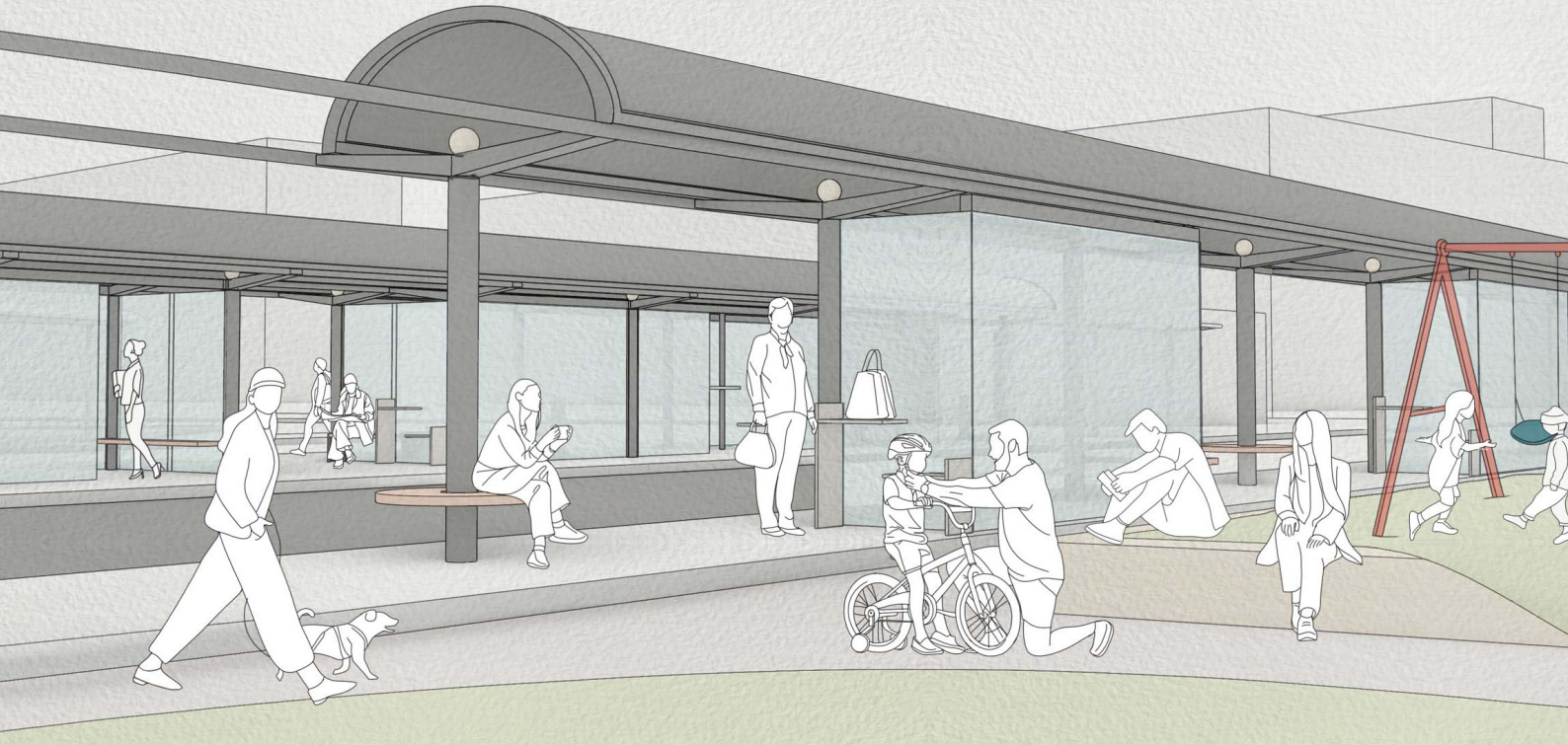
Hej Stranger

Encouraging copresence in public transport stops



Sai Sita Lakshmi Nagappan | Master's Thesis 2025
Examiner: Ioanna Stavroulaki | Supervisor: Flavia Lopes
Profile: Urban Design
Chalmers School Of Architecture
Department of Architecture and Civil Engineering

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Master Thesis 2025 by Sai Sita Lakshmi Nagappan

Chalmers University of Technology

Department of Architecture and Civil Engineering

Program: Master of Architecture & Urban Design

Profile: Urban design

Examiner: Ioanna Stavroulaki

Supervisor: Flavia Lopes

CHALMERS

Student Background

1998.07.26 Chennai, India

BACHELOR OF ARCHITECTURE
BMS College of Engineering
Bangalore, India | 2016-2021

INTERNSHIPS
Arun and associates | 2020
Warp archtects | 2021

MASTER OF ARCHITECTURE
Chalmers University of Technology
Architecture and Urban Design
Gothenburg, Sweden | 2023-2025

STUDIOS
Architecture in the anthropocene | 2023
Urban prototypes | 2023
Media and representation | 2024
Socio-Ecological urbanism | 2024
Building on context and building | 2024

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Sambanthan Palaniappa, my husband, who has always been a pillar of support.

My parents and family, to whom I owe everything.

'Without a strong awareness of the social implications of urban form, we might end up building cities but not societies.'
(HILLIER, 2009)

Abstract

Urban planning has always given importance to the design of public spaces like parks, squares, etc. and there is also the economic and environmental pressure on developers to do so. But how far these spaces encourage copresence of people remains a question. Urban form influences how people use and interact with any space and other users of the space. It is not always necessary to have face-to-face interaction with others but being copresent in the same urban environment as many others can by itself form the foundation for other complex social relations.

The main aim of this thesis was to rethink whether public transport stops could become more than just being mobility infrastructures and how through evidence-based design strategies their design could encourage copresence.

A good amount of research existed about copresence on squares, but copresence in public transport stops was less explored. The research focused on understanding how the spatial configuration of the city influenced both intensity and diversity of people copresent in public transport stops. An understanding of the relation between spatial conditions and supported human behavioral patterns was established.

Analytical data was collected through comparative case studies of different public transport stops using space syntax analysis and observational mapping. This data along with the theoretical framework helped develop the design strategies.

The result is a design manual, comprising of design strategies. Using the design manual has been demonstrated through a design implementation example in Gothenburg, Sweden. The indexes of this manual could be used in the design of socially sustainable public transport stops.

Keywords
Familiar stranger, Public space, Public transport stops, Copresence, Evidence-based design

Terminology

Space syntax
This concept was introduced by Bill Hillier and Julienne Hanson in the 1980s to analyze and understand the spatial configuration of the built environment and its effect on human behavior (Hillier & Hanson, 1984).

Angular Betweenness Centrality
It is a measure of centrality in space syntax. It analyses how often a path or segment is part of the shortest route between all segments in the city within a certain radius. When a path is highly-between, it forms an important link in the system, attracting through movement. Betweenness gives information about the amount of people moving through the space.

Angular Integration
It is a measure of centrality in space syntax. This measure is used to understand how accessible one place is to all other places in the system. It analyses how many steps are needed from one point to all another points in the city within a certain radius. When more steps are needed to reach a place, it is located deeper in the system, thereby more segregated. Whereas on the contrary, if a place is reached with minimal steps, it is located shallower in the system, thereby more integrated. Integration analysis helps understand the diversity of people co-present (Legeby, 2013; Sun, 2016).

Attraction Reach
It is a measure of accessibility. Attraction Reach measures the total amount of attractions that can be reached within a certain distance from the points of origin. For example, this analysis gives a measure of how many schools, shops or people can be reached within a certain distance from the point of origin.

Social Interaction
It refers to how people communicate, behave and react to others in a space. Though verbal communication is the common type, social interaction can also happen in non-verbal ways such as through body language, eye contact etc. In this thesis, social interaction refers to non-verbal communication amongst people which is less intense in nature.

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Fig 1 : Brunnsparken stop. Source: Author

Chapter 1 / Introduction

This chapter will set the foundation for the thesis project by introducing the discourse.

1.1. Background & Problem Description

Increasing population in cities

Urbanism today is at its peak. Cities are expanding and densifying. The number of people moving to cities is also increasing. 68% of the human population will live in cities by 2050 which is a substantial increase from 55% today (United Nations, 2018). With the population in cities increasing so rapidly, one is prone to meet strangers regularly. The strategic development plan of many cities has a detailed record of how many houses, schools, public transport stops, businesses, parks and other public spaces should be planned in the next 15-20 years to accommodate the needs of the increasing population. But little do these plans strategize on how the design of the public realm can promote or hinder social relations.

'Living among Strangers'

As Jacob (1961) points out in 'The life and death of great American cities', it is necessary to live amongst a concentration of strangers. *Stranger* is any unacquainted person, a local or a non-local, whom one meets. In villages, a stranger never remains so, for long. He/ she becomes part of the community soon. But so is not the case with cities. City dwellers have an increased chance of seeing so many strangers daily. People we start seeing on a regular basis become familiar to us despite not having any face-to-face conversation with them. Their presence is not intimidating. They are *Familiar strangers*. The unseen contact made with a stranger is at the modest level. The mere act of seeing and hearing many other people results in a social environment. Hence, it is the *secondary contacts* which defines the city (Legeby, 2013)

Need for copresence

Copresence is "Two or more people are physically assembled in the same place, so that they affect each other by their bodily presence, whether it is in the foreground of their conscious attention or not" (Collins, 2004, p.48). Copresence is fundamental for many social processes (Legeby, 2013). Being informed and aware of eachother's presence makes one feel safe in any environment. It is thereby very important to understand with whom we share a space (Berghauser Pont, M. et al, 2016).

Urban life is the by-product of several frequent and rather anonymous encounters in connection to everyday life activities (Legeby, 2013 pg.37). The material preconditions for patterns of movement, encounter and avoidance are structured by architectural design and urban planning principles (Hillier and Hanson, 1984). Therefore it is important to understand how the urban spatial layouts can support or hinder copresence.

Anne Legeby (2013) in her PHD dissertation on *Patterns of copresence* speaks about the importance of social networks *'within an area'* (Bonding) and social networks *'between areas'* (Bridging). This thesis sets out to explore if public transport stops can support the formation of such social networks.

Transport stops as more than mobility infrastructures

Extensive research has been done to understand the phenomenon of copresence in public squares, streets, markets, etc. The available research discusses how to increase copresence by interventions on multiple scales. But there is only limited research about copresence in public transport stops.

With the focus now shifting towards sustainable mobility and transit oriented development, there is an increasing need to design more attractive transport stops. As Bertolini (1996) points out, public transport stops are both nodes (Nodes of network) and places (Places in the city). They are affected by both local and global dynamics. He highlights 'intensification of flows', 'accumulation of activities' and 'tangle of actors' as complexities affecting the redevelopment of the station and surrounding areas. He stresses on the need to integrate the node in the place.

As Gehl (2010) mentions, transport stops should both be attractive to daily travelers and also to local users who should be able to use the facility as a destination in its own right. Public transport stops, rather than being just carrier spaces, should be able to encourage people to stay and linger around.

Like streets and squares, public transport stops provide an arena for many social activities to unfold, though its fullest potential has not been explored much. Design of transport stops has been predominantly generic, with them functioning as just mobility infrastructures. But it is important to understand that few transport stops can become social spaces because of their placement in the urban network. For transport stops to also function as social spaces, there is a need to think of alternate design strategies which can unleash the potential of transport stops as good public spaces.

Transport stops offer diverse groups of people a reason to be at the same place at a given point in time. Two prerequisites for increased copresence, as extensively discussed by Anne Legeby (2013), are intensity and diversity, and transit stops offer both. This makes it interesting to understand the social impact of public transport stop design.

Like pointed out by Hyeong (2022) in his Master's thesis there is not much attention given to the behavioral patterns of people during their waiting times in transport stops. How they interact with the space, how they relate to others in the space is not investigated much. How people behave in a space is highly influenced by what the space affords. For example, a post affords leaning onto, seating affords sitting, etc. Therefore, this thesis will try to analyze the relation between the spatial conditions of transport stops and the supported behavioral patterns.

Public transport stops as third places

Oldenburg (1999, pg. 41) defines third places as different public spaces that host regular, informal and voluntary meetings or gatherings of individuals and communities outside the work and home realm. Given this definition, it is evident that public transport stops fall under the category of third places.

Public spaces are social catalysts. Thereby, public transport stops, which are potential public spaces, can become social catalysts. A sense of place is imbibed in the minds of the users through three core ingredients – *'Things to do, people to meet and comfortable places to dwell'* (Lavadhino 2017 pg. 174). Most transport stops lack things to do and comfortable places to dwell, making waiting for the bus or tram a task that people want to get done with as soon as possible.

Responsibility to design for people's wellbeing

Public space can be designed either to bring people together, supporting movement and copresence, or to inhibit such processes (Berghauser Pont, M. et al, 2016). So, it is highly important for architects to design the public realm in such a way that people are unconsciously encouraged to take part and interact. The architect's role is to influence the possibilities of such social contacts without worrying about the intensity of such interactions (Gehl, J. 2010a). This thesis will explore how an architect could design the public realm, in particular public transport stops, to encourage copresence.

1.2. Personal motivation

As a kid, it was never difficult for me to make new friends. But as I grew up, the desired contact with others started to dwindle. This reality hit me hard only after I moved to Gothenburg couple of years ago. As an immigrant I constantly felt lonely in this new urban setting. I hardly knew anybody from my apartment building. If not for university, I didn't have a place to go to or anyone to meet. That is when I started to wonder about stranger interactions in urban public spaces. Streets and public transport stops provided me with spaces to encounter many others. I usually felt intimidated to establish a conversation with the person next to me. But seeing them move about in the same space gave me a sense of relaxation, a sense of being actively present in their world, even if that was just for a transient moment. That was when the core idea for this thesis project was born.

My interest in space syntax was instigated by socio-ecological urbanism studio offered by SMOG (Spatial morphology group) at Chalmers. Hence, this thesis was steered towards understanding the spatial morphology of the city and its contribution to social relations and interactions.

1.3. Aim

The aim of this thesis was to explore, through evidence based design, the potential of public transport stops as more attractive social spaces.

Purpose of the project and contribution

The main purpose of this project was:

• Re-imagine transport stops as vibrant social spaces rather than merely functional mobility infrastructure.

• Create evidence-based design strategies to transform the mundane public transport stops into more attractive spaces with increased copresence.

• To explore and showcase how evidence based design can be used in creating a design manual.

Relevance for sustainable development

It is very important to understand if a public space is facilitating or hindering connections and interactions amongst 'the others'. The focus of this thesis was on social sustainability. This thesis supports SDG 3 – Good health and wellbeing and SDG 11 – Sustainable cities and communities by creating awareness amongst people as to how they could help fellow others by just being present in the same physical setting as them.

Fig 2: The UN SDGs 3 and 11. Source: Official logos (United Nations, n.d)

1.4. Delimitation

• Evidence-based design has been adopted to be the main approach in this thesis. Evidences were gathered using only spatial analysis and observational mapping.

• Spatial analysis (e.g. space syntax, accessibility analysis) was restricted to only the most relevant analysis.

• Observational mapping, an important method in this thesis, was carried out on the weekdays, from Mondays-Thursdays. Fridays were excluded because of the perceived notion that many people can also work from home, as Friday becomes part of an extended weekend. The stop's usage during the off peak times was not included in the analysis. Observational mapping was carried out only for a duration of two and a half weeks, because of the limited time span of this thesis.

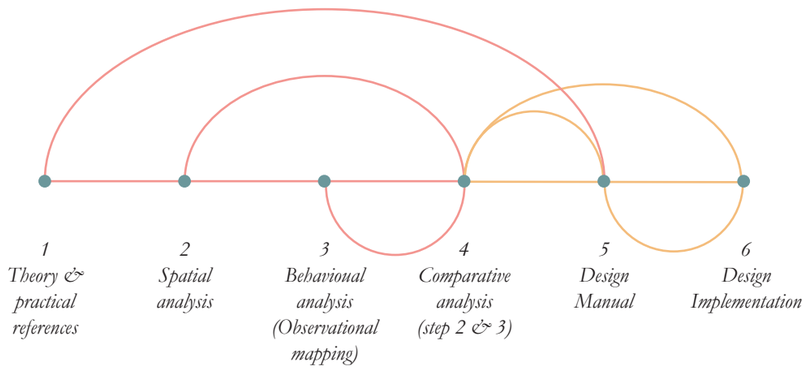
• Interviews, as a method was not adopted because of the need to carry out multiple interviews to compile and compare responses to get a holistic understanding of the phenomenon under study, and not enough time to realize the same.

• The result of this thesis was imagined to be a design manual consisting of architectural principles and not a concrete design proposal. The proposed strategies do not include aesthetical design interventions.

1.5. Thesis Question

How can evidence based design strategies help transform the mundane public transport stops into more attractive spaces for increased copresence?

Thesis Process



1.6. Overview of Methodology

Different methods have been adopted to realize this thesis project. The thesis process has been split into three sections.

1. Desk research

During the research phase, measures were taken to gain an in-depth understanding of the main discourse under study - *'Copresence'*. Because of the limited amount of literature available on public transport stops - the research spectrum was broadened to include public space in general, such as squares. *Life between buildings', 'Patterns of copresence in squares' and Behavioral patterns of people* have been found to influence the possibilities of social interactions. Therefore, it was important to gain an understanding of how people behaved during their waiting times at public transport stops.

2. Analysis

The chosen case studies are located in Gothenburg. The analysis phase includes two different types of analysis namely - *Spatial analysis and social analysis.*

During first level of spatial analysis, the different urban layers influencing copresence in public transport stops were identified and analyzed. Network analysis (Angular betweenness, angular integration), Built density and population density (Total population, working population, residential population, population of kids (0-6yrs), population of elderly (>65yrs) and population of non-natives) were carried out on the chosen stops. This was followed by accessibility analysis (i.e. attraction reach analysis) with the public transport stops as the origin to all other spatial layers.

For social analysis, observational mapping exercise was carried out. The main aim of this step in the process was to identify the existing affordances of the bus stop design and understand how people behaved during their waiting times. The main aim was to identify and reflect on existing group behaviors, patterns of use and categories of people present. This phase in the thesis was concluded with a comparison between spatial and social analysis. This step helped to identify the existing copresence profiles and the relation of this profile to the stop's spatial properties.

3. Contribution

The final product of the thesis is a design manual. Evidence based design has been used as the design methodology. Strategies based on the existing copresence profiles were identified and documented in the form of a design manual which could help in the design process of socially sustainable public transport stops. This design manual is the main contribution of this thesis to the ongoing discourse. The proposed design strategies are predominantly based on the spatial conditions and do not include design aesthetics. The final section showcases an example of how the design manual could be used through a design example in Gothenburg followed by discussion and conclusion.

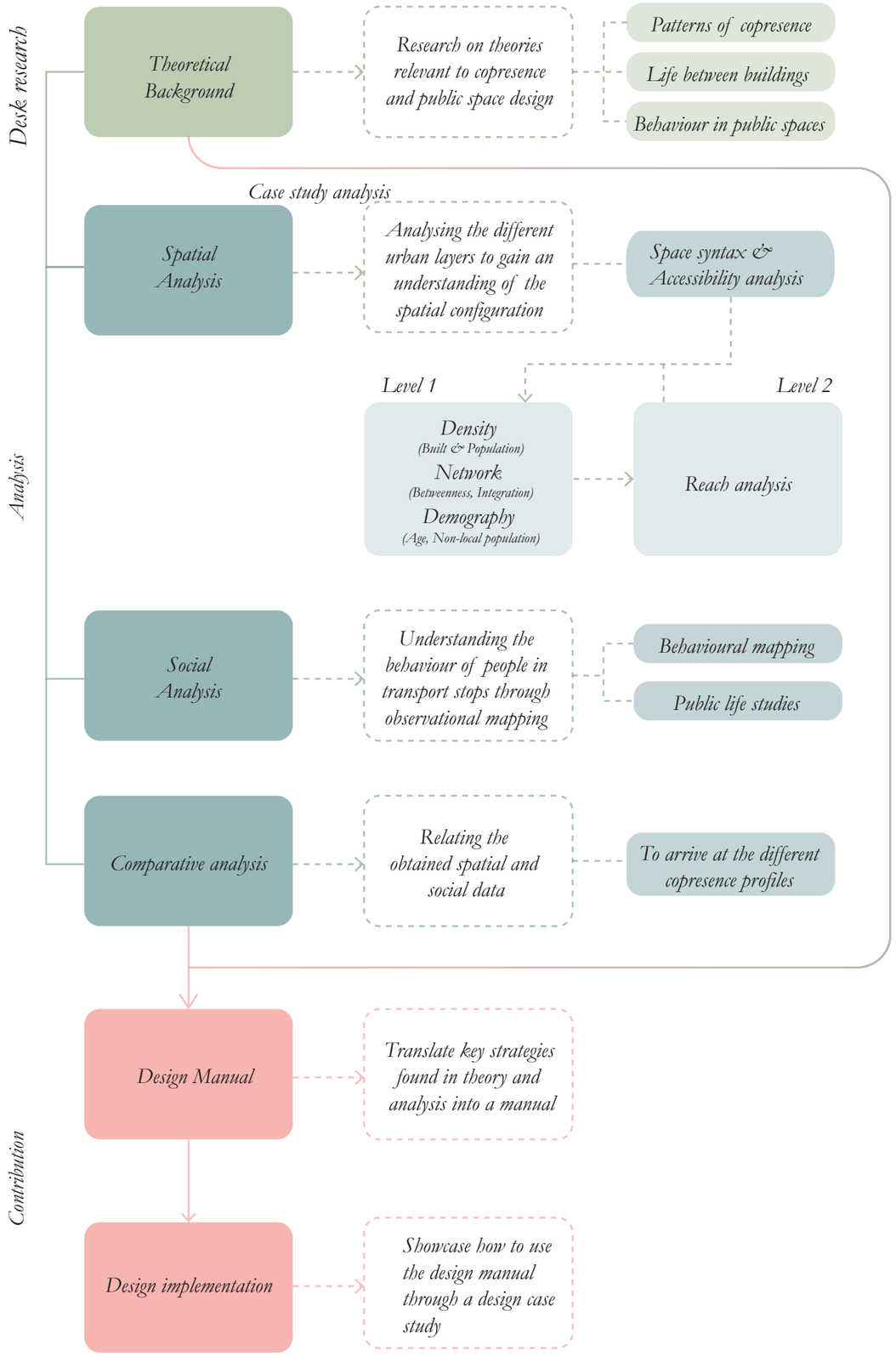


Fig 3 : Method diagram. Source: Author

1.7. Theoretical Background

Fig 4: Copresence.
Source: Author

Fig 5: Intensity of copresence.
Source: Author

Fig 6: Diversity of copresence.
Source: Author

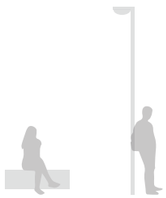


Fig 7: Affordances.
Source: Author

Copresence & Affordances

"Cities may be described as mechanisms generating contact" (Hillier 1996, 174). As explained by Bill Hillier in The Social Logic of Space (1984) copresence deals with how the spatial configuration of any environment influences social interactions and human behavior. The urban system provides people with material preconditions for movement, encounter and avoidance. Space syntax studies show that street network configuration and centrality are the main factors that affect the intensity of movement and co-presence in space. Copresence is influenced by accessibility, diversity, density and visibility (Legeby, 2013). Spaces that facilitate copresence (such as public squares, transport stops, parks and marketplaces) are crucial for the development of social relationships. They serve as gathering places where people share common experiences. Conversely, poorly designed spaces that inhibit copresence can isolate individuals and reduce social cohesion.

Ann Legeby (2013), in her PhD dissertation investigates extensively the patterns of copresence. The two crucial aspects of copresence pointed out by Legeby (2013) - Intensity of people copresent and Diversity of people copresent will be studied with regards to public transport stops in this thesis. She explains how everyday trajectories of people when overlapped with such trajectories of other people results in a shared public space. Physical conditions of public spaces afford different activity trajectories to overlap. She elaborately discusses about how high centrality of the square in a larger scale was associated with higher mix of locals and non-locals whereas lower centrality was associated with presence mostly by locals (Legeby, 2013; Sun, 2016). James J. Gibson explains the concept of affordances in his book "The Ecological Approach to Visual Perception" published in 1979. Hillier and Hanson further adapt this theory to suit the built environment in their book "The Social Logic of space (1984)". Affordance is defined as the ability of the spatial configuration of few environments to 'afford' certain human behavior. A well connected and attractive walkway invites people to pass through. Whereas, a narrow walkway or a dead end inhibits movement, increases privacy and exclusion. Hence, spatial configurations can afford or inhibit copresence.

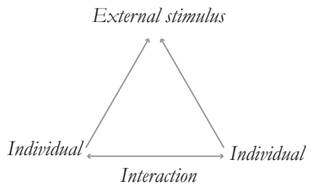


Fig 8: Triangulation. Source: Author

Triangulation

The book, "The social life of small urban spaces' by William H. Whyte (1980) is a collection of observational studies conducted by him to document the social activities of people on city squares, playgrounds, streets, etc., in the city of New York through time-lapse photography, interviews, and direct observation of users. William H. Whyte's triangulation theory in the context of urban design and architecture refers to the process by which some external stimulus or element in a public space sparks interaction between strangers. Triangulation occurs when a third element such as a public art piece, street performer, or a unique architectural feature — brings people together and encourages spontaneous social interaction. As Aelbrecht (2016) points out, triangulation doesn't necessarily depend only on an external stimulus but also on where and on what conditions it takes place. As Jan Gehl adds, both fixed objects such as sculptures, solid furniture, shade under the tree and flexible objects such as temporary art installations, street buskers, etc can bring people together (Gehl, 2010). The stimuli can also be negative in nature such as an unexpected tram accident, tram delay, etc. Though the thesis doesn't take into consideration such unexpected occurrences, it is important to be informed of them.

Behavior of people during waiting times

The behavior of people during their waiting times in bus stops can be categorized into different modes as laid out by Kärrholm & Sandin (2011). (1) *Settled mode* when people are well informed about the waiting. Eg: When a person waits as he/she reads a book, drinks a coffee or smokes. (2) *Pre-settled mode* when the person is waiting for someone alongside waiting for the bus. Eg: When a preplanned meeting has been fixed to occur at the transport stop. (3) *Unsettled mode* when the wait is simply for a situation to pass. Eg: Tram delay or stuck in traffic. Users of public transport stops usually prefer activities which do not demand a lot of attention and offer better visibility of the ongoing traffic (Bins Aly, V.M.H, et al. 2012). *Territoriality and ownership* can be perceived in public transport stops. People own their waiting space in three different ways. *Delimitation* - people delimit the space around them by keeping a personal item next to them. *Exploration* - when a vacant seat is not available to sit, people usually explore with alternate elements such as a step or a parapet to seat on. *Obstruction* - When a person occupies more space than intended obstructing either the view or opportunity of others to sit. People usually adopted certain *postures* as they waited - standard seated, inclined seated, reclined seated, standard standing and supported standing (Bins Aly, V.M.H, et al. 2012).

Proxemics

Edward. T. Hall in his book 'The Hidden Dimension', published in the year 1966, introduces the theory of proxemics. Proxemics refers to the study of personal space and how the physical distance between individuals affects communication, behavior, and interaction in social contexts. He speaks about intimate distance, personal distance, social distance and public distance and distance receptors such as eyes, nose, ears etc and immediate receptors such as skin and muscles. It is very important to understand how cultural norms, personal preferences, and social contexts influence how people manage space around themselves to create successful environments for social interactions. Close relations maintain an intimate (0-0.45m) or personal distance (0.45-1.3m). Acquaintances maintain social distance (1.3-3.75m) whereas strangers maintain public distance (>3.75m) and in certain scenarios social distance based on spatial constraints. When a person realizes the invasion of a stranger into their personal space when not desired, they usually move aside to regain their territory. Only under forced circumstances do they allow for the distance between them to reduce, for example while boarding a bus.

Life between buildings

Jan Gehl in his book 'Life Between Buildings', emphasizes the importance of creating public spaces for people. He categorises outdoor activities into *Necessary activities* (compulsory in nature, which requires people to participate like going to work or waiting for a bus), *Optional activities* (likely to occur only under favorable external conditions, the users are actually provided with a choice here. All of the recreational activities fall under this category like waiting to catch a view, walking along a promenade etc.) and *Social activities* (which is the resultant of the presence of others in the same space). Gehl (2010) also explains about the desired outdoor space qualities necessary for the different activities to take place. Though waiting at a transport stop is considered to be a necessary activity, it is important to enhance the quality of transport stops for them to support social activities.

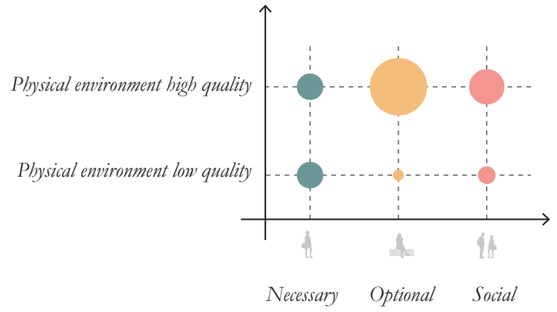


Fig 9 : Desired outdoor space qualities (Cities for people, 2010). Source: Author

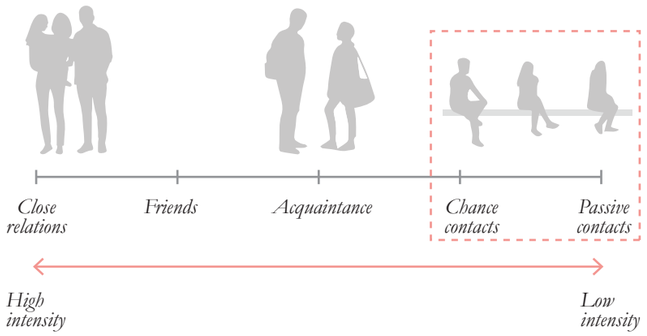


Fig 10: Levels of interaction. Source: Author

People interact with each other on many different levels - (1) High intensity such as close friendships, friends and acquaintances (2) Low intensity such as chance contacts, see and hear passive contacts (Gehl, 2010). The focus of this thesis will be on the low intense passive interaction which forms the basis for long term high intense relations. Gehl (2010) states that it is possible for people to develop contacts due to frequent meetings or encounters in connection with their daily activities. This is why the study of transport stops proves beneficial because visiting the transport stop is a part of one's daily routine. Therefore, the probability of people being co-present and the chances of meeting familiar strangers is higher.

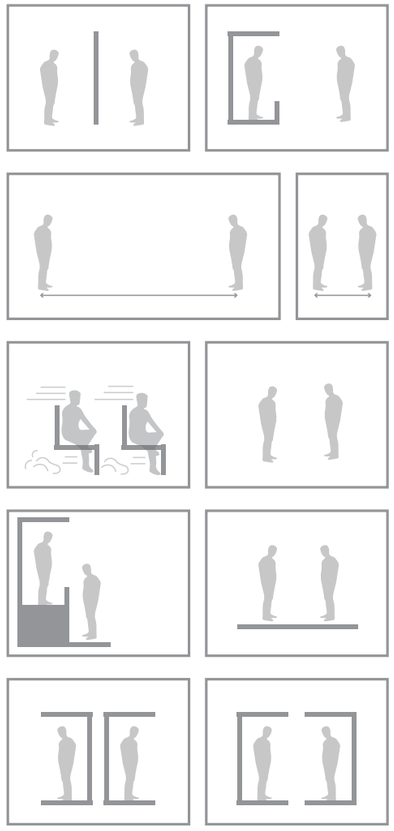


Fig 11: To invite or repel (Gehl, 2010). Source: Author

Gehl (2010) explains about the physical conditions necessary to promote or hinder social contacts. Inviting requires unobstructed views, short distances, low speeds, staying on the same level and orientation towards what is to be experienced. In contrast, interrupted lines of vision, large distances, high speeds, multistory placement and orientation away from people deter people from seeing and hearing others (Gehl 2010, Pg 236).

Jan Gehl (2006) outlines the twelve quality criteria which fall under three larger categories of Protection, Comfort and Enjoyment. Any good public space should (1) feel safe and secure (Supported by eyes on the street, lively public realm, good lighting) (2) should support sitting, staying, walking, playing, unobstructed views (3) should be designed to the human scale and (4) should provide opportunities to enjoy positive aspects of climate and protect from harsh weather conditions. If a public space needs to function well, a careful treatment of most of the mentioned quality criteria is essential. When developing the design strategies in Chapter 4, measures were taken to reflect on these 12 quality criteria and integrate them with the proposed design strategies.

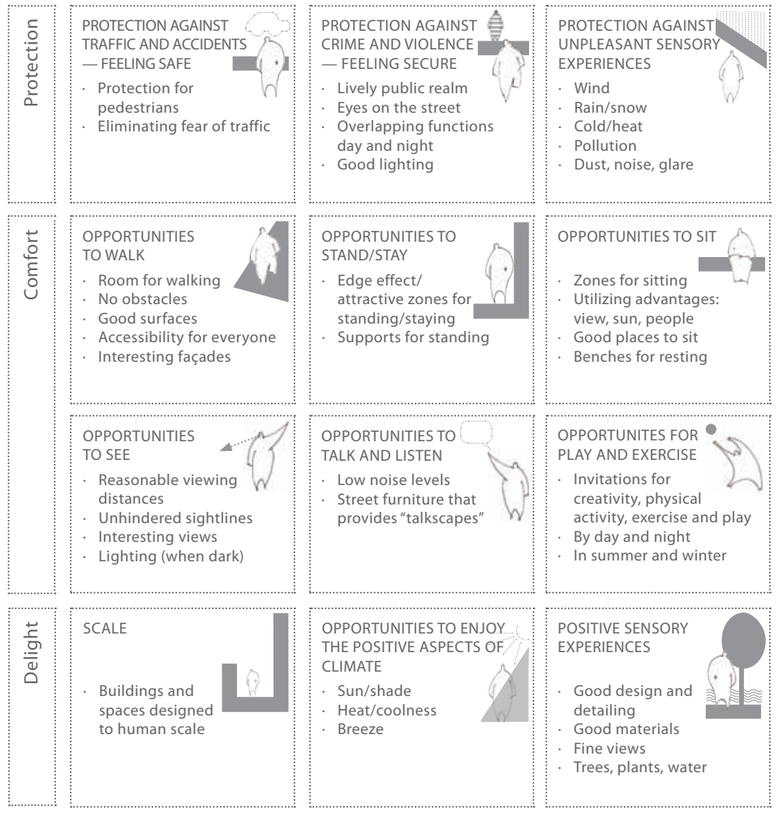


Fig 12: 12 quality criteria. Source: Cities for people (2010) Pg 239

Public life study

Jan Gehl and Birgitte Svarre (2012) in the book *'How to study public life'* have emphasized on the need to understand the interaction between city life and city space. It is important to understand *Who* (gender or age), *Where* (people move and people stay), *Why* (reason for being in the space), *How long* (waiting time), *How many* (are moving through the space and how many are staying). Observations should also include information on group behaviors. Time (How long do people stay in a place or how long a particular activity lasts) and distance (how long does it take for people to move from one point to another) are two important dimensions.

The book also outlines the different mapping methods: Counting (at every 10min interval), behavioral mapping (to note down where people stand or sit), tracing (movement flows as lines on paper), tracking (shadowing), looking for traces, photographing, keeping a dairy and test walks. As a part of my thesis process - counting, mapping, photography and test walks were adopted to be important methods. In the case of transport stops, it was important to understand who was using the space, how many were they, where did they locate themselves and why.

Fig 13: Duration and mapping days. Source: Author

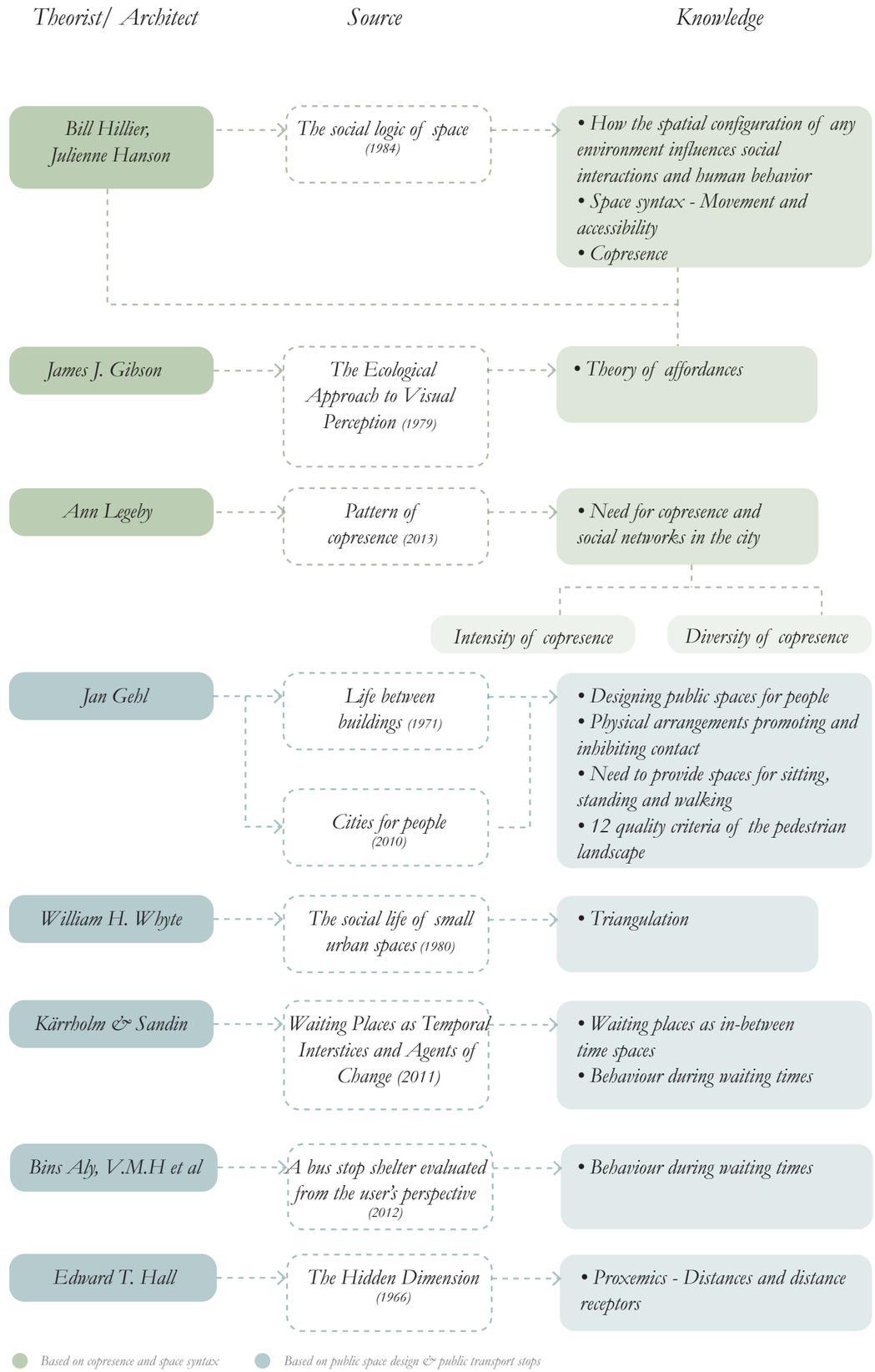


Fig 15 : Theory diagram. Source: Author

1.8. What is Space Syntax ?

The core of the space syntax theory, as coined by Bill Hillier and Julienne Hanson in the 1980s, is that the spatial configuration of the built environment influences movement patterns, inter-human interactions and other behavioral aspects (Hillier & Hanson, 1984). Space syntax is based on two formal ideas: Space should be perceived as an intrinsic aspect of everything human beings do. Movement happens in a linear path, human interaction occurs within a convex space, such as squares and public transport stops, where a person can see all others in the space. Also, a person perceives things differently depending on where he/she is in the space and can also experience changing visual fields as he moves through the space called the isovist. The second idea is that the interrelations between the different spaces which make up the city also matters (Hillier and Vaughan, 2007). Though space syntax analysis is based on street-scale data, as it is the level at which people experience the city, it can aggregate this micro-scale information to suit the macro scale. The three main variables analyzed within space syntax are accessibility, density and diversity (Marcus, 2007).

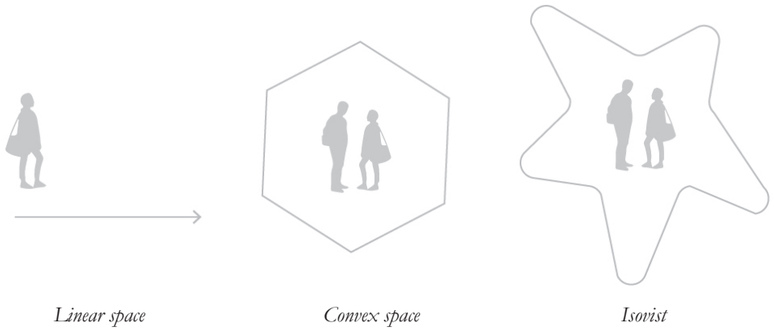


Fig 14: From Hillier and Vaughan (2007). Source: Author.

1.9. What is Evidence - Based Design ?

Evidence based design was first introduced in the field of healthcare which was later adapted to the field of urban design and planning. The dictionary defines evidence as something that is a proof. Scientifically evidence is defined as “any empirical observation about the apparent relationship between events” (Guyatt et al., 2000, p. 1292). Evidence-based design involves a quantitative analysis of data which later informs the design decisions. The strength of the evidence depends on the quantity (e.g., number of studies, sample size), quality (e.g., rigor), appropriateness (e.g., applicability to context), and its feasibility (Stichler, 2010a).

EBD (Evidence based design) is based on EBM (Evidence based medicine). As pointed out by Berghauser Pont, M. (2024), the conventional design practice, unlike evidence based design, is highly influenced by artistic expression, designers intuition and desires of other actors involved. But it is scientific evidence that should guide decision making. Evidence based design helps us understand why something works or not. The focus should not always be on generating ideas but also critically evaluating the ideas. There needs to occur a shift from creative decision making to evidence based decision making in architectural practice (Berghauser Pont, M., 2024).

Urban morphology is a study of urban forms (Karimi, 2003). It includes the exploration of urban morphological elements such as buildings, blocks, plots and streets. It is not always the tangible form but also the interstitial space between them that defines the urban landscape. Design is not an instantaneous idea but a progressive journey, which involves both intuitive and analytical decision making. “Evidence-based approach intended for integration into the design process must possess three fundamental characteristics: it should be specifically spatial, inherently social, and intrinsically analytical” (Karimi, 2003. pg11). During the evidence based design process each design element is scrutinized individually before being interwoven to make the whole. Evidence based design is adapted to be an important method in this thesis, to empirically support the design strategies to be developed as part of the manual.

1.10. Practical references

It was difficult to identify some real-time examples of public transport design where copresence or social sustainability was highlighted. Most of the identified examples dealt with the aesthetics of the stop. It is true that to an extent the aesthetics of the public transport stop is important but it is not the only aspect which influences the usage of the stop. A few other examples highlighted the usage of smart technology. None of the examples were relevant for the discourse under study. Hence, the search was broadened to include examples of other potential public spaces where people were at the center of design.

The Station of Being (2021)

The station of being is a climate-smart bus stop prototype designed in Umeå, Sweden by architecture studio Rombout Frieling Lab along with Research Institutes of Sweden. The main aim of the design proposal was to provide the commuters with a welcoming and safe environment. The features include a smart roof with lighting and rotating pods which provided the travelers with wind protection which proved beneficial while waiting for a bus in cold and snowy conditions (EU, 2021).

Take away: When designing a public transport stop in a cold country, wind protection measures need to be taken.

Critic: This design provides privacy, which can be a hindering factor when it comes to copresence and social interactions.

Fig 16: The Station of Being Copyrights: European Union Bauhaus

Revitalizing Chongqing towards people-centric urban design (2014)

This includes a series of pilot projects introduced over a period of 3 years by Gehl Architects. The vision was to test and transform neighborhood streets into small scale inviting social spaces for interaction. The focus was to enhance the existing pedestrian infrastructure. Connecting the pedestrian network with the public spaces was undertaken as a part of revitalizing the urban core.

Take away: When designing spaces to encourage copresence, it is necessary to think of ways to make people want to come, stay and take part. The physical preconditions to allow for people to linger around should be taken care of.

Fig 17-18: Revitalising Chongqing. Credit: Gehl

Fig 19: Weiselgrensplatsen. Source: Author

Chapter 2 / Analysis

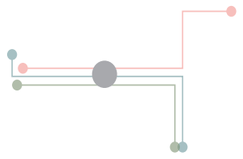
This chapter is a compilation of spatial and social analysis.

2.1. Site & Context

City of Gothenburg in Sweden was chosen as the study area for this thesis. Gothenburg is the second largest city in Sweden next to the capital Stockholm with a population of over 6,38,000 people (as of 2024). The city has a really good transport network, comprising of tram and bus lines, provided by Vasttrafik. As the focus of this thesis was to encourage copresence in public transport stops, it was necessary to identify few transport stops to begin with spatial analysis and behavioral mapping. Few general criteria were adopted while identifying the desired transport stop typologies:

• **Number of transport lines:** If it is a transport stop with few transport lines, it is evident that the transport stop will feed the transportation demands of only one or two neighborhoods around. In some cases, it can also be a transport stop in a more segregated area. Whereas, if a transport stop has many transport lines, it is likely a transfer stop or is in the reach of several destinations around, like in the city center. Thereby, it can be argued that the number of transport lines can have an impact on the number and diversity of people co-present at the transport stop.

Number of transport lines



• **Position in the urban network:** If a transport stop is not well-connected in the system, it takes the nature of a neighborhood stop with just the local community using it. Whereas if a transport stop is well-connected in the system, like the central station, diverse population use it and also there is an increased footfall. Betweenness centrality of a location as discussed before gives a good indicator of the number of people copresent. Hence, it is important to choose stops with varying betweenness values in order to have different copresence profiles.

Position in the urban network

• **Nature of enclosure:** The building facades around the stop also provide the users with the desired attractiveness to either use a stop or abandon it. People are likely to use a transport stop with a retail outlet close by, because of the need to buy groceries on their way back home. Interactive ground floors offer people something to window shop during their waiting times. If a stop is located below or above ground level, it has a different language altogether.

Nature of enclosure

Fig 20: Selection criteria
Source: Author

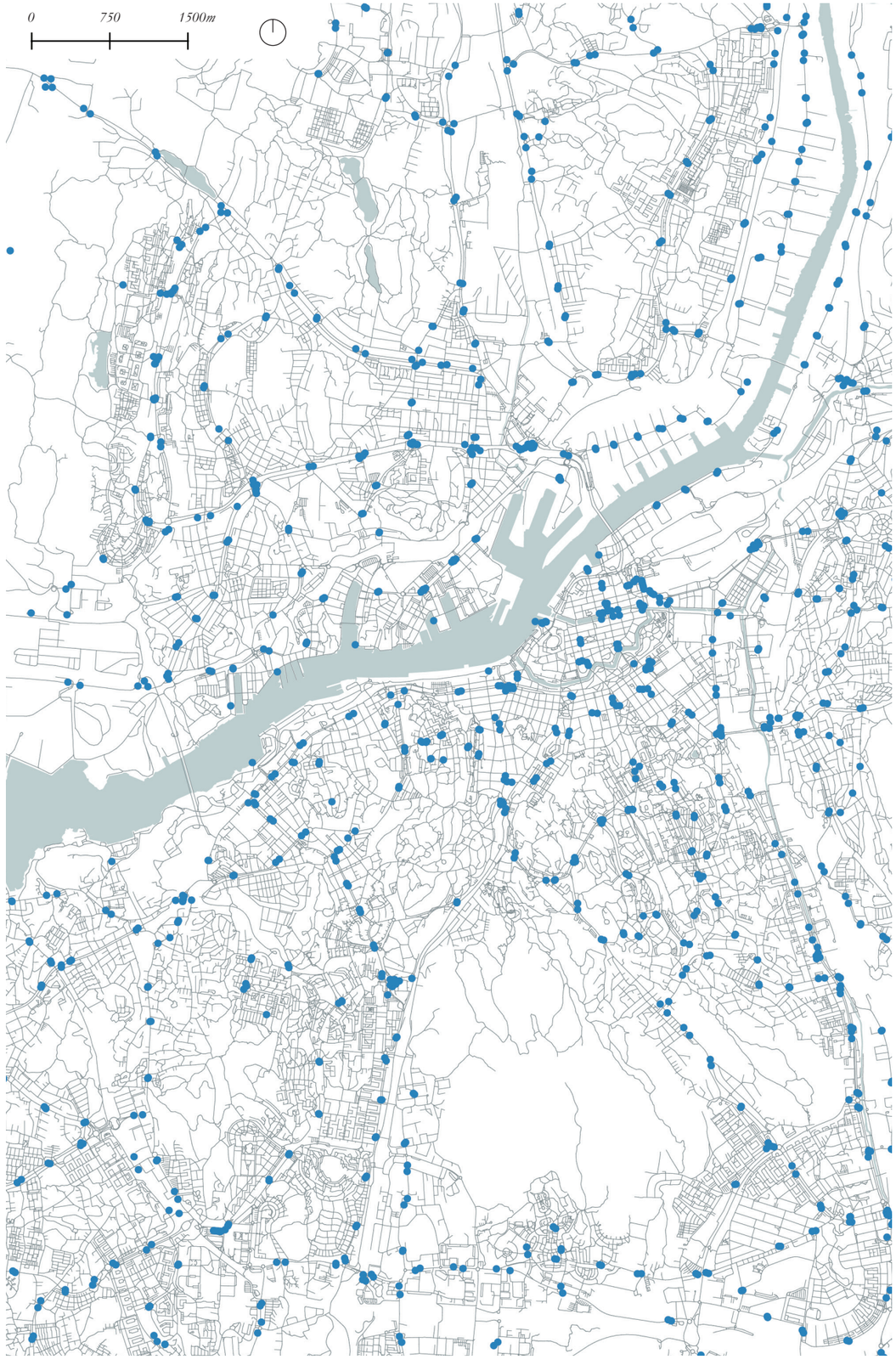


Fig 21: Map showcasing all the public transport stops in the city. Source: Author

Based on the above mentioned criteria and the researcher's familiarity with the different stops, four stops were selected to proceed with: Marklandsgatan, Brunnsparken, Weiselgrensplatsen and Lansmansgården.

Marklandsgatan, located in Högsbo (Southern Gothenburg), has multiple tram lines to both the city center and the suburban areas. It is also highly impacted by Frolunda Torg, another center (recentrum) nearby. Marklandsgatan has a few points of interest around. Lots of people use this stop as a transfer on their way to work or school.

Brunnsparken is in the heart of the city closer to the central station. With its proximity to Nordstan mall, lot of commercials around, the transit square and Gustaf Adolfs torg, it makes for an interesting study location, as it attracts a lot of people daily.

Weiselgrensplatsen, located in northern Gothenburg, is surrounded by healthcare facilities, restaurants and a market. What makes it different from the other stops is that it does not support a lot of transport lines. Also, two of the platforms are underground giving it a different experience.

Länsmansgården (Stop: Varmfrontsgatan), located in Biskopsgården (northern Gothenburg), is the last stop of tramlines 5 and 6. A dead end stop. The context is dominated by varying topography, residential complexes and a school. Because of its location in a relatively segregated area, it only feeds the demands of the local community.

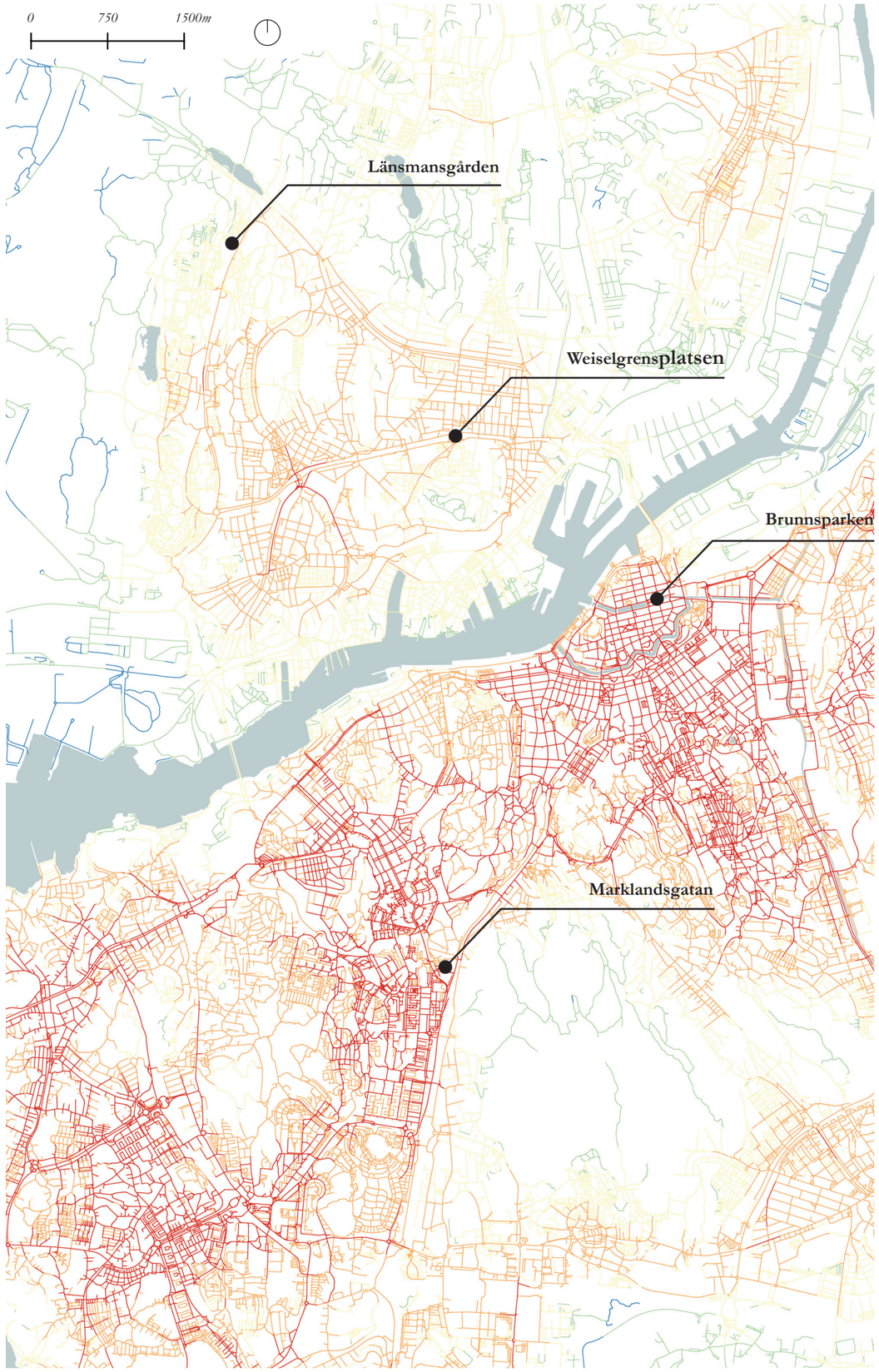


Fig 22: Angular Integration | 2Km | Non-motorised network | Highlighting the chosen transport stops. Source: Author

Fig 23: Marklandsgatan Source: Author

Fig 24: Brunnsparken Source: Author

Fig 25: Weiselgrensplatsen stop.Source: Author

Fig 26: Länsmansgården stop.Source: Author

2.2. Spatial analysis

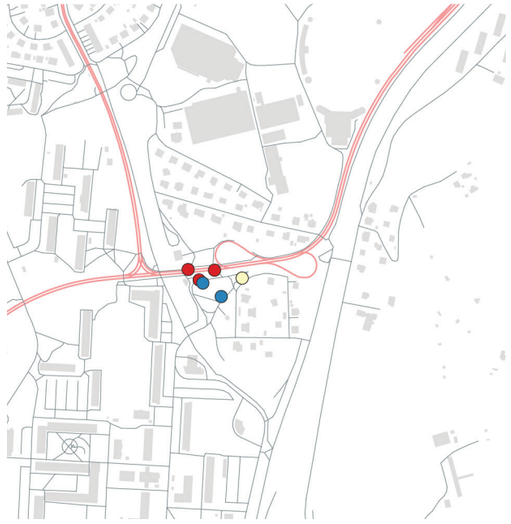
Spatial analysis has been adopted as an important method in this thesis. A set of different analyses was run using PST (Place Syntax Tool (Stavroulaki et al. 2024)) plugin on QGIS. The results obtained were critically reflected upon. Public transport accessibility, betweenness centrality analysis on three different walking radii (500m, 1Km, 2Km), density analysis (built and population density), demographics analysis (age, non-local population), facade analysis and building typology study were carried out for each of the four chosen stops. These analyses gave an understanding of the intensity and diversity of copresence and what external factors (amenities) influenced the usage of public transport stops. (GIS dataset source: Stavroulaki (Socio-ecological urbanism course) & trafiklab)

Public transport accessibility

This analysis helped identify the number of other public transport stops accessible while traveling by public transport within 15minutes. This gave an understanding of a stop being a transfer or not and the number of transport lines supported by each of the chosen stops. When the public transport reach of a stop was higher, it supported high number of transport lines, resulting in increased transport frequency and flow of people in the stop. On the other hand if a transport stop had lower public transport reach, it supported fewer transport lines thereby supporting the needs of just one or two neighborhoods. The public

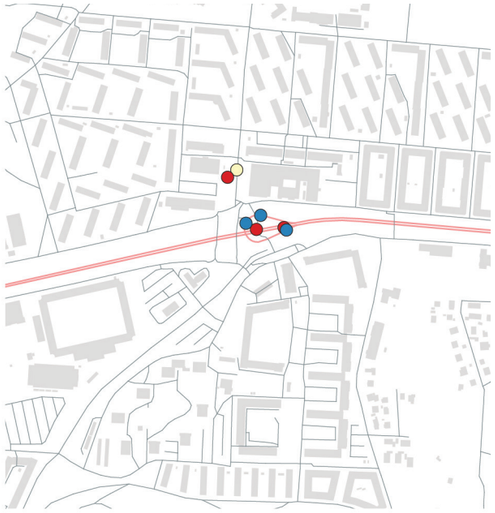
Reached number of stops (Public transport accessibility)

- *8 - 24*
- *24 - 89*
- *89 - 205*



Marklandsgatan (Number of transport lines: 17)

Brunnsparken (Number of transport lines: 15)



Weiselgrensplatsen (Number of transport lines: 7)

Länsmansgården (Number of transport lines: 3)

Fig 27: Public transport reach | Accessibility within 15min

transport reach matters as it influences the intensity of people copresent. Marklandsgatan (highly accessible) is a transfer, Brunnsparken is a hub whereas Länsmansgården (least accessible) is a dead end stop.

Betweenness

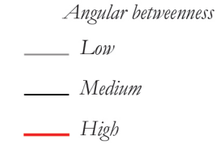
Betweenness is a measure of centrality (Refer terminology section). Betweenness centrality is considered important as it gives information about existing movement flows. It is performed on the street network of Gothenburg. Betweenness analysis was done on radii 500m, 1000 and 2000m. Local betweenness is extremely important for the study of transport stops as it gives information about the intensity of people copresent. The results were divided by natural breaks into 3 groups - High, Medium and Low.

Marklandsgatan - The betweenness centrality is higher at 500m but gradually decreases as the walking distance is increased from 500m to 2Km. Betweenness values suggest that probability of walking to the stop is higher resulting in a local copresence (higher betweenness on 500m). The likelihood of people from other areas coming by foot is decreased (lower betweenness on 2Km). But the transport stop itself is an attractor bringing in a lot of people because of its high public transport accessibility, therefore there is a constant copresence of people at the stop.

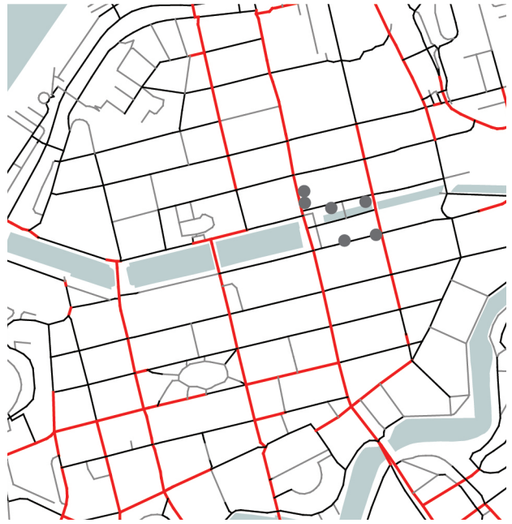
Brunnsparken - The betweenness centrality is higher on 500m. Though Betweenness reduces a little when the radius is increased from 500m to 2km, the overall betweenness of the area is very high. The higher Betweenness value on 2km suggests high intensity of non-locals in the stop (likelihood of people from other areas).

Weiselgrensplatsen - The Betweenness centrality around the transport stop is medium and remains constantly so, when the radius is increased from 500m to 2Km.

Länsmansgården - The betweenness centrality is higher at 500m but gradually decreases as the walking distance is increased to 2Km. Betweenness values suggest that the probability of walking to the stop is higher resulting in a local copresence (higher betweenness on 500m). Although Betweenness in 500m is low as the topography hinders walking to the stop.

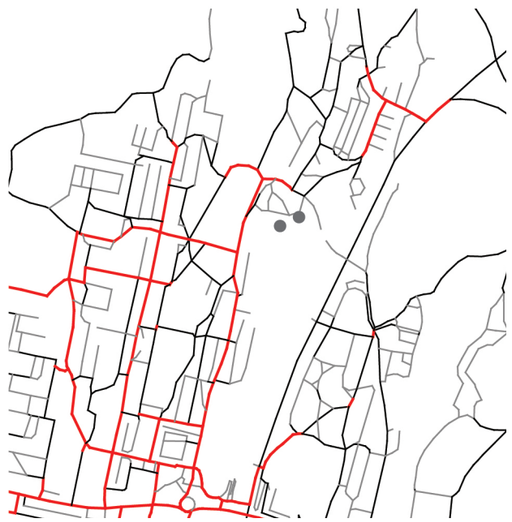


Marklandsgatan



Brunnsparken

Weiselgrensplatsen



Länsmansgården

Fig 28: Angular Betweenness & Reached no. of lines | 500m | Non-motorised network

Density

The density analysis includes built density (Berghauser and Haupt, 2005), population density distinguishing work and residential population and attraction reach to points of interest and services. Density analysis was done on two levels:

•Level 1 - Accessible built density, total population density, working population density analysis were carried out for a walking distance of 500m.

•Level 2 – Attraction reach analysis was carried out with the bus stops as the origin layer. The attraction reach analysis gives information on the number of attractions (e.g. population, points of interest, etc.) that can be reached, through the network (here the street network is used), within a certain radius (500m).

Marklandsgatan – The built density (Accessible FSI (Floor Space Index)) is low in the area, suggesting that the buildings are not dense but more dispersed. This could be a reason why a lot of people are not seen walking to the transport stop, contradicting the potential created by the high Betweenness values on 500m. The residential population density is moderate. The working population density (Day) is also low in the surroundings, suggesting that there are not many workplaces or commercial areas where people go for work or shopping during the day. There is a lack of a mixed use environment because of which the stop loses its potential to become a destination and remains a transfer stop.

Brunnsparken - The built density is very high in the area. This is the nature of any city center. This could be a reason why a lot of people are seen walking to and from the transport stop. The working population (Day) is very high in the surroundings, suggesting that there are many workplaces and commercial areas which attract a lot of people. This results in a lot of non-locals using the stop. On the other hand, the residential population is less, suggesting that not a lot of people reside in the area, but rather use it only for work and recreation.

Weiselgrensplatsen - Built density is moderately good in the area, suggesting that the buildings are neither very dense nor very dispersed. The residential population is higher in the area. The working population (Day) is not as low as Marklandsgatan and not as high as Brunnsparken suggesting that there is a decently good number of workplaces and commercial areas to attract both local residents and non-locals.

Länsmånsgarden – The built density is low to moderate in the area. This reduces the probability of many people walking to the transport stop. The residential population is higher. The working population (Day) is very low in the surroundings, suggesting that there are not many workplaces and commercial areas to attract non-local people. This suggests that the copresence in the public transport stop is extremely local.

Demographics

The demographics analysis was performed by analyzing the associated information of the population dataset - their age, gender, education, country of origin, and the income. The analyses gave an understanding of the demographic profile around the chosen stops.

Fig 29: Accessible FSI & Attraction reach to built density| Walking distance 500m

Attraction reach to total pop
- *781 - 1537*
- *1537 - 2925*
- *2925 - 4642*

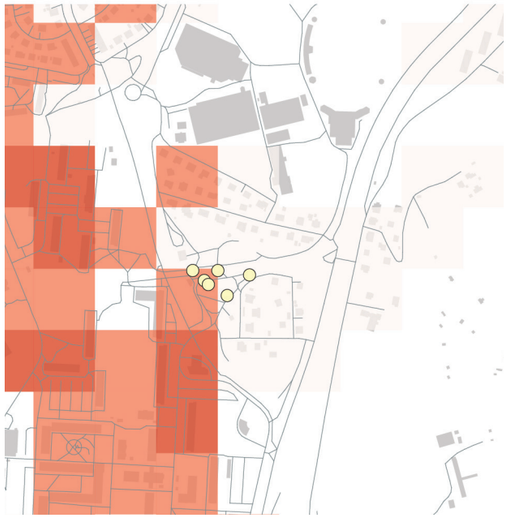
Total pop density (Per ha) (100mx100m grid)
- *0 - 42*
- *42 -174*
- *174 - 1008*

Marklandsgatan - There is a higher percentage of native Swedish people living in the area, resulting in less population diversity. There is an increased attraction reach to senior citizens, suggesting that a lot of elderly people live in the area and copresence of senior citizens can be higher at the transport stop.

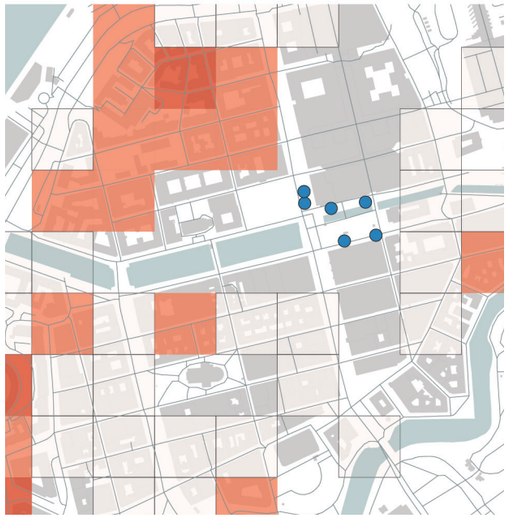
Brunnsparken - There is a good mix of natives and non-natives inhabiting the area resulting in a diverse population, resulting in diversity of copresence. The percentage of seniors when compared to kids is higher. Higher population of kids usually suggests an increased residential nature to the area, but Brunnsparken is more commercial than residential. The demographics of Brunnsparken is mixed, which is highly essential for increased copresence.

Weiselgrensplatsen - There is a higher percentage of non-natives inhabiting the area, suggesting a higher population of immigrants. This could result in reduced diversity of copresence. There are chances for the inhabitants of the area to feel more segregated because of the lack of a mixed population. There is a good percentage of both seniors and kids in the area resulting from its residential character.

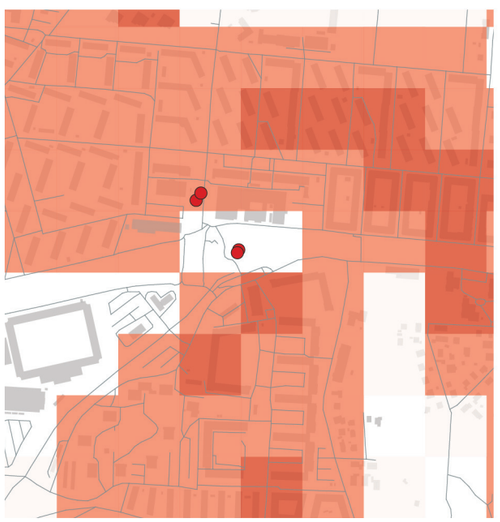
Länsmansgården - The demographic profile of Länsmangården is very similar to that of Weiselgrensplatsen.



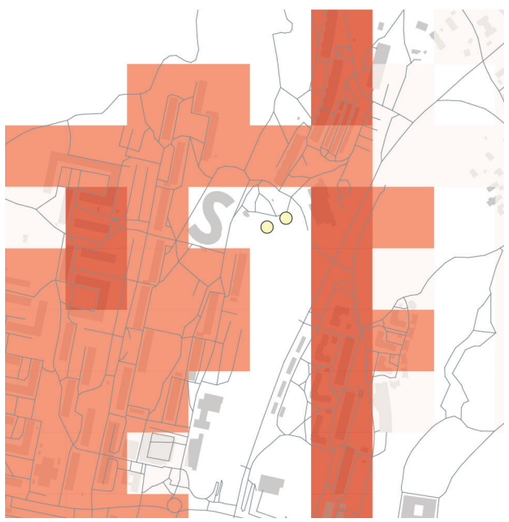
Marklandsgatan



Brunnsparken



Weiselgrensplatsen

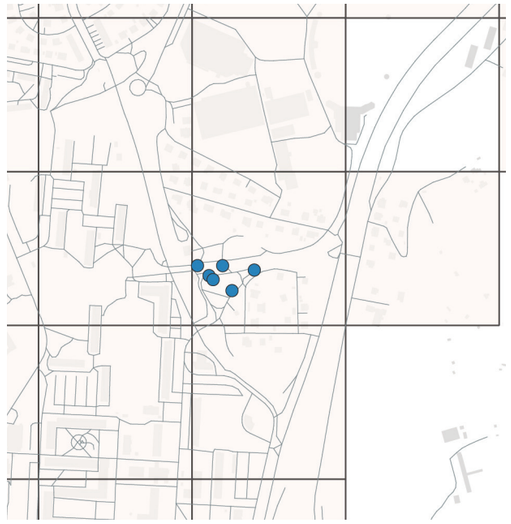


Länsmansgården

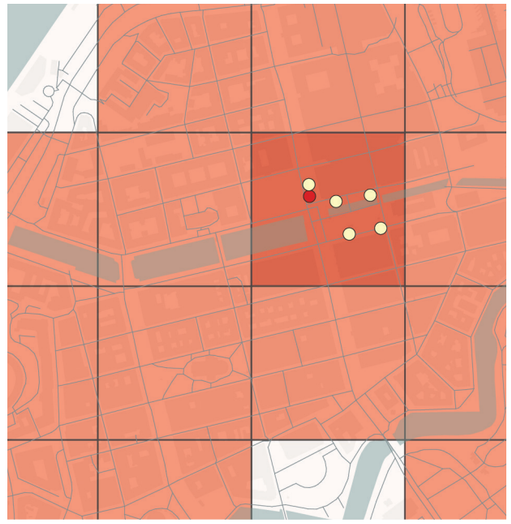
Fig 30: Population density & Attraction reach to population | Walking distance 500m

Attraction reach to working pop
- *279 - 1163*
- *1163 - 23138*
- *23138 - 25512*

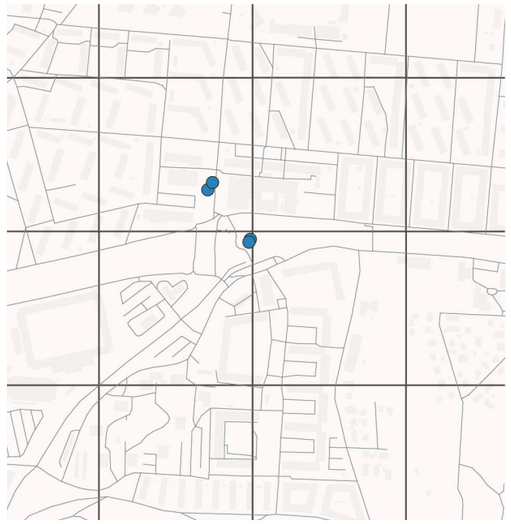
Working pop density (Per ha) (250mx250m grid)
- *0 - 130*
- *130 - 889*
- *889 - 3130*



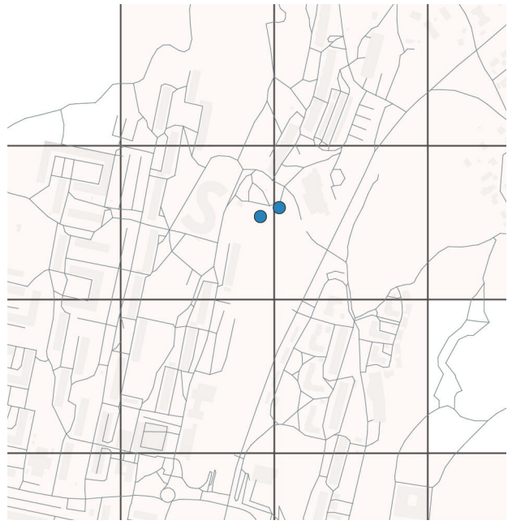
Marklandsgatan



Brunnsparken



Weiselgrensplatsen



Länsmansgården

Fig 31: Working population density & Attraction reach to working population | Walking distance 500m

Enclosure

Enclosure describes how the public transport stops are surrounded by buildings. Enclosure influences what people do as they wait at the transport stops mainly what views they are offered.

Marklandsgatan stop is not immediately enclosed by buildings. The commercial and residential frontages are located at a distance from the stop. There is not much eyes on the street. Visual access to the villas is cut off completely by a blank wall.

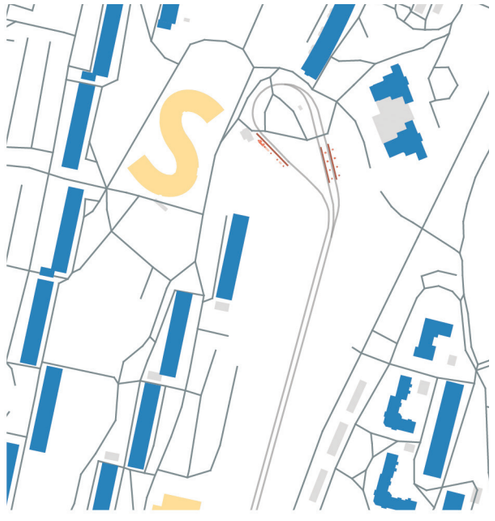
Residential
Industrial
Community buildings
Operational

Brunnsparken stop has active commercial frontages along its edge. This results in multiple edge behaviors. The waiting behaviors are influenced by the attractive ground floors.

Marklandsgatan

Brunnsparken

Weiselgrensplatsen



Länsmansgården

Fig 32: Building typology

Weiselgrensplatsen stop has two different enclosures. One is the mosaic patterned underground walls with the multi-leveled apartment buildings looming overhead. The buildings feel highly imposing. The eyes on the street cannot be strongly felt. The other enclosure comprises of commercial facades on ground. Comparatively, the stop on the ground level feels livelier.

Länsmansgården stop is surrounded by undulating terrain and looming apartment buildings with nothing much to keep one visually occupied.

Full exposure
Visual exchange
Visibility but no exposure
Enclosed

Facade analysis (Visibility & Accessibility)

How active or not the frontages are is found to influence the usage of any space. In this analysis, the parameters set by Gimford

Marklandsgatan

Brunnsparken

Weiselgrensplatsen

Länsmansgården

Fig 33: Transparency - Facade analysis

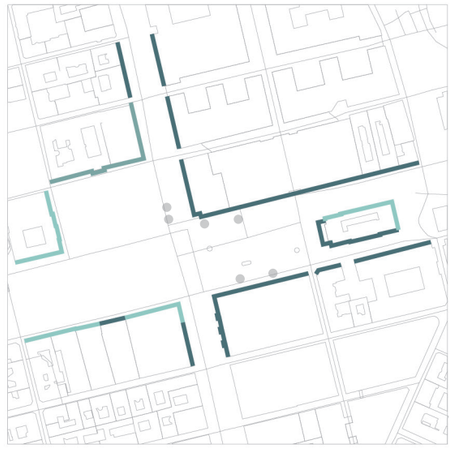
(2023) are used to identify how transparent and permeable the frontages surrounding the chosen public transport stops are. The parameters are:

1. Transparency (Visibility) - *Full exposure* (when there are large openings with a clear vision of the interior), ***Visual exchange*** (openings provide visual interaction and also some privacy), ***Visibility no exposure*** (openings are only to provide day light and visual relief like in the case of residential and healthcare buildings) and ***Enclosed*** (no visual connection like storage or parking) (Gimford, 2023).

2. Permeability (Accessibility) - *Open access* (Anybody can access the space during open hours), ***Addressed access*** (Only certain groups of people can access such as students), ***Restricted access*** (Only few people are allowed to access such as residents to their houses) and ***Impermeable*** (Not accessed regularly such as emergency exists). Of the four chosen stops Brunnsparken has the most active frontages and Länsmånsgarden has the least.

Open access
Addressed access
Restricted access
Impermeable

Marklandsgatan



Brunnsparken

Weiselgrensplatsen

Länsmansgården

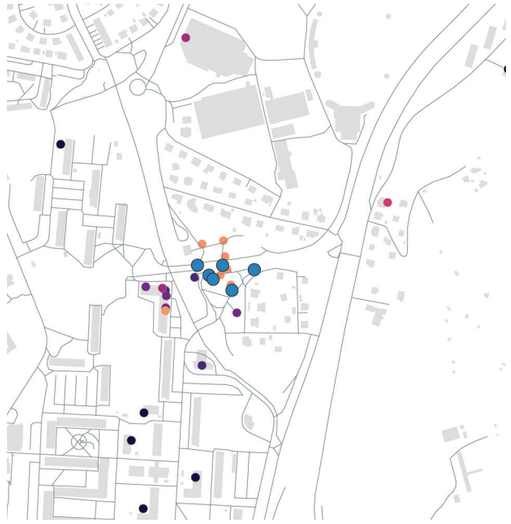
Fig 34: Permeability - Facade analysis

Attraction reach to (POI)
2 - 22
22 - 53
53 - 392

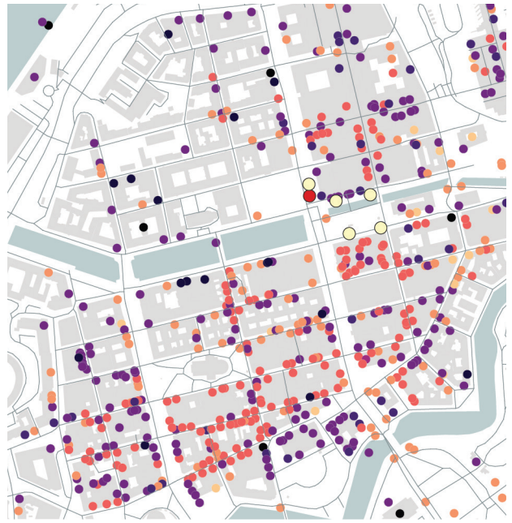
Points of interest
Cultural
Education
Food store
Foods and drinks
Health
Retail
Service
Tourism

Services

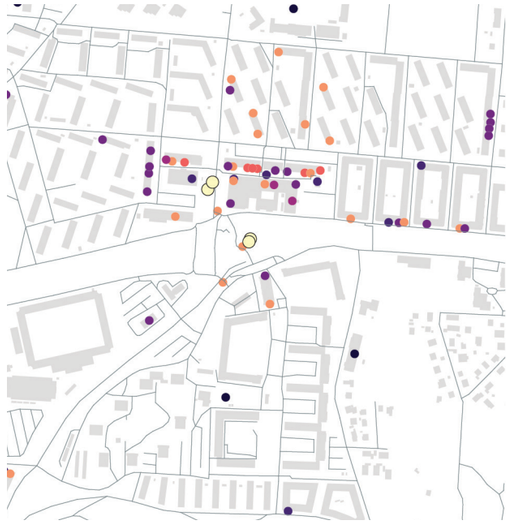
The points of interest around, highly influences both the intensity and diversity of people copresent. When the stop is in the vicinity of many services around, diverse population of people are found to use it in good numbers, like in Brunnsparken contributing to global copresence. Whereas in the case of Marklandsgatan, where only few services are present nearby, only people who are well aware of the context use it. Lansmansgården is the opposite example of Brunnsparken.



Marklandsgatan



Brunnsparken



Weiselgrensplatsen

Länsmansgården

Fig 35: Points of interest | Walking distance 500m

Summary

Aspect	Analysis	Sub-analysis	Category (L,M,H)
Intensity	Public transport accessibility	Reach within 15mins	Medium
	Network analysis	Reached number of lines	High
	Built density		Low
	Population density	Total pop density	Medium
		Residential pop density	Medium
Density	Population density	Working pop density	Low
		Non-native pop density	Medium
		Kids pop density	Medium
		Elderly pop density	Medium
	Services	Points of interest	Low
(Local context)	Land use		Low mix
	Facade analysis		Low constituted

Aspect	Analysis	Sub-analysis	Category (L,M,H)
Intensity	Public transport accessibility	Reach within 15mins	High
	Network analysis	Reached number of lines	Medium
	Built density		High
	Population density	Total pop density	Low
		Residential pop density	Low
Density	Population density	Working pop density	Medium
		Non-native pop density	Low
		Kids pop density	Low
		Elderly pop density	Low
	Services	Points of interest	High
(Local context)	Land use		High mix
	Facade analysis		Highly constituted

Aspect	Analysis	Sub-analysis	Category (L,M,H)
Intensity	Public transport accessibility	Reach within 15mins	Medium
	Network analysis	Reached number of lines	Low
	Built density		Medium
	Population density	Total pop density	High
		Residential pop density	High
Density	Population density	Working pop density	Low
		Non-native pop density	High
		Kids pop density	High
		Elderly pop density	High
	Services	Points of interest	Medium
(Local context)	Land use		Medium mix
	Facade analysis		Low constituted

Aspect	Analysis	Sub-analysis	Category (L,M,H)
Intensity	Public transport accessibility	Reach within 15mins	Medium
	Network analysis	Reached number of lines	Low
	Built density		Low
	Population density	Total pop density	Medium
		Residential pop density	Medium
Density	Population density	Working pop density	Low
		Non-native pop density	High
		Kids pop density	High
		Elderly pop density	Medium
	Services	Points of interest	Low
(Local context)	Land use		Low mix
	Facade analysis		Low constituted

- Marklandsgatan
- Brunnsparken
- Weiselgrensplats
- Länsmansgården

Conclusion

The stops should either be well connected to the neighborhoods around or be a transfer to house a diverse group of commuters. Betweenness analysis gives an understanding of the intensity of people co-present at the public transport stop. Working population plays an important role in understanding the availability of services and if there is any need for added services e.g. Food services in areas with high population density can prove beneficial. Built density or total population gives an estimate of how many people's demands are met by the transport stops. Residential population shows the presence of families with kids around. Points of interest plays a crucial role in understanding the availability of active spaces around, thereby influencing the diversity and the intensity of people co-present at the stop. As Bill Hillier points out, social interactions are not just accidental—they emerge from spatial design (Hillier and Hanson, 1984).

2.3. Observational mapping

Observations

Qualitative and quantitative observational mapping is the main method to obtain social data. Observations were made for a span of two and half weeks, because of the time constraint, with two days of on-site observational study allocated for each stop. The observations were made during the peak mornings (6-9am) and peak evenings (15-18pm) on weekdays from Monday to Thursday. Three spots were decided at each stop to carry out the mapping. These spots gave a full vantage point of all that was happening around. Spots which were not heavily preferred by others were chosen just to avoid invading into the space of others. The observations were made for a duration of 10 minutes at each of the three spots.

Multiple aspects were recorded, excluding aspects and patterns which might be difficult to record when dealing with multiple observation subjects. Age (kid, adult or elderly), activities during waiting (talking on the phone, reading a book, sitting, standing, eating, smoking), group behaviors, non-locals (carrying a suitcase) were aspects recorded during the observations. An accurate record of all the amenities (travel-time display board, shelter, dustbin, seating) was made to help understand where and why people positioned themselves in a certain way at the public transport stop. Efforts were taken to record precise locations of where people sat, stood etc. Mapping on days when the weather was extremely harsh or when trams were impeded was not carried out to avoid discrepancies.

Once all the on-site recordings were done, the obtained data was then imported into QGIS as a point shape file. Each person was translated into a point on the software. Each point was associated with different attributes such as category (Kid (0-10yrs), Youngsters or adults, Seniors (>60)), action (sitting, standing), group behavior (Yes or no) and if they were playing, eating or smoking. These observations were helpful in understanding the affordances of the public transport stops and supported human behavioral patterns.

To understand how and why people behave in a certain way in public spaces and how the spatial conditions support or hinder different behaviors was important. To carry out the observational mapping exercise, counting, photographing and test walks were methods undertaken. The observational mapping on Marklandsgatan was the pilot. The methods and observational mapping measures used here were applied to the other three stops. Few observations and behavioral patterns were common across all the chosen stops.

General observations and behavioral patterns

There was high frequency of transport connections and a shifting population (avg of 5min waiting time) both during the peak mornings and evenings. Spatial conditions and layouts were similar across the public transport stops. As they waited, people were either scrolling through their phone or listening to music. It was only on very cold days that many people were not on their phones as they preferred their hands inside their pockets. People on call preferred a free zone to stand and talk. More people waited inside the cubicle with the time display. Some people preferred a less crowded cubicle to wait. Even when inside the same cubicle, people oriented themselves to the extreme corners. When a bus arrived, there was a threshold created near the boarding door where strangers were forced into proximity. People who were smoking

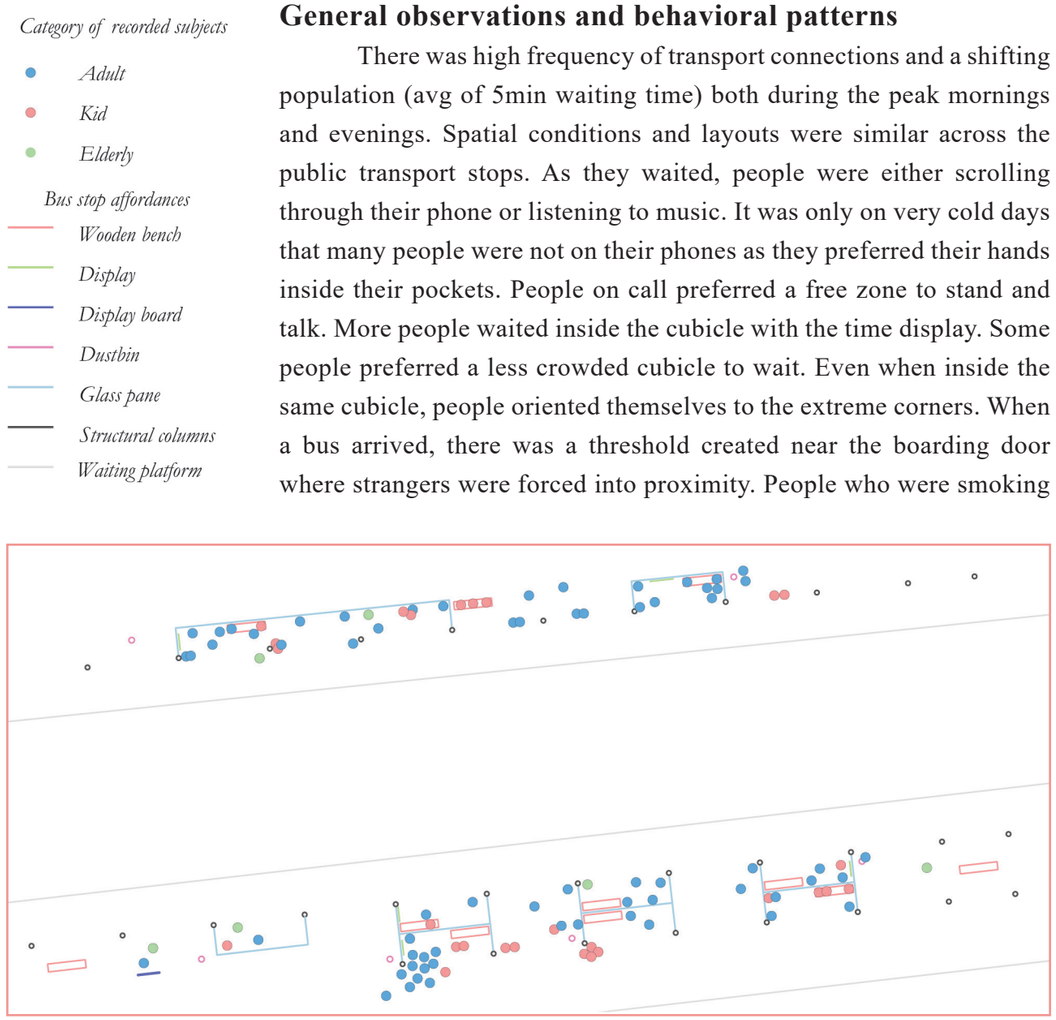


Fig 36: Marklandsgatan | Day 1 | Morning | Category of people waiting

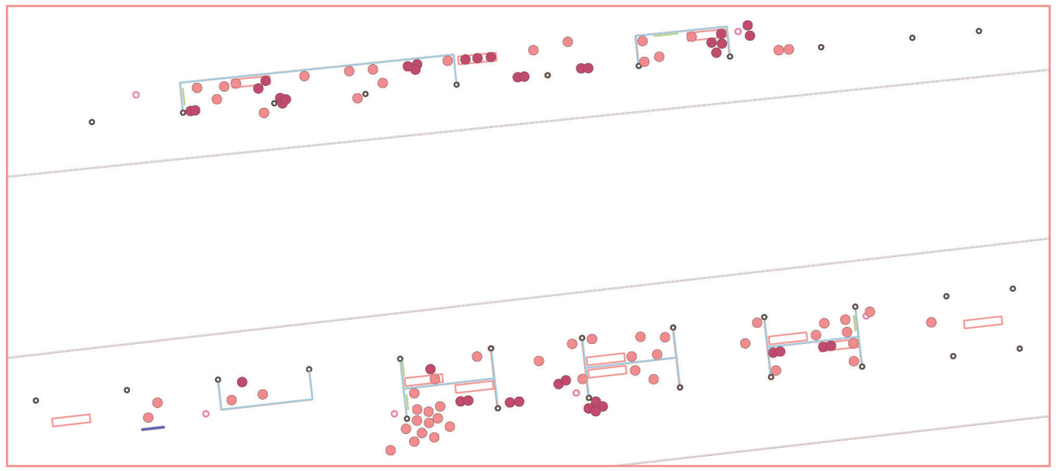


Fig 37: Marklandsgatan | Day 1 | Morning | Group behaviour

Recorded group behaviours

- *Group behaviour*
- *Non-group behaviour*

preferred to stay closer to a dustbin. People who carried heavy bags preferred to place them on a bench, though they did not sit. People who were eating moved away from the rest of the crowd. In the peak mornings, majority of the travelers had a lunch bag/ laptop bag/ school bag suggesting they were headed to school or work. Unexpected events such as tram breakdown or a bus delay made people restless, resulting in people bonding over this common emotion. People usually preferred not to sit on the same bench as others. It was the elderly people and kids who were more in the exposed positions. Sharing the seat with them was much easier than sitting beside an adult. People, especially seniors preferred to wait right next to the boarding area. One or two people looked familiar to the author on the second day of mapping suggesting increased chances of meeting familiar strangers.

At *Marklandsgatan* , platforms with buses to the city, workplaces and schools were crowded in the peak mornings. Most people walked along the crowded path after getting off, while some people moved away from the crowd. A few people walked to Presbyran to grab a coffee or breakfast. Lot of group behaviors could be spotted. Lot of teenagers and kids in groups were pushing each other, playing and talking during the peak evenings. Very few people walked to the stop from the neighborhood. The stop functioned mostly as a transfer. The structural columns and glass panes of the cubicle afforded leaning onto. The observational mapping on the other three stops were carried almost two weeks after completing the Marklandsgatan mapping because of the impeded tram and bus connections in the Hisingen area due to repair works.

Brunnsparken was not as crowded as Marklandsgatan during the peak mornings, as it was only after 9 or 10 in the mornings that both workplaces and commercial spaces started to function (dominant land use in the area). Few people ran across tram lines for their connection, as the pedestrian crossings were placed faraway to where people got down. Waiting to cross tram lines created interesting thresholds and nodes. People used the parapet of the bridge to place coffee cups and food packages. A handful of people located themselves away from the stop in the square, though they did not sit. The stop didn't feel fully occupied or cramped, as in the case of Marklandsgatan, as the waiting cubicles were more spread out. Because of the active commercial frontages along both edges, people paused to view the displays for a moment or two. Few people waited along the building edge.

At *Weiselgrensplatsen*, platform A with trams to the city was crowded – commuters on their way to office or school. Lot of people arrived on foot through the dark and dingy underpass. The staircase was rarely used. Seating options provided along the platforms below ground level were underused. The platforms at ground level felt more integrated with their surroundings, with a comparatively livelier environment. But as you waited all that you were forced to see were cars passing by because of the increased car traffic in the area. Local copresence can be observed. Chance encounters could be spotted amongst people who happened to recognize each other. Larger waiting times because of the reduced frequency of connections.

At *Länsmansgården*, platform A with trams to the city was crowded during peak mornings – commuters on their way to office or

Action

- *Standing*
- *Sitting*

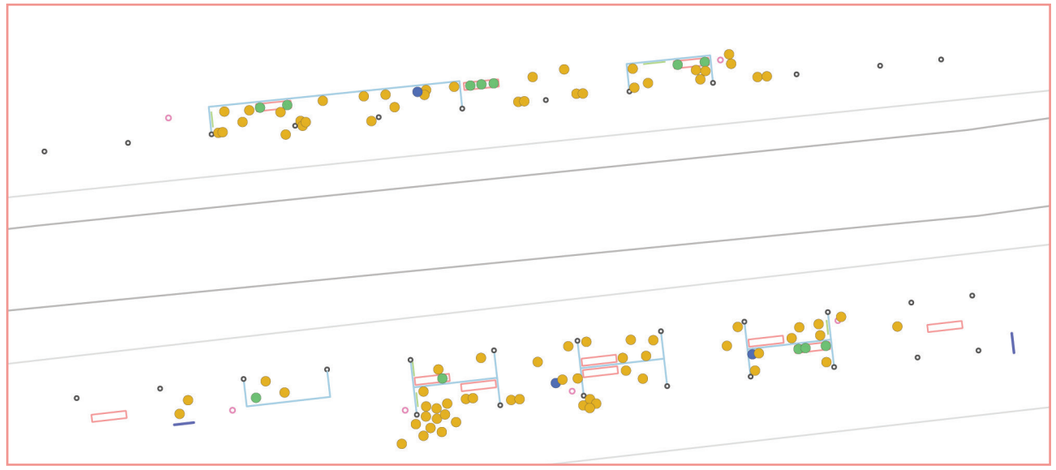


Fig 38: Marklandsgatan (136)| Day 1 | Morning | Action

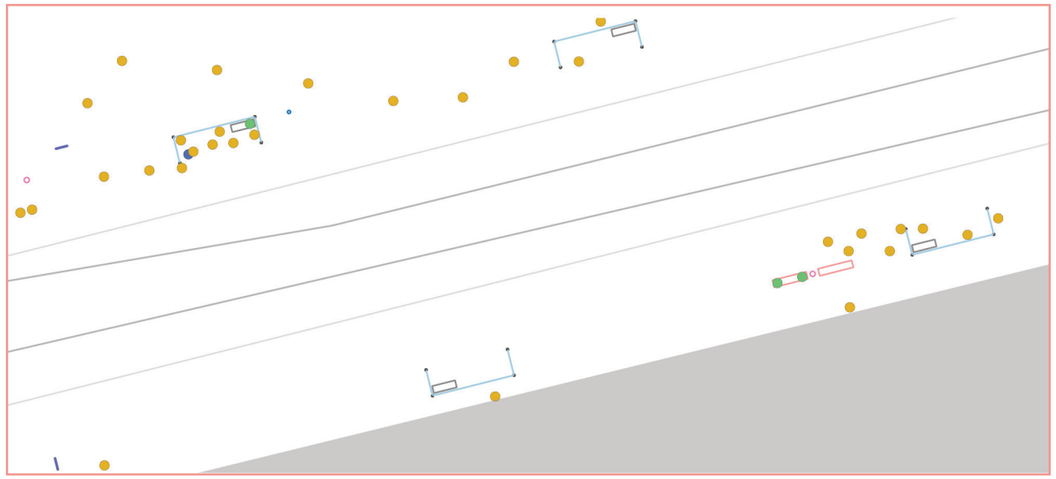


Fig 39: Brunnsparken (124)| Day 1 | Morning | Action

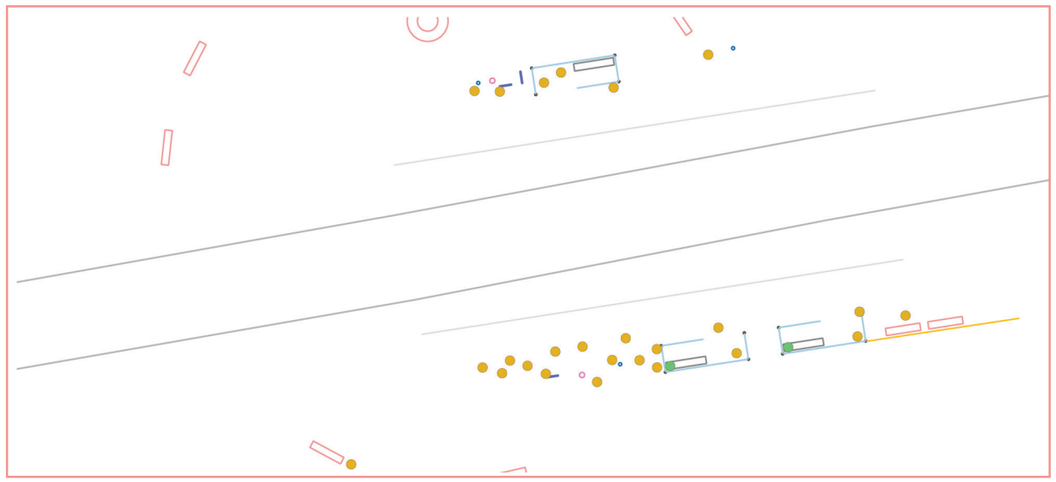


Fig 40: Weiselgrensplatsen (60) | Day 1 | Morning | Action

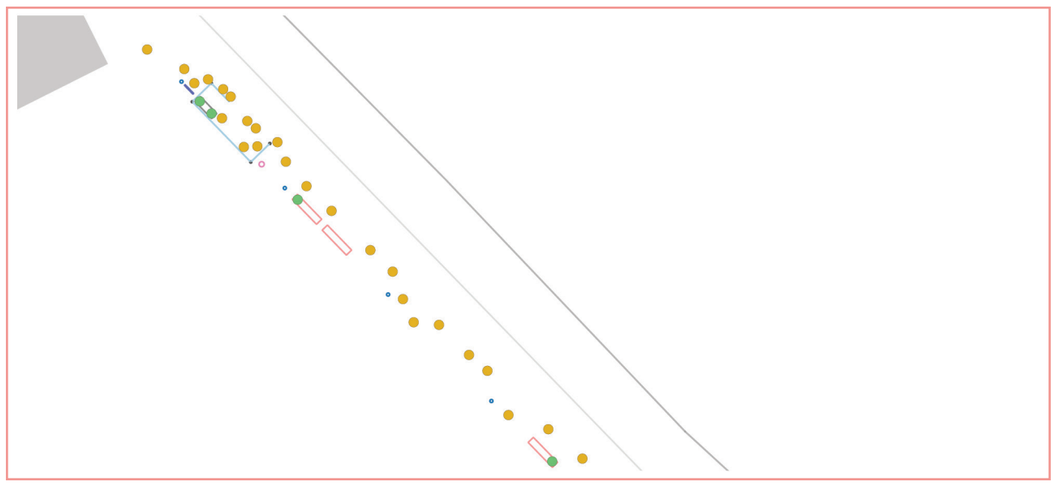


Fig 41: Länsmansgården (30) | Day 1 | Morning | Action

Category of recorded subjects

- *Adult*
- *Kid*
- *Elderly*

Recorded group behaviours

- *Group behaviour*
- *Non-group behaviour*

school. The other two platforms were deserted. Commuters arrived on foot. As this is the first and last stop of tram lines 6 and 5, trams were usually halted on the boarding platform for 1min before departure before which it was parked along platform B. Closer to the departure time the platform got crowded. Local copresence can be observed. Chance encounters could be spotted amongst people who happened to recognize each other. Larger waiting times because of the reduced frequency of connections.

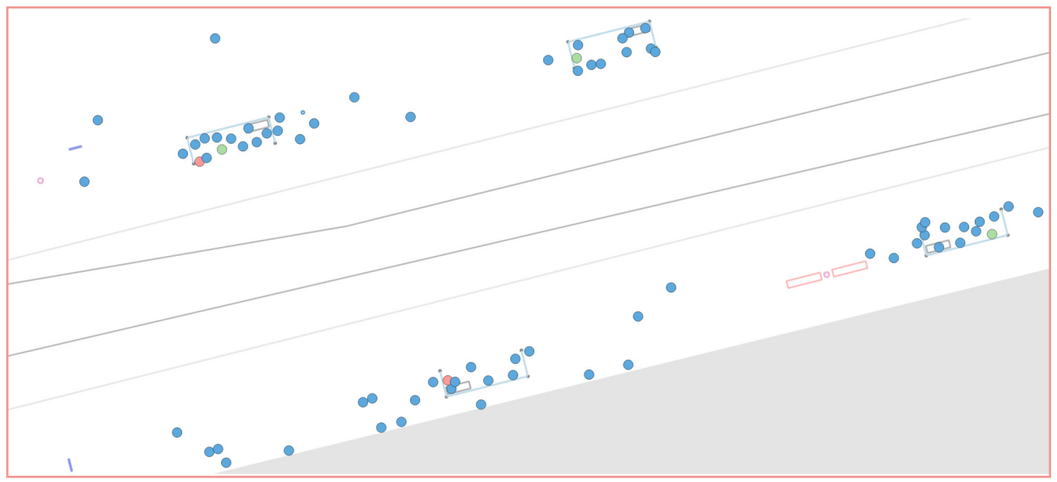


Fig 42: Brunnsparken (211) | Day 1 | Evening | Age

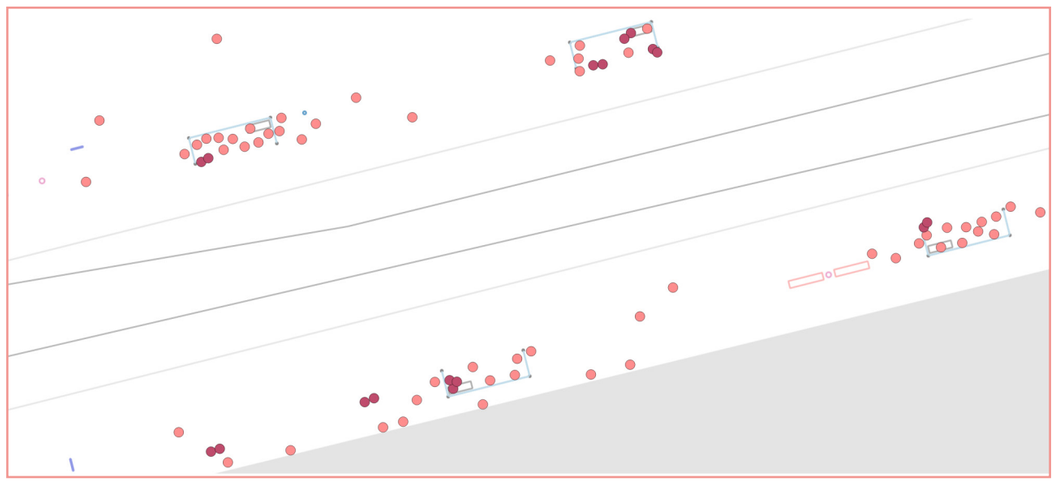


Fig 43: Brunnsparken (211) | Day 1 | Evening | Group Behaviour

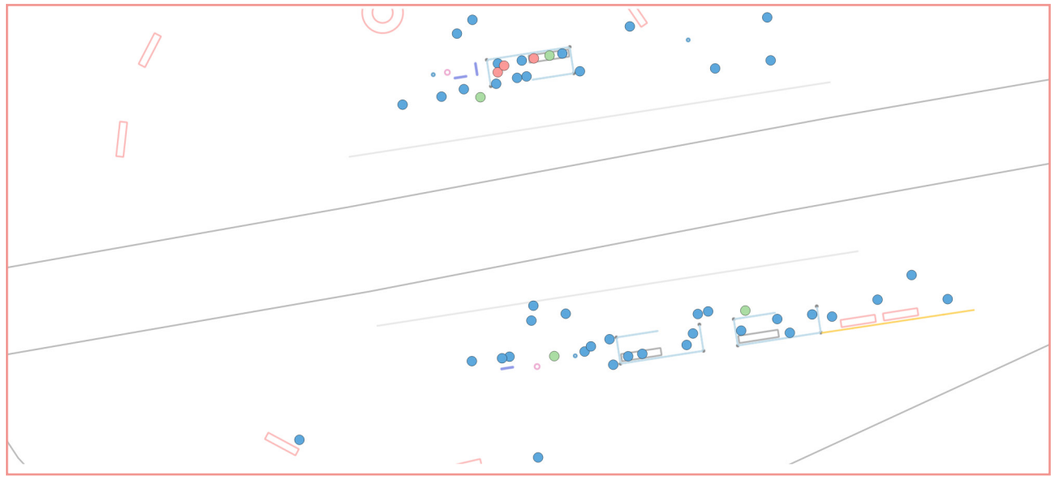


Fig 44: Weiselgrensplatsen (83) | Day 1 | Evening | Age

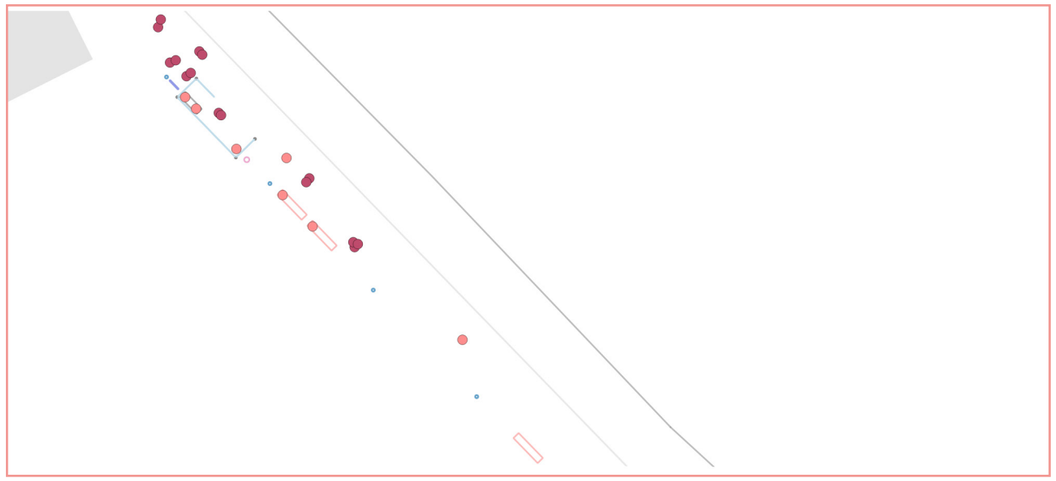


Fig 45: Länsmansgården (35) | Day 1 | Evening | Group behavior

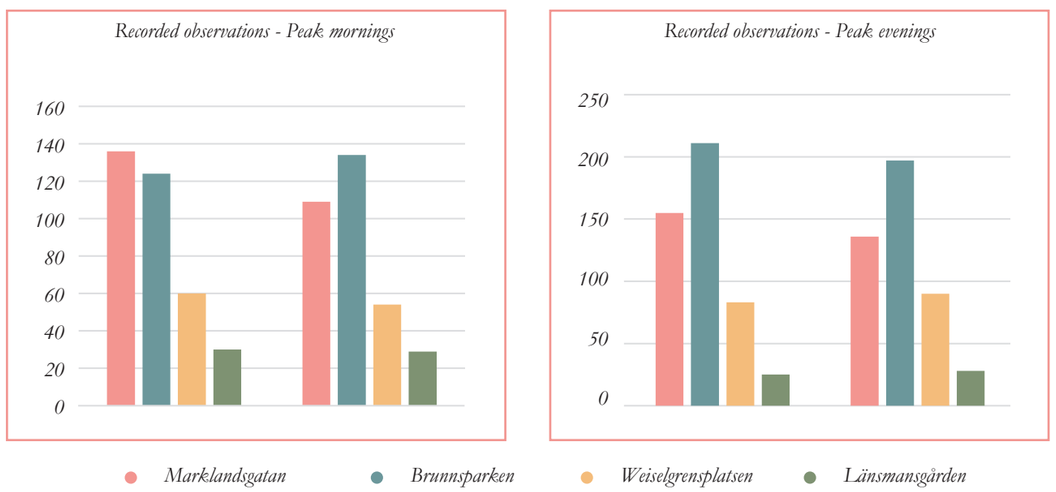


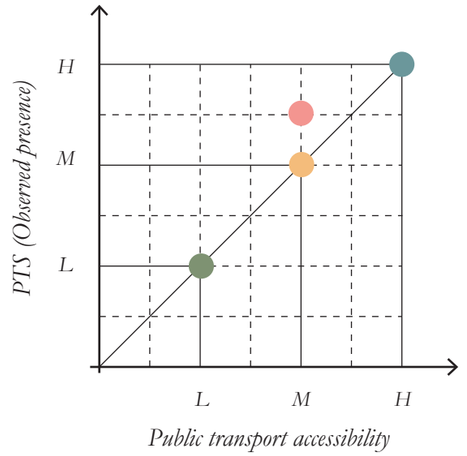
Fig 46: Graph showing the recorded observations during peak mornings (7:00 - 8:00 am) and peak evenings (4:00 - 5:00 pm)

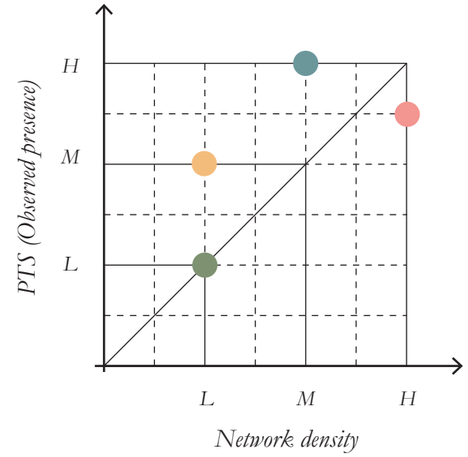
2.4. Comparative analysis

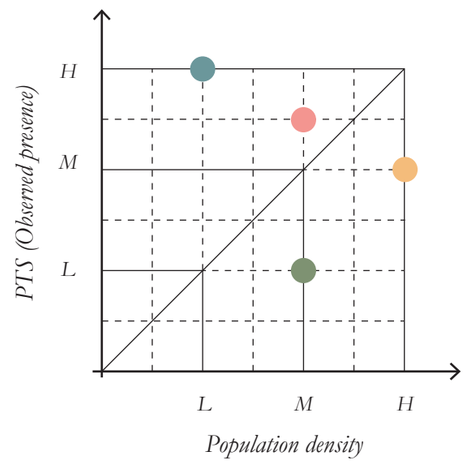
Marklandsgatan
Brunnsparken
Weiselgrensplats
Länsmansgården

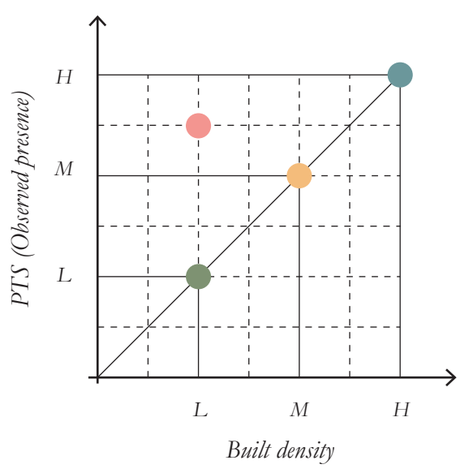
L - Low
M - Medium
H - High

The results of the spatial analysis were compared with the recorded observations to identify the predominant copresence profiles in the chosen public transport stops. The comparisons were visualized through multiple graphs. The observed presence of people in the public transport stops were plotted along the Y axis and the spatial analysis parameters such as public transport accessibility, network density, population density, etc., were plotted along the X axis. Three categories - High, medium and low were used for easier understanding.

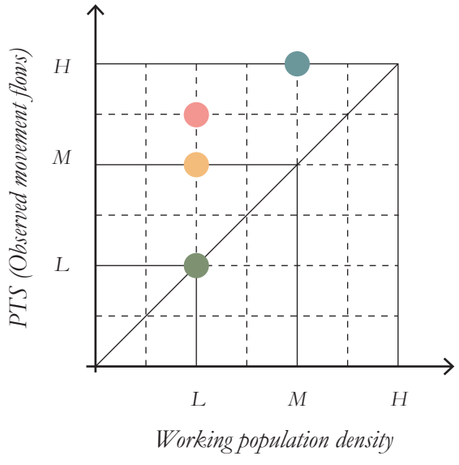


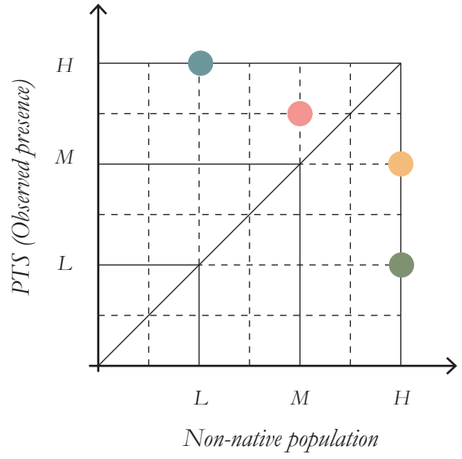


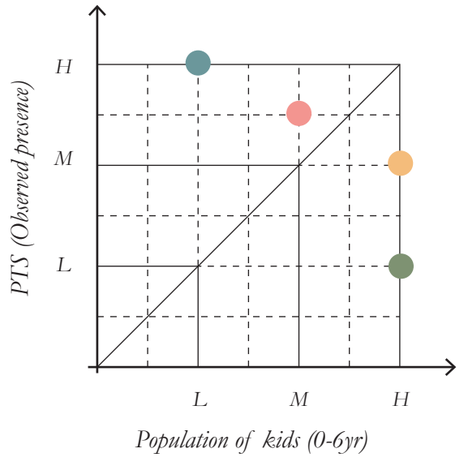


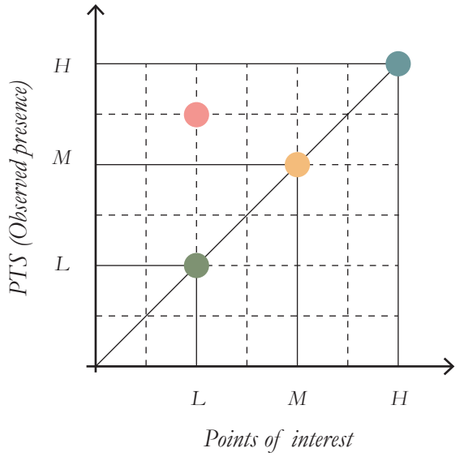


2.5. Identifying the existing copresence profiles









The comparison graphs evidently show that the observed presence of people is highly influenced by the spatial layers of the city and the local context. The existing copresence profiles are identified based on the spatial analysis results and observational mapping.

The intensity profile is obtained from network density, public transport accessibility, total population density and built density. The density profile is obtained from working population density, points of interest, non-local population and population density of kids and elderly.

The copresence profiles of the different stops as identified are:

• Marklandsgatan - *Medium intensity & low diversity of copresence (Global copresence).* The observed presence is highly unlike what is suggested by the spatial analysis and local context study because of the stop functioning as a transfer connection in the network

• Brunnsparken - *High intensity & diversity of copresence. (Global copresence).* Stands as a major transit hub because of its ideal location in the network.

• Weiselgrensplatsen - *Medium intensity & Medium diversity of copresence. (Local copresence)* This stop is an intermediate between Brunnsparken and Marklandsgatan.

• Länsmansgården - *Low intensity & diversity of copresence. (Local copresence).* This stop dominated by a local character.

Profile based on Intensity & Diversity

Aspect	*Marks*	*Brunns*	*Weis*	*Läns*
Intensity	*Medium*	*High*	*Medium*	*Low*
Diversity	*Low*	*High*	*Medium*	*Low*

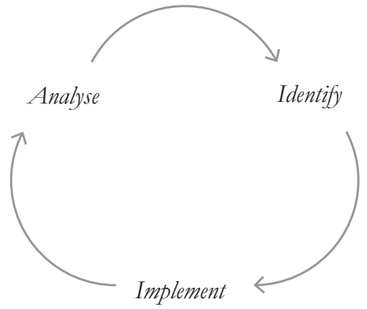
Fig 47: Brunnsparken. Source: Author

Chapter 3 / Design manual (Beta)

This chapter will discuss about the Beta version of the design manual highlighting the many design strategies.

Riders value out - of - vehicle travel time at 2-3 times the value of in – vehicle travel time (Daly & Zachary, 1975). Therefore, there is a need to design public transport stops for increased commuter satisfaction for shorter perceived waiting times. The potential of public transport stops being active public spaces should be unleashed.

The knowledge and understanding gained so far in this thesis process has been translated into a design manual consisting of suitable design strategies based on the identified copresence profiles. This design manual aims at equipping architects with a ready to use toolkit to be able to design more sociable public transport environments. This manual can be used in the initial phases of designing a transport stop or in redesigning an existing public transport stop.



There are three steps in how to use the manual:

1. The analyze stage is all about understanding the current situation of the context. This stage predominantly includes spatial analysis. Observational mapping could be carried out if time and resources are available but is not considered mandatory to be able to use the manual. The most relevant analysis is carried out and the analysis results are documented.

2. In the identify stage, the copresence profiles based on the analysis results are identified.

3. In the implementation stage, the design strategies proposed in the later part of this chapter are implemented at the public transport stop based on its copresence profile. After implementing the relevant design strategies, the analysis stage should be repeated to understand if and how the proposed strategies have fostered copresence in the public transport stop. It is identified to be an iterative process.

The manual sets the foundation for what could be done. The proposed strategies could be implemented in numerous ways. There is no one perfect design. The idea is to help architects and planners easily decide early on what needs to be implemented in the transport stop to achieve the desired results. The design manual is a beta version and needs to be tested and validated further by others.

1. Analysis

The following table contains a list of spatial analysis (Level 1) to be carried out during the analysis stage. The level 1 of analysis is followed by attraction reach analysis with the public transport stop as the origin to all other spatial layers. Observational mapping here is again proposed as an additional step to be carried out only if possible. Observational mapping comes with some added benefits such as to understand the behavioral patterns of people as they wait, clustering behaviors etc. It helps in further validating the spatial analysis results. But this manual can also be used with only spatial analysis results. These step will give an understanding of the expected copresence based on the spatial analysis.

Aspect	*Analysis*	*Walking radius*
* *Intensity*	*Public transport accessibility*	*500m*
	Network analysis	*500m, 1km, 2km*
	Built density	*500m*
	Total population density	*500m*
* *Density*	*Working population density*	*500m*
	Services	*500m*
	Non-native population	*500m*
	Kids population	*500m*
	Elderly population	*500m*
(Local context)	*Land use*	
	Facade analysis	
Observed use	*Type of usage*	

* *Mandatory to carried out*

2. Identify

In this stage spatial analysis results are used to identify the existing copresence profiles. As mentioned earlier, the intensity profile is obtained from network density, public transport accessibility, total population density and built density. The density profile is obtained from working population density, non-local population, services around and population density of kids and elderly. Few of the profiles identified based on the studied transport stops in this thesis are:

• Profile based on intensity & diversity

- Medium intensity – Low diversity: The stops with this profile have moderate flow of people. Diversity of people is less pronounced because of a lack of commercial and recreational facilities.

- High intensity – High diversity: The stops with this profile are located closer to the city center serving the needs and demands of lot of people.

- Medium intensity – Medium diversity: The stops with this profile adopt an intermediate nature with the right balance between both residential and commercial establishments.

- Low intensity – Low diversity: The stops with this profile are dominated by residential character.

There may exist a few additional copresence profiles but owing to the time constraint of this thesis only the above mentioned profiles are addressed as part of the Beta version of the design manual. If this study is further explored by others to come, then working with other copresence profiles and associated design strategies could be an interesting start.

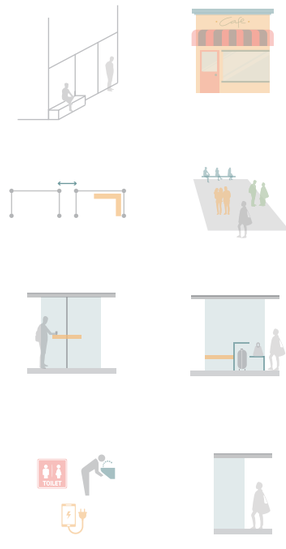
3. Implement

In the implementation stage relevant strategies are chosen to be implemented on the public transport stop. For example, if the identified profile is High Intensity and High diversity, it implies that a lot of people use the stop. So relevant measures can be taken to encourage people to linger around. If the identified profile is Low Intensity and Low diversity, it signifies local copresence. So measures need to be taken to strengthen the community character of the place.

A collection of design strategies based on theoretical evidence and analysis results have been proposed in the following section. The proposed strategies include both global and local scale interventions. Global interventions include measures to bridge the stop with the adjacent neighborhoods, whereas local interventions mainly focus on activating the stop and its immediate surroundings. For example, when a public transport stop is a transfer and brings many people, to prioritize activation around in order to serve more people from the local

- *Global*
- *Local*

Strategies

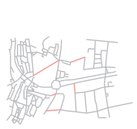
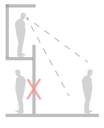
Profile	Strategy
High intensity – High diversity 	**Create good conditions to make people stay:** • Encouraging edge behavior by placing additional furniture along the building edge to make people want to stay for longer. (Taking advantage of the active frontages) • Providing opportunities for temporary installations such as cafes, play spaces and pop-up markets. • If the stop is located right next to a square, measures should be taken to better integrate the stop with the square. • Placing the different shelters at shorter distances to prevent people from spreading out. • Providing places to rest shopping bags. • Providing high benches to place food and drinks. • Provide additional facilities such as charging stations, drinking fountain and toilets. • Expanding the width of side projections for additional shade at busy stops can help prevent overcrowding within the shelter. **Increase visual exposure** • Providing more seating options within the primary shelter to bring the waiting crowd together.

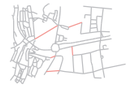
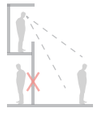
neighborhood or to integrate it more to the local network to increase accessibility and walkability can prove beneficial. The aim here is to balance the 'node' to 'place' potential of the public transport stops.

After analyzing the spatial layers and identifying the copresence profiles, architects and planners can choose the relevant strategies to be implemented from those provided here for their design.

- *Global*
- *Local*

The manual is based on the intensity - diversity profile. The strategies proposed mainly focus on increasing the intensity of

Profile	Strategy
Medium intensity – Low diversity     	**Increasing the intensity of use** • The network could be more integrated into the system to increase diversity. (Increase walking to and from the stop) • Creating a more mixed use environment with access to more services in the local context. **Create good conditions to make people stay:** • Play facilities could be introduced at stops with high pedestrian flow and significant reach to children. Any open unutilised space next to the stop can be redesigned and incorporated with the stop to extend the place to stay. • Motion activated LED lights can be installed in poorly lit areas. • Provide more seating options to make people stay. **Increase visual exposure:** • Measures need to taken to increase eyes on the street by increasing visibility to and from the stop. Impermeable walls separating the bus stop and the surrounding areas should be avoided, making the stop feel more integrated. Instead, some privacy could be provided by incorporating trees and shrubs along the edge. • Measures need to be taken to create a sense of identity (Could be through physical atttributes such as pavement material, color and lighting)

Profile	Strategy
Medium intensity – Medium diversity      	**Increase intensity of pedestrians:** • Pedestrianising the area and reducing car traffic could prove beneficial. **Create good conditions to make people stay:** • Encouraging edge behavior by placing additional furniture along the building edge to make people want to stay for longer. (Taking advantage of the active frontages) • Providing places to rest bags. • Providing high benches to place food packets. **Increase visual exposure** • The frontages along the bus stop need to be active with no dead walls.
Low intensity – Low diversity       	**Increase intensity of pedestrians:** • The network could be more integrated into the system to increase diversity. (Increase walking to and from the stop) **Create good conditions to make people stay:** • Community facilities can be combined along with the transport stop. (Joint use) • Play facilities could be introduced at stops with high pedestrian flow and significant reach to children. • Measures could to be taken to increase eyes on the streets. (Topography should not obstruct visibility) • A community information board could be installed. • Even when shelter is not required, some shade and minimal seating should be provided, to make the stop more usable. **Increase visual exposure:** • Provide a smaller waiting platform to prevent people from spreading out.

Type of use	Strategy (Regardless of the profile)
Sitting	• Need for diverse seating options with the freedom to choose from. • More seating within the primary shelter at stops with increased traffic. • Add enclosed seating areas to provide weather protection at busy stops. • Redesign seating areas to align with natural clustering behaviour of people (Observational mapping).
Standing	• Providing places to rest bags. • Providing high benches to place food packets. • Provide lateral supports to lean onto.
Listening to music/ on phone	• Local news display or mild music in the background or public art. (Infrastructure to capture attention) • Virtual community platforms could be introduced.
Eating	• Providing high benches to place food packets.
Smoking	• Providing a segregated smoking area.

Strategy despite the intensity profile
Create good conditions to make people stay: • The placement and design of the shelter should take into consideration climatic aspects – such as wind protection and thermal comfort. **Increase visual exposure:** • Shelters should face each other rather than being oriented back-to-back, fostering a greater sense of interaction. • Placement of advertisement panels on the shorter edge of the shelter can obstruct visibility, reducing copresence—this should be reconsidered. • Additionally, spacing shelters closer together enhances copresence. • Avoid back-to-back seating.

pedestrians using the public transport stops, providing good conditions for people to stay and increasing visual exposure to other people and the context.

When dealing with *high intensity and diversity profile*, global scale interventions are not necessary as the global copresence is already good. Only the most relevant local interventions to increase the opportunities to make people stay and take part have been proposed.

The *medium intensity and diversity profile* demanded some network interventions to strengthen walkability to the stop alongside other local interventions. For *medium intensity and low diversity, low intensity and diversity profiles*, both global and local scale strategies have been proposed. These two profiles demanded an increased sense of identity and belonging to increase copresence. Therefore, proposed strategies aim at strengthening the community character of the context.

A few strategies on observed use have been proposed. These strategies are mainly based on the recorded observations of human behavior during waiting times at transport stops. Depending on what the architects and planners aim at achieving, relevant strategies could be chosen.

Conclusion

The proposed strategies mainly highlight how the spatial layout of the public transport stop could be, how the shelter could be and how they should possibly interact with the local context in order to create the desired copresence. The strategies do not take into consideration aesthetical aspects of design such materiality, lighting, color etc.

The main intention was to break the notion of creating standard monotonous public transport enclosure. It is very important to adapt the public transport stops to the local context and other spatial layers of the city for them to be successful in bringing about many social activities.

Fig 48: Brunnsparken. Source: Author

Chapter 4 / Design implementation

This chapter will showcase how to use the design manual through a design case study

This chapter showcases an example of how to use the design manual. Owing to the time constraint of the thesis, a public transport stop which was analyzed earlier has been chosen for the design implementation stage - *Marklandsgatan*.

As mentioned earlier ***Marklandsgatan***, located in Högsbo (southern Gothenburg), has multiple transport lines (17) to both the city center and the suburban areas. It is also highly impacted by Frolunda Torg, another center (recentrum) nearby. Marklandsgatan has a few points of interest around. Lots of people use this stop as a transfer on their way to work or school. Therefore the indented usage of the stop is higher compared to what the spatial analysis results suggest.

Fig 49: Marklandsgatan context map. Source: Author

4.1. Analysis

Analysis mentioned as part of the table in the design manual were carried out and results were tabulated. (Refer Chapter 2)

Aspect	*Analysis*	*Sub-analysis*	*Category (L,M,H)*
Intensity	*Public transport accessibility*	*Reach within 15mins*	*Medium*
	Network analysis	*Reached number of lines*	*High*
	Built density		*Low*
	Population density	*Total pop density*	*Medium*
		Residential pop density	*Medium*
Density	*Population density*	*Working pop density*	*Low*
		Non-native pop density	*Medium*
		Kids pop density	*Medium*
		Elderly pop density	*Medium*
	Services	*Points of interest*	*Low*
(Local context)	*Land use*		*Low mix*
	Facade analysis		*Low constituted*

2. Identify

Based on the spatial analysis results, copresence profile of Marklandsgatan stop was identified. In this case, the obtained results were further validated by recorded observations.

Profile of Marklandsgatan:

- **Based on Intensity:** Medium intensity and low diversity

3. Implementation

The relevant design strategies proposed under the Medium intensity and Low diversity profile were identified from the design manual to be implemented. The following design section is just a showcase of one way of realizing the proposed design strategies. As observational mapping was carried out at Marklandsgatan stop, few strategies based on the observed usage patterns have also been implemented.

Strategies

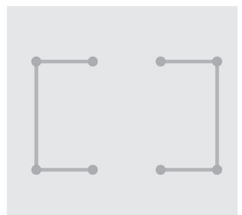
Impermeable wall to be removed

Extended seating along eatery

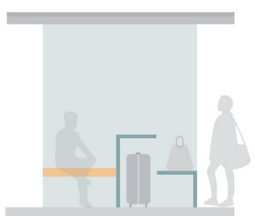
Kids play area

Community/ cultural facility

High benches for standing behavior



Facing shelter



Storage for bags to support standing crowd

Flexible seating

- *Create good conditions to make people stay*
- *Increase visual exposure*

Waiting shelter
Cultural facility/ Community facility
Outdoor seating along eateries
Make shift space - Kids play/ Pop-up market
Connections
Soft edge

Though the spatial analysis suggests that the copresence profile of Marklandsgatan is Medium intensity and low diversity, the observed intensity is high (Results from observational mapping). As Marklandsgatan stop is identified to be a transfer connection, there is already a good intensity of people. Hence, strategies to increase the intensity of people have not been adopted in this design showcase.

In this design showcase, strategies to create good conditions for people to stay (creating a variety of seating options to choose from not

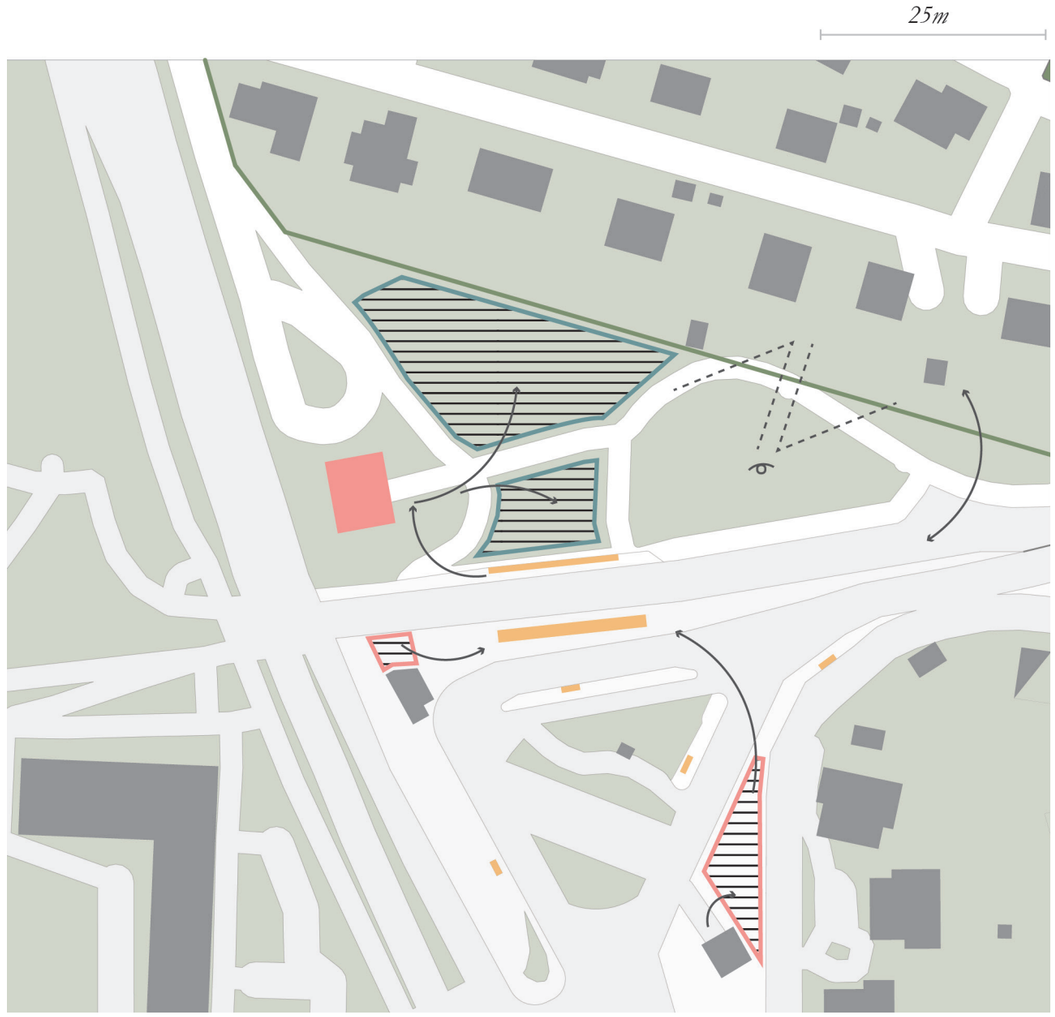


Fig 50: Site map showcasing the applied strategies on a zoomed out scale at Marklandsgatan stop. Source: Author

just within the shelter but also in the surroundings, providing additional activities to make people stay such as kids play area or a cultural facility) and increase visual exposure (increase eyes on the street, make people sit facing each other) were applied.

The proposed spatial layout was carefully thought of based on the evidence obtained from observational mapping (Clustering behavior). This is when observational mapping can prove extremely beneficial but is not always necessary to be carried out. The applied strategies increase the potential of the stop to be more integrated with the context creating opportunities for people to stay and interact. It is clearly evident that with just a few smaller interventions, a sense of identity and belonging can be imbibed into the public transport stop. This is why it is extremely important to analyze and strategically plan the public transport environments.

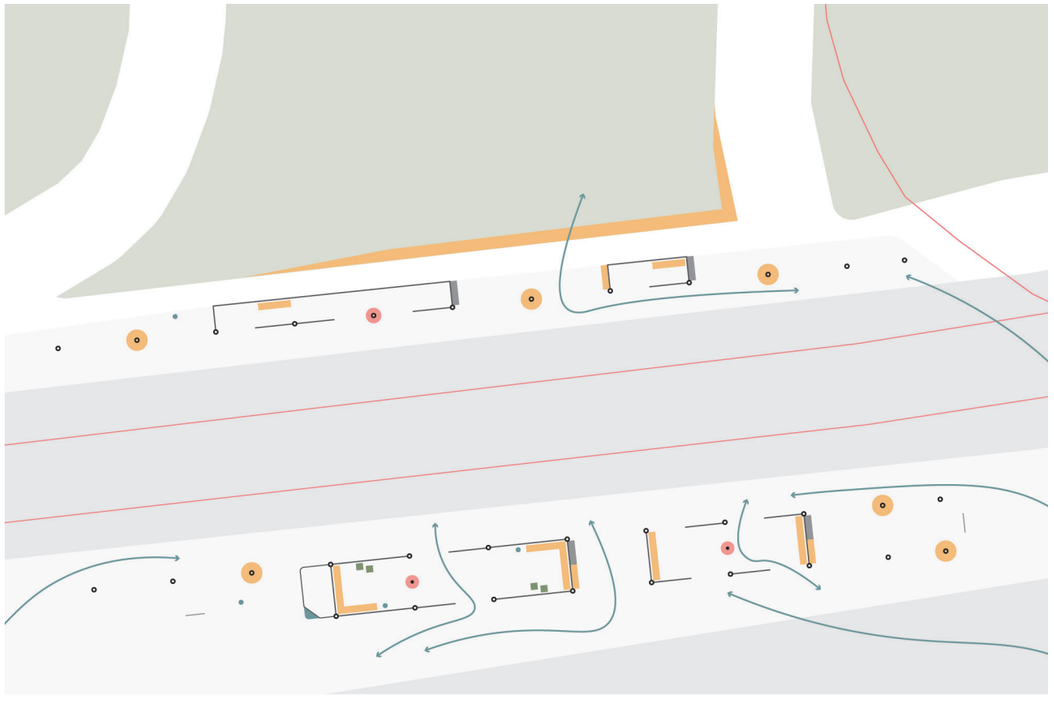


Fig 51: Proposed spatial layout of platforms A,B and C at Marklandsgatan stop. Source: Author

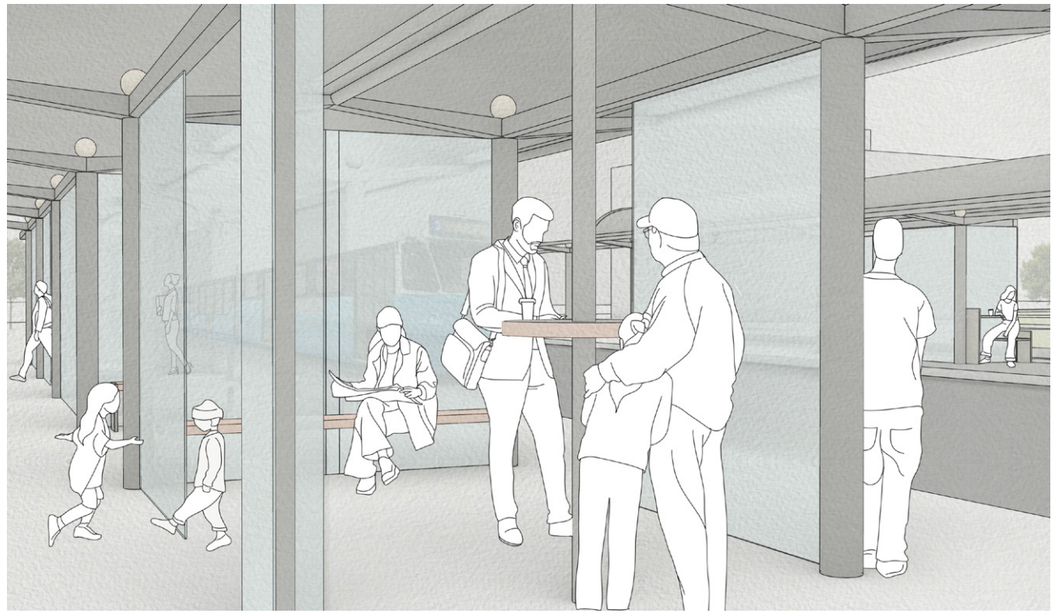


Fig 52: View showing how the high bench adds more dynamics to the waiting area. Source: Author

Fig 53: View showing how the stop interacts with the play area and landscape around. Source: Author

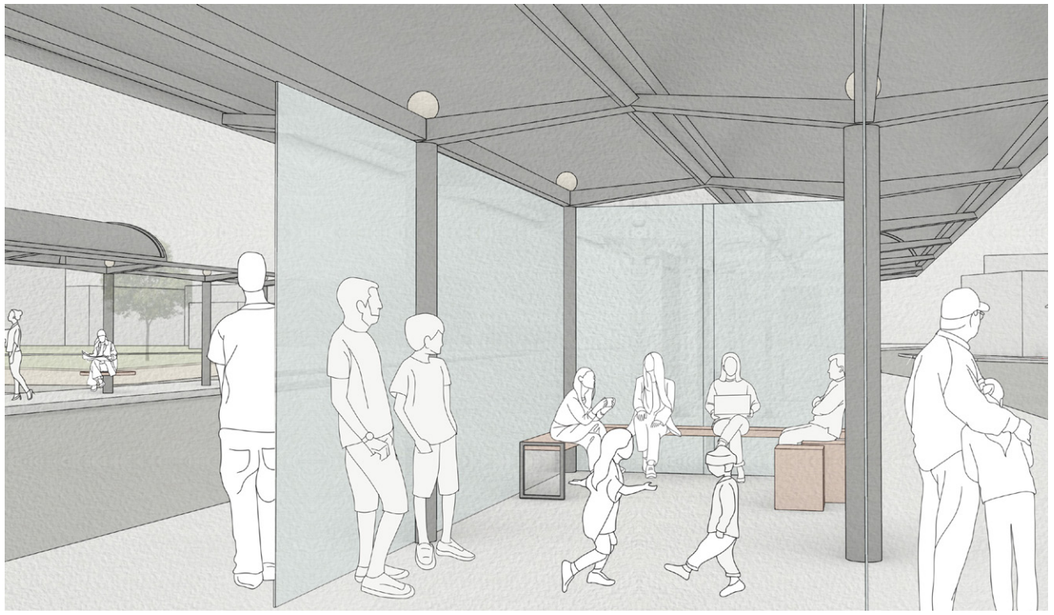


Fig 54: View showing how the modified layout allows for more people to wait together. Source: Author

Fig 55: View showing the activated context. Source: Author

Conclusion

The main intention of this design implementation exercise was to showcase how a few thought of design strategies could successfully activate the mundane transport stop, encourage copresence and provide ground for social interactions. The focus here was to highlight where the furniture could be placed, how the spatial layout of the shelter could be and was not about the design of the furniture or the shelter. Call for design is solely dependent on the style and preferences of the architect and is not included as a part of the design manual.

Fig 56: Länsmansgården. Source: Author

Chapter 5 / Discussion & Conclusion

This chapter will open ground for further discussions on the discourse, summarize the thesis and its contribution.

Shift towards Evidence-based design

In many urban design projects, space is imagined to become an attractor with an attractive design (discussion mainly revolves around aesthetics and physical attributes of design). But so is not the case always. The usage of any public space is influenced by all the spatial layers of the city. Network, population, demographics and the built fabric all affect the usage of any space. More than the architectural characteristics of the public transport stop, it is the surroundings and it's spatial conditions which attract people. So, while designing public transport environments, the node and place potential of the stops should be considered. Evidence based design gives a solid understanding of why certain things work and others don't. Design should not always just be a creative dialogue but should have an analytical approach as well.

As pointed out by Berghauser Pont, M. (2024), academic education should stress the importance of evidence based design in urban design and planning. Shifting from research to practice can be challenging. This thesis shows that with the right methods it is possible to translate the spatial analysis results into tangible design strategies. The design manual, which is in its Beta version, needs further development, but in its current state, it can encourage copresence in public transport stops with the aid of the proposed design strategies.

Benefits of observational mapping for understanding behavioral patterns

It is an ongoing trend to design aesthetically pleasing and attractive spaces and later leaving it to the users to explore how they can use the space. But it is important to remember the alternate approach of analyzing how people use a space through case studies and later decide what behavior the design could afford or hinder. This is why this thesis benefited the most from observational mapping. Observational mapping gave strong evidence of how people used the public transport stop.

Global and local scale interventions

When it comes to creating sociable public transport stops, both global and local scale interventions should be given equal importance. Starting from how the network is to how comfortable the furniture is, influences the overall usage of the stop.

Public transport stops are by themselves attractors of crowd, isn't that sufficient?

Previous decades were dominated by car-oriented development. It is only in the recent years that more emphasis is put on transit-oriented planning and development. Even with this evident shift, the usage of cars hasn't reduced a lot as people prefer the comfort of using cars. This scenario can be well observed especially in the segregated areas of the city. Then what should be done to force people shift towards using public transport is to provide them with an infrastructure that compels them to use it and take part. This is why it is necessary to rethink the design of public transport stops and its surrounding environment.

Potential for future research

It will be interesting to carry out observational mapping during other times of the day and shed light on unnoticed aspects. The design manual does not contain strategies based on material, lighting and other cultural aspects. It will be beneficial to explore and include other such relevant aspects in the manual. Next step to this thesis could be to create a virtual community at public transport stops. This idea was discussed during the thesis process but was not explored owing to the time restrictions.

Personal experience

In most of the projects I have worked so far, my focus has largely been on creating attractive spaces with well-chosen materials, lighting, color and overall architectural design. But never did I ever analyze how people used a space and why they used it in a certain way. So, with my master's thesis I wanted to shift my focus to understanding human behavior in public spaces. The methods, process and approach of this thesis were all so new to me as a person who majorly worked

with understanding the site, ideating the concept and developing the design. Every single day was a learning experience. If I hadn't adopted the evidence-based approach I am not sure if I would have been this confident with my proposed strategies, as now I have solid evidence and understanding to back them with. The city is so much more than what we see. It is an entanglement of so many layers, with each layer being equally important in the system.

Only when I started working with public transport stops did I realize that they were not explored much when it came to copresence. Copresence at public transport stops when encouraged further than what can be seen today, is going to heighten urban social life. It is true to say that the potential of public transport stops has never been unleashed completely. During this thesis I realized that public transport stops with the right design interventions can become so much more than they are today.

Conclusion

In this thesis, the focus has been to break the notion of constructing standard public transport stops. When it comes to copresence at public transport stops it is important to understand the local context, the system of the city and its influence on the public transport stop. ***It is very important to think beyond the stop.***

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Dataset source:
https://github.com/FlaviaMLopes/tuptp
https://www.trafiklab.se/api/gtfs-datasets/gts-regional/