

Sensescapes

Restorative public spaces in de Lijnbaan



Colophon

Sensecapes

Restorative public spaces in de Lijnbaan

Msc graduation thesis

June 2026 Msc track Urbanism

MSc Architecture, Urbanism and Building Sciences

Delft University of Technology

Faculty of Architecture and the Built Environment

Author

Elena Agterdenbos

Student number: 5310601

First mentor: Maurice Harteveld

Second mentor: Teake Bouma

Graduation studio: Hyperdiverse Public and Space

All the images and pictures are taken or
made by the author, unless stated otherwise



Acknowledgements

The completion of this thesis would not have been possible without the support of many people. I would like to express my gratitude and appreciation to everyone who supported me throughout this project.

First of all, I want to express my gratitude to my two mentors. To my first mentor, Maurice Hartevelt, for his invaluable guidance. His constructive feedback and knowledge about public spaces helped me define my project further. I am grateful for the enjoyable and insightfull meetings we had every Friday about my project, but also about various other topics. This has been very valuable to me. Beyond our discussions about the graduation project, we also talked about topics such as future plans, career paths, hobbies, and Netflix series. This made him not only a supervisor, but also a mentor beyond the project. I appreciate your broader support beyond this project. Thank you for your guidance, encouragement, and the space you gave for both academic and personal growth throughout this project. I would also like to thank my second supervisor, Teake Bouma, for helping to sharpen my project and for asking thought-provoking questions that encouraged me to reflect on my process. He helped me to connect the project to a larger urban scale and taught me about the value of design within research. He also helped to strengthen my investigative approach.

In addition, I would like to thank the participants who took part in the walk-along interviews for their time, openness, and valuable insights, which were essential for this research.

Finally, I would like to thank my friends and family for their support during this period. I am especially grateful to Eline, Elke, Marit, Max, Laura, Ruben, and Susanne for all the enjoyable moments outside of studying together and the memories we created during this time. Thank you for providing encouragement, distraction, good company and coffee breaks. And Fiep, for always being there for me. Thank you all for the support.

Abstract

This thesis investigates how restorative urban design strategies can minimize or compensate stressors and overstimulation in dense urban public spaces, with a focus on the Lijnbaan in Rotterdam's city center. Rapid urbanization has led to increasingly dense cities where people are exposed to continuous sensory input such as noise, crowding, visual clutter, traffic, and pollution. By 2050, more than two-thirds of the global population is expected to live in urban areas, which intensifies the issues of environmental overload, attention fatigue, and psychological stress. While these challenges are well documented in environmental psychology research, their translation into spatial and multisensory urban design strategies is still limited.

The research combines literature review, walk-along interviews, site analysis, and a research-by-design approach. Important theoretical frameworks are Attention Restoration Theory, Stress Reduction Theory, and Perceived Sensory Dimensions. The study explores how urban stressors and stimuli are perceived through the senses and how their interactions can either intensify or reduce sensory overload.

Findings show that stress or overstimulation is caused by multiple sensory stimuli working together, and not by single stressors alone, and that spatial conditions strongly influence how these stimuli are perceived and experienced.

Restoration is therefore not achieved only by reducing input, but by shaping the quality, rhythm, and legibility of sensory experiences.

This led to the development of the Urban Restorative Sensecape Theory (URST), which has five principles: modulation, rhythm, gradation, engagement, and spatial language. The core principle of URST is that restoration does not arise from the absence of stimuli or stressors, nor from escaping them by relocating to other spaces. Instead, restoration arises from the quality, gradation, manageability, and meaningful interpretation of sensory stimuli, while still allowing urban environments to remain lively and rich in sensory experience, and supportive of calm.

The thesis also includes a design proposal for the Lijnbaan, where the five principles from URST are translated into a network of interconnected restorative public spaces. These support sensory balance, restoration, and inclusive urban experience.

Keywords: restoration, public space, urban stressors, mental health, senses

Table of content

Colophon	2
Acknowledgements	3
Abstract	5

01 Introduction **11**

1.1 Personal motivation	12
1.2 Problem statement	13
1.3 Societal relevance	14
1.4 Scientific relevance	16
1.5 Contextualisation Rotterdam	18
1.6 Research questions	20
1.7 Scope	21
1.8 Objective	21

02 Approach **23**

2.1 Methods	24
2.2 Planning	28

03 Theory **31**

3.1 Theoretical framework	32
3.2 Definitions	33
3.2.1 Urban stress	33
3.2.2 Overstimulation	33
3.3. Restorative environment	34
3.3.1 Attention Restoration Theory	34
3.3.2 Stress Reduction Theory	35
3.3.3 Percieved Sensory Dimensions	35
3.3.4 Biophilic design	36
3.4 Sensory stimuli	37
3.4.1 Collection of sensory stimuli	37
3.4.2 Relationships between sensory stimuli	40
3.4.3 Conclusions	44
3.4.4 Developing design strategies	45

04 Analysis **49**

4.1 The Lijnbaan	50
4.1.1 Lijnbaan introduction	51
4.1.2 Functionalism	54
4.1.3 Urban flows in the Lijnbaan	56
4.1.4 People movement and behaviour	60
4.1.5 Spatial lay-out and dimensions	64
4.1.6 Vacant buildings	66

4.1.7 Hidden vacancy	68
4.1.8 Softmap drawing	69
4.1.9 Sensory stimuli	74
4.1.10 Photo collection of sensory stimuli	76
4.2 The Lijnbaan within Rotterdam	81
4.2.1 Zooming out: from functional city to mixed use city	82
4.2.2 Zooming out: unequal distribution of recreational green spaces	84
4.2.3 Zooming out: de 7 stadsprojecten	84
4.3 Walking through the Lijnbaan	86
4.3.1 Research method	87
4.3.2 Ethics, anonymity, and data collection	87
4.3.3 The route: four different spaces	88
4.3.4 Quotes from participants during the walk-along interviews	90
4.3.5 Findings	94
4.3.6 Making connections	101
4.4 Positioning the vision within its context	109

05 Research by design **113**

5.1 Extreme future scenarios	115
5.2 Cross axes	119
5.3 Balance between busy and quiet	121
5.3.1 Less active moments-> stimulus activation	122
Restorative sensory design principles	
5.3.2 Less active moments-> stimulus activation	125
Spatial design strategies on urban scale	
5.3.3 Design principles for nighttime	128
5.3.4 Design principles for seasons	129
5.3.5 Design principles for rain	131
5.4 Design strategies	132
5.5 Reflecting back on theory and literature	142

06 Design proposal for the Lijnbaan **145**

6.1 Strategy	147
6.2 Restorative route design	154
6.3 Design locations	156
6.3.1 Lijnbaan	160
6.3.2 Jan Evertsenplaats -> Sensory garden	172
6.3.3 Lijnbaanplein -> Urban pocket park	178
6.3.4 Joost Banckertsplaats -> expression garden	182
6.3.5 Ecological corridor	183

07 A new framework	185
7.1 A new framework	186
7.2 The development of URST	187
7.3 Research foundation for URST	192
7.4 A general framework with context-specific outcomes	193
7.5 Reflection of URST on the design	194
08 Conclusion & discussion	203
8.1 Conclusion	204
8.2 Discussion	210
8.3 Reflection	211
09 References and appendices	217
9.1 Bibliography	218
9.2 Figures	221
9.3 Appendices	224
Appendix 1: Stressors of outdoor environments in the Lijnbaan : overstimulation. Weaknesses	
Appendix 2: Benefits of outdoor environments in the Lijnbaan : restoration. Strengths	

01

Introduction

1.1 Personal motivation

This thesis is inspired by my own fascinations: public spaces, mental health, and the sensory experience of a place. I find it very interesting to see how people interact with their surroundings and the built environment. The intersection of the social sciences and urbanism is something I would like to explore more deeply. Because of this, the thesis also engages with environmental psychology, especially how sensory input shapes the way people give meaning to space. The interaction of our senses with the built environment is something I would like to dive deeper into.

Growing up in Heemstede, I was not used to very busy or crowded environments. Later, when I started visiting larger cities more often, I became aware of how beautiful but also intense urban life can feel. I have always enjoyed exploring cities and discovering new places. At the same time, my experiences in busy city centers have made me aware of the impact that noise, visual stimuli, and crowds can have on the way people experience urban environments and that it can affect people's well-being and comfort.

In those moments, I noticed that certain public spaces offer a sense of calm and can help people feel more grounded in their surroundings. This made me realize how important urban public spaces can be for mental well-being and it sparked my interest in the relationship between urbanism, environmental psychology, and sensory experience. I became curious about how our senses shape the way we experience the built environment and how urban design can create restorative places within dense city centers.

My interest is also influenced by the Five Senses Technique, a grounding method that redirects

attention from internal stress to external sensory input. By focusing on what we can see, touch, hear, smell, and taste, it helps people reconnect with the present moment. This inspired me to explore how urban public spaces can enhance restorative experiences through multi-sensory design.

When I moved to Delft, Rotterdam became one of the cities I visited most often. There, I found the ideal site for this thesis: the Lijnbaan. Although the area feels vibrant and lively, it can also feel busy and overwhelming due to urban stressors and sensory stimuli. This raised the question of how moments of activity and restoration can coexist within the same urban environment. Through this thesis, I aim to investigate how urban design can contribute to mental well-being by creating restorative public spaces through sensory design strategies that provide opportunities for retreat and recovery within busy city centers, while maintaining their vibrant and dynamic character.

1.2 Problem statement

Cities all around the world are becoming increasingly dense as populations continue to grow. Urban environments now accommodate more people, buildings, and activities within limited space. By 2050, more than two-third of the global citizens is expected to live in urban areas (United Nations, 2018).

The rapidly urbanizing world causes many people to deal with overcrowding, relentless noise and a lack of restorative spaces (Karwa & Chauhan, 2025). Not only has rapid urbanization heightened physiological stress among urban residents, but also attention fatigue (Dong et al., 2024). This attention fatigue from the physical urban environment is caused by sensory overstimulation; due to the rich mix of built elements and human activities, people are more easily exposed to multisensory stimuli and not just to one single sense.

Urban life can be stressful and people living in large cities are exposed to many stimuli (Moser, 1988). This includes visual stimuli, noise, pedestrian density, traffic etc. This can form 'urban stress' and environmental overstimulation. The abundance of urban stimuli produce this 'environmental overload' (Moser, 1988). Elements such as visual clutter, and traffic noise, often produced by dense building clusters and high-rise structures, can trigger stress responses, including anxiety, fatigue, and reduced attention.

It shows that the intensity of sensory stimulation in built environments can overload people's attentional capacities. This leads to psychological strain (Fan et al., 2025). Other factors such as congestion, pollution, and the absence of personal space can strengthen this feeling. This is often caused by overcrowded spaces, and an absence of landscape elements

(Karwa & Chauhan, 2025). It leads to individuals being overstimulated.

In addition, this feeling of being overstimulated is even a bigger problem for individuals with sensory sensitivities (Finnigan, 2024). There is a significant gap in the way public outdoor spaces are designed: the sensory needs are often overlooked, although there is documented discomfort.

This leads to a gap between accessibility and inclusion. According to Toronyi, urban designers and landscape architects have clear responsibilities to design inclusive spaces for all users, including those with sensory, cognitive, and neurodivergent needs (Toronyi, 2019). Existing guidelines are too limited, and there is an urgent need for inclusive, sensory-aware design strategies that serve all users (Finnigan, 2024).

To conclude, due to rapid urbanization, cities become increasingly dense. This leads to overstimulation, which has negative effects on human health. Not only does it affect physical health. For example, traffic-related air pollution can be harmful when it is inhaled, and noise exposure can lead to hearing damage. But it also impacts mental health. Overstimulation can trigger stress responses, contribute to anxiety, and cause attentional fatigue.



1.3 Societal relevance

The problem of overstimulation in cities caused by environmental stressors is not merely an individual experience but a broader societal challenge. It is a shared experience that affects many other people which makes it a societal challenge. And this societal problem is also discussed and acknowledged in newspapers, policy papers, and by municipal governments.

For example, in the article *Toon daadkracht tegen de drukte in de stad* in Het Parool it has been stated that the senses of many inner-city residents in Amsterdam are overstimulated in many ways due to crowds because of mass tourism and environmental stimuli (Welles, 2018).

When looking at the bigger picture, overstimulation is not only a city problem but a wider issue in society, as people are increasingly overstimulated in everyday life. The mental pressure and “hyper-stimulation” are very common in today’s society. It highlights the urgency of creating calm and restorative inclusive urban environments. The report *Op de rem! Voorbij de hypernerveuze samenleving* calls for slowed-down, more calmly structured societal frameworks in areas like work, leisure, healthcare, and everyday life. It is about creating environments that are not constantly “switched on” (Raad voor Volksgezondheid en Samenleving, 2025). This argument can be applied to urban design and public spaces, emphasizing that cities should provide not only physical accessibility but also the human need for rest, deceleration, and psychosocial well-being. Our society is becoming too stimulating, which leads to more mental health problems. The report shows that mental health and societal pressures are acknowledged at the national policy level, which supports the case for restorative and sensory-conscious public spaces as an important social problem.

This is already reflected in practical initiatives. There is growing societal attention on creating healthy spaces where people can relax and unwind. On September 15, 2022, the Ministry of Luwte has been established in the Netherlands, an initiative and network dedicated to creating spaces for rest and relaxation in a busy urban environment (Ministerie van Luwte, 2023). They investigate the development of ‘luwteplekken’ (quiet or sheltered spots) in urban areas, where people can escape the hustle of the city. The ministry collaborates with a mix of professionals, policymakers, and residents to design spaces that balance calm and activity. This initiative shows the growing interest in urban public spaces that enhance restorative benefits and reduce environmental stressors, highlighting the relevance of this thesis.

Another practical initiative can be seen in museums. These are also urban, and cultural , public spaces, that can be overwhelming due to noise, lighting, and crowds. The article *Met de prikkelplattegrond het museum in* shows that sensory maps help visitors navigate these spaces and manage overstimulation (Hulshof & Moraal, 2025). This highlights a wider societal issue: our stimuli-rich environments can lead to sensory overload and stress. Designing restorative and sensory-conscious public spaces addresses a real social need and promotes inclusion for all.

Opinie

'Toon daadkracht tegen de drukte in de stad'

Luwteministerie werkt aan rust in de stad. Kan het geluid even uit?

27-JUN-2024 - De Ministerraad van Luwte kwam onlangs voor de derde keer bijeen. Eén van de ministers is stadmaker Martine Sluijs. Zij creëert luwteplekken: plekken om te ontsnappen aan de stadse drukte. Maar wat is een luwteplek eigenlijk? En moet het er echt stil zijn? Atlas-medewerker Dienneke nam de proef op de som en onderzocht haar eigen favoriete luwteplek.



Figure 1.1: Collage showing the societal relevance (Welles, 2018; Atlas Leefomgeving, n.d; Raad voor Volksgezondheid en Samenleving, 2025); Hulshof & Moraal, 2025; Schuitem, 2019)

1.4 Scientific relevance

The problem is also identified in scientific literature. In the article *Urban Anxiety ; How Crowded Cities Affect Well-Being and the Role of Architectural Design* it has been written that in dense cities the health of many individuals is affected (Karwa & Chauhan, 2025). Here are some quotes that indicate this :

'In many cases, individuals are exposed to constant noise from neighbors, vehicular traffic, and commercial activities, which exacerbates stress levels and contributes to insomniac tendencies'(Karwa & Chauhan, 2025, p.1).

'The overwhelming visual clutter of advertisements, neon lights, and towering structures can also create a sense of cognitive overload, making it difficult for city dwellers to find a mental respite from their surroundings' (Karwa & Chauhan, 2025, p.1).

Another study on urban restorative environments, *Urban restorative environments: The critical role of building density, vegetation structure, and multi-sensory stimulation in psychophysiological recovery*, includes more evidence showing that high-density environments can lead to overstimulation and increased urban stressors, which negatively affect human health (Fan et al., 2025).

'According to Environmental Load Theory (ELT), environmental stimuli—such as noise, crowding, lighting, and temperature—can impair individuals' information-processing capacity, leading to increased cognitive load and subsequent alterations in behavior, emotional state, and attentional control'(Fan et al., 2025, p.1).

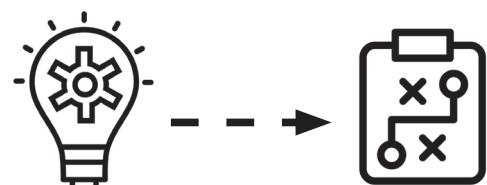
'Empirical studies have demonstrated that elements such as visual clutter, sensory overload, and noise—often resulting from dense building clusters and high-rise structures—can elicit stress responses, including anxiety, fatigue, and reduced attention' (Fan et al., 2025, p.1).

Finally, in the Journal of Environmental Psychology the article *Urban stress and helping behavior: Effects of environmental overload and noise on behavior* identifies the problem in the following quote (Moser, 1988).

'People living in large cities are exposed to a variety of stimuli including visual stimuli, noise, pedestrian density, traffic, etc., forming what has been called 'urban stress' (Glass and Singer, 1972)' (Moser, 1988, p.287).

It becomes clear that rapid urban growth makes it increasingly important to address the mental health challenges that come with massive urbanization and its environmental stressors.

However, much of the existing scientific literature on overstimulation in cities is rooted in environmental or social psychology. These insights are rarely explained or translated in a spatial or urban design-oriented way. This reveals a **knowledge gap** that this project aims to address.



First knowledge gap:

Translation gap:

Health-related and psychological insights on overstimulation are not enough translated into spatial urban design strategies.

The book *Restorative cities, urban design for mental health and wellbeing*, written by environmental psychologist and landscape architect Jenny Roe and psychiatrist and public health specialist Layla McCay (2021), is one of the few that do contain concrete design strategies. According to Roe and McCay, the future healthy city should present a 'quieter' approach that place mental health, wellness and quality of life at the center of urban design. Although the mental health benefits of rich sensory experiences in cities have often been overlooked, paying careful attention to the **senses** in urban design is essential for supporting well-being (Roe & McCay, 2021). There is growing interest in integrating sensory experiences into urban design. However, much of the research about how to leverage this effect to improve mental health is still not fully investigated. This reveals a **second knowledge gap**. Attention to all five senses has the potential to offer new ways of thinking about designing a city; especially when designing a city to promote mental health and restoration, because each of our senses impacts our mental health (Roe & McCay, 2021).



Second knowledge gap:

Multisensory gap

Most research and urban design focus on visual stimuli, while the other senses, such as sound, smell, touch, and taste, remain underexplored

Other papers align with the importance of using all senses in urban design to enhance restoration benefits. In the article, *How Public Urban Space Enhance Restoration Benefits Through Combined Multisensory Effects: A Systematic Review*, it has been stated that the restoration benefits of urban spaces mainly are focusing on the visual stimuli and on their spatial properties (Dong et al., 2024). However, other sensory stimuli, the auditory, olfactory, gustatory, and tactile systems are overseen, but could play an important role in achieving restoration. This indicates the same lack of knowledge in this area; How to design public spaces by making use of all senses. To sum up, there seem to be two knowledge gaps. But, these two gaps are closely interconnected. Psychological and health studies shows that overstimulation is a multisensory experience; it emerges from the combination of sound, visual clutter, smells, tactile sensations, and spatial intensity. When these insights are not translated into concrete urban design (translation gap), urban designers tend to focus on only the visual. This leads to an urban design that often remains mostly visually spatial or aesthetic, while the other senses, which play also a crucial role in stress regulation and recovery, are overlooked.

To conclude, these two aspects together form **one overarching knowledge gap. This gap lies in the lack of spatial and restorative urban design strategies that translate psychological insights on urban stressors and overstimulation into multisensory design strategies for restorative urban public spaces.**

Urbanists have an important role in addressing this gap, as they are able to integrate knowledge of human perception, behavior, and sensory experience into the spatial design of public spaces. In this way, they can design public spaces that not only serve practical and social purposes, but also help people feel calm and recover in busy, crowded cities.

1.5 Contextualisation Rotterdam

After identifying the problem in both societal and scientific literature, it is important to translate it into a spatial context. This can't be done in multiple locations, because that would make it too abstract. Therefore, a specific location is needed to provide context.

The location selected for this thesis is Rotterdam. Instead of including the entire city, the focus is on an area where most of urban stressors and environmental stimuli, across the five senses, are most prominent. The aim is to find a zone where urban stressors and sensory experiences are very intense. Therefore, the research will focus on the dense inner city, with the Lijnbaan-ensemble as case study. It is the most well-known shopping street in Rotterdam, and is known as the retail heart of the city. This area has been chosen because of the vibrant activity and identity as a bustling city center, which provides a rich context for overstimulation. A more extensive analysis and introduction of the Lijnbaan will come in a later chapter.

Ongoing projects and articles

There are already some projects going on and articles that show that Rotterdam is aware of the issue and is actively working on it. This places the thesis within an existing context where others are already engaged with the topic.

Hofplein

The report *Hoe klinkt het Hofplein, nu en in de toekomst* demonstrates that Rotterdam is already paying attention to sensory quality. The report shows that sound is an essential part of urban experience. It confirms that auditory stimuli strongly shape how people experience a place. As people perceive with all their five senses, it is important that when designing a space, to concentrate not only on the visual aspects, but also the tactile, olfactory, auditive elements. These elements should also get enough attention (Cobussen, et al. 2021)

'Mensen nemen een omgeving waar met al hun zintuigen. Daarom is het bij het ontwerpen van een omgeving belangrijk zoveel mogelijk met al die menselijke waarnemingsinstrumenten rekening te houden: een plek die lelijk oogt, zal indien mogelijk vermeden worden. Datzelfde geldt voor een omgeving die niet aangenaam ruikt, een plaats waar bijvoorbeeld de wind je huid onaangenaam beroerd, en ... een plek die niet plezierig klinkt. Daarom is het bij het (her)inrichten van een ruimte noodzakelijk om niet louter of primair op visuele aspecten te concentreren, maar ook aan tactiele, olfactorische, en auditieve elementen voldoende aandacht te geven' (Cobussen, et al. 2021, p.6)

Because the study focuses on Rotterdam, it provides local evidence that the city acknowledges the impact of sensory stimuli in public space, strengthening the relevance of this thesis. The report also links design decisions to sensory experience. It shows how spatial interventions, such as traffic flows, materials, and the layout, shape the acoustic environment. It is a useful example of sensory research in an urban context, and evidence that sensory approaches are recognized, but not yet enough. Because the report concentrates mainly on auditory stimuli, it emphasizes that the other senses, olfactory, visual, tactile, are still underexplored. This thesis aims to address this knowledge gap.



Figure 1.2: Front page of Hofplein report (Cobussen et al., 2021)

Increasing noise

This article *VERKEERSLAWAAI EEN PLAAG IN ROTTERDAM* (2024) describes that there is an increasing nuisance, which is caused by 'loud cars and motorbikes' in Rotterdam; noise from popping exhausts and roaring engines on streets. It makes the GGD Rotterdam-Rijnmond warn about traffic noise and nuisance in the city centre. It is referred to as 'a plague', and residents say the noise is harmful to their health; sleep, stress and anxiety. According to GGD-Rijnmond, long-term exposure to this type of noise can be harmful to people and affects their enjoyment.

Nieuw Actieplan Geluid

Currently, Rotterdam is working on a new noise policy for 2025-2029 to tackle noise pollution, especially from road traffic (Gemeente Rotterdam, n.d). A survey of 2085 residents shows that many people complain about noise nuisance, and want a balance between quiet and vibrancy. Road traffic has been seen as the main source of disturbance.

Growing attention to sensory sensitivity

There is also a trend in Rotterdam in growing attention to sensory sensitivity. The article *Met de prikkelplattegrond het museum in* makes that already clear. Also the Natural History Museum aims to open in a sensory-friendly way for people that are sensitive to overstimulation (De Havenloods, 2022). Although it is outside the context of streets and public spaces, it shows that there is a growing focus on it. It organizes "low-stimulus openings" for people who are sensitive to crowds, noise, and light. It is also for people with autism, high sensitivity, burnout, or acquired brain injury. Museum Rotterdam also offered a "sensory-friendly visit" in 2025: fewer visitors, a quiet space, videos turned off, and an adjusted experience (Week van de toegankelijkheid, 2025). These initiatives show that in Rotterdam there is already attention to sensory overload and overstimulation with its health effects in the (cultural) public space.

VERKEERSLAWAAI EEN PLAAG IN ROTTERDAM

© 21/10/2024 redactie Algemeen, Gezondheid, Wegverkeer

Een Rotterdamse straat waar ze last hebben van verkeersherrie is de Rochussenstraat in Rotterdam. Hier zien ze al tientallen jaren snelheidsduivels voorbij razen. Een steeds groter wordend probleem in de straat is het aantal lawaaimakers in de straat. Knallende uitlaten en brullende motoren blijken een echte plaag te zijn.

Bewoner van de Rochussenstraat, Jocké Bloks, zegt bij het AD het volgende: „Helemaal gek word ik ervan. Het lawaai is ongelooflijk en het wordt erger. Steeds meer mannen vinden het blijkbaar leuk om de uitlaat te laten knallen. Achterlijk macho gedrag, een totale verhuftering.“ Ze geeft aan dat ze angstig, zenuwachtig en opgevoerd wordt van het geluid. Verder vertelt ze dat haar buuren met speciale oordopjes slapen en in het weekend wel een aantal keer per nacht wakker worden.



Figure 1.3: Increasing nuisance in Rotterdam (Geluidsnieuws.nl, 2024)

Gemeente Rotterdam



Figure 1.4: Actieplan Geluid Rotterdam (Gemeente Rotterdam, n.d)

Natuurhistorisch Museum Rotterdam dimt licht, geluid en bezoekersaantal voor mensen die snel overprikkeld zijn

14 juni 2022, 16:23 Algemeen 948 keer gelezen

Rotterdam - Op zondag 26 juni is er 09.00 tot 11.00 uur voor de eerste keer een prikkelarme openstelling bij het Natuurhistorisch Museum Rotterdam. Speciaal voor kinderen en ouders die snel overprikkeld zijn, worden de lichten in het museum gedimd, geluiden geminimaliseerd en het bezoekersaantal verlaagd.

Figure 1.5: Sensory friendly visits in museum (Dehavenloods.nl, 2022)

1.6 Research questions

To guide this project, a research question is formulated. The main research question of this thesis is:

What restorative urban design strategies can be used in public spaces to minimize or compensate stressors and overstimulation in Rotterdams city's center?

To answer this main research question, sub-questions have also been formulated. These sub-questions help to answer the main research question.

1. What are stressors and overstimulation in public spaces?
2. What is a restorative environment?
3. Which sensory stimuli are present in urban public spaces and what relationships exist between different sensory stimuli?
4. How does the perception of urban stressors in public space in Rotterdams city's center influence the individual senses?
5. What restorative urban design strategies can be used to minimize or compensate stressors ?

1.7 Scope

This project defines its scope by focusing on overstimulation caused by environmental urban stressors, rather than stress originating from societal or socio-economic factors. The research specifically addresses how these stressors in the urban environment lead to mental fatigue and stress.

The scope is also defined by focusing on sensory sensitivities, that are often overlooked in public space design. The idea is that designing calm, restorative spaces is not only more inclusive, but also makes places more pleasant for everyone. By considering different sensory needs, public spaces can be designed that feel more comfortable, accessible, and welcoming to all. So by designing spaces with sensitivities and sensitive people in mind, it will also benefit the less sensitive people in the population.

The Lijnbaan in Rotterdam is selected as location because of its high intensity of stimuli and its importance as a vibrant shopping street. This location allows for investigation of how restorative design principles can be applied within a dense urban context. The project focuses on the scale of public space and an urban network, allowing for strategic design interventions without going into excessive technical detail.

Finally, this study will not delve into the technical measurement of sensory experiences, such as acoustic analyses, wind studies, or solar exposure. Instead, the focus lies on perceived experiences and not on quantifiable environmental data.

1.8 Objective

Through this project I intend to achieve a network that connects new designed public spaces in the Lijnbaan-ensemble that have restorative effects. The final product would be a design of a route or network that goes through this vibrant city center and it will also include zoom-in designs for these public spaces. It is described as a network because people move through it rather than staying in one place. So this is also seen as public space. This network, connecting new public spaces would be a fragment of the urban fabric of the Lijnbaan, consisting of several streets. This network allows for exploration of different design interventions at multiple locations within the Lijnbaan. Another final product would be a set of restorative sensory strategies.

The aim is to explore the five senses, to develop new insights into how sensory design can strategically contribute to mental restoration. The five senses influence urban experience in different ways, and each sense can be addressed through multiple urban design approaches. This allows for a layered exploration of sensory interventions within the created urban network.

02

Approach

2.1 Methods

To answer the main question and its sub research questions, different methods will be used. The diagram below illustrates which method is used for each sub-question. There are also descriptions and objectives for each method, explaining why each method is used and showing the relevance to this research. The research will be done within a design driven and spatial research framework.

A research by design approach will be used because it tests insights which let theory and design develop at the same time within the project timeframe. This approach can allow the project to explore how environmental urban stressors can be addressed through restorative public space design, instead of focusing on policy or societal interventions.

METHODS

	What are stressors and overstimulation in urban public spaces?	What is a restorative environment?	Which sensory stimuli are present in public spaces and what relationships exist between different sensory stimuli?	How does the perception of urban stressors in public space in Rotterdam's city center influence the individual senses?	What restorative urban design strategies can be used to minimize or compensate stressors?
Literature study	●	●	●		
Spatial analysis				●	
Data analysis				●	
Site visits			●	●	
Walk- along interviews				●	
Policy and news analysis				●	
Research by design		●			●

Figure 2.1: Methods for each sub- research question

Literature study

- **Description:** Reading and studying literature, such as research papers.
- **Aim:** Gaining more knowledge and understanding the theme and case. Creating a theoretical framework and describing important terms.

Spatial analysis

- **Description:** Making analyses of the location by making maps and sketches.
- **Aim:** Understanding the site in its context, and finding out how it is embedded in different scales, and how these scales interact with each other.

Data analysis

- **Description:** Collecting data and make conclusions. Visualising the data in maps.
- **Aim:** Collecting concrete information about the location.

Site visits

- **Description:** Visiting de Lijnbaan and making observations by writing, making photos, and sketches.
- **Aim:** Understanding how the Lijnbaan works at eye-level view and getting experiences.

Walk-along interview

- **Description:** Participants walk through the Lijnbaan with the researcher, stopping at multiple locations to answer open-ended questions about their sensory experiences.
- **Aim:** Understanding how urban stressors in the Lijnbaan influence individual senses and behaviour in different spatial typologies

Policy and news analysis

- **Description:** Reading policy documents and news articles to understand how urban issues are discussed in public and institutional discourse
- **Aim:** Identifying key themes and narratives that are currently going on.

Research by design

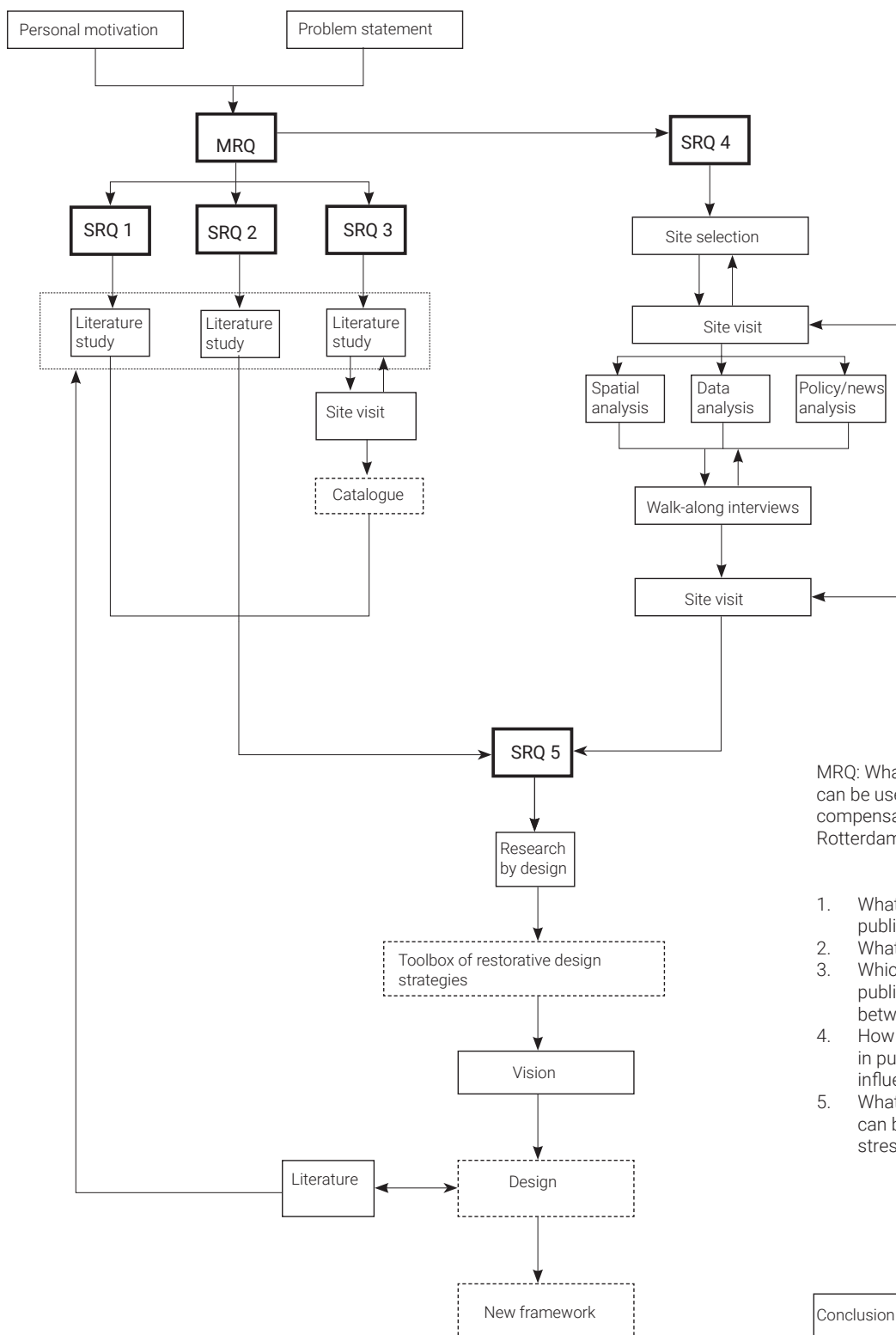
- **Description:** Trying different possible design strategies and options that are based on the research. Doing more researching based on the outcomes of the design process
- **Aim:** coming to a proposal of a design through an iterative process where research informs the design.

In the diagram on the next page the methodology and approach is outlined. The topic of this thesis originates from my personal motivation and the problem statement. This together leads to the Main Research Question.

This MRQ splits into Sub Research Questions 1,2,3 and 4. SRQ 1, SRQ 2 and SRQ 3 contain most of the theoretical framework and focuses a lot on literature study. SRQ1 will discuss the Environmental Load Theory and it will define urban stressors and overstimulation. SRQ2 also involves literature study and it defines restorative environments, including Attention Restoration Theory (ART), Stress Reduction Theory (SRT), Percieved Sensory Dimensions (PSD) , and biophilic design. SRQ 3 will contain literature study to identify the sensory stimuli and the relationships they have with each other. This will be presented in a catalogue. In SRQ 4 an analysis of the location will be done, and also site visits. For SRQ4 , walk-along interviews with participants will be conducted, to understand how urban stressors in the Lijnbaan influence individual senses and behaviour.

The knowledge gained from SRQs 1, 2, 3 and 4 will lead to multiple sets of restorative design strategies (SRQ5). These sets of restorative design strategies will be applied to the project location. This application results in a vision. Finally, these principles will be translated into a design proposal for the Lijnbaan, envisioned as a network of interconnected restorative public spaces.

Throughout the process, a research-by-design approach will be applied. The combination of this iterative design process and the knowledge gained through research and designing will lead to the development of both a design proposal and a new framework for understanding restoration through sensory design.



MRQ: What restorative urban design strategies can be used in public spaces to minimize or compensate stressors and overstimulation in Rotterdam's city center?

1. What are stressors and overstimulation in public spaces?
2. What is a restorative environment?
3. Which sensory stimuli are present in urban public spaces and what relationships exist between different sensory stimuli?
4. How does the perception of urban stressors in public space in Rotterdam's city center influence the individual senses?
5. What restorative urban design strategies can be used to minimize or compensate stressors?

Conclusion

Reflection

Figure 2.2: methodology and approach

2.2 Planning

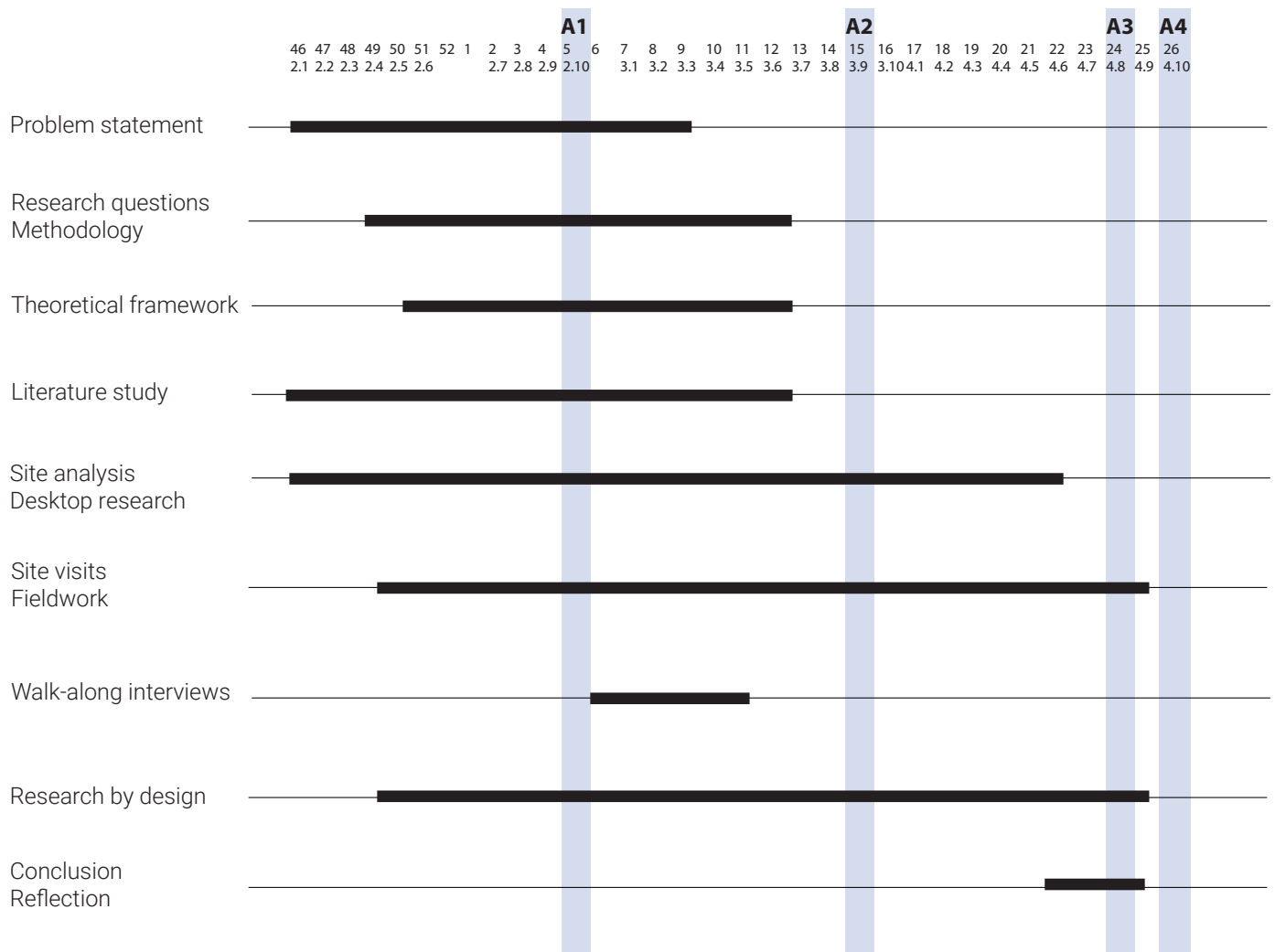


Figure 2.3: Timeline



03

Theory

Sub questions

What are stressors and overstimulation in urban public spaces?

What is a restorative environment?

Which sensory stimuli are present in urban public spaces and what relationships exist between different sensory stimuli?

3.1 Theoretical framework

Environmental Load Theory (ELT) in urbanism explains that urban environmental stressors, like noise, crowding, and pollution, can overwhelm people's ability to process information. This overload leads to stress and mental fatigue. This creates a need for **restorative environments**; where users can recover from mental fatigue and stress.

Public space functions as a physical environment that shapes multi-sensory experiences. Through its spatial and visual, auditory, tactile, and olfactory qualities, the design of public spaces activate attention restoration (**ART**) and stress reduction (**SRT**).

These emotional and sensory responses can be captured by the Perceived Sensory Dimensions (**PSDs**). These help identify environments that reduce stress and promote mental recovery. The senses being engaged enable this and multi-sensory experiences can enable restorative experiences. So, public spaces can play an important restorative role by optimizing positive sensory input and also minimizing urban environmental stressors.

Some aspects of **biophilic design** can be applied in public space design, as it contributes to emotional anchoring and supports attention restoration.

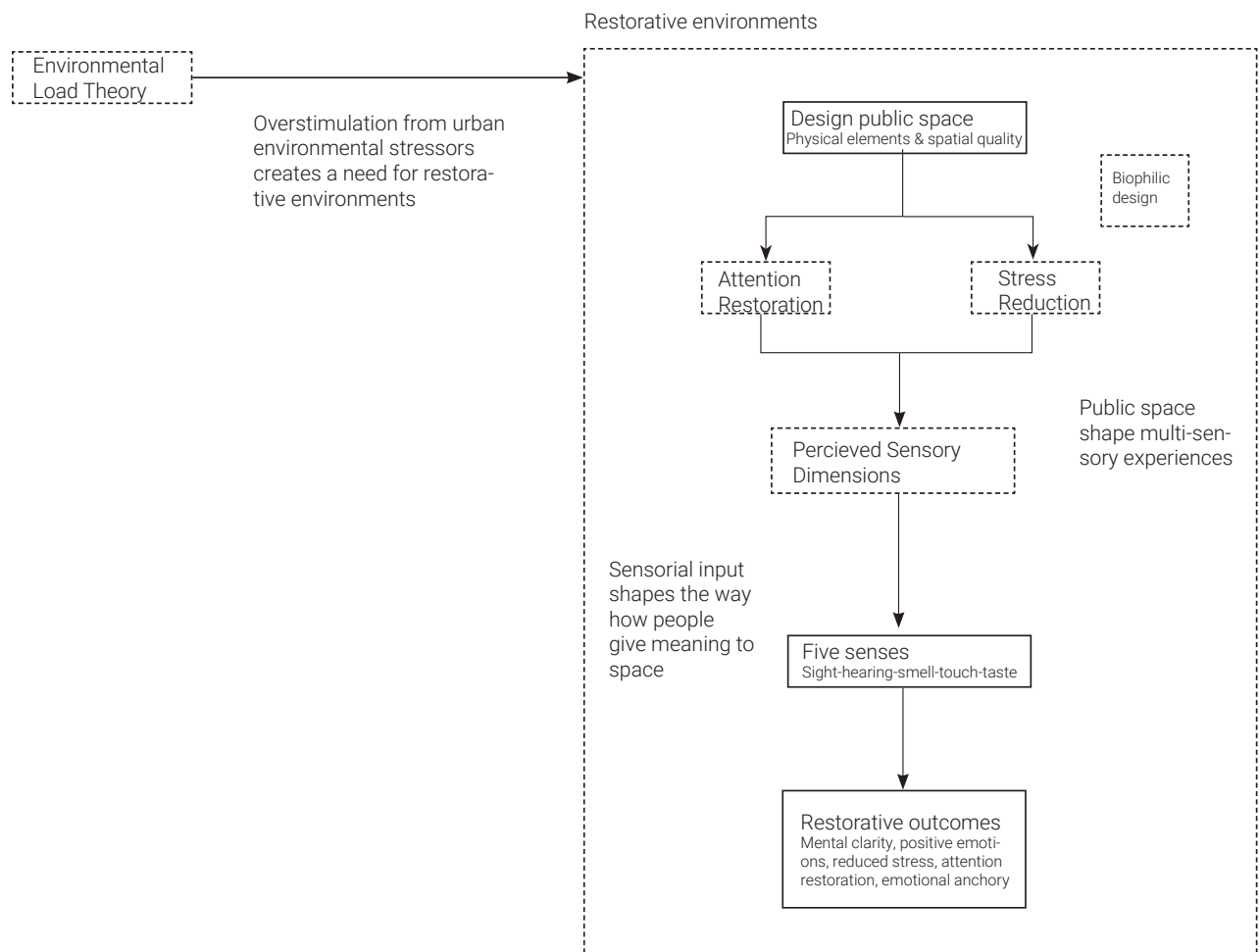


Figure 3.1: Theoretical framework

3.2 Definitions

Sub-research question 1: What are urban stressors and what is overstimulation?

3.2.1 Urban stressors

First, it is important to define a clear definition of urban stressors for the purpose of this thesis.

Urban dwellers are often exposed to a wide range of environmental stimuli that can feel overwhelming. City residents continuously encounter complex, intense, unpredictable, and potentially threatening situations. Random bursts of noise, crowded public transportation, and polluted air filled with ash are just a few examples of the many stimuli present in urban environments (Cohen, 1978). These environmental inputs can lead to behavioral and physical consequences for individuals. In his research, Cohen used the term stressor to describe "stimulation that represents an adaptive threat or potential adaptive threat to the organism" (Cohen, 1978). In other words, a stressor is something in the environment that challenges or threatens a person's body or mind, requiring them to adapt.

So, for the purpose of this thesis, urban stressors are defined as environmental stimuli within urban environments that can produce behavioral and physical effects on individuals and may require them to adapt.

3.2.2 Overstimulation

As urbanization accelerates, more people live in crowded urban environments (Moser, 1988). This can result in individuals experiencing many urban stressors; environmental stimuli. An overload of these stimuli can lead to environmental overstimulation, and occurs when urban environments are filled with many stimuli

that constantly demand people's attention and reactions. The abundance of urban stimuli produce the so called 'environmental overload' (Cohen, 1978). The Environmental Load Theory (ELT) by Cohen suggest that the sensory and cognitive demands of an environment strongly affects a person's ability to focus and their emotional well-being (Cohen, 1978). It is the theory that humans have a limited ability to handle environmental stimuli.

In dense urban settings, the abundance of visual stimuli can increase cognitive load, which may lead to higher stress levels and diminished attentional capacity (Fan et al., 2025). The environmental stimuli, such as noise, crowding, lighting and temperature can reduce individuals' information-processing capacity. This leads to more mental strain and changes in behavior, emotions, and attention control (Fan et al., 2025).

This all can result into individuals experiencing overstimulation, or 'overload'. This occurs when the environmental load caused by the urban environment exceeds the limit of an individual's limited capacity to process information (Moser, 1988). The central nervous system then reacts by ignoring some of the inputs. It is also described as 'cognitive overload', and occurs when people do not have enough mental capacity to handle many stimuli in different social environments (Liu et al., 2023).

To conclude, overstimulation is a state in which the amount of environmental stimuli in an urban environment exceeds an individual's limited capacity to process information, which leads to cognitive overload. As a result, this overload can increase stress, reduce attention, and cause the brain to ignore certain stimuli in order to cope.

3.3 Restorative environment

Sub-research question 2: What is a restorative environment?

A restorative environment refers to an environment that improves psychological and physical health by lowering stress levels, diminishing negative emotions, reducing mental fatigue, improving concentration, and supporting recovery processes (Zhang et al., 2019). It can be seen as any setting that can help us regulate our emotions and recover from mental fatigue, stress and the demands of everyday life (Roe & McCay, 2021). These restorative environments can be very valuable in busy urban settings, where individuals are exposed to urban stressors that may result in overstimulation. It can help by providing a place where people can unwind and reduce sensory overload.

Currently, the literature on restorative environments is mainly based on two theories. These are Attention Restoration Theory (ART) and Stress Reduction Theory (SRT)

3.3.1 Attention Restoration Theory

The Attention Restoration Theory has been introduced by environmental psychologists Kaplan and Kaplan in 1989. The theory provides analyses of the kinds of experiences that lead to recovery from attention fatigue (Kaplan, 1995). It explains that natural environments are rich in characteristics and aspects that are needed for restorative experiences. According to ART, spending time in nature can help the brain recover after long periods of mental effort. Natural environments allow the mind to relax because they naturally capture attention without effort, which helps restore energy and focus.

According to Kaplan (1995) there are four key components of a restorative element:

1. **Being away:** having the feeling of being away from one's usual surroundings. A restorative space can give people a mental break from daily tasks that demands focus and concentration. People don't need to go far for this; even a small park or green area nearby can create that feeling of escape.
2. **Fascination :** Some natural places have a special quality that draws attention in a relaxing way; this is called 'fascination.' This not only helps individuals recover from mental fatigue caused by focused tasks, but also gives the opportunity to think and reflect, which further enhances the recovery process (Kaplan, 1995). Restorative environments should include features that naturally capture attention and spark curiosity without requiring a lot of effort. This allows the mind to focus fully on the surroundings instead of other thoughts.
3. **Extent:** the environment must have extent, and should be rich enough and coherent enough so that it constitutes a whole other world (Kaplan, 1995). It must provide enough to see and experience
4. **Compatibility:** There should be compatibility between the environment and one's purposes and needs (Kaplan, 1995). Thus, a restorative environment must align with the needs of a person that is in the place. This setting must fit what one would like to do.

3.3.2 Stress Reduction Theory

The Stress Reduction Theory (SRT) has been developed by Roger Ulrich. The theory states that exposure to nature or natural settings can calm people down and reduce stress (Ulrich et al., 1991). The constant sensory overload in urban settings can raise stress, which negatively affects mental and physical health. In contrast, natural environments provide restorative benefits that help reduce these stress levels. Natural elements can, in fact, improve relaxation. Especially in urban areas, where stress is high because of noise, pollution, and other city-related pressures, it is important to include natural elements like high-quality green spaces, trees, and water features to help reduce urban stressors.

To conclude, ART focuses on restoring mental energy and concentration through specific restorative components, while SRT emphasizes how natural elements help reduce stress and support emotional and physiological recovery from daily pressures.

3.3.3 Perceived Sensory Dimensions

Existing literature shows that there is a relationship between health and sensory perception of natural environments. According to landscape architects Stigsdotter and Grahn (2010), people perceive these environments in different dimensions. Some of these dimensions have been found more important and are more preferred than other dimensions to restoring people from stress. They have identified which dimensions people prefer. Based on their research, they developed a framework of eight perceived sensory dimensions that help explain how people experience restorative environments. It is important to have an understanding of these dimensions to examine which ones people find most significant for restoration.

These dimensions are:

- Serene: An undisturbed, calm and silent environment. It can be used for retreat. The environment is a tranquil and safe place and promotes relaxation.
- Space: The space feels open and unrestricted, giving people the freedom to move without worrying about spatial limits. This sense of openness relates to the Attention Restoration Theory concept of extent, which refers to environments that feel large and continuous.
- Nature: An area that has a lot of nature, including vegetation, water, trees and ecological processes.
- Rich in species: The environment has a many forms of life: animals such as birds, flowers, but also vegetation, such as flowers and diverse type of trees.
- Refuge; an enclosed and safe environment where people can watch other people being active. The space provides a sense of shelter and safety. It offers a feeling of protection.
- Culture; a place that contains an essence of human culture, such as history or art.
- Prospect: the environment has open and plane areas with prospect, such as wide sight lines over the surroundings. It is an open area with a view, so individuals can have visual control over the environment. This can allow them to detect danger.
- Social: The environment can host social activities. It is a place where people can meet, amuse themselves, and are able to watch another.

From these dimensions, Serene was found to be the most preferred dimension. Furthermore, the dimensions Refuge and Nature were strongly correlated with stress reduction (Grahn & Stigsdotter, 2010). Their research also shows that a combination of Refuge, Nature, and Rich in Species, together with a low or absent presence of the Social dimension creates the most restorative environment for stressed people. These findings provide a useful basis for designing public spaces that aim to achieve restoration.

3.3.4 Biophilic design

ART and SRT both consider nature as an important element to improve people's mental health by overcoming stress and mental fatigue. So, nature plays an important role in restoration. Biophilic design focuses on integrating the human connection with nature and the satisfying experience of nature in the built environment (Kellert & Calabrese, 2015). Successful biophilic design can improve people's physical health, mental well-being, and behavior by making them feel healthier, more comfortable, and less stressed.

3.4 Sensory stimuli

Sub-research question 3: Which sensory stimuli are present in urban public spaces and how do they influence each other?

3.4.1 Collection of sensory stimuli

For this research question, a large number of academic articles were read, to identify different types of sensory stimuli in urban environments. These stimuli include both stressors (negative sensory effects) and restorative elements (positive or healing sensory effects).

During the first weeks of the research, the main focus was on reading and collecting sensory stimuli mentioned in the literature. All identified stimuli were documented and organised in a structured overview. This resulted in a collection in which the sensory stimuli were grouped per sense (sight, sound, smell, touch, and taste) using a Miro board.

After a certain point, no new sensory stimuli were found in the literature. At this stage, the research reached the so called point of saturation, which means that additional articles no longer gave new information. All identified stimuli, both stress-inducing and restorative, were then placed in the Miro board, with each stimulus represented as a separate post-it note.

The overview with the stimuli can be found on the next page.

Benefits of outdoor environments -> restorative Strengths

Sight

Biodiversity, such as trees and orchids (Finnigan, 2024)	Natural water bodies (Finnigan, 2024)	Muted colors (Finnigan, 2024)	Uniform step depths in stairs and ramps (Finnigan, 2024)	Muted colors (Finnigan, 2024)	presence of building spacing; affects human perception of oppressiveness and decreases noise annoyance (Dong et al., 2024)	Wide sightlines enhance the psychological effect of reducing perceived noise (Dong et al., 2024)
Natural lighting (access to natural light) (Finnigan, 2024)	Diverse plant species reduce stress (Dong et al., 2024)	Variety in different types of spaces (Finnigan, 2024)	Balance between open and closed spaces (Finnigan, 2024)	Sculptures (Dong et al., 2024)	Historic buildings with characteristic visual patterns provide a psychological sense of "distancing" from stress. (Dong et al., 2024)	Density of street trees creating green vista (Dong et al., 2024)
Vertical greening (Dong et al., 2024)	Facade design (Dong et al., 2024)	Viewing natural elements (e.g., vegetation and water) could ameliorate stress (Zhang et al., 2019)	Shadow mottle (Zhang et al., 2019)	Richness off plants' color (Zhang et al., 2019)	A feeling of openness in high density commercial areas can allow odor dispersal and reducing noise levels (Dong et al., 2024)	
Enveloping shape and transparency of water (Dong et al., 2024)	Nice road texture (Zhang et al., 2024)	Openess and view towards the air (Dong et al., 2024)	Graduated curves and shapes (Finnigan, 2024)	Tree plantings with different canopy sizes can create thermal and visual comfort and reduce heat stress (Dong et al., 2024)		

Touch

Natural materials; wood, grass, stone (Finnigan, 2024)	Ergonomic, smooth edged benches (Finnigan, 2024)	Benches (Dong et al., 2024)	Wide sidewalks (Dong et al., 2024)	Historic buildings with characteristic textures provide a psychological sense of "distancing" from stress. (Dong et al., 2024)	Vertical greening (Dong et al., 2024)	Road material is comfortable and the foot feels good (Zhang et al., 2024)
--	--	-----------------------------	------------------------------------	--	---------------------------------------	---

Smell

Natural pleasant scents from flowers and plants (Finnigan, 2024)	Compactness of fragrant plants affect odor concentration and can reduce stress (Dong et al., 2024)	Planting design can promote attenuation of artificial odors (Dong et al., 2024)	Scent of food (Finnigan, 2024)	Aroma's of stores that make coffee, bread etc create recovering effects (Dong et al., 2024)	Natural scents from plants and even food aromas help with making sound less disturbing (Dong et al., 2024)
--	--	---	--------------------------------	---	--

Taste

Urban food markets (Roe & McCay, 2021)	Good access to nutrition and food (Roe & McCay, 2021)	Dining streets or nightlife districts (can contribute to feelings of identity, memory (Kavee & Flanigan, 2025)
--	---	--

Sound

Moving water (Finnigan, 2024)	Birdsong (Finnigan, 2024)	Fontains enhance restoration in environments enclosed by buildings (Dong et al., 2024)	Human sounds such as street music promote restoration (Dong et al., 2024)
-------------------------------	---------------------------	--	---

Stressors of outdoor environments -> overstimulation

Weaknesseses

Sight

Artificial lightning (Finnigan, 2024)	High rise buildings and towering structures (Karwa & Chauhan, 2025)	Enclosed spaces block sunlight (Finnigan, 2024)	Flickering lights from shops and advertising in stores (Finnigan, 2024)	Chrome ; cold, devoid of emotional appeal (Finnigan, 2024)
Abundant colors (Finnigan, 2024)	Traffic congestion (Karwa & Chauhan, 2025)	Busy roadways (Finnigan, 2024)	Lots of movement (Finnigan, 2024)	

Touch

Extreme temperatures (Finnigan, 2024)	Feels too concrete and artificial (Finnigan, 2024)	Crowds (Finnigan, 2024) 	Tactile sensation of dirt and plants (Finnigan, 2024)	Highly processed materials are percieved as discomfoting (Finnigan, 2024)
Reduces overall sensory comfort and has masking effect on all other senses				

Smell

Busy roadways (Finnigan, 2024)	Perfumes (Finnigan, 2024)	Pollution from traffic (Karwa & Chauhan, 2025)	Trash (Finnigan, 2024)	cigarette smokes from people (Finnigan, 2024)
Body odors (Finnigan, 2024)	Scent of food (Finnigan, 2024)			

Taste

Sound

Buzzing fly and insects (Finnigan, 2024)	Busy roadways (Finnigan, 2024)	Noise from human-made sources: shouting people, lawn mower, shouting people (Finnigan, 2024)	Traffic noise (Finnigan, 2024)	Echoes (Finnigan, 2024)	Traffic congestion (Karwa & Chauhan, 2025)
---	-----------------------------------	---	-----------------------------------	----------------------------	---

Antagonistic effect: Traffic noise reduce the positive effect of pleasant smells (Dong et al., 2024)

Figure 3.2: Overview of collected stimuli

Analysis

After collecting the stimuli, they were analysed and categorised. Based on this analysis, several categories were identified, such as materiality, colour, and traffic. Each post-it note (each sensory stimulus) was assigned a colour based on the category to which it belongs. This can be seen in the next spread. This made it possible to quickly see which categories occur most often for each sense. In this way, the research provides insight into which categories of stimuli are most strongly associated with specific senses and which types of sensory stimuli have the most impact.

3.4.2 Relationships between sensory stimuli

In the next step, relationships between the sensory stimuli were identified. These relationships were visualised in the overview by drawing connections between the different stimuli. The relationships are based on the study by Dong et al. (2024).

In their article *How Public Urban Space Enhance Restoration Benefits Through Combined Multisensory Effects: A Systematic Review* (Dong et al., 2024), three main types of multisensory effects on restorativeness are identified: additive effects, synergistic effects, and antagonistic effects. This means that the senses do not function on just their own, but interact with each other and influence each other.

Additive effects occur when multiple positive sensory inputs work together to support restoration, such as greenery combined with plant scents or birdsong. In this case, sight, smell, and sound strengthen each other.

Synergistic effects occur when one positive sensory experience reduces discomfort caused by another stimulus, for example when visual or olfactory qualities reduce heat stress or traffic noise.

Antagonistic effects occur when a negative sensory stimulus weakens the positive effect of other stimuli, such as traffic noise reducing the restorative effect of pleasant smells or crowding reducing overall sensory comfort.

These relationships were therefore also visualised in the overview using connecting lines, in order to better understand how the sensory stimuli influence each other.



Figure 3.3: Categories, after analysing the stimuli

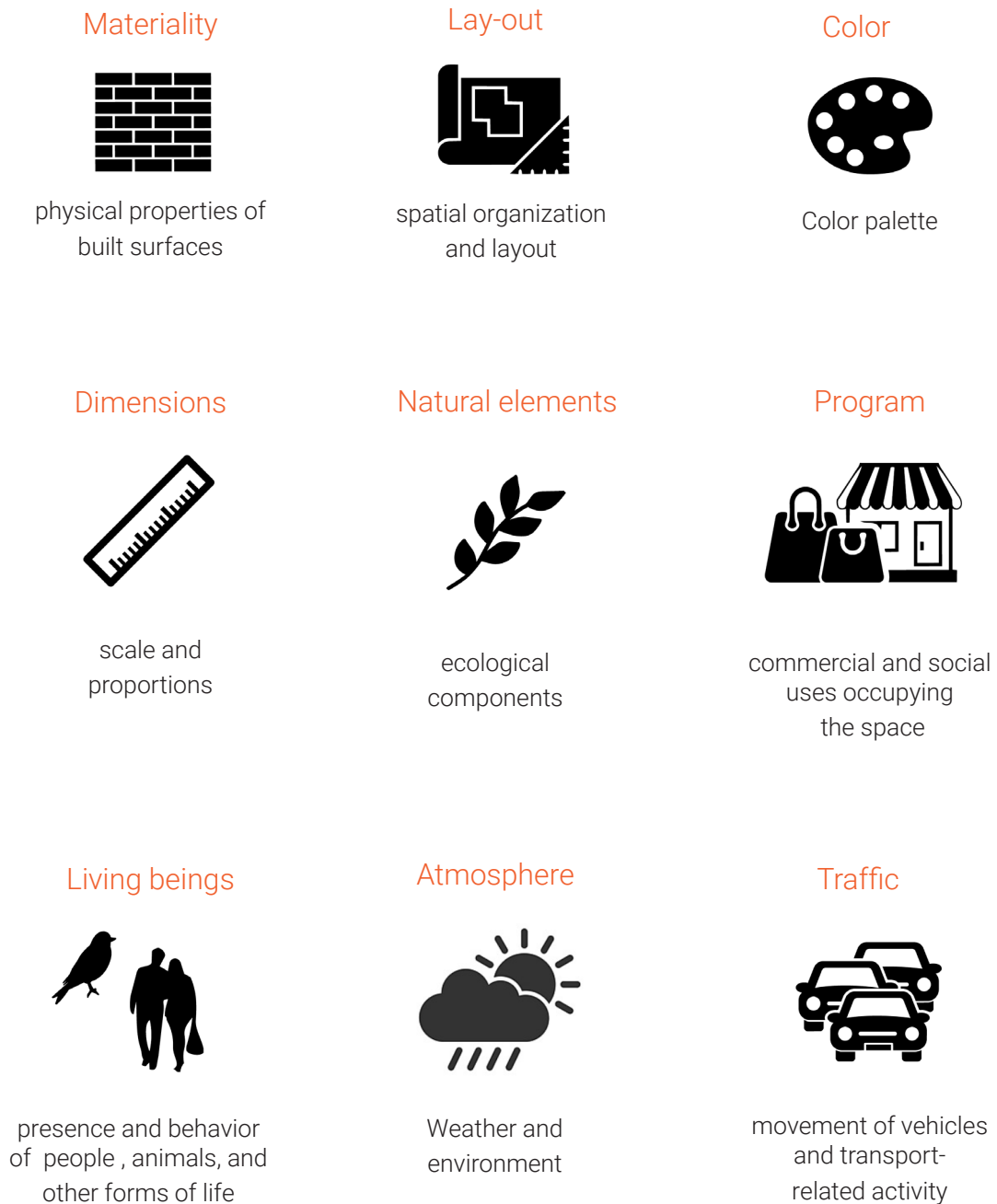
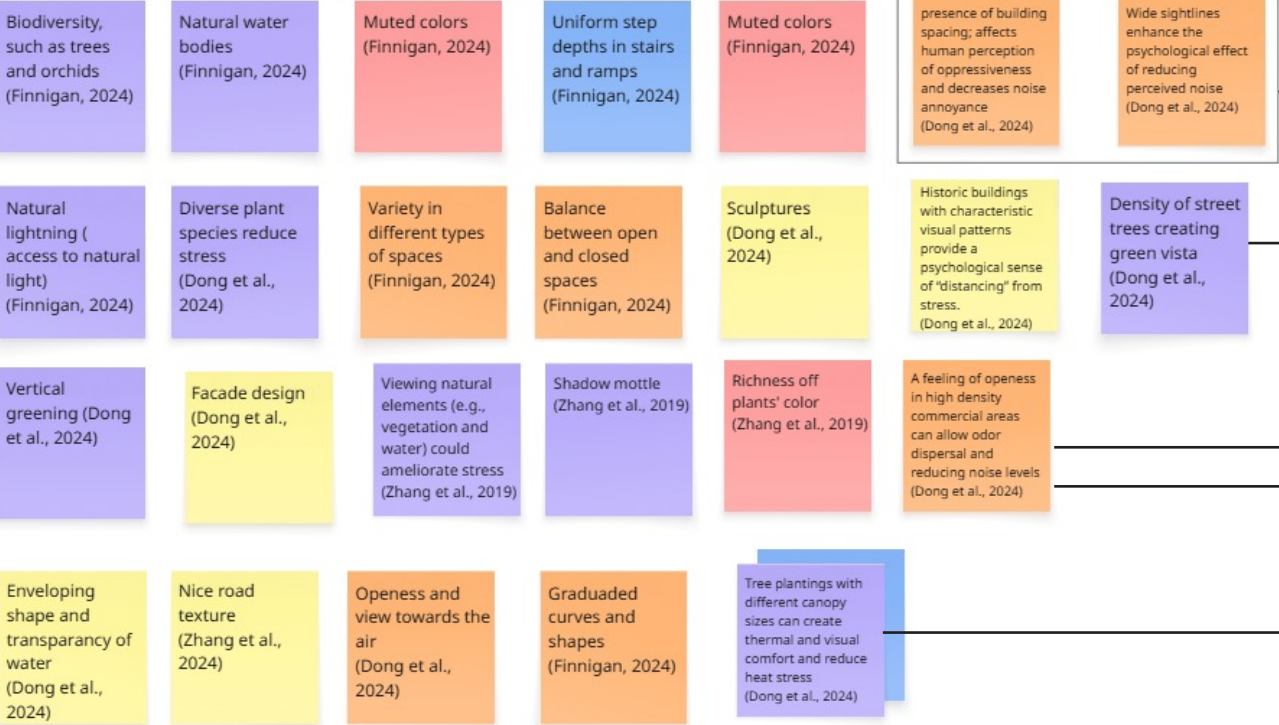


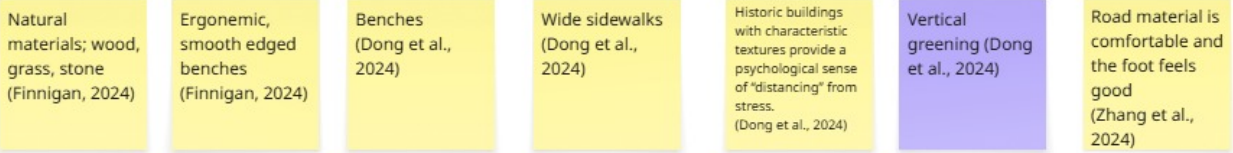
Figure 3.4: The categories and their descriptions

Benefits of outdoor environments -> restorative Strenghts

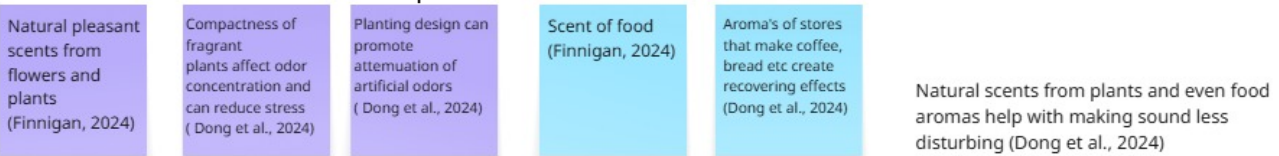
Sight



Touch



Smell



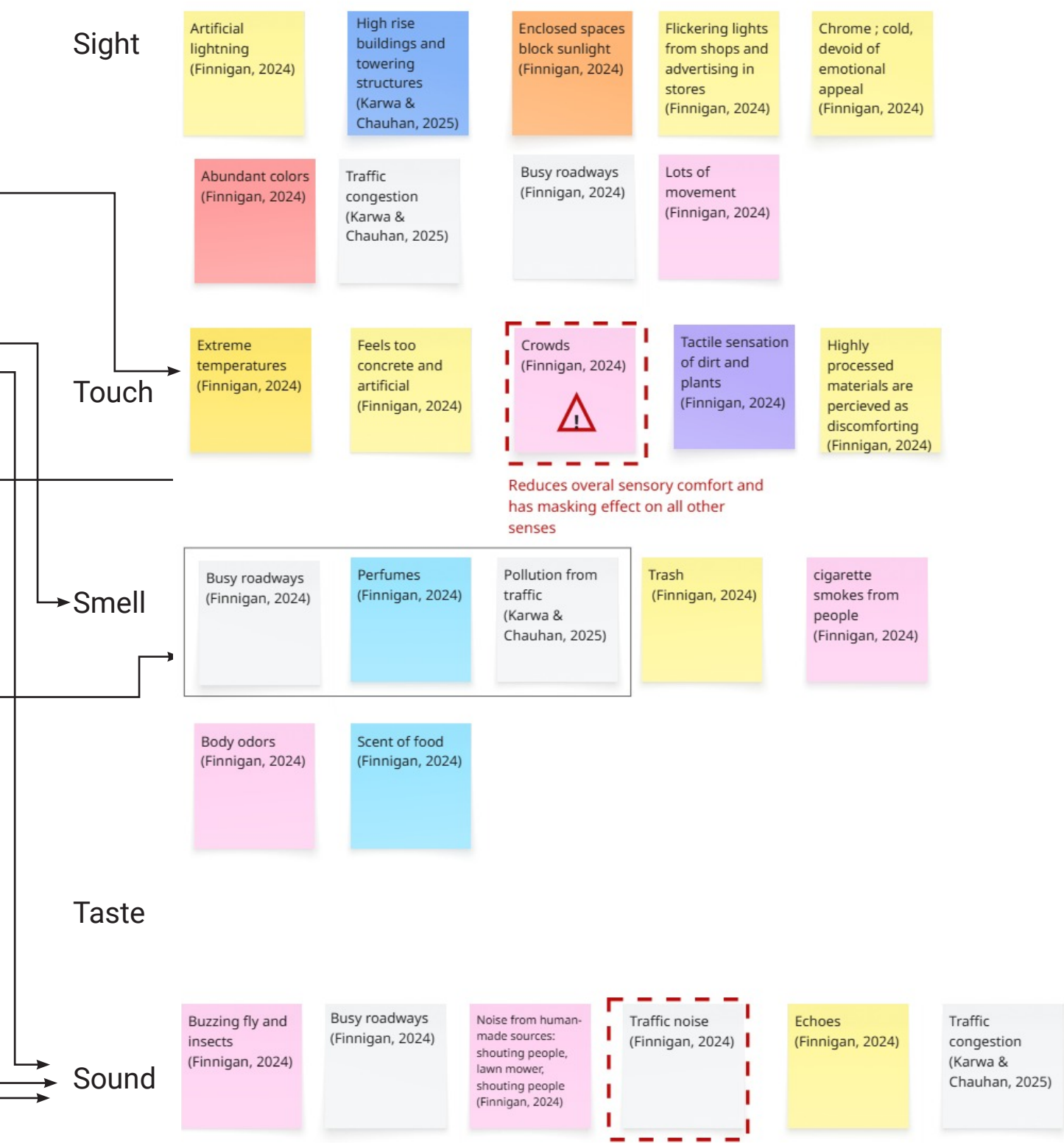
Taste



Sound



Stressors of outdoor environments -> overstimulation Weaknesses



Traffic noise reduce the positive effect of pleasant smells (Dong et al., 2024)

→ Synergistic effect
- - -> Antagonistic effect

3.4.3 Conclusions

The overview created with post-it notes shows which sensory stimuli are present in urban public space. It becomes clear that, among the stressors, the categories traffic, living beings, and materiality occur the most frequently. The stimuli within these categories contribute a lot to overstimulation and sensory overload.

In contrast, the analysis indicates that natural elements form the most dominant category among restorative stimuli. This finding suggests that nature plays an important role in reducing overstimulation and the negative effects of urban stressors. This aligns with the **Attention Restoration Theory (ART)** and **Stress Reduction Theory (SRT)**. Both make clear that natural environments are essential for recovering from mental fatigue and stress.

This finding also relates to **biophilic design**, which focuses on connecting people with nature in the built environment to improve well-being and create more pleasant sensory experiences. The importance of natural elements is also supported by research on **Perceived Sensory Dimensions (PSD)**, which shows that environments with qualities such as *Nature* and *Rich in species* are especially restorative for people experiencing stress.

Overall, these findings support the idea that natural elements can help balance out stress-inducing factors such as traffic, living beings, and materiality. At the same time, the overview shows that restoration does not depend on only nature; spatial layout and materiality also play an important role, as they influence how sensory stimuli are experienced and how they interact in urban public spaces.

Multisensory interactions

The literature identifies three main types of multisensory effects on restorativeness: additive, synergistic, and antagonistic effects. These effects demonstrate that the senses interact with and influence each another.

Several synergistic effects are particularly relevant. For example, natural scents from plants, and even food-related aromas, can reduce the perceived disturbance of noise. This is an important insight, especially since there is also an antagonistic relationship between traffic noise and pleasant smells: traffic noise can reduce the positive effect of these smells.

Another synergistic effect is that planting design, through natural scents, can contribute to the reduction of artificial odours, such as perfumes or pollution from traffic emissions.

Role of sight

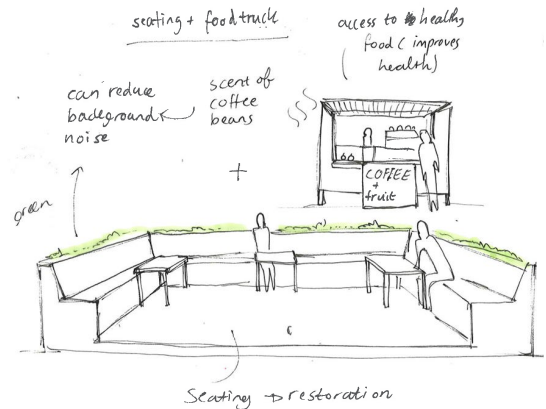
A notable finding is that many synergistic effects come from the sense of sight, indicating its importance in restorative environments. For example, spatial features like openness and long sightlines can help disperse odors and reduce noise. In this way, visual design can indirectly lessen overstimulation in other senses, such as smell and sound.

Antagonistic effect

Another important antagonistic effect involves the sense of touch, in the form of crowding. High levels of crowding reduce overall sensory comfort and can have a masking effect on other sensory experiences, which lowers the restorative potential of the environment.

3.4.4 Developing design strategies

Based on the findings and conclusions from literature about sensory stimuli, some design strategies can be developed. By translating the theoretical insights into potential design strategies during the research process, theory and design development can inform each other from an early stage. This iterative approach allows the research to already begin exploring the sub-question : What restorative spatial design strategies can be used to minimize or compensate stressors? while building a foundation for their application in later design phases.



Smell reduces perceived noise:

introduce planting (**SRT & PSD**; rich in species and nature) and small coffee kiosk/ tea houses to create pleasant scents

Wide sightlines reduce perceived noise and smell:

avoid placing large objects in the center of the space to maintain openness.

Antagonistic effect: traffic noise reduces positive effects of pleasant smells

-> redesign streets with more greenery and sound-dampening paving.

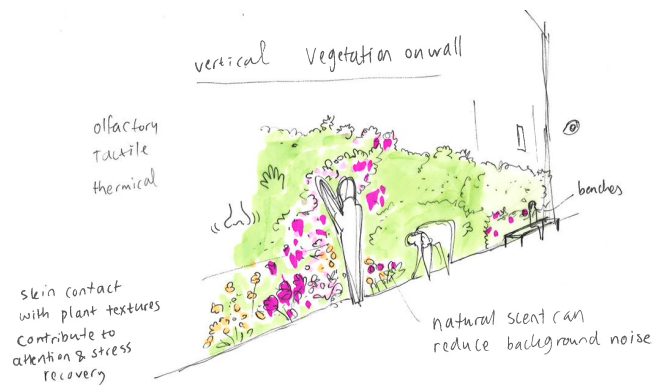


Figure 3.5 & 3.6: Sketches of the literature

Design strategies that counteract the antagonistic effect of crowding, where crowding masks other sensory qualities

-> create clear circulation routes and separate staying areas to reduce conflicts between flows

-> Create micro-refuges: integrate benches with backrests and niches to provide shelter and a sense of retreat (**PSD**: Refuge; **ART**: Being away).

-> Create hierarchy in movement : differentiate between main routes (movement) and secondary spaces (staying) to reduce perceived crowding.

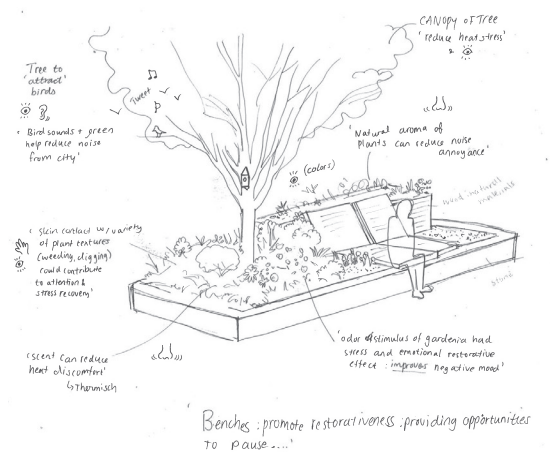
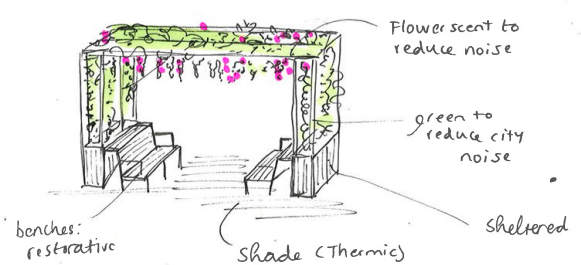
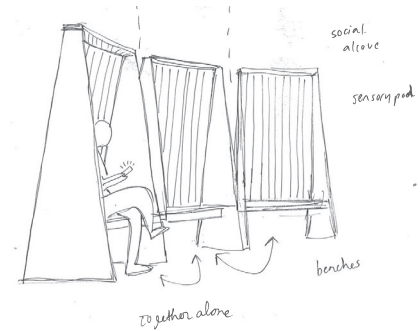
-> Create meandering paths instead of linear layout : break continuous flows and reduce the perception of mass.

-> create spatial segmentation : divide space into smaller "rooms" so crowding is experienced in parts rather than as one large flow.

-> Add parallel routes : distribute pedestrian flows across multiple paths.

-> alternate between wide and narrow sections to reduce the feeling of constant pressure.

-> create variety in openness : combine open and enclosed spaces, allowing users to choose environments that fit their needs (**ART**: Compatibility).



Taste

Access to flavour some, nutritious food

food truck/market

urban farming

retreat/pause

combine w. benches



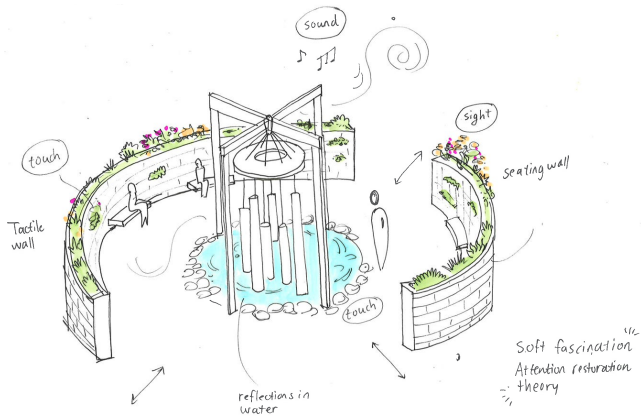
Fountain

Auditory
Visual
Thermal
Tactile

enveloping shape and transparency
of the water influence restoration
+ Attentional recovery
from road traffic
noises

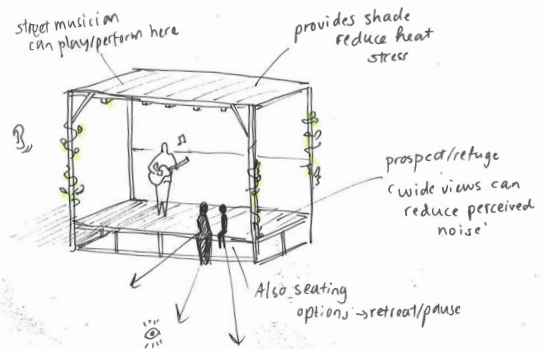


Touching water → therapeutic



'human sounds: street music can help w. recovery'

Dong et al., (2014)



reduce stress + connection to nature: biophilic design
interactive gardening



Sensory Entry (Roe & McCann)

Sound



'green barrier walls and vegetation can help reduce noise'

Figure 3.7 - 3.15: Sketches of the literature

04

Analysis

Sub questions

How does the perception of urban stressors in public space in Rotterdams city's center influence the individual senses?

What restorative spatial design strategies can be used to minimize or compensate stressors?

4.1

The Lijnbaan

Spatial analysis
Site visit and observations
Softmapping
Picture collection

4.1.1 Lijnbaan introduction

The Lijnbaan ensemble in Rotterdam is a traffic-free urban retail area, which is designed during the post-war reconstruction period, by architects Van den Broek and Bakema. It opened in 1953 and the Lijnbaan became Europe's first pedestrian-only shopping street. It also represents a new approach to modern architecture and urban design.

Van den Broek en Bakema designed the Lijnbaan as a highly functional system, where the spatial organization strictly separated the flows, uses, and circulation. They designed the Lijnbaan in such a way that it almost function like a machine, with an underlying structural logic that coordinates movement, efficiency, and function.

Together with the surrounding residential flats, green semi-public courtyards, and service streets (expeditiestraten), the ensemble is a new way of organizing the city.

Today, the Lijnbaan continues to combine commerce with public space quality. However, high visitor density and overstimulation caused by urban stressors and sensory overload, raise new questions about comfort, rest, restoration, and urban well-being within this iconic urban ensemble.



Figure 4.1 & 4.2 : Lijnbaan

The Lijnbaan in Rotterdam's city center is therefore selected as the location for this thesis. This choice is not only based on its role as a busy shopping street, but on its combination of urban stressors and spatial characteristics that contribute to this overstimulating environment.

The Lijnbaan contains a high density of sensory stimuli, including continuous pedestrian flows, commercial signage, and urban noise. Spatially, the street's narrow profile blocks a sense of openness and reduces the sense of open air. Its long, straight perspective creates a tunnel-like effect with few visual escape points. In addition, there is a lack of seating and greenery, which reduces opportunities for rest and relief.

Together, these factors make the Lijnbaan a relevant site for studying the stressors.



Figure 4.3: Narrow streetprofile of the Lijnbaan



Figure 4.4: Plan of the Lijnbaan within its current context
1:2000 (scaled to 50% of its original size)

4.1.2 Functionalism

An important concept in the design of the Lijnbaan ensemble was the clear separation of urban functions; functionalism. This forms a contrast with the traditional Dutch shopping streets, where housing is placed on top of shops. Retail functions in the Lijnbaan are placed in low, buildings along the shopping promenade, while housing was located in separate taller, residential blocks behind the shops, instead of located above of the shops. Logistics and deliveries are accommodated through dedicated service streets, the 'expeditiestraten', and green semi-public courtyards function as areas for recreation and rest. (CRIMSON Architectural Historians, 2004). By separating housing, traffic, and shops, a pedestrian-focused shopping street with service streets behind it was created.

The residential layout consists of a repeating "stamp" around three courtyards; 13-story blocks positioned perpendicular to the shopping street, nine-story blocks parallel to it, and lower 3-story blocks along Karel Doormanstraat (CRIMSON Architectural Historians, 2004). Two of these courtyards are semi-public green parks, while at the third one the residential blocks surround a service- and parking courtyard. (CRIMSON Architectural Historians, 2004)

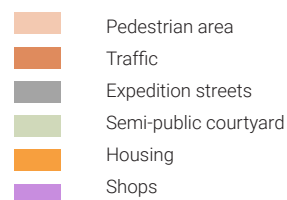
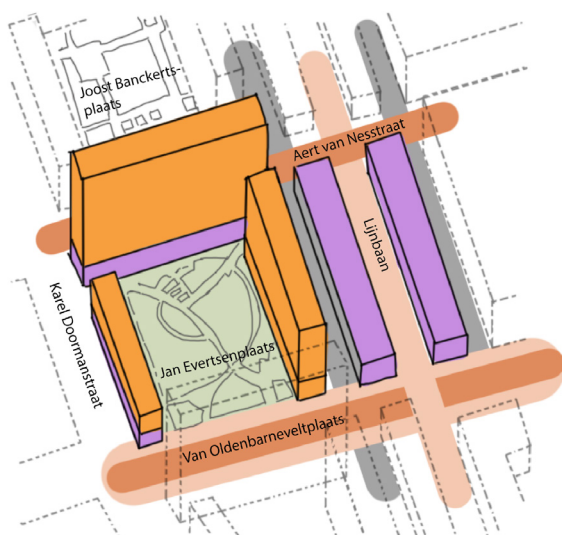


Figure 4.5: Concept of a block

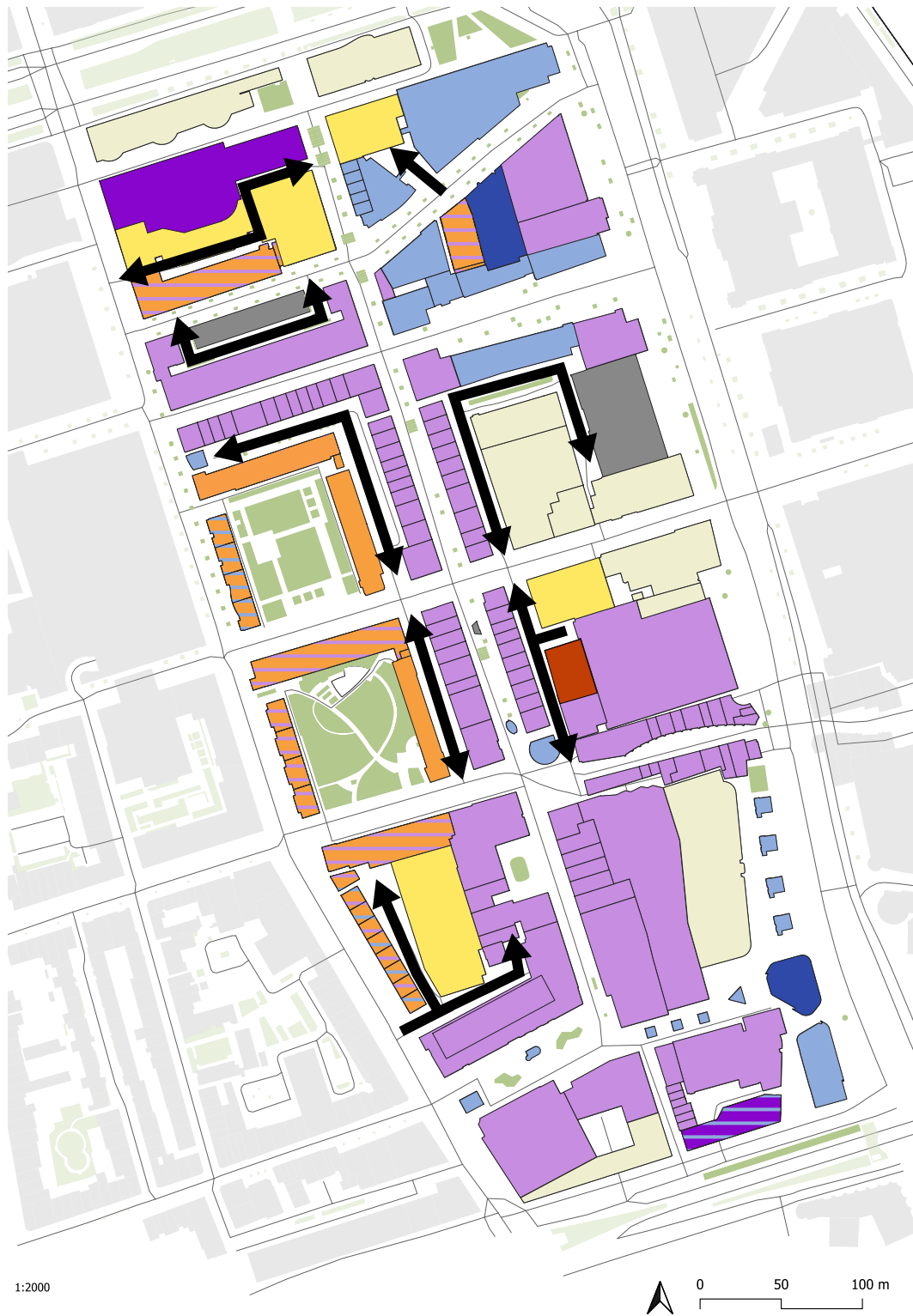
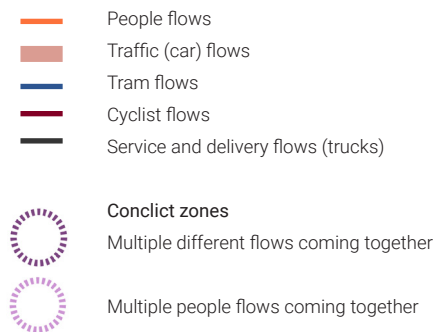


Figure 4.6: Building functions
1:2000 (scaled to 50% of its original size)

4.1.3 Urban flows in the Lijnbaan

The Lijnbaan is shaped by various urban flows, including pedestrians, cyclists, cars, delivery trucks, and trams. These flows were mapped during a site visit. The map shows where different flows meet, which can create conflicts. For example, pedestrians often have to move close to trams and cyclists, forming bottlenecks. These areas have many sensory stimuli and potential stressors, which can lead to overstimulation. Identifying these spots can help find areas for potential design interventions. The map also highlights places where only people flows and large crowds come together. In these areas, crowding can occur, and people may bump into each other, which can also cause overstimulation. At the same time, these points are social nodes where people can meet and pause, for example by sitting on benches, offering moments of rest within the Lijnbaan.



Figures 4.7 - 4.10 Area 1; Van Oldenbarneveltplaats

For area 1, photographs were taken to illustrate the *different urban flows*. They show car traffic, the tram, pedestrians moving close to the tracks, and sometimes crossing the tram tracks, as well as motorcyclists. The intersection of all these flows creates a conflict zone, where movement is constrained and interactions between users can lead to overstimulation.



Figures 4.11 & 4.12: Area 2; Binnenwegplein

For example, in area 2, *multiple pedestrian flows* converge. This creates crowding, but the area also functions as a social node where people can meet and sit on benches. Compared to Area 1, this area has a wider street profile, allowing for more space for movement and pauses.

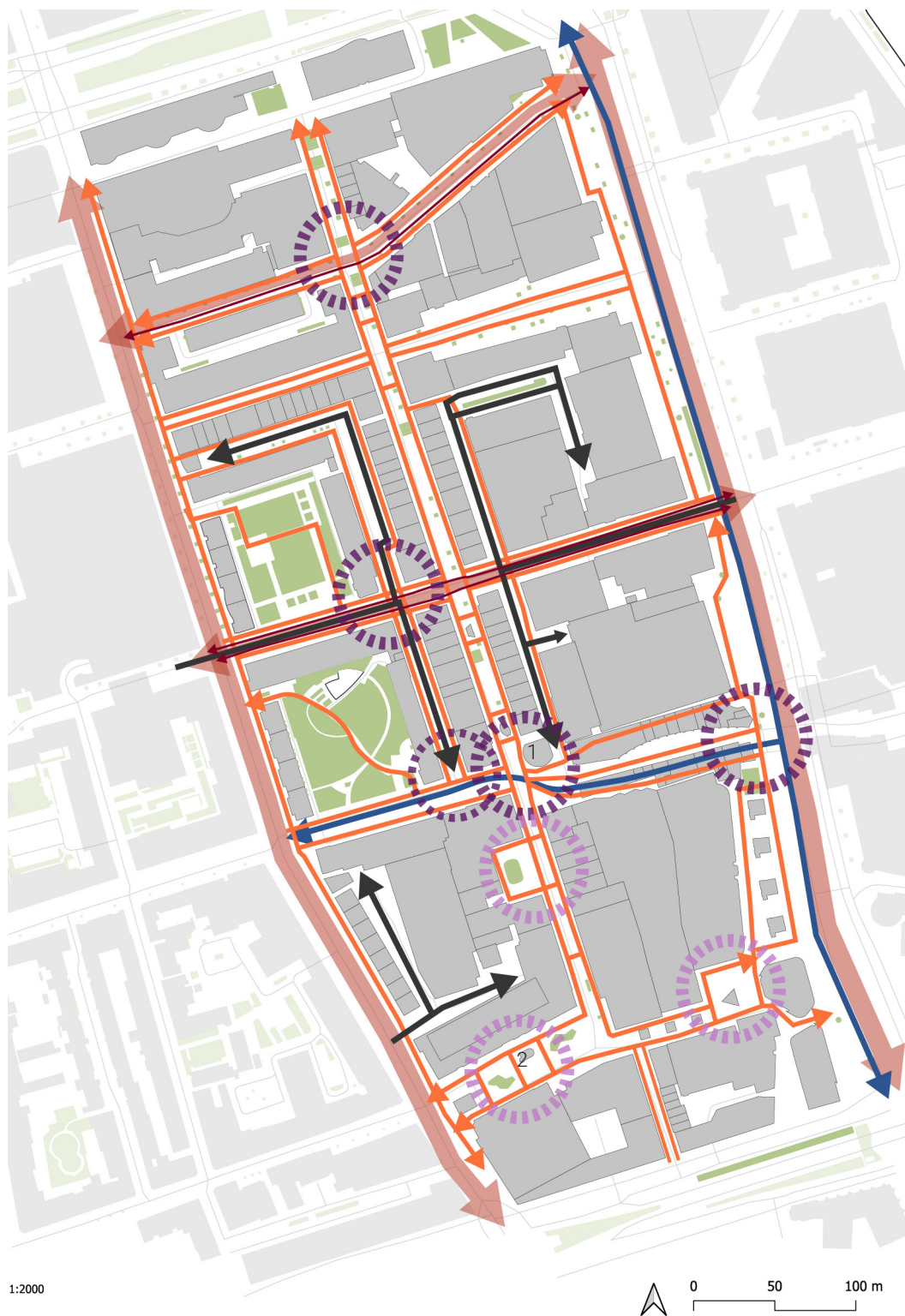


Figure 4.13: Urban flows analysis
1:2000 (scaled to 50% of its original size)

Expedition streets

The expedition streets are the result of separating the urban flows in the Lijnbaan. These streets are parallel to the Lijnbaan and are used by delivery trucks to deliver goods to the shops from the rear facade. This keeps the front side of the Lijnbaan free of cars and supports a pedestrian-friendly public space.

As a result, the rear facades of the shops are mostly functional and not very attractive, with ventilation grilles, closed facades, and little visual quality. This creates an unpleasant streetscape.

On the other side of the expedition street are residential buildings, with garages at street level. Besides freight trucks, cars also use these streets. Therefore, the street is not often used by pedestrians.

The street is quite wide, with a lot of paved surface and little greenery, which reduces its quality as a public space.



4.1.4 People movement and behaviour

During one of the many site visits, observations were made of how people move through the Lijnbaan and where they stop to take a break. This helped to better understand where pedestrian density is high and where crowded conditions may lead to overstimulation. The focus was on pedestrian flows and how public space within the Lijnbaan is used.

It was observed that in the main shopping street, where shops are located on both sides, pedestrians mainly walk along the edges of the street (orange). These flows move most of the time in opposite directions, while the central area of the street is mostly unused, except when people cross from one side to the other.

In some cases, benches or seating elements are located in this central zone. These are used by people to pause briefly or stand in small groups (area 2 in the map on the next page) , creating a type of stay space positioned between two opposing flows (blue). Pedestrian movement often follows a clear pattern, with people keeping to the right when walking forward and to the left when approaching others, similar to traffic behavior on a roadway.



Figure 4.14: Pedestrian movement at the edges

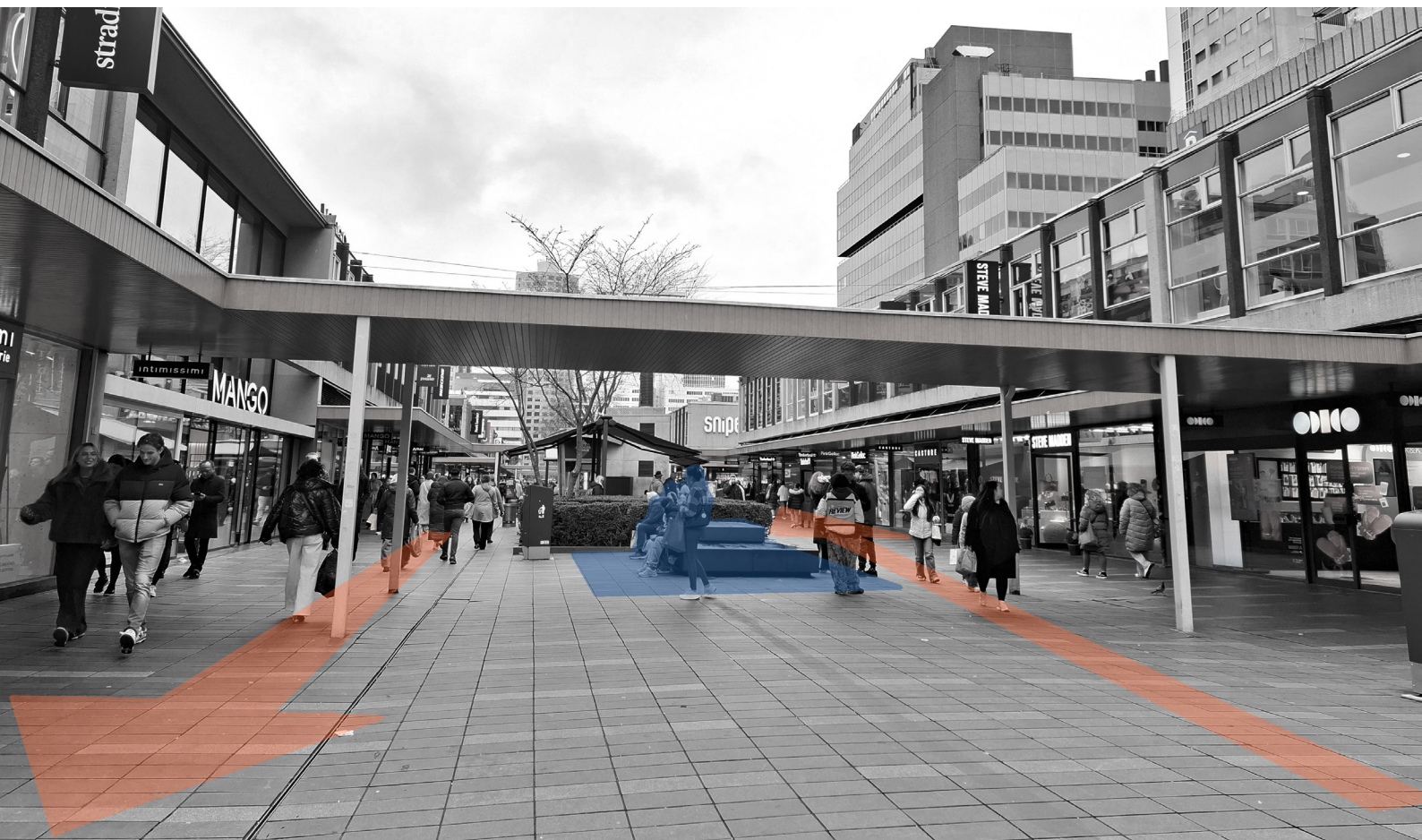


Figure 4.15: Pedestrian movement at the edges and stay spaces in between the flows



1

Another observation is that seating is available throughout the Lijnbaan, but its use strongly depends on location and spatial quality. Simple benches or picnic tables without greenery, especially in narrower streets, are rarely used (area 1).



6

In contrast, seating areas located in wider and more open streets, where greenery and trees are present (area 6), are used much more frequently. People use these spaces to rest and recover, indicating a stronger restorative quality. These seating areas with greenery and trees are mostly positioned at the edges of the space, instead of in the middle of pedestrian flows.



6



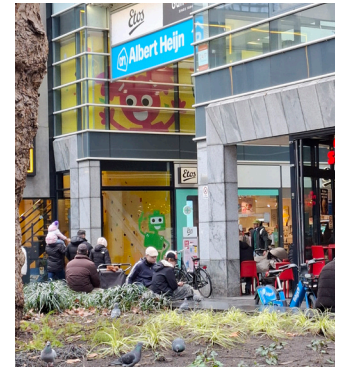
3

At area 3, where multiple pedestrian flows intersect, there is no clear directional movement as observed in area 2. Instead, people approach from multiple directions, creating a more chaotic situation. This increases perceived crowding and can more easily lead to overstimulation.



4

Finally, the large seating area (area 5) located under the plane tree is actively used. This space is unique because it is positioned slightly away from the main urban flow (area 4), and at the same time it remains close to the busy street. People use this spot to temporarily withdraw from the surrounding activity and rest, which makes it an important potential restorative area within the Lijnbaan.



5

Figure 4.16 - 4.21: pedestrian behaviour in the Lijnbaan

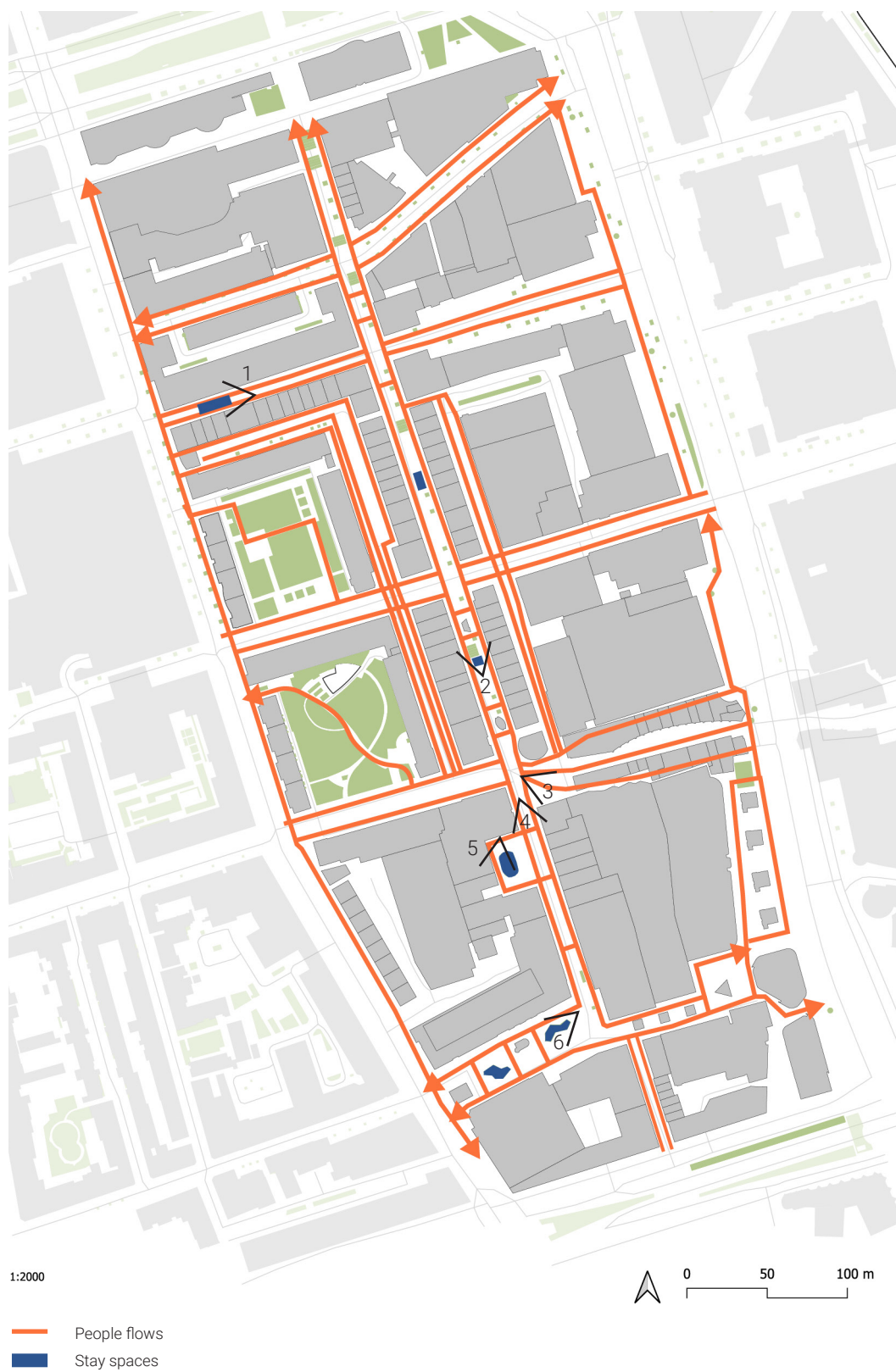


Figure 4.22: Pedestrian movement and stay spaces
1:2000 (scaled to 50% of its original size)

4.1.5 Spatial lay-out and dimensions

The canopies create an oppressive feeling because they seem to press down from above, blocking the view of the open sky. Together with the narrow street profile, this reduces the sense of openness and fresh air. The long, straight layout of the street strengthens this effect, creating a clear tunnel feeling. There are hardly any views towards the horizon or places for visual escape, which makes the space feel enclosed and stretched, adding to the sense of pressure.

On the other hand, the canopies can also create a sense of shelter and protection, as they give the impression of something overhead that protects from unpleasant weather, such as rain.



Figures 4.23 & 4.24: Narrow streetprofile of the Lijnbaan and its canopies
Figure 4.25 (right): Tunnel effect



RITUALS...

Classico Denim
GSTAR

4.1.6 Vacant buildings

During the site visit, photographs were also taken of vacant buildings in the Lijnbaan. By mapping these, potential locations for interventions can be identified. This may include, for example, opening up a building block or changing its function. In this way, a transformation can be spatially and conceptually supported.



1



2



3



4



5



6



7



8



9

Figure 4.26: Vacant buildings in the Lijnbaan



Figure 4.27: Vacant buildings in the Lijnbaan
1:2000 (scaled to 50% of its original size)

4.1.7 Hidden vacancy

During the site visit, it was observed that along the dominant retail chains on the Lijnbaan, there are also niche shops and specialty food concepts. These niche shops offer a very specific range of products, which makes them more vulnerable. These functions attract attention and add liveliness to the area, but they often act as temporary uses of economically weaker retail spaces.

As a result, these shops are sometimes temporary or experimental. Over time, these temporary shops seem to disappear, and then leave a vacant unit. This is later then filled by another temporary store. In this way, the street remains lively. This process can be described as “hidden vacancy.” If this hidden vacancy is added to the actual vacancy, it becomes clear that there is a big amount of underused retail space. This suggests that not all ground-floor spaces are economically sustainable as shops.

These plinths could then be used for other functions, such as a quiet room, or reading room in the future Lijnbaan, when looking at reducing stressors. This is especially useful in a busy shopping area, where there is little space for rest.

This conclusion forms a bridge to the idea that the concept of shopping will likely change in the future. This will later be addressed in a next chapter.

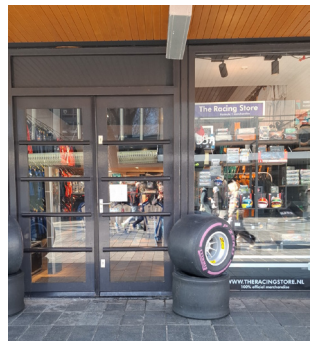


Figure 4.28 : Examples of niche shops in de Lijnbaan that focus on a specific product segment and are not mass-market. These types of shops tend to be vulnerable to changes in retail trends

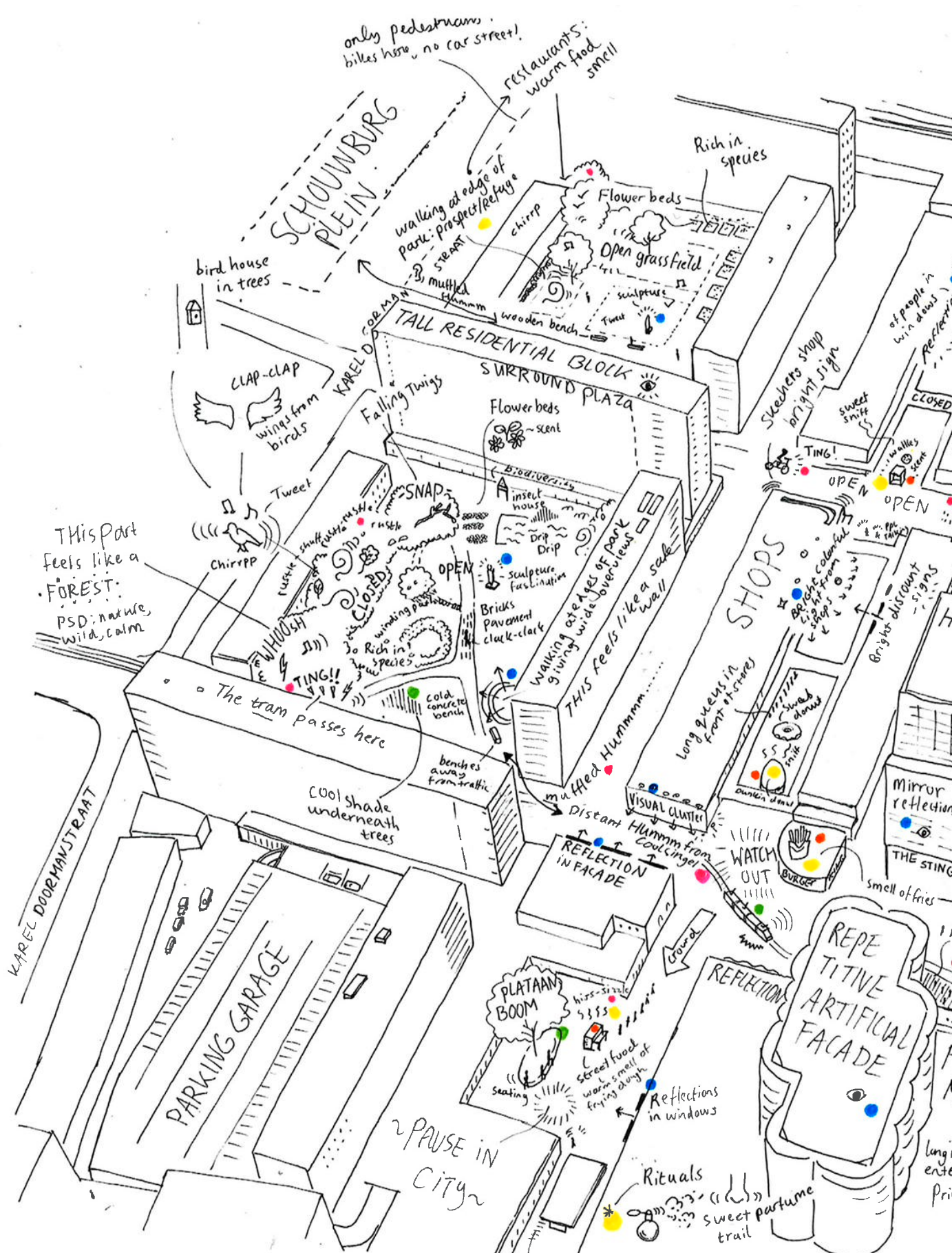
4.1.8 Softmap drawing

After visiting the Lijnbaan, a soft map drawing was made. Soft mapping is useful because it helps to understand how a place is experienced by people, instead of only looking at the physical layout. It makes invisible aspects of a space visible, such as sensory stimuli, emotions, and stress levels. This makes it easier to see where people may feel overwhelmed and where calmer areas are located. Because of this, it is a valuable tool when designing public spaces that focus on well-being and user experience, which is especially relevant for this thesis.

So after the site visit, sensory stimuli and stressors were written down and were drawn in a soft map drawing of the area.

The soft map drawings on the next pages include both the positive and the negative sensory stimuli. Each stimulus was then given a color based on the sense it belongs to. This method showed where many different sensory stimuli come together. These are the places where people can feel the most overwhelmed. At the same time, the map also shows the calmer areas with fewer stressors. It also helps to identify possible locations for restorative environments.

NB: The soft map is based on the author's personal experiences and should therefore be considered subjective



sensory stimuli

- visual
- sound
- smell
- taste
- touch

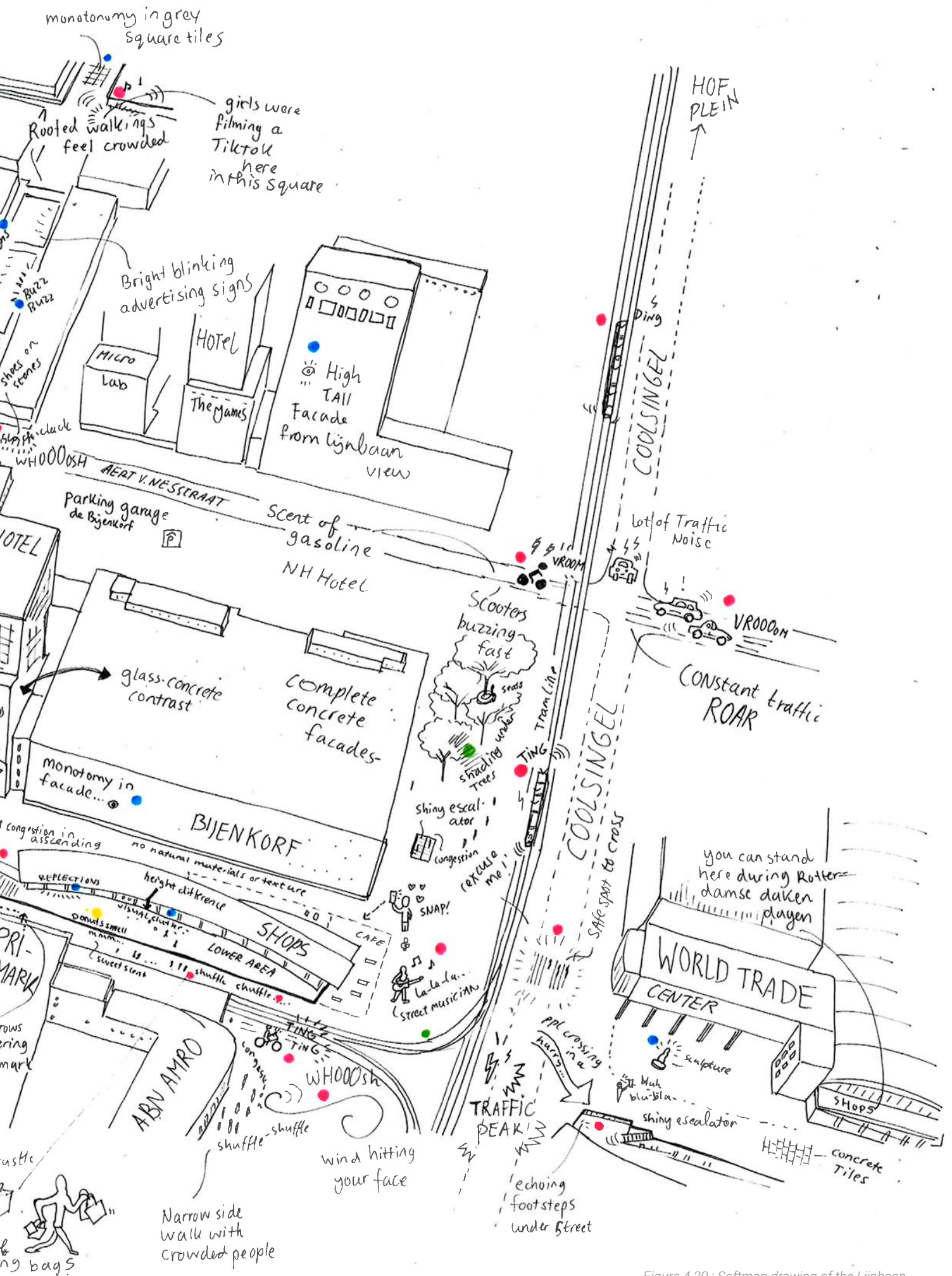


Figure 4.29: Softmap drawing of the Lijnbaan

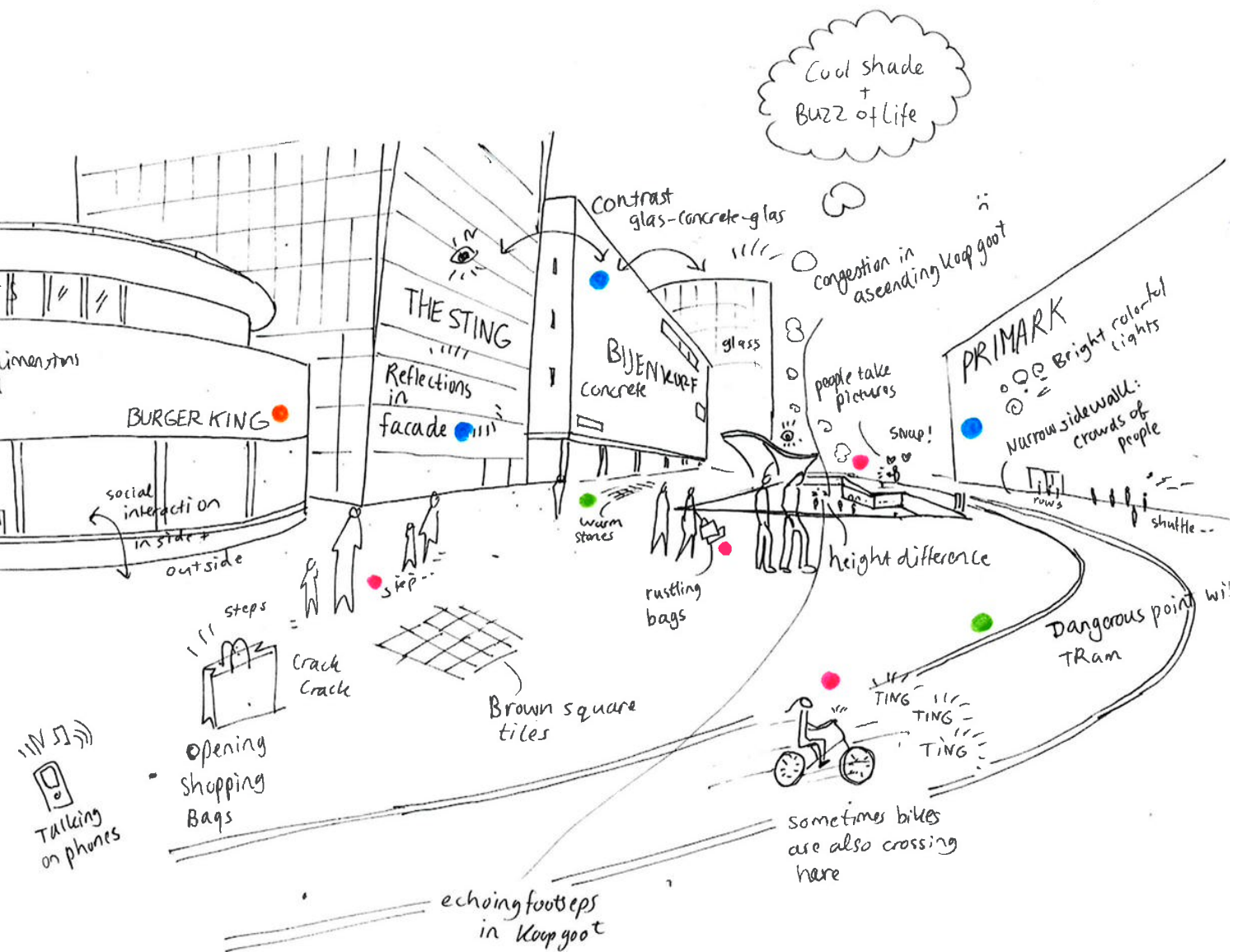


Figure 4.30 : Softmap drawing of a segment of the Lijnbaan

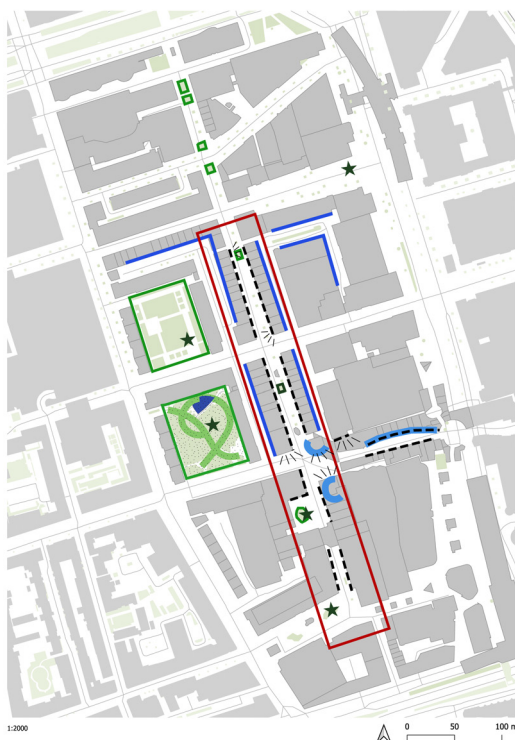
4.1.9 Sensory stimuli

For each sense, a separate map was created with the spatial elements of the Lijnbaan and the sensory experiences. In this way, the soft map drawings are divided into multiple layers. This way, the different stimuli per sense can be shown individually. This makes it easier to see which spatial elements influence multiple senses at the same time and therefore have the strongest impact on the experience of the space. For example, the materiality of the main shopping

street affects several senses at once; the small grey tiles cause sound to echo, the surface becomes slippery when it rains, and visually the street appears grey and monotone.

Smell and taste were combined, because they are often associated with each other and are closely connected from a sensory perspective.

Sight



Scaled to 25% of its original size

- Water element
- Round shapes in surroundings
- Neglected rear facade
- Picturesque romantic park layout
- Lack of greenery and grey monotonous view
- Green element
- Sculpture or visual focus point
- Round building volumes
- Reflections in window stores
- Visual clutter in stores

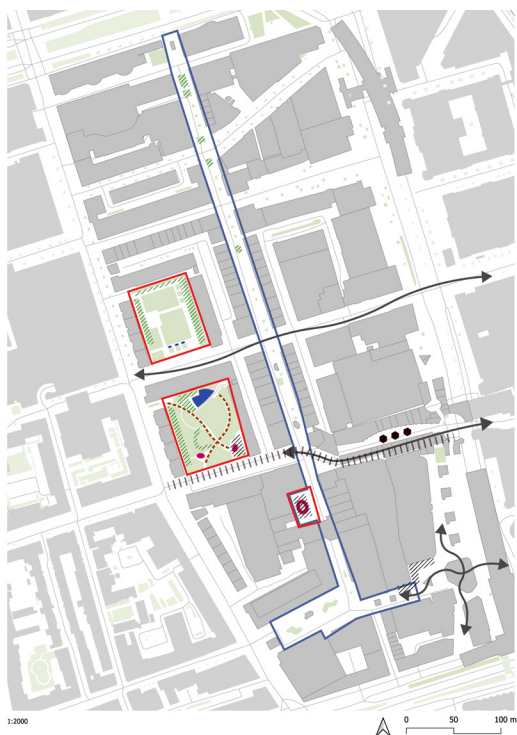
Sound



Scaled to 25% of its original size

- Water fountain
- Birds singing
- People talking and echo of tiles
- Wind through rustling leaves
- Traffic noise
- Calm semi-public inner space
- Calm/silent expeditiestraat
- Tramline

Touch



Scaled to 25% of its original size

- Water element
- Plastic benches
- Tram vibration in ground
- Brick pavers
- Smooth paving tiles (slippery when wet)
- Soft and low vegetation
- Sheltered spots from rain
- Low wind exposure
- Wind corridor/tunneleffect
- Wooden benches
- Hard and cold concrete bench

Smell and taste



Scaled to 25% of its original size

- Aromatic vegetation
- Vehicle emissions
- Wet grass after rain
- Frying oil/food
- Garbage odor - waste collection point
- Coffee smell
- Fries
- Vegetable and fruits shop
- Food consumption zone
- Perfume
- Bakery/pastries odor

4.1.10 Photo collection of sensory stimuli

During one of the site visits, the focus was on collecting sensory stimuli and identifying stressors that may lead to overstimulation. While walking through the Lijnbaan and examining the space per sense, many elements were identified that could be considered weaknesses or sources of sensory stress.

The stressors were based on stimuli identified in the literature (see sub-chapter 3.4) as well as on observations that I, as a researcher, considered relevant and logical within the context of this thesis. The identified stimuli were documented through pictures in a large overview.

The categories that were developed after finding the stimuli in literature (sub-chapter 3.4) were applied to the stimuli that were captured during the site visit. These categories were: Materiality, natural elements, lay-out, color, dimensions, living beings, traffic and program. These categories are shown on the next right page. Applying the categories to the stimuli made it possible to identify which categories have the biggest impact in the Lijnbaan and therefore contribute the most to overstimulation. It also helped to clarify where spatial improvements could be made and which categories should be addressed, or strategically used, to create a restorative network.

The same method was then also applied to positive stimuli (strengths). For each sense, elements with restorative qualities were identified and captured. These were also based on findings from the literature and on personal observations and insights. The same categories were used to create consistency in the analysis.

In an overview of images, the pictures are placed next to each other and grouped by their category. This makes it easier to see which categories have the strongest influence

on overstimulation and which contribute to restorative effects. Each picture also includes a short description of the associated stressor or restorative element.

The pictures and descriptions can be found in *Appendix 1 : Stressors of outdoor environments in the Lijnbaan; overstimulation (weaknesses)* and in *Appendix 2: Benefits of outdoor environments in the Lijnbaan; restoration (strengths)*

At the bottom of this page, a screenshot of a spread of the overview is shown.

Conclusions

After collecting pictures of both the stressors and the restorative elements and placing them in an overview, some clear conclusions can be drawn.

These conclusions are shown on the next pages.

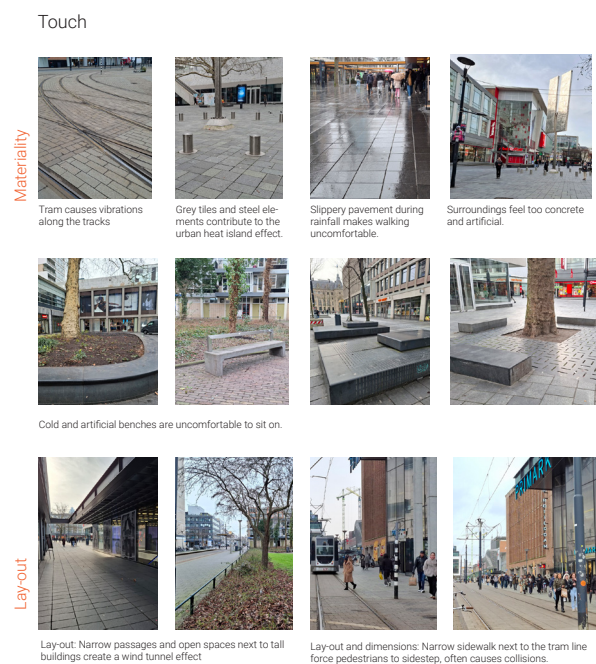


Figure 4.31 : Fragment of the pictures and descriptions overview of the stressors (Appendix 1)

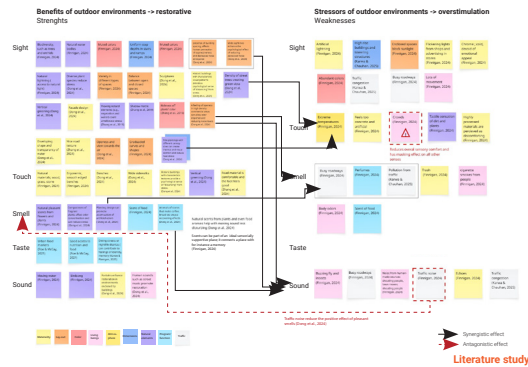


Figure 4.32 : Overview of collection pictures (appendix 1 &2) after applying the categories found in literature

Conclusions: stressors

For **sound**, the category traffic has the greatest impact, followed by living beings.

Traffic



Living beings



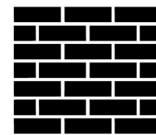
For **smell**, program has the strongest influence.

Programme



For **touch**, materiality is the main factor, with layout also playing an important role.

Materiality

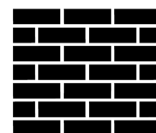


Lay-out

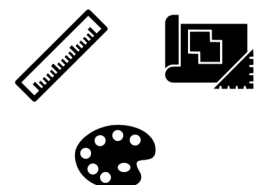


For **sight**, materiality is most contributing to stress, but dimensions and layout also play an important role. In addition, color seem to have an influence.

Materiality



Dimensions, lay-out and color



For **taste**, no stressors were identified. Literature also shows that taste has a minimal influence on urban form perception (Kavee & Flanigan, 2025, p. 18). Although taste can influence place perception, the effects are activity-based instead of structurally spatial. Taste seem to not affect broader spatial behavior. Therefore, no stressors were found for taste in a spatial way, because it does not influence or cause overstimulation in an urban context.

Conclusions: restorative elements

For **sound**, the categories natural elements and living beings with their calm sounds have the strongest restorative effect.

For **smell**, natural elements and program/function have the greatest influence.

For **touch**, it is clearly shown that materiality has the strongest influence on restoration. This is especially important for direct contact. In an indirect way, layout is also important, for example by creating a spatial structure that helps prevent collisions between many people or prevent windtunnel effects.

For **sight**, the most important factors for restoration are layout and natural elements. In addition, material and color also play a role. It is noticeable that, for sight, many categories contribute and have an impact.

Finally, regarding **taste**, program and function have the strongest influence. Taste is mainly experienced as restorative, rather than as a stressor. This matches the findings of Kavee and Flanigan (2025). They explain that taste is activated in consumption-related places, such as food streets and nightlife areas. This shows that taste is more connected to activities than to the physical design of the environment. Literature also shows that

Natural elements



Living beings



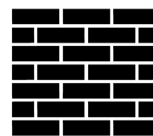
Natural elements



Programme



Materiality



Lay-out



Lay-out



Natural elements



Material and color



Programme



taste contributes to cultural place identity (Kavee and Flanigan, 2025). Because place identity strengthens feelings of belonging and emotional comfort, taste can therefore also be seen as having a restorative effect.

Jenny and Roe (2021) also state that taste is important in urban environments and can be restorative when there is good and easy access to food places. From this, it can be concluded that taste is a positive stimulus (restorative element) and not a negative one (stressor). It should be noted that the food discussed should not be unhealthy; however, the aspect whether a certain food is healthy, is not the focus of this thesis.

So, restorative sensory design strategies that engage the sense of taste could be adding accessible and inviting food-related interventions. These include elements such as fruit stands, coffee kiosks, and urban farming areas where people can pick and eat fresh products, creating moments of comfort, interaction, and support mental well-being.

Insights

When looking at the overview of the stressors (Appendix 1), it seems that the category of traffic has an overstimulating effect on multiple senses and is therefore an important point of attention. Based on this observation, it can be concluded that a new streetprofile for the traffic roads, tramline and expedition streets could be developed. A well-designed system could help reduce the sensory stimuli caused by traffic.

Finally, there is a clear overlap between taste and smell, as these senses are often experienced and associated at the same time.

4.2

The Lijnbaan within Rotterdam

From stimuli to structure: situating the Lijnbaan within Rotterdam's urban framework

After focusing on the sensory stimuli, stressors and experiences, the analysis now shifts in scale. While the previous parts explored how the Lijnbaan is perceived on the level of perception, stimuli, and bodily experience, it is also very important to understand how the Lijnbaan is connected to the broader urban structure.

To fully understand the position and potential of the Lijnbaan, the analysis now zooms out to the scale of the city. Here, the street is no longer seen as an isolated space of experience but as a part of a larger urban system shaped by spatial typologies, green structures and current development strategies. This makes it possible to understand how the Lijnbaan is related to Rotterdam as a whole, and how a transformation fits within ongoing shifts in urban thinking.

4.2.1 Zooming out: from functional city to mixed used city

An important trend is that in urban design theory there is a shift from functionalism and modernism to mixed-use, with an increasing focus on human-scaled design (Kavee & Flanigan, 2025). This transition is also currently taking place in Rotterdam. While the city is moving towards a more mixed and human-centered urban environment, the Lijnbaan has stayed behind in this development.

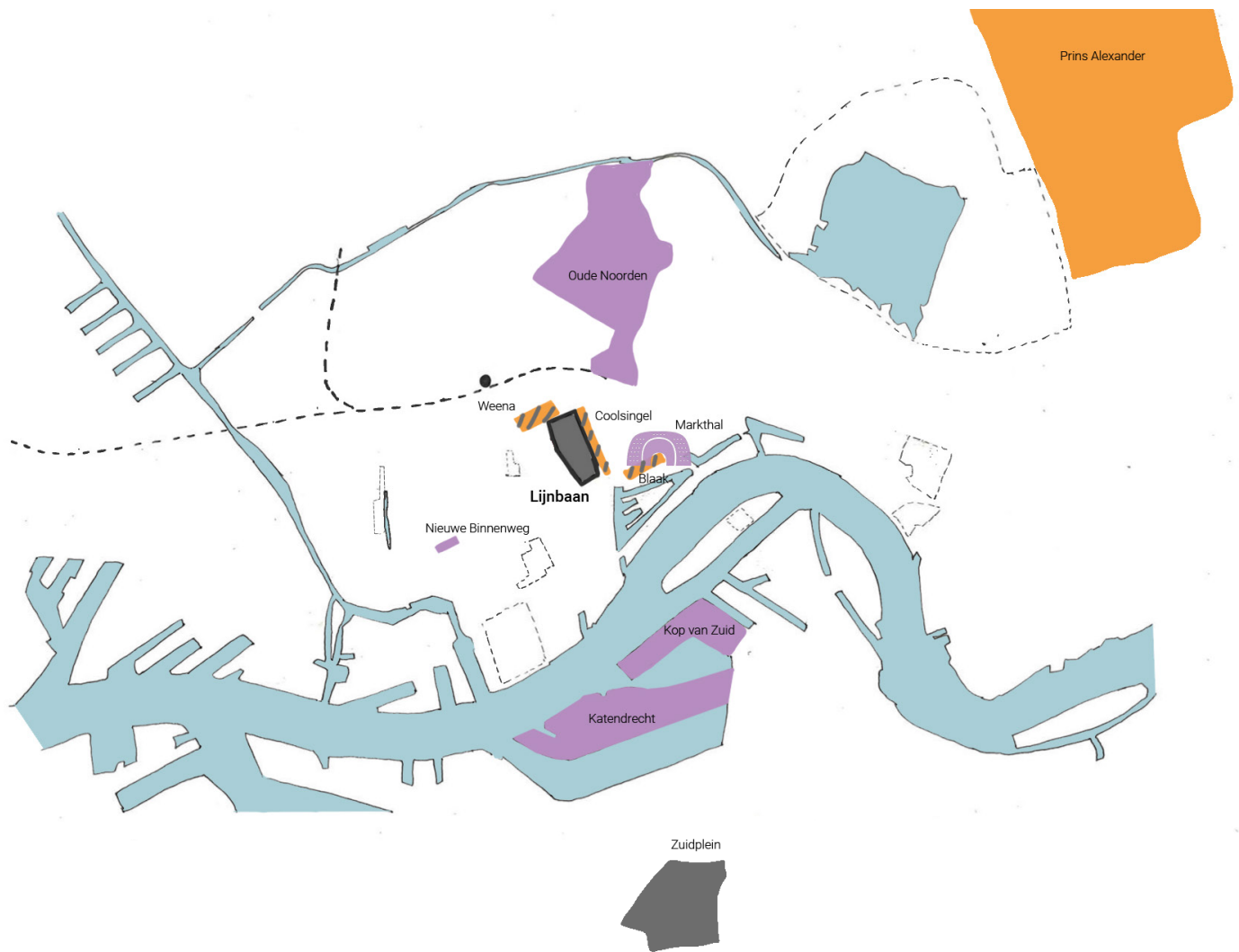
To gain better insight into which areas in Rotterdam are characterized by functionalism and modernism, and which by mixed-use, a typology map has been created. This map also positions the Lijnbaan alongside mixed-use examples, demonstrating that the vision of a restorative network through the Lijnbaan fits within broader urban development and is not an isolated intervention.

The typology map of Rotterdam shows how different parts of the city are organized and used. Large areas in the city centre, including the Lijnbaan, were rebuilt after World War II according to principles of **modernism** and **functionalism**. These areas have clear block structures, wide streets, and separated functions for shopping, working, and living. They focus on efficiency and movement. They also focus on creating space for circulation but offer little space for rest, calm, decompress, or human-scale experiences. The Lijnbaan is part of this modernist network, and therefore a logical place to take a next step toward a more human-centered city.

In contrast, other parts of Rotterdam, such as Katendrecht, and the Oude Noorden, show a mixed-use. These areas combine shops, housing, leisure, and public spaces. This creates a more varied and lively urban environment. It seems that Rotterdam increasingly contains places where functions are mixed and where the

street becomes a place to stay, instead of only a space for movement. These areas show that Rotterdam is shifting from functional separation toward human-centered urbanity.

By comparing these typologies, the map shows the potential of the Lijnbaan. While it remains functionally strong, it could be transformed to include mixed uses, spaces for rest, and decompress and greenery. Adding these elements would create a more layered, human-focused street while keeping the clear structure intact. The typology map shows where the city has already experimented with mixed use and human-scaled design, and that the Lijnbaan can evolve, to meet the changing urban needs of daily life.



Functionalism

Lijnbaan:

- Strict separation of functions (shopping, living)
- Clear block structure
- Emphasis on circulation and flow

Zuidplein:

- Shops separated from the street
- Closed volumes
- Car-oriented
- Function retail typology



Modernism

Coolsingel

- Clear separation of functions (traffic, offices, shops)
- Focus on movement
- Monumental boulevard with wide streets and large-scale buildings

Blaak

- Function-focused layout, limited public space
- Large scale

Weena:

- Principles of clarity, order and efficiency
- Strong focus on traffic flow
- Separation between functions (offices, services, traffic)
- Limited emphasis on small-scale public life
- Buildings positioned as objects in space rather than forming continuous street walls



Mixed-use

Markthal:

- Housing + market + horeca + public circulation in a single building
- Mixed-use through vertical stacking

Katendrecht

- Combination of housing, horeca, culture, and public space
- Greater emphasis on staying rather than circulation
- Reuse of existing buildings

Kop van Zuid

- Combination of housing, work, culture, and recreation
- Increased focus on street fronts, routes, and quality of stay

Nieuwe Binnenweg

- Mix of shops, cafés, and housing
- Human-scale street with active street fronts
- Encourages staying and social interaction

Oude Noorden

- Small shops, workshops, cafés, and housing mixed together
- Informal spaces for staying and socializing

Figure 4.33 : Urban typologies in Rotterdam: functionalism, modernism, and mixed-use

4.2.2 Zooming out: unequal distribution of recreational green spaces

The next step is identifying where urban calm currently is located in Rotterdam.

This city-scale map of Rotterdam reveals that recreational green spaces that provide restoration benefits are mostly concentrated in large parks such as the Kralingse Bos, Het Park, and Museumpark. These green areas are mostly located at the edges of the inner city or at specific urban nodes, while the commercial heart of the Lijnbaan offers relatively few opportunities for rest, stay, and decompress. By visualizing this uneven distribution, the map shows a scarcity of restorative and recreational green within the city centre. So, the introduction of small-scale, restorative green spaces within the Lijnbaan not only enhances local spatial quality but also addresses a broader urban gap in access to everyday green and spaces for mental restoration.

Thus, positioning the Lijnbaan alongside recreational green spaces shows that a transformation of the Lijnbaan can be seen as an urban necessity rather than just a local intervention. It shows that a transformation of the Lijnbaan could be a structural enrichment of the urban system.

4.2.3 Zooming out: de 7 stadsprojecten

Finally, in 2021, urban development projects were initiated in Rotterdam by de Gemeente Rotterdam as part of the *Stadsakkoord Rotterdam. Sterker Door 7 Stadsprojecten* (Gemeente Rotterdam, 2021). These projects are implemented by the municipality to make public spaces more attractive, greener, and multifunctional, which will allow residents and visitors to meet, move, recreate, and stay.

The vision this thesis proposes for the Lijnbaan can be positioned within the context of these 7 Stadsprojecten, as it aligns with their goals of creating greener, and more multifunctional public spaces that promote social interaction, movement, recreation, and staying. By situating the Lijnbaan within this broader urban development strategy, the project contributes to Rotterdams' vision of human-centered, restorative, and multifunctional spaces, rather than functioning as an isolated intervention.



Figure 4.34 : City-scale map of Rotterdam with recreational green spaces

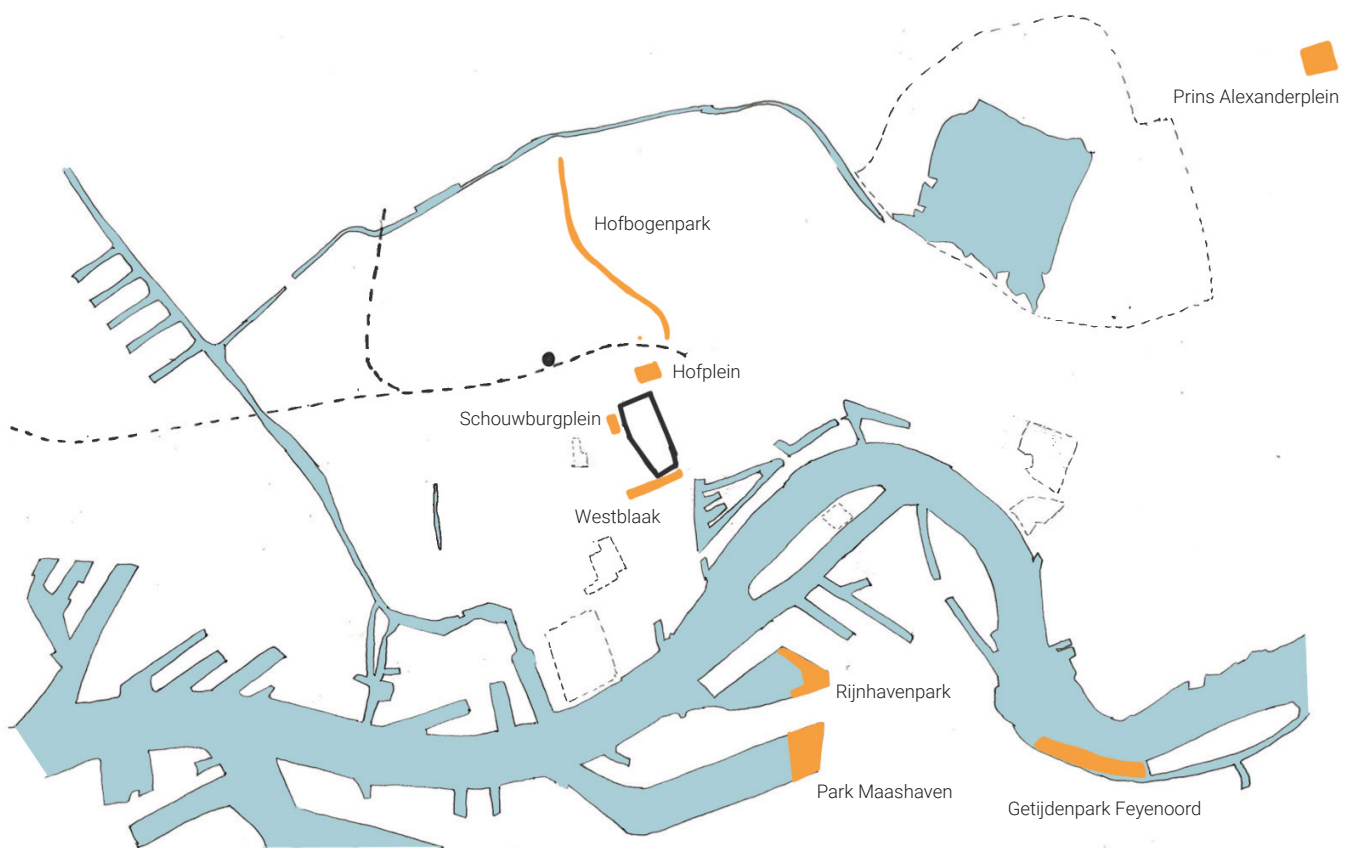


Figure 4.35 : City-scale map of Rotterdam with the 7 stadsprojecten

4.3

Walking through the Lijnbaan

Experiencing the Lijnbaan through the senses

After zooming out to the city scale, the analysis now shifts back to the Lijnbaan itself. This time, the focus is on how stimuli and stressors are experienced at the level of the individual body and the senses. To explore this in more depth, walk-along interviews are used as a method to understand how stimuli and stressors in the Lijnbaan influence sensory perception.

Walk along interviews

4.3.1 Research method

To investigate how the perception of urban stressors in public space influences the individual senses (sub-research question 3), walk-along interviews were used as the main research method. Six participants walked along a route through the Lijnbaan in the city center of Rotterdam. During the walk, the participants were asked to stop and stand still at four different locations. These locations were different spatial typologies, so it could be analysed how the perception of urban stressors changes in different types of public space. By comparing these different spatial atmospheres, it was possible to observe differences in sensory experience, perception, and behavior.

At every location, the same five questions were asked. The questions were open-ended, which let participants describe their experiences with their own words. When they gave relevant insights, follow-up questions were asked to gain a deeper understanding of the participant's perception. To answer the sub-research question "How does the perception of urban stressors in public space in Rotterdam's city centre influence the individual senses?", the question was translated into five accessible interview questions:

1. Do you feel stressed or uncomfortable in this part of the Lijnbaan?
2. What do you notice the most here, or what disturbs you?
3. What do you usually do when you feel stressed in a place like this?
4. Are there places in this street where you feel particularly comfortable or uncomfortable? What makes you feel that way?
5. How do you notice that this environment affects your senses?

Each walk-along interview lasted about twenty minutes. This length gave participants enough time to experience each location and reflect on their sensory perception, while maintaining concentration and keeping the interview informal and natural.

The participants were people familiar to the author. This made the walk-along interviews more comfortable and encouraged more open and detailed responses. Most importantly, all participants walked the same route and were asked to answer the same questions. Since the research focuses on individual perception and sensory experience, each personal experience was considered relevant. Working with familiar participants made it easier for them to respond honestly and give longer, more detailed answers. This made it possible to gain deeper responses. For this thesis, this approach was seen as suitable, as it would give better quality qualitative data than short street interviews.

4.3.2 Ethics, anonymity, and data collection

This research focuses on sensory experience in public space instead of on personal data of the participants. The walk-along interviews were conducted in an informal way, and no personal information like names or background details were asked and collected. So, all participants will remain anonymous. There were also no audio recordings made; instead, quotes and notes were taken during the interview, and immediately afterwards. The collected information consists of relevant insights about how people perceive the urban environment, instead of personal data.

4.3.3 The route: four different spaces

1. Corridor space

The street is surrounded by two long building blocks on both sides. It is more enclosed. The space is mainly used for movement, with people walking in straight directions. There is more movement at the sides, while the middle area is sometimes used for staying.



2. Open space

An open space that interrupts the linear structure of the street. The tram line runs through this area and people move in different locations instead of one straight flow. The space is wider and more open.



3. Semi-enclosed space

A small square positioned next to the main pedestrian flow, but enclosed by surrounding buildings. Because of this, the space is a sheltered and protected corner within the shopping street.



4. Wide corridor space

The area is a wider corridor space. It is broader and surrounded by higher buildings with more variation in height. Movement and staying happen at the same time and place and the pedestrian flow is less clearly structured. The seating areas are mainly located along the edges instead of in the middle of the space, like location 1 did.



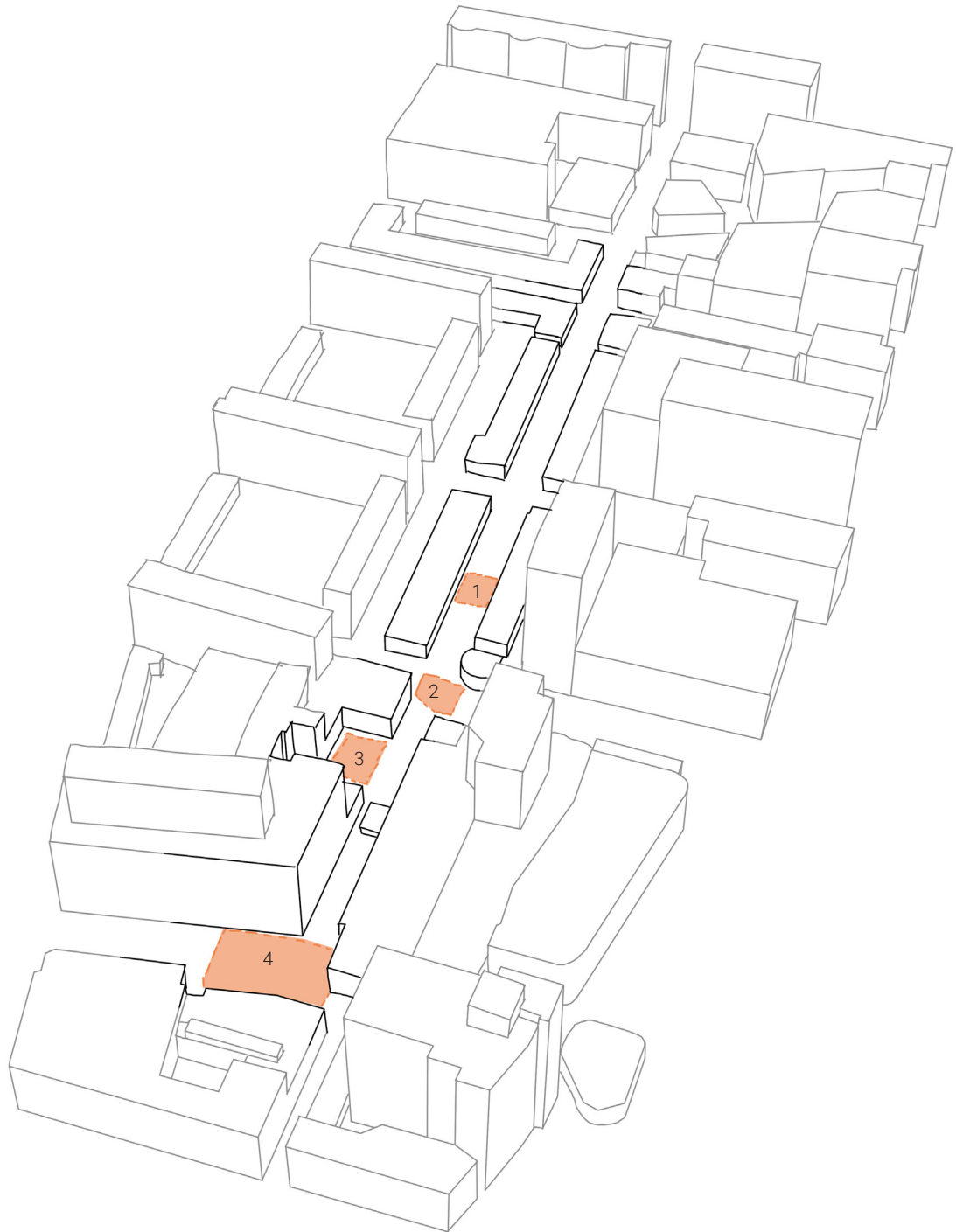


Figure 4.36 : The four locations in the Lijnbaan, along the route for the walk-along interviews

4.3.4 Quotes from participants during the walk-along interviews

"Het is fijn dat je onder de beschutting van de luifels kan lopen. Maar het voelt ergens ook bedrukkend, want je loopt tussen hoge gebouwen die op je neer kijken, en het voelt bedrukkend dat het hier dan laag is"

"De stenen zijn wel heel fel, dat is irritant want dat doet pijn. Je moet zo met je ogen knijpen"

"Ik hoor het geluid hier zachter. Er zijn minder prikkels hier en ik voel me scherper. Het pad waar de mensen lopen is verder van de boom, lekker gescheiden van elkaar"

"Ik voel de wind hier. Ik ben meer aan het luisteren omdat ik zit. In de winkelstraat moet ik meer filteren, hier kan ik meer luisteren."

"Je hebt hier meer rugdekking wat ik fijner vind"

"Er is zoveel vogelpoep, ik weet niet waar ik moet zitten"

"Wel een erg stenig bankje, erg hard"

"Het zit niet lekker en er is geen rugdekking. Steen zit niet fijn, en dat het vies is werkt niet mee"

"Het bankje heeft een naar materiaal en ziet er vies uit"

"De boom is prettig maar het bankje niet prettig"

"De boom valt het meeste op, en die poort ook. Hij staat vaag in de situatie maar het maakt me wel nieuwsgierig"

"Ik voel me hier scherper"

"Leuk dat die poort hier staat"

"Die domme paaltjes storen mij. Je moet er zo omheen manoeuvreren, dat stoort me"

"Dat grote ding is reflecterend en de duiven storen mij"

"Het is levendig hier en dat is leuk. Het komt wel harder binnen, maar dat is omdat het open is en je kan zien waar het geluid vandaan komt."

"De auto geluiden en motor geluiden zijn wel vreselijk"

"Best veel lelijke prullenbakken van Bram Ladage, oogt vies"

"Die sinaasappel kraam komt ook intenser binnen. Er is meer ruimte waardoor de mensen meer verspreid aanvoelen. Het achtergrondgeluid lijkt zachter, maar andere dingen komen harder binnen."



"Het stoort dat de tegels reflecteren door de regen en zonlicht, het is fel licht"

"Die frituurlucht vind ik niet lekker"

"De duiven vallen het meest op. Ze vliegen alle kanten op. Is voor mij een visuele prikkel wat ik niet fijn vind. Het geluid is ook niet fijn, het gefladder van de vleugels vind ik ook niet chill."

"De geur van Bram Ladage vind ik fijn en lekker"

"Het kruispunt een stukje terug is vreselijk; de hele tijd auto's die er tussendoor willen jassen"

"Af en toe wat groen tussen de winkels is prettig"

"Het is hier rumoerig en ik kan me niet goed focussen hier"

"Ik moet geluid hier filteren. Er is veel geluid. En er zijn veel bewegende mensen."

"De muziek uit de winkels stoort me"

"Die gillende mensen zijn ook onprettig en stoort"

"The tram affects me"

"Ik vind het nu wel druk, jezus".

"Ik word afgeleid door de schermen hier"

"Het is erg grijs hier en dat heeft wat treurigs en somber"

"De tram die langs dendert is druk. Die trillingen vind ik arelaxed"

"Dat hoereding werkt wel op me zenuwen"

"Er is veel keuze qua richtingen. Mensen lopen kriskras door elkaar heen, dat is irritant"

"I become more aware of my surroundings; there is a tram, there are bikes, and people are walking in different ways and directions, it is more overwhelming"

"Aah die paal, hij beweegt. Ik zat de vorige keer de hele tijd te kijken naar hoe hij draait. Ik word er zenuwachtig van"

"Het kost meer energie om hier te focussen"

"Ik zie veel afval, dat is vies"

"There are so many people here"





4.3.5 Findings

Sound

Sound was the factor that was mentioned the most during the interviews. Most participants immediately noticed the noise in the four locations, and it was also the element that seemed to disturb them the most. Several participants mentioned loud music coming from shops, such as the JD and the Snipes. One of them said that they found that annoying. The overall noisiness of location 1 also made it difficult for one participant to focus. Traffic noise was mentioned as well, especially the sound of cars and motorcycles. But mostly the tram at location 2, which many participants described as annoying.

However, the perception of sound changed, depending on the location. In location 3, the more sheltered corner space, the sound was experienced as softer and less disturbing. At location 4, the noise was also by a few participants perceived as lively and pleasant. This shows that sound is one of the most important stressors, but that its impact depends strongly on the spatial characteristics of the space.

Auditory stressors are already well described in the literature. These findings from the interviews are therefore more seen as confirmation, as participants' responses are similar to what has been described before. While no new auditory stressors were identified, the results strengthen the importance of these factors in everyday urban experience.

Advertisements and visual overstimulation

Advertisements and shop logos were also mentioned during the interviews. One participant explained that the advertisements in windows of the stores sometimes made her feel confused and visually overwhelmed. At location 2, several

moving advertisements are shown on LED screens, and she mentioned that these screens were very distracting. Another participant also said that he finds moving advertisements irritating.

This suggests that not only noise, but also strong visual stimuli such as advertisements and digital screens influence how people experience public space. Moving images attract attention very strongly and can make the space feel more chaotic and overwhelming.

This finding connects to existing literature on visual stressors (chapter 3.4.1, page 39). Previous studies have identified elements such as flickering lights from shops and advertisements as sources of visual stress.

Reflection of light, visual discomfort, and behavioural response

One participant experienced the space during changing weather conditions: it first snowed and hailed, and then the sun started to shine. As a result, the tiles were wet and strongly reflected the sunlight. The participant mentioned that the reflection of the tiles felt disturbing and that the light was very bright. She explained that this glare was painful for her eyes and forced her to squint while walking.

This was very interesting because it influenced her behaviour. The participant explained that when she feels stressed in public space, she normally looks down while walking, in order to avoid eye contact and reduce sensory pressure. However, in this situation that was not possible, because the strong reflection on the pavement made it uncomfortable to look down.

This shows that visual stimuli such as glare and reflection do not only influence how a space is perceived, but also how people move through

it. This example shows how visual perception and behavioural response are connected to each other in the experience of urban stressors.

This finding is interesting, as it highlights something that is not yet really discussed in existing literature. It can be understood as a form of antagonistic multisensory effect, (see chapter 3.4.2, page 40) where a negative visual stimulus, such as glare, reduces overall sensory comfort.

In this situation, the strong reflection not only caused visual discomfort, but also prevented the participant from using her usual coping strategy. As a result, stress was not reduced, but rather increased.

Touch and material experience

The circular bench around the monumental tree at location 3 also led to some strong sensory responses from participants. While the location of the bench was seen as pleasant, the materiality of the bench was also criticized. One participant described the material as unpleasant and visually unappealing. Another mentioned that the bench felt very hard and stony, making it uncomfortable to sit on. He suggested that a wooden bench would be better for tactile comfort.

Hygiene also affected the sensory experience: the presence of bird droppings made the bench feel dirty and made it difficult to find a good spot to sit. Also, the continuous, circular shape of the bench created uncertainty about where to sit and how much personal space to keep when sitting next to others. It was also noted that the bench was too deep and missed back support, which reduces overall comfort. It shows that tactile experience is an important factor of how people perceive a space.

This aligns with findings in the literature (see page 39), which show that tactile sensations such as dirt and highly processed materials contribute to discomfort.

Odor and subjective perception

Olfactory stimuli were also mentioned by several participants. This shows the subjectiveness of scent in public space. For example, the smell of fried food from Bram Ladage was often noticed: some participants found it pleasant, while another one found it unpleasant. This shows that sensory experiences, odors, are very personal and can influence how comfortable people feel in the same environment.

The tram and sensory impact

The tram also had a big impact on sensory perception. Participants mentioned that the sound of the tram is unpleasant and that it feels stressful as it passes by. One participant also noted that the vibrations caused by the tram were uncomfortable, so it also affected the tactile experience. Overall, the tram negatively affects both auditory and tactile experiences in the space.

The vibrations caused by the tram, experienced as a tactile stressor, are not yet discussed in the literature. This finding adds a new perspective, suggesting that these kinds of tactile stimuli play a role in sensory discomfort.

Color and emotional experience

One participant mentioned the influence of colour of the space. At location 2, she described the environment as very monotonous in colour. The space felt very grey, and this felt to her as a sad and gloomy atmosphere. In contrast, the cherry blossom tree at location 1 was experienced as very pleasant. Another participant also mentioned that being near the colourful cherry blossom felt comfortable and visually appealing.

The interviews also showed that participants appreciated the presence of greenery between the shops. Even small elements of nature, like the hedges or the flowering tree, had a clear positive effect on how the space was experienced.

These findings partly connect to existing literature. While previous studies identify abundant colours as visual stressors (see page 39), there is less attention to how grey and monotonous environments can act as emotional stressors. In this case, the lack of colour was linked to a gloomy atmosphere. At the same time, the positive effects of the cherry blossom tree and greenery align with Stress Reduction Theory (discussed at page 35), which suggests that natural elements can help reduce stress and improve the experience of a space. This also aligns with Attention Restoration Theory, as the cherry blossom provides a sense of “being away,” which can allow to mentally escape from the stress of the urban environment.

Edges and corners versus the middle of the space

Another interesting finding from the interviews is that participants responded different to the edges of the space and the middle of the space. One participant explained at location 2 that when she feels stressed, she prefers to stay close to the edges and walk along the buildings. In this way, people only pass her on one side instead of from both directions. She also mentioned that one of the corners of the square at location 3 felt more comfortable, because stimuli then come from just two directions instead of four, and it creates a sense of “back

protection.”

This relates to the literature on Perceived Sensory Dimensions (discussed at page 35), particularly the dimension of Refuge. Edges and corners can give a sense of overview, offering feelings of shelter and protection in the space.

However, another participant had a different experience. He mentioned that he actually preferred the middle of the space, especially in the narrower part of the Lijnbaan (location 1) where there is more seating in the centre. He explained that he would not stop near the edges close to the shops, because there is too much movement there.

This difference suggests that the perception of comfort depends not only on personal preference, but also on the spatial context. In a more open space, the edges and corners may feel calmer and more protected. And in a more enclosed space, the middle area can feel more comfortable because it is separated from the movement along the shopfronts.

Sudden movements as a stressor

Unexpected events in public space can also create a strong sensory reaction. For example, a person was running out of a shop while being chased by enforcement and security officers was described as a “sensation,” because of the sudden movement, increased noise and the attention of people in the street. So it is not only about a thief, but about the sudden change in the atmosphere of the space. This also aligns with other participants saying they were bothered by the sudden movement of pigeons. Pigeons flying up or unexpected events in the street, made the space feel less calm. This

suggests that people feel more comfortable in environments that are predictable and easy to understand.

So, next to main stressors like noise, crowding and traffic as main urban stressors, the interviews also revealed that unexpected movement plays an important role in how people experience public space. Sudden movements were described as disturbing. This shows that not only permanent stressors, but also unpredictable sensory stimuli influence the individual experience of public space. It influences how people emotionally and physically experience public space, even when they do not explicitly describe the space as stressful.

Expeditiestraten

Two participants mentioned independently the parallel streets next to the Lijnbaan, the so-called expeditiestraten. When asked which places in the area felt uncomfortable, one participant described the parallel street as strange and called it “weird concrete blocks,” explaining that the residential flats felt too close to the shops of the Lijnbaan. However, the participant also mentioned that if the street was greener and designed with more space, she would consider to use it as an alternative walking route next to the Lijnbaan. She also said that it would be interesting if the shops along the Lijnbaan were accessible from both sides, so also from the side at the expeditiestraat.

Another participant said that if he felt stressed, he might consider going into this parallel street because it is “quieter.” This suggests that the expeditiestraten have the potential to function as restorative calmer alternative routes where people can move away from the intensity of the main shopping street.

Location 3 ; the corner

Another clear finding from the interviews is that location 3, which is slightly away from the main urban flow, was experienced as a pleasant place. The area with the bench surrounding the large plane tree was often described as calmer than the rest of the Lijnbaan. Participants mentioned that they felt more relaxed there. One participant even said that she felt more alert and more aware of her surroundings in this space. She explained that she took more time to look around and listen carefully to the environment. This aligns with another participants’ experience. She said that she hears the noise more softly here. It was mentioned that there are fewer stimuli here and she felt more alert as well. According to her, it was very nice that the path where people are walking is further away from the tree, which creates this pleasant separation. This suggests that places that are a bit removed from the main pedestrian flow can create a calmer and more conscious sensory experience.

Sitting and sensory experience

Two participants immediately sat down when we approached location 3. It became clear that sitting in this area changed the sensory experience of the space. Sitting on the bench changed how the space was experienced: one participant mentioned that he focused more on listening while seated and thus was more sensitive to auditory stimuli. He explained that in location 1, along the street, he mostly had to filter noise, while at the bench he could listen more and became more aware of sounds and the wind.

This suggests that the activity of sitting versus walking influences how people perceive and experience sensory stimuli in public space.

The canopies

Another important finding from the interviews was that the canopies along the Lijnbaan have a clear influence on the sensory experience of the space. One participant mentioned that walking under the canopies feels comfortable because it creates a sense of shelter. When the participant later moved into a more open area (location 2), where people were walking in different directions and the tram line crossed the space, the canopied area was suddenly perceived as a more pleasant place to return to. The open area felt more chaotic and exposed, and the participant also mentioned feeling the wind more strongly there.

This suggests that the canopies function as a form of protection and help create a calmer spatial experience. At the same time, another participant also mentioned that the alternation between covered and open spaces is important. The variation between open and sheltered areas was experienced as pleasant, as it creates different spatial atmospheres instead of one monotonous environment. Another participant also noted that the wooden canopies make the space feel more intimate and comfortable, which shows that they also contribute to the overall atmosphere of the street.

These participant responses align with literature on stimuli for restorative benefits (see page 39). In terms of visual experience, previous studies suggest that a balance between open and enclosed spaces is perceived as pleasant, and that variety in different types of spaces contributes in a positive way to the overall experience.

Spatial openness

One important insight from the interviews is that spatial openness influences how people perceive urban stimuli. When the space becomes more open and spacious (location 4),

it does not necessarily remove stimuli such as noise, movement, or visual elements. Instead, the perception of these stimuli changes. One participant mentioned that this more open space felt more spacious and that “less noise was coming at her.” However, at the same time, she became more aware of individual elements, such as shops or a small food stand. The background noise also seemed softer because people were more spread out, but this made other elements stand out more visually.

This suggests that more enclosed spaces like the corridor space location 1 can create a form of “visual overload as a whole,” while more open spaces allow for a more conscious perception of separate elements. In this sense, spatial openness does not reduce stimuli, but changes the way they are experienced. This insight directly relates to the sub-research question: How does the perception of urban stressors in public space influence the individual sense? It seems that spatial openness reduces sensory pressure, but increases awareness of individual visual elements.

When linking this to the literature and stimuli overview on page 39, a synergistic relationship can be observed. Wide sightlines and feeling of openness can have a positive effect by reducing the perception of noise. In contrast, when noise levels are lower, visual elements become more prominent, as other details in the environment stand out more.

Going into stores as a coping strategy

Many participants mentioned that at location 2, the open area with the tram line crossing the space felt more stressful. When one of the participants was asked what she would do in this situation, she explained that she would go into a shop. Another participant responded differently and said that he would rather leave the area and walk away instead of going into

a shop. However, when this same participant was asked what would feel like a pleasant place at that location, he mentioned that a calm and quiet shop would actually be a comfortable option. A third participant also said that she would not immediately go into a shop, because shops can also contain many sensory stimuli.

This suggests that shops are sometimes seen as an alternative “escape space,” but only when it is a calmer environment. If a shop is crowded, noisy, or visually overwhelming, it does not function as a place of relief. Therefore, these findings indicate that there is potential for creating quieter interior spaces within the shopping street. This could be a calm zone, quiet room, small reading areas, tea rooms, or passages that allow people to temporarily step away from the sensory intensity of the public space.

Nervousness triggered by sensory stimuli

Another interesting finding is that participants sometimes felt nervous after experiencing strong visual or auditory stimuli. For example, one participant mentioned the street organ, which gave off very loud sounds, and explained that the noise “worked on her nerves.” Another participant referred to the artwork on location 4 with two rotating elements. She explained that she kept looking at the movement and said that it made her feel nervous.

This suggests that both auditory and visual stimuli can directly influence emotional responses such as nervousness. It also shows that not just the large-scale factors such as crowding or traffic affect the experience of public space, but also smaller, more specific sensory triggers.

Sequence in which the spaces are experienced

After the walk-along interview, one participant shared an important reflection. This insight was not only about the spaces itself, but also about

how people experience space depending on the order in which it is perceived. According to the participant, the experience of the Lijnbaan changed because the route of the interview moved from a more enclosed space to a more open space. At the beginning (location 1), the participant felt a sense of pressure but as the route led into a more open area, the space felt increasingly free and comfortable.

The participant explained that when you are in a dense environment and are asked for the first time how you feel, the immediate reaction is that “everything comes at you at once.” When the route then moves to a more open space, the environment feels calmer and less overwhelming. However, the participant suggested that the experience might have been very different if the route had been the other way around. Starting in an open space could make someone feel more exposed to stimuli at first, while moving toward a more enclosed space might then feel safer and more protected. The stimuli that at first might feel overwhelming in the open area would become less intense in the more enclosed part, which could create a stronger sense of calm and security.

This reflection also shows that the interview questions themselves made the participant more aware of the surroundings. The first moment of awareness seemed to have influenced how the rest of the space was experienced. This suggests that the perception of urban stress is not only related to objective factors such as noise or crowding. But is also subjective and depends on personal experience. It depends on where someone begins, what they experience first, and when they become aware of the environment.

This insight shows that the experience of public space is not only determined by design, but also by movement through the space and the experience of time. It can be concluded that the

perception of urban stressors is not only related to the physical environment, but also to the sequence in which spaces are experienced.

Perceived stress versus sensory overload

At almost all locations, most participants at first answered that they did not feel stressed and responded with “no.” on the first question. However, this was different at location 2, the open central area where the tram line crosses the space. At this location, participants appeared clearly less comfortable and said they were more stressed than at location 1. Most participants described the space as very busy, with people walking in different directions and a high level of noise and movement. One participant mentioned that he felt less at ease and as if he was “in the way” of others. He also described this space as having more stimuli compared to other parts of the Lijnbaan. Another participant said that in this area she constantly had to look around and found it difficult to focus.

Even though participants said they did not feel stressed at locations 1, 3, and 4, they still noticed many aspects of the Lijnbaan that bothered them. They mentioned sensory elements that were unpleasant and described difficulties focusing or filtering out stimuli, showing that they experienced several stressors.

This suggests that even when participants did not always explicitly experience the space as stressful, their responses clearly indicated a high level of sensory stimulation. The findings therefore show that the perception of urban stressors does not always result in a conscious feeling of stress, but it still influences behaviour, comfort, and awareness of the environment.

Personal factors and internal stress

One participant made an important comment about the perception of stress in public space.

She explained that stress is not only caused by the environment itself, but it also strongly depends on personal factors. For example, she mentioned that if she feels stressed in a place it also depends on if she has an exam coming up, if she slept badly, or if she already has a lot on her mind. Because of this, she, and the other participants did not directly describe the Lijnbaan as stressful. However, she did mention that the spaces contains many stimuli and that it clearly affects her senses, which aligns with other participants experiences.

This shows that the perception of urban stressors does not always lead to a conscious feeling of stress. Instead, the environment can influence the senses without people explicitly describing it as stress.

Reflection on the hypothesis

The hypothesis of this subresearch question was that people would explicitly feel stressed in the Lijnbaan. However, the results of the walk-along interviews show a more nuanced outcome. Most participants did not directly describe it as feeling stressed, but they did experience the spaces as busy, overwhelming, or uncomfortable.

This suggests that urban stress is not always consciously recognized or explicitly named. Participants were still able to function normally in the space, but their sensory experience clearly changed. Many mentioned that they had to filter noise, look around more often, or found it difficult to focus.

The findings therefore show that urban stress in public space is often subtle: people may not describe the space as stressful, but their senses work harder, experience feelings of being overwhelmed, feel the need to filter, and their behaviour adapts to the environment.

4.3.6 Making connections

In addition to the strategies that were developed from the literature (sub-chapter 3.4.4), further design strategies can also be developed based on the findings from the walk-along interviews. Just as in the previous chapter, where literature insights were translated into design strategies, the iterative process of this thesis allows for a similar translation at this stage, but now grounded in empirical findings. This allows that theory and lived spatial experience continuously inform each other through the research.

But most important, this does not yet involve the creation of a concrete design, but an early exploration of how insights can already be translated into potential design strategies. In this way, the subquestion *what restorative spatial design strategies can be used to minimize or compensate stressors?*, is further explored through the analysis of the walk-along interviews.

Developing design strategies

Based on the results of the walk-along interviews, a clear overview is created, which can be found on the next pages. In this table, each finding is linked to the sense it affects. The findings are then connected to the categories of stimuli (see page 41 for the categories). After that, they are linked to relevant theories and sensory effects from the literature. Finally, these insights are used to develop new design strategies.

Overview

Senses

Conclusions



Advertisements and led screens -> distracting



Reflection pavement -> painful to eye and prevents coping mechanism



Material experience of stony bench and uncertainty about proximity -> discomfort



Odor from street food -> both unpleasant and pleasant



Tram and sensory effect-> disturbing sound and vibrations in ground



Color and emotion -> grey is gloomy, pink and green comforting and appealing



Edges and corners vs middle of the space -> in wider areas, edges feel more comfortable because stimuli come from fewer directions. In narrower spaces, edges can feel more stressful because of constant pedestrian flow, making the center a more comfortable place with more space.



Sitting and sensory experience: when seated, people need to filter less noise and are better able to focus



Nervousness triggered by sensory stimuli (rotating object, street organ)



Sound ; traffic, music from store, crowds -> disturbing, also pleasant (lively)

ART= Attention Restoration Theory

SRT= Stress Reduction Theory

PSD = Perceived Sensory Dimensions

Categories

Literature

Design strategy

Materiality



Materiality



Materiality



Programme



Traffic



Color



Lay-out



Lay-out



Materiality



Traffic



Materiality



Materiality



Living beings



Antagonistic effect

Antagonistic effect

ART; fascination
PSD; rich in species

PSD; refuge

PSD; refuge
ART; compatability

ART; fascination

Antagonistic effect

Adding vertical wooden slats / semi transparant screens for windows

Replacing the current pavement with porous, textured pavers and adding more greenery

Replacing the stone bench with a wooden bench with a backrest

Replacing the current pavement with sound-dampening pavers combined with a vibration-dampening sublayer, and introduce greenery between and around the tram tracks to help reduce noise.

Introducing more greenery and diverse (colorful) plant species

Placing niches and benches at the edges and corners of open spaces

Placing more wooden benches and niches

- Introducing greenery to reduce noise and natural scents that make sound feel less disturbing.
- Adding a small café or waffle stand for coffee scent and sweet aroma (reduces perception of noise)
- Adding herbs and low plants that create pleasant smells (reduce perception of noise)
- Replace the current pavers with sound dampening pavers
- strategies for crowds (sub chapter 3.4.4, p.44)
- Transforming the canopy into gallery and adding second level
- Adding quiet rooms
- Adding passages
- Adding rooftop garden

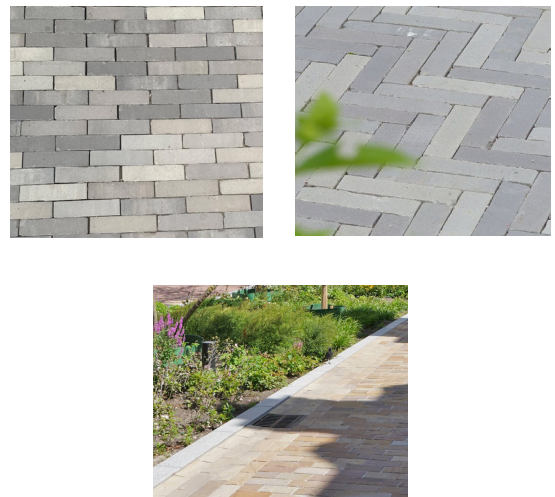
Further explanation of some design strategies based on findings

Reflection pavement -> painful to the eye and prevents coping mechanism looking at the ground



Reflection in pavement by rainfall and sun, causing glare

Replacing the current pavement with porous, textured pavers and adding more greenery



Examples of new materialisation of the Lijnbaan

“Als de tegels niet reflecteren zou ik naar beneden kijken om mensen niet aan te kijken”

“De stenen zijn nu wel heel fel, dat is irritant want dat doet pijn. Je moet zo met je ogen knijpen”.

“Het stoort dat de tegels reflecteren door de regen en zonlicht, het is fel licht”

Figure 4.37 (top): Porous pavers (Postmus, n.d)
Figure 4.38 (top): Porous pavers (Bestratingsweb, n.d.)
Figure 4.39 (bottom) : Greenery in street (Sluijsmans, N. in Noordhuis, P., 2023)

Advertisements and LED screens -> distracting



LED-screens with moving images at storefront

Adding vertical wooden slats / semi transparent screens for windows of stores



Drawing of research by design process, showing the wooden slats and semi transparent screens

“Ik word afgeleid door de schermen hier”

Crowds -> lots of movement and noise
difficult to focus



Living beings



Antagonistic
effect

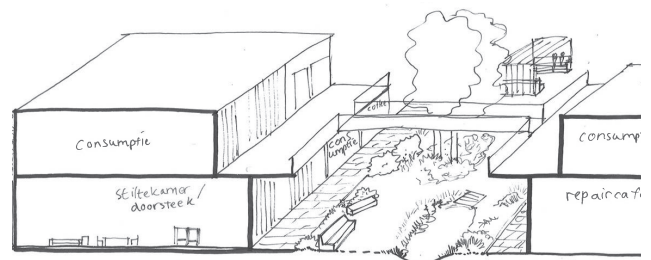


Vibrant Lijnbaan

“Ik moet geluid hier filteren. Er is veel geluid.
En er zijn veel bewegende mensen.”

Transforming the canopy into gallery
and adding second level

Create clear circulation routes and
separate staying areas to reduce
conflicts between flows.



*Drawing of research by design process, showing the trans-
formed canopy and new circulation routes*

Overview of developed design strategies

The next page shows a summarizing overview of the design strategies developed so far, with a focus on the senses and on creating restorative environments. The overview distinguishes between strategies based on literature and those that were based on the walk-along interviews.

Overview design strategies: based on literature and analysis

Literature study

Smell reduces perceived noise: introduce planting (**SRT** en **PSD**; rich in species and nature) and small coffee kiosk/ tea houses to create pleasant scents

Wide sightlines reduce perceived noise and smell: avoid placing large objects in the centre of the space to maintain openness.

Antagonistic effect: traffic noise reduces positive effects of pleasant smells -> redesign streets with more greenery and sound-dampening paving.

Antagonistic effect: crowding masks other sensory qualities:

- > create clear circulation routes and separate staying areas to reduce conflicts between flows.
- > Create micro-refuges: integrate benches with backrests and niches to provide shelter and a sense of retreat (**PSD**: Refuge; **ART**: Being away).
- > Create hierarchy in movement : differentiate between main routes (movement) and secondary spaces (staying) to reduce perceived crowding.
- > Create meandering paths instead of linear layout : break continuous flows and reduce the perception of mass.
- > create spatial segmentation : divide space into smaller "rooms" so crowding is experienced in parts rather than as one large flow.
- > Add parallel routes : distribute pedestrian flows across multiple paths.
- > alternate between wide and narrow sections to reduce the feeling of constant pressure.
- > create variety in openness : combine open and enclosed spaces, allowing users to choose environments that fit their needs (**ART**: Compatibility).

Taste as a restorative element

- Introduce accessible, small-scale food interventions that engage taste, such as fruit stands, coffee kiosks, and urban farming.
- Enable everyday interaction through picking and consuming fresh products

Analysis/fieldwork/site-visit

Adding vertical wooden slats / semi transparent screens for windows

Replacing the current pavement with porous, textured pavers and adding more greenery

Replacing the stone bench with a wooden bench with a backrest

Replacing the current pavement with sound-dampening pavers combined with a vibration-dampening sublayer, and introduce greenery between and around the tram tracks to help reduce noise.

Introducing more greenery and diverse (colorful) plant species

Placing niches and benches at the edges and corners of open spaces

Placing more wooden benches and niches

- Introducing greenery to reduce noise and natural scents that make sound feel less disturbing.
- Adding a small café or waffle stand for coffee scent and sweet aroma (reduces perception of noise)
- Adding herbs and low plants that create pleasant smells (reduce perception of noise)
- Replace the current pavers with sound dampening pavers
- Transforming the canopy into gallery and adding second level
- Adding quiet rooms
- Adding passages
- Adding rooftopgarden

4.4

Positioning the vision within its context

From functional city to restorative city: Reinterpreting the Lijnbaan

The previous chapters explored how restorative design strategies were developed from both literature and walk-along interviews. Together, these strategies provide the base for the vision of a restorative Lijnbaan. However, before translating these strategies into a concrete design, it is important to position the vision within its broader context. This means that it's important to understand how the vision fits within contemporary societal developments, changing patterns of urban life and shopping behaviour, and how it relates to the original ideas of Van den Broek and Bakema. The following part of the thesis therefore explains the vision and its place within both the historical and contemporary context of the Lijnbaan.

4.5 The vision

To illustrate how the design proposal, a restorative Lijnbaan, fits within its context, a series of drawings has been made in the form of a comic. This comic presents a step-by-step approach showing how the proposal can be integrated. The drawings will be explained in more detail below.

The vision is to transform the Lijnbaan from a space full of stimuli into a restorative public space. The aim is to create a restorative Lijnbaan: a human-centered, sensory layer that responds to mental health and stimulus processing (1). This new layer should be combined with the current situation; a functional system.

To combine these two worlds, it is necessary to determine what kind of transformation is suitable (2): The restorative layer should not be a temporary addition, but a structural transformation.

This transformation means a shift from a one-dimensional shopping street to a layered urban system, where movement, shopping, staying, and mental restoration coexist (3).

To achieve this, it is important to carefully look at how these two worlds intersect (4). The different flows within the Lijnbaan, especially pedestrian flows, play a key role. The existing flows will remain, but will be expanded with moments of "thickening," where space for staying and resting is introduced.

Another important aspect in positioning the vision within its context is the shift in shopping behavior (5). Spacious shopping areas have increasingly become places where people not only shop but also spend their free time (Baghaee et al., 2021, p.7). Shopping is therefore becoming more a recreational activity. In addition, there is a trend that shopping is

less goal-oriented, where shopping often involves browsing without the intention to purchase something. (McCarville et al., 2023, p.1). Shopping can thus be seen as not only as a task, but also as a leisure activity with recreational value. In the future, the focus will probably shift further away from only purchasing towards staying and recreation. A restorative Lijnbaan can respond to this change.

At the same time, online shopping continues to grow. This growing popularity in online shopping cause an increase in retail vacancy (Coster, 2018). As a result, more space becomes available, creating opportunities to transform and green shopping areas such as the Lijnbaan.

The structural transformation (6) can be achieved through four key interventions. First, routes are adjusted to promote rest, calmness, and slower movement. Second, blocks (shops) are opened up, for example by creating connections to the service street behind or to green semi-public courtyards. Vacant buildings can serve as new passages. Third, programs are reorganized, introducing new functions focused on restoration, such as reading spaces, quiet rooms, a library of things, communal kitchens, tea or coffee spaces, and creative workspaces. Finally, facades are adapted to create a softer, calmer, and more human-scale environment, for example through green facades, floral elements, and tactile materials, considering that the current Lijnbaan exist of hard materials

Lastly (7), the vision is positioned in relation to Van den Broek en Bakema. While they organized the Lijnbaan based on functional clarity, this thesis reinterprets their approach for a contemporary context where mental health and stimulus processing have become increasingly important.

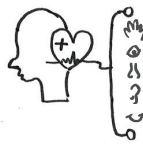
Designproposal/visie positioneren in de context

① De twee werelden worden gecombineerd

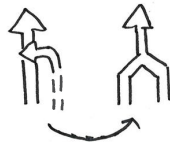
1. Huidige functionele stad



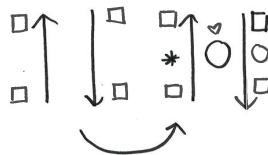
2. Restorative stad: mens-gerichte, zintuiglijke laag mbt mentale gezondheid en prikkelverwerking



② Dit is een tijdelijke toevoeging, nr structurele transformatie



③ Transformatie van een-dimensionale winkelstraat naar geland stadelijk systeem waarin bewegen, verkleven, ontprikkelten naast elkaar bestaan



④ Kijken waar Werelden raken elkaar: (Mensen) stromen. stromingen blijven bestaan nr krijgt verdikkingen waar verblijf mogelijk is



⑤ Er is een shift in manier waarop we winkelen: niet doelgericht, nr ook doelloos en recreatief

* Ook meer online winkelen

* Meer ruimte voor transformatie & vergroenen



⑥ Structurele transformatie door:

1) routes aanpassen:



die herstel, rust en verfrissing promoot

2) Blokken doorbreken:



geeft toegang tot public space exp. straat, en leegstaande gebouwen

3) Programma's herschikken



parade worden naar parallelle exp. straat 'stille kamer'

4) Gevels aanpassen:

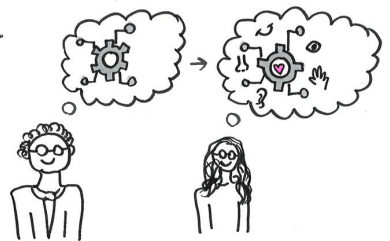


Groene gevels, bloemenwand, tact. materialen

maakt de straat zachter, menselijker, rustiger (huidig is hard)

⑦ Koppeling Joop Bakema

waar Bakema de stad organiseerde uit functionele helderheid, herinterpreteer en vertaal ik het naar een tijd waarin mentale gezondheid en prikkelverwerking cruciaal is.



05

Research by design

Sub question

What restorative spatial design strategies can be used to minimize or compensate stressors?



5.1 Extreme future scenarios

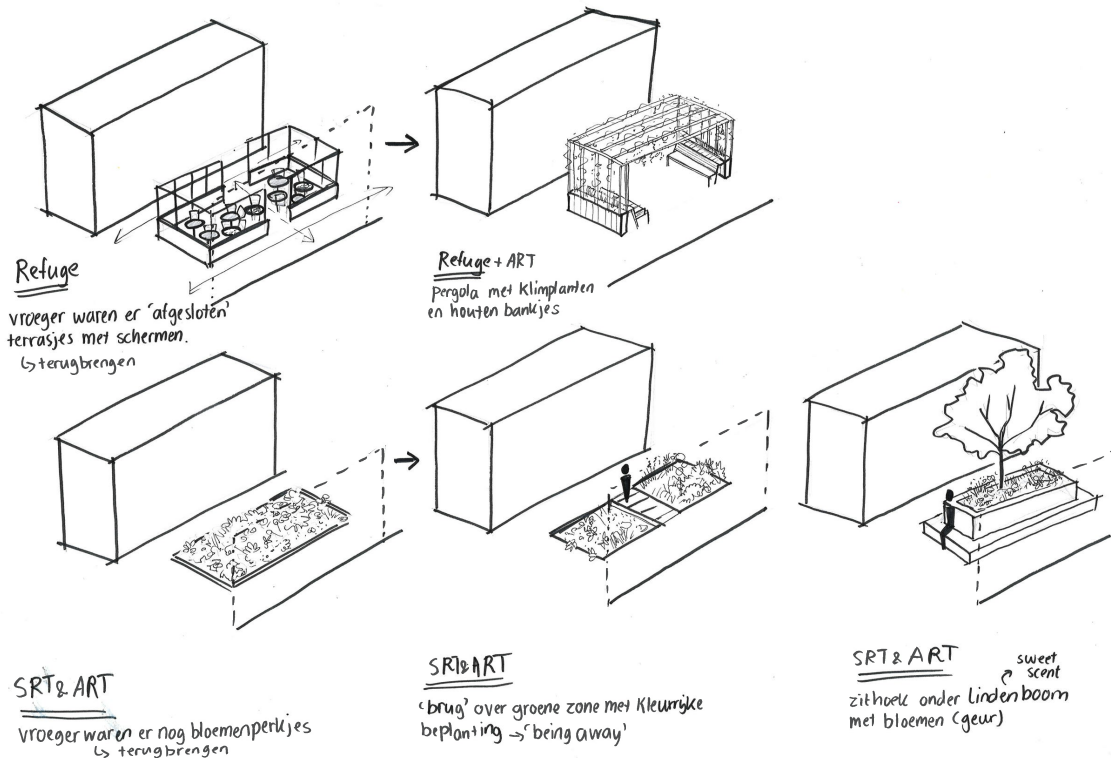
Seven different future scenarios for the Lijnbaan were explored and drawn, all focused on restoration. These include ideas such as an urban forest, ecological corridor, and slow spaces. These scenarios are used as a form of research by design. By exploring more extreme possibilities, it investigates how the Lijnbaan could shift from a space centered on consumption to a more restorative urban environment.

These seven future scenarios will be part of the input for the design proposal

VARIANT 0

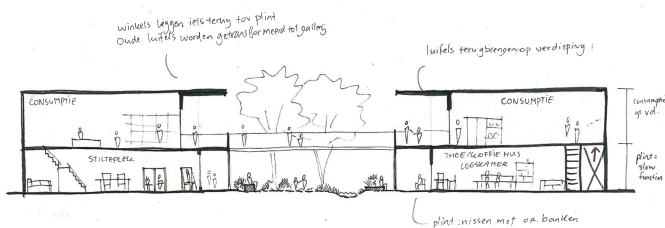
Vergroenen in de middenstraat, consumptie blijft op begane grond

Herstructurering Lijnbaan



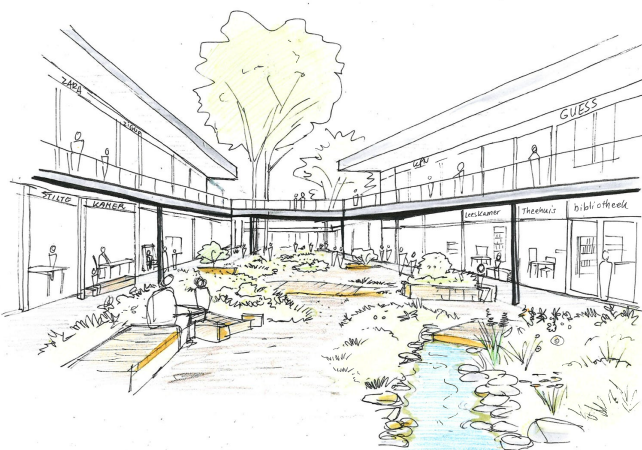
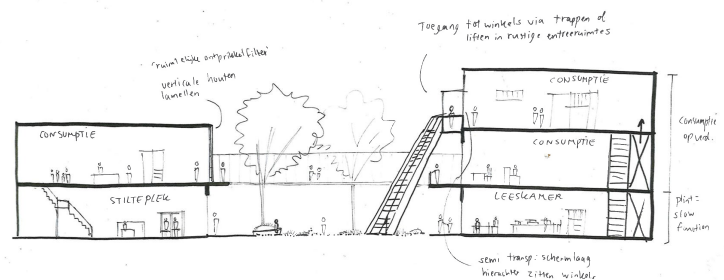
① SLOW SPACE : consumptie op 2^e vd : ingetrokken verdieping

- Ruimtelijke hercompositiëring v. consumptie
- plinten zijn 'Slow functions'
- consumptie op vd 1 & 2
- winkel is aanwezig, mr niet dominant in straatbeeld
- winkels liggen terug tot plint
- oude luifel getransformeerd tot galerij waar je op kan lopen
- lijnbaan straat : kleine andere paden



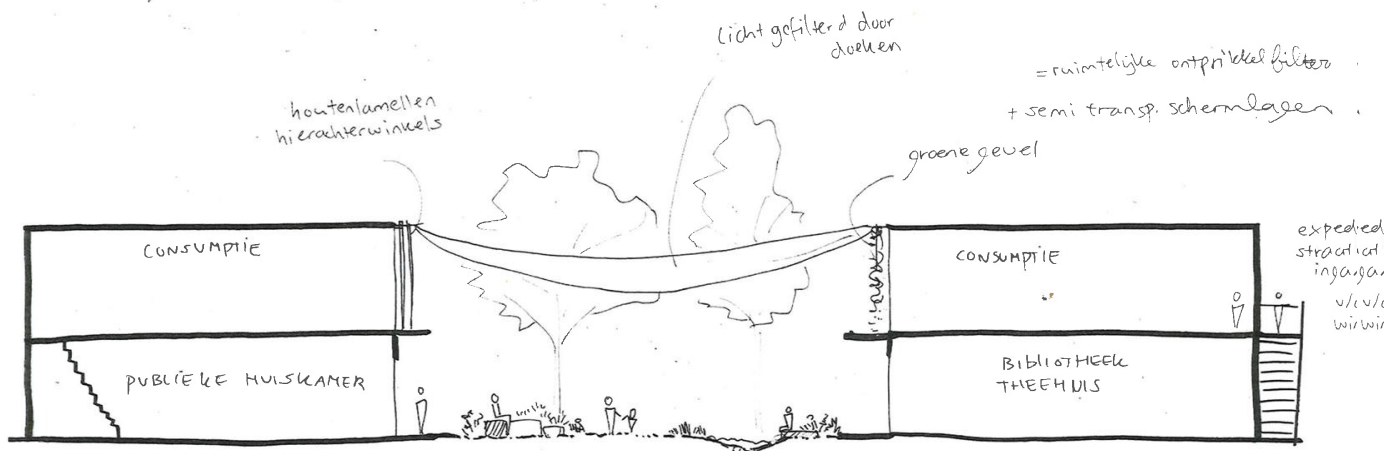
② SLOW SPACE : consumptie op 2^e vd : de verticale straat

- Toegang tot winkels via trappen of liften in rustige entree ruimtes
- De commerciële laag is een 2^e netwerk boven straatniveau
- Op straat alleen 'rustige functies'
- slow city & consumptie city → 2 snelheden, 1 plek



③ SLOW SPACE : CONSUMPTIE op 2^e vd: semi transparante schermlagen

- Licht is gefilterd door doeken
- verticale houten lamellen, groene gevels, semi transp. scherm laag
- Winkels hierachter
- RUIMTELIJKE ONTPRIKKELFILTER



④ URBAN FOREST

- Doorlopende stads wildernis
- Bomen vormen bladerdak
- Klimplanten langs gevels + groene gevels
- vlonders
- (Regenwater opvang in)
- Natuur als hoofdstructuur en architectuur als secundaire laag
- Wind door bladeren
- Stroomd water
- Vogels
- Geluid gefilterd door vegetatie
- Ruimte absorbeert prikkels

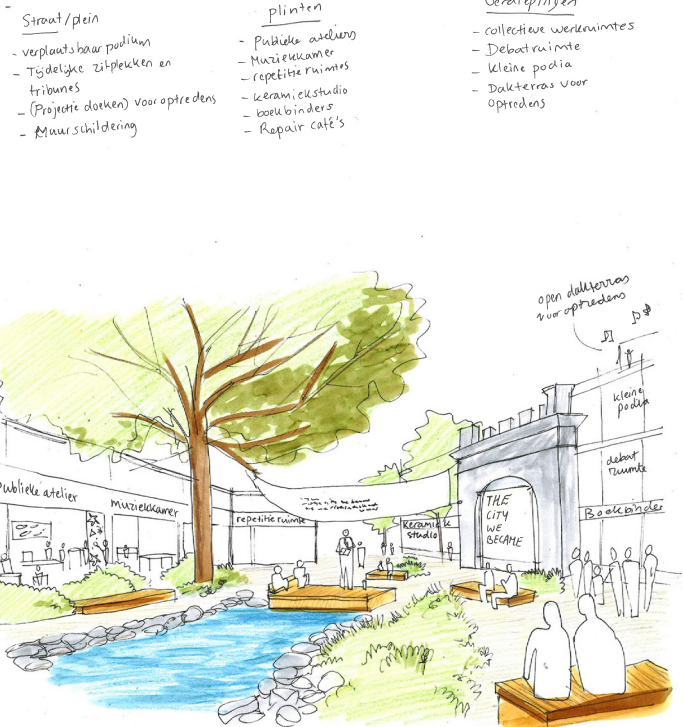
Restorative elements: (ART)

- Soft fascination: bewegende bladeren, reflecterend water
- Being away: in een bos, weg uit consumptie wereld
- Extent: enough scope, richness, depth to create sense of 'whole other world'
- Compatibility: mensen kunnen en mogen vertragen en rust opzoeken



⑤ LIJNBAAAN ALS ZACHTE EXPRESSIERUIMTE

- Tegenover gestelde v. markt / kapitalisme / consumptie = identiteit & expressie
- Restoration door betekenis en verbondenheid ipv stilte
- Geen focus op producten, maar op verhalen, creativiteit, kleine akoestische optredens, poëzie en kunst op straatniveau
- straat is geen koopplek, mr 'publiek podium'
- Private winst → publieke stem
- economische waarde → culturele waarde



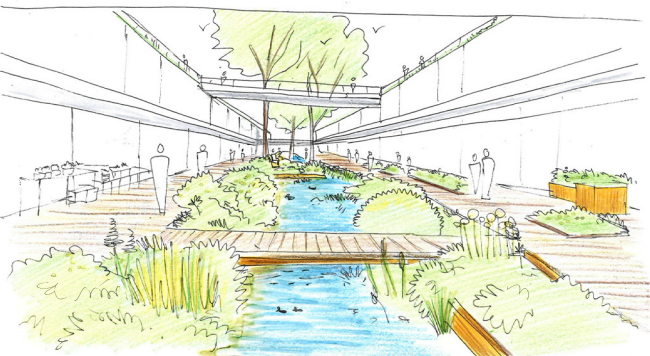
⑥ Ecologische CORRIDOR

- Water
- Riet en waterplanten
- fluiten vlonders
- Dieren en bomen
- Bomenplinten: stadslandbouw, biologisch cafe, plant en bloemenwinkels
- Park Corridor
- Restoration: Sound: water en bladeren en vogels → Soft fascination
- Sight: Natuur
- Being away
- Stress Reduction Theory



lijnbahn is een horts
canaluis en de plinten als
'muren'

SOUND, SIGHT, TOUCH



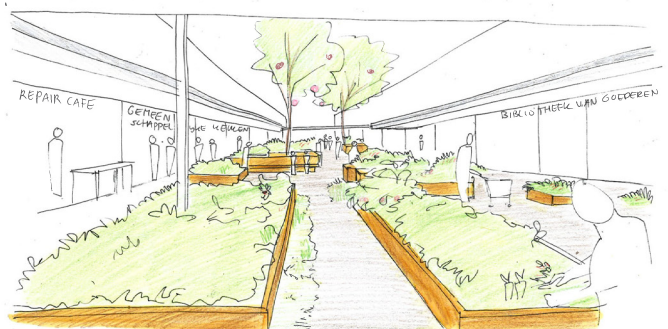
⑦ LIJNBAAAN ALS COMMONS (gemeenschappelijk beheer, anti-eigendom) food production straat

- Tegenover gestelde van markt consumptie & kapitalisme = gemeenschappelijk bezit
- Consumptie wordt produceren
- geen winkels
- ruilsystemen ipv kopen
- bij bli of heel v. gorden
- plint: open werkplaats
- gemeenschappelijke keukens
- verhoogde plantbreedten door de straat + looppaden
- fruit bomen
- straat: collectieve moestuin



straat wordt collectieve moestuin

TASTE, SMELL, TOUCH



5.2 Cross axes

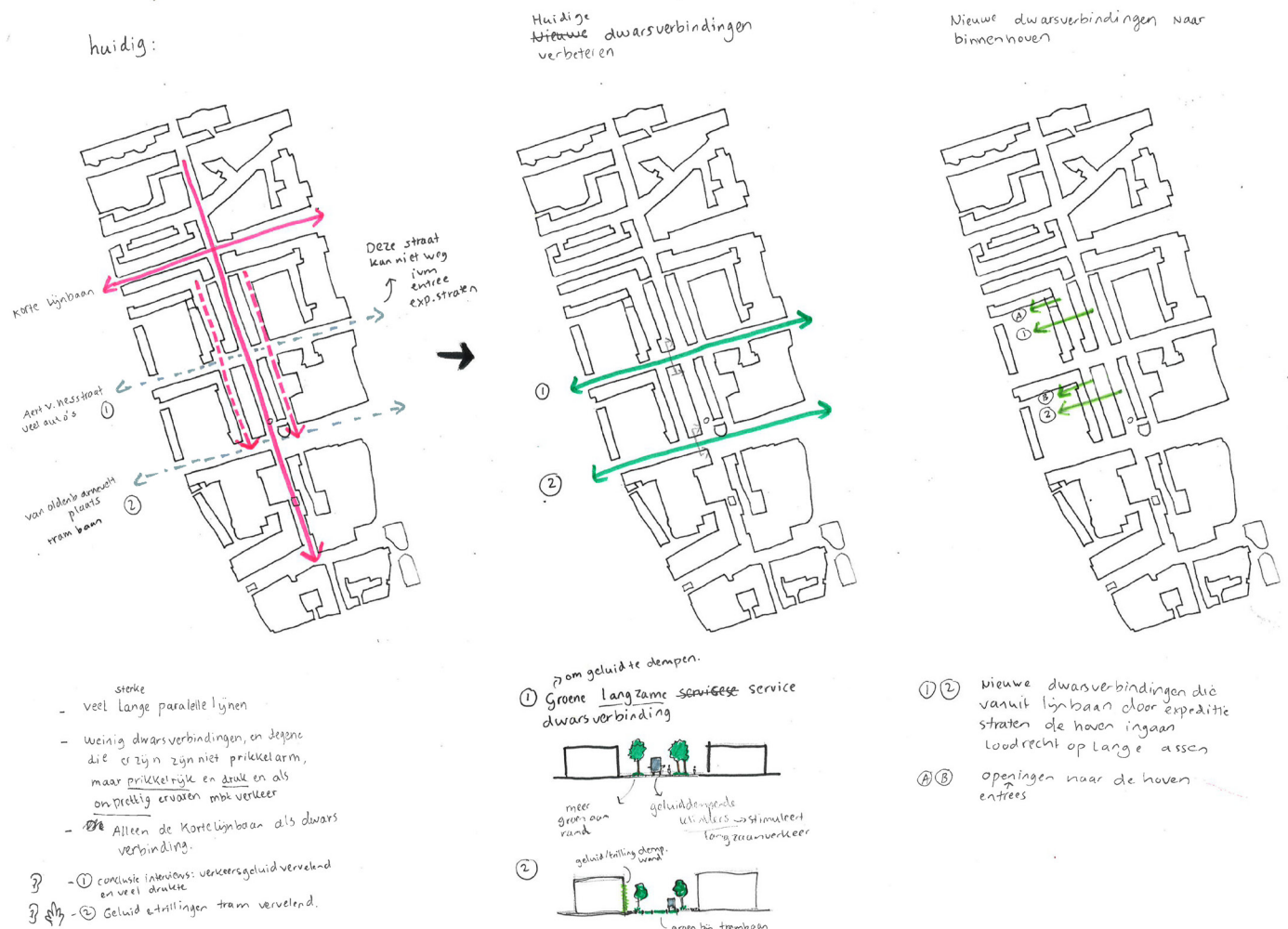
After exploring different restorative atmospheres for different parts of the Lijnbaan, the perspective zooms out to consider the area as a whole. Besides creating restorative experiences at the local scale, it is important to develop a vision at the urban scale that can influence the overall structure of the Lijnbaan.

The current spatial structure of the Lijnbaan is defined by a series of long, parallel lines, in which the central pink axis functions as the primary spine (the shopping street), while the dotted pink lines represent the secondary spines which are the expedition streets. Right now, the number of cross axes is limited. Those that do exist, the car street and the tramline, were

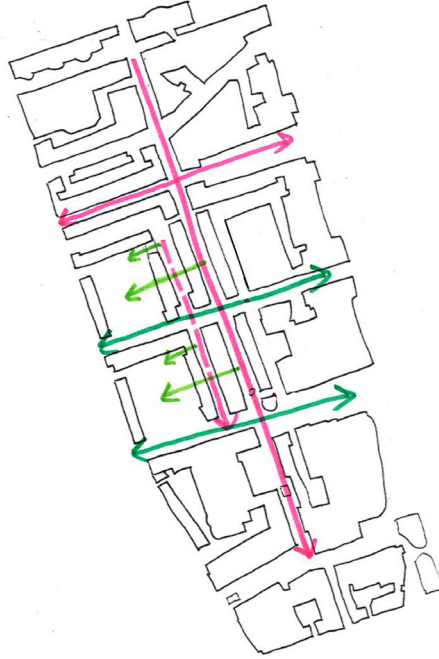
perceived as unpleasant and were disturbing to the pedestrian experience.

For the design concept, these existing cross axes will therefore be reconsidered and improved. In addition, new cross axes are introduced to enhance connectivity between the Lijnbaan and the green semi-public courtyards. These connections can go through one of the blocks of the Lijnbaan. These courtyards will be envisioned as spaces of retreat, which can give a more sheltered and restorative environment next to the Lijnbaan.

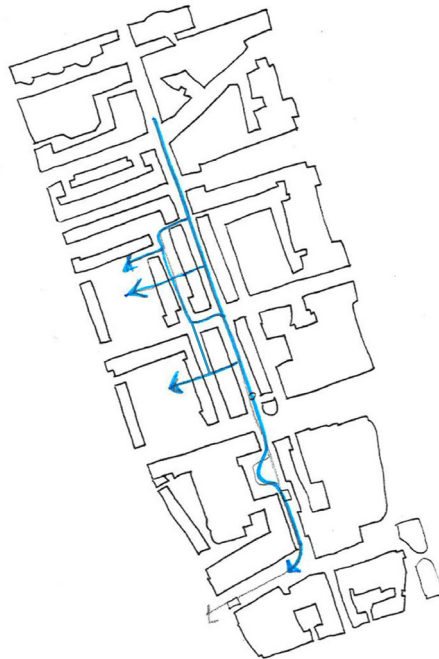
Based on this new structure, a restorative route is developed



Concept for new structure of Lijnbaan



Restorative route



5.3 Balance between busy and quiet

It is important to recognize that the Lijnbaan is a dynamic environment, characterized by varying conditions such as moments of high activity, calmness, and everyday use. Therefore, the design must be able to adapt to different levels of intensity. Even during quieter moments, stimuli such as sound and a sense of emptiness remain present. Rather than focusing only on “reducing stimuli during busy periods,” the design aims to regulate sensory experiences at all times. During peak moments, stimuli are softened and filtered, while in quieter situations the space is subtly activated through gentle lighting, small-scale movement, and tactile elements. This way, a balanced and restorative atmosphere will be created.

So, instead of designing for a fixed situation of either “busy or overstimulation” or “quiet and calm,” the design proposal sees the Lijnbaan as a place with changing levels of sensory intensity. Even when it is not busy, the space is still experienced through light, sound, and feelings of emptiness or safety. Therefore, the design is not only about reducing stimuli, but about adjusting them to different situations.

When the area is busy, the design helps to soften and filter overstimulation, creating calmer restorative environments and slowing down movement. When the Lijnbaan becomes calmer, the design should enhance comfort and atmosphere through material choices, lighting, and subtle movement, helping the space remain inviting and lively.

Therefore, the design also includes specific interventions for moments when the Lijnbaan is less active. These consist of low-intensity stimuli that support restoration, focusing on subtle sensory activation while also maintaining a calm and restorative atmosphere.

Time as a designlayer



Figure 5.1 & 5.2 : Lijnbaan during calm and busy moments

5.3.1 Less active moments-> **stimulus activation**

Restorative sensory design principles :

Adding elements with subtle movement (sight)

During calm moments, for example early morning, the Lijnbaan can feel “empty”. So small, slow movement helps to activate it without creating overstimulation. It provides visual calm through repetition while preventing a sense of emptiness.

- planting that moves in the wind (pampas grass, reeds, small wind elements)
- swings in trees
- hammocks
- soft light strings
- public art with shadow play or installations that respond to wind

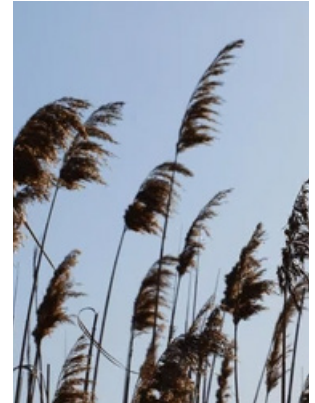


Figure 5.3 (left): Garden windmill
(Huis en Tuin Decoratie Marie, n.d.)

Figure 5.4 (right): Pampas grass moving in wind
(Shutterstock, n.d.)

Adding light lines in the plinth (evening + low-activity moments) (sight)

Integrated light interventions that create a subtle sense of presence:

- thin, horizontal light lines in facades or seating edges, or along routes
- warm light that slowly responds to pedestrian movement; enhances a feeling of safety and presence without being visually overwhelming.

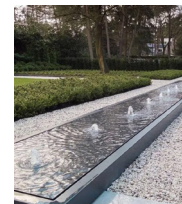
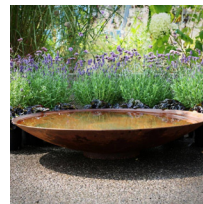


Figure 5.5: Light lines along edges
(Massaro, M., in Michael Grubb Studio., n.d.)

Integrate soft sound (hearing)

In silence, harsh sounds become more noticeable, so a controlled auditory layer is important:

- dripping water elements or rain features
- fountains with varying intensity
- gravel paths that softly crunch underfoot
- wooden deck that produces subtle sounds when it is used



From left to right:
Figure 5.6: Rainwaterbowl (Cortenstaaltuinproducten, n.d.)

Figure 5.7: Fountain (Adezz, n.d.)

Figure 5.8: Walking on gravel path (Koltykova N., in Alamy, n.d.)

Integrating tactile materials (touch)

Restoration and gentle activation also occur through physical interaction:

- interactive urban farming elements
- berry picking
- seating edges that invite use
- tactile walls with vegetation
- variation in textures along routes (smooth, rough, soft)

This contributes to a grounding sensory experience.



Figure 5.9: Tactile wall with vegetation (Paisajismo Urbano via ArchiExpo, n.d.)

Creating small activity spots

Not busy, but signs of life:

- small coffee points
- small-scale play elements (hanging bars, swings)
- interactive elements (scent cabinets)



Figure 5.10 : Small coffee point (Smith & Newton Architects, n.d.)

Taste

-berry bushes and fruit trees: people can pick from them. This creates a connection with nature (SRT) and offers a calm and sensory experience.

-small kiosks with tea, fruit, and coffee: in this way, taste becomes part of staying in the Lijnbaan

Taste is introduced through edible planting and small-scale food interventions, such as kiosks. Rather than being a dominant sensory layer, it acts as a supporting element that adds a human and comforting quality to the overall restorative experience.



Figure 5.11: Picking berry bushes (Explore Genesee Valley, n.d.).



5.3.2 Less active moments-> **stimulus activation**

Spatial design strategies on urban scale:

It is also important that the design also needs to move from isolated interventions towards a coherent spatial logic at the urban scale. Otherwise, it remains too object-based. The following spatial strategies function at the scale of the Lijnbaan and focus on creating subtle activation during quieter moments. These will prevent emptiness while also maintaining a restorative atmosphere.

Create density at nodes (instead of dispersion)

When activity is low, spreading functions across the area can make the space feel empty. Instead, clusters of activity will be created, such as on rooftops, small squares, or at intersection, with calmer spaces in between, which allows for both stimulation and rest.

Creating rhythm in space (repetition + variation)

A long street like the Lijnbaan can become monotonous, especially in quiet moments. Creating a spatial rhythm, such as alternating open and semi-enclosed spaces, or hard and soft materials, creates a more engaging walking experience, where subtle variations provide gentle sensory stimulation.

Activate the plinths

The ground floors will be made more transparent and incorporate small-scale functions, which shows activity, also during quieter hours. Additionally, the expeditiestraten are activated by transforming garages into ateliers, creative workspaces, studio housing, and pick-up points. This supports a parallel route with sufficient sensory engagement. These plinths are further activated through facade lighting and niches, which maintains a continuous low level of sensory stimulation and preventing the space from feeling empty.

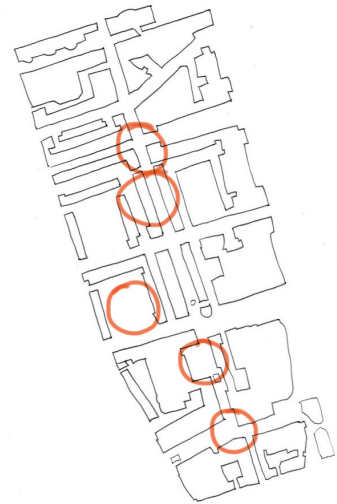


Figure 5.12: clusters of activity



Figure 5.13: Creating rhythm in spaces

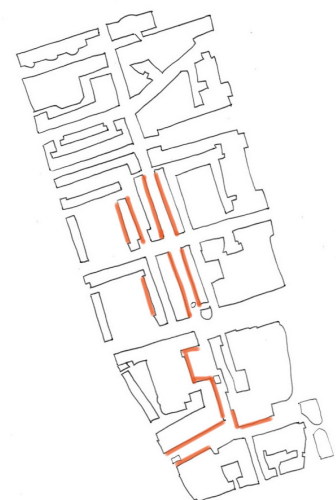


Figure 5.14: Activating plinths

Creating sequences of staying spaces

The Lijnbaan can also feel empty and inactive during quieter moments. Therefore, the Lijnbaan is divided into a sequence of smaller spaces, each with its own character. Such as an ecological corridor, areas with 'slow functions', expedition street, sheltered corners, passage, rooftopgarden or courtyard. This chain of diverse staying spaces encourages a natural distribution of people and makes each place feel intentional.

A rhythmic sequence of public spaces, alternating in scale, atmosphere and program, maintains presence and liveliness during low-activity periods

- 1

15

ECOLOGICAL CORRIDOR
Green and blue, slower space (calm)
- 2

13

ROOFTOP GARDEN
Open and elevated views (calm)
- 3

8

12

CORRIDOR SPACE
Flow and orientation, narrow, active plinth with slow functions (active)
- 4

6

PASSAGE
Flow and place to retreat, through an previous shop or former garage of residential flat. (between calm and active)
- 5

EXPEDITION STREET
Flow, narrow, active plinth with 'make' functions/expression. Focus on tactile experience (active)
- 7

GREEN COURTYARD
Being away scenery, green (calm)
- 9

GREEN DECK
Flow and place to retreat, above the street (between calm and active)
- 10

SENSORY GARDEN
Being away scenery, green, discovery (calm)
- 11

SHELTERED CORNER/URBAN POCKET
Intimate, cozy. Pause and retreat (calm)
- 14

WIDE CORRIDOR SPACE
Open and flexible, movement and social (active)

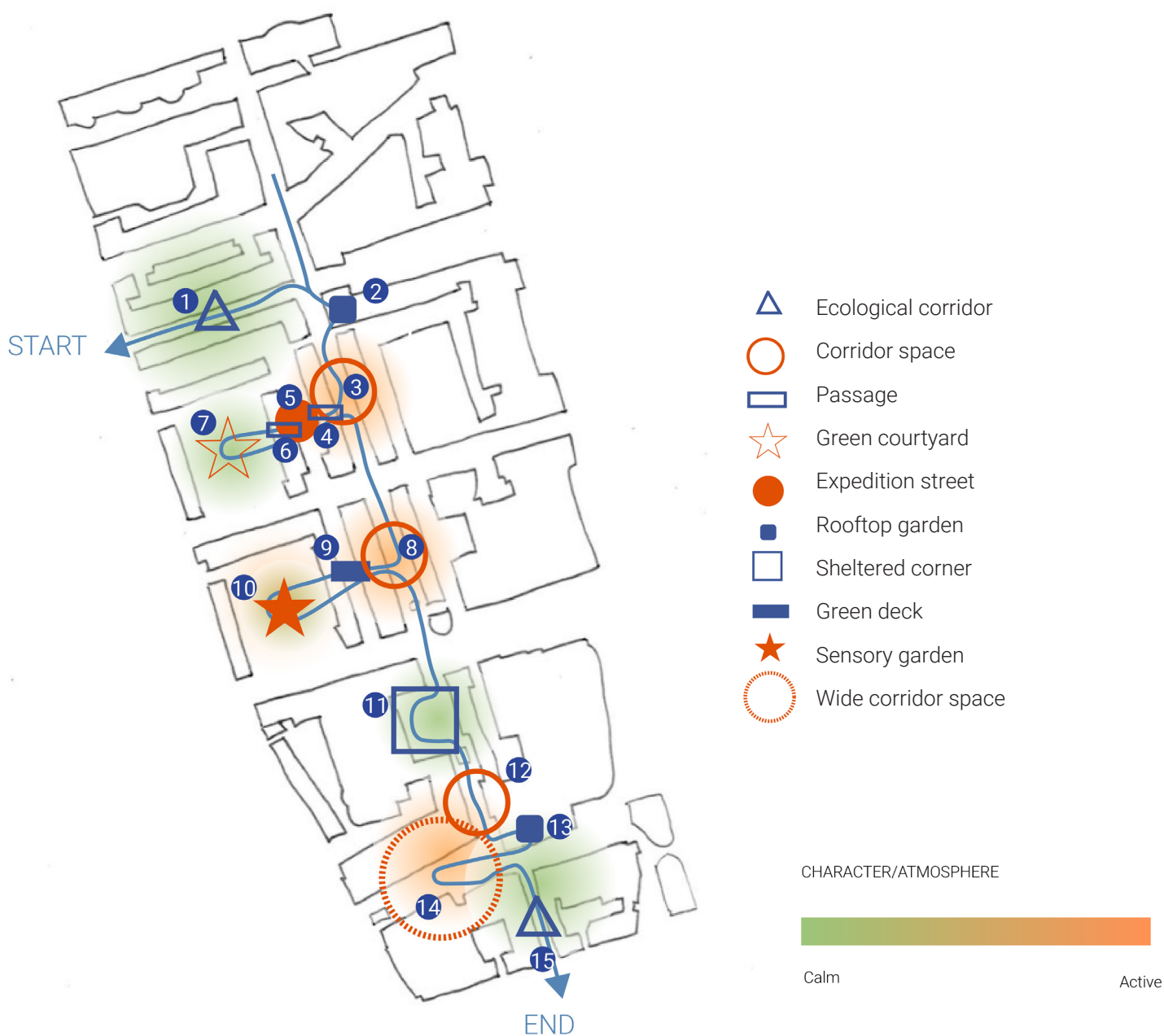
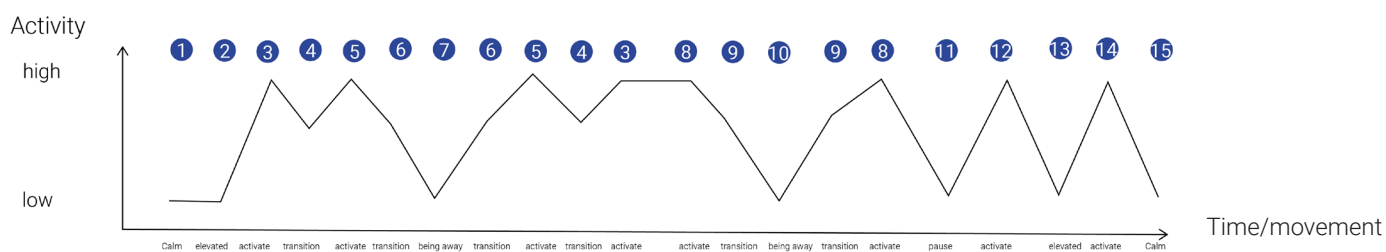


Figure 5.15: A chain of diverse public spaces with their own character creates a rhythm of experiences that keeps the Lijnbaan present, engaging and safe; also during quieter moments

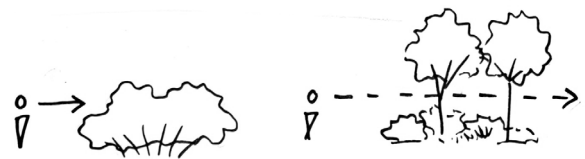
Rhythm creates life (even when quiet)



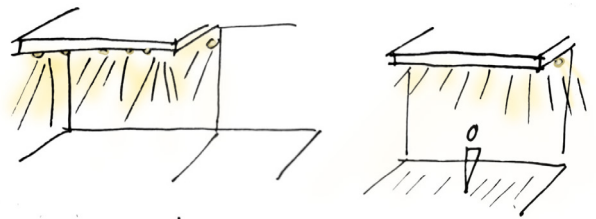
5.3.3 Design principles for nighttime

There is also a tension between reducing stimuli and maintaining social safety, especially in the evening and late hours. Too much calm in the evening can feel empty, dark, and unsafe, so the design should not only focus on quiet, but also on safety and a sense of presence. Making sure that calm does not become isolation.

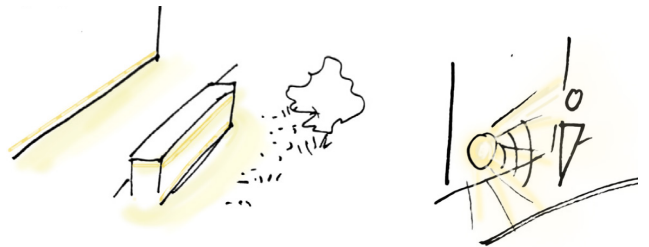
- keep sightlines open (no dense shrubs at eye level)



- use lighting underneath canopies with soft, warm tones

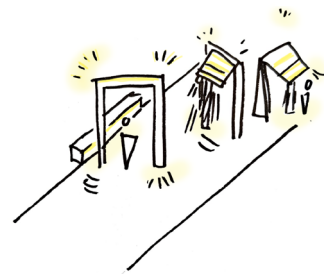


- integrate light lines in plinths, or in facades or seating edges



- integrate motion-sensitive lighting

- introduce small-scale evening programs (light art)



This creates a sense of presence and safety without being harsh, especially during quieter periods.

5.3.4 Design principles for seasons

Because time is considered as an important additional design layer, the proposal should also respond to seasonal change and should also work in colder season. Also, light, temperature, sound, and use shift significantly in winter. Therefore, the design principles should adapt to these changing conditions.

Winter design principles

Restorative qualities can not only be achieved through greenery but also through light, material, and spatial conditions. In darker months, light becomes extra important.

- Adding warm, diffuse illumination in plinths and under canopies
- adding subtle light lines along planters, seating, and pathways.

Microclimate and comfort (touch)

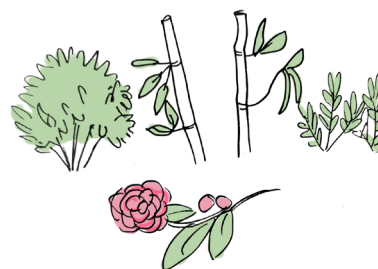
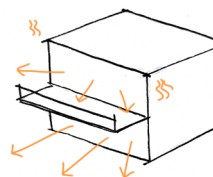
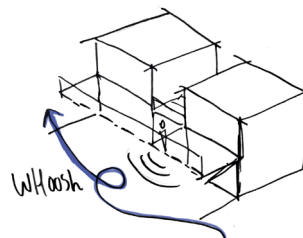
Creating sheltered and comfortable microclimates is also essential.

- creating wind-protected zones through semi-enclosed spaces or passages, as well as places to sit or stand out of the wind.
 - adding subtle heat sources; such as heated benches or radiant facades
- This adds a tactile layer of comfort and reduce physical stress.

Winter-proof greenery (sight + smell)

As lush summer greenery disappears, planting should focus on evergreen structures, grasses, and seasonal scents, so that it still works in colder seasons.

This ensures that sensory stimulation remains present.



Bambus = wintergroen
 Laurier = wintergroen
 Olybomen = " "
 Pittosporum
 Camelia : wintergroen en bladhoudend
 "opvallende kleur + geur"
 "mooie"
 Mahonia
 Ruishede
 Lavendel - geur
 Peperboomje

Compact activity and “warm clusters”

Activity becomes more concentrated in winter, with fewer dispersed functions

- create more compact clusters of “warm” places
- add small-scale programs, such as coffee points or social spaces around light or heat installations.

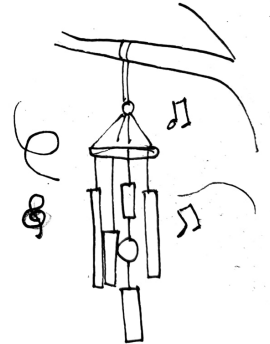
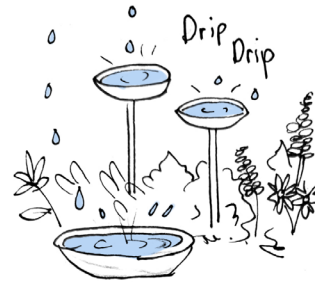
This helps prevent the space from feeling empty or abandoned.



Shift in sensory emphasis

With reduced visual intensity in colder seasons, other senses become more prominent.

- add soft sounds, such as water or wind through vegetation
- add subtle scents from planting or plinths.



To conclude, **adapt rhythm to the seasons.**

The spatial rhythm stays the same, but its expression changes: in summer, it is open, lively, and visually rich, while in the winter it becomes more enclosed, intimate, and subdued, with a focus on warmth and comfort. In essence, the design shifts from openness and vibrancy to shelter, light and warmth.

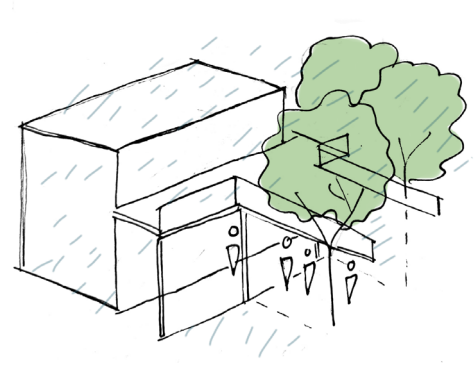
5.3.5 Design principles for rain

Rain also needs to be considered as an integral part of the design. Rather than being treated as a problem, rain can become an opportunity for a stronger sensory experience. Without specific interventions, the Lijnbaan quickly becomes uncomfortable during rainfall. It will be wet, empty, and characterized by hurried movement. However, rain can instead be used as a calming, almost meditative stimulus.

Shelter

- create continuous canopies or overhangs along the plinths
- add semi-covered spaces such as niches, and passages
- add informal shelter spots where people can pause without needing to leave the space -> under clusters of trees)

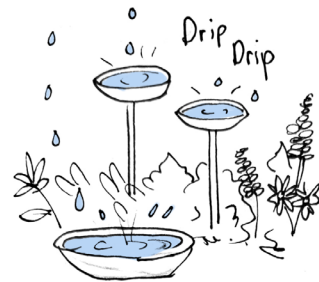
This encourages people to stay longer, rather than rush through



Make rain visible and audible (Sight and sound)

Instead of hiding rain, the design works with it:
-expose water drainage through channels and subtle water lines

- allow rain to drip onto different materials (wood, stone, water surfaces), for example into shallow basins -> this creates a calming, repetitive sound, similar to white noise
- collect rainwater within planted areas in the center



Active plinths during rain

- transparent facades with sufficient lighting and small-scale functions
- visual connection to indoor activities (warmth, movement)

5.4 Design strategies

All design strategies developed throughout the research, emerged from literature (subchapter 3.4.4), walk-along interviews (subchapter 4.3.6), and research by design (chapter 5), are brought together in a single structured table. This table provides a clear overview of the complete set of strategies. The strategies are grouped into thematic categories, with each category assigned a specific colour.

This structure allows the strategies to be linked to later visualisations of possible design interventions for the Lijnbaan, showing how the space could be designed. In these representations, strategies are placed next to design proposals and marked with the corresponding colour from the table. This makes it clear which type of strategy is applied and what its purpose is.

The first set (light blue) of strategies focuses on restorative sensory qualities. A second set (dark blue) addresses quieter moments in the Lijnbaan, exploring how sensory elements can be introduced to keep the space lively. These strategies mainly operate at a small scale and are about elements such as street furniture and small sensory additions.

A third set (turquoise) also responds to low-activity situations, but at a larger spatial scale. These focus on spatial structure, making sure that the Lijnbaan does not feel empty and remains coherent and active.

Finally, sets of strategies relates to time as a design layer, including seasonal changes, night conditions, and weather situations such as rain.

Together, these strategy sets function as a design tool for urban designers, landscape architects, and architects working on the Lijnbaan or similar urban contexts.

Restorative sensory design strategies (based on literature study)

Strategy	Sense	Effect	Design intervention	Theory
Introduce pleasant scents	 	Smell reduces perceived noise	Adding diverse planting and coffee kiosks/ tea houses	SRT & PSD: <i>rich in species</i> Synergistic effect (multi-sensory effect) ART ; <i>fascination</i>
Create open sightlines	  	Wide sightlines reduce perceived noise and smell	Keep central space open and avoid large obstacles to maintain openness	Synergistic effect (multi-sensory effect)
Reduce traffic noise	 	Traffic noise reduces positive effects of pleasant smells	Redesign streets by adding greenery and sound-dampening paving	Antagonistic effect (multi-sensory effect)
Introduce taste as restorative element		Enhances joy, health and well-being	Adding small-scale food interventions like fruit stands and coffee kiosks	
Enabling taste through interaction	 	Enhances interaction and well-being	Integrate urban farming; picking and consuming fresh products	
Clear circulation vs staying zones		Reduces conflicts between flows	Create separate walking routes and places to stay	
Micro-refuges	 	Creates sense of safety and retreat	Add niches and benches with backrest	PSD; <i>refuge</i> ART; <i>being away</i>
Crowding reduction through hierarchy in movement		Reduces perceived crowding and sensory overload	Differentiate between main routes (movement) and secondary spaces (staying)	
Meandering paths		Breaks continuous flows and reduces mass perception	Curved/ non-linear paths	
Create spatial segmentation		Reduces large-scale crowd perception in parts rather than one large flow	Divide space into smaller 'rooms'	
Add parallel routes		Distributes pedestrian flows	Create multiple walking paths; meandering paths in Lijnbaan, transforming canopy into walkable gallery, and transform expeditiestraat	
Create width variation		Reduces feeling of constant pressure	Alternate between wide and narrow sections	
Create openness variation		Increases user choice and comfort	Mix open and enclosed spaces	ART; <i>compatibility</i>

Strategy	Sense	Effect	Design intervention	Theory/literature
Integrate green wall to facades	 	Provides visual relaxation and reduces stress	Add green walls with vegetation to walls of passages	SRT
Integrate mural paintings		Provides positive visual distraction that increases feeling of enjoyment	Add paintings and mural art on walls	ART; <i>fascination</i>
Add tactile wall with vegetation		Stimulates the sense of touch through skin contact with natural textures, reducing stress and creating a calming, restorative feeling.	Add tactile walls with natural vegetation combined with seating elements attached to it	ART; <i>fascination</i>
Add water	 	Moving water restores through its calming sound and the enveloping, transparent movement of its form creates visual calmness	Add natural waterbodies and fountains	ART; <i>fascination</i>
Integrate nature sounds and birdsong		Restores because of its soft, natural patterns which engages hearing without stress, helping the brain relax and recover.	Create bird habitats by using dense native planting, trees and shrubs for nesting and shelter, and integrating water and food sources to support biodiversity and encourage birdsong.	SRT ART; <i>fascination</i>

Restorative sensory design strategies (based on fieldwork/analysis)

Strategy	Sense	Effect	Design intervention	Theory/literature
Add semi-transparent facade elements		Reduces visual exposure	Vertical wooden slats, semi-transparent screens for frontshops on first floor	Environmental Load Theory
Implement textured, porous paving		Reduces visual glare (+ reduces noise reflection)	Replace current pavement of Lijnbaan with porous, textured pavers + greenery	Antagonistic effect
Create comfortable seating with backrest		Increases comfort and reduces sensory load	Replace current stone bench with clean wooden benches with backrest	
Create sound/vibration-dampening ground + vegetation integration		Reduces traffic noise and vibration of tram	Replace current pavement of Aert van Nesstraat and Van Oldenbarneveltplaats with sound-dampening pavers, vibration-dampening sublayer, add greenery along tram tracks	
Add diverse greenery and color-rich planting		Increases positive emotions, enhances the mood, supports-restoration	Introduce varied, colorful plant species	ART; <i>fascination</i> SRT PSD; <i>rich in species, nature</i>
Add edge-based seating and niches		Creates refuge and reduces exposure to stimuli from multiple directions	Add benches and niches at edges and in corners	PSD; <i>refuge</i> ART; <i>compatibility</i>
Create more seating possibilities		Sitting reduces the need to filter noise, and increases ability to focus	Place more seating areas, also in calmer zones	
Smell-based noise mitigation		Pleasant scents reduce perceived noise	Add more cafés, waffle stand, coffee kiosk in the Lijnbaan for sweet aroma and coffee scent	Synergistic effect (multi-sensory effect)
Adding more greenery		Dual effect of introducing greenery by reducing noise and introducing pleasant natural scents	Introduce greenery in the Lijnbaan	Synergistic effect (multi-sensory effect) ART; <i>fascination</i> SRT
Introduce aromatic and edible planting		Enhances comfort and well-being while also reducing perception of noise	Add herbs and low (edible) planting with scents in the Lijnbaan	SRT
Add sound dampening paving		Reduces overall noise levels	Replace current pavers of Lijnbaan with sound dampening pavers	

Strategy	Sense	Effect	Design intervention	Theory/literature
Create layered spatial programming		Adds spatial variation and distributes pedestrian flows	Transform the canopy of the Lijnbaan into gallery, add second level	
Add quiet interior spaces		Provides 'escape' from sensory overload	Introduce quiet rooms in the Lijnbaan by transforming or opening up (hidden) vacant retail units	ART; <i>being away</i> PSD; <i>refuge</i>
Add passages		Provides shelter and transition between spaces, + 'escape' from stimuli	Introduce passages between Lijnbaan and the two semi-public courtyards by transforming retail unit and garages of residential flat and add green deck above expeditionstreet between Jan evertsenplaats and Lijnbaan	ART; <i>being away & extent</i> PSD; <i>refuge</i>
Add rooftop garden as refuge		Provides escape from noise and crowding, supports restoration	Add accessible rooftop gardens in Lijnbaan to temporarily withdraw from street-level activity and experience views	ART; <i>being away & fascination & extent</i> PSD; <i>refuge</i>

Restorative stimulus activation strategies for low-activity moments

Strategy	Sense	Effect	Design intervention	Theory/literature
Add subtle movement elements		Prevents emptiness while maintaining calm, adds gentle visual activation	Add wind-responsive planting (pampas grass, reeds), swings, hammocks, soft light strings, wind-reactive public art, public art with shadow play	ART; <i>fascination</i>
Add light lines in plinth		Creates subtle presence and safety during low-activity moments without overstimulation	Integrate thin horizontal lines in facades, seating edges, and routes; warm light that responds slowly to pedestrian movement	ART; <i>fascination</i>
Add a soft sound layer		Masks silence and creates calm background atmosphere	Add water dripping elements, fountains with varying intensity, gravel paths, wooden decks producing soft sounds	ART; <i>fascination</i>
Introduce tactile material activation		Provides grounding sensory experience and gentle stimulation and restoration	Add urban farming, berry picking, seating edges, tactile walls with vegetation, varied textures along routes (smooth, rough, soft)	
Create small activity spots	 	Signals life without creating crowding, supports low-intensity use	Add small coffee points, small play elements (hanging bars, swings), scent cabinets	
Introduce taste through edible landscape as a supporting element that adds a comforting quality	 	Creates nature connection, and gentle sensory engagement	Add berry bushes and fruit trees that people can pick from, small kiosks (tea/coffee/fruit), edible planting	SRT

Urban-scale spatial strategies for restorative activation during low-activity moments

Strategy	Spatial principle	Effect	Design intervention	Relation to restorative design
Create density at nodes	Concentration vs dispersion	Prevents emptiness , creates focal points of activity	Create clusters of activity, such as on rooftops, small squares, at intersections, with calm spaces in between	Balances stimulation and rest
Create spatial rhythm (repetition + variation)	Alternation of space types	Reduces monotony, creates engaging walking experience	Alternate open/semi-enclosed spaces, hard/soft materials	Provides subtle sensory variation
Activate the plinths of Lijnbaan	Edge activation	Maintain sense of presence and safety during low activity. Prevents emptiness	Integrate transparent facades, small-scale functions, facade lighting and niches.	Continuous low-intensity stimulation
Activate the parallel street; expeditiestraten	Edge activation	Distributes activity, prevents single-axis emptiness	Activate expeditiestraten by transforming garages of residential flat into ateliers, creative workspaces, and pick-up points.	Supports 'soft expression space /tactile maakstraat'. Continuous low-intensity stimulation
Create sequence of staying spaces	Rhythmic sequencing (activity vs calm)	Creates a dynamic walking experience with alternating intensity, preventing monotony and emptiness	Create a chain of spaces with varying characters ; ecological corridor, areas with 'slow functions', passages, activated expeditiestraat, sensory garden, rooftopgarden) to alternate active and calm areas in a clear rhythm	Supports restoration through balance between stimulation and calm

Restorative design strategies for evening/nighttime perception and safety

Strategy	Nighttime challenge	Effect on perception	Design intervention	Design intention
Open sightlines	Limited visibility and fear of hidden areas	Increases orientation and perceived safety	Avoid dense shrubs at eye level, maintain clear views	Prevent calm from feeling unsafe
Soft ambient lightning	Dark, undefined spaces	Creates safe and comfortable environment	Use warm diffused lightning under canopies and along routes	Balance calmness and visibility
Integrated light lines	Lack of visual cues and spatial definition	Adds subtle presence and readability of space	Integrate light lines in plinths, facades, and seating edges	Maintain low-intensity activation visibility
Motion-responsive lightning	Feeling alone or unseen	Reinforces sense of presence and awareness	Integrate lightning that responds to pedestrian movement -> motion sensitive lightning	Enhance perceived safety without overstimulation
Small-scale evening activation	Absense of activity and social presence	Signals life and reduces emptiness	Introduce light art, evening programs	Ensures that the space feels 'not empty'

Restorative design strategies for seasonal challenges

Strategy	Seasonal challenge	Effect on experience	Design intervention	Design intention
Integrate warm ambient lightning	Reduced daylight in winter and dark low activity environments	Enhances visibility, comfort, and atmosphere	Add warm, diffuse lightning in plinths and under canopies. Add light lines along planters, seating and pathways	Maintain calm while ensuring visibility and safety and introduces low-intensity presence
Create microclimate	Cold temperatures and wind exposure	Increases physical comfort and reduces stress	Add wind-protected zones, semi enclosed spaces and passages	Enable staying in colder conditions
Integrate heat sources	Low temperatures	Adds warmth and encourages staying	Add heated benches and radiant facades	Enhance physical comfort and encourage longer stays
Add winter-proof greenery	Loss of lush vegetation	Maintains visual and sensory quality	Introduce evergreen planting, grasses. (bamboo, laurel, camellia, Pieris or Andromeda lavender)	Sustain sensory richness in winter
Compact 'warm'-clusters	Lower activity levels in winter	Prevents emptiness, concentrates social presence	Add clustered programs (small-scale programs), such as coffee points, spaces around light or heat installation	Create social presence and avoid emptiness
Build on seasonal sensory shift	Reduced visual richness	Engages other senses for atmosphere	Add soft sounds (water, wind), subtle scents (planting, kiosks)	Balance sensory experience beyond vision

Restorative design strategies for rainy conditions

Strategy	Rain challenge	Effect on perception	Design intervention	Design intention
Create continuous shelter system	Exposure to rain and discomfort	Increases comfort and encourages staying instead of rushing through	Create continuous canopies, overhangs, semi covered niches and passages, informal shelter under trees	Enable staying and reduce hurried movement
Make rain visible and audible	Rain perceived as disruptive or unpleasant	Transforms rain into a calming sensory experience	Integrate exposed drainage channels, water lines, allowing rain to drip into shallow basins, let rain fall on varied materials (wood, stone, water)	Turn rain into a meditative sensory layer
Rainwater integration in landscape	Surface water buildup	Adds visual richness and gentle movement	Collect rainwater in planted areas and in central green zone	Enhance atmospheric quality through natural processes
Activate plinths in rain	Reduces street activity and visual dullness	Maintains sense of presence and warmth indoors-outdoors	Integrate transparent facades, warm lighting, visible indoor activity	Maintain presence and continuity during wet conditions

5.5 Reflecting back on theory and literature

In this project, the design will not be approached as a final solution, but as a research method. Rather than only translating theory into design, the design process is also used to reflect back on the theory itself. By drawing the future scenarios, restorative sensory principles were tested within the specific spatial conditions of the Lijnbaan, it became clear that there were tensions that emerged between theoretical ideals and urban reality. For example, literature suggests that restoration can be achieved through large green vistas, spatial openness, and variation between enclosed and open spaces. However, the Lijnbaan's narrow and linear structure limits the possibility of introducing extensive planting or creating strong spatial segmentation without large structural transformation. Also, introducing micro-refuges and sheltered niches may support feelings of refuge and "being away," while at the same time it conflicts with visibility and uninterrupted pedestrian flow in such a compact urban setting.

The design process also revealed conflicts between different restorative principles themselves. Open sightlines can improve orientation and calmness, while sheltered spaces and niches are needed to create refuge. In addition, food-related interventions to introduce taste as a restorative element, such as kiosks or edible planting, may enhance sensory experience and well-being, but can also increase activity, stimulation, and commercial pressure.

At the same time, the Lijnbaan reveals new opportunities that extend existing theory. The existing canopies and expedition street make

it possible to introduce parallel routes, such as elevated walkways and alternative pedestrian flows, helping to distribute crowds and sensory stimuli. This shows how the specific qualities of the Lijnbaan can actively inform restorative design strategies, rather than theory being applied in a one directional way. The design therefore becomes iterative: experimenting within the real context of the Lijnbaan generates new insights into what restorative sensory design can mean in dense urban environments.



06

Design proposal for the Lijnbaan

Sub question

What restorative spatial design strategies can be used to minimize or compensate stressors?

After exploring future scenarios for the Lijnbaan and creating an overview with all strategies, and reflecting back on literature, a detailed spatial strategy at the scale of the entire Lijnbaan-ensemble and its surroundings was developed. This strategy has been drawn in a strategy map on the next pages.

It is important to emphasize that this strategy map also represents a future scenario: a conceptual framework of what is aimed to achieve, grounded in research and studied urban theories. It should be read as a principle drawing that shows what interventions are intended to achieve, where they should take place, and how they relate to each other within the broader urban system.

In contrast, the later following masterplan should be understood as a possible translation of this strategy into spatial form. It illustrates how the strategy could be materialized in a more detailed design proposal, but it is not a fixed or final outcome. It remains open to interpretation and adjustment. This distinction is important, as the intention is to avoid a rigid end-state: the masterplan should not be seen as the only or definitive solution, but as one of several potential spatial expressions of the underlying strategy.

In addition, a few of the 7 stadsprojecten (see subchapter 4.2.3) have been drawn in the strategy map to show how the proposed interventions connect to ongoing developments. In this way, the Lijnbaan functions as a connector within the broader urban framework.

Value of the design

The value of this design lies in its role as a research instrument. In this project, the design is not approached as a final solution, but as a method of inquiry. Rather than only translating theory into spatial proposals, the design process is also used to critically reflect back on the theory itself.

The design therefore becomes iterative: by experimenting within the real context of the Lijnbaan, new insights emerge into what restorative sensory design can mean in dense urban environments. In this way, design and theory continuously 'feed' each other. This makes the project more than just a drawing: it becomes a way of doing research through design.

6.1 Strategy

Greening and sensory restructuring of the Lijnbaan

The existing pavement of the Lijnbaan will be replaced with sound-absorbing pavers and the middle of the shopping street will be greened. Vegetation with subtle fragrances will be introduced to reduce perceived noise, and enhance sensory comfort.

Within this green structure, meandering walking paths are implemented. These break the current monotonous linear sightline of the Lijnbaan, which can reduce perceived crowding and encourage slower movement.

Reprogramming of plinths: from consumption to restoration

In addition, the plinths along the Lijnbaan will be reprogrammed with new functions. Based on the assumption that shopping patterns will change in the future, becoming less consumption-driven and less goal-oriented, with a stronger focus on mental well-being, staying, and recreation, the design proposal reduces the number of retail functions at ground level.

A significant part of consumption is relocated from the ground floor to the first floor. This creates a secondary commercial layer above street level, forming a new network of retail spaces. At the street level, about 70% will be allocated to "slow functions". Some shops will still remain on the ground floor to prevent stressors and crowding from simply shifting to upper levels. This helps create a more varied and dynamic street level experience. So at street level, about 30% will be consumption-oriented programs. In this way, the spatial reconfiguration of consumption becomes a key part of the overall strategy. The plinths that become available through this relocation, and also through vacancy and 'hidden vacancy'

(chapter 4.1.6 and 4.1.7) are programmed with so-called "slow functions". These functions are specifically aimed at slowing down the pace of the urban environment in support of restoration. Examples include a reading space, a library of goods, a communal kitchen, urban farming, a quiet room, and tea or coffee spaces.

By embedding these functions within the plinth, in combination with the newly greened inner street, a restorative public space emerges that supports both everyday use and mental well-being.

Integration and transformation of the semi-public courtyards

The semi-public courtyards, the two dark green hatched areas, are more strongly integrated into the Lijnbaan and redesigned as key sensory spaces and refuges, as a place for 'being away' (ART).

Joost Banckertsplaats: expressive courtyard

The Joost Banckertsplaats is transformed into an expressive urban garden, where restoration emerges through interaction, creativity, and sensory engagement rather than quiet or withdrawal.

This courtyard activates the senses touch and sight and functions as a space for being away within the urban context.

Its character is defined as a soft expression space, balancing calmness and liveliness. Design elements include temporary seating and flexible layouts, projection screens and light

installations , murals and chalk drawing walls , movable stages for performances , interactive objects , hanging tactile elements and swing benches and hammocks.

Visual expression is emphasized through:

- reflections through mirrors -> seeing yourself and others
- user-generated art on walls with chalk
- dynamic lighting, especially in the evening

Tactile engagement is stimulated through:

- textile elements such as hammocks
- interactive water features responding to movement

Here, restoration is achieved through meaning, participation, and social connection.

New cross-passage as connection and transformation of the service street

The expression garden is connected to the Lijnbaan through a new cross-passage, created by opening up an existing retail block, which is transformed into a permeable through-route; the green striped arrow. The route continues through the expedition street and into the courtyard via a transformed plinth of the adjacent housing block.

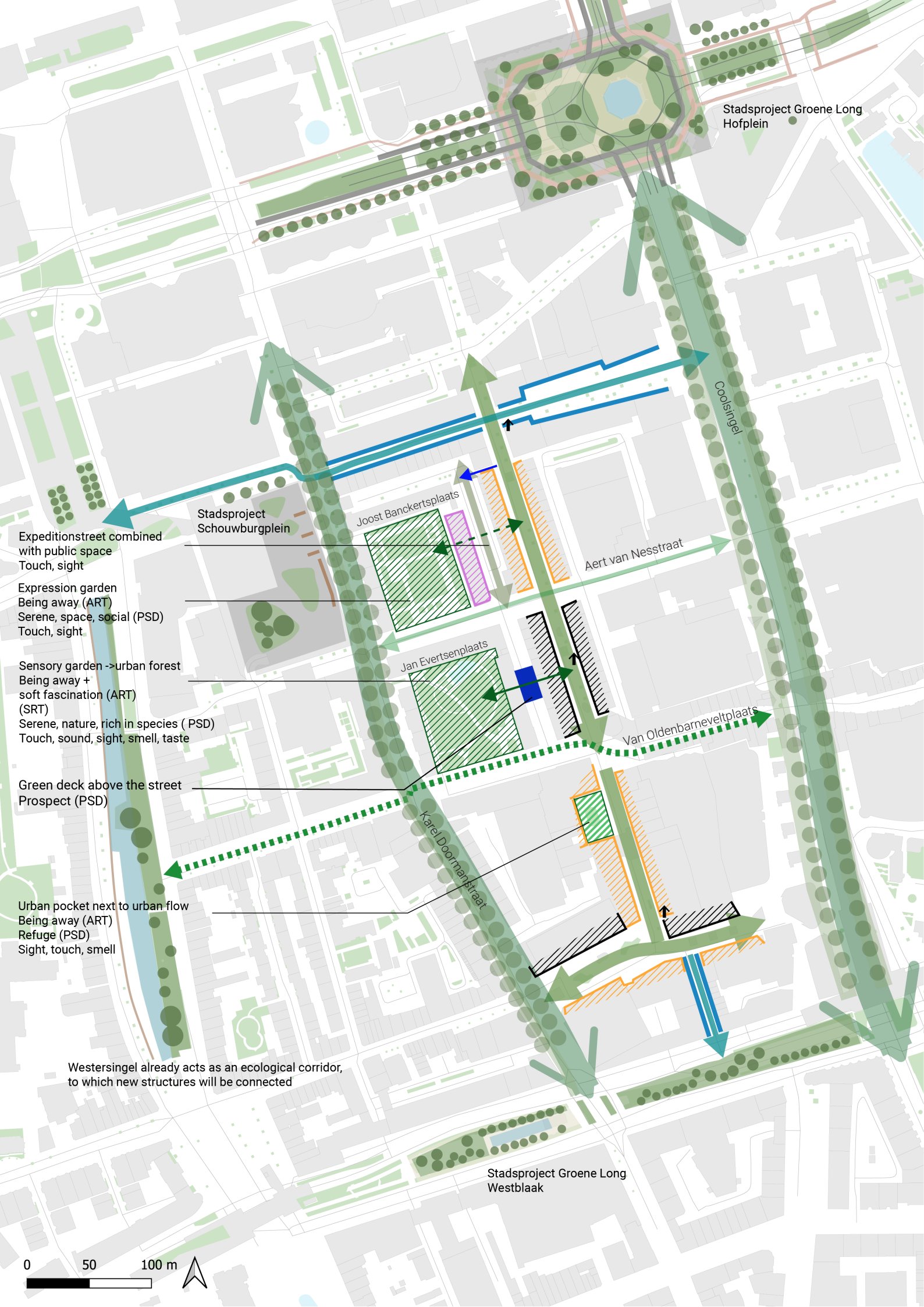
In addition to facilitating movement, the cross-passages also provides moments of retreat from the surrounding urban activity.

Exeditistraat as tactile production street

The pink area, the current service street is reimagined as a tactile production street, where small-scale making and urban agriculture shape its identity.

Former garages of the residential block are

-  Redesign green space
-  New urban pocket (sight, touch, smell)
-  Redesign facade first floor; semi transparent screens and vertical wooden slats
-  Redesign facade first floor; setback level
-  Transformation garages in plinth residential flat
-  Adding more greenery along parallel traffic axis
-  Adding more green to the Lijnbaan and slow functions (sight, touch, smell)
-  Expedition street combined with public space to soften the plinth (touch, sight)
-  Green the tramline
-  Green the cross traffic axis
-  Connection to surrounding green structure
-  Ecological corridor
-  Improve the passage to the courtyard and exp. street
-  Connecting Lijnbaan to courtyard through passage through blocks and exp street
-  Connecting Lijnbaan to courtyard via a raised green platform and cutting through the building blocks
-  Green deck above exp street (all senses)
-  Stair access to the canopy/gallery



Stadsproject Groene Long Hofplein

Coolsingel

Aert van Nesstraat

Van Oldenbarneveltplaats

Karel Doormanstraat

Joost Bankertsplaats

Jan Evertsenplaats

Stadsproject Schouwburgplein

Stadsproject Groene Long Westblaak

Expeditionstreet combined with public space
Touch, sight

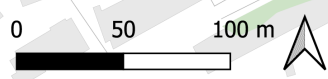
Expression garden
Being away (ART)
Serene, space, social (PSD)
Touch, sight

Sensory garden -> urban forest
Being away + soft fascination (ART) (SRT)
Serene, nature, rich in species (PSD)
Touch, sound, sight, smell, taste

Green deck above the street
Prospect (PSD)

Urban pocket next to urban flow
Being away (ART)
Refuge (PSD)
Sight, touch, smell

Westersingel already acts as an ecological corridor, to which new structures will be connected



transformed into workshops and ateliers, repair spaces (e.g. bicycle repair), pick-up points, or small studios (e.g. ceramics). This introduces a “maakstraat” character, emphasizing touch, craft, and slow mobility. Urban farming further enhances sensory engagement through smell and direct interaction with vegetation.

Due to decreasing car dependency, many garages of this residential block can be repurposed, while a limited number remain for necessary parking. The current existing expedition street is relatively wide. This makes it possible to accommodate public space alongside its logistical function. The strategy for the service street is therefore to combine logistics with public space.

One of the retail units along the Lijnbaan, located at the entrance of the service street, will be transformed into a logistics hub. Delivery trucks will stop here to unload goods, so that they do not need to drive through the entire street. From this hub, goods are transferred to smaller electric carts or vans. These produce less noise and fewer vibrations than conventional trucks, thus reducing sensory stimuli and contributing to restoration.

In some cases, trucks will still need to drive through the street for large or heavy deliveries. However, the service street will be largely free of truck traffic, approximately 90%, with only limited access (around 10%) when it is necessary.

Jan Evertsenplaats ; sensory garden

The Jan Evertsenplaats is redesigned as a sensory garden with an urban forest character, stimulating all five senses. This space emphasizes biodiversity, natural soundscapes and seasonal change. It offers restorative and educational experiences. It provides a place

for being away, and the Perceived Sensory Dimensions serene, nature, and rich in species will be applied. It also aligns with Stress Reduction Theory (SRT) by strengthening the human-nature connection.

New cross-passage as connection: elevated deck

This sensory garden is connected to the Lijnbaan through a new type of cross-passage: a green deck that spans above the service street. From the shops along the Lijnbaan, visitors can move up one level to access this deck. The deck offers open sightlines and also functions as a place for temporary retreat. From here, the route continues through the residential block, after which a staircase leads down into the sensory garden. The garden is also accessible directly from the expedition street, forming part of the parallel route through the area.

Facade strategy and sensory filtering

The areas of the Lijnbaan that are marked with orange hatching represent retail facades that will be adapted. Analysis showed that these facades currently contain a high level of visual clutter, including LED screens, and that loud music from shops contributes to an unpleasant sensory environment. To address this, some of the facades (of the relocated shops to first floor) will be modified by adding vertical wooden slats at the first-floor level or semi-transparent screen layers in front of the shopfronts. The retail functions remain visible behind these layers, but the intervention acts as a spatial sensory filter, reducing overstimulation. To maintain variation and avoid creating a tunnel-like effect, not all the facades will be redesigned, and some will just stay the same.

In the areas indicated with black lines, the facades of relocated shops are adapted in a different way. Here, the retail units on the first floor are set back from the plinth, creating a recessed facade. As a result, the shops are still present but less dominant in the streetscape. The existing canopies are transformed into accessible galleries that can be walked on. This intervention supports the strategy of creating clear circulation routes and separating movement spaces from staying spaces, thereby reducing conflicts between flows. It also introduces a hierarchy in movement, distinguishing between primary routes (movement) and secondary spaces (staying), which helps to reduce perceived crowding. These elevated galleries can be accessed via stairs from the central shopping street, or via stairs and elevators from within the shops

Urban pocket park

The small light- green hatched area right next to the Lijnbaan will be redesigned as a new urban pocket park, functioning as a refuge space alongside the urban flow. It can be seen as a recessed corner where visitors can withdraw, centered around a monumental tree.

Ecological corridors

At the northern and southern edges of the Lijnbaan ensemble, the streets are transformed into ecological corridors that connect to the surrounding green structure. This makes the design proposal embedded within its broader context.

In addition, the southern ecological corridor is connected to one of the seven urban projects, Westblaak. Along these corridors, some of the plinths are reprogrammed with functions such as organic cafés, urban agriculture, and plant and flower shops.

The spatial atmosphere is defined by a waterbody in the middle, with reeds and aquatic planting along the edges. Wooden boardwalks and bridges are integrated. There is also space for trees and biodiversity. The corridors will have the character of a park-like landscape.

Restoration is achieved through multiple sensory experiences:

- sound: water, rustling leaves, and potentially birds
- sight: views of greenery and natural elements
- smell: flowers, trees, and herbs

These spaces create a strong being away experience (ART) and, through their natural character, align with Stress Reduction Theory (SRT).

Greening the two cross traffic axes

Another part of the strategy is greening the two cross traffic axes. The cross-axis Van Oldenbarneveltplaats, where the tram intersects the Lijnbaan, will also be redesigned. The existing paving will be replaced with sound-absorbing pavers to reduce noise and vibrations, and greenery will be introduced between the tram tracks to further dampen sound and improve visual quality.

Similarly, the Aert van Nesstraat, which functions as a vehicular axis, will be greened by adding more planting and trees within the street profile.

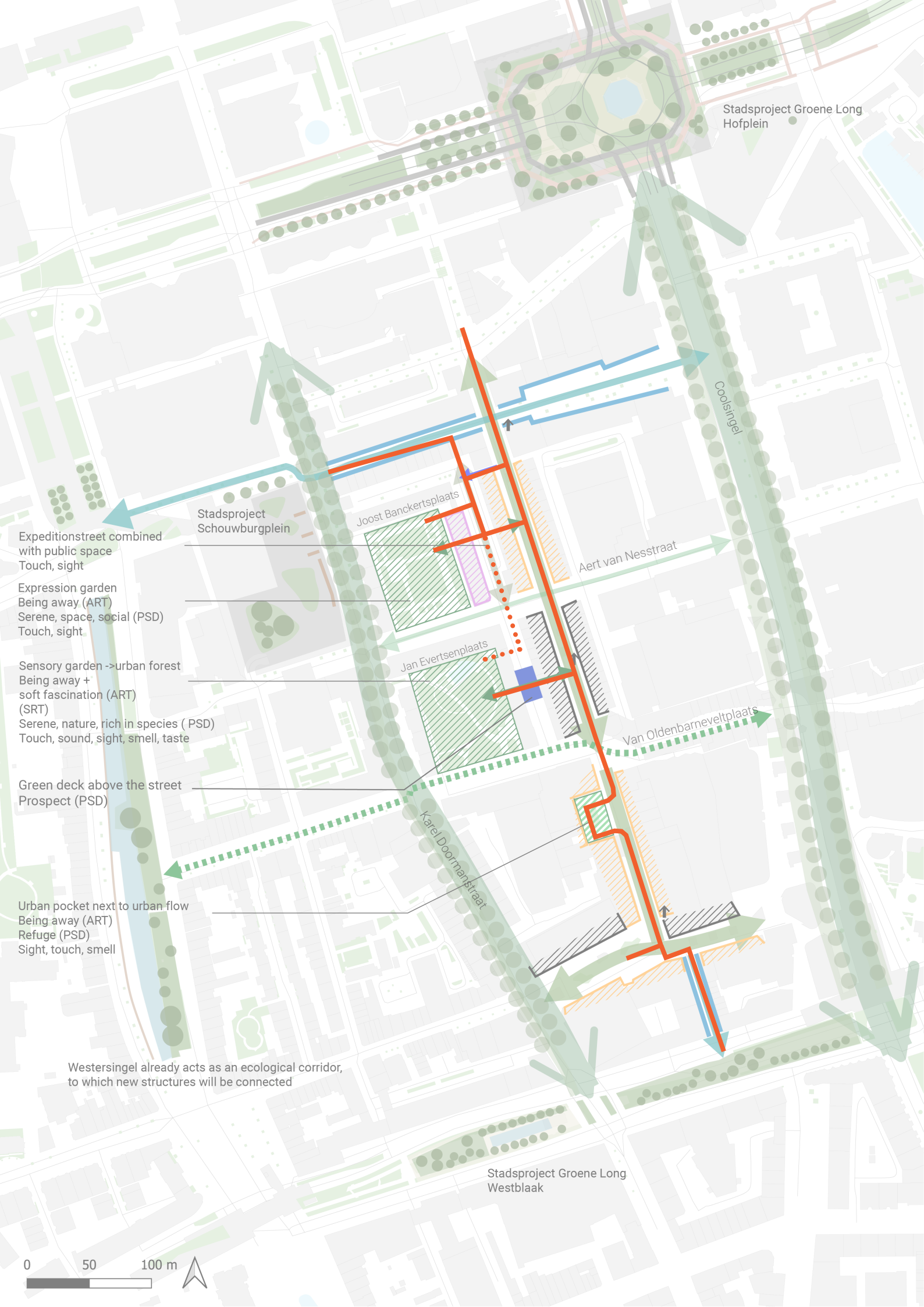
A spatial framework

Finally, a strategy at the larger urban scale is proposed. The two parallel traffic axes along the Lijnbaan, Karel Doormanstraat and Coolsingel, are further greened with additional vegetation and trees.

Together with the stadsproject Groene Long Westblaak, these greened streets form a spatial framework that anchors the Lijnbaan within a larger ecological network. By greening the Coolsingel, the connection between Hofplein and Westblaak is also strengthened.

The indicated route on the page has been chosen as the restorative network to further elaborate on. This will be done in the next chapter.





Stadsproject Groene Long
Hofplein

Coolingsingel

Stadsproject
Schouwburgplein

Joost Bankertplaats

Aert van Nesstraat

Jan Evertsenplaats

Van Oldenbarneveltplaats

Karel Doormanstraat

Stadsproject Groene Long
Westblaak

Expeditionstreet combined
with public space
Touch, sight

Expression garden
Being away (ART)
Serene, space, social (PSD)
Touch, sight

Sensory garden -> urban forest
Being away +
soft fascination (ART)
(SRT)
Serene, nature, rich in species (PSD)
Touch, sound, sight, smell, taste

Green deck above the street
Prospect (PSD)

Urban pocket next to urban flow
Being away (ART)
Refuge (PSD)
Sight, touch, smell

Westersingel already acts as an ecological corridor,
to which new structures will be connected



6.2 Restorative route design

The strategy is then turned into a possible translation in the form of a masterplan to show how the strategy could be materialized. An important note is that this is not a definitive solution, but one of the potential spatial expressions of the underlying strategy.

The restorative network through the Lijnbaan will be portrayed on two scales. The first is on the scale of the entire network, while the second focuses on smaller scale, which are presented at the end of this chapter.

The plan shows the different characters, atmospheres, and spatial qualities of the public spaces, which builds on a rhythmic sequence. An important thing of the masterplan is the continuous chain of diverse public spaces. These alternate in scale, atmosphere and program. This rhythmic sequence of public spaces maintains presence and liveliness during low-activity periods as well.

Meandering paths break continuous flows and reduce perception of mass

Perceived Sensory Dimensions: rich in species, nature

New parallel route to distribute pedestrian flows

Being away: restoration through interaction and creativity

Greenery and sound-dampening paving

Being away and stimulating all the senses

Green in streetprofile and along tramrails

Refuge next to urban flow

Introduce planting and coffee/tea house in vacant store to create pleasant smells



0 50 100 m



6.3 Design locations

To really apply the strategies (from the tables in subchapter 5.4) to the design of public space scale, a few small scale designs are made. These are zoom-ins of the restorative network. A design proposal has been made for 3 different areas to zoom in on.

1= Lijnbaan (6.3.1)

2= Jan Evertsenplaats -> Sensory garden (6.3.2)

3 = Lijnbaanplein -> Urban pocket park (6.3.3)

Each design proposal is directly linked to the tables of design strategies from the previous subchapter 5.4. This table provides the full overview of all strategies developed in the project. For each area, a strategy map, a plan, section, and illustration are made.

The strategy map has symbols with the colors from the table, to connect them. These colours correspond to the different sets in this strategy toolbox, making both the type of strategy and its intended purpose immediately legible.

Two other areas within the restorative network will be represented through 3D visualisations only, in order to illustrate how these spaces could potentially look and feel without further detailed elaboration. These are the ecological corridor (6.3.4) and the expressiongarden at Joost Banckertsplaats (6.3.5)



4

1

5

2

1

3

0

50

100 m





Location 1: Lijnbaan segment



Location 2: Jan Evertsenplaats



Location 3: Lijnbaanplein



Location 4: Korte Lijnbaan



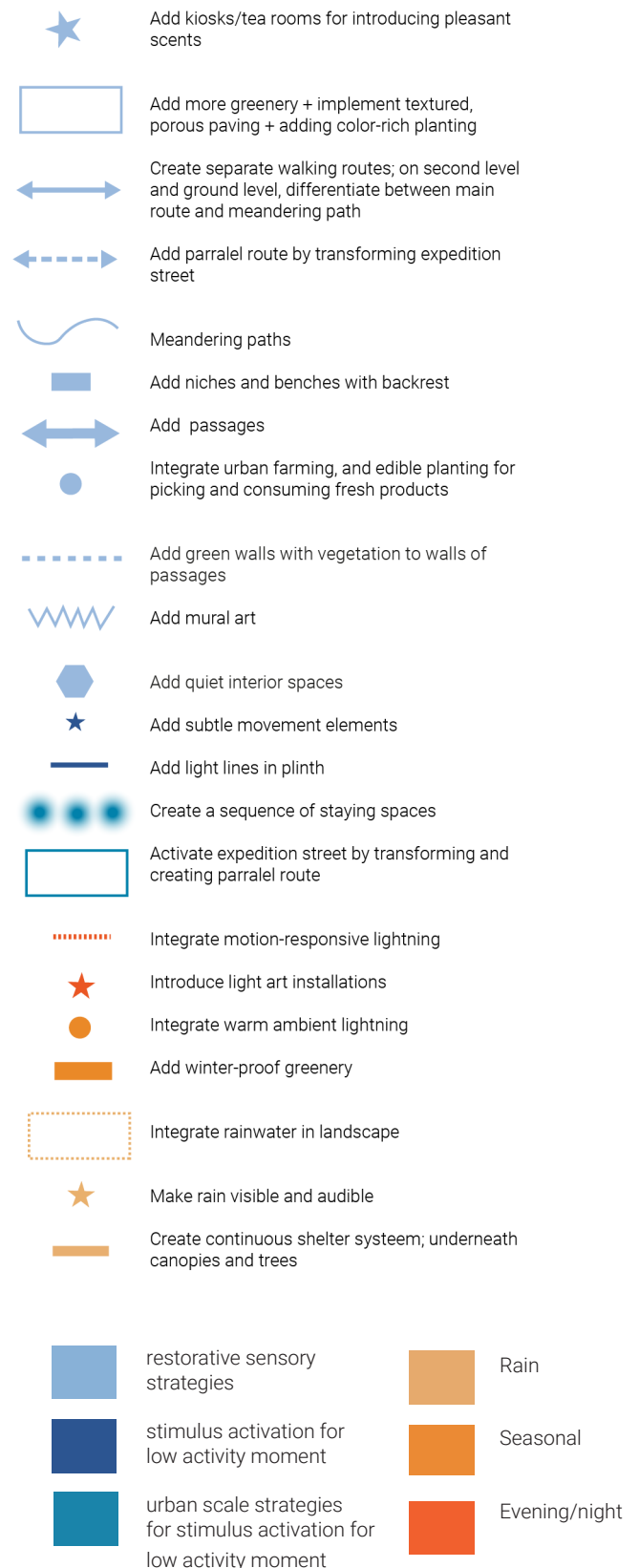
Location 5: Joost Banckertsplaats

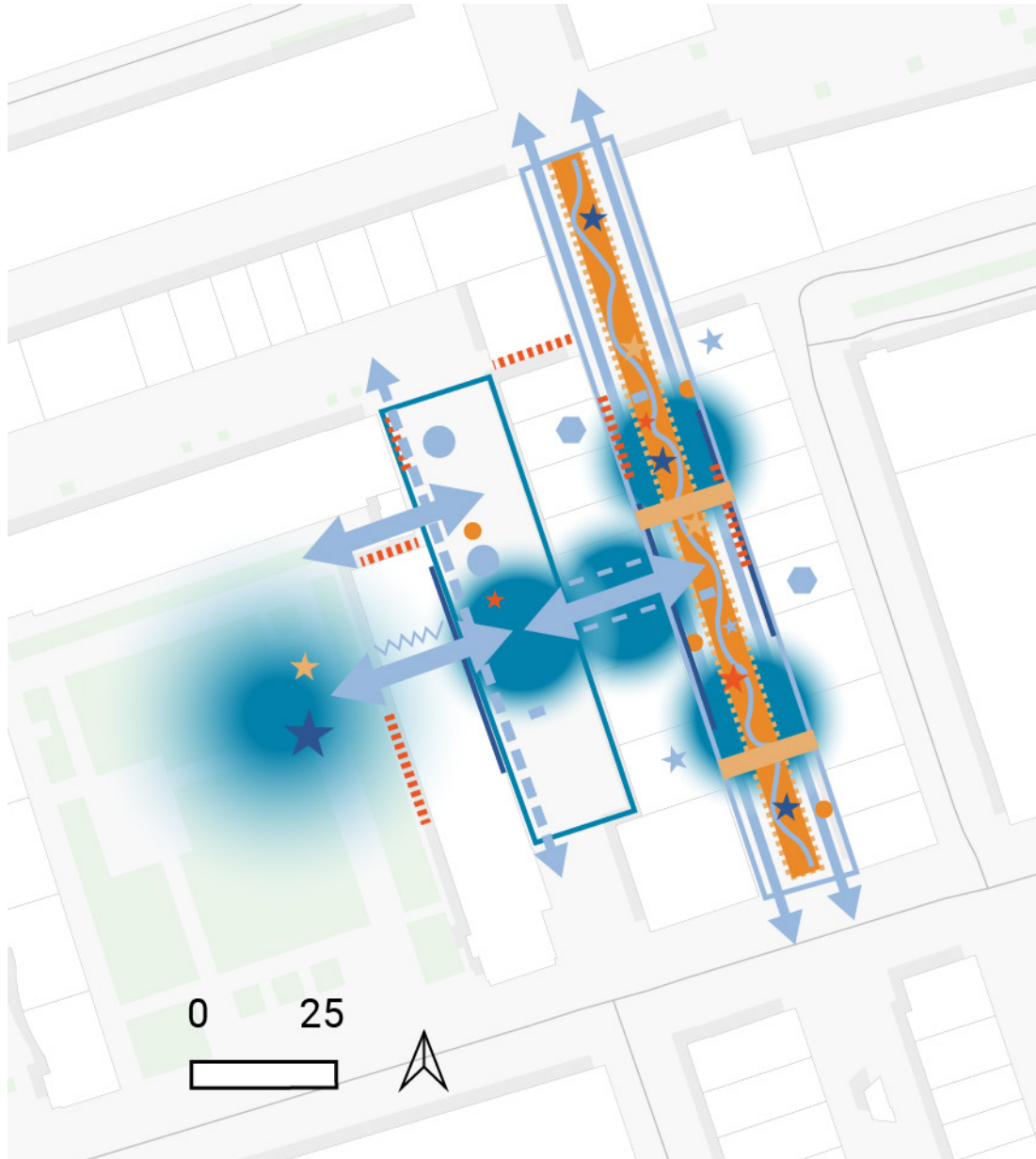
These images show the current situation of the locations. They are placed next to the masterplan to allow a comparison between the current and proposed situation. This gives a general impression of how the sites could look after redesigning.



6.3.1 Lijnbaan

The first zoom-in location focuses on the first section of the Lijnbaan route, where the existing pavement will be replaced with greenery in the center of the street, and with porous textured pavers, and also new slow functions in the plinth. The restorative sensory strategies, highlighted in light blue and linked to the strategy tables from chapter 5.4, focus on how sensory experiences can support restoration. For example, meandering paths (which has effects on the sense vision) through the greenery break continuous flows and reduce the perception of crowds. The strategy map also shows a rhythmic sequence of staying spaces, represented by turquoise dots, connecting different atmospheres along the route: from the green Lijnbaan to narrow passages for gradual transitions, the activated Expeditiestraat, the passage through the residential flat with mural art interventions, and the redesigned Joost Banckertsenplaats as an “expression garden.” This alternating sequence of stimulation and calm creates a more dynamic and restorative walking experience, with alternating intensity, which prevents monotony and emptiness. The map also shows additional strategies for seasonal changes, rain, and nighttime.





Strategy map of the first segment of the Lijnbaan
Scaled up to 200% of its original size

The rhythmic sequence is also visible in the main part of the Lijnbaan itself, where more enclosed and calmer spaces, such as the micro-refuge huts and sensory pods around the tree, alternate with more open and active spaces, such as the large bench surrounding the tree.



0 5 10 m





The section illustrates the new cross connection and shows the restorative strategies in vertical side view, such as the addition of semi-transparent facade elements to reduce visual clutter from the shops on first floor.



A new cross-passage, created by opening up an existing retail block, which is transformed into a permeable through-route. With green vegetation walls and benches combined with green for stress reduction. Also for *being away* and *fascination*

The straight sightline of the Lijnbaan has been broken and now has meandering paths and greenery.

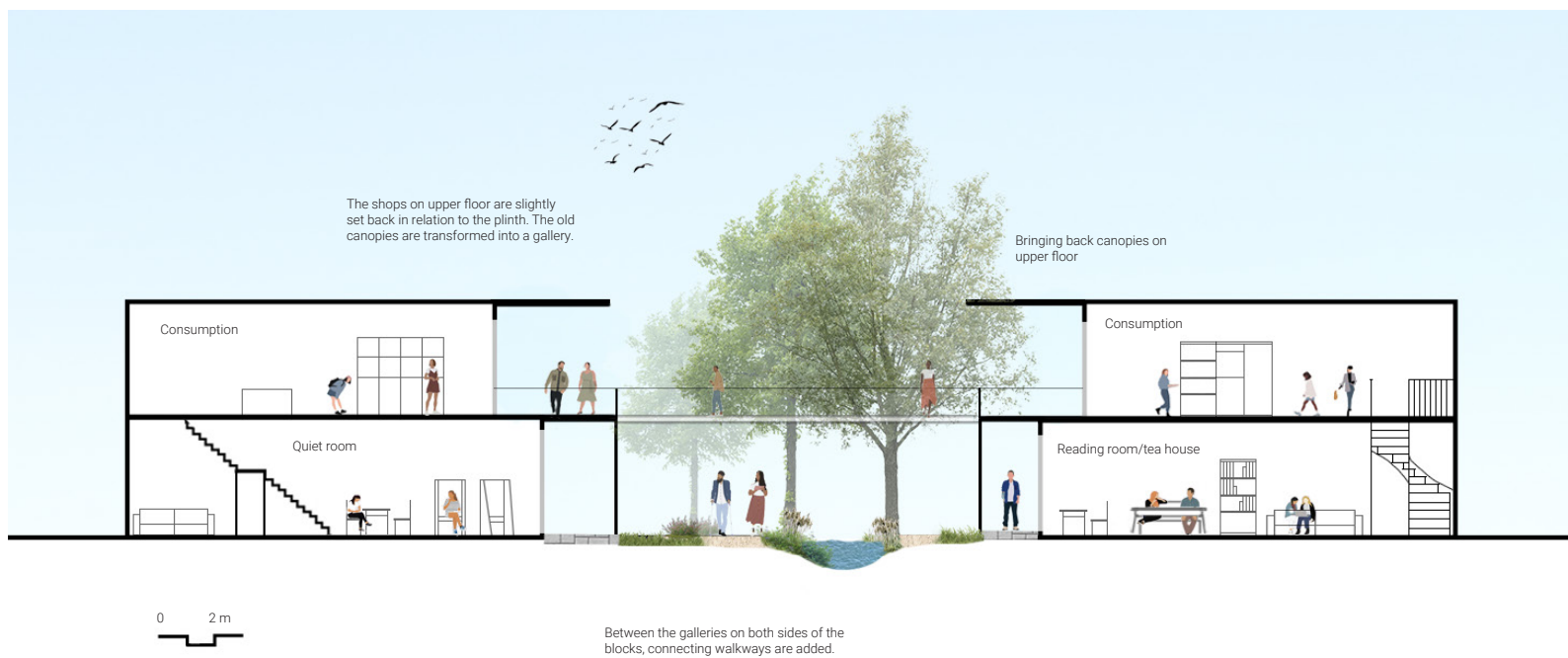


This perspective drawing illustrates how a restorative Lijnbaan could engage the senses to support restoration. Subtle movement elements, such as wind-responsive planting and hanging public art elements in the tree, create gentle visual activation and respond to the ART principle of fascination without overwhelming the space. At the same time, strategies that reduce sensory overload, including semi-transparent facades screens that soften visual clutter and noise from the retail functions, help create a balance between stimulation and calm. In addition, added greenery contributes by dempening noise while enhancing the visual quality of the space, also because of the more colorful planting. These fragrant vegetation also can provide pleasant smells.



This drawing shows the same space in the evening and at night, illustrating how it remains lively, safe, and inviting after dark. Integrated light lines along edges improve spatial legibility and provide subtle guidance through the area. Light art installations and soft ambient lighting under canopies and along routes prevent the space from feeling empty, while creating a safe and comfortable atmosphere. Together, these elements address the issue of darkness and undefined spaces, ensuring that the Lijnbaan stays readable and welcoming at night.

Lijnbaan middle segment



This section shows the middle segment of the Lijnbaan, where the first-floor facades are also redesigned but in a different way. Here, the facades are set back from the plinth instead of adding screens or wooden slats as in the previous section. This increased distance helps reduce noise transmission from the first floor to the public space below, creating a calmer street environment. It also shows the transformed canopies into a gallery and the new connecting walkways between both sides of the blocks.



The perspective drawing of the middle segment of the Lijnbaan shows the addition of a soft sound layer through water dripping elements within the greenery, wind chime, and a wooden deck that produce subtle sounds. Together, these elements create a calm background atmosphere. Subtle movement is also introduced through hanging plants in the micro-refuge huts, which function as small spaces for withdrawal and temporary escape. The design also shows a modulation of stimuli: not only activating the senses in a gentle way, but also carefully regulating and reducing them. This is reinforced by the setback first-floor facade, which helps dampen noise and creates a quieter, more comfortable public space.



Even during colder weather and rainfall, the Lijnbaan will remain a restorative environment. Rainwater is integrated into the central green zone, introducing gentle movement through natural water flows and sound dripping elements. These features enhance visual richness, create a soothing soundscape, and contribute to the atmospheric quality of the space through natural processes. Canopies, connecting walkways, and the micro-refuge huts provide shelter, while integrated light lines improve spatial legibility and comfort during darker conditions.

6.3.2 Jan Evertsenplaats Sensory garden

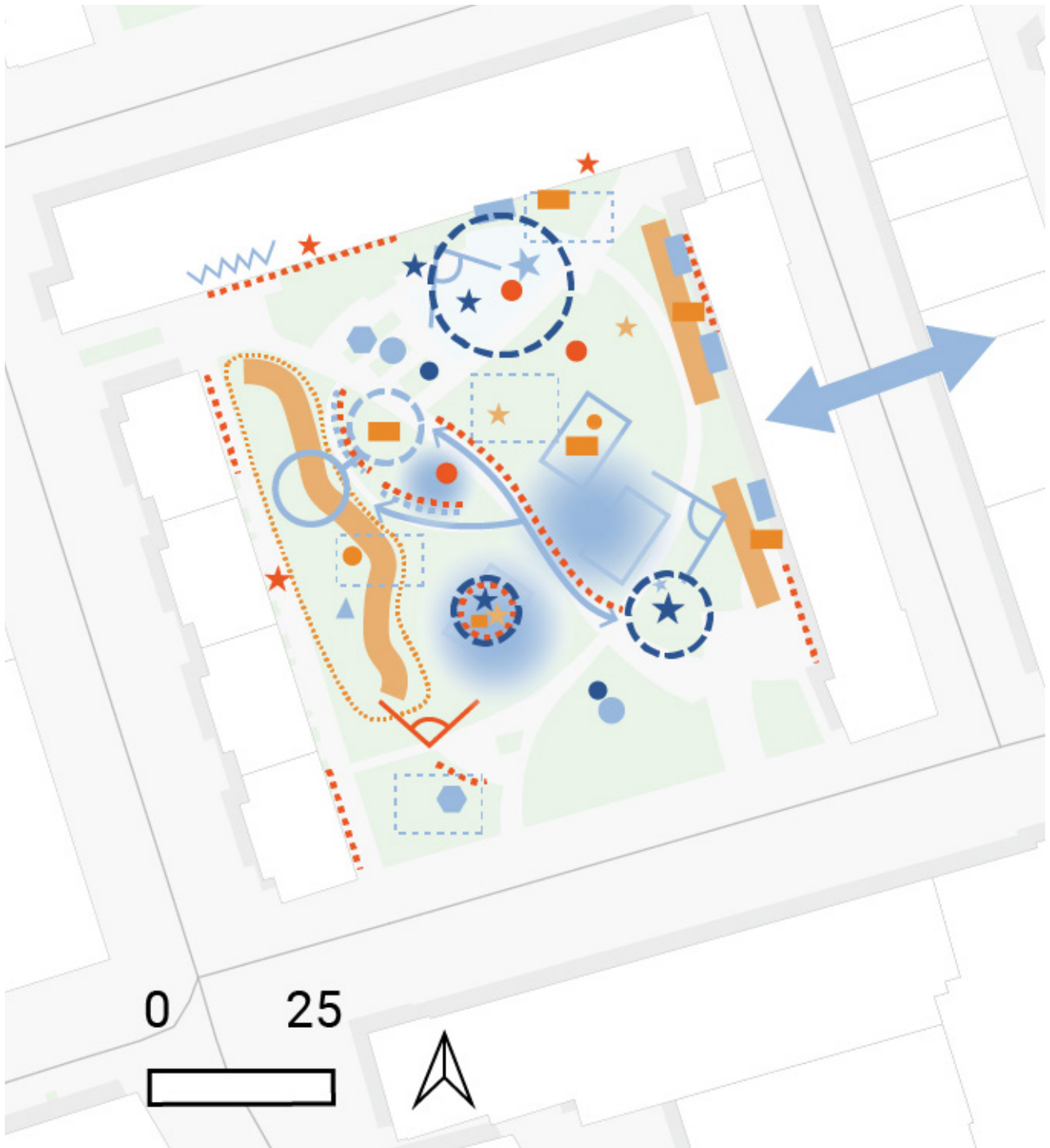
The sensory garden is a place of retreat, located at the end of the cross connection and accessible from both the Lijnbaan and the parallel route. Visitors can enter the garden via the restorative deck, which spans above the expedition street, or directly from the expedition street itself. As part of the restorative network, it is a public space where visitors can slow down and reconnect with nature.

The courtyard is designed to engage all five senses while maintaining a balance between calmness and stimulation.

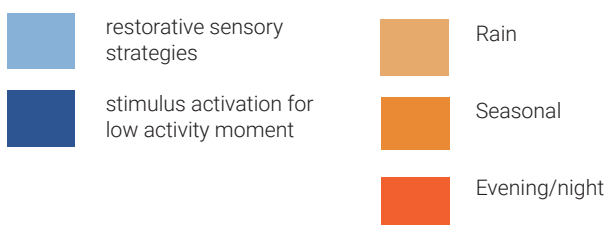
Visual stimulation is achieved through colourful planting schemes, transparent water features such as fountains, and pergola structures that create dynamic patterns of light and shade. Sound is introduced through the gentle movement of water and birdsong coming from densely planted tree areas. Tactile experiences are encouraged through natural vegetation, textured walls combined with seating, and interactive water features. Fragrant herbs and flowering plants engage the sense of smell, while fruit trees and urban farming areas stimulate the sense of taste. Visitors can even harvest and consume fresh produce. Together, these sensory elements create a rich and restorative environment that supports wellbeing and encourages meaningful interaction with the landscape.



-  Create open sightlines
-  Add diverse planting for creating pleasant natural scent + colorful plant species
-  Create separate walking routes and places to stay
-  Add tactile walls with natural vegetation and seating elements -> tactile material activation
-  Mix open and enclosed spaces
-  Add micro-refuges: niches and benches along edges
-  Add green deck (as a cross-connection/ passage) above expeditionstreet between Lijnbaan and Jan evertsenplaats ;also to allow withdrawal from street-level activity and experience views
-  Integrate urban farming, and edible planting for picking and consuming fresh products
-  Add more seating areas
-  Add herbs and low (edible) planting
-  Add green walls with vegetation
-  Add natural waterbodies and fountains
-  Create bird habitat to invite birdsong
-  Add subtle movement elements
-  Add a soft sound layer that masks silence and creates calm background atmosphere; water dripping elements, fountains with varying intensity, gravel paths, wooden decks producing soft sounds
-  Introduce taste through edible landscape which creates gentle sensory engagement
-  Maintain clear views by avoiding dense shrubs at eye level to prevent feeling unsafety
-  Add light lines along facades, routes and seatings, walls
-  Integrate motion-responsive lightning
-  Introduce light art installations
-  Integrate warm ambient lightning
-  Add winterproof dense native planting, trees and shrubs for nesting and shelter
-  Create microclimate against cold temperatures and wind exposure -> semi-enclosed spaces
-  Make rain visible and audible
-  Create shelter system; trees and pergola structure



Strategy map for Jan Evertsenplaats
Scaled up to 300% of its original size



The pergola structure around the fountain encourages interaction by inviting people to walk through it, while also creating dynamic light and shadow effects. It adds subtle sensory stimulation through climbing plants and other elements such as light strings. Similar pergolas along the garden edges provide sheltered places to pause, retreat, and have a overview of the space. The consistent use of wooden pergolas strengthens spatial coherence and creates a unified design language, which contributes to a calmer and more legible environment. This design approach is also applied in the final intervention for section 6.3.3.

The existing curved layout of the Jan Evertsenplaats has been kept and further developed in the design. Curved forms are often associated with restorative environments, because they create a softer and more calming spatial experience than rigid, angular geometries. Building upon these existing curves helped preserve the identity of the place while enhancing its restorative qualities.

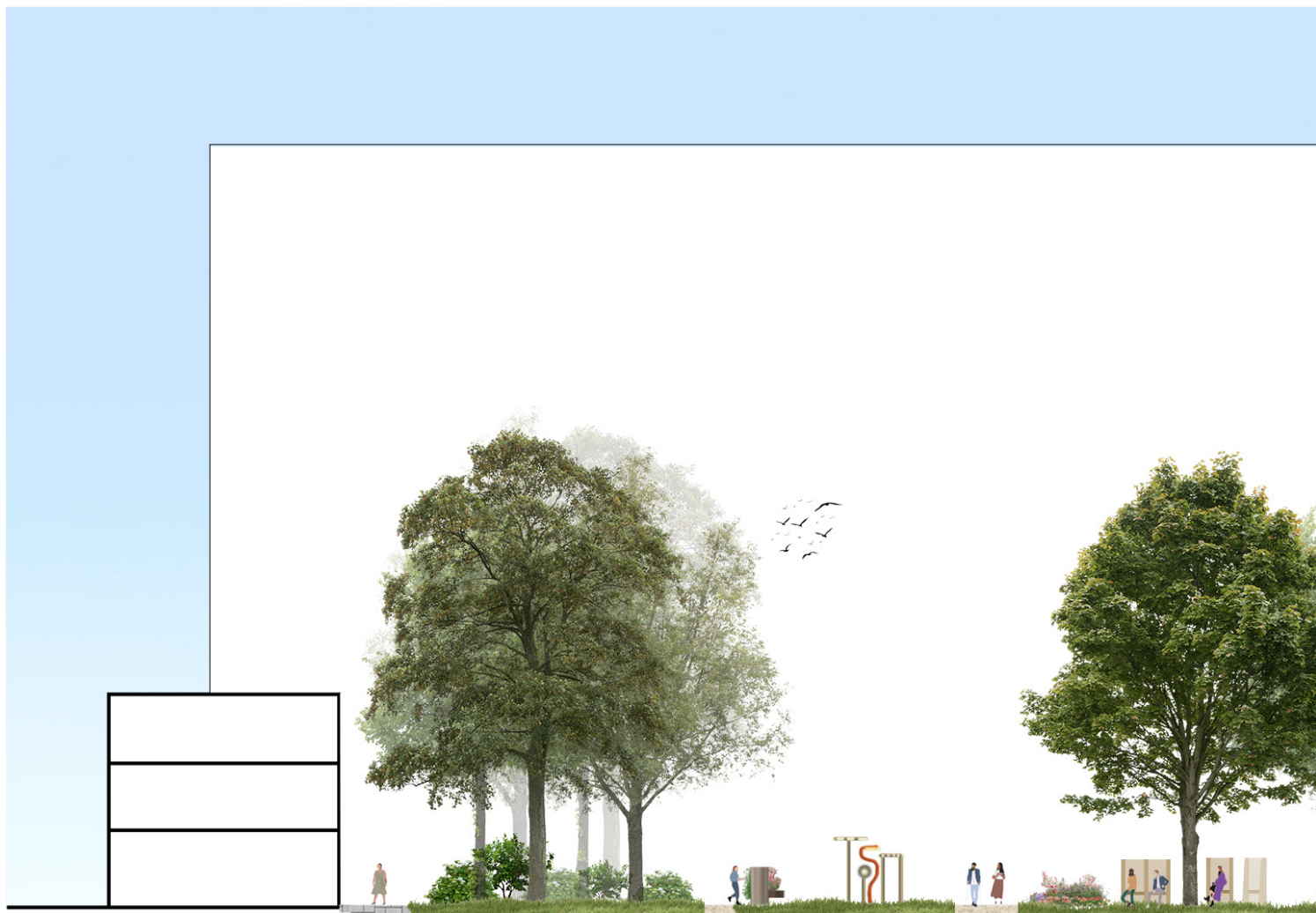




Scaled down to 25% of its original size

In addition, sensory pods are placed around the tree, which can act as small spaces where visitors can withdraw from the lively surroundings while still remaining connected to nature. From these seating areas, visitors can experience multiple sensory layers, including the sound of flowing water, birdsong, wind moving through the leaves, people passing by, raindrops falling into water bowls, the subtle sound of wind chimes, but also the scent of flowers

and herbs. Together, these elements create a rich yet calming sensory environment that encourages restoration and engagement with the surroundings.



Densed area with trees

Tactile wall with seating element and vegetation

Public art -> light installations (also for evening/night)

Fragrant flowers

Sensory pod around tree



Rainbowl
for making
raindrops
audible

Entering the sensory
garden by a staircase
(but also accessible
through expedition
street)

A new cross-passage, created by
transforming one of the existing housing units
in the housing block, which is transformed
into a permeable through-route. With green
vegetation walls and benches combined with
green for stress reduction. Also for *being
away and fascination*

Green deck above
expeditionstreet as new
cross-connection

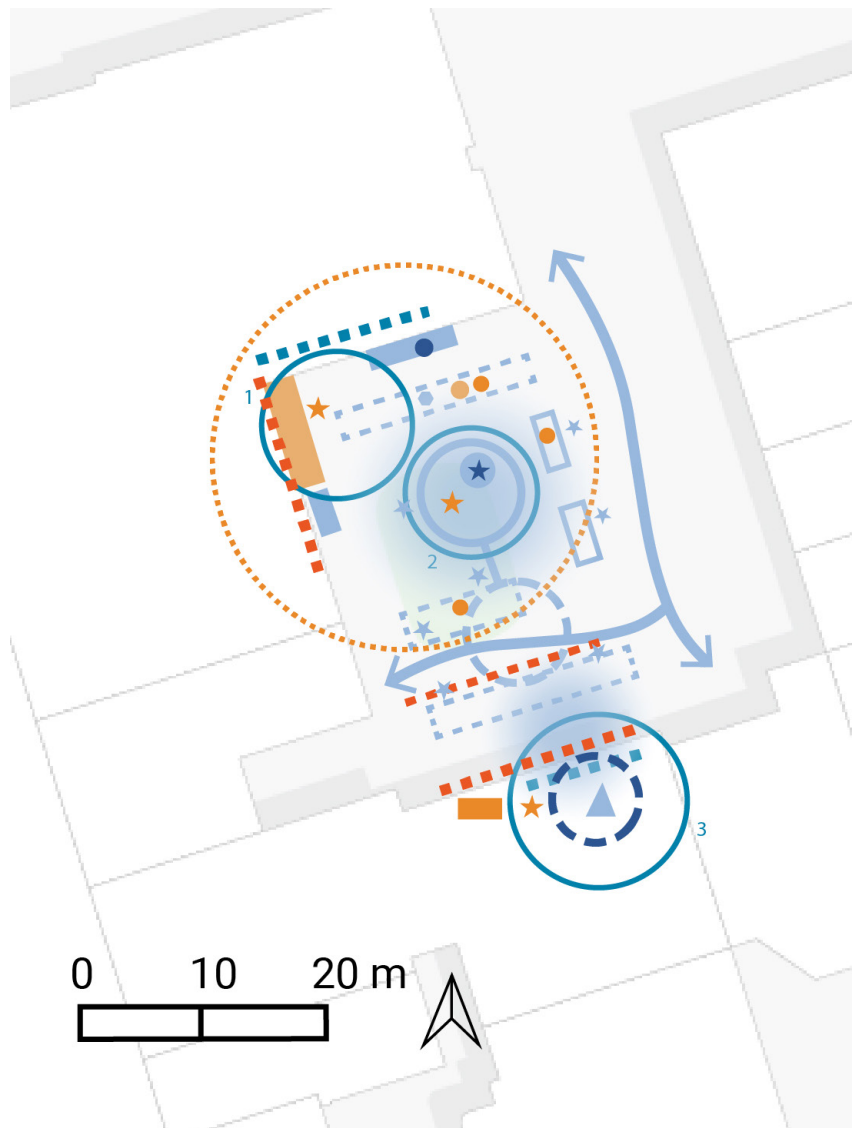
6.3.3 Lijnbaanplein -> Urban pocket park

The recessed space along the urban flow of the Lijnbaan is redesigned as a refuge area, where visitors can withdraw around the monumental tree. Restoration is achieved through sensory engagement, focusing on sight, smell, sound, and touch, which are further detailed later.

An example of a restorative strategy is the separation of movement and stay. By creating distinct walking routes and designated places to pause, conflicts in spatial flows are reduced. Micro-refuges, such as benches and pergola structures, are added at the edges, which allows visitors to retreat while maintaining overview of the space. This reduces sensory overload by limiting stimuli to two main directions instead of a fully surrounding exposure.

In addition, the urban pocket park functions as a microclimate buffer against wind and low temperatures. It has semi-enclosed spaces, so it provide a sense of shelter and protection. Warm ambient lighting is integrated into the surrounding facades, and also radiant warmth from adjacent uses such as the café. As a result, the space remains comfortable and inviting even during colder weather.





Strategy map
Scaled up to 400% of its original size

Restoration through the senses is achieved by adding more diverse planting. The presence of flowers and herbs introduces pleasant natural scents that help reduce the perceived noise of the urban flow. A café, located in a currently vacant store, also adds sensory qualities, where the smell of coffee and baked goods enhances this calming effect. The sound of the fountain contributes to a soothing atmosphere while also encouraging interaction, as it invites touch.

Sensory pods allow visitors to physically withdraw while still experiencing their surroundings.

This creates a dual condition of retreat and engagement, where restoration takes place through layered sensory input. It enables users to feel temporarily removed from the urban environment without losing connection to it.

The pergolas and wooden sensory pods, the same as in the sensory garden, form part of the broader spatial language of the Lijnbaan. This coherence creates legibility and contributes to a calmer, more restorative urban experience.





6.3.4 Ecological corridor



The space is characterized by a central waterbody with reeds and aquatic planting along the edges, wooden boardwalks and bridges, and enriched with trees and biodiversity, which together creates a park-like landscape. Along the ecological corridors, plinths are reprogrammed with functions such as organic cafés, urban farming and plant and flower shops.

6.3.5 Joost Banckertsplaats Expression garden



The Joost Banckertsplaats is reimagined as an expressive urban garden where restoration emerges through interaction, creativity, and sensory engagement. Sight is activated through mirrors, reflections, and lighting, while touch is engaged through chalk walls, hammocks, swing benches, tactile elements, and a movement-responsive fountain. A small performance stage further encourages social and creative engagement, which can lead to restoration through meaning, participation, and connection.

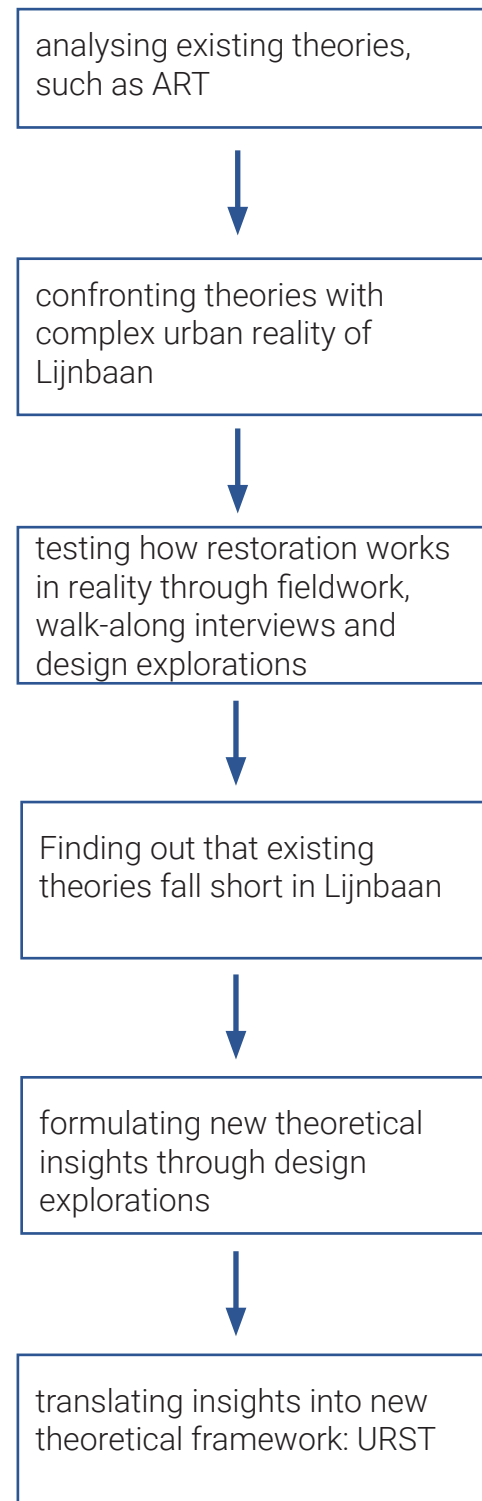
07

A new framework

7.1 A new framework

The primary outcome of this thesis is not only a spatial intervention for the Lijnbaan, but the development of a new framework that emerged through research by design. This framework was developed through several steps. First, existing restoration theories, such as the Attention Restoration Theory, were analysed and confronted with the context of the Lijnbaan and the contemporary urban reality. Through fieldwork, walk-along interviews, and design explorations, the research tested how restoration is actually experienced within the city. This process revealed that existing restoration theories sometimes fall short in explaining restoration in dense and stimulus-rich urban environments such as the Lijnbaan. These existing restoration theories do not fully explain the complex sensory conditions of contemporary urban space, particularly in environments where stimuli are always present. As a result, the design process became more than a spatial solution; it functioned as a research instrument that produced knowledge and reveals new insights into restoration in contemporary urban environments. From these design explorations, new theoretical insights about the relationship between sensory experience and urban restoration emerged.

These insights led to the formulation of the **Urban Restorative Sensescape Theory (URST)**, which can actually be seen as the main contribution to knowledge of this thesis. As a result, this framework becomes the answer to the research question of this thesis, and not just the design itself.



7.2 The development of URST

This theoretical framework, combined with own fieldwork observations, spatial analysis, and the process of designing, can generate new insights for urban designers. This new framework positions itself in the fields of urbanism, sensory design, environmental psychology, and public space design.

The URST framework builds further upon Attention Restoration Theory (ART). At first, the research suggested that this thesis could add a possible fifth principle to ART: *sensory*. However, the research eventually showed that it goes beyond the addition of a single principle. Instead, the research shifted to a broader theoretical shift in how restoration can be seen within dense urban environments.

ART is based on the idea that mental restoration occurs through exposure to natural environments. According to the theory, a restorative environment is formed through four key characteristics: being away, fascination, extent, and compatibility.

Observations and research conducted in and about the Lijnbaan reveal that restoration in contemporary urban environments functions differently.

In dense city environments, restoration does not occur through 'quiet/calm' or "escaping" stimuli, but through:

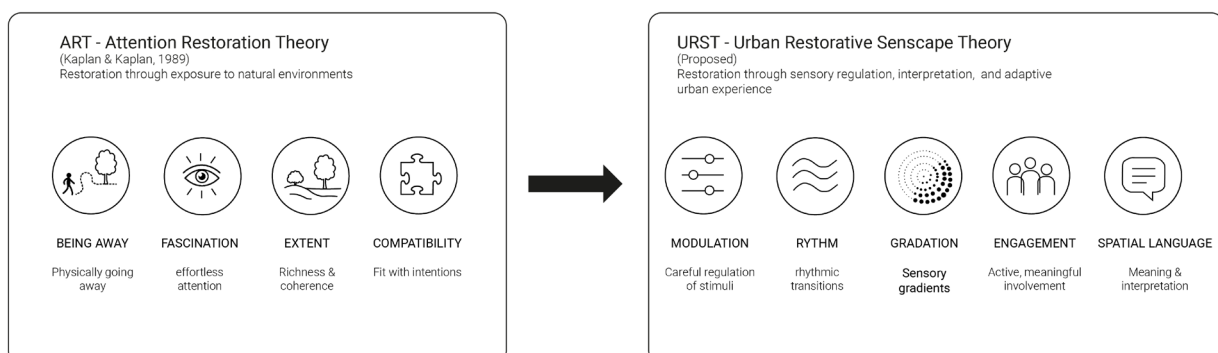
- careful modulation of stimuli
- rhythmic transitions
- sensory gradations
- active engagement

This leads to the theoretical position that an urban environment does not need to be silent or totally natural to become restorative. Because in city centers, complete silence rarely exists. At the same time, people often are looking for urban liveliness and social presence. Social activity itself can become calming, while soft forms of activity may reduce mental fatigue. Most importantly, dynamic sensescape can also produce restorative experiences.

With this new perspective, the understanding of restoration in urban contexts shifts from restoration through escape from stimuli (often associated with natural environments) toward restoration through sensory regulation and adaptive urban experience.

That is why the outcome of this research should not be seen as just as a fifth ART principle, but as the base for a new theoretical framework

This new proposed framework is defined as:
Urban Restorative Sensescape Theory (URST)



A shift in understanding restoration: expanding the concept from restoration, rather than replacing existing theory.

The core of URST is that, within busy urban environments, restoration emerges not through the absence of stimuli, but through the quality, gradation, rhythm, and manageability of sensory stimuli. The framework suggests that some stimuli may be stressful, some activating, some restorative, and some adaptively restorative, which depends on the mental state of an individual and on contextual conditions.

Rather than proposing escaping or avoiding urban stimuli and stressors, URST says that urban stimuli should be designed in ways that they are regulating, bearable, adaptive, and mentally restorative.

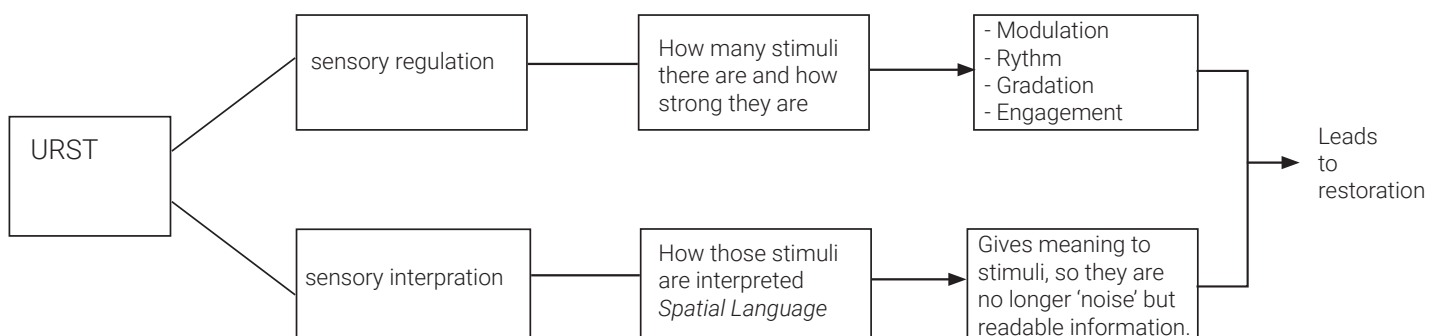
This can be seen as a new theoretical contribution, because many existing theories about restoration seem to rely a lot on the contrast between nature and the city. Instead, URST investigates how the city itself can become restorative without losing its urban identity, social vitality, or sensory intensity. So, URST proposes a new research framework and design approach within urbanism, environmental psychology, restorative cities, and public space design.

Spatial Language

In addition, a fifth principle is introduced to the URST framework: *Spatial Language*. While the first four principles, modulation, rhythm, gradation, and engagement, focus on sensory regulation, so on on how urban stimuli are spatially organized, a second layer is added through sensory interpretation: how urban stimuli communicate meaning and are cognitively and emotionally interpreted by people.

Spatial Language therefore is about the meaning people assign to sensory stimuli. It still relates to sensory input, but not to the quantity of stimuli; rather, it focuses on how these stimuli are perceived and understood. It can be seen as the consistent vocabulary of forms, materials, textures, and spatial gestures through a public space or design.

Even when sensory input is similar, a coherent and consistent spatial language can make an environment feel calmer and more legible. This reduces cognitive effort and helps people feel more at ease. Therefore, spatial language leads to restoration not by making a space less stimulating, but by making it more legible and predictable.



The addition of this second layer, sensory interpretation, strengthens the URST framework as it creates a distinction between the organization of sensory input and the interpretation of sensory input. Restoration in urban environments therefore depends not only on the sensory characteristics of space, but also on how these sensory conditions are understood.

Thus, within URST, restoration does not only occur through the regulation of sensory stimuli, but also through sensory cues that communicate meaning.

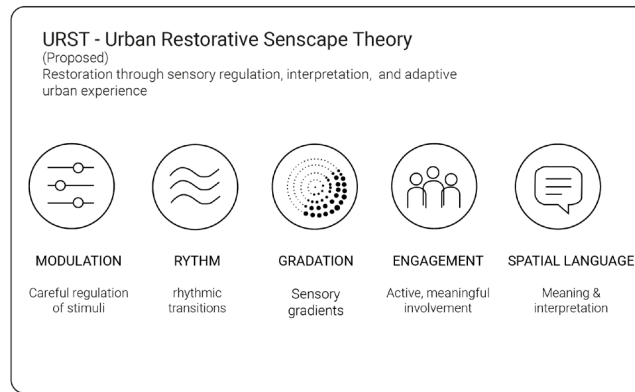
So regarding *Spatial language*, public spaces, such as the Lijnbaan, should be designed in a way that communicate meaning, identity, and narrative

A complete framework of the URST has been developed and is shown on the next page.

URST FRAMEWORK

URBAN RESTORATIVE SENScape THEORY

a shift from escape and avoidance to regulation and interpretation - towards restorative cities

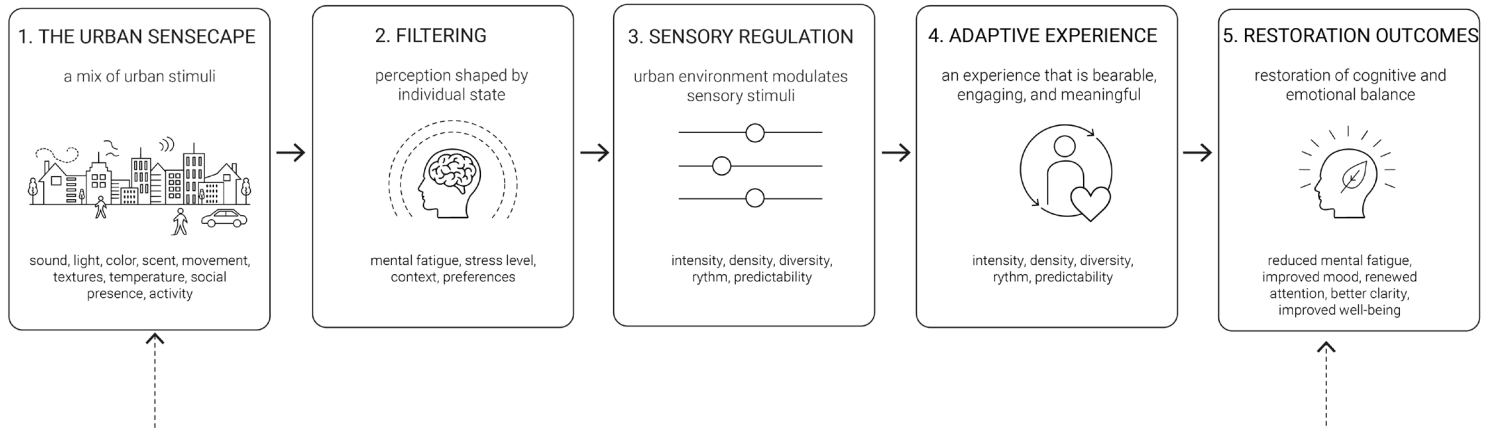


CORE PRINCIPLE

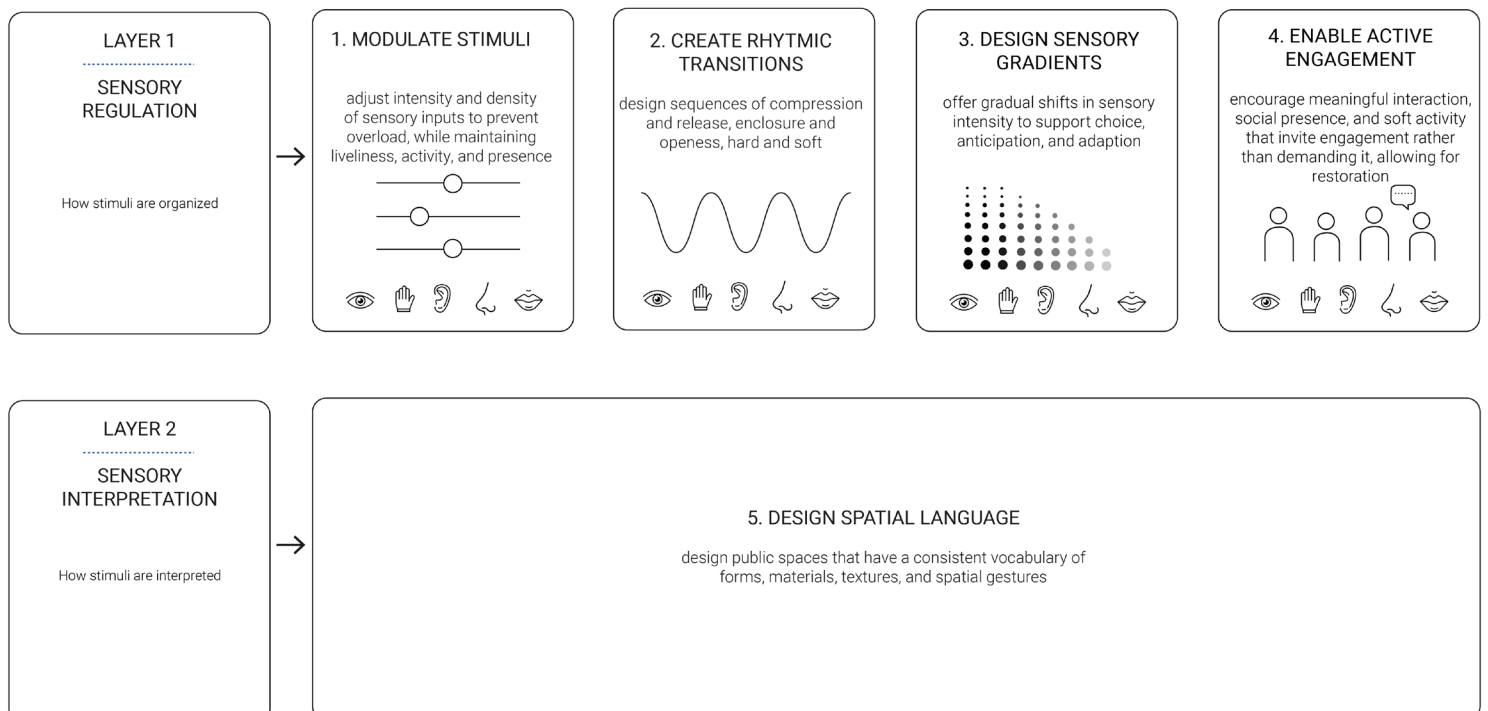
In busy environments, restoration does not occur from absence of stimuli, but from the **quality, gradations, manageability, and meaningful interpretation of sensory stimuli**

Stimuli can be restorative, stressful, activating, and adaptively restorative -> depending on mental state of individual, context and interpretation

THE SENSORY RESTORATION PROCESS IN PUBLIC SPACE



URST DESIGN PRINCIPLES



Sensescapes

*Not the emptiness, not the silence,
but the rightful melody.
Where stimuli and senses may softly rustle
and meaning is allowed to bloom again.
Between the dimming and the awakening,
I hope you find the space to restore.*

7.3 Research foundation for URST

In this paragraph, a short explanation of the foundations of the URST framework will be given, based on own (design) research and literature research. It kind of serves as background and justification for each principle

7.3.1 Justification of modulation

Interview findings showed that large rotating reflective objects and unpredictable movement stimuli, such as flocks of pigeons, were often experienced as overstimulating in the Lijnbaan. It was described as visually annoying and difficult to ignore. At the same time, existing literature about restoration says that subtle and rhythmic movement, such as leaves moving in the wind or soft water movement, can contribute positively to restoration by generating soft fascination and subtle attentional engagement (Kaplan, 1995, p. 174)

These findings suggest that restorative urban environments are not defined by the absence of movement, but by the careful modulation, rhythm, intensity, and predictability of moving stimuli.

In addition, the design process and site observations revealed that the Lijnbaan is never consistently busy or completely quiet. The intensity varies with the day, week, and seasons, which creates a constantly shifting experience. This temporal fluctuation shows that stimuli are never constant, so they can't be designed as fixed conditions. Instead, they need modulation to respond to these changing rhythms of use, time, and atmosphere.

As a final insight, the design process of the Lijnbaan emphasized the importance of modulation even more. During the design process, the idea emerged to place semi-transparent screens and vertical wooden slats in front of shop windows in order to reduce visual overload and buffer noise. However, it became

clear that applying these interventions to every storefront would dampen the environment too much, which can result in a monotonous and too much muted spatial experience.

This revealed that restorative environments are not created by eliminating all stimuli, but by carefully balancing and regulating them. By selectively applying these elements and not just implementing them uniformly, stimuli could be moderated without removing the liveliness and character of the street. This design decision further strengthened the understanding that modulation is not only a strategy, but also a key principle within the framework.

7.3.2. Justification of rhythm

Sensory rhythm within URST can be supported by both theoretical and empirical findings which highlights the restorative role of spatial variation in urban environments. Literature shows that variety in different types of spaces contributes to restoration, as it prevents sensory monotony. (Finnigan, 2024). In addition, a balance between open and closed spaces works beneficial for restorative experiences, as it creates a clear spatial structure (Finnigan, 2024). This is also reflected in walk-along interviews, where participants describe the open space near the tram line as a "nice interruption" as a soft break and moment of spatial relief in the continuous built environment of the Lijnbaan, emphasizing its openness and contrast. These findings indicate that restoration is supported not by uniform spatial conditions, but by rhythmic transitions between contrasting spatial atmospheres.

7.4.3 Justification of gradation

Sensory gradation is also supported by walk-along interviews, where respondents experienced spatial differences in sensory intensity in the route we walked. Location

3, characterised by a large tree, circular bench, and separated right next to pedestrian flow was experienced as calmer and more sheltered. Participants clearly linked this spatial configuration to a reduction in auditory stimuli, describing it as “calmer” and “less noisy.” This suggests that restoration does not depend on only silence, but also on decreases in sensory intensity.

7.3.4 Justification of active engagement

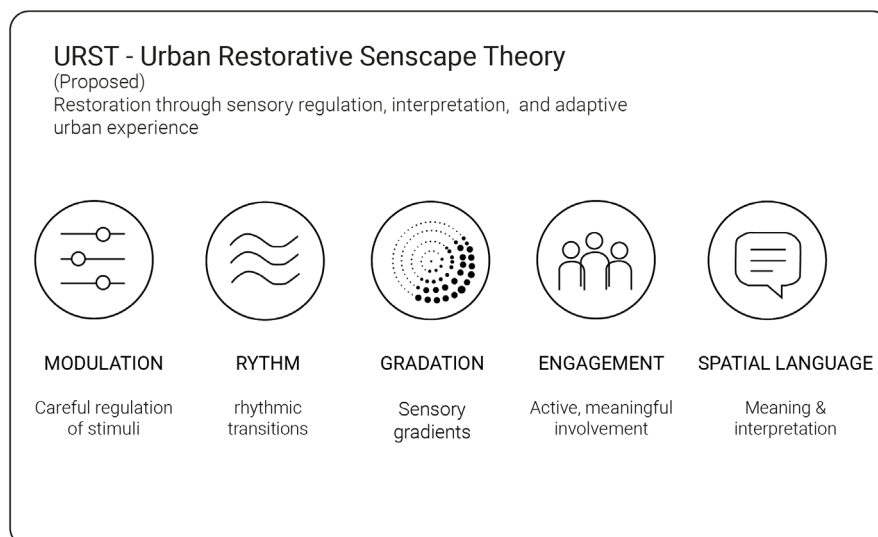
Active engagement within URST can be supported by the dual role of human stimuli in the urban environment. Research shows that certain human-generated sounds, such as street music, can have a restorative effect and contribute to a positive urban experience (Dong et al., 2024).

At the same time, other forms of human-produced noise, such as shouting voices, are perceived as stressors that disrupt restoration (Finnigan, 2024). This suggests that it is not the presence of activity itself that matters, but how people sensorially experience and interpret it. This is also supported by findings from walk-

along interviews. For example, one participant described the liveliness of the Lijnbaan as pleasant and stimulating instead of giving stress, which indicates an active and positively perceived form of auditory stimulus.

7.4 A general framework with context-specific outcomes

To conclude, URST functions as a universal framework with general design principles which is aimed at supporting restoration through sensory design. These principles can be applied to other urban contexts, but their translation into concrete sensory interventions is always site-specific. Therefore, while the framework itself is broadly applicable, the further concrete design strategies depend on the identity and sensory characteristics of each location. This will later be discussed in the reflection.



7.5 Reflection of URST on the design

URST in the Lijnbaan

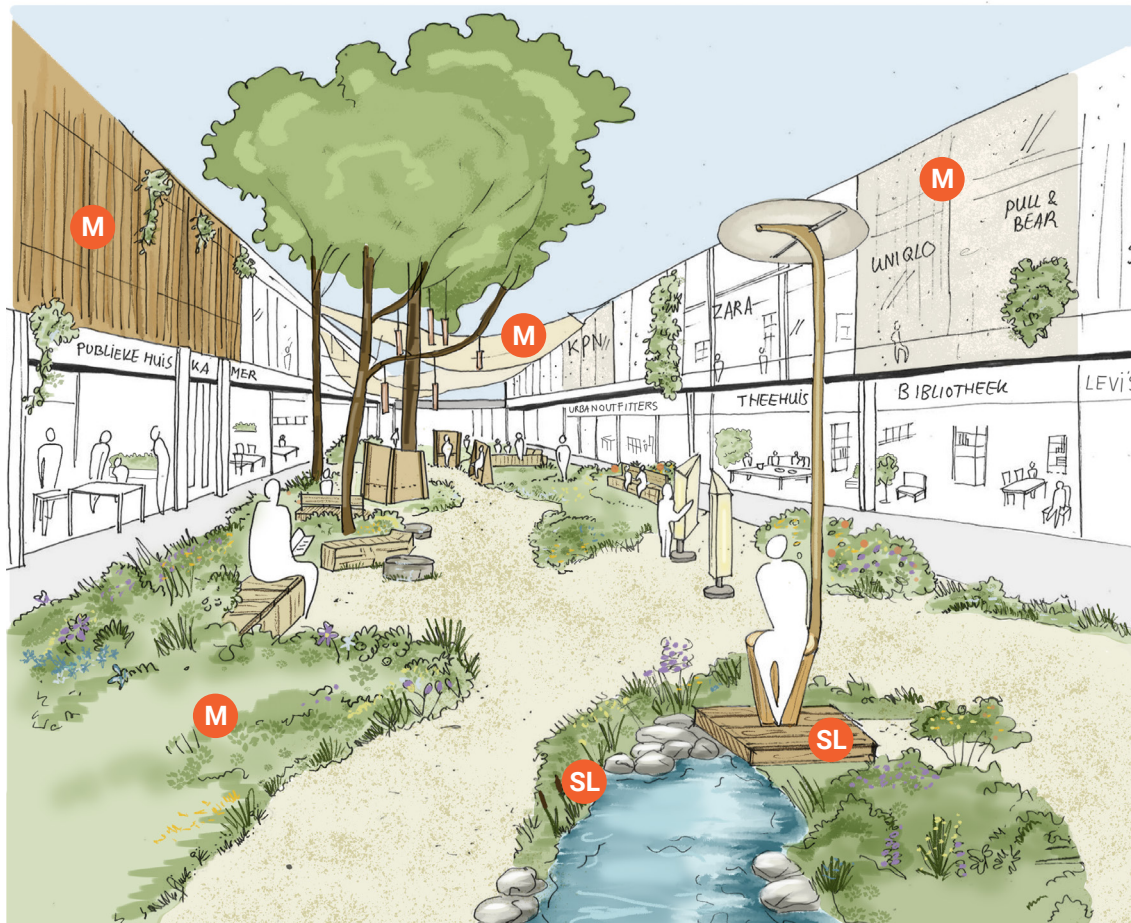
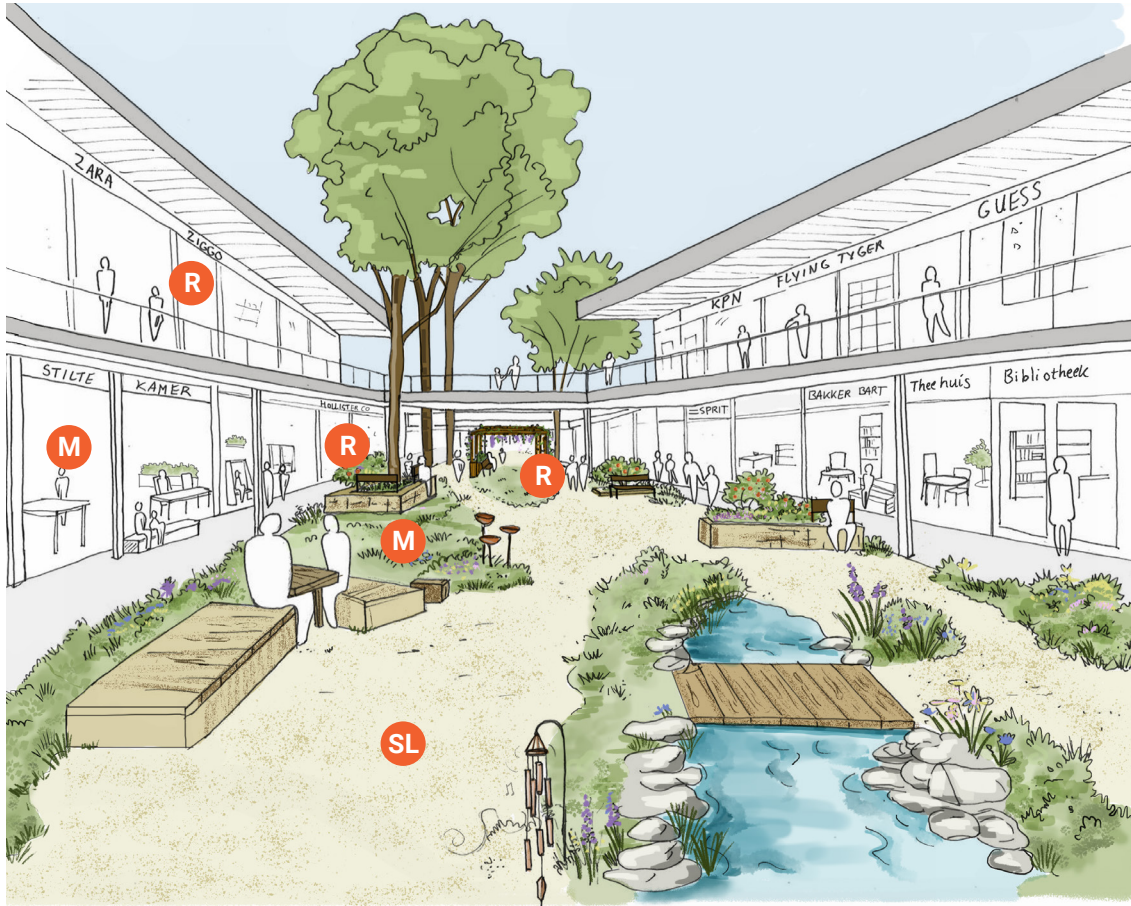
Finally, a reflection is made on the design proposal for the Lijnbaan. Since the design and URST framework have developed in parallel, it is valuable to show where and how the principles of URST are expressed within the proposal. Rather than only explaining the framework, the focus should be on making visible where modulation, rhythm, gradation, engagement, and spatial language can be recognized in the drawings.

R **Rhythm** appears in alternation between enclosed and open spaces, and between more active and calm areas. Rhythm is also visible in the ground floor layout, where some shops still remain in the plinth, but are embedded in between the slower functions in the plinth. This creates a balanced alternation of activity and calm, and a rhythm in the program. A vertical rhythm is also present, with these restorative and slower functions at ground level and more active commercial functions above, creating a layered sensory experience.

M **Modulation** can be seen in the softening of auditory sensory intensity through greenery, canopies, and quieter retreat spaces (wooden micro-refuge hut and stiltekamer). It is also visible in the way some commercial functions on the first floor are visually filtered through wooden slats and semi transparent screens. In addition, stretched fabric elements help block and filter sunlight, which can reduce glare and reflections on the pavement and shopfronts, which softens the overall sensory experience.

SL The **spatial language** of the design is based on organic and nature-inspired forms that contrast with the current rigid commercial layout of the existing Lijnbaan. The meandering pathways refer to natural movement and encourage people to slowing down, which creates a softer alternative to the current linear and high-intensity character of the shopping street. Organic shapes in the greenery and water bodies imitate natural landscapes, and the stones next to the water emphasizes the tactile and natural character.

The repeated use of wood throughout the design creates a sense of unity and adds warmth to the space. The repetition of rounded and organic forms further contributes to a sense of calmness, rhythm, and recognisability within the space. Together, these elements form a coherent spatial language that creates a softer and more restorative urban experience.



G Gradation is visible because of adding the new cross-connections from the Lijnbaan, which creates a transition towards the green inner courtyards, either by crossing a transformed expeditiestraat and passages or via a deck. In this way, the intensity of the Lijnbaan slowly decreases as people move deeper into these courtyards.

E Engagement is introduced through tactile materials, such as the green vegetation walls in the passages. Also through sensory activations, like the wind chimes and public light art installations, further enhance sensory awareness without causing sensory overload. The expression garden provides space for small performances, a mirror art installation, and creative activities such as drawing with chalk.





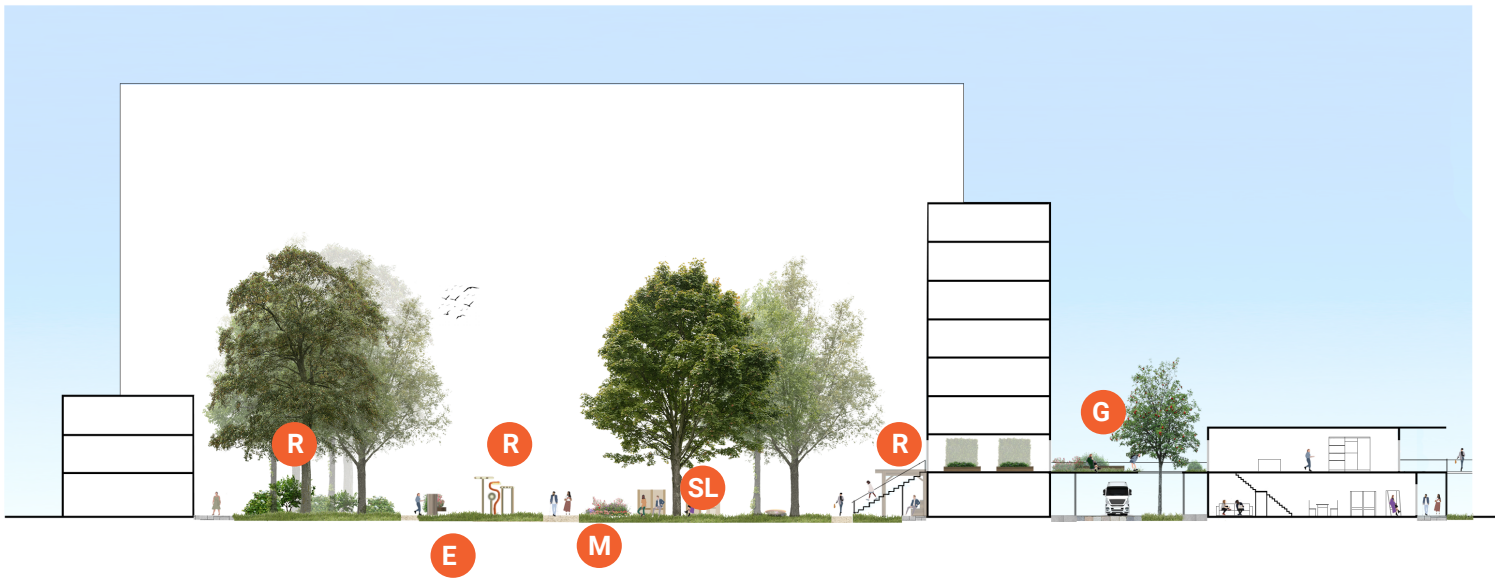
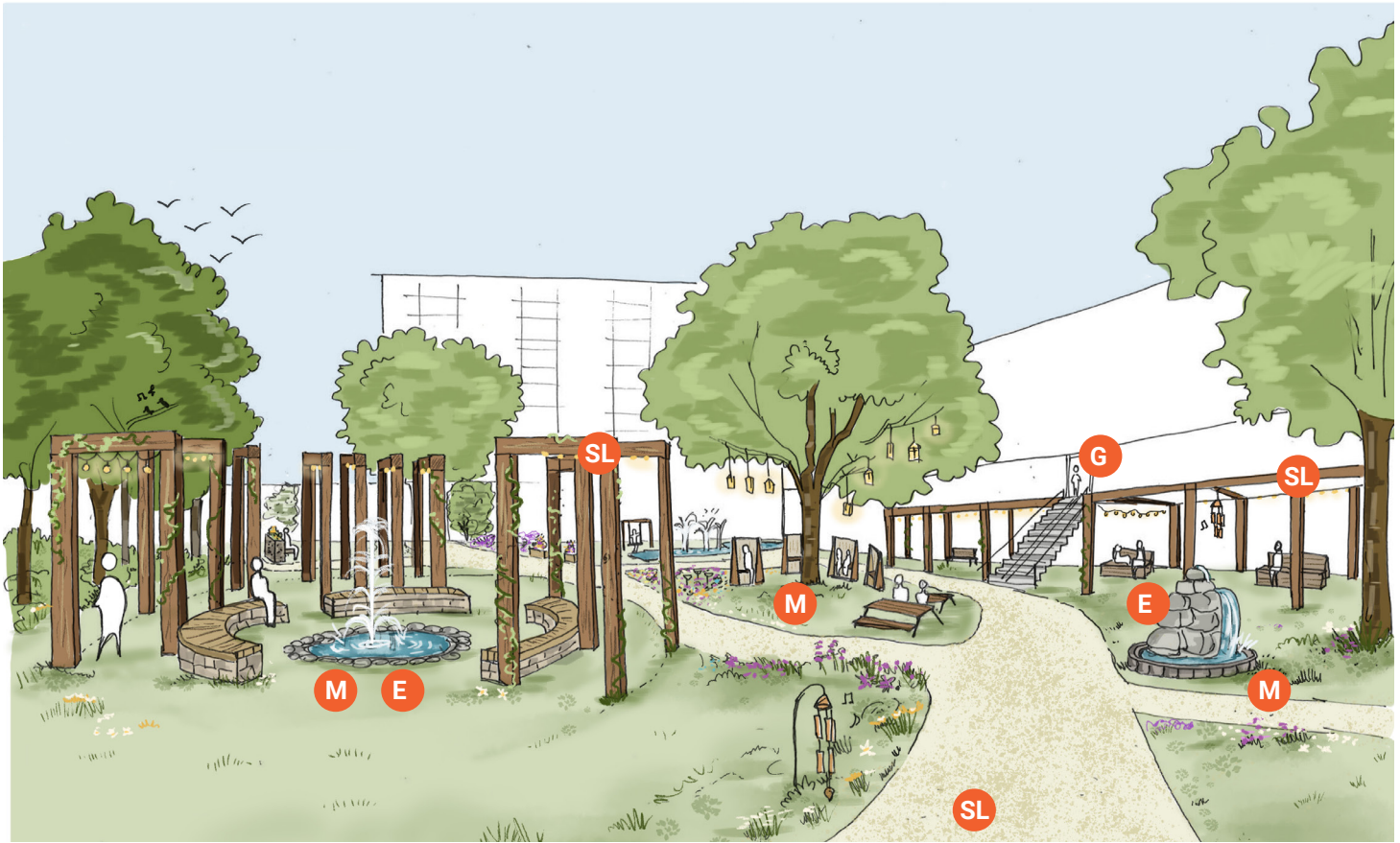
Transition from Lijnbaan to Joost Banckertsplaats
through passage



Joost Banckertsplaats - expression garden

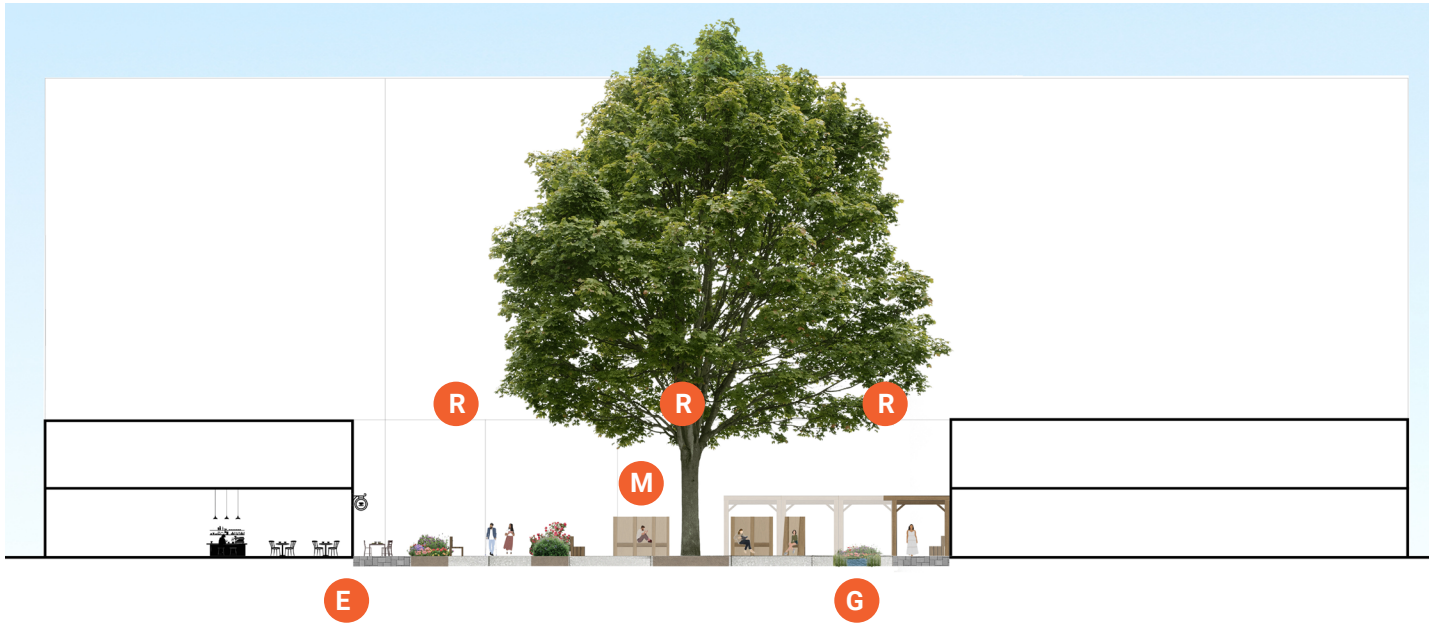
URST in the sensory garden

- R** **Rhythm** is expressed in the sensory garden through the alternating pattern of enclosed and open spaces. The densely planted area with trees on the left contrasts with the open central area, while the pergola structure along the edge creates a more sheltered environment. This sequence of spatial conditions creates a clear rhythm and enriches the sensory character of the garden.
- M** **Modulation** is reflected through the careful adjustment of sensory intensity across different areas. More stimulating elements, such as fragrant planting beds and the interactive water feature in the circular pergola structure, are balanced by quieter retreat spaces, including sensory pods around a tree and sheltered seating beneath the pergola at the edge of the garden. This allows visitors to choose between active engagement and calm refuge, helping to prevent sensory overload.
- G** **Gradation** is expressed from the Lijnbaan towards the deck and into the sensory garden, where sensory intensity gradually shifts from an urban environment to a calmer, more natural setting. Within the garden, there are different sensory gradients; different areas emphasize specific senses, such as smell in the flower and herb beds, and sound at the water feature. This creates a layered distribution of sensory focus and intensity.
- SL** **Spatial language** is visible in the consistent form vocabulary that connects the sensory garden to the Lijnbaan. The meandering paths connect to the meandering paths in the Lijnbaan, which creates continuity in spatial form. The repeated use of timber elements, such as the pergola structures and sensory pods, enhances the material unity throughout the design.
- E** **Engagement** is introduced through tactile materials, such as the tactile wall and public art light installation, and the green vegetation wall in the passages, as well as the water fountain and urban farming, which also introduce taste as a restorative sensory element.



URST in the urban pocket park

- R Rythm** in the urban pocket park next to the urban flow is visible through a repeated sequence of enclosure and openness. This is seen in the pergola structures at the edge that create an enclosed space, with in the middle a sheltered space around the tree, and a more open space at the left side.
- M Modulation** is reflected through the careful adjustment of sensory intensity across different areas. More stimulating elements, such as fragrant planting beds and the interactive waterfountain are balanced by the sensory pods where visitors can retreat, and sheltered seating beneath the pergola at the edge of the square. This allows visitors to choose
- E Engagement** is expressed by the café that introduces soft activity and more warmth, creating a moment of engagement where visitors can pause, sit, and experience the space rather than just walking through. The combination of coffee and pastry scents, seating opportunities, and views toward a monumental tree encourages low-intensity social interaction. This results in a subtle but continuous form of engagement that contributes to restoration.
- SL Spatial language** is visible in the repeated use of timber elements, such as the pergola structures and sensory pods, which enhances the material unity throughout the design.
- G** The benches with greenery create a **gradation** between the urban flow of the Lijnbaan and the square. Rather than forming a hard boundary, they slow down movement and shift the experience from circulation to a more relaxed atmosphere. This gradation is enhanced by a sensory gradient, where the dominant visual and acoustic intensity of the Lijnbaan shifts to a focus on smell and touch by subtle sensory cues such flower and herb beds, nearby scents of coffee and baked goods, and a fountain to enhance the perception of a calmer space.



08

Conclusion & discussion

8.1 Conclusion

The main research question will be answered by answering the sub-questions first:

What are stressors and overstimulation in public spaces?

Urban stressors are environmental stimuli in cities that can produce behavioral and physical effects on individuals and therefore need some level of adaptation. In dense urban environments, people are often exposed to intense, unpredictable, or potentially threatening inputs, such as noise, crowding, and air pollution (Cohen, 1978). When these stressors accumulate, they can lead to overstimulation, which occurs when the amount of environmental input becomes too high and continuously demands attention and response. The Environmental Load Theory explains this by saying that humans have a limited capacity to process environmental information, and this can easily be exceeded in dense urban settings (Cohen, 1978; Moser, 1988). When this limit is exceeded, cognitive overload happens, which leads to more stress, less ability to pay attention, and the brain filtering out some sensory information to cope..

What is a restorative environment?

A restorative environment is an environment that supports psychological and physical recovery by reducing stress, mental fatigue, and negative emotions while also improving concentration and overall well-being (Zhang et al., 2019; Roe & McCay, 2021). It can be seen as a setting where individuals can recover from the demands and daily pressures of everyday life and where they can regulate their emotional and cognitive state, which is very important in urban contexts where overstimulation and stress are common. The most important theories about restorative environments are the Attention Restoration

Theory (ART) and the Stress Reduction Theory (SRT). ART explains that restoration is a recovery of directed attention through environments that have qualities such as being away, fascination, extent, and compatibility. SRT focuses more on the calming and stress-reducing effects of natural settings (Kaplan, 1995; Ulrich et al., 1991). In addition, literature research on Perceived Sensory Dimensions and biophilic design shows that environments that are rich in nature, provide possibilities to refuge, contain serenity, and sensory diversity are most effective in promoting restoration.

Which sensory stimuli are present in urban public spaces and what relationships exist between different sensory stimuli?

In urban public spaces there are a lot of sensory stimuli that can cause stress (stressors), but can also be restorative. These sensory stimuli are categorised into the senses of sight, sound, smell, touch, and taste. The analysis shows that these stimuli do not operate in isolation but are structured in categories such as traffic, materiality, living beings, nature, colour, and spatial layout, which together shape how sensory input is experienced. According to the literature, these stimuli interact through additive effects, where positive sensory inputs reinforce each other; synergistic effects, where one stimulus reduces the negative effect of another stimulus; and antagonistic effects, where negative stimuli weaken or mask positive sensory effects and experiences (Dong et al., 2024). For example, pleasant natural scents can reduce the perceived impact of noise, while traffic noise can reduce the restorative effect of pleasant smells, and crowding can lower overall sensory comfort across multiple senses. Overall, this shows that sensory stimuli in urban

environments are closely connected. Natural elements tend to support restoration, while stressors such as traffic and crowding can interrupt or weaken it.

How does the perception of urban stressors in public space in Rotterdam's city center influence the individual senses?

The walk along interviews showed that the perception of urban stressors in Rotterdam's city center influences the individual senses in a subtle but consistent way. The walk-along interviews in the Lijnbaan demonstrate that sensory stimuli such as sound, visual input, materiality, smell, movement, and spatial layout are connected to each other and together shape how the environment is experienced. Rather than being perceived as direct and constant stress, urban stressors mainly affected how the participants perceived and processed their surroundings. Participants often did not explicitly describe feeling stressed, but they did experience discomfort, feelings of being overwhelmed, or reduced focus. This was reflected in behaviours such as filtering sounds, tending to avoid visual stimuli by looking at the ground, tending to change walking patterns, or looking for calmer edges and sheltered spaces. The findings show that certain stimuli have a stronger impact on the senses than others. Noise from traffic and people and music in stores, visual overload from advertisements and movement, and tactile discomfort were the most frequently mentioned stressors. However, their effect depended strongly on spatial conditions. The enclosed and sheltered space along the Lijnbaan was generally experienced as calmer, while open and highly dynamic spaces increased sensory awareness and exposure to multiple stimuli.

At the same time, the research shows that sensory experience is not fixed, but depends on the situation. Natural elements in the Lijnbaan, seating areas, canopies, and corners can lower sensory pressure and support restoration. Unexpected movement, reflections, and vibrations increase sensory load. Even small changes in materials, light, glare, or movement changed how the participants experienced the space.

In conclusion, the perception of urban stressors in the Lijnbaan does not directly lead to a feeling of stress, but influences the individual senses by shaping attention, sensory filtering, and bodily responses. Urban stress is therefore experienced as a dynamic interaction between multiple sensory stimuli and spatial conditions, rather than as one clear and single feeling.

What restorative urban design strategies can be used to minimize or compensate stressors?

This research shows that restorative spatial design strategies in urban public spaces are not limited to reducing or eliminating urban stressors to minimize stressors and overstimulation. Based on the literature study, research by design, and fieldwork in Rotterdam's city center, multiple strategies were identified that together form a more balanced approach to restoration. These strategies can be grouped into three categories. The first set are restorative sensory design strategies that focus on directly engaging one or more senses in a positive way. An example is introducing pleasant natural scents to reduce the perception of noise, or creating meandering paths to break continuous flow and reduce mass perception, and adding micro-refuges that can give moments of retreat within the urban environment. Second, there are strategies that respond to

quieter or low-activity moments. Their goal is to subtly activate the space in a sensory way during less intense periods, for example by adding soft movement elements or tactile material activation. Rather than reducing stimulation, they provide controlled sensory input that supports awareness and comfort. A third set also responds to low-activity situations, but at a larger spatial scale. These focus on spatial structure, making sure that the Lijnbaan does not feel empty and remains coherent and active. Examples are creating a spatial rhythm (repetition + variation) and creating a sequence of staying spaces. Finally, there are sets of strategies designed for evening and nighttime use, for seasonal challenges, and for rainy conditions.

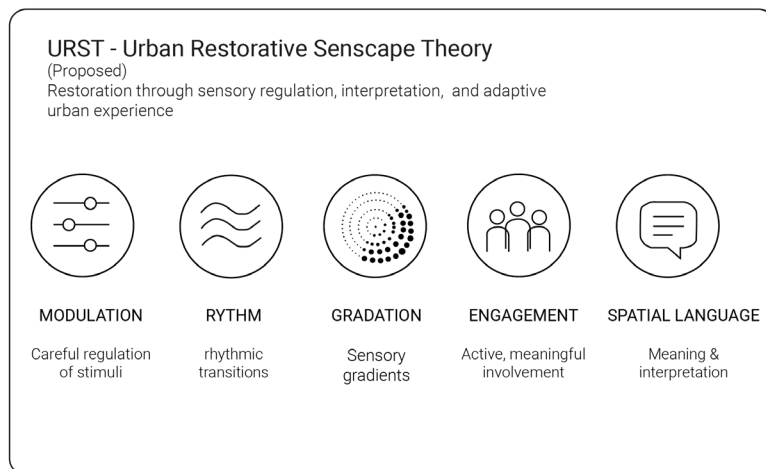
Conclusion to main research question: what restorative urban design strategies can be used to minimize or compensate stressors and overstimulation in Rotterdams city's center?

Together, these findings show that restorative design for public spaces is not only about reducing sensory input or providing options for escape from urban stressors. This led to the development of a new framework: Urban Restorative Sensecape Theory (URST). The core principle of URST is that restoration in dense urban environments does not arise from the absence of stimuli, but from their quality, rhythm, gradation, and overall manageability. Within URST, different stimuli can play different roles depending on the context and how they are perceived. They can be experienced as activating, restorative, or adaptively restorative, depending on the spatial situation and the

mental state of the user. Instead of completely avoiding urban stimuli, the framework proposes that they should be designed in a way that makes them balanced, legible, and adaptable.

URST is built on five connected principles. The first four, modulation, rhythm, gradation, and engagement, focus on how sensory stimuli are arranged and controlled in urban public space. These principles deal with how a space is physically and sensorially structured, and how intensity, flow, and variation can be designed to avoid overload while still keeping the space rich and lively.

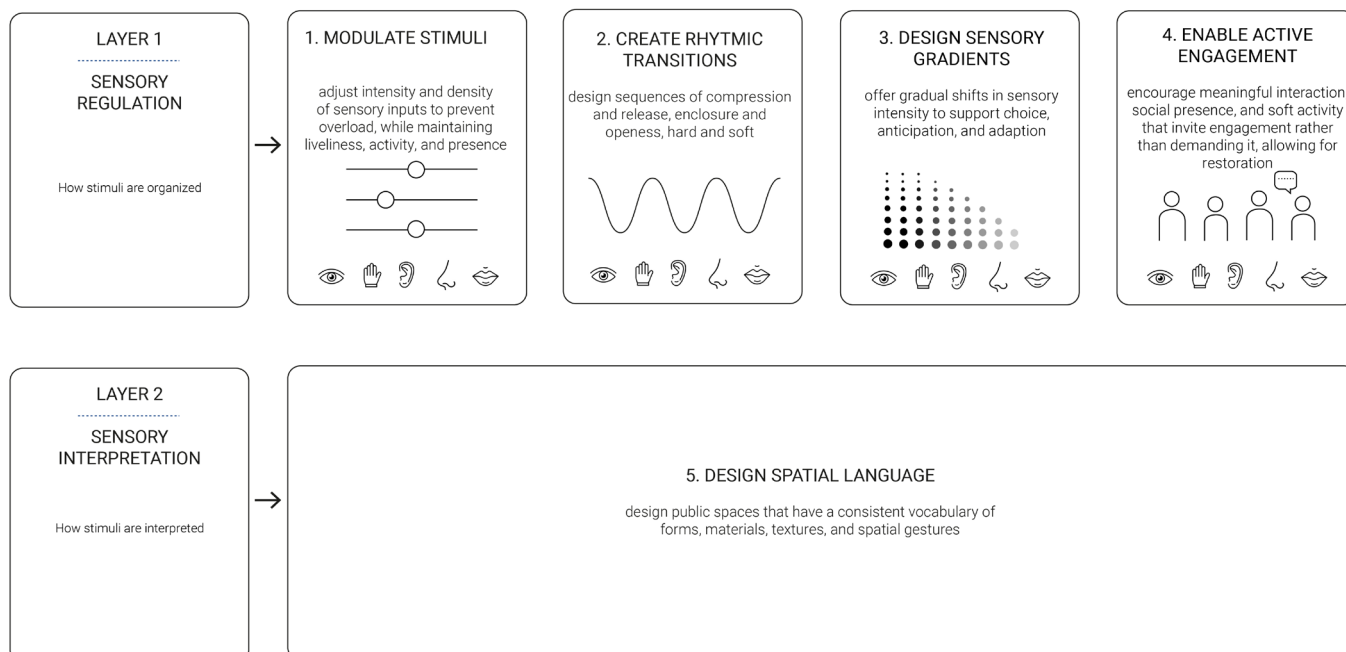
The fifth principle is spatial language. This principle adds an interpretative layer to the framework. Spatial language can be seen as the consistent vocabulary of forms, materials, textures, and spatial gestures used throughout a public space or design. It shifts the focus from the amount of sensory input to how people perceive and interpret it. It can make an environment feel calmer and more legible. This reduces cognitive effort and helps people feel more at ease. Therefore, spatial language leads to restoration not by making a space less stimulating, but by making it more legible, predictable, and emotionally reassuring.



CORE PRINCIPLE

In busy environments, restoration does not occur from absence of stimuli, but from the **quality, gradations, manageability, and meaningful interpretation** of sensory stimuli

Stimuli can be restorative, stressful, activating, and adaptively restorative -> depending on mental state of individual, context and interpretation



So, restorative urban design strategies in Rotterdam's city center should not be working for the removal of stressors and sensory input. It should be understood as the careful shaping of sensory experiences through modulation, rhythm, gradation, engagement, and spatial language. This shifts restoration away from simply reducing stimuli or escaping the city, towards creating structured, adaptive, and meaningful environments that support both perception and interpretation.

Finally, a design proposal has been made for the Lijnbaan where also the principles of URST are translated into a spatial design. The design and the URST framework were developed at the same time and continuously informed each other through the whole process. This iterative relationship strengthened both the theoretical framework and the design outcomes.

Together, the URST framework and the design proposal for the Lijnbaan can contribute to improving well-being and mental health in the city, by addressing stressors and supporting a more balanced sensory experience in the city. Ultimately, the aim of the design is to transform the Lijnbaan into a sensescape; a more comfortable, enjoyable, and restorative urban environment.



8.2 Discussion

Recommendations and implications

This thesis has implications on both a theoretical and spatial level. The URST framework introduces a new way of understanding restoration in dense urban environments. Instead of seeing restoration only as silence, greenery, or escape from the city, the research shows that restoration can also emerge within busy urban public spaces through carefully regulated and meaningful sensory experiences. This expands the existing understanding of restorative environments within urbanism.

The research also shows that urban stress is not only caused by the amount of stimuli, but also by how sensory stimuli are organized, experienced, and interpreted. As a result, the thesis highlights the importance of multisensory urban design, where sound, light, visual stimuli, movement, tactility, smell, and spatial rhythm become important design elements rather than just only secondary extra elements.

Finally, the design proposal for the Lijnbaan shows how sensory-oriented urban design can contribute to urban well-being and mental health. By creating more balanced, adaptive, and restorative sensory environments, the city can become not only more functional, but also more comfortable and enjoyable for everyday urban life.

This research also has methodological implications for future studies on urban stress and restoration. While this thesis mainly focused on qualitative sensory experiences, the URST framework could be further developed into more measurable design parameters. For example, future research could explore sound levels (in decibels) at when people reach perceptual limits

or discomfort, or quantify spatial qualities such as the amount of greenery per square meter, or amount of trees, sidewalk width, or the density of spatial elements.

Translating sensory experiences into measurable outcomes could make the URST framework more applicable in practice and easier to use in urban design guidelines. This would help bridge the gap between subjective sensory perception and more technical design decisions in urban planning and policy.

Input from more participants

One limitation of this research is the number of participants in the walk-along interviews. Because of limited time, only six interviews were conducted. Although the interviews provided very valuable insights, more participants could have added more different experiences and perceptions, since every sensory experience is different and meaningful. In addition, all participants were familiar to the researcher. Future research could also include a bigger and more diverse group of people. This could be done by for example by approaching visitors directly on the Lijnbaan and asking about their experience of the space.

8.3 Reflection

What is the relation between your graduation project topic, your master track (Hyperdiverse Public and Space), and your master programme (Urbanism)?

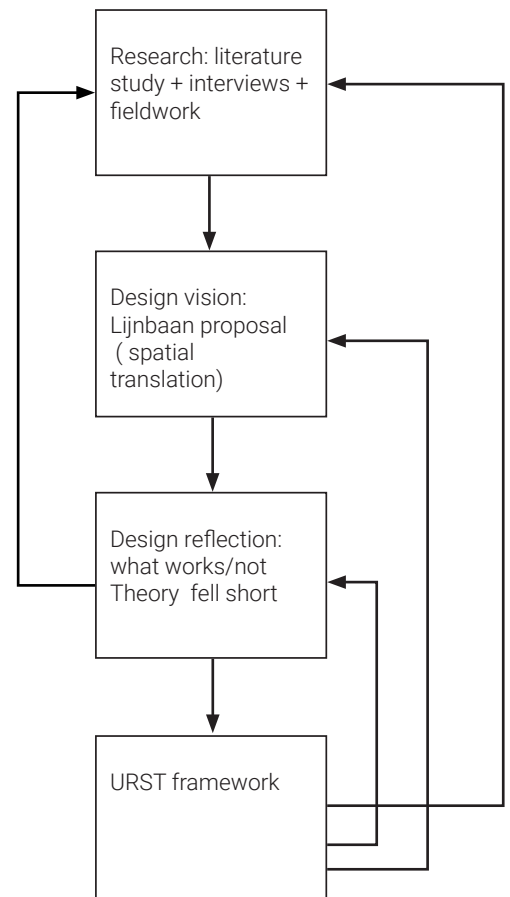
The graduation project relates to the Hyperdiverse Public and Space graduation cluster, as it focuses on how people experience and use public space. The project aims to create a public space that is accessible and comfortable for different user groups, including people who are more sensitive to sensory stimulation. At the same time, the project acknowledges that public space is used by diverse groups with different needs and preferences, which raises questions about inclusion, exclusion and the balance between conflicting needs.

The project also connects to the Urbanism master programme through its focus on the relationship between human experience and the spatial design of the city. While the design interventions are developed at the human scale, the project also looks at the wider urban context of the Lijnbaan. This includes analysing the functionalist urban structure of how the Lijnbaan was developed, as well as the surrounding spatial networks and flows that influence how the area is experienced and used. By linking sensory experience and wellbeing to larger urban structures, the project combines human-scale design with an urban scale perspective, which relates to Urbanism.

How did your research influence your design/ recommendations and how did the design/ recommendations influence your research?

The interviews and literature study led to key insights about urban stressors and sensory experiences in the Lijnbaan. Based on these findings, the initial design vision was developed. However, during the research process and during designing it became clear that existing theories often describe an idealised situation that does not fully match the complexity of the current Lijnbaan. In that sense, theory sometimes fell short in explaining the real, complex urban conditions.

At the same time, the design process generated new insights that influenced the research and the way existing literature was understood. While designing, it became clear that restoration is not only about reducing sensory input and stressors. Instead, the design process revealed the importance of rhythm, modulation, gradation, engagement, and spatial language. This iterative process eventually led to the development of the URST framework as an integration between research and design. In this way, the design did not only apply theory, but also actively contributed to reshaping and extending the theory.



Research by design process

How do you assess the value of your way of working (your approach, your used methods, used methodology)?

This research followed more of a iterative proces than a linear process. Research and design continuously informed each other and developed in parallel. This approach was very valuable, as it allowed insights from literature, interviews, and design explorations to interact and evolve over time. As a result, the URST framework emerged not only from analysis, but also from design experimentation and reflection. It is likely that this framework would not have developed in the same way if the process had been linear.

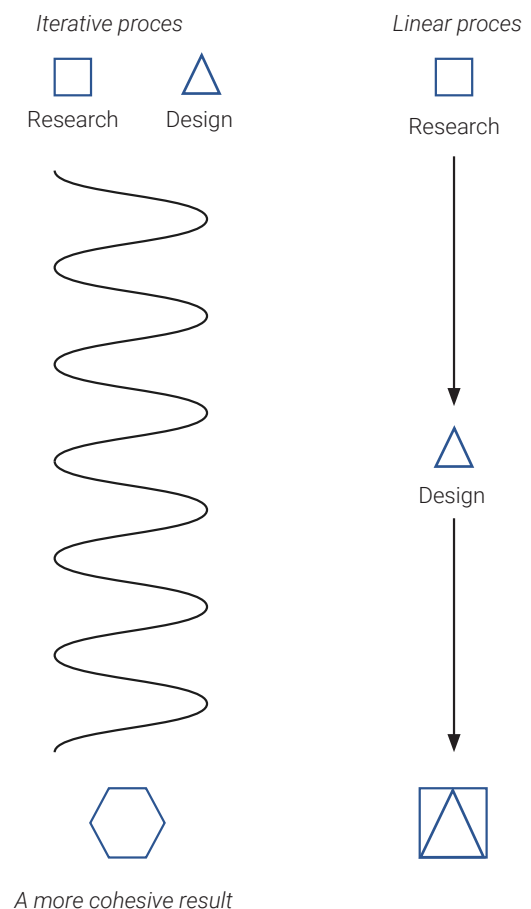
Working in a iterative way also meant that sketching and design explorations started early in the process, together with doing literature study and analysing. Looking back, this flexibility improved the final result, as the design better matches real urban conditions.

At the same time, the iterative process was sometimes challenging, as it needed switching between analysis, theory, and design without a fixed structure. I personally found this sometimes very difficult, as I tend to prefer a more linear and structured way of thinking and working, because that gives me a clearer overview and more mental organisation. Because of this, the lack of a fixed structure sometimes made the process feel less organised and harder to keep track of. However, it also allowed for continuous learning and adjustment, which improved the quality and relevance of the research.

Overall, the chosen methods are considered important for this type of research. The walk-along interviews, in particular, were valuable

, especially because of multiple locations along the route and the open-ended questions. These provided interesting and meaningful insights into sensory perception in the Lijnbaan. If I had more time it would be interesting to interview more people, and also people who are not familiar to me.

Some methods took a lot of time, such as the detailed categorisation of sensory stimuli by making photos. Looking back, this did not directly contribute to the main research question, and the time could perhaps have been used better for more interviews or deeper qualitative analysis.



How do you assess the academic and societal value, scope and implication of your graduation project, including ethical aspects?

Academic value

The academic value of this graduation project lies in addressing the identified knowledge gap from the introduction by translating psychological insights on urban stressors and overstimulation into spatial and multisensory design strategies. By developing the framework URST, the project tries to bridge the gap between environmental psychology and urban design, as it offers a structured approach for how to integrate restorative principles into the design of urban public spaces.

This can be seen as a new theoretical contribution, because many existing theories about restoration seem to rely a lot on the contrast between nature and the city. Instead, this new framework investigates how the city itself can become restorative without losing its urban identity, social vitality, or sensory intensity. So, regarding academic value, URST proposes a new framework and design approach within urbanism, environmental psychology, restorative cities, and public space design.

Societal value

The societal value of this project is in the contribution to improving mental health and urban well-being through the design of more restorative public spaces. By applying URST, urban environments can be designed to reduce the negative effects of stress and overstimulation in everyday city life. This supports healthier and more inclusive public spaces that enhance users' mental health and overall experience of the city, especially in dense urban areas where exposure to sensory overload is common.

Scope

The scope of this graduation project is limited to the Lijnbaan in Rotterdam as a representative case of a dense urban shopping street. The research focuses on urban stressors and restorative potential in this specific location, and uses qualitative methods and design exploration. Although the URST framework has broader relevance, this project focuses on developing it as a conceptual design framework for restorative public space. It concentrates on multisensory urban interventions rather than providing full empirical validation or a universal model that can be applied in all contexts.

Ethical aspect

The ethical aspects of this project relate mainly to the walk-along interviews in the Lijnbaan. Participants remained anonymous and no personal data or recordings were collected, which ensures privacy and low research risk.

In addition, the research raises ethical questions in urban design, since sensory-focused interventions affect how people experience public space. The URST framework aims to improve well-being rather than control behaviour, but it also highlights that sensory experiences are subjective and can vary between people.

So, future research on this topic might also focus more on the ethical tension that designing sensory experience is also about influencing perception.

Finally , in the restorative redesign of the Lijnbaan, an ethical question could be if focusing on users who are sensitive to sensory stimuli prioritises one group over others in a shared public space. While this may seem to favour specific needs, it can also improve overall accessibility by making the city usable in different ways for different people. The main challenge is finding a balance between equal access to public space and inclusive design that supports a wide range of users.

How do you assess the value of the transferability of your project results?

The transferability of the project results lies in the fact that URST works as a general framework that can be used in other places with similar urban conditions. It is especially relevant for dense and busy public spaces that deal with stressors, stimuli and overstimulation. However, the way it is applied depends on the specific characteristics of each location, such as its spatial layout and user groups. Therefore, URST is not a fixed solution, but a flexible framework that can be adapted to different contexts, especially places similar to the Lijnbaan. It can be used for example for shopping streets, stations, and public squares. The framework can therefore function as a broader design tool for urban designers, architects and policy makers for dealing with overstimulation and urban stress in contemporary cities.

Since URST was developed in the context of the Lijnbaan, its application is influenced by the site's street profile and available space for interventions. In narrower urban environments with less space, implementing the URST principles may be more challenging. Therefore, the framework is transferable, but its practical application depends on the lay-out and available space for each location.

09

References & appendices

9.1 Bibliography

- Baghaee, S., Nosratabadi, S., Aram, F., & Mosavi, A. (2021). Driving Factors Behind the Social Role of Retail Centers on Recreational Activities
- Berto, R. (2005). Exposure to restorative environments helps restore attentional capacity. *Journal Of Environmental Psychology*, 25(3), 249–259. <https://doi.org/10.1016/j.jenvp.2005.07.001>
- Cobussen, M., Huijsman, M., & de Graaff, H. (2021). Hoe klinkt het Hofplein, nu en in de toekomst? Een onderzoek naar de geluidsbeleving. Gemeente Rotterdam / Universiteit Leiden. Geraadpleegd van <https://www.universiteitleiden.nl/nieuws/2021/06/hoe-klinkt-het-hofplein-nu-en-in-de-toekomst>
- Cohen, S. (1978). Environmental load and the allocation of attention. In A. Baum, J. E. Singer and Valins, S. (eds), *Advances in Environmental Psychology, Vol. I: The Urban Environment*. Hillsdale, NJ: Erlbaum.
- Coster, D. (2018). The effects of online shopping on the market for retail real estate. *Faculty of TPM, Delft University of Technology*
- CRIMSON architectural historians (2004). De Lijnbaan; cultuurhistorische verkenning van het Lijnbaan ensemble. Retrieved on 6-1-2026. <https://usercontent.one/wp/www.crimsonweb.org/wp-content/uploads/2007/07/lijnbaan-screen.pdf>
- Dong, W.; Dai, D.; Shen, P.; Zhang, R.; Liu, M. (2024). How Public Urban Space Enhance Restoration Benefits Through Combined Multisensory Effects: A Systematic Review. *Land* 2024 (Vol.13, p. 2018).
- Fan, X., Hu, D., Fan, Y., Yang, J., Liang, H., Gao, T., & Qiu, L. (2025). Urban restorative environments: The critical role of building density, vegetation structure, and multi-sensory stimulation in psycho-physiological recovery. *Building And Environment*, 281, 113190
- Finnigan, K. A. (2024). Sensory Responsive Environments: A Qualitative Study on Perceived Relationships between Outdoor Built Environments and Sensory Sensitivities. *Land* (Vol. 13, p. 636).
- Gemeente Rotterdam. (n.d.) Rotterdam.nl . Retrieved on 5-1-2026 <https://www.rotterdam.nl/geluid>
- Gemeente Rotterdam. Geluid (n.d.) Rotterdam.nl . Retrieved on 5-1-2026 . <https://www.rotterdam.nl/geluid>
- Gemeente Rotterdam. Stadsakkoord Rotterdam. Sterker door 7 Stadsprojecten (15 juni, 2021). <https://persberichtenrotterdam.nl/persberichten/stadsakkoord-rotterdam-sterker-door-7-stadsprojecten/#:~:text=De%207%20stadsprojecten%20zijn%3A%20Groene,Schouwburgplein%2C%20Rijnhavenpark%20en%20Getijdenpark%20Feyenoord.>
- Grahn, P., & Stigsdotter, U. (2010). The relation between perceived sensory dimensions of urban green space and stress restoration. *Landscape and Urban Planning*, 94, 264–275.
- Gruebner, O.; Rapp, M.A.; Adli, M.; Kluge, U.; Galea, S.;Heinz, A. (2017). Cities and Mental Health (24.02.2017) *Deutsches Arzteblatt*. Retrieved on November 28th, 2025, from <https://di.aerzteblatt.de/int/archive/article/186433>
- Hulshof, M., & Moraal, A. (2025, 7 november). Met de prikkelplattegrond het museum in: Hoeveel prikkels kan prikkelarme cultuur verdragen? *NRC Handelsblad*. Retrieved on November 29th, 2025, from <https://www.headliner.nl/item/met-de-prikkelplattegrond-het-museum-in-hoeveel-prikkels-kan-prikkelarme-cultuur-verdragen-nrc-202128>

- Kaplan, R., & Kaplan, S. (1989). The Experience of Nature: A Psychological Perspective. Retrieved on 18-1-2026, via <https://archive.org/details/experienceofnatu00kapl/page/82/mode/2up?ref=ol>
- Kaplan, S. (1995). The Restorative Benefits of Nature: Toward an Integrative Framework. *Journal of Environmental Psychology*, 15(3), 169-182.
- Karwa, T. & Chauhan, N. (2025). Urban Anxiety; How Crowded Cities Affect Well-Being and the Role of Architectural Design. *International Journal Of Engineering Research & Technology (IJERT)*, 14–14(03).
- Kavee, K., & Flanigan, K. (2025). Encoding experience: Quantifying multisensory perception of urban form through a systematic review. *Computers, Environment And Urban Systems*, 122 (2025) 102349. Elsevier. <https://doi.org/10.1016/j.compenvurbsys.2025.102349>
- Kellert, S.R., & Calabrese, E.F. (2015). The Practice of Biophilic Design.
- Liu, J., Sun, X., Chen, H., & Yang, Z. (2023). Passive nature exposure positively predicts prosocial behavior by alleviating perceived crowdedness. *Journal Of Environmental Psychology*, 91, 102146. <https://doi.org/10.1016/j.jenvp.2023.102146>
- McCarville, R. E., Shaw, S. M., & Ritchie, M. (2013). Shopping as leisure: a study of avid shoppers. *World Leisure Journal*, 55(2), 167–178. <https://doi.org/10.1080/04419057.2013.782561>
- Ministerie van Luvte, 2023. <https://ministerievanluwte.nl/>
- Moser, G. (1988). Urban stress and helping behavior: Effects of environmental overload and noise on behavior. *Journal Of Environmental Psychology*, 8(4), 287–298. [https://doi.org/10.1016/s0272-4944\(88\)80035-5](https://doi.org/10.1016/s0272-4944(88)80035-5)
- Natuurhistorisch Museum Rotterdam dimt licht, geluid en bezoekersaantal voor mensen die snel overprikkeld zijn.(June, 14th, 2022). Dehavenloods.nl. Retrieved on 5-1-2026. <https://www.dehavenloods.nl/nieuws/algemeen/42424/natuurhistorisch-museum-rotterdam-dimt-licht-geluid-en-bezoeker?>
- Pallasmaa, J. (2005). The eyes of the skin: Architecture and the senses. John Wiley & Sons.
- Prikkelvriendelijk bezoek bij Museum Rotterdam (2025.) Week van de Toegankelijkheid. Retrieved on 5-1-2026 <https://weekvandetoegekankelijkheid.nl/evenement/prikkelvriendelijk-bezoek-bij-museum-rotterdam/#:~:text=Heb%20jij%20moeite%20met%20het,de%20week%20van%20de%20toegankelijkheid.>
- Raad voor Volksgezondheid en Samenleving. (2025). Op de rem! Voorbij de hypernerveuze samenleving
- Roe, J. & McCay, L. (2021). Restorative cities; urban design for mental health and wellbeing
- Tamilarasan, S., & R, Dr. R. (2025). DESIGNING FOR MENTAL WELLNESS: THE IMPACT OF SENSORY ELEMENTS IN PUBLIC SPACES ON STRESS REDUCTION. *SEEJPH (Vol. XXVI, S1, p. 2884–2891)*.
- Toronyi, D. (2019). Hidden geographies: design for neurodivergent ways of hearing and sensing. *Cities & Health*, 5(1–2), 133–137. <https://doi.org/10.1080/23748834.2019.1627059>

Ulrich, R.S., Simons, R.F., Losito, B.D., Fiorito, E., Miles, M.A., & Zelson, M. (1991). Stress Recovery During Exposure to Natural and Urban Environments. *Journal of Environmental Psychology*, 11(3), 201-230

United Nations (2018). 68% of the world population projected to live in urban areas by 2050, says UN. Retrieved on November 28th, 2025, from <https://www.un.org/development/desa/en/news/population/2018-revision-of-world-urbanization-prospects.html>

Van Nes, A., & Yamu, C. (2021). Introduction to Space Syntax in Urban Studies. <https://doi.org/10.1007/978-3-030-59140-3>

VERKEERSLAWAAI EEN PLAAG IN ROTTERDAM. (October 21th, 2024). Geluidsnieuws.nl. Retrieved on 5-1-2026. <https://geluidnieuws.nl/home/verkeerslawaaai-een-plaag-in-rotterdam/>

Welles, A. (may 5th , 2018). Toon daadkracht tegen de drukte in de stad. *Het Parool*. <https://www.parool.nl/columns-opinie/toon-daadkracht-tegen-de-drukke-in-de-stad~b15661fe/?referrer=https%3A%2F%2Fwww.google.com%2F> Retrieved on 18-12-2025

Zhang, T., Liu, J., & Li, H. (2019). Restorative Effects of Multi-Sensory Perception in Urban Green Space: A Case Study of Urban Park in Guangzhou, China. *International Journal Of Environmental Research And Public Health*, 16(24), 4943. <https://doi.org/10.3390/ijerph16244943>

9.2 Figures

Figure 1.1: Collage showing the societal relevance

- Figure 1.1.1: Welles, A. (may 5th , 2018). Toon daadkracht tegen de drukte in de stad. Het Parool. Retrieved on 18-12-2025 from <https://www.parool.nl/columns-opinie/toon-daadkracht-tegen-de-drukke-in-de-stad~b15661fe/?referrer=https%3A%2F%2Fwww.google.com%2F>
- Figure 1.1.2: Atlas Leefomgeving (n.d.) Luwteministerie werkt aan rust in de stad. Kan het geluid even uit? Retrieved on 18-12-2025 from <https://www.naturetoday.com/intl/nl/nature-reports/message/?msg=32491>
- Figure 1.1.3: Raad voor Volksgezondheid en Samenleving. (2025). Op de rem! Voorbij de hypernerveuze samenleving. Retrieved on 18-12-2025 from <https://www.rijksoverheid.nl/documenten/2025/10/20/op-de-rem>
- Figure 1.1.4: Hulshof, M., & Moraal, A. (2025, 7 november). Met de prikkelplattegrond het museum in: Hoeveel prikkels kan prikkelarme cultuur verdragen? NRC Handelsblad. Retrieved on November 29th , 2025 , from <https://www.headliner.nl/item/met-de-prikkelplattegrond-het-museum-in-hoeveel-prikkels-kan-prikkelarme-cultuur-verdragen-nrc-202128>
- Figure 1.1.5 Schuiten, L. (2019). Dossier Bijzondere plekken. Tijdschrift publieke ruimte, 19/2019, p.2. Retrieved on November 29th , 2025 , from https://omgeving.vlaanderen.be/sites/default/files/2021-11/Artikel%20Stilteplekken%20in%20de%20stad_04_TPR29.pdf

Figure 1.2: Front page of Hofplein report.

Cobussen, M., Huijsman, M., & de Graaff, H. (2021). Hoe klinkt het Hofplein, nu en in de toekomst? Een onderzoek naar de geluidsbeleving. Gemeente Rotterdam / Universiteit Leiden. Geraadpleegd van <https://www.universiteitleiden.nl/nieuws/2021/06/hoe-klinkt-het-hofplein-nu-en-in-de-toekomst>

Figure 1.3: Increasing nuisance in Rotterdam.

VERKEERSLAWAAI EEN PLAAG IN ROTTERDAM. (October 21th, 2024). Geluidsnieuws.nl. Retrieved on 5-1-2026. <https://geluidnieuws.nl/home/verkeerslawai-een-plaag-in-rotterdam/>

Figure 1.4: Actieplan Geluid Rotterdam

Gemeente Rotterdam. Geluid (n.d.) Rotterdam.nl . Retrieved on 5-1-2026 . <https://www.rotterdam.nl/geluid>

Figure 1.5: Sensory friendly visits in museum.

Natuurhistorisch Museum Rotterdam dimt licht, geluid en bezoekersaantal voor mensen die snel overprikkeld zijn.(June, 14th, 2022). Dehavenloods.nl. Retrieved on 5-1-2026. <https://www.dehavenloods.nl/nieuws/algemeen/42424/natuurhistorisch-museum-rotterdam-dimt-licht-geluid-en-bezoeker?>

Figure 4.37: Porous, textured pavers

Postmus. (n.d) Gebakken waalformaat 20x5x6 cm Latiano. Retrieved on 3-6-2026 from <https://www.postmus.nl/gebakken-waalformaat-20x5x6-cm-latiano>

Figure 4.38: Grey, porous textured pavers

Bestratingsweb. (n.d). Lotis Vida UWF60 Grijs Onbezand 20x5x6 cm. Retrieved on 3-6-2026 from <https://www.bestratingsweb.nl/lotis-gebakken-klinker-vida-grijs-onbezand-2>

Figure 4.39: Greenery in the street

Noordhuis, P. (2023). 'Een groene winkelstraat heeft meer allure. Dat is goed voor de klandizie' . Nederlands Dagblad. Foto: N. Sluijsmans. Retrieved on 3-6-2026 from <https://www.nd.nl/nieuws/nederland/1196822/een-groene-winkelstraat-heeft-meer-allure-dat-is-goed-voor-de#closemodal>

Figure 5.3: Garden windmill

Huis en Tuin Decoratie Marie. (n.d.). Windmolens & windspinners. Retrieved on 3-6-2026 from <https://www.huisentuindecoratiemarie.nl/c-1268658/windmolens-windspinner/>

Figure 5.4: Pampass grass moving in wind

Shutterstock. (n.d.). Pampas grass blowing in wind sunlight. Retrieved on 3-6-2026 from <https://www.shutterstock.com/nl/image-photo/pampas-grass-blowing-wind-sunlight-against-2626071031>

Figure 5.5: Light lines along edges

Michael Grubb Studio. (n.d). West End Project, London, UK. Foto: M. Massaro. Retrieved on 3-6-2026 from <https://www.michaelgrubbstudio.com/portfolio/west-end-project-london-uk/>

Figure 5.6: Rainwaterbowl

Cortenstaaltuinproducten. (n.d.). Cortenstaal waterschaal Elvio Ø60xH14 cm. Retrieved on 3-6-2026 from <https://www.cortenstaaltuinproducten.com/a-60179699/cortenstaal-waterschalen/cortenstaal-waterschaal-elvio-oe60xh14-cm/>

Figure 5.7 Fountain

Adezz. (n.d.). Watertafels standaard- aluminium (product 8645). Retrieved on 3-6-2026 from https://www.adezz.com/nl-nl/p/tuinproducten/167/watertafels/watertafels-standaard/aluminium/8645?productId=8645&bg_source=ga&bg_campaign=23322660412&bg_kw=-mi-736158320-pi-185686-ppi-&bg_source_id=&gad_source=1&gad_campaignid=23318582843&gbraid=0AAAAApbUwfpO8InGpwHM-gTX17T7kzW4x&gclid=EAlalQobChMly9H9m8eDIAMVrJKDBx2JChbrEAKYBCABEgJKOPD_BwE

Figure 5.8: walking on gravel path

Alamy. (n.d.). Women's feet in colored shoes walking on gravel in spring . Foto: N. Koltykova. Retrieved on 3-6-2026 from <https://www.alamy.com/womens-feet-in-colored-shoes-boots-walking-on-gravel-in-spring-image425846777.html>

Figure 5.9: Tactile wall with vegetation

Paisajismo Urbano. (n.d.). ArchiExpo. Retrieved on 3-6-2026 from <https://www.archiexpo.com/prod/paisajismo-urbano/product-94556-2198150.html>

Figure 5.10: Small coffee point

Smith & Newton Architects. (n.d.). Perky Blenders Kiosk. Foto: N. perry. Retrieved on 3-6-2026 from <https://www.smith-newton.com/index.php/projects/the-kiosk/>

Figure 5.11: Picking berry bushes

Explore Genesee Valley. (n.d.). Where to pick berries in the Genesee Valley. Retrieved on 3-6-2026 from <https://exploregeneseevalley.com/entries/where-to-pick-berries-in-the-genesee-valley/a37ec231-417d-48bf-8ba7-b63f8950ea59>

9.3

Appendices

Appendix 1: Stressors of outdoor environments in the Lijnbaan : overstimulation
Weaknesses

Appendix 2: Benefits of outdoor environments in the Lijnbaan : restoration
Strengths

Appendix 1

Stressors of outdoor environments in the Lijnbaan : overstimulation Weaknesses

Sight

Dimensions



Tall buildings and towering structures can create overwhelming and oppressive experiences

Materiality



LED screens in shop windows and on shop walls appear visually aggressive and are distracting

Reflections in the glass facades of shop windows can sometimes show your own reflection, which can be distracting.



Flickering advertising lights in shop windows create constant visual stimuli that can be distracting in peripheral vision and contribute to sensory overload.



Materiality: Solar reflections from smooth pavement tiles and under the canopies create a dazzling effect that can feel blinding.

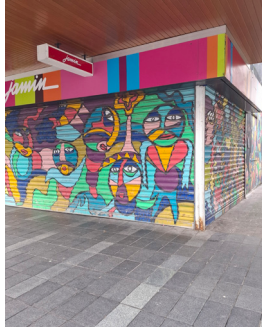
Visual clutter in windows introduce intense visual stimuli

The unattractive rear facades and visible trash create an unappealing environment that can feel unwelcoming.

Color

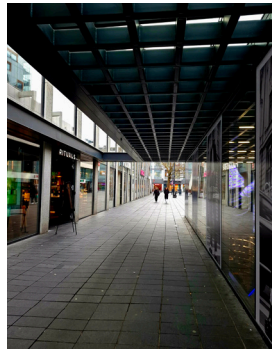
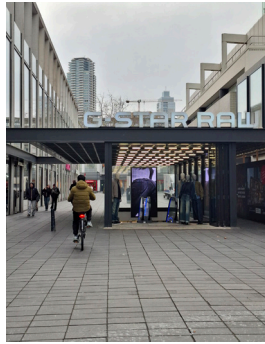


Neon lights create a strong visual impact and create a strong contrast with the grey, paved environment.



The grey pavers and uniform facades create a monotonous street view, which can feel dull and uninviting.

Lay-out



Layout: The spatial organization of the Lijnbaan creates enclosed spaces due to the canopies and shops located within the shopping street. This configuration blocks sunlight and leads to narrow sightlines

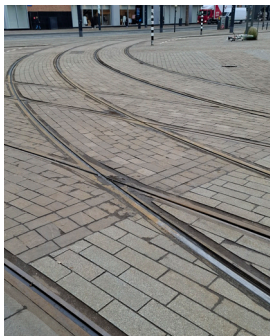
Living beings



Living beings: Unexpected encounters with urban wildlife can create sudden visual stimuli that may surprise pedestrians.

Touch

Materiality



Tram causes vibrations along the tracks



Grey tiles and steel elements contribute to the urban heat island effect.



Slippery pavement during rainfall makes walking uncomfortable.



Surroundings feel too concrete and artificial.



Cold and artificial benches are uncomfortable to sit on.



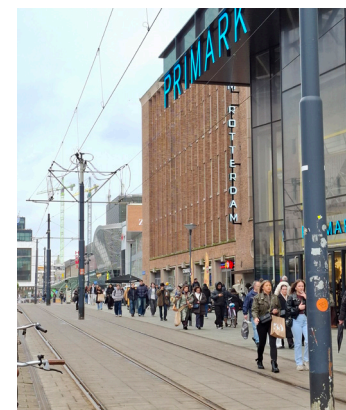
Lay-out



Lay-out: Narrow passages and open spaces next to tall buildings create a wind tunnel effect



Lay-out and dimensions: Narrow sidewalk next to the tram line force pedestrians to sidestep, often causes collisions.



Living beings



Living beings: Crowds of people create a sense of presence and pressure.



Dimensions



Natural elements



Plants and dirt cause negative tactile sensation

Smell

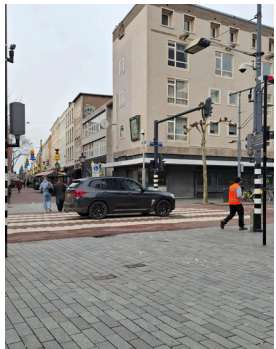
Materiality



Trash from containers



Traffic/mobility



Traffic: Exhaust fumes from traffic create an unpleasant smell.

Living beings



Body odors from large crowds can be overwhelming.



Cigarette smoke is unpleasant and unhealthy.

Programme



The smell of fast food creates a strong odor.



Perfume store gives off a strong, sweet scent, which can be very sweet



Unpleasant odors from waste disposal



Strong frying food odor

Sound

Materiality



The sound of shoes on the tiles resonates through the space.



The sound of rolling wheels on the tiles resonates through the space.

Program



Loud music coming from JD store

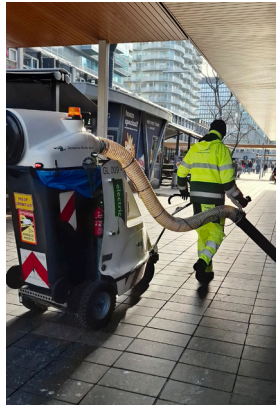


The loud street organ produces a sharp, rattling sound.

Living beings



The loud noise from using a leaf blower can be overwhelming.



Street cleaner produces loud vacuuming noises



The voices of people echo in the lowered shopping area.

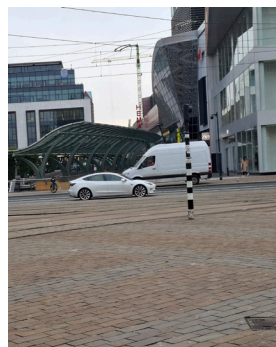


The loud, clamorous crowd creates a constant, overwhelming noise.

Traffic



Tram produces loud sounds when it arrives.



Cars accelerating and speeding by create loud noise.



Delivery truck produces loading noises



Transporting foodtruck

Traffic



Loud noise from park maintenance vehicle



Motorbikes speeding by create loud noise



Cyclists ringing their bells



Maintenance sounds from vehicle

Appendix 2

Benefits of outdoor environments in the Lijnbaan : restoration Strengths

Sight

Materiality



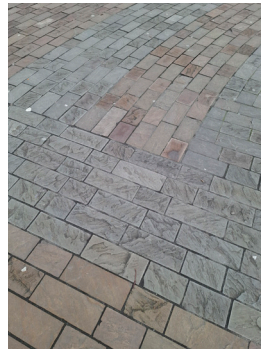
Sculpture creates soft fascination by gently attracting visual attention which helps people feel calmer



Historic buildings with characteristic visual patterns provide a psychological sense of "distancing" from stress.



Cobble stone pavers with its natural texture have a soft visual appearance which create a calm experience



Patterned pavement has repeating pattern that creates soft fascination



Historic statue with characteristic visual patterns provide a psychological sense of "distancing" from stress.

Natural elements



Organic shape of a tree and slow movement of leaves create calm visual experience and reduce stress levels



Diverse plant species reduce stress because natural variation in shapes, colors, and textures creates a calm visual environment



Green hedges break up the visual monotony, providing visual interest



Vertical greening creates soft fascination and sparks interest



To see through the water creates a calm and clear visual experience, reduces visual pressure

Touch

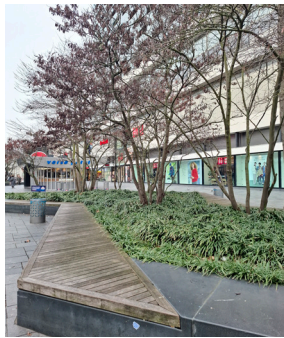
Materiality



Cobblestone pavers create a more pleasant and varied tactile experience than flat artificial surfaces, making walking feel more comfortable and calming.



Wooden benches: The natural material feels warmer and softer than artificial surface



Wooden bench next to vegetation and under a tree create a calmer sensory experience and gives a place to sit down.



Brick wall/ art object: texture invites people to interact with it, creating a pleasant tactile experience



Green hedges soften the hard urban environment.

Lay-out



Spacious layout reduces collisions and physical contact, which makes the environment feel calmer

Smell

Natural elements



Natural scent from flowers gives a pleasant sensory experience

Programme



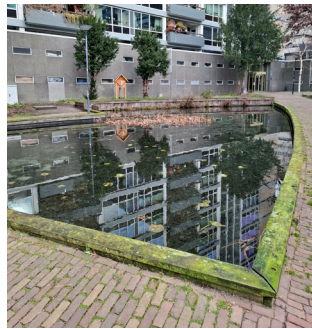
Aromas from stores that make coffee, sweet pastries and similar foods, have familiar and pleasant smells which trigger comfort and positive memories

Sound

Natural elements



Rustling leaves in trees creates a gentle, natural noise for a calming auditory environment



The soft sound of flowing water creates a gentle, soothing auditory

Lay-out



Wide sightlines enhance psychological effect of reducing perceived noise



Birdsong has natural and melodic sounds



Human sounds and soft chatter are gentle in volume as they create a social yet calm auditory environment



Street musicians can create pleasant music at a moderate volume, as it provides enjoyable auditory stimulation that capture attention without causing stress and enhances the atmosphere of the space.

Taste



Street food offers familiar and enjoyable flavors and create a comforting and pleasurable sensory experience



Easy access to nutritious and delicious food supports physical well-being and creates a sense of care and comfort for the body



A row of four restaurants next to each offers a variety of tastes and aromas in one area



Street food provides flavorful and enjoyable experiences. Also the sweet taste of stroopwafels can be restorative because it provides a comforting and pleasurable flavor that boosts enjoyment



