site. Tactile pathways guide movement, while textured seating, bark surfaces and vegetation invite dwelling and exploration. This scenario reveals the strength of touch in creating orientation and comfort, yet also shows the practical limits of relying too heavily on tactile variation, as too much texture can cause confusion rather than clarity. The experiment highlights where tactile cues are most meaningful and where restraint is essential.

CONTRAST

This experiment exaggerates visual contrast as the dominant sense, supporting users with low vision. High-contrast borders, illuminated lines, differentiated paving tones and layered lighting sequences define circulation, edges and resting zones. The two different mains shapes highlight a different occasion. One is to sit down and relax, the other one is to find the main route to the different entrances. The scenario reveals how contrast can build legibility, but also emphasises that over-contrasting surfaces may fragment the space visually or draw attention away from tactile and auditory cues.



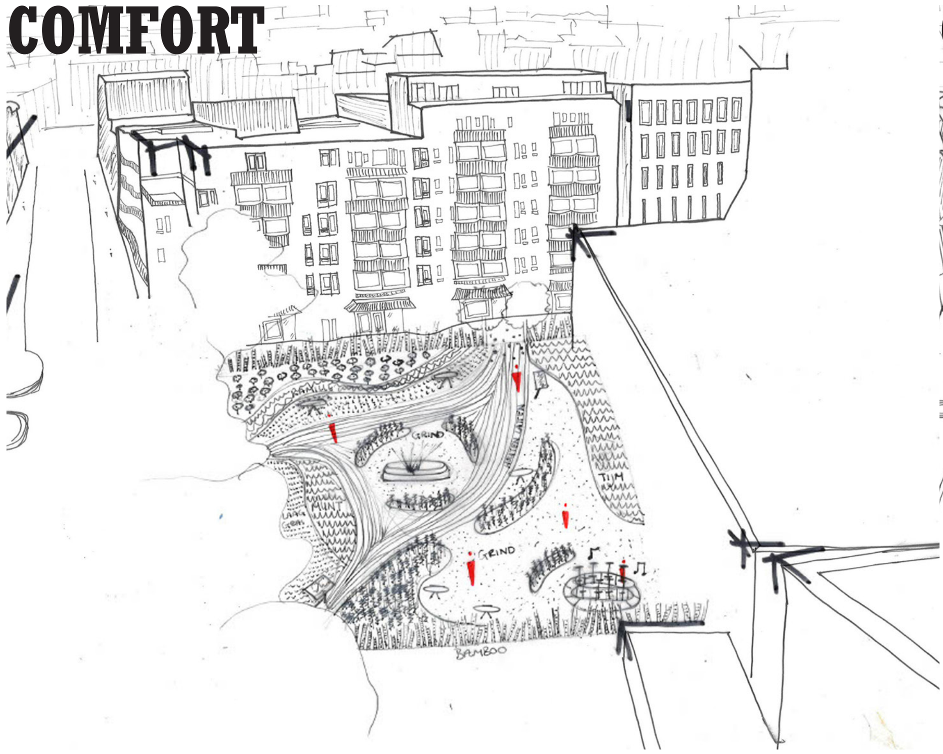
7.14.1 The first optimization

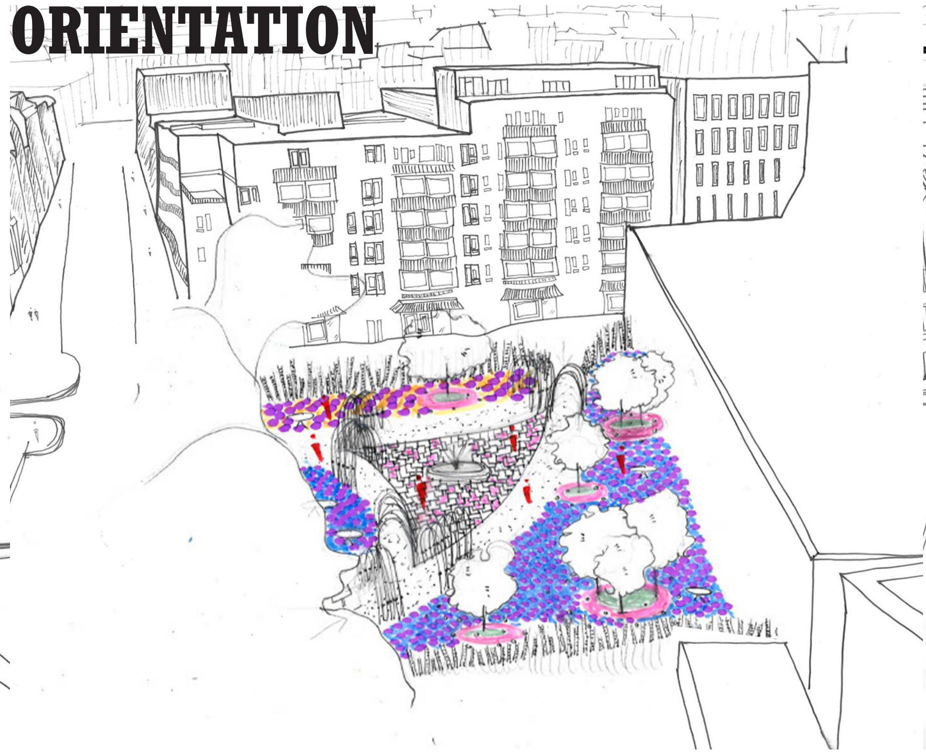
Phase II of the maximization method explores how sensory cues behave when paired, revealing which combinations reinforce one another and which create tension. Each pairing results in a separate drawing, allowing the first signs of synergy and conflict to emerge. Some senses blend intuitively: for example, sound and touch work particularly well together, as different tactile materials naturally produce distinct auditory qualities. Likewise, sound and scent form a coherent pair when based on natural elements such as wind, water and vegetation. Scent and contrast also complement one another, with colourful, aromatic planting providing both visual guidance and a recognisable olfactory anchor.

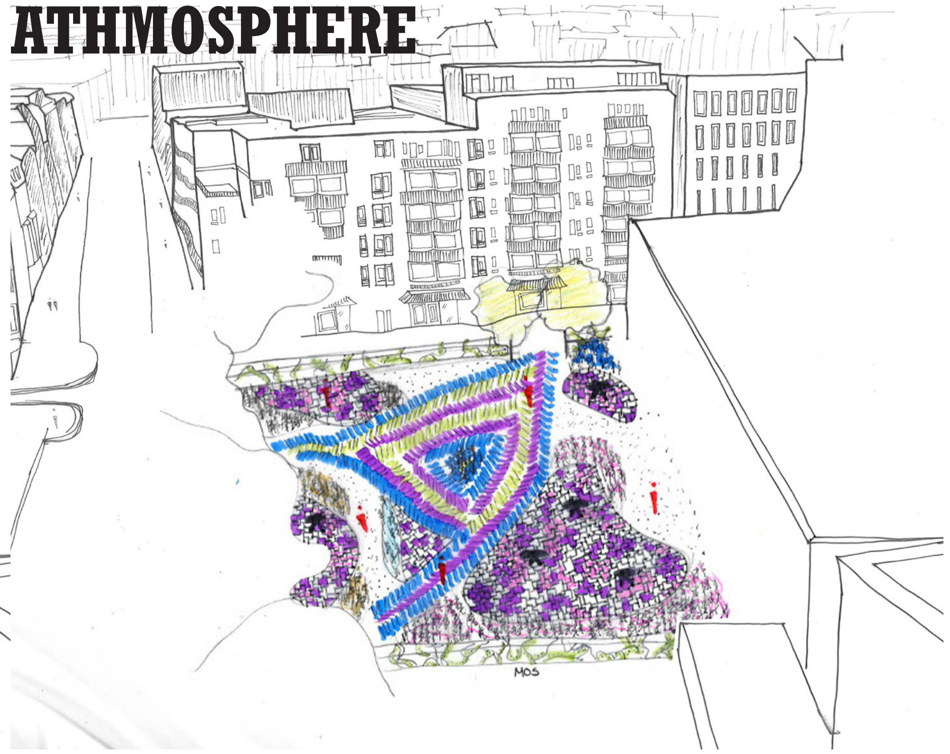
Other combinations are more challenging. Sound and contrast often compete for attention, as strong visual contrasts can already create a "loud" environment, making the addition of auditory cues overstimulating. In many cases, it proved difficult to find a configuration where these two senses could coexist without overwhelming users. These tensions reveal where sensory layers must be moderated or sequenced rather than stacked simultaneously.

Decisions about which sensory elements continue into later phases and which ones are set aside are guided by the wellbeing of the user. Natural cues, birdsounds, water, vegetation, wind, consistently prove more comfortable and cognitively manageable than artificial elements such as mechanical sounds, or man-made scents. As the aim of the dwelling space is to create a calm, restorative environment where users can rest, eat or enjoy a snoezelgarden-like atmosphere, natural stimuli were prioritised throughout the process. Sound is used sparingly, making sure that not every place is filled with a noise, often integrated through subtle elements such as bamboo poles that produce varying tones when moved by the wind. A fountain at the centre of the space creates a multisensory landmark that can be felt, heard and smelled, marking the middle of the plaza without dominating it.

Phase II therefore does not arrive at one fixed configuration but instead produces a set of possible outcomes. These paired scenarios reveal the sensory combinations that hold the most promise for comfort and orientation and those that require careful modulation. The subsequent phases build on these insights, gradually moving toward an optimised design in which sensory cues are balanced, intentional and well-suited to the calm, sheltered atmosphere of this pocket space between the busy Grote Marktstraat and Chinatown.







7.14.2 The second optimization

Phase III narrows the six paired maximization drawings into three optimized scenarios, each corresponding to one of the core intentions of the dwelling space: orientation, atmosphere, and comfort. This step marks the transition from sensory extremes to balanced compositions, showing how different cues can work together without overwhelming the user. Through the process, sensory elements that were removed in earlier phases can reappear in later phases, demonstrating that while certain cues may be unsuitable as maximised stimuli, they remain valuable when carefully moderated.

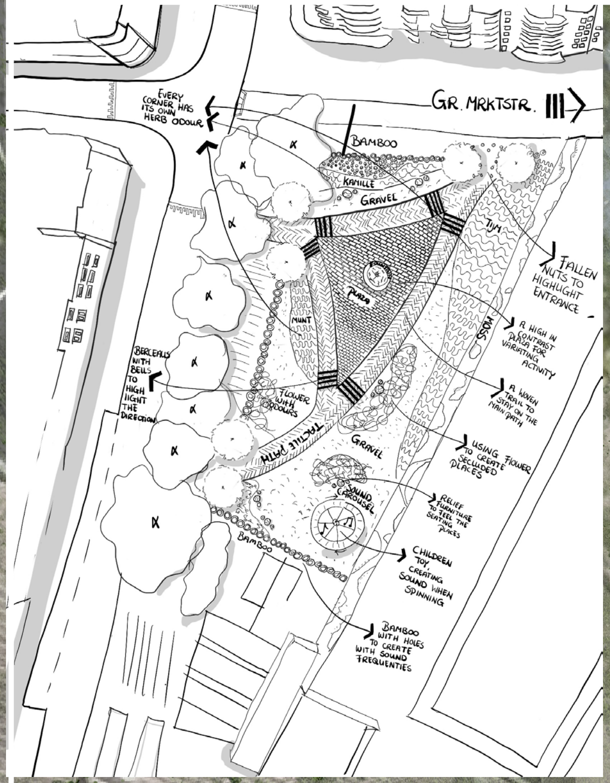
The orientation optimization builds primarily on sound with tactile cues and contrast. This combination proved the strongest together in Phase II, as tactile transitions naturally produce legible sound signatures when activated by footsteps or wind. Together, they mark boundaries and guide movement without adding unnecessary visual or olfactory complexity. The result is a clear spatial logic in which direction, edge conditions and turning points become intuitive. The contrast part aids significantly to address different zones.

The atmosphere optimisation, combines contrast with sound, supported by subtle tactile cues. This pairing creates recognisable zones through fragrant vegetation and colour variation, producing a distinct sensory character that feels calm yet lively. Surprisingly, contrast emerged as an important atmospheric tool, not in its maximised loud form, but as a soft enhancer of depth, planting structure and centrality. Its ability to highlight the middle of the space makes it particularly effective for activating the plaza's core as a social or spatial anchor. The contrast and tactile part both highlight the routes that bring you from entrance to exit.

The comfort optimisation, blends scent and sound with gentle tactile textures, emphasising natural cues that support relaxation and presence. Scent differentiates zones without dominating them, while soft sound sources, such as bamboo poles that resonate with the wind or a central fountain, provide subtle orientation and emotional grounding. This configuration preserves the quiet, restorative quality needed for a snoezelgarden space while maintaining clarity and spatial legibility.

Across the three outcomes, one notable pattern emerges: contrast, though not initially associated with dwelling, gradually becomes more prominent. As the drawings progress, the proportion of contrast-based elements increases, demonstrating that visual cues, when carefully calibrated, can significantly support both atmosphere and recognition for visually impaired users. Simultaneously, sound takes on a strategic role along the edges rather than the centre, marking transitions and thresholds without overpowering the space. Tactile materials retain their importance as carriers of meaning, and scent continues to operate as a zoning tool rather than a dominant stimulus.

Phase III therefore produces three balanced sensory scenarios that demonstrate how different combinations can support dwelling in distinct ways. These outcomes form the foundation for the final optimisation, where the most promisi



THE FOOD SENSORY GARDEN

7.14.3 Synthesis

The final drawing brings together the most promising elements from all earlier phases into a single balanced scenario. The result is a calm, multisensory garden where people can rest, eat, wander or simply retreat from the intensity of the surrounding Chinatown and Grote Marktstraat. The atmosphere shifts the moment one approaches the entrances: subtle bamboo borders rustle in the wind, creating a soft sound signature that signals the threshold even before it is seen. These entrances are intentionally open and recognisable, inviting both sighted and visually impaired users through clearly marked transitions of texture, sound and planting.

Upon entering, a tactile map offers an immediate understanding of the layout, allowing visitors to decide where they want to go. Tactile pathways guide movement intuitively: the main path provides a smooth, continuous route, while the semi-paved "shoelace paths" support more dynamic, meandering walking behaviour. These smaller paths reflect Arthur and Passini's (1992) observation that movement is never linear but shaped by micro-decisions, impulses and personal rhythms. Along these paths, edible herbs and spices can be plucked, adding both scent and a playful sensory interaction.

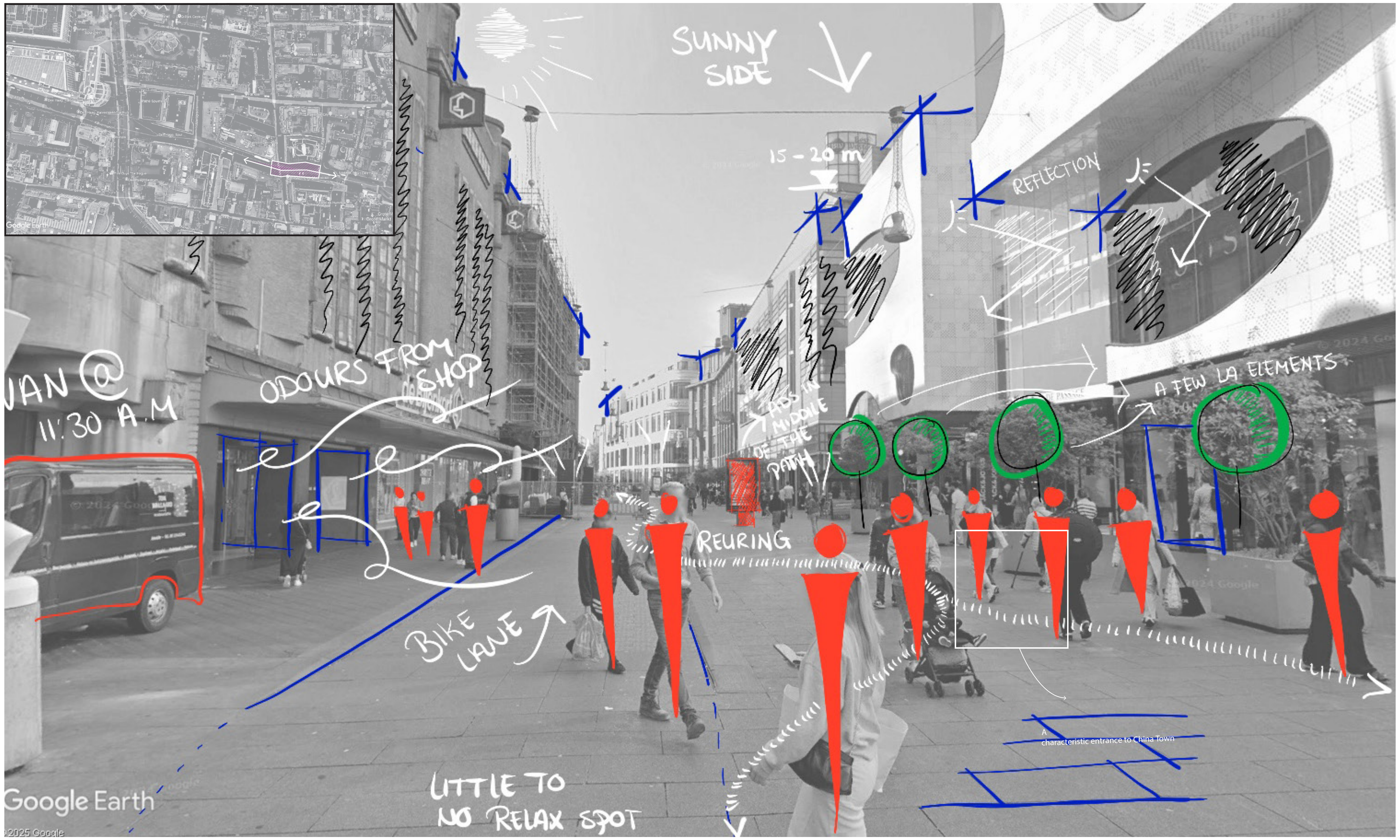
Across the site, different scents define distinct zones. Fragrant planting softens the heavy odours from nearby waste storage, transforming the air into something pleasant, natural and grounding. Scents also act as spatial cues: warmer, sweeter smells mark sitting and eating areas, while cooler, herbal scents line transitional paths. The arrangement creates a sensory gradient that subtly orients users as they move through the garden.

Sound takes on a gentle but purposeful role: at key splits and junctions, small hanging bells ring when touched, offering an interactive cue when choosing a path. A children's play area in one corner incorporates sound-making elements that activate only when used, allowing parents to hear where their children are without introducing constant noise. The bamboo edges act as a soft perimeter sound, while the central fountain provides a continuous, calming anchor. Its subtle movement of water creates a multisensory landmark that can be heard, felt and even smelled. From outside the park, the fountain acts as a beacon; inside, it becomes a gathering point where people sit, rest or enjoy their food.

The bright purple square in the centre, surrounding the fountain, provides a visually distinct and easily detectable surface that supports multiple small-scale activities. Its colour contrast ensures that people with low vision can identify where others are standing or moving, reducing the risk of collisions and creating a sense of spatial awareness. Tactile textures and soft planting around it frame the square gently, preventing overstimulation while reinforcing the centrality of this communal place.

Overall, the final scenario synthesises all sensory layers into a garden that feels sheltered, legible and emotionally comfortable. It is a snoezelgarden-like environment in the heart of the city: a calm pocket where one can sit down, relax, meet a friend, eat something, or simply enjoy a moment of sensory softness amidst the urban reuring. The design embodies the central aim of the maximization method, transforming sensory overload into sensory balance, and turning a forgotten negative space into a meaningful place of dwelling.

Figure 14. *Location for the Third Design Proposal*
Figure 15. *Analysis Location Design Proposal*



Note. Base from Google Earth satellite imagery

7.15.1 maximization | wayfinding

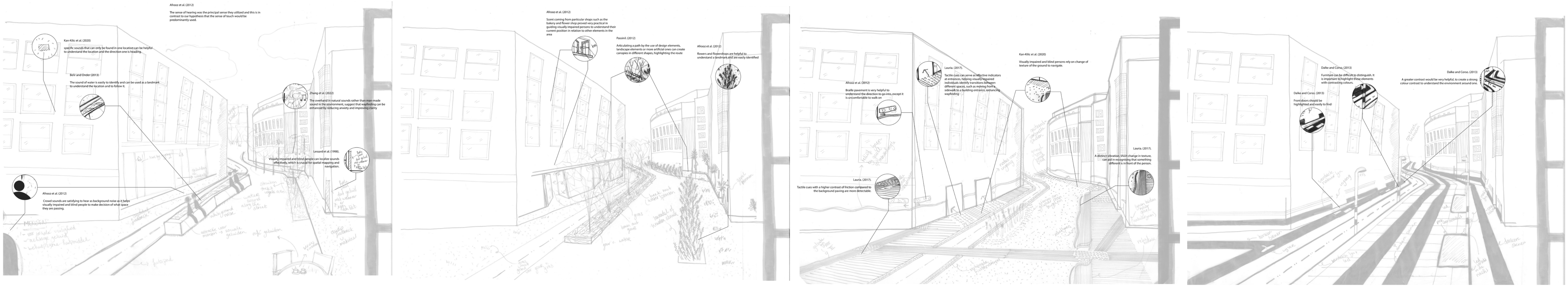
For the wayfinding maximization, a different type of site is selected. Unlike the dwelling location, where users may choose to enter or avoid the space, a wayfinding route is a place that most people must pass through. This fundamental difference creates distinct demands: safety becomes more critical, movement must remain uninterrupted and sensory cues must prioritise direction, predictability and collision avoidance. In such environments, tactile information in particular gains importance, as mistakes or misinterpretations can quickly lead to dangerous situations.

The chosen site is the Grote Marktstraat, one of the most intensively used streets in The Hague. It connects residential neighbourhoods with the municipality, workplaces, public transport hubs and major commercial destinations. The street hosts a wide range of activities: shopping, eating, commuting, leisure, and everyday tasks such as visiting the dentist or running errands. It is therefore a typical multifunctional urban corridor where many different intentions and movement speeds overlap.

The street is approximately 20 metres wide, offering generous physical space but very few cues to keep users on a straight or intuitive path. Although a cycle lane is positioned slightly lower than the surrounding pavement, cyclists frequently move onto the pedestrian area, particularly during busy hours. As a result, pedestrians and cyclists often mix unpredictably. The street also accommodates logistics traffic in the early morning and irregular service vehicles throughout the day, introducing additional obstacles that visually impaired users cannot easily anticipate.

The street is enclosed by façades of 15–20 metres in height, creating a canyon-like effect that can be disorienting for those unfamiliar with the environment or walking without a specific purpose. The abundance of shopfronts, ranging from fashion to drugstores, electronics, home goods, creates visual and sensory clutter. Additionally, many side streets converge into the Grote Marktstraat, making it a highly permeable and heavily trafficked pedestrian zone. These conditions make the street challenging to interpret, especially for visually impaired and blind individuals.

The specific section selected lies between Hema and De Bijenkorf. This location was chosen deliberately, as it forms a logical link between the dwelling site behind De Bijenkorf and the broader pedestrian network. By designing both locations in relation to one another, the maximization method begins to explore how sensory strategies can connect different types of public spaces into a coherent urban experience.

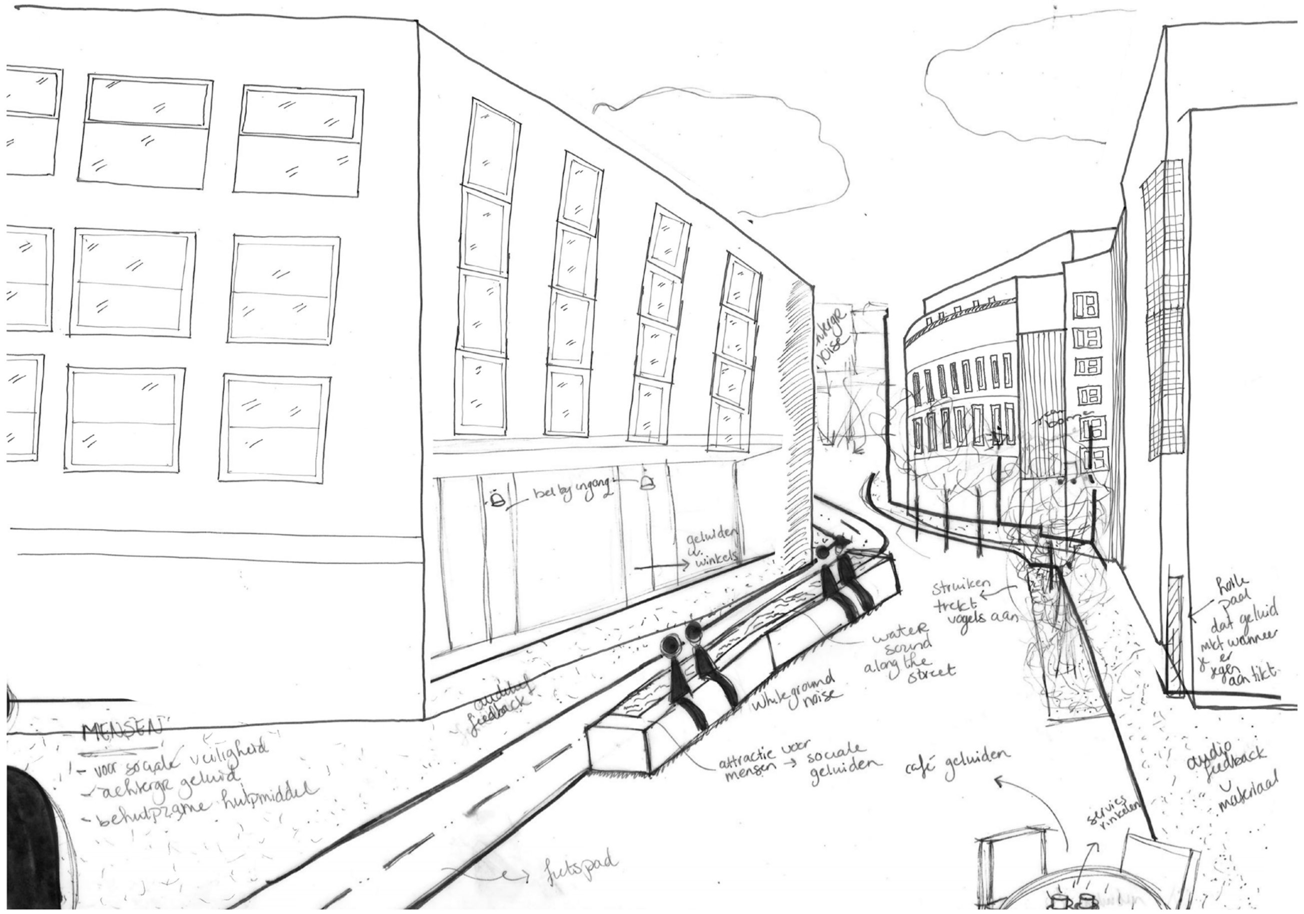


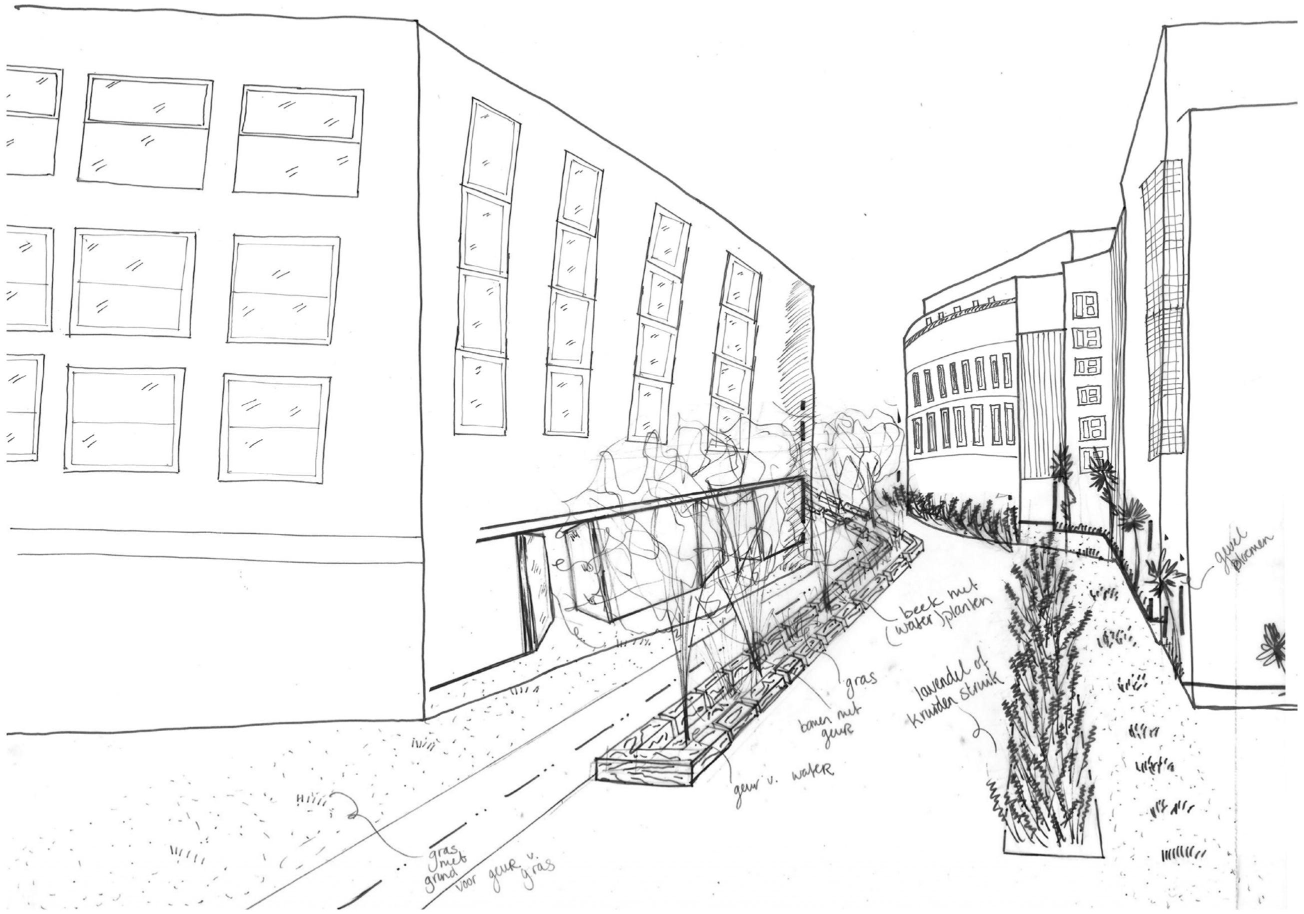
7.16.1 input maximization

Phase I of the maximization method investigates how each sensory modality can independently support wayfinding when amplified to its fullest plausible extent. The drawings presented here show the foundational input derived from literature, while the four maximization drawings that follow incorporate this input together with empirical findings from interviews and on-site observations. By deliberately exaggerating sound, scent, touch and visual contrast, the method tests how each sense can shape clarity, orientation and movement when pushed to its spatial extreme.

These scenarios are, like the dwelling first drawings, not design proposals but research-through-design experiments: they visualise exaggerated sensory conditions to reveal boundaries, synergies and conflicts that would remain invisible in a conventional design process. In contrast to the dwelling site, wayfinding requires predictable movement, low cognitive load and minimal distraction. The aim of this phase is therefore not to create atmosphere, but to clarify direction, establish recognisable edges and support the user in moving from A to B with confidence. In this context, the Grote Marktstraat is divided into two functional layers: the side paths, where users slow down to access shops, façades and entrances; and the central path, which acts as the clearest, most continuous line for moving through the street.

These drawings are, like the dwelling first drawings, not design proposals but research-through-design experiments: they deliberately exaggerate sensory cues to reveal their boundaries, synergies and conflicts. When viewed together, they show where senses can reinforce predictable wayfinding, where they may overwhelm or contradict each other, and where careful optimisation will later be necessary.





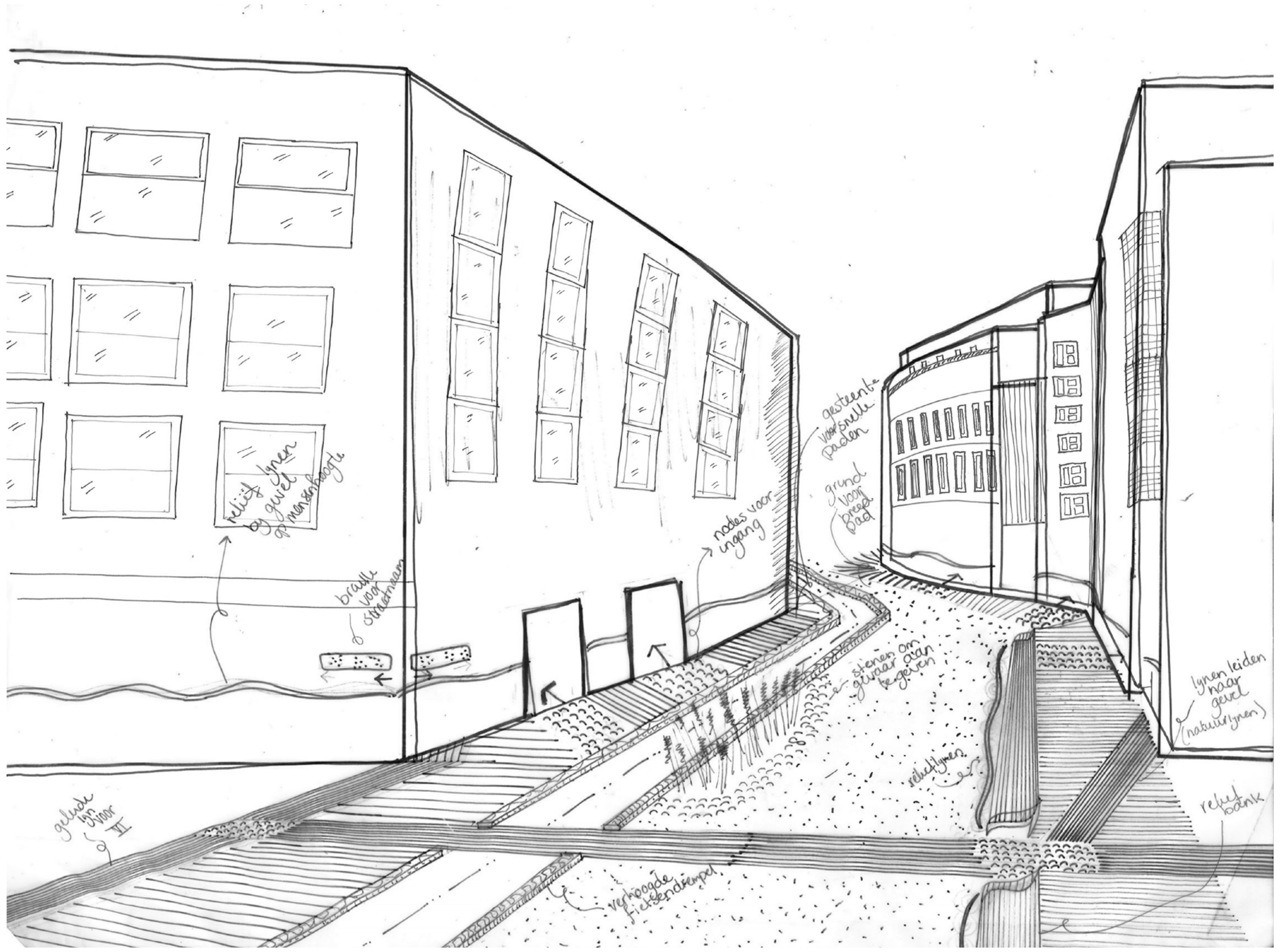
SOUND

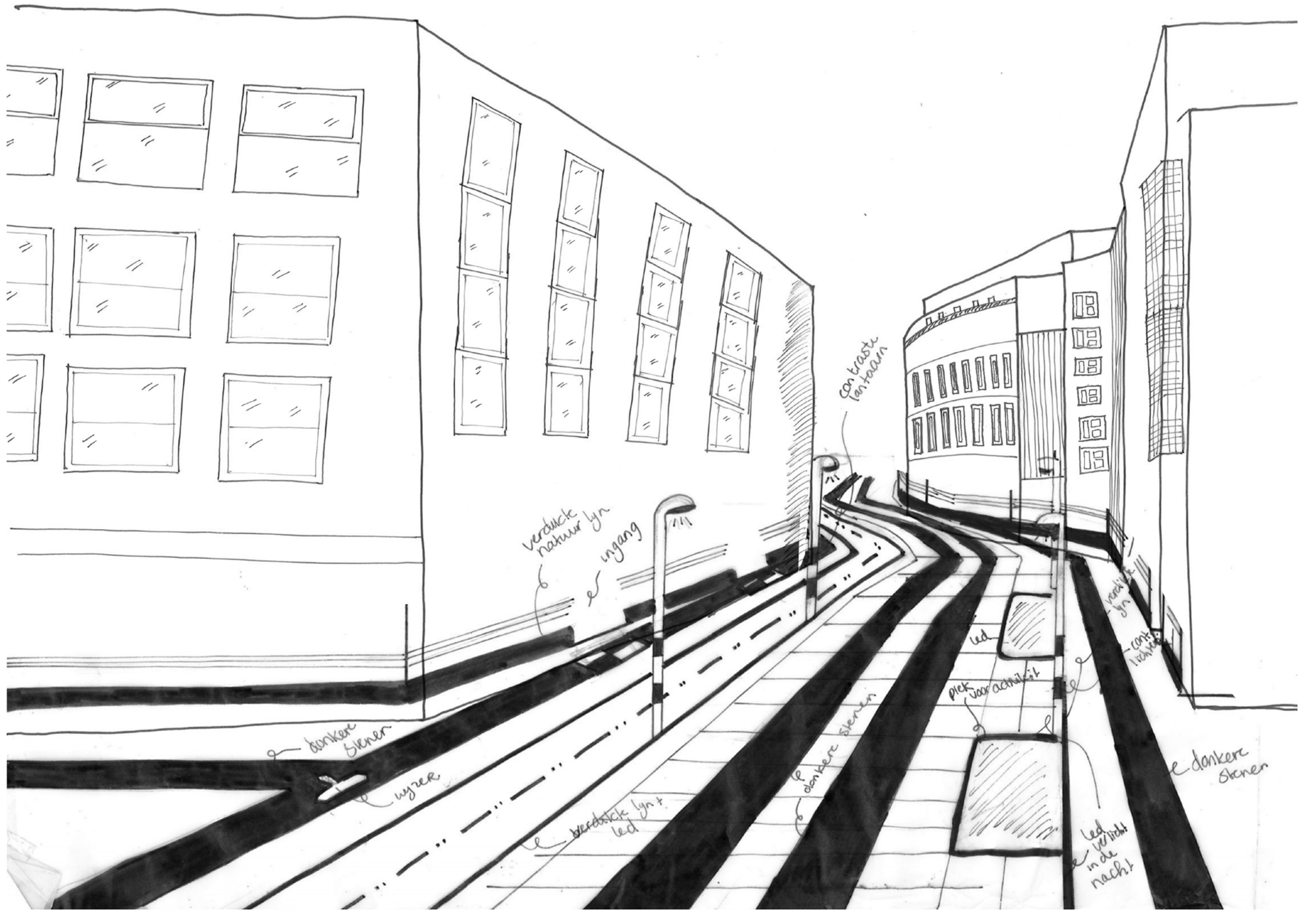
In the sound-maximization drawing, auditory cues structure the entire street. Sources include water elements, rustling vegetation and human presence, as people themselves serve as both social safety anchors and locational references for visually impaired users. Small sound beacons are placed at key shops and intersections to function as recognisable landmarks within a cognitive map. The implementation of soundmarks, signal orientation and direction, helping users prioritise safe movement. The exaggeration reveals both the potential of sound as a navigational tool, while at the same time showing the risk of overstimulation if too many sound sources converge in a complex street environment.

SCENT

The scent scenario uses olfactory cues to anchor position and highlight direction along the street. Stronger concentrations of scent mark entrances, blending with the existing smells of bakeries, cosmetic shops and food stores, which naturally signal the identity of specific locations. Fragrant vegetation lines the accessible routes, creating gentle scent gradients that shift as one moves, allowing users to sense proximity, direction and spatial change. Amplifying scent in this way reveals how olfaction can support wayfinding by clarifying location, differentiating zones and reinforcing cognitive maps of the street.

However, the exaggeration also exposes challenges: in a commercial environment already rich in competing odours, scents can easily clash or become overwhelming. For this reason, the maximised scenario prioritises natural scents. Interviews confirmed that synthetic or heavily perfumed smells, common in drugstores and cosmetic shops, can quickly become nauseating or confusing, whereas natural fragrances are perceived as calmer, more legible and more pleasant to follow.



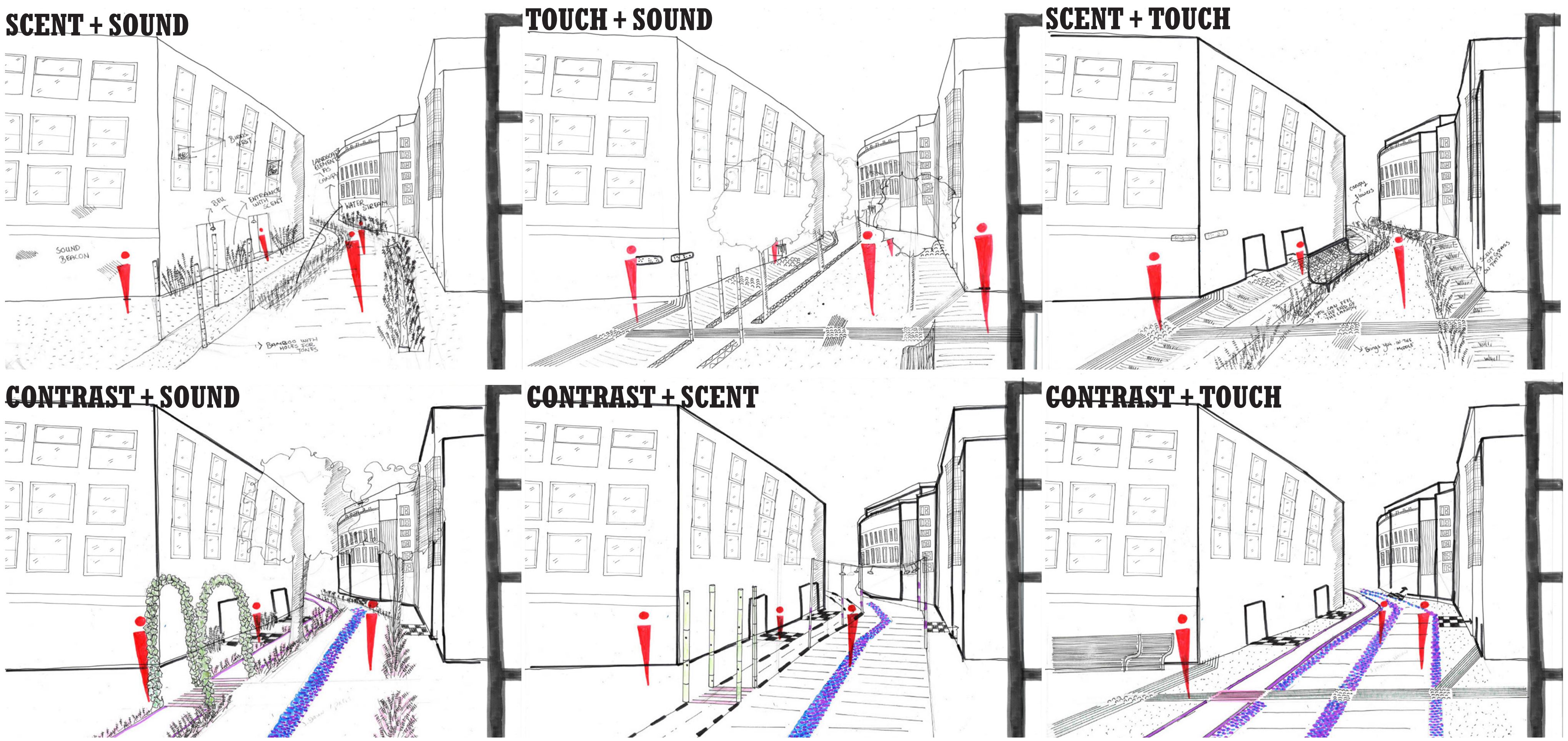


TOUCH

The tactile maximization creates a fully continuous tactile network across the entire street. Textures differentiate the central path from side paths, allowing users to maintain a straight line with minimal cognitive load. Changes in friction and tactile rhythm reveal transitions, edges and shopfronts. Tactile cues also highlight urban furniture such as benches, reducing collision risk. Braille information is added at façades and transition points, creating fixed reference points for orientation. This scenario demonstrates the strength of touch in supporting clarity, but also shows that too many textures or dramatic contrasts may become confusing, suggesting the need for moderation in later phases.

CONTRAST

The contrast drawing exaggerates black and white luminance differences throughout the corridor. High-contrast surfaces mark edges, façade lines, poles, urban furniture and shop entrances. The central path becomes a visually distinct spine to orient low-vision users quickly, while transitions to side paths are signalled through sharp tonal shifts. This experiment reveals how contrast can anchor the route, clarify direction and reduce ambiguity for users with residual vision. At the same time, it shows that extreme contrast can become visually noisy or overwhelming especially in a street already filled with commercial stimuli, highlighting the need for careful calibration later.



7.17.1 The first optimization

Phase II of the maximization method examines how sensory cues behave when combined, revealing which pairings strengthen wayfinding and which create tension or overstimulation. While Phase I isolated each sense to test its full spatial potential, Phase II moves toward integration, analysing how these cues interact along the chosen wayfinding segment of the Grote Marktstraat.

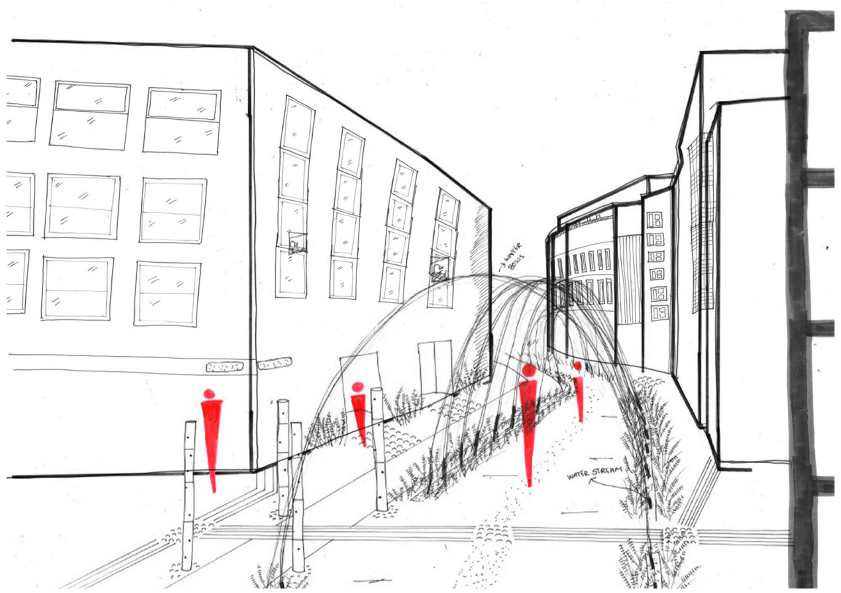
Certain sensory combinations prove especially effective. Sound and tactile cues form a robust duo: different ground materials generate distinct audio feedback, enabling users to detect transitions and maintain direction with minimal cognitive effort. Contrast and tactile cues also work intuitively together, as strongly distinguishable textures, translated through the cane or underfoot, provide reliable information even when visual contrast alone may be misleading. Participants noted that black–white contrasts can appear as "holes" or drops, making tactile confirmation a crucial complement. Although tactile paving is often perceived by visually impaired users as uncomfortable or disruptive when used continuously, it becomes extremely valuable at specific moments, such as crossings, transitions or intersections. For this reason, the tactile layer in the maximization method focuses not on continuous blister paving, but on clear differences in ground materials, which users reported as easier to detect, less intrusive, and more cognitively manageable in a long linear route.

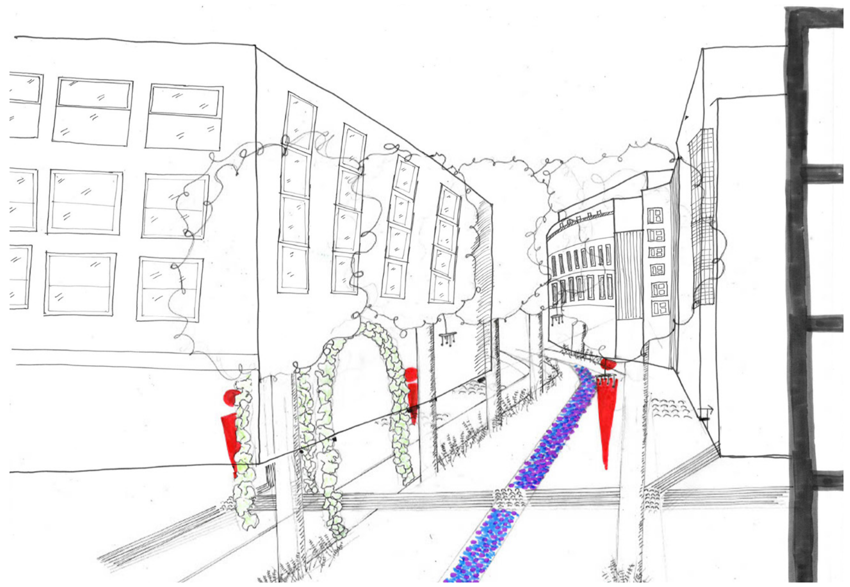
Scent cues are similarly promising: tactile lines structure the route while olfactory anchor, entrances of bakeries, drugstores, or scented vegetation, signal orientation and help users recognise where they are along the street.

Other pairings surfaced important limitations. Sound and contrast, again, frequently compete for attention; strong visual contrasts already register as "loud", meaning the addition of distinct auditory cues can overwhelm or startle users. Participants consistently mentioned that although sound is easily detected, it can also provoke sudden anxiety if overused. This insight suggests that sound should not function as the primary guiding element, but rather as a punctual marker, for example at crossings, bike lanes or decision points, rather than a continuous navigational spine.

Natural sensory elements again demonstrated the highest usability. Consistent with earlier phases, cues such as birds sound, wind, running water or fragrant vegetation were found to be more intuitive and emotionally stable than artificial indicators. As a result, the optimisation process prioritised natural cues for continuous guidance (scent, vegetation, tactile ground textures), while reserving artificial signals (bells, beacons, lighting contrast) for discrete moments where clarity is most needed. Some elements introduced in Phase I were removed for safety reasons, for instance, tactile curbs around bike lanes, which may pose risks for cyclists when falling. These cues were replaced with safer, alternative indicators such as sound or contrast.

A key spatial insight emerges from this phase. The wide, ambiguous width of the Grote Marktstraat benefits greatly from the introduction of a spatial corridor, a structured central pathway that can be continuously followed with reduced cognitive load. Arthur and Passini (1992) emphasise that corridors enhance wayfinding by providing a clear, legible structure that guides movement effortlessly. In this design, the A–B route becomes such a corridor: not a walled-off channel, but an enclosed-yet-permeable spine, framed by recognisable sensory cues. The sides of the street remain flexible zones for commercial display and entrances, while the central corridor quietly organises the space, making the walking route predictable and calm without inhibiting visual openness.
Phase II therefore does not converge on a single solution but generates a spectrum of viable sensory configurations. These pairings reveal early signs of synergy, especially between tactile, scent and natural sound and also expose where sensory layering must be moderated.





7.17.2.The second optimization

In the third phase of the maximization process, the wayfinding strategy is further refined by reducing the six paired sensory scenarios to three consolidated configurations. This step is necessary to move beyond open-ended exploration and toward a more coherent and applicable design direction. Rather than introducing new sensory extremes, this phase focuses on selecting and balancing those sensory combinations that proved most compatible during the previous phase.

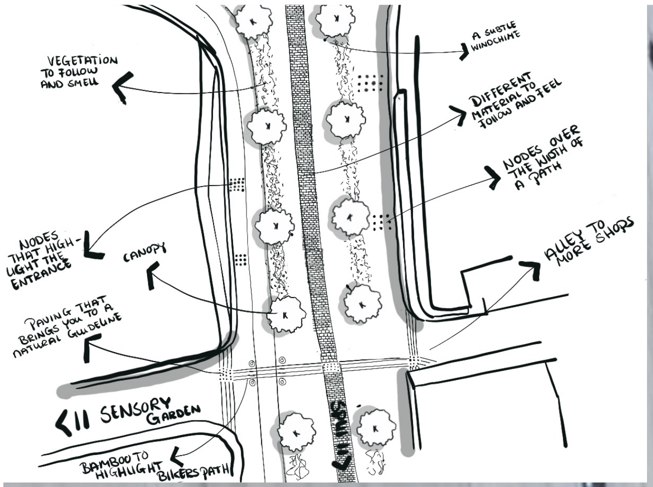
The three remaining drawings are not organised around thematic categories, but around synergistic sensory relationships. Each configuration combines sensory cues that were found to reinforce one another without increasing cognitive load. Importantly, sensory elements that were temporarily set aside in earlier phases due to their intensity reappear here in moderated form, demonstrating that information filtered out at one stage can return later when placed within a clearer structure.

Across the three configurations, a consistent logic emerges. Tactile cues form the continuous spatial backbone of the route, offering reliable ground-based information through material changes rather than extensive tactile paving. Tactile paving itself is used sparingly, as interviews revealed it is often perceived as uncomfortable over long distances and only truly helpful at crossings and decision points. Sound is positioned primarily along the edges of the route and at transitions, where it signals change rather than guiding continuous movement. Scent is used to define zones and support recognition, allowing users to “follow their nose” without overwhelming the environment. Contrast becomes increasingly prominent in this phase, not as decoration but as an anchor that clarifies the central corridor and highlights key spatial elements. Although contrast may not be the first sense associated with blind users, this phase shows its value for partially sighted users and its role in structuring space for all.

A key outcome of this phase is the emergence of a central corridor. Drawing on Arthur and Passini (1992), the corridor functions as a clear and legible organising structure for wayfinding. It does not aim to accelerate movement, but to distinguish between a predictable, unobstructed route for through-movement and more flexible side zones where clutter, shop displays and lingering can occur. The corridor is articulated rather than enclosed: it remains visually and spatially open, acknowledging that the surrounding building façades already provide a strong sense of enclosure. This approach avoids creating a rigid or tunnel-like condition while still offering guidance and continuity.

Certain design elements were deliberately removed during this refinement. Raised tactile curbs along the bicycle lane, for instance, were excluded due to the risk they pose when cyclists fall. Instead, the presence of the bike lane is indicated through other sensory means, reducing danger while maintaining legibility.

Overall, Phase III shifts the focus from experimentation to coherence. The resulting configurations prioritise low cognitive load, intuitive reading of space and continuity from point A to point B. By balancing tactile structure, moderated sound cues, scent-based zoning and strategic contrast, this phase demonstrates how wayfinding environments can be made legible and calm without becoming overstimulating. The outcome is not a single fixed solution, but a refined sensory logic that informs the final synthesis of the wayfinding design.



THE CORRIDOR OF THE GR. MARKT

7.17.3 Synthesis

The final drawing is a synthesis of all the drawings that have been made in this process. The underlying thought during this process was to create a calm wayfinding route that attracts many people due to its rustique ambiance, the use of elements that can be fuond in nature (vegetation, bamboo, attraction of animals). The main element that would lead the user is the corridor. During the process many shapes of corridors (vegetation, contrast, water) have been used.

However, when the user comes to the Grote Marktstraat, it will will have two options. Based on the purpose of the visit he will be subconsciously led to one of the two paths. If he or she is enjoying a day in The Hague and wants to see what it has to offer, the environment of the trees will make her feel like she is not in the big city at all, but in a calm environment. She can follow this big space easily due to the scent of the vegetation between the trees or the big contrasting line on the floor. The trees however don't cover everything. They can be placed every so meter and they are not too compact/intense, to make sure that the facades are still visible from the corridor and the overall ambiance of the Grote Marktstraat won't dissappear. Everytime a small street crosses the big street she will feel a tactile texture under her, indicating that she can go another street if she wants to. These tactile paving tile will lead her to the first natural guid (facade) and from there she can feel in braille what street she is heading towards.

If she has a purpose to a certain shop she can follow the wide path until she smells or knows that her shop is there and go on to the smaller path on the side, she can feel the entrance of the shop by the tactile nodes and the smell of the shop can ben smelled from the entrance.

If she wants to go from part A to B, she simply has to follow a line and walk between the corridor. Through the contrast line, it is possible to see if others are standing here.

The bamboo stocks near the bikelane create a whistle sound effect through the bamboo. This, incombination with the contrast line in the center indicates the food snoezelgarden that is situatied behind the Bijenkorf, near the Grote Marktstraat.

Around each entrance, some flowers are placed in colour to highlight the entrance as well.
This drawing is more subtle than the dwelling drawing, the main reason for this is because of its purpose. A strucutral and clear route can be reached more easily when there isn't too much clutter or a design too loud. Some benches can be placed between the trees as to not obstruct the route between the corridor.

Dwelling and wayfinding have different needs, dwelling has athmosphere on a higher note and wayfinding comfort. This doesn't mean that dwelling doesn't need comfort and wayfinding doesn't need athmosphere. As it turns out, a bit of dwelling is in wayfinding and the other way around. You can't go without one. The dwelling drawing also has wayfinding elements, like the main path, the tactile map. While the wayfinding drawing has a lot of natural elements with the goal to improve the athmosphere of de Grote Marktstraat.

Figure 16. *Sensory Graphic Season*

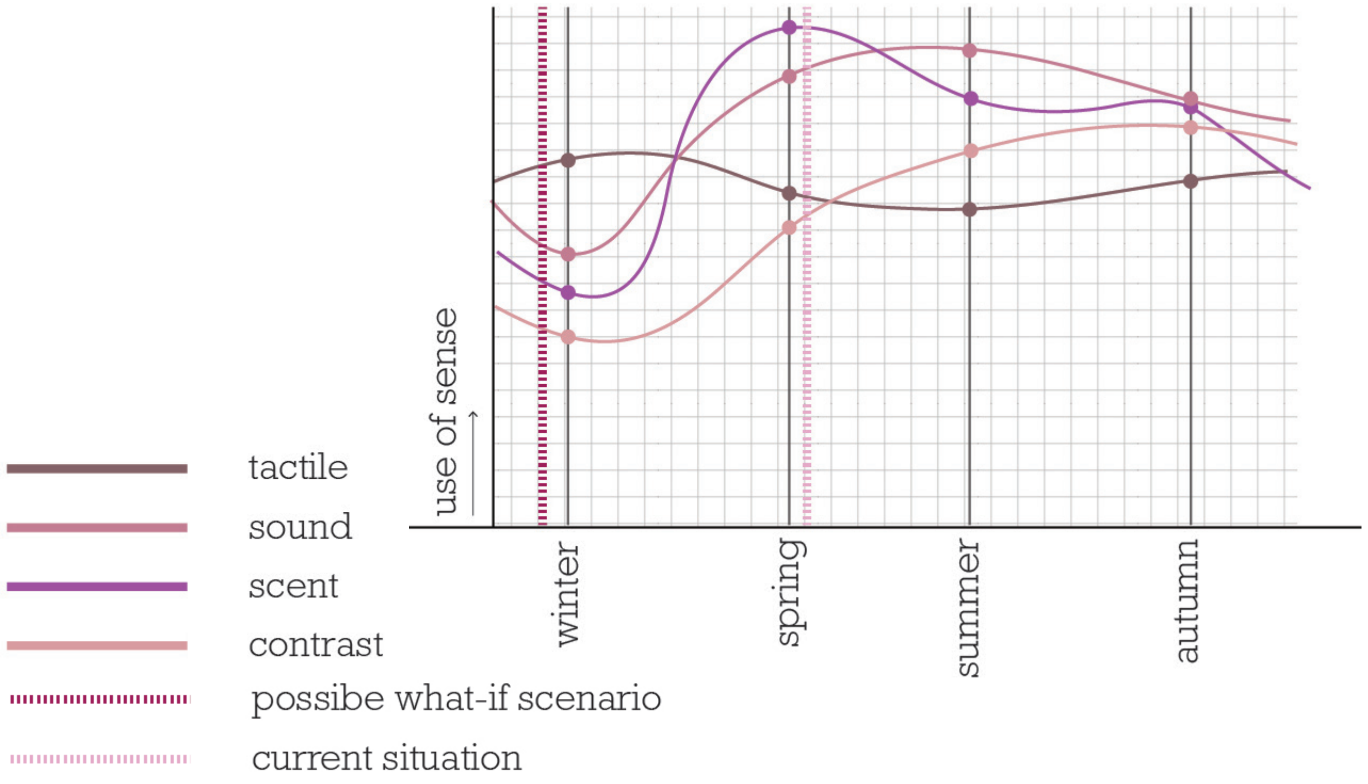
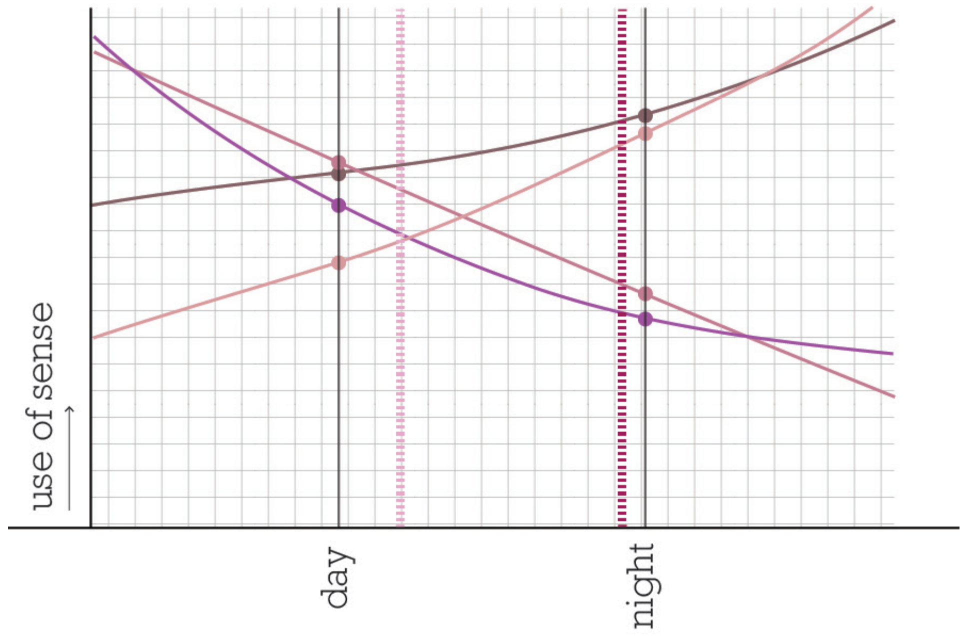


Figure 17. *Sensory Graphic Time*



7.18.1 Scenarios

The two outcomes developed through the maximisation method provide multisensory scenarios based on sound, scent, touch and contrast. However, as established in the User and Sensory chapters, sensory cues in public space are never static. They shift throughout the day, across seasons and in response to weather, activity levels and urban rhythms. Shops close and open, rain alters acoustics, snow dampens sound and changes ground texture, wind redistributes scents and daylight gradually fades into darkness. As these conditions fluctuate, different senses become dominant or recede in importance.

For visually impaired and blind people, but also for the average person, these variations can significantly alter how a space is perceived, navigated and inhabited. This makes it essential to test how the maximised scenarios behave under contrasting environmental conditions. To explore this, two additional scenarios were studied: night-time and winter, in contrast to the spring/summer daytime conditions used during the design process.

Night-time emerged as a particularly relevant condition, since participants repeatedly emphasised the importance of lighting for orientation and safety. Research confirms this heightened sensitivity: individuals with partial light perception are disproportionately affected by seasonal and daytime changes. Even minimal light input influences mood, energy levels and behaviour, making the absence of daylight especially impactful (Dam & Hageman, 2016). According to the study of Dam and Hageman (2016) winter brings additional challenges. Reduced daylight hours, persistent darkness and icy surfaces can restrict mobility, limit social interaction and contribute to feelings of isolation, all factors associated with increased depressive symptoms among visually impaired individuals. These seasonal vulnerabilities make it crucial to understand how sensory strategies operate beyond ideal conditions.

The What-If Scenarios therefore examine how the proposed sensory configurations adapt when the environment changes. They test whether the cues remain legible, whether they overload or disappear, and whether the balance between senses shifts in ways that support, or hinder, navigation and dwelling.

These scenarios expose the robustness and limitations of the designs.
Together, they provide an essential final layer of reflection, ensuring that the multisensory strategies developed in this thesis are not only effective in ideal daytime conditions, but continue to support clarity, comfort and presence across the full range of urban realities.

7.18.2 Winter

Winter and night present sensory conditions that differ significantly from the spring/summer daytime scenarios used during the design process. Both require additional lighting, but winter demands this over a much longer period. Darkness, reduced vegetation, colder air and dormant scents reshape how sound, touch, scent and contrast behave in public space. These shifts are particularly relevant for visually impaired individuals, whose experience of space depends on precise sensory cues that fluctuate with environmental change.

Winter | Dwelling Scenario

In winter, vegetation becomes sparse, scent intensity declines and ground textures change. The bamboo poles, used as wind-activated sound markers, must therefore be permanently angled to prevent rain or snow from collecting inside them. This avoids freezing, blockage or structural damage and ensures that the bamboo continues to produce its subtle tones throughout the year.

Because the trees lose their leaves, entrances become more visually open. This creates an opportunity to introduce illuminated arches at entry points, placed in front of the bare trees so none of the vegetation needs to be removed. These arches support orientation in low-light conditions and maintain a sense of welcome. Arches at path splits can also hold softly glowing bells, reinforcing the continuity of the main route.

Snow pushed gently toward the edges of the plaza further emphasises the central path, enhancing visual and tactile clarity. This requires light seasonal maintenance but strengthens legibility at a time when other sensory cues are weakened.
Seasonal planting is also adapted. Tender herbs such as mint or chamomile are replaced in winter by robust herbs like rosemary and sage, which retain their scent and remain legible in cold air. Low shrubs are added to block winter winds and protect these herbs, ensuring that the scent-based zoning continues to function even in the cold season. Over the year, this cyclical change creates a natural seasonal variation in scent.

The fountain adapts as well. In winter, it won't run. Instead, a soft upward light illuminates the fountain structure from below, highlighting the central landmark without producing glare. This preserves the spatial anchoring role of the fountain even when water movement is minimal due to freezing temperatures.

Winter | Wayfinding Scenario

Along the wayfinding corridor, winter again changes the perceptual landscape. With trees losing their leaves, their trunks become more prominent and act as a natural structural rhythm, reinforcing depth, direction and corridor legibility. Areas where seasonal flowers are dormant are supplemented with gentle lighting so entrances and key thresholds remain recognisable. As scent becomes muted in winter air, light and contrast take over as primary cues.

Illuminated edges, tree bases and façade lines maintain a clear A–B route. Reflective materials embedded in tactile transition zones improve visibility under artificial lighting, ensuring that cross streets and decision points remain unambiguous.

Night Scenario | Both Sites

Night intensifies the need for dependable lighting across both designs. Interviews repeatedly highlighted that lighting is one of the most critical elements for evening navigation. Research further shows that individuals with partial light perception are especially sensitive to daytime and seasonal shifts in brightness; even minimal light differences influence confidence, orientation and mood (Dam & Hageman, 2016).

In response, both designs apply layered, low-glare lighting that supports structure: entrances, crossings, furniture and path boundaries are illuminated softly and consistently. In the wayfinding corridor, lingering shop window lighting reinforces the path, creating a continuous illuminated spine where visual contrast replaces the more active sensory cues of daytime.

At night, tables, bench areas and trees emit a soft under-glow, ensuring visibility without glare. Small, shielded lights placed discreetly within the vegetation provide subtle vertical illumination while preventing direct exposure to the eyes. The result is a calm, evenly lit environment that preserves a sense of safety and warmth.

Together, the What-If Scenarios reveal how multisensory strategies must adapt, when daylight or temperature changes. They ensure that the proposed environments remain supportive, legible and comfortable not only during ideal conditions, but throughout the full range of seasonal and nightly urban realities, these scenarios act as a stress-test of the synthesis outcome.


PULL&BEAR

07 SITE

SYNTHESIS

QUESTION 03

What strategies can be explored to create site-specific multisensory designs for visually impaired and blind users?

Designing site-specific multisensory environments for visually impaired and blind (VI/B) users requires strategies that provide both a city-wide baseline of predictability and a human-scale layer of contextual sensory detail. This chapter demonstrates that no single approach can sufficiently address the dual challenges experienced by VI/B users: structural unpredictability and unsafe ambiguity on the one hand, and sensory overload on the other. Instead, the chapter explores two complementary design approaches, Pattern Language and Sensory Maximisation, which are employed as research-through-design tools to investigate how spatial structure and sensory experience can be developed in relation to one another.

Within this chapter, the Pattern Language functions primarily as a connecting framework between research and design. It translates insights from literature, interviews and site observations into communicable spatial principles that can guide design decisions. By structuring recurring issues such as design blindness, aspects of environmental overstimulation and spatial chaos into patterns, the method helps to clarify structure, reduce ambiguity and reinforce legibility. Continuous tactile rhythms, clear crossing islands, alignment cues and recognisable entrances together form a coherent spatial logic that supports mental mapping and reduces cognitive load. This role becomes particularly important in complex urban situations such as multi-directional intersections or shared spaces, where a lack of clarity can directly affect safety. The evaluation by ten VI/B judges confirms the relevance of this structural clarity, not as an automatic outcome of the method itself, but as a quality that proved critical in these specific spatial conditions.

At the same time, the chapter makes clear that structural clarity alone does not guarantee multisensory accessibility. Sensory conditions shift throughout the day and across seasons, and are influenced by microclimate, traffic intensity, surrounding activities and spatial density. To explore these dynamics, Sensory Maximisation is applied as an ordering, exploratory and communicative design tool. By isolating and amplifying sound, scent, touch (including texture) and contrast, the method allows the spatial behaviour of each sense to be tested under extreme conditions. This process reveals which cues support orientation and comfort, which combinations reinforce one another, and which risk becoming overwhelming. In this chapter, Sensory Maximisation is therefore not used as a prescriptive solution, but as a way to structure sensory experimentation, compare scenarios and reflect on sensory behaviour in context.

The outcomes of this process show that multisensory design depends not only on selecting effective cues, but on understanding how, when and in what sequence they should appear. Natural sensory cues such as water, birdsong, wind, herbs and soft vegetation consistently emerge as the most cognitively manageable and emotionally grounding for VI/B users across both dwelling and wayfinding situations. Artificial sensory elements, particularly mechanical sounds or synthetic scents, tend to increase stress and must therefore be applied with caution. Sensory layering proves to be critical: some cues function best as continuous background signals, while others should be reserved for specific moments such as crossings, thresholds or decision points. The balance between clarity and atmosphere also differs between spatial conditions. Dwelling environments allow for richer atmospheres and softer transitions, while wayfinding environments require stronger structure and reduced ambiguity. These needs inform one another, and many design elements ultimately serve both purposes simultaneously.

When structural and sensory strategies are brought together, a site-specific design logic emerges. In this chapter, the Pattern Language is primarily used to articulate a clear spatial framework of movement lines, junction logic, crossings and entrance clarity, functioning as a bridge between research insights and spatial design. Sensory Maximisation operates within this framework as an ordering and exploratory tool, informing how sensory cues can be introduced, combined and moderated without compromising legibility. As a result, individual design elements often fulfil multiple roles: a fountain may act both as a resting place and a navigational landmark, a tactile centreline may guide movement while offering reassurance, and vegetation may soften a corridor while subtly reinforcing orientation.

Rather than functioning as fixed solutions, both Pattern Language and Sensory Maximisation are understood as flexible research-through-design and communication tools. Their application is not tied to a single scale or purpose, but adapted to the specific spatial and experiential questions addressed in this chapter. Insights gained through sensory maximisation informed the development of certain patterns, such as In Bloom or Follow the Water Trail, while pattern principles, in turn, guided decisions within the maximisation drawings. In this way, the two approaches evolve together rather than operating independently.

The What-If Scenarios further demonstrate that multisensory environments must remain responsive over time. In darkness, light becomes the dominant cue, with subtle, low-glare illumination compensating for the loss of colour and contrast. In winter, vegetation thins, scents weaken and sound behaves differently, requiring a shift toward lighting and tactile clarity. Seasonal variations in planting maintain recognisable olfactory zones throughout the year. These scenarios underline that multisensory design cannot be static, but must adapt to temporal fluctuations while preserving spatial coherence.

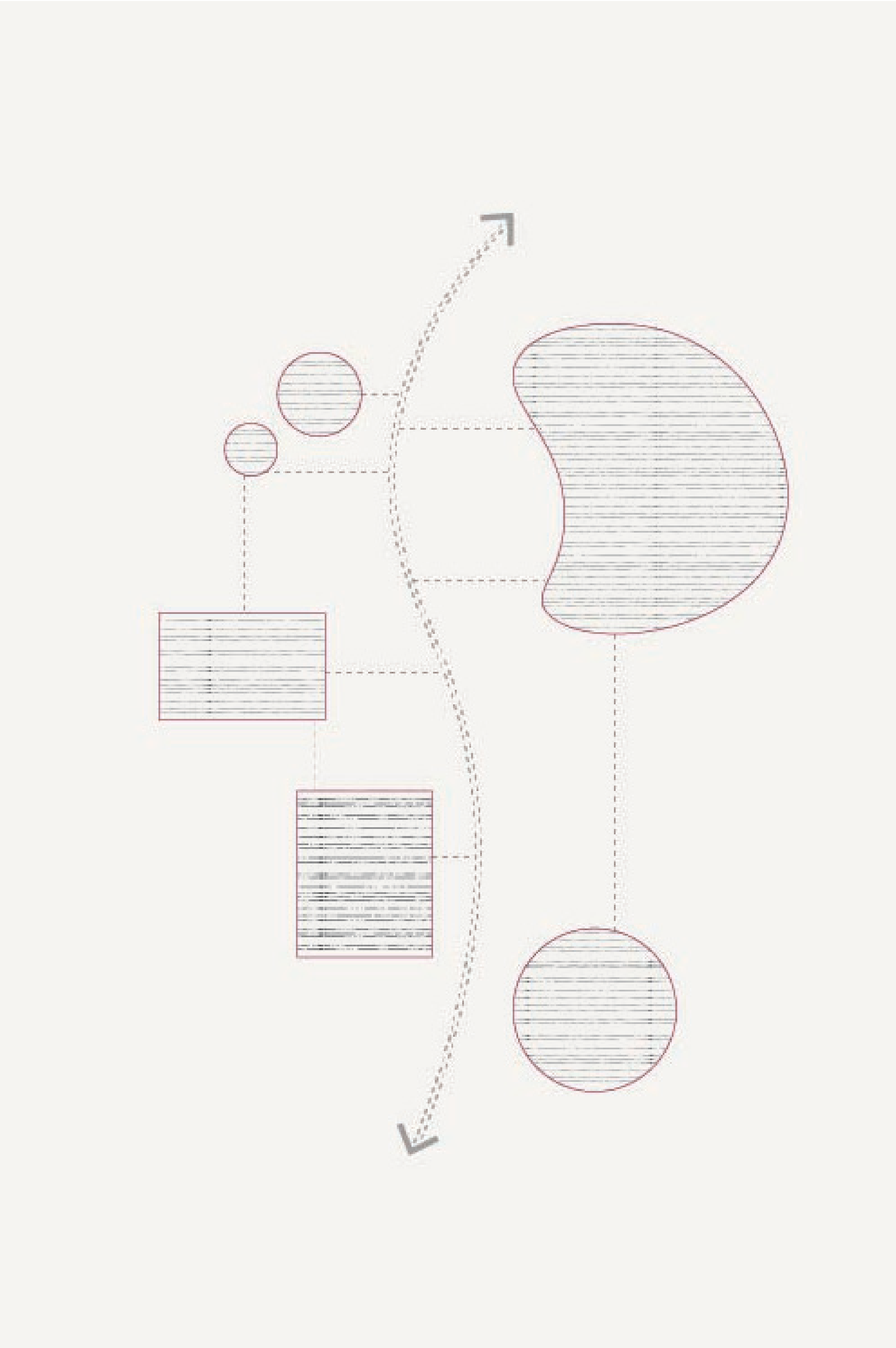
Across the chapter, the distinction between the two approaches becomes clear through their application rather than their definition. Pattern Language provides structured design guidance for recurring spatial problems, particularly where clarity and safety are critical, such as intersections and shared spaces. Sensory Maximisation focuses on exploring and enhancing sensory experience, especially in contexts where atmosphere, comfort and nuanced orientation play a larger role. Each strategy serves a different purpose and is applied where it fits best, together forming a layered design approach in which structure and sensory experience are developed in parallel.

In conclusion, creating site-specific multisensory environments for visually impaired and blind users requires a synthesis of structural legibility, sensory intentionality and temporal adaptability. Pattern Language contributes a coherent and communicable spatial framework, while Sensory Maximisation reveals how sensory cues can enrich this framework without overwhelming it. When combined, these approaches enable the transformation of ambiguous, overstimulating or underused urban spaces into environments that are coherent, calming, navigable and sensorially engaging, offering both functional independence and meaningful experience for visually impaired and blind individuals.

08 ACTIVATE

This chapter shows how individual urban places in The Hague can be strung together into a continuous, multisensory wayfinding structure.

Figure 18. *Conceptual Diagram Current Situation*



8.1.1 introduction

The previous chapters showed how visually impaired and blind individuals navigate the city through embodied perception, how sensory cues in The Hague currently support or hinder orientation, and how site-specific strategies developed through the Pattern language and Maximization methods can enhance legibility and dwelling. These findings highlighted structural gaps as well as opportunities for multisensory design. However, the interventions remain isolated. They strengthen individual places but do not yet provide a unifying framework that supports movement between them, nor do they address how The Hague can become navigable as both a familiar and unfamiliar environment.

This chapter therefore shifts from the site scale to the urban scale. It examines how The Hague can be activated as a continuous sensory system, translating insights from the User, Sensory and Site chapters into a coherent spatial structure. Here, activate refers to enabling the city to operate as a recognisable network for visually impaired and blind individuals, creating continuity between destinations and offering support along the routes that connect them.

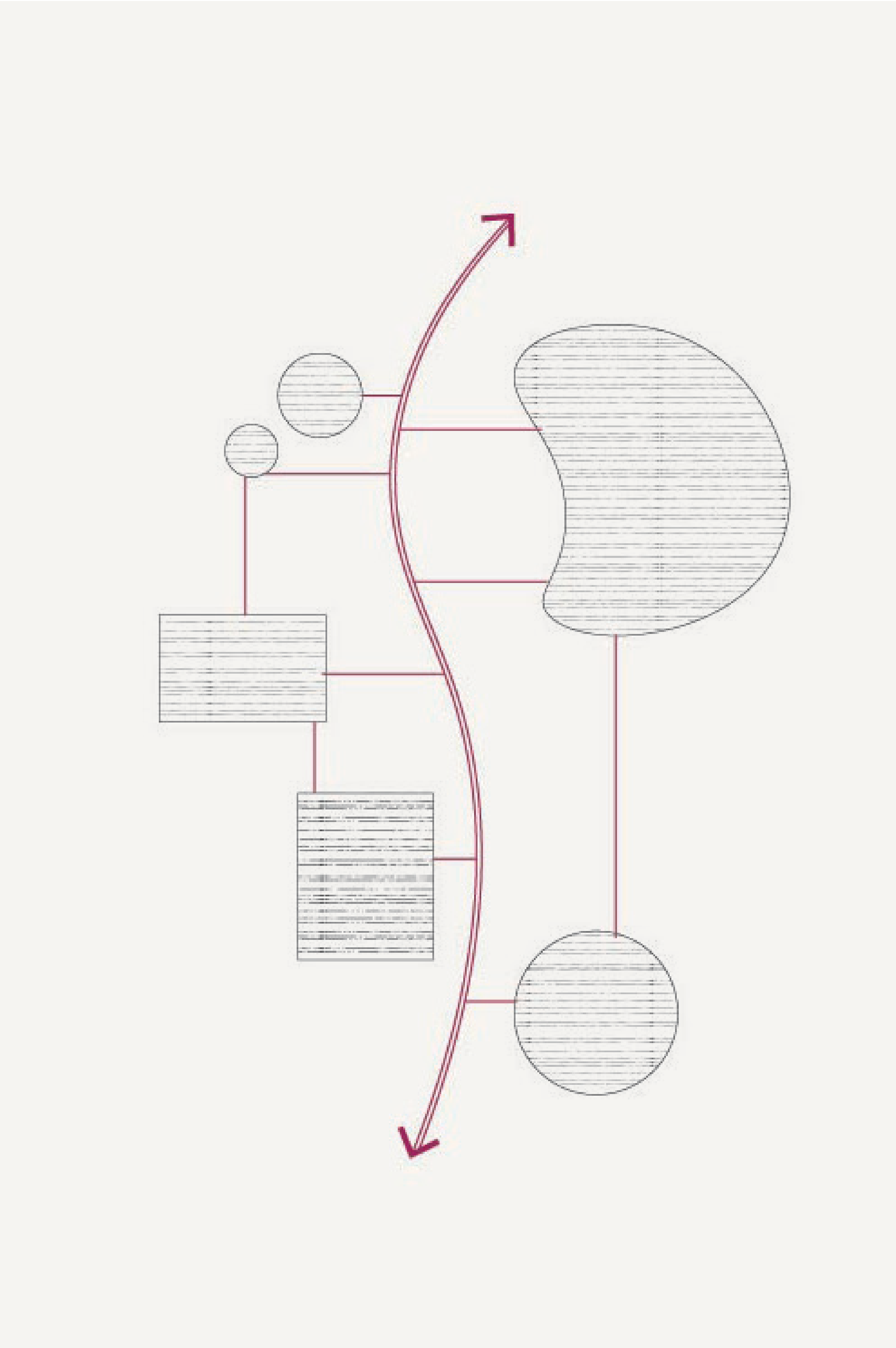
In this chapter, the three interventions (crossing at Spui, Snoezelgarden behind Bijenkorf and the wayfinding in front of the Bijenkorf) are treated as nodes within a broader sensory network, each contributing a distinct character along a spectrum of rust reuring ruis. Together they serve to illustrate how orientation can emerge at the city scale.

To build this larger framework, the chapter draws on the existing spatial logic of Den Haag, de 7 lijnen by Bregit Janssen (Gemeente Den Haag, 2004). This book describes seven lines as seven identities within the city centre.

This leads to the subquestion central to this chapter: *How can different sensory modalities be structured to enhance wayfinding coherence and orientation across the urban environment?*

The following sections outline why a city-scale wayfinding system is needed, introduces the spatial logic of the seven lines and demonstrates how these lines can form a multisensory route. These steps show how the earlier design insights can be expanded into a city-scale framework. The following chapter will be the conclusion. Wrapping up this chapter, the thesis moves toward its conclusion, where the main research question will be answered.

Figure 19. *Conceptual Diagram Desired Situation*



8.2.1 The Last String

Findings from the user interviews showed that visually impaired and blind individuals strongly prefer navigating in familiar rather than unfamiliar environments. This preference was not rooted in comfort alone, but in uncertainty: participants frequently expressed that they could not assume the presence of reliable cues or aids in new areas of the city. The greatest stress occurred not during movement itself, but at the moments where no clear information was available to confirm direction, location or orientation. Many respondents therefore prepared their journeys by first visiting the location with a sighted friend, underscoring how essential predictability and repetition are for building confidence and spatial understanding.

Orientation broke down most clearly in situations where continuity between cues was missing. Without sequential anchors, participants struggled to form a mental map of the area, making it difficult to anticipate what would come next or how far they had moved. Junctions. as explained before, can cause anxiety: they often presented multiple possible directions, lacked distinct sensory identifiers and offered little structure for decision-making. These findings resonate with Passini and Arthur's (1992) argument that wayfinding is not a series of isolated decisions but "a continuous spatial problem," one that depends on environmental coherence rather than scattered points of information. Without such coherence, urban environments quickly become unpredictable.

The sensory analysis in The Hague confirmed this fragmentation. While tactile paving is present, its application is inconsistent; patterns shift abruptly, begin or end without logic and differ between adjacent streets. Similarly, sensory atmospheres across the inner city follow an incidental rather than intentional rhythm: variations in rust, reuring and ruis occur, but are not structured in a way that supports orientation. As a result, the city offers distinct sensory moments, yet lacks an overarching sequence that guides users from one to the next.

The three design explorations in this thesis, the shared-space junction, the wayfinding maximization route and the snoezelgarden, demonstrate how sensory cues can meaningfully support navigation and comfort at the local scale. However, these experiments also revealed their own limits: they functioned as strong but isolated "patches." Users cannot teleport between improved sites; without a connective structure, the benefits offered at one location dissolve as soon as the user leaves it. The city centre currently lacks a recognisable macro-pattern that can bind these places together.

This need for spatial coherence aligns with Lynch's claim (1960) that cities become legible when their nodes, paths and edges form an organised pattern. In The Hague, nodes can be strong, such as Spui or Grote Marktstraat, but the paths between them lack a clear sensory logic. For visually impaired and blind individuals, this absence of continuity results not only in confusion but in hesitation, extra cognitive load and a reduced sense of autonomy.

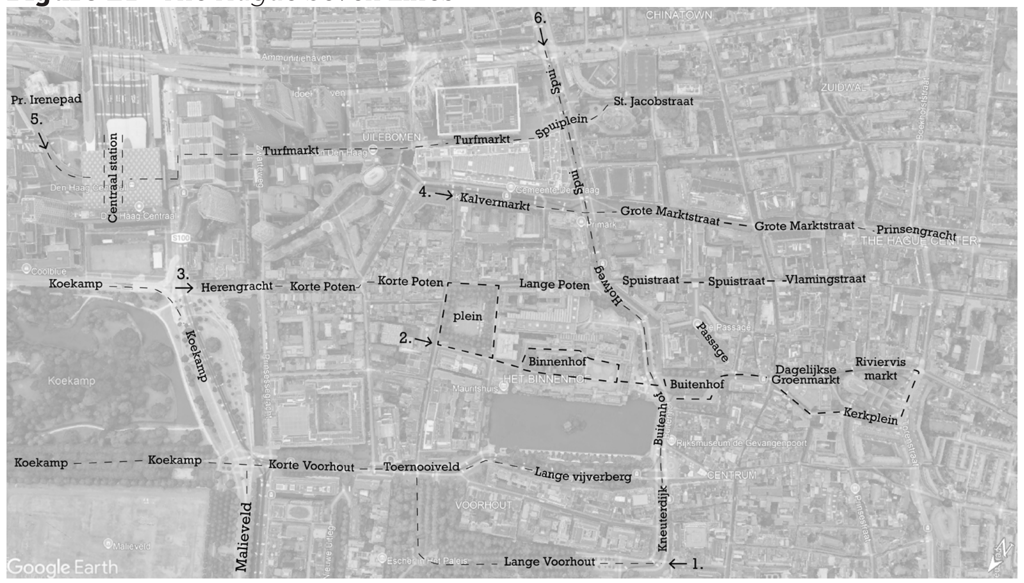
Therefore, improving single locations is not enough. To support navigation, design must move from nodes to networks: from isolated interventions to continuous, city-scale structures. What is required is a "red line" through the city, an underlying system that is predictable, sequential and recognisable at every stage of the journey. Only then can the insights developed through the Pattern language and Maximization methods operate beyond the boundaries of their sites and contribute to a truly navigable environment.

The following section introduces the existing spatial framework in The Hague that can support this transition: Den Haag, de 7 lijnen.

Figure 20. *The Hague*

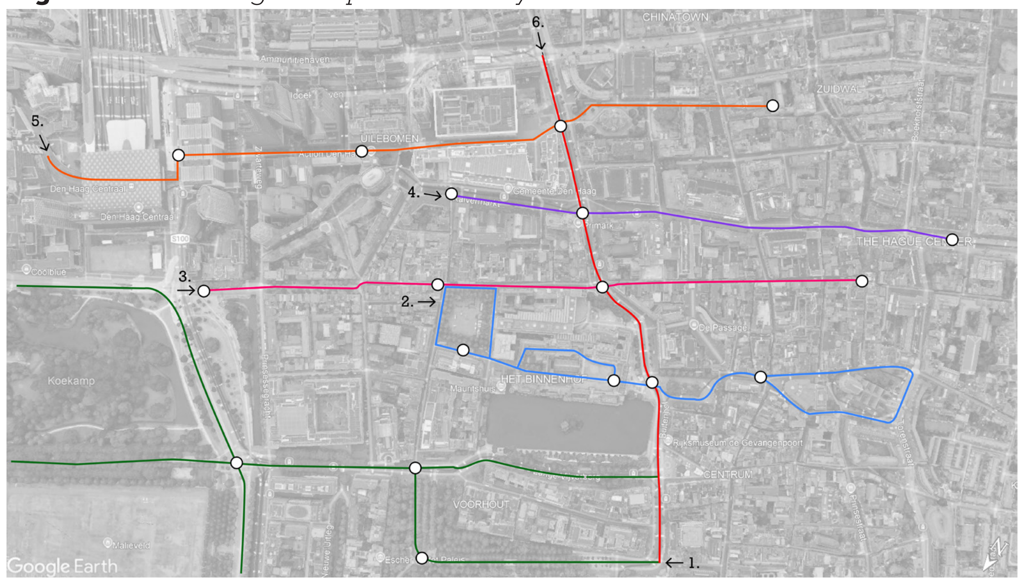
Note. Base from Google Earth satellite imagery

Figure 21. *The Hague Seven Lines*



Note. Based on the seven lines, The Hague [book].

Figure 22. *The Hague Proposed Subway Skeleton*



Note. Base from Google Earth satellite imagery

8.2.2 Den Haag 7 lijnen

The publication Den Haag, de 7 lijnen by Bregit Janssen (Gemeente Den Haag, 2004) provides a spatial reading of the city centre through seven characteristic lines. These lines form a conceptual backbone of The Hague, each representing a distinct spatial identity shaped by urban history, materiality, atmosphere and use. Although it is originally developed as a design instrument to understand the essence of the city, the seven lines also offer a highly legible structure: they capture the essence of the city as a sequence of recognisable spatial conditions. This makes them a fitting foundation for a city-scale wayfinding concept.

Within the city centre, six of the seven lines operate as organising routes, while the seventh is situated along the coast. Each line is associated with a particular character and colour in the book. The colours are not expressed in the physical city, the lines are:

Line 1 | The Stately Line (green)
A sequence of dignified, elegant public spaces connected through a shared green character. It reflects The Hague's formal identity: proud, refined and marked by stately urban composition.

Line 2 | The Enclosed Line (blue)
A chain of urban squares defined by enclosure and protection from external influences. Squares such as Plein, Binnenhof and Buitenhof share a spatial intimacy that binds them into a coherent sequence.

Line 3 | The Strip (pink)
A long, narrow commercial line between the Grote Marktstraat to the Herengracht. Its identity stems from its linearity, narrow profile and retail activity.

Line 4 | The Line of Scale Enlargement (purple)
Originating from historic urban breakthroughs, this line expresses width, openness and monumentality. It marks the transition from the medieval fabric to a modern, broad commercial and traffic street.

Line 5 | The Monolith Line (orange)
Formed through postwar restructuring, this line represents contemporary redistributions of space and function. Starting at Den Haag Central Station.

Line 6 | The Heart Line (red)
The central structural connector of the inner city. It links lines 1 through 5 and creates distinctive urban moments at each intersection. As such, it acts as the spatial hinge within The Hague's core.

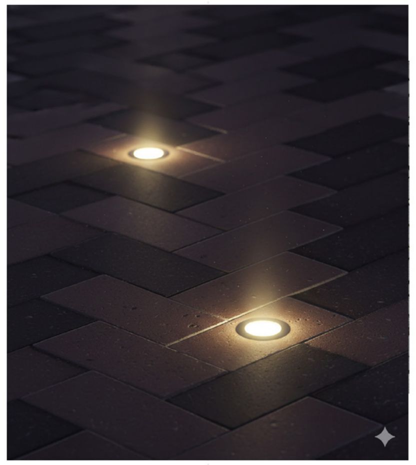
Line 7 | The Coastal Line (yellow)
A linear landscape of sand and dunes stretching from Scheveningen to Kijkduin. Though outside the central area, it represents the city's relationship to the coast.

Viewed collectively, these seven lines form a system with shared principles: each describes a continuous urban sequence, each carries a spatial identity and each organises movement across the city. Together they provide a clear morphological logic that underpins the structure of The Hague.
For this thesis, the seven lines serve not as an aesthetic tool but as a city-scale framework that can be translated into a multimodal wayfinding structure. Highlighting the inherent clarity, linearity and recognisable characters can make them well suited for reinterpreting the city as an accessible network for visually impaired and blind individuals.

The next sections build on this foundation by transforming the seven lines into a subway-like skeleton, highlighting how their distinct characters can be reinforced through sensory themes and paving. This translation is then examined more closely through selected segments of the lines, showing how visually impaired and blind individuals might navigate them in practice. To illustrate this, the chapter follows a narrated journey of a woman who arrives by tram on line 4, walks toward the Spui intersection where line 6 begins, and continues along this line toward the snoezelgarden. Through this narrative, the chapter demonstrates how the spatial logic of the lines can support real, embodied wayfinding across the city.

Figure 23. *The Six Different Paving System in the City Centre*

LINE 1



Reflective / light stone
Sense: Sight (indirect light) / Touch
How it works: Subtle micro-reflectors or matte coating create contrast and guide light without glare.
Benefit: Enhances spatial legibility for people with low vision; improves orientation at night or in shade.

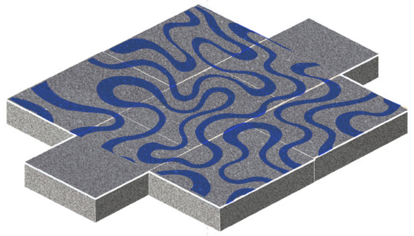
LINE 2

matte stone
Sense: Touch / Temperature
How it works: The dense, matte-smooth surface of the stone feels naturally cool and slightly silky to the touch.
Benefit: Creates a calm, formal atmosphere that reflects the historic and institutional character of the Binnenhof.

LINE 3

Scented stone
Sense: Smell + Touch
How it works: Porous stones stay warm. When the first drops of rain hit, they release a subtle earthy scent, slightly change texture and they become cooler
Benefit: The scent and tactile change after rainfall help people smell and feel the place.

LINE 4



Hydrochromic stone
Sense: Sight + Touch
How it works: Hydrochromic paving changes color when wet, revealing patterns as rain falls. The coating reacts to moisture, allowing the ground to visually transform during or after rain.
Benefit: Turns rain into a guide. The shifting pattern becomes a subtle orientation.

LINE 5

Crunching or "leaf-like" texture stone
Sense: Hearing / Touch
How it works: This paving mimics the sound of dry leaves or gravel through a porous, composite surface that slightly compresses underfoot. Tiny gaps and mixed organic particles create a soft, crisp sound that changes with dryness and weight.
Benefit: Creates an audible landmark or transition zone; adds liveliness and sensory depth to the path.

LINE 6

Hollow resonant stone
Sense: Hearing / Vibration
How it works: A partially hollow core beneath the surface amplifies the sound and vibration of footsteps.
Benefit: Creates an audible and tactile resonance that signals direction or a change in zone; helps users orient through subtle acoustic feedback.

Note. Images generated using Google Gemini, 2025.

8.3.1 The renewed seven lines

The seven lines of The Hague offer a strong framework, but their value for this thesis lies in their potential to function as an above-ground subway skeleton. A subway map is intuitive, linear and predictable: it organises movement through clear lines, transfer points and recognisable stations. Reinterpreting the seven lines in this way allows the city centre of The Hague to be understood as a legible system of connected routes. The lines become guiding corridors, the intersections become "stations" where a user can change routes, and the underlying structure becomes the skeleton of the city, the framework that always provides orientation.

Within this transformation, each of the seven lines is reimagined as a subway line running across the inner city. The "stations" are landmarks, these landmarks are based on the themes derived from the identity of each line. They help users recognise when they are on a line, leaving a line or arriving at a point of transition. This can be seen in the Transformation to a subway skeleton framework map (P. X).
To support wayfinding for visually impaired and blind individuals, each line is given a distinctive sensory theme, derived from the spatial character described by Janssen. These themes serve as the base for both the landmarks and the paving along each line:

Line 1 | Vegetation / Scent
A calm, green identity translated into a soft scent- and shadow-oriented theme.
Line 2 | Texture
A spatially enclosed sequence emphasising tactile surface qualities.
Line 3 | Subtle Scent
A narrow shopping street expressed through micro-scale atmospheric cues.
Line 4 | Water
Monumentality and openness paired with a theme of water and rain-activated effects.
Line 5 | Shelter from Wind
Large-scale institutional character expressed through microclimatic calm.
Line 6 | Sound
The core of the city centre, with sound as its most dominant navigational cue.
Line 7 | Texture / Softness
The coastal line, suggesting a soft, rubber-like tactile identity.
Based on these themes, each line has its own type of paving, besides the landmarks, that runs along the entire length of the line. The paving can be followed by VI/B people through their cane, guide dog, heightened senses. This ensures that the skelet-structure is not fragmented but connected, allowing users to remain on a line without interruption.

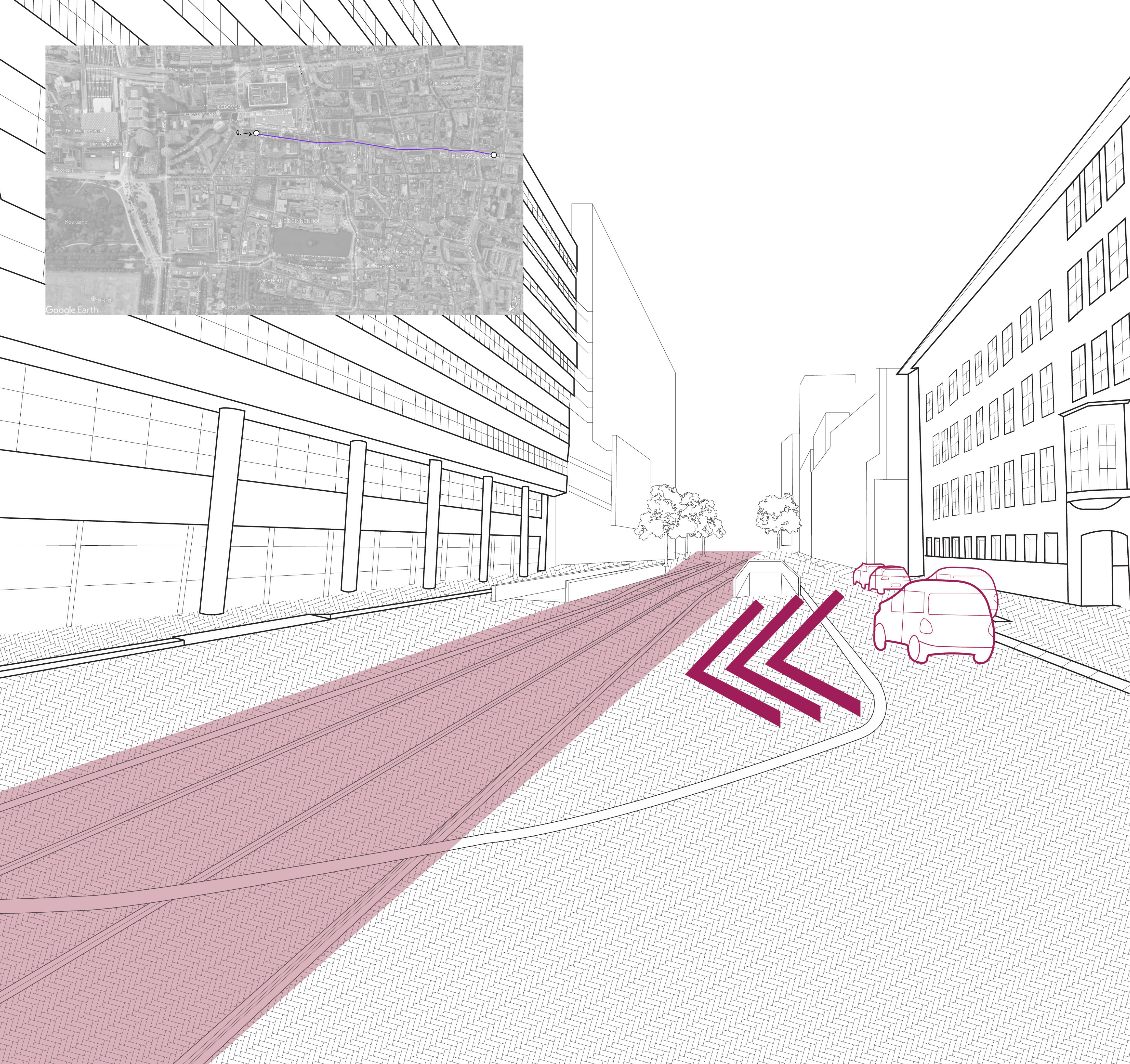
The pavings follow the same visual aesthetic as the current pavings. This choice has been made as to not disrupt the ambiance and aesthetic character of The Hague. It focuses on the non-visual cues through tactile, acoustic, climatic or olfactory elements:

Line 1 | paving with soft light spots that form a continuous guiding rhythm
Line 2 | a matte, fine-textured stone as a full-length tactile carpet
Line 3 | a porous stone that releases an earthy scent after rain
Line 4 | hydrochromic paving revealing patterns when wet
Line 5 | porous stone with embedded leaves that create a subtle crunch
Line 6 | hollow stone that produces distinct acoustic feedback
Line 7 | a soft rubber-based stone

Together, these continuous pavings reinforce the subway skeleton by providing a predictable and repeatable sequence. Just as a subway line is identifiable by colour and direction, a sensory line becomes identifiable by its tactile, acoustic or atmospheric qualities. This repetition is essential for visually impaired and blind individuals, enabling them to build mental maps, anticipate upcoming segments and recognise transitions between lines.

The themes, landmarks and paving systems collectively turn the abstract structure of the seven lines into a navigable, above-ground subway network.

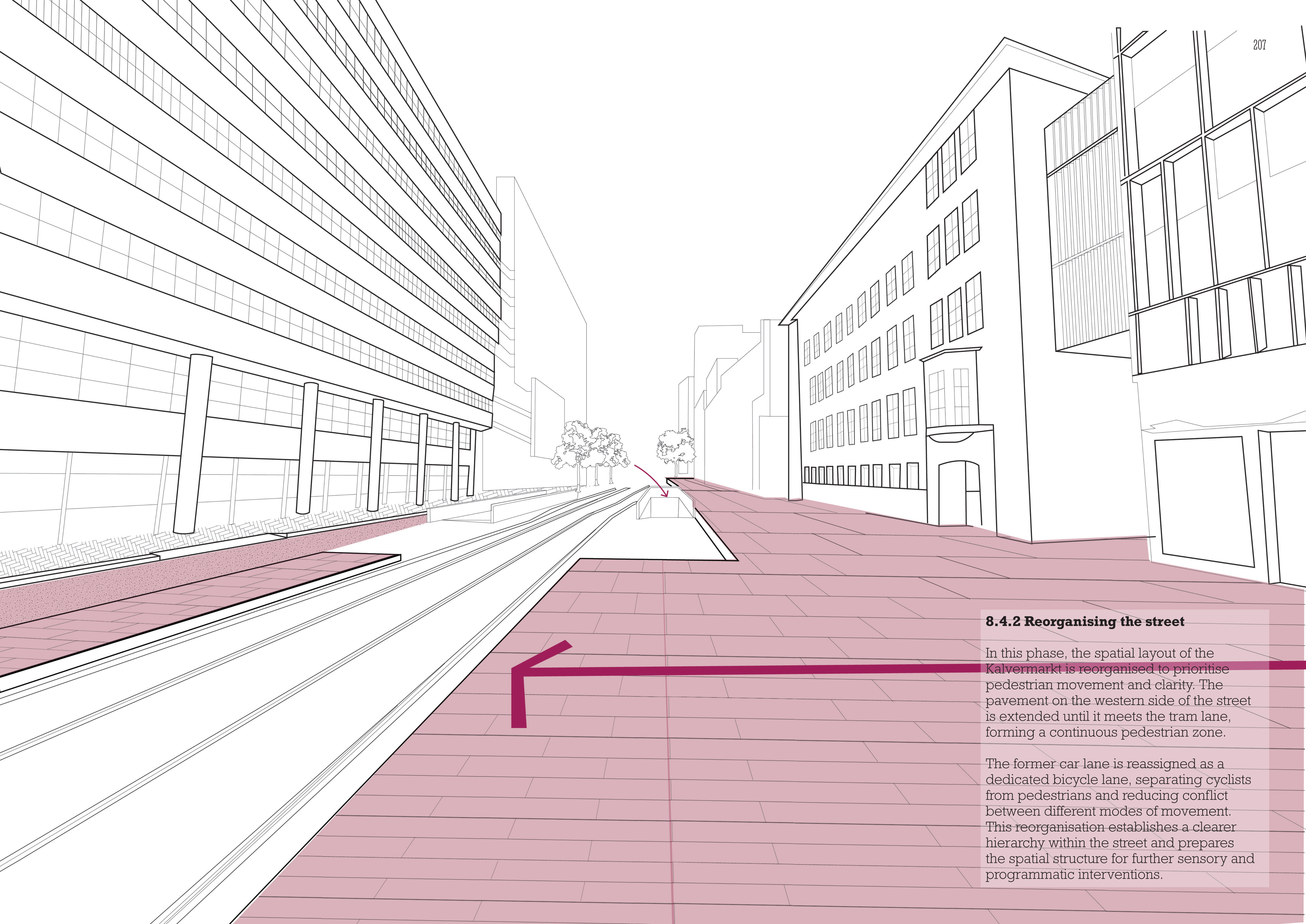
The following section demonstrates how this system functions in practice, through a narrated journey of a woman who arrives by tram on Line 4, walks toward the Spui intersection where Line 6 begins, and continues along this sensory route toward the snoezelgarden.



8.4.1 Current situation

Kalvermarkt in The Hague currently accommodates a tram line, two one-way car lanes, and pavements along both facades. In addition, the street provides access to two entrances of an underground parking garage. The concentration of motorised traffic and infrastructure dominates the spatial profile, leaving limited room for pedestrian use and reducing overall perceptual comfort.

To create a calmer and more legible street environment, a key intervention is the consolidation of traffic flows. By combining car traffic with the tram lane, substantial space can be freed up, allowing the street to shift from a traffic-dominated corridor towards a more balanced and pedestrian-oriented public space.



8.4.2 Reorganising the street

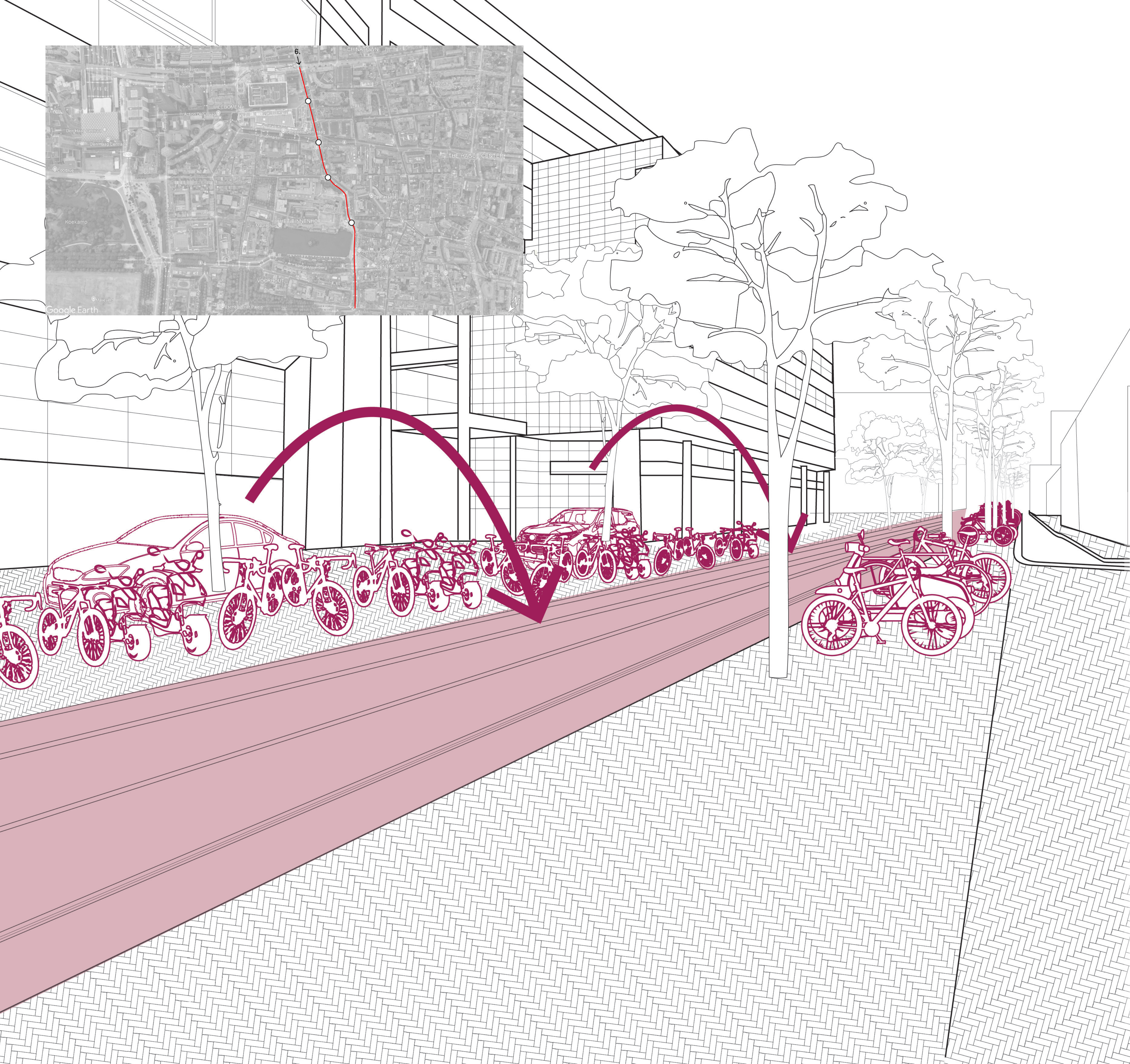
In this phase, the spatial layout of the Kalvermarkt is reorganised to prioritise pedestrian movement and clarity. The pavement on the western side of the street is extended until it meets the tram lane, forming a continuous pedestrian zone.

The former car lane is reassigned as a dedicated bicycle lane, separating cyclists from pedestrians and reducing conflict between different modes of movement. This reorganisation establishes a clearer hierarchy within the street and prepares the spatial structure for further sensory and programmatic interventions.

8.4.3 (Re)furnishing the street

In the final phase, the street is furnished to support orientation, accessibility and sensory legibility. Bus stops are reintroduced at their original locations, reinforcing spatial familiarity. Each stop is equipped with a large, clearly readable display indicating tram number, direction and arrival time. To ensure accessibility for visually impaired and blind users, a small speaker is integrated into the information board, providing the same information audibly.

Tactile paving guides users from the pavement towards the tram doors, which stop at a consistent position each time, enabling predictable boarding. In addition, the paving pattern at the stop responds to rainfall, creating a visible contrast that functions as a continuous guideline through the street and reinforces orientation under changing weather conditions.

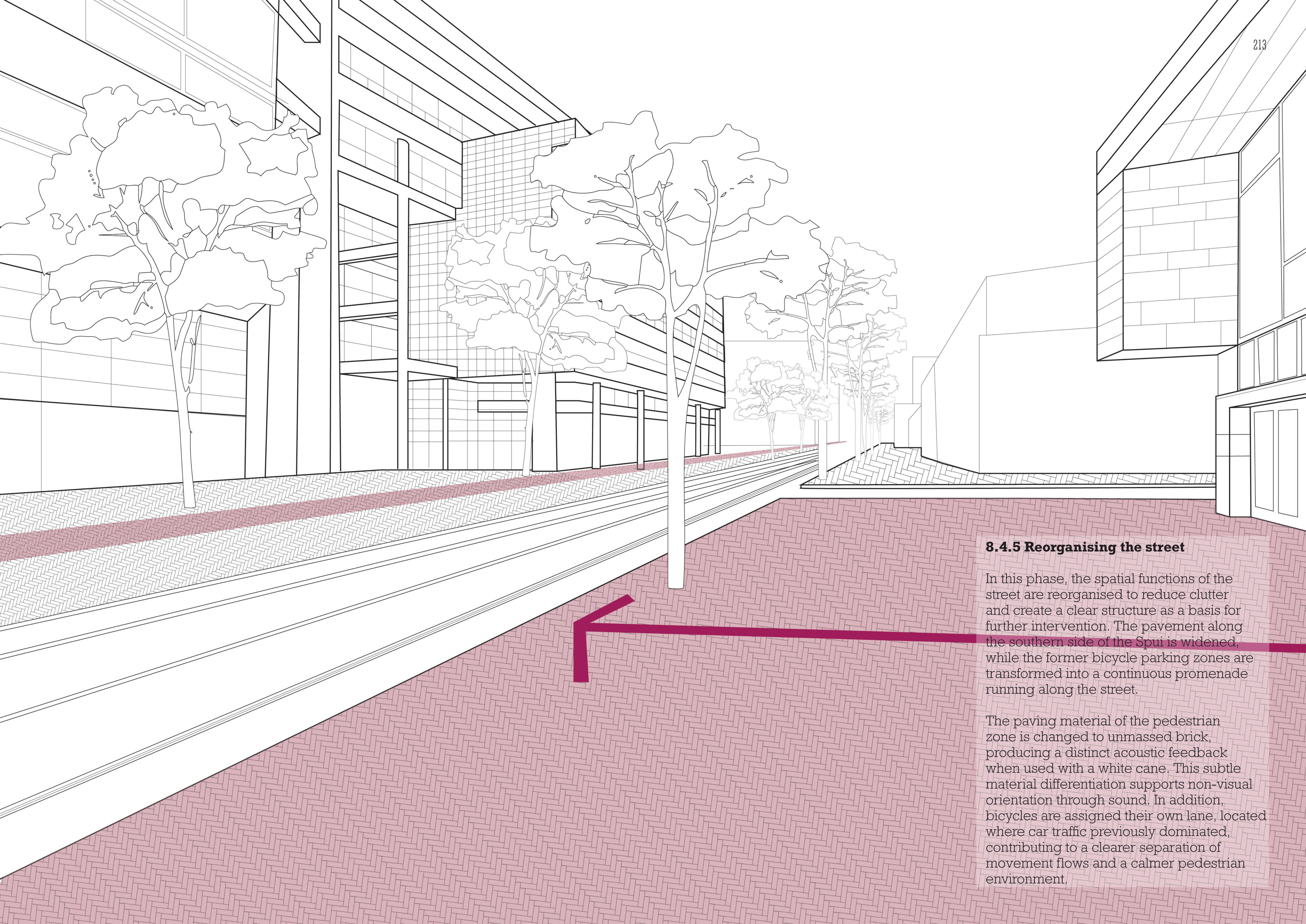


8.4.4 Current situation

The section of the Spui adjacent to the Municipality currently accommodates two car lanes, a tram line, and pavements along both facades. In addition, a large amount of bicycle parking occupies the street edges, significantly hindering crossing. The coexistence of multiple modes of transport within a limited spatial profile results in acoustic overload and reduced perceptual comfort.

During the walk-along interviews, several participants identified this location as one of the most difficult places to cross and orient themselves. The fragmentation of functions and the lack of clear spatial hierarchy contribute to confusion and stress.

A key opportunity lies in consolidating mobility functions: by combining car traffic with the tram lane, a substantial amount of space becomes available. Relocating bicycle parking to the Spui roundabout, currently characterised by underused residual spaces, would further reduce clutter and significantly improve crossability and spatial legibility along the Spui.



8.4.5 Reorganising the street

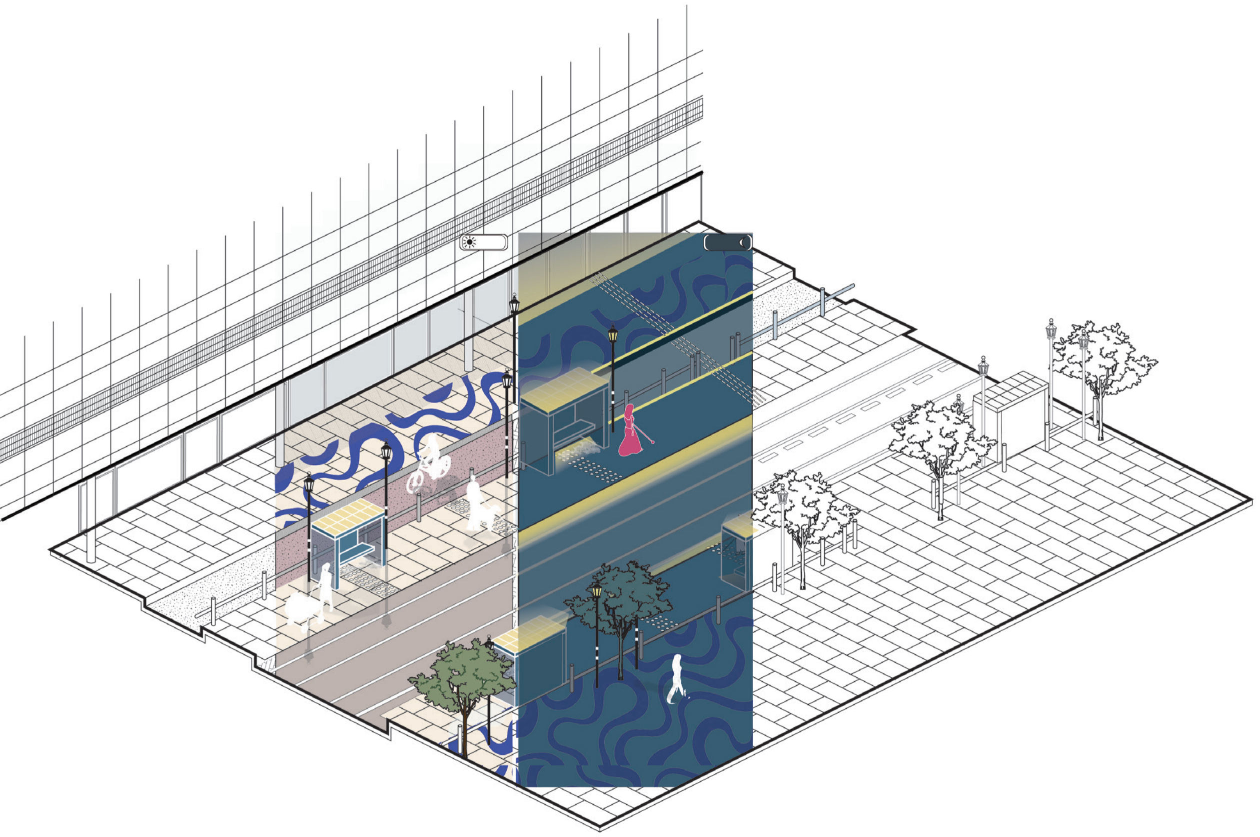
In this phase, the spatial functions of the street are reorganised to reduce clutter and create a clear structure as a basis for further intervention. The pavement along the southern side of the Spui is widened, while the former bicycle parking zones are transformed into a continuous promenade running along the street.

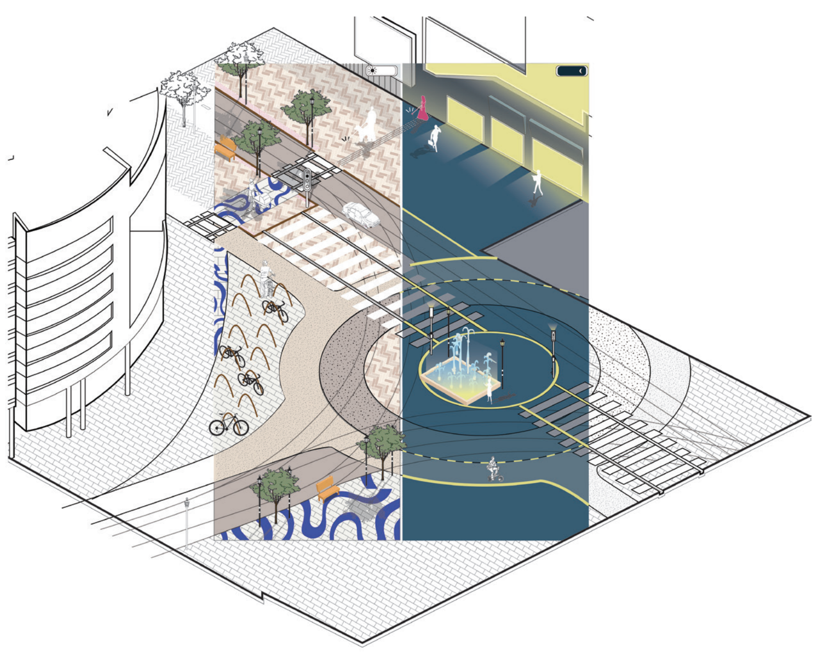
The paving material of the pedestrian zone is changed to unmassed brick, producing a distinct acoustic feedback when used with a white cane. This subtle material differentiation supports non-visual orientation through sound. In addition, bicycles are assigned their own lane, located where car traffic previously dominated, contributing to a clearer separation of movement flows and a calmer pedestrian environment.

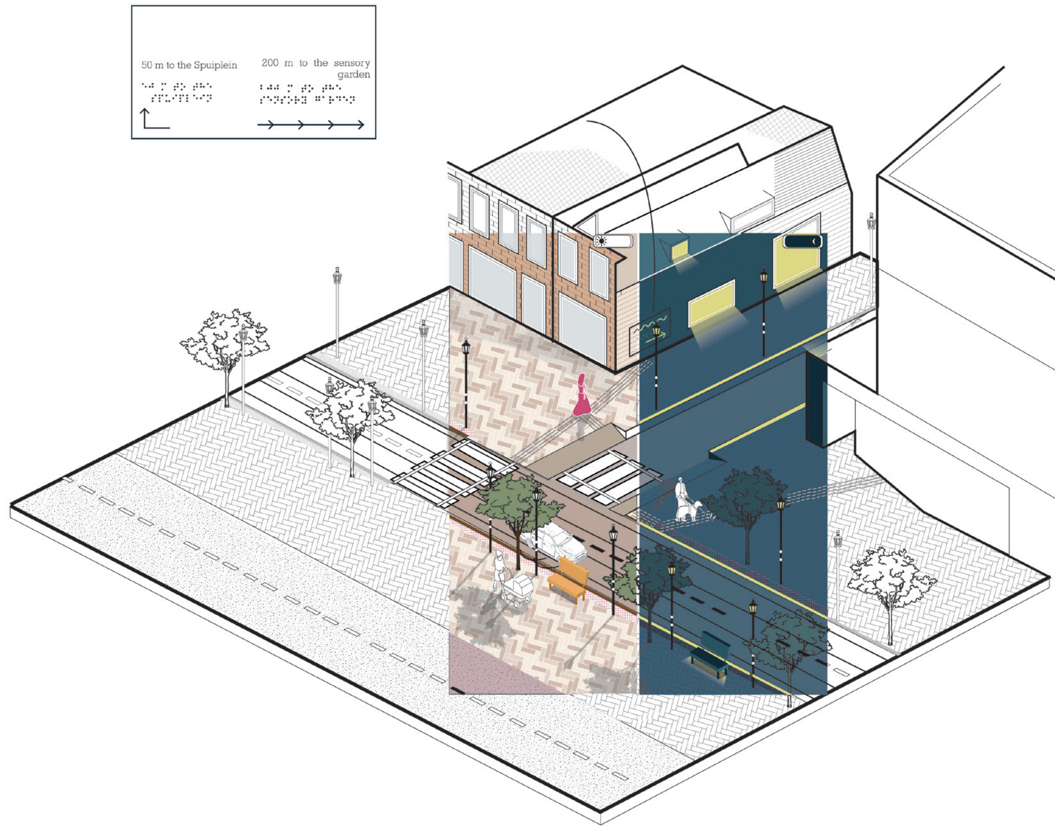
8.4.6 (Re)furnishing the street

In the final phase, the street is furnished to enhance perceptual legibility and comfort. Acoustic diffractors are placed alongside the combined tram–car lane to bend and reflect sound, reinforcing spatial cues for non-visual navigation. Lampposts are positioned at regular intervals to establish a rhythmic streetscape, aiding orientation.

Finally, tactile paving is introduced from the end of the crossing towards the building facades, each facade has its own street name in braille and a tactile map is placed for visually impaired and blind people to understand their location. The car can drive in the direction of the sensory garden, however only until the parking garage.







8.5.1 A day in the life of Jolene

To demonstrate how the subway skeleton operates in practice, this section follows a narrated journey of a visually impaired woman, (shown in magenta). Her route begins at the tram stop on Line 4, her goal is to go to the Snoezelgarden.

At first, she steps out of the tram, the tram has left and she was standing on the tactile nodes. In front of her was the bench that illuminated light from underneath as well as some condense that she subtly felt. The cool mist on their surface affirms that she is line 4. She has turned right. She immediately recognises the hydrochromic pattern that has appeared through the rain as it just happened to have rained, luckily it's dry now, but the water-induced elements are still clearly seen as they stay for a while after it stops raining. The stones are still damp from the recent rainfall, against the light grey pavement, the pattern stands out clearly to her low vision, it acts as a visible guide that she can follow towards her . The clarity of this theme, the condensation that subtly falls upon her and the clarity of the pattern keeps her oriented.

She approaches the Spui junction, focusing on the transition to line 6.
It is easy to find, besides the pattern, the distant sound of the fountain landmark grows clearer, acting as a spatial anchor that confirms her location. The combination of a strong visual cue (the fountain's colour and movement) and a distinct sound guides her confidently toward the junction. The pattern guides her to the crossing, the traffic lights produce a rhythmic auditory pattern that signals it is safe to cross. She places her cane in the shallow gutter guidance to ensure she stays aligned with the intended path. This physical groove anchors her direction while crossing the tram tracks.

Once she reaches the other side of the junction, Line 6 begins. The theme of this line, sound, becomes immediately perceptible. The paving beneath her changes to the hollow acoustic pavings, which resonate differently under her cane. This altered sound signature tells her that she has successfully moved from Line 4 to Line 6.

The acoustic diffractors that are placed alongside the car and trampath, soothes the surrounding noise of traffic and trams. This reduces auditory overload, allowing her to hear the more subtle cues coming from the pavement and the echo of other visitors in her environment better. The tactile paving brings her to the facade which will act as a natural guide. Eventually she'll come to the next crossing, she places her cane in the gutter again, the stop of the gutter and the tactile nodes tell her that she reached the other side. The tactile paving brings her again to the natural guide safely. The consistent repetition of the hollow paving sound reinforces her mental map, she knows that she is still on the same line and in what direction she is heading.

She arrives at a tactile map installed at the corner. It provides both tactile and Braille information, confirming that the snoezelgarden lies just 200 metres ahead, to the right. This corresponds with her own sensory expectations: as she will continue walking, scents of China Town and the snoezelgarden meet her, indicating that she is nearing the garden, concluding her adventure.

The combination of predictable paving, controlled sound environment and deliberate scent cues enables her to navigate the last segment autonomously and confidently.
This narrated sequence demonstrates how the subway skeleton, its themes and its pavings together create a coherent multisensory system that supports orientation not only at individual sites but across the scale of the inner city.

08 ACTIVATE

SYNTHESIS

QUESTION 04

How can different sensory modalities be structured to enhance wayfinding coherence and orientation across the urban environment?

Wayfinding coherence in an urban environment emerges when sensory modalities are not applied as isolated cues but are organised into a continuous and recognisable system. In The Hague, this structure is formed by translating the seven spatial identities of Den Haag, de 7 lijnen into an above-ground subway framework in which each line carries a distinct sensory theme. These themes, derived from the inherent character of each line, establish a stable logic in which sound, scent, texture and light are not scattered across the city but concentrated into linear sequences. This allows visually impaired and blind individuals to recognise when they are on a specific line as each tells its own story. It tells the visitor when they are transitioning to another line and what sensory qualities they can expect along the route.

Within this framework, coherence is achieved through two complementary components: landmarks and continuous paving systems, the "pavings." Landmarks serve as the above-ground equivalent of subway stations, marking decision points where users can enter, leave or change lines. Their design is visually the same as the surrounding paving, however for the heightened senses, there are some clear distinctions, thematically aligned with the line identity, ensuring that recognition remains intuitive for visually impaired and blind users while not overwhelming sighted pedestrians or disrupting the urban aesthetic. The paving systems then provide the continuous thread between these landmarks. Each line is equipped with an uninterrupted paving type that can be followed through tactile, acoustic or atmospheric cues. This creates a predictable sensory rhythm: the same underfoot texture, sound resonance or subtle environmental theme repeats along the entire line, forming a traject that supports mental mapping and reduces cognitive load.

Together, these components, the thematic lines, the landmarks that belong on these lines and the pavement transform individual sensory cues into a cohesive spatial system. As demonstrated in the design elaborations, this structure integrates insights from the previous chapters: the need for predictability identified in the user interviews, the importance of rhythmic atmospheres observed in the sensory analysis and the micro-scale strategies tested through Pattern language and Maximisation. These elements reappear in the design examples as interventions, such as gutters for directional alignment, tactile crossings, acoustic diffusers and natural guiding façades. They ensure that the sensory logic of the lines is not abstract but embedded in the everyday material fabric of the city.

By organising sensory modalities into continuous, line-based sequences and reinforcing them with recognisable landmarks and subtle material cues, wayfinding becomes coherent at the scale of the entire urban environment. This structure transforms disjointed places into navigable routes, enabling visually impaired and blind individuals to orient themselves with greater confidence, autonomy and spatial understanding.

09 CONCLUSION

This chapter answers the research question, followed by the discussion of the results

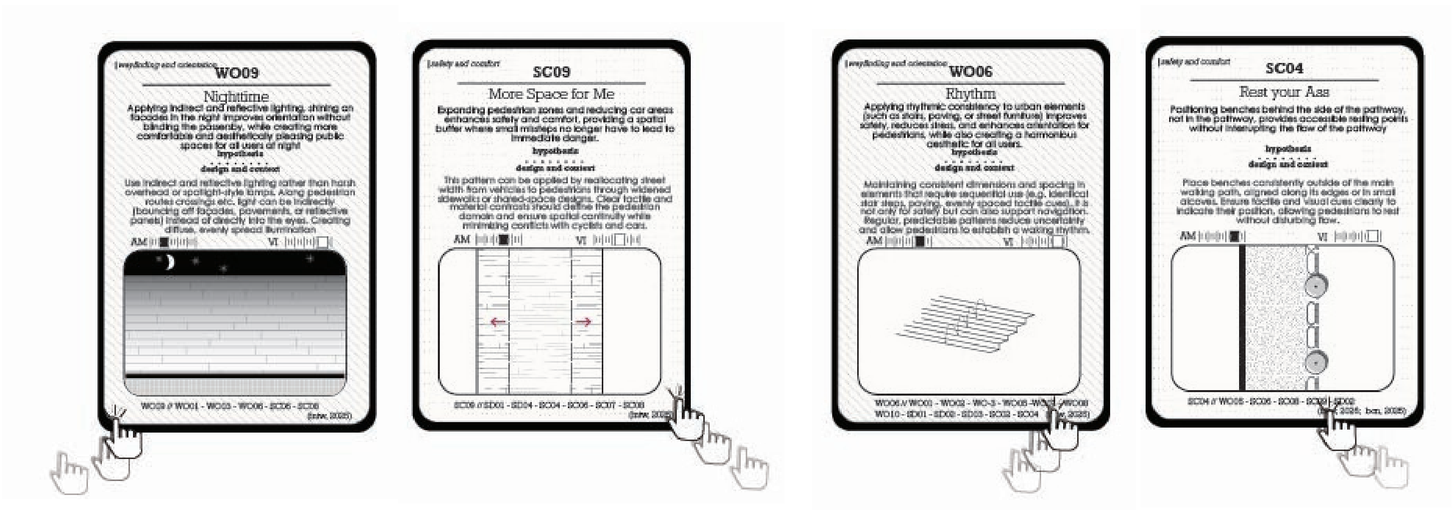


Figure Y:
The 4 most popular pattern evaluted by VI/B participants

09 CONCLUSION

SYNTHESIS

RESEARCH QUESTION

Which multisensory spatial design variables support wayfinding and perceptual comfort for people with different degrees of visual impairment, and how can these variables be translated into design strategies for high-density urban environments?

The number of visually impaired and blind people continues to rise each year. Some are born with visual impairment, while others experience a gradual deterioration of sight over the course of their lives. This makes it necessary to question how well contemporary urban environments support those who navigate the city primarily through non-visual means. Across interviews, walk-along observations, fieldwork and literature review, the conclusion is consistent: current urban design practices frequently fall short in addressing the spatial and perceptual needs of visually impaired and blind individuals.

Understanding how visually impaired and blind people perceive and move through the city reveals that non-visual orientation relies on an underlying spatial rhythm. Continuous edges, height differences and consistent material changes form the basis for legibility, allowing users to anticipate where the next anchor point will appear. When this rhythm is interrupted or absent, people do not merely lose orientation; they lose the narrative of the street. Interviews demonstrate that disorientation is rarely caused by a single obstacle, but by an accumulation of small uncertainties that gradually erode trust in the environment. Shared space concepts, which rely heavily on eye contact and visual negotiation, further amplify this insecurity, making independence difficult or even unsafe for visually impaired and blind users.

The sensory analysis revealed that high-density urban environments such as The Hague lack a balanced alternation between rust, ruis and reuring. While traffic corridors, commercial streets and intersections generate constant sensory pressure, places of genuine rust remain scarce, particularly in the city centre. This imbalance results in environments that demand continuous vigilance without offering moments of recovery. Measurements and observations confirmed that fluctuating wind corridors, sharp acoustic transitions, uneven paving and competing signals accumulate into sensory overload, not through intensity alone, but through a lack of orchestration.
Tactile paving is widely recognised as a navigation aid for visually impaired users and is commonly applied in Dutch cities. However, fieldwork and interviews show that its effectiveness depends strongly on placement rather than quantity. Missing tiles, uncomfortable textures and inconsistent application reduce its usefulness, particularly for guide dog users. Despite these limitations, tactile paving remains valuable when applied strategically at crossings, lane transitions and connections to natural guiding elements. This indicates a broader desire for multimodal anchoring rather than reliance on a single sensory cue.

Other sensory variables play a crucial role in supporting wayfinding and comfort. Scent functions as a mnemonic layer, anchoring locations through vegetation, cafés and characteristic environments, while also acting as a boundary when associated with unpleasant sources such as waste or drainage. Sound is often the first cue perceived and plays a key role in orientation. Natural sounds such as water and birdsong were consistently experienced as calming and grounding, while sudden artificial sounds triggered hesitation and stress. Visual–material contrast proved especially relevant for partially sighted users, with strong colour differentiation and material changes supporting recognition and spatial understanding.
International case studies reinforced these findings. Barcelona demonstrated how tactile logic aligned with façades can reduce anxiety and support reliance, while Tokyo illustrated the effectiveness of continuous tactile paths and auditory traffic signals as part of an everyday urban language. These examples confirm that sensory legibility is not abstract, but a practical spatial logic when applied consistently.

These insights were translated into three interconnected design strategies. The first is the development of a pattern language. Rather than functioning as a fixed solution, the pattern language operates as a research-through-design and communication tool that connects analytical insights to spatial design decisions. Each pattern articulates a recurring spatial principle that helps organise complex urban situations such as intersections, plazas and shared spaces. The pattern language is particularly effective as a city-wide structuring framework, capable of generating multiple variations while maintaining coherence. Patterns such as "Rhythm", "Nighttime", "More Space for Me" and "Rest Your Ass" were consistently valued by participants for restoring continuity, reducing uncertainty and supporting moments of pause.

While the pattern language proved effective in structuring spatial layout and legibility, sensory patterns were evaluated with greater nuance. This reflects the fact that many stressful or dangerous situations occur near motorised traffic, tramlines and crossings, where clear and robust spatial cues are prioritised. In quieter public spaces, where traffic pressure is reduced, sensory variables can be explored more freely through a different design approach.

Here, maximization is applied as an ordering and exploratory design tool. Maximization allows sensory cues to be isolated, intensified and compared within specific spatial contexts, making their interaction and impact explicit. Rather than prescribing outcomes, the method reveals how sensory signals reinforce or conflict with one another and how they contribute to wayfinding and perceptual comfort. In the dwelling scenario, sensory cues were combined to create rust places through scent-based zoning, subtle sound markers, tactile orientation and contrast-based distinction. In the wayfinding scenario, tactile lines, façade alignment and recognisable sound and scent anchors guided movement through transitions and corridors. Dwelling and wayfinding emerged as overlapping experiential conditions, each requiring a calibrated balance between clarity and atmosphere.

To connect these site-specific interventions at the urban scale, a broader strategy was developed in the form of a multisensory backbone. Inspired by the 7 Lines of The Hague, this framework structures the city through sensory continuity, with each line expressing a dominant sensory theme. Line 4: Water illustrates how this operates, using hydrochromic paving, condensation-emitting benches and fountains as transferable landmarks. These elements construct a narrative that supports memory, recognition and cognitive mapping across the city.

In response to the research question, this thesis identifies four key multisensory spatial variables that support wayfinding and perceptual comfort for people with different degrees of visual impairment: tactile structure, auditory indicators, scent-based anchors and visual–material contrast. These variables are translated into three complementary design strategies for high-density urban environments: a pattern language that structures complex spatial situations, maximization as a method for exploring and ordering sensory experience, and a city-wide multisensory backbone that connects local interventions into a coherent whole.
Together, these strategies demonstrate that multisensory design is not about adding stimuli, but about composing legible, adaptive and supportive environments. When applied consistently and tested with visually impaired and blind users, they can strengthen autonomy, comfort and orientation. The city without sight is not a lesser city, but a more deeply understood one. Through sound, touch and scent, its hidden structures and overlooked potentials become readable, offering a richer urban experience for all.
The number of visually impaired and blind people continues to rise each year. Some are born with visual impairment, while others experience a gradual deterioration of sight over the course of their lives. This makes it necessary to question how well contemporary urban environments support those who navigate the city primarily through non-visual means. Across interviews, walk-along observations, fieldwork and literature review, the conclusion is consistent: current urban design practices frequently fall short in addressing the spatial and perceptual needs of visually impaired and blind individuals.

Understanding how visually impaired and blind people perceive and move through the city reveals that non-visual orientation relies on an underlying spatial rhythm. Continuous edges, height differences and consistent material changes form the basis for legibility, allowing users to anticipate where the next anchor point will appear. When this rhythm is interrupted or absent, people do not merely lose orientation; they lose the narrative of the street. Interviews demonstrate that disorientation is rarely caused by a single obstacle, but by an accumulation of small uncertainties that gradually erode trust in the environment. Shared space concepts, which rely heavily on eye contact and visual negotiation, further amplify this insecurity, making independence difficult

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The sensory analysis revealed that high-density urban environments such as The Hague lack a balanced alternation between rust, ruis and reuring. While traffic corridors, commercial streets and intersections generate constant sensory pressure, places of genuine rust remain scarce, particularly in the city centre. This imbalance results in environments that demand continuous vigilance without offering moments of recovery. Measurements and observations confirmed that fluctuating wind corridors, sharp acoustic transitions, uneven paving and competing signals accumulate into sensory overload, not through intensity alone, but through a lack of orchestration.
Tactile paving is widely recognised as a navigation aid for visually impaired users and is commonly applied in Dutch cities. However, fieldwork and interviews show that its effectiveness depends strongly on placement rather than quantity. Missing tiles, uncomfortable textures and inconsistent application reduce its usefulness, particularly for guide dog users. Despite these limitations, tactile paving remains valuable when applied strategically at crossings, lane transitions and connections to natural guiding elements. This indicates a broader desire for multimodal anchoring rather than reliance on a single sensory cue.

Other sensory variables play a crucial role in supporting wayfinding and comfort. Scent functions as a mnemonic layer, anchoring locations through vegetation, cafés and characteristic environments, while also acting as a boundary when associated with unpleasant sources such as waste or drainage. Sound is often the first cue perceived and plays a key role in orientation. Natural sounds such as water and birdsong were consistently experienced as calming and grounding, while sudden artificial sounds triggered hesitation and stress. Visual–material contrast proved especially relevant for partially sighted users, with strong colour differentiation and material changes supporting recognition and spatial understanding.
International case studies reinforced these findings. Barcelona demonstrated how tactile logic aligned with façades can reduce anxiety and support reliance, while Tokyo illustrated the effectiveness of continuous tactile paths and auditory traffic signals as part of an everyday urban language. These examples confirm that sensory legibility is not abstract, but a practical spatial logic when applied consistently.

These insights were translated into three interconnected design strategies. The first is the development of a pattern language. Rather than functioning as a fixed solution, the pattern language operates as a research-through-design and communication tool that connects analytical insights to spatial design decisions. Each pattern articulates a recurring spatial principle that helps organise complex urban situations such as intersections, plazas and shared spaces. The pattern language is particularly effective as a city-wide structuring framework, capable of generating multiple variations while maintaining coherence. Patterns such as Rhythm, Nighttime, More Space for Me and Rest Your Ass were consistently valued by participants for restoring continuity, reducing uncertainty and supporting moments of pause.
While the pattern language proved effective in structuring spatial layout and legibility, sensory patterns were evaluated with greater nuance. This reflects the fact that many stressful or dangerous situations occur near motorised traffic, tramlines and crossings, where clear and robust spatial cues are prioritised. In quieter public spaces, where traffic pressure is reduced, sensory variables can be explored more freely through a different design approach.

Here, maximization is applied as an ordering and exploratory design tool. Maximization allows sensory cues to be isolated, intensified and compared within specific spatial contexts, making their interaction and impact explicit. Rather than prescribing outcomes, the method reveals how sensory signals reinforce or conflict with one another and how they contribute to wayfinding and perceptual comfort. In the dwelling scenario, sensory cues were combined to create rust places through scent-based zoning, subtle sound markers, tactile orientation and contrast-based distinction. In the wayfinding scenario, tactile lines, façade alignment and recognisable sound and scent anchors guided movement through transitions and corridors. Dwelling and wayfinding emerged as overlapping experiential conditions, each requiring a calibrated balance between clarity and atmosphere.

To connect these site-specific interventions at the urban scale, a broader strategy was developed in the form of a multisensory backbone. Inspired by the 7 Lines of The Hague, this framework structures the city through sensory continuity, with each line expressing a dominant sensory theme. Line 4: Water illustrates how this operates, using hydrochromic paving, condensation-emitting benches and fountains as transferable landmarks. These elements construct a narrative that supports memory, recognition and cognitive mapping across the city.

In response to the research question, this thesis identifies four key multisensory spatial variables that support wayfinding and perceptual comfort for people with different degrees of visual impairment: tactile structure, auditory indicators, scent-based anchors and visual–material contrast. These variables are translated into three complementary design strategies for high-density urban environments: a pattern language that structures complex spatial situations, maximization as a method for exploring and ordering sensory experience, and a city-wide multisensory backbone that connects local interventions into a coherent whole.

Together, these strategies demonstrate that multisensory design is not about adding stimuli, but about composing legible, adaptive and supportive environments. When applied consistently and tested with visually impaired and blind users, they can strengthen autonomy, comfort and orientation. The city without sight is not a lesser city, but a more deeply understood one. Through sound, touch and scent, its hidden structures and overlooked potentials become readable, offering a richer urban experience for all.

And that is how the thesis A City Without Sight comes to an end.

09 CONCLUSION

DISCUSSION

Based on the design proposals and the results in the previous chapter, one conclusion is clear: the current urban environment does not meet the needs of visually impaired and blind people. This chapter discusses what these findings mean for multisensory design, for existing concepts such as shared space, for urban practice in high-density environments, and for the methodology of this thesis.

Sensory thresholds and who is included

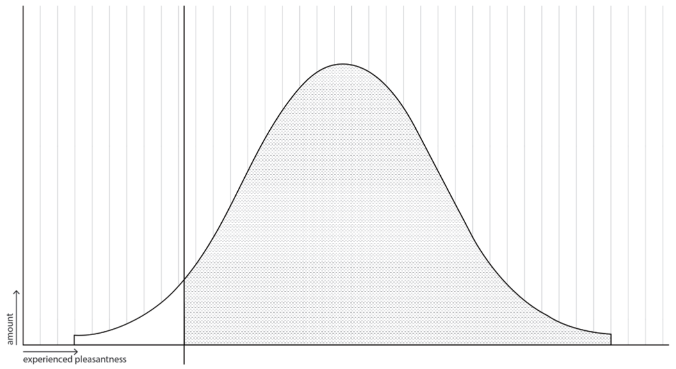
Each sensory layer has a pleasant and unpleasant threshold, and, as shown in the Sensory chapter, these thresholds differ per person. This thesis therefore focuses on the "middle band" of visually impaired and blind users (as indicated in the diagram), rather than on the full spectrum of disability. In many cities, design currently prioritises the "average" sighted user and only a small portion of visually impaired people. Here, the line is intentionally shifted towards VI/B users, while still aiming for environments that remain comfortable for the average user.

The group at the left side of the line in Figure 9, the ones with a higher sensitivity, or those with additional impairments, are not fully addressed by the proposed strategies. They are not ignored, but they would require further, more specialised research and design. This is a deliberate scope choice rather than a full solution.

Shared space and the limits of visual negotiation

Shared space has become a popular concept in the Netherlands, but the thesis findings strongly question its suitability for high-density urban environments.

Figure 9. *Sensory Variability and Design Threshold*



Note. Adapted from insights shared by Guus Janssen (Municipality of The Hague, 2025).

The idea behind shared space, eye contact and informal negotiation between users, is fundamentally visual. As one participant stated:

"If you are in a small town and they know that you are blind, they will stop, but in big cities like The Hague, like Spui, it doesn't work." (G. Janssen, 2025)

In dense places such as Spui, too many people pass through and many are inattentive to others. For VI/B users, this makes shared space not just uncomfortable but structurally unsafe. The pattern language is therefore not a neutral design tool; it is a direct critique of shared space as currently implemented. It proposes to reintroduce clear crossings, thresholds and hierarchies in places where "everyone together" in practice means "those who cannot see are excluded."

Tactile paving: regulation, practice and critique

Tactile paving is often the first cue people associate with accessibility for VI/B users. The conclusion of this thesis, that quality (placement) matters more than quantity, may seem obvious, but it stands in contrast to how tiles are frequently applied. While guidelines exist for crossings, platforms and stairs, their interpretation in practice is highly inconsistent: tiles are placed in the same colour as the surrounding pavement, leading nowhere, or duplicated where natural guides already function.

The interviews revealed that many participants disliked extensive tactile paving: guide dogs avoid it, walking long distances on guidance tiles becomes uncomfortable and tiles are often missing or misplaced. At the same time, tactile paving is essential at specific locations: lane changes, crossings, entrances, and inside public buildings to connect people to elevators, platforms and stairs.

This raises an important design question: is the problem tactile paving itself, or the way we deploy it? The thesis argues for a more selective, strategic application of tactile cues, combined with natural guides, rather than carpet-like coverage of whole cities. The suggestion from participants to move clutter from pedestrian lanes to car lanes also challenges current practice and could be tested experimentally at a city-centre scale.

Multisensory cues and trade-offs

The maximisation explorations and pattern evaluations show that no single sense can carry the whole burden of legibility.

Sound proves to be a double-edged sword. Ticking traffic lights and water sounds were experienced as helpful during walk-along interviews, signalling crossings and acting as calm anchors. However, in the pattern language assessment, sound-focused patterns were rated relatively low. The evaluation group and the interview group were not the same, and the written pattern descriptions can lack the contextual nuance of a walk-along interview. This gap suggests that sound-based interventions are easier to understand in situation than on paper, and that design communication itself shapes how sensory strategies are perceived. It also confirms that adding more sounds in an already noisy city easily tips into overload.

Scent is valued as a mnemonic and atmospheric cue, vegetation, food and cafés help people remember locations, but it is volatile. Seasonal changes, closing times of shops and wind conditions make scent less reliable than material or structure. This limits its use as a primary wayfinding tool, but reinforces its role in structuring zones and atmospheres rather than precise routes.

Materials and ground textures are consistently appreciated: granite and semi-paved surfaces are pleasant and legible. At the same time, maintenance and accessibility constraints mean that such surfaces cannot be applied everywhere.
Strategic placement is therefore key. For instance, using granite on car lanes rather than on pedestrian routes allows electric cars to remain audible without making wheelchair movement more difficult.
This again shows that sensory design must be coordinated.

Contrast primarily benefits visually impaired users, who form a larger group than those who are completely blind. Methods like the Puccini approach, which uses different materials / colours to structure streets into lanes and edges, can be highly valuable, but only it should add a tactile relief so that blind users are not excluded. Multisensory design must therefore account for both blind and low-vision users simultaneously, rather than solving for one group at the expense of the other.

Nighttime as a separate condition

Nighttime emerged as a separate design condition rather than a mere variation of daytime. For many partially sighted users, darkness effectively removes their remaining vision, pushing them closer to the experience of blindness. This justifies the decision to develop a nighttime variant for every proposal. Lighting design becomes a primary tool here: lights must improve legibility without blinding users. Diffuse floor lighting, rather than harsh point sources, can clarify paths, thresholds and entrances without creating glare. Material contrasts, which remain in the dark, form an additional non-visual cue. Nighttime therefore requires its own layer of design logic.

International precedents and contextual limits

Japan and Barcelona offered important precedents but also clear warnings against simple copying. Japan demonstrates the power of consistent tactile systems and auditory cues integrated into everyday infrastructure. However, participants indicated that excessively dense tactile networks can become unpleasant, especially when tiles are placed where natural guides already exist. Barcelona shows how spatial programming (terraces, buffers, façades) can create intuitive separation between pedestrians and traffic without explicit signage.

Both cases also highlight contextual limits. Barcelona's climate and social rhythms (siestas, long outdoor breaks) keep terraces active for much of the year, making buffers effective. Dutch city centres, especially in autumn and winter, are often emptier, and the same configuration would not produce the same sensory or social effect. Japan's culture of quietness amplifies subtle bird sounds at crossings; in the Dutch soundscape, such cues might be lost in background noise.

Roles and limitations of the three design tools

The three design tools, pattern language, maximisation and wayfinding, respond differently to the research gap and each has its own strengths and limitations.

The pattern language proved effective in restructuring complex junctions and shared spaces. The categories of wayfinding/orientation and spatial chaos were evaluated most positively by VI/B participants; they deal with highly tangible problems: where to cross, how to reduce conflict, how to reduce chaos. The sensory design patterns were evaluated less positively. Evaluators found it difficult to imagine how these patterns would work in reality, and raised concerns about maintenance. This suggests that patterns are well-suited for structural, geometric and programmatic decisions, but that sensory design requires more situational prototyping and material testing.

The Spui junction illustrates this tension. The pattern language proposes a central crossover island, shorter crossing distances and rest benches, addressing the need for safety and clarity rather than social interaction. Yet multiple evaluators noted that only real-world testing can show whether such an arrangement would truly work in daily flows. The persuasive power of drawings is not the same as proof of effectiveness.

The sensory maximisation scenarios, for dwelling and wayfinding, explore how combinations of senses can create meaningful environments. They also underline the distinction between wayfinding spaces (which must be clear, legible and efficient from A to B) and dwelling spaces (which must invite staying, resting and sensing at a different tempo). In practice, both contain elements of each other, but their primary function differs. The maximisation outcomes are inherently context-dependent: applying the same framework in another city would yield different solutions depending on whether a rust, reuring or ruis place is needed.

The wayfinding paving is the most visionary and speculative of the tools. Some of the proposed paving, such as hydrochromic patterns, are only visible to visually impaired users and offer nothing to those who are completely blind. Others, like leaves embedded in bricks or subtle sound-producing paving, do not yet exist and raise questions of durability and maintenance. This makes them promising directions for innovation rather than ready-made solutions. Future studies could investigate which bricks are technically and economically feasible, whether they should be applied as full surfaces or as lines, and how easy they are to find in practice.

Tactile cartography, although only briefly developed, points to another direction: pre-navigational tools that allow VI/B users to prepare for a route. This area remains underexplored due to time constraints, but it connects strongly to the need for autonomy and self-planning.

A key lesson is that the most successful strategies are those that improve the urban environment for everyone, while quietly embedding support for VI/B users. This aligns with the ambition of the design proposals: not "special" infrastructure for a separate group, but sensory logics that upgrade public space as a whole. As an improved urban space for VI/B is an improved urban space for all.

Technology and the intentional exclusion of digital aids

Technology has deliberately not been included as a central component in this thesis. Organisations such as Bartiméus are currently developing navigation apps, and multiple existing apps support VI/B users with orientation, positioning and route guidance. However, this research intentionally focused on how a city can become legible without reliance on technological aids. Digital tools may fail, batteries die, Russia can break into our network and bring it down, disabling the aids.
Because of this, the thesis prioritises sensory cues, spatial logic and environmental design strategies that allow visually impaired and blind individuals to navigate independently, without needing a device or another person. Technology can complement environments, but it should not compensate for shortcomings in the physical city. The aim here was to explore what urban wayfinding and comfort look like when the user must rely solely on the city itself.

Methodological reflection: questions, interviews and designer bias

Methodologically, the thesis rests on an intense interaction between literature, interviews, site observations and design. The literature review guided the topics addressed in the interviews, but the interviews themselves reshaped the emphasis of the design. Without them, sound might have remained the dominant sense, as literature often suggests, whereas the interviews revealed the importance of tactile structure, scent anchors and the role of clutter. Blindfolded tests offered a partial, embodied understanding of non-visual navigation and made everyday habits, such as parking a bike anywhere or standing on tactile paving, suddenly questionable.

The interview questions were not taken from a standardised questionnaire. Instead, they were derived from two sources: assumptions in literature that needed to be confirmed or challenged (for example about sensory hierarchies and cognitive mapping), and concrete design questions that required user input. While there are existing frameworks for interviewing VI/B users, these often focus on assistive technologies or mobility training rather than urban sensory experience. The questions used here therefore diverge from existing standards but could serve as a starting point for a more structured approach to walk-along interviews in sensory urban research. The walk-along format itself proved crucial: it allowed participants to react to real-time conditions and raise issues that would not have been anticipated on a static questionnaire.

At the same time, the thesis recognises that the process remains designer-driven. Even with user input, decisions were filtered through a designer's perspective, aesthetic preferences and assumptions about feasibility. This underlines the importance of iterative evaluation with VI/B users in future work, not only at the research phase but also during prototyping and implementation.

Limitations, testing and future research

From the perspective of this thesis, it may seem that the research gap is largely addressed: variables have been identified, and design strategies have been proposed at multiple scales. However, for a group that knows better than designers what works for them, proposals cannot be considered successful without direct testing. The main limitation of the thesis is that the design proposals have not yet been prototyped and evaluated with VI/B users. Time constraints and the complexity of implementation made this unfeasible within a one-year graduation project, but it remains essential. Everything proposed in this thesis ultimately has to be tested.

Other limitations are the number of interviews (n = 8) is modest, the case study is specific to The Hague, the focus seasons are spring and summer, and some results are less strongly grounded in existing literature due to the novelty of the topic.

These are not reasons to dismiss the results, but they define their scope: the outcomes should be seen as a baseline logic and a set of hypotheses for multisensory design, not as universally validated rules.
Future research could:

- prototype key elements from the pattern language and maximisation scenarios in real urban settings;
- study different seasons and weather conditions, especially winter;
- explore wind more deeply as a carrier of scent, sound and comfort;
- expand the interview base to include a broader range of VI/B experiences;
- further develop tactile cartography and pre-navigation tools;
- investigate which paving types are technically, economically and socially viable.
- experiment how the flow a city would work if all clutter (lampposts, garbage, park meters etc) would be placed on the care lane

Towards a baseline logic for multisensory urban design

The aim of this thesis was to investigate how multisensory urban design can be translated into spatial cues for VI/B users. The three components, pattern language, maximisation and sensory lines,contribute to that aim in different ways and, together, form a baseline logic for reorganising shared spaces, difficult junctions and fragmented environments.

The results do not always rest on extensive existing literature, and in places the work stretches beyond what is currently academically formalised. Yet this is also its value: it opens up a field of multisensory urban design that is urgently needed but still under-defined. If taken as a starting framework rather than a final answer, the outcomes can support the creation of clearer, calmer and more enjoyable public spaces for visually impaired, blind and sighted users alike.

10 REFLECTION

Looking back at the graduation year, this topic and its relevance

10 REFLECTION

1. How do you see the relation between your graduation project topic, the studio topic, your master's track (Urbanism), and your master's program (MSc Architecture, Urbanism and Building Sciences)?

Relation to the Studio: Design of the Urban Fabric
The studio focuses on understanding and redesigning the city at the human and neighbourhood scale, examining how urban form, street life, behaviour and the psychological environment intersect. Its emphasis on public space redesign, resilience, circularity, social functioning and human-scale qualities directly aligns with my ambition to understand how urban space can better serve visually impaired and blind individuals.

I chose this studio because it was the one that most directly supported my interest in the non-visual experience of space. Improving the daily lived environment of VI/B people requires attention to small-scale spatial logic, materiality, edges, transitions, and sensory atmospheres, precisely the scale the studio investigates. Although the studio did not push me in a predetermined direction, the freedom it offered, combined with its grounded focus on behavioural and spatial analysis, allowed my project to expand into a multisensory exploration.

Relation to the Urbanism Track
During my master Urbanism, I learned to look critically at the systems and assumptions that shape contemporary cities. Which is why I am looking at the current urban design paradigms which are dominantly designed through visual cues, which marginalise those who rely on non-visual sensory information.

There are many terms and elements that I learned during my master, like liveability and public-space quality. These elements create an understanding in my thesis of how people experience stress, comfort or disorientation in dense environments. Spatial justice questions who the city is designed for, whose needs are centred and whose experiences remain overlooked. However, during the design assignments there was little to no perspective for people that can not rely on sight, which made me interested in multisensory approaches.

The research-through-design culture of the track was essential to my process. By iteratively sketching, modelling, testing and re-testing design ideas, I could move easily between concept, analysis and application. Design became a research tool rather than an outcome, helping me understand what worked, what conflicted and what required rethinking.

Relation to the MSc AUBS Programme
The AUBS master programme demands an inclusive design in almost every assignment. When we are designing we always have to think about people in wheelchairs, creating social interaction and the wellbeing of the user. However, I found out that I didn't think about other sorts of inclusivity. Because of this gap, I chose to dedicate an entire year to researching this user group. During a workshop I co-taught in the Bachelor programme (POW week, November 2025) with Gelly Sehat, it became clear that students had little awareness of accessibility problems in their own faculty or surrounding campus. This experience strengthened my conviction that education needs more attention on sensory diversity, and that this graduation project could contribute to that awareness.

2. How do you see the relation between research and design in your graduation project?

Research and design continuously informed one another in an iterative, reciprocal process. Rather than existing as separate phases, they become intertwined: research generates design directions, and design prototypes reveal new research questions. This back-and-forth dynamic was essential to understanding how visually impaired and blind (VI/B) people navigate and experience public space beyond the limits of visually centred urbanism.

Research shaping design
This thesis started with a thorough research. Literature review consistently stated problems for visually impaired and blind people like unclarity, isolation and overstimulation. These elements were the starting points for the different interviews and walk-along sessions with VI/B participants. Their first-hand accounts confronted many of my initial assumptions about how they use and interpret public space. The participants also gave their opinion about the overall conclusions of the literature that were shaped in questions for the interview. Through these encounters, I learned not only about the practical challenges they face but also about their diverse attitudes, from optimism to frustration, and their individual techniques for moving through the city. Several participants expressed that unclear or disorderly public spaces discouraged them from going outside at all. Marking the importance of creating the bare minimum: a public space accessible for VI/B people.

Field observations and photo analyses further highlighted the disconnection between design intention and real-world behaviour. Tactile paving was frequently blocked by temporary furniture, tree pits, information signs or even placed in ways that led users directly into obstacles. These observations underscored that accessibility issues often stem not from malice but from a lack of awareness; many people simply do not realise how critical these cues are. Creating ideas for spatial logic and predictability within my design proposals.

Environmental and sensory mapping also played a key role. By documenting soundscapes, wind conditions and microclimate patterns around The Hague, I identified critical gaps and opportunities. For example, the scarcity of quiet "rustplekken" in the city led me to design new forms of sheltered sensory retreats. On the other side, the recurring identification of the Spui - Grote Marktstraat - Kalvermarkt junction as a stressful and confusing node, mentioned by multiple interviewees and even by blindfolded sighted friends, motivated me to develop a structural approach for such intersections through the pattern language.

Unexpected findings also redirected the design process. At the start of the project, I believed that tactile paving and acoustic traffic signals formed a sufficient foundation for accessibility. Through interviews and literature, it became clear that this is far from enough. Non-visual anchors such as scent, consistent textures, wind cues and predictable sound sources play an important role in memory, orientation and emotional comfort. Initiating the multisensory scope of the design approach.

Design shaping research
The design process itself became a research instrument. Sketching, modelling and prototyping multisensory patterns enabled me to understand the research insights at a deeper level. For example, developing different patterns (urban lay-out, sensory and safety and comfort) helped clarify which sensory elements complemented or contradicted one another, and which were intuitive for VI/B users.

Testing early pattern-language sketches with users was particularly revealing. Their feedback sharpened my understanding of what cues were meaningful versus confusing. A visit to Visio School with Ana Petrovic profoundly inspired a design choice in the maximization process. Just by observing children with different forms of visual impairment. Creating the playground in the maximisation | dwelling drawings.

Designing maximisation scenarios also functioned as a method of hypothesis-testing. By placing sensory extremes into drawings, I could evaluate where interventions offered clarity, where they overwhelmed the user and how different senses could support one another. As one interview participant emphasised during a call: "Everything you design for visually impaired people should be tested before implementation." This validated the iterative approach and highlighted the ethical need for prototyping.

Research through design
Throughout the year, research and design collaborated continuously. Each site visit, interview, sketch and sensory measurement added a new layer of insight. Iterations were shaped and refined by new information, whether from field observations or user feedback. Design became a tool for understanding the research material, just as the research material guided every design choice. Through designing, some problems occurred as well when I started thinking from the perspective of a visually impaired or blind person. Designing gives new insights and problems that occurred, especially at junctions with the pattern language, were then asked by participants who assessed the patterns and the ideas for urban design.

A strength of this approach is the depth of multisensory integration: by combining all data that is gathered through the different methods, the design is grounded in real user experience rather than in assumptions. At the same time, a key limitation is the inability to test design proposals at full scale in real urban conditions.

As is stated before, every intervention for VI/B users must be tested before implementation. While all ideas in theory might seem helpful, physical testing before implementation remains an essential next step.

3. What do you see as the value (and limitations) of your way of working: your approach, your used methods?

There are different things to say about the methods and the approach that I used during this graduation year. The value of my approach lies primarily in its user-centred, multisensory and research-driven nature, which shaped every stage of the project. Because my thesis investigates the city from the perspective of visually impaired and blind (VI/B) individuals, my methods were intentionally grounded in their lived experiences. Interviews, walk-along sessions and field observations were not simply supportive sources of information, they formed the foundation upon which all design decisions were made. Listening to people explain how they move, navigate, get startled, avoid certain streets or creatively develop techniques to orient themselves provided insights that no desk research or conventional analysis could have offered.

A key strength of this approach was the active involvement of VI/B participants throughout the process. As someone who can see, the bias that I have can sometimes be in opposition to what VI/B people need. Which is why the involvement of the VI/B during this graduation year was very valued. Not everything has been assessed. The maximisation drawings were more abstract and difficult to "test" directly, however choices for these scenarios were guided by patterns emerging from interviews and literature. For instance, elements such as water and vegetation consistently appeared in both academic research and participant feedback as pleasant and memorable which is why they are used frequently.

The research-through-design method also proved particularly valuable. Designing, whether sketching maximisation scenarios, shaping patterns or mapping sensory routes, functioned as a form of thinking. Drawing allowed me to reconnect fragmented ideas, recall field observations and recognize patterns that I had not explicitly articulated before. For example, while sketching maximisation scenarios, I rediscovered how strongly sound influenced behaviour during walk-alongs; this gave me the idea to use sound in a precise way, only to indicate changes or critical spatial moments, rather than as constant background stimulation.

Another strong aspect was the combination of technical analysis and experiential research. Site visits in both The Hague and Barcelona offered contrasting examples of sensory-rich and sensory-poor environments. The Barcelona trip, in particular, revitalised the project during a moment in the year when my motivation hit a dip. Experiencing a different city through the lens of sensory design and documenting it through photos and notes, brought new ideas, energy and clarity.

At the same time, my approach also had limitations. Sensory-focused research inevitably includes many subjective components. Although literature supports many of the choices made, some decisions were influenced by personal experience or intuitive judgments of what felt pleasant or coherent. Sensory design involves emotional, atmospheric and perceptual dimensions that cannot always be fully justified through quantitative data.

Another limitation is that, despite careful grounding in interviews and literature, real-world testing of design proposals remains essential. Several VI/B participants emphasised that any intervention developed for their user group should be prototyped and tested before implementation. This is understandably a constraint within the scope of a graduation project. Likewise, sensory data, particularly sound, scent and atmosphere, is difficult to capture in an objective, universally applicable way, which places natural limits on how definitive conclusions can be. However, it is a perspective that deserves more attention as everyone experiences the world around him or her through the senses.

Because of this, the design part (in the maximisation) had a lot of possibilities, but occasionally restricted by the need to justify choices through research. This could be difficult while some decisions simply felt right, even when no explicit dataset could support them, a tension that is inherent to research-through-design. Additionally, participant perspectives varied: while many interviewees appreciated vegetation for its smells, orientation cues and calming effect, one participant expressed strong dislike due to litter accumulation. These differing opinions reveal the diversity within the user group and highlight the challenge of designing for a spectrum of preferences. In sum, the value of my way of working lies in its strong grounding in lived experience, back and forth with VI/B participants during the whole process, its multisensory focus and its iterative interplay between research and design. By combining interviews, walk-alongs, literature and environmental analysis with drawing, prototyping and pattern testing, the project remained closely tied to the needs and perceptions of visually impaired and blind users. The main limitations stem from the subjective nature of sensory research and the inability to test interventions at full scale, which means that all proposals should be prototyped before implementation. Nevertheless, this approach allowed me to uncover insights that traditional urban analysis would overlook, resulting in a design methodology that is both user-centred and experientially rich.

4. What are the academic and societal value, scope and implications of your graduation project, including ethical aspects?

The scope and implications of my graduation projects operate across academic, societal and ethical dimensions. Academically, the project contributes to bridging a clear gap between the lived needs of visually impaired and blind (VI/B) people and the spatial strategies required to support them. Although there is extensive literature on tactile paving, orientation contrasts and some forms of assistive technology, very little research addresses how multiple senses interact simultaneously in dense public spaces or how design can support sensory navigation when technology fails. This project therefore expands the phenomenological discourse by examining the city through non-visual perception and by proposing design approaches that respond to these sensory realities.

A key academic contribution is the interplay between empirical sensory data and design strategy. Information gathered through measurements, interviews, observations, sound mapping, microclimate analysis and site photography fed directly into the design proposals. This creates a bridge between research and design that is uncommon: sensory findings are often described, but rarely operationalised into structural urban design tools such as a pattern language or maximisation scenarios. The project therefore demonstrates a method for translating real sensory conditions into spatial strategies.
The societal value of the project lies in addressing a pressing issue: most cities are not designed for non-visual navigation or enjoyment. While the project is dedicated to the experience of VI/B individuals, its implications improve public space for all users. Clearer wayfinding, calmer sensory environments, and readable spatial structures support general comfort, safety and orientation. Importantly, the project reframes accessibility not as something "special" or exceptional, but as a fundamental aspect of good urbanism. VI/B people are not to be pitied; they represent a user group whose spatial needs reveal weaknesses that affect everyone. In this sense, the project advocates for universal design that strengthens spatial awareness across society.

The scope of the project encompasses a set of transferable processes rather than fixed, universal solutions. The pattern language, for example, is meant to generate multiple design outcomes and can be tested in other cities to explore its wider applicability. The maximisation scenarios are more context-specific, but the underlying method of balancing senses, sound for indication, scent for zoning, tactile surfaces for guidance, and contrast for activation, can be translated to different environments. The wayfinding concept, based on consistent material "lines," offers an alternative to the overuse of tactile paving (criticised both in interviews and international contexts such as Japan) and presents a replicable framework for multisensory navigation.

However, the implications of the project also reveal its limitations. Sensory environments differ greatly between cities, climates and cultures, meaning that no design proposal can be universally applied without adaptation. The design choices should be viewed as proposals, ideas that must be tested in real environments before implementation. Some elements, such as hydrochromic bricks or specific scent anchors, require further research to understand their long-term performance, maintainability and sensory reliability. While the overall process is widely applicable, the final outcomes are inevitably shaped by the specific conditions of The Hague.

Ethical Aspects
Ethically, designing for VI/B people requires careful consideration. The group is not homogeneous; experiences and preferences vary greatly. What comforts one person may confuse another. This makes design decision-making more sensitive than in general public-space design, where it is acceptable for some people to dislike certain places. VI/B individuals often do not have alternative routes or spaces available, so each design choice carries more weight.

It is therefore essential to communicate decisions transparently and to acknowledge limitations openly. All interventions for VI/B users must be tested with local users before any implementation takes place. Drawings and theories can only approximate experience; the true ethical responsibility lies in ensuring that real-world prototypes do not unintentionally harm, confuse or overwhelm the very people they aim to support.
Moreover, it is important to avoid paternalism. Design should not claim to "solve" disability, nor assume that designers know what is best. Continuous dialogue with users, respect for their autonomy and an understanding of their lived experience are central to ensuring that the work remains grounded and ethically sound.

5. How do you assess the transferability of your project results?

My project delivers three types of design proposals: the pattern language, the maximisation scenarios and the wayfinding concept, each proposal has a different degree of transferability. Some outcomes can be applied directly in other cities, while others depend strongly on local sensory conditions, cultural contexts, or user needs.

The pattern language is the most transferable component of the project. Patterns are designed to be adaptable guidelines: they can generate countless spatial solutions without ever being replicated twice. Because they operate at the level of structure, logic and sensory intention, not form, they can support designers in other cities who want to improve junctions, high-demand environments or organise chaos in highly-used places.
Applying these patterns in different contexts would

also allow municipalities to test how broadly they function: do the principles hold across cities and cultures, or are some patterns more specific to The Hague? This in itself could be an interesting continuation of the research.

The maximisation outcomes are more context-dependent. The dwelling scenario, the "snoezelgarden", was developed for a very specific location between two busy streets, surrounded by restaurants and wind shelters. The idea of creating a rustplek is transferable, but the exact configuration is not. What is transferable is the process: balancing senses, organising zones through scent, using sound to indicate transitions, providing different ground materials to guide the users and create contrast to highlight activation. These design logics can be applied in other cities, but they will inevitably produce different results because each site has its own sensory landscape, however this of course could be seen as an advantage.

The wayfinding strategy , a "subway-map logic" of continuous lines with their own material identities, can be used in any city that lacks consistent non-visual orientation cues. However, the specific translation in The Hague is based on the Seven Lines, a structural characteristic unique to its centre.
The underlying principle is the transferable part: relying less on tactile paving alone (especially since both interviewees and international examples, such as Japan, highlight its overuse), and instead creating continuous,
natural, recognisable lines through material, sound, microclimate or texture. The idea of using variations in pavement or "bricks with character" can help users understand position and direction in any city.
It is important to recognise that designing for visually impaired and blind (VI/B) people involves an additional layer of complexity. Every design solution will have disapproval. However, this report addresses an urgent problem that must be improved, the current design of public space for VI/B that currently meets little to no needs of this group. In general public-space design, if people don't like a certain proposal, they can always go to alternative locations within the city. For VI/B users, however, such alternatives often do not exist, currently. This makes every design decision sensitive: improving the environment for one subgroup may unintentionally make it less comfortable for another.

It is never possible to design a space that accommodates every individual equally. To create progress, choices where some users may disagree are inevitable. This makes it essential to communicate these choices clearly, acknowledge where limitations exist and provide additional support or alternative strategies for those who may not feel comfortable with particular design decisions. Above all, it is crucial to speak directly with the people you are designing for, especially when you are not personally familiar with how this group experiences and behaves in public space.

That is why designs for visually impaired and blind people must always be tested locally before implementation. This ethical obligation places a natural limit on transferability: the methodology can travel, but every city must critically test, adjust and verify the outcomes with local users.

In summary, the methods and principles of my project, the pattern language and the wayfinding structure, are broadly transferable, whereas the maximisation solutions are not. What can be replicated is the process: designing with users and balancing senses. What cannot be copied are the site-specific outcomes shaped by the unique sensory conditions of The Hague. Transferability is therefore possible, but always conditional on local testing, user involvement and adaptation.

6. What is your motivation for this thesis

see the motivation text (p. 6)

7. How has engaging with visually impaired and blind people changed your understanding of urban design?

When I started this project, I had no clear expectations about what the outcome would be. I chose the topic, but I had no idea how my end products would look or even which design directions would emerge. My understanding of urban design shifted fundamentally through the conversations, walk-along and engagement with visually impaired and blind (VI/B) individuals.

Speaking with participants was deeply enriching. Their enthusiasm for the topic gave me motivation during moments of uncertainty, and their openness allowed me to access a way of perceiving the city that I didn't know about. Until this graduation year, I had never created a design that meaningfully included VI/B users; "inclusive design" during previous education often meant nothing more than adding a ramp. I assumed senses might be relevant, but I did not anticipate how profoundly multisensory urbanism would reshape the design process.
The interviews revealed frustrations but also opportunities. Each participant had their own strategy, perspective and attitude, some highly optimistic, others more disappointed in how society treats them. Their comments were often surprising and refreshing. Suggestions like "why not use the car lane as a drainage channel so cars must drive slower?" showed me how differently VI/B individuals reason about spatial logic. During the walk-alongs, I gained a new respect for their skills: navigating without sight requires an immense cognitive and sensory effort. When I walked blindfolded myself, I quickly realised how dependent I am on vision; without my friends stopping me, I would have collided with many obstacles. I often had no idea where I was, even in streets I thought I knew well.

These experiences directly reshaped how I design. Elements that seemed obvious in hindsight, the need to accent the first and last step of every staircase, to emphasise entrances, a place to park bikes, using sound and tactile cues to accentuate elements, to avoid placing text on glass, or to ensure tactile paving connects entrances to key functions, were never part of my design thinking before this year. A comment from a university lecturer "isn't tactile paving enough for them?" showed how widespread misconceptions are. I once thought tactile paving was indeed sufficient; only by observing its inconsistencies, blockages, and confusing placements in the city did I understand how unreliable it often is in practice.

This project made me see urban design through a different lens. I realised how often cities are designed with a reliance on visual cues and assumptions that exclude large groups of people. Sudden noise bursts, unmarked thresholds, irregular paving or chaotic intersections such as the Spui can create environments that feel overwhelming or unsafe for VI/B individuals. Engaging with participants taught me that good urban design is not only about form but about sensory clarity and predictability.

Ultimately, working closely with VI/B people has broadened my understanding of what designing for a city means. It means designing above your own bias. It has shifted my design thinking towards multisensory awareness and a more nuanced understanding of human diversity. If every designer experienced navigating the city blindfolded, even for a single day, I believe urban design would make a big change.

11 BIBLIOGRAPHY

Every article and statement said in this thesis in APA 7

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