



CLOSE THE GAP

Exploring evidence-based design as a tool to bridge the
strategic and detailed planning

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I would like to thank:

Flávia Lopes
Evgeniya Bobkova
Kristoffer Olofsson
Lars Marcus

for making this Master's thesis possible.

My thanks also go to Frida Eriksson for
interesting discussions, and to Peter Åsfjäll for
providing geodata.

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Abstract

Cities play a central role in addressing current and future social and ecological challenges. Meeting these challenges requires us to take a comprehensive approach to the planning and developing our urban environments. A challenge in the Swedish planning system is the gap between strategic planning and detailed planning. This gap could hinder positive system effects and limit the potential of planning. Furthermore, if conflicts between social and ecological aspects are not identified and addressed early in the planning process, resolving them later becomes both more difficult and expensive.

This thesis explores how an evidence-based design method can bridge this gap. The aim is to develop a framework for planning places based on their system conditions, with the goal of achieving desirable system effects. The design method also aims to foster a deeper understanding of the system by providing spatial insight into potential conflicts between social and ecological values in urban development projects and offering strategies for managing these conflicts through urban design and planning.

The method is being applied and tested on a site in the municipality of Varberg, which has been selected as a case study. Several spatial studies are being conducted on the site to analyse its spatial configuration and identify how it may contribute to socio-ecological conflicts, as well as which conflicts may potentially arise in future development. Furthermore, the evidence-based design method is used to investigate the possibilities for mitigating these conflicts while enhancing desired system effects.

The design phase involves testing and evaluating different spatial configurations, based on the thesis's theoretical framework. Based on these evaluations, the site's spatial configuration is redesigned to achieve the desired effects. This iterative design process contributes to knowledge development by demonstrating the impact of different configurations on socio-ecological conditions.

The study results in an evidence-based design process that can be incorporated into the planning of urban development projects, helping to identify contextual design criteria that can enhance positive system effects and mitigate potential conflicts between ecological and social aspects.

01. Introduction

This chapter presents the overall subject area in which the study operates, as well as the problem formulation and the two underlying research questions on which the thesis will be based on.

Background

Cities are hubs of economic activity, cultural exchange and social cohesion, but they can also be centres of environmental degradation and social inequality. The planning and development of our cities, often driven by economic growth and expansion, has largely failed to address the broader ecological and social consequences of urbanisation, resulting in unsustainable resource consumption and deepening socio-economic divides (UN Habitat, 2024; UN, n.d). For example, the green space in Sweden's 20 largest cities decreased by approximately 1.1 million square meters (equivalent to approximately 153 soccer fields) between 2021 and 2022 (HUGSI 2024). Moreover, the IPCC (2022) estimates that 70 % of global carbon emissions originate from urban areas, with transport and buildings being the largest contributors.

While cities are at the centre of many social and climate-related challenges, they also have the potential to be at the forefront of addressing these challenges directly. As highlighted in the UN Habitat World Cities Report (2024), urban areas are crucial in the global effort to tackle climate change and social inequality. It is therefore important that urban planning is characterised by a more holistic approach that considers the multidisciplinary and complex challenges we face.

Kate Raworth (2017) who's the founder of Doughnut economics, a theory about how we can make a transition to live within planetary boundaries, argues that one pillar of enabling this is by making a shift to systems thinking in how we plan our cities. Systems thinking is a holistic method of analysis that focuses on how different parts of a system interact and how they affect each other within a whole (Colding et al, 2022). Cities are made up of multiple systems that are constantly evolving and influenced by each other. For example, the design of the street network and the density of buildings affect how and where people move in- and around the city. Furthermore, a higher flow of people generates a greater basis for economic activities and opportunities for people to meet. This shows how the street network and urban density as a system interact to influence social and economic systems in the city. It is therefore important to recognise that the processes that take place at the local level are often dependent on system characteristics at larger levels.

However, system effects are not always positive and may also conflict with each other. For example, higher building and population densities can be positive from certain economic (larger customer base) and ecological (less resource use) perspectives (Colding et al, 2022). At the same time, it can have negative consequences in the form of more congestion in the city, leading to increased stress among the population and the exploitation of green spaces that are important for people's well-being and ecological functions in the city. It is therefore important that these potential conflicts are addressed in the early planning process as they can be both more difficult to manage at a later stage.

The planning of our cities is thus a central part of how we will meet and cope with our future challenges. In Sweden, planning is governed by Plan- och bygglagen (PBL) and municipalities have a planning monopoly, meaning that they alone have the power to decide how land and water resources in their municipality are to be planned and utilised (Boverket, 2023). Municipalities have two main planning tools, the comprehensive plan and the detailed plan, which are regulated by the PBL. The comprehensive plan is linked to the strategic planning of the city and the detailed plan is a legally binding document that regulates the land use of places. According to PBL, every municipality must

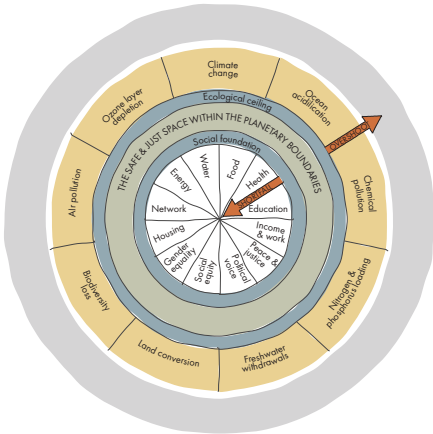


Figure 1: The doughnut model

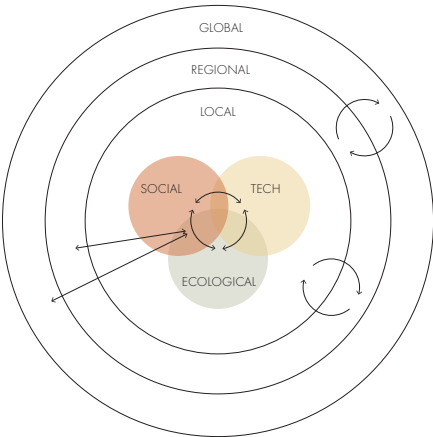


Figure 2: Different systems interact and affect each other across different scales

have a valid and relevant comprehensive plan that sets out the municipality's long term planning for the management of land and water resources. The plan therefore addresses the overall structure of the city and many of the system characteristics that influence the conditions for the processes that take place at the local level. In the case of particularly important areas, an in-depth comprehensive plan (FÖP) can be produced, which can deal with a greater degree of detail of the issues than covered by the comprehensive plan (SOU 2018:46). What is written in the comprehensive plan is not legally binding, but is strictly advisory when, for example, new detailed plans are drawn up.

In addition to this, there are also several other guiding municipal planning documents, such as planning programmes or structure plans, but these are not legally binding or regulated in PBL. Boverket (2022a), The National Board of Housing, Building and Planning, recommends that these shall be produced to guide future detailed planning work and that they can be beneficial when many stakeholders with different opinions are affected by the planning. As they are not regulated, there is no given process or content requirements, it is instead up to the municipalities themselves to design them.

Problem

A challenge in the Swedish planning system is the gap between the strategic planning and detailed planning (SOU2018:46). In its evaluation of comprehensive planning, Boverket assesses that there is a need for municipalities to investigate issues at a more comprehensive level than the detailed plan allows, but within a more limited area and with a higher degree of detail than the comprehensive plan. The programmes that the municipalities themselves choose to produce, such as planning programmes or structure plans, are intended to meet these needs. However, Boverkets evaluation shows that there is considerable uncertainty as to what these programmes should contain and how they can be produced and used. This risk leading to a situation where how the built environment and green spaces in the city are planned and developed is not adapted to their systemic conditions and the city's overall structures.

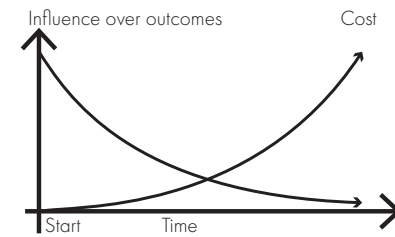


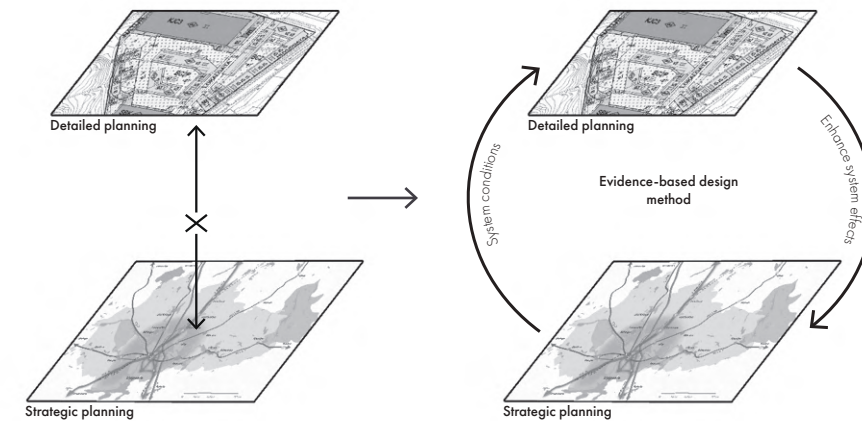
Figure 3: Relation between influence and cost during a process

Aim & research questions

The aim of this thesis is to investigate how a design methodology can serve as a tool to bridge the gap between strategic planning and detailed planning in urban development projects. The study focuses on how this process can be used to formulate design criteria that both mitigate potential conflicts between social and ecological aspects and that can enhance their positive systemic effects in the built environment. Therefore, the following research question has been chosen as the basis for the study:

How can a design methodology be used to identify context specific design criteria based on a site's systemic conditions, in order to support the planning process in medium-sized Swedish cities?

How can a design methodology help identify design criteria that mitigate social-ecological conflicts, and thereby contribute to more informed planning processes in medium-sized Swedish cities?



Delimitations

The study is based on the functional dimension of the city, which means that the focus is on the physical and economic structures that influence how people and animals use the built environment (Marcus 2022, p. 23). The delimitation consists in analysing only the morphological elements of the city and the system effects they give impact to, paying particular attention to system aspects such as density, connectivity, co-presence, habitat connectivity and land use. In terms of Space syntax, the main focus will lie on the betweenness centrality, as the street network in Varberg is well integrated, the integration centrality is not as relevant.

Social justice and inclusion issues, including socio-economic aspects, fall outside the scope of the study. Even if aspects such as accessibility to parks and green spaces are related to the questions, they won't be the focus of this thesis.

Habitat connectivity is examined exclusively in terms of land use, dispersal routes, barriers and value centres for bees. Other factors that may affect bee's habitats and dispersal, such as noise, are not included, although they may be relevant to the study question. However, these are beyond the scope and time frame of the work.

Terminology

Affordance: Refers to the possibilities for action that an environment or object offers an individual, depending on both the characteristics of the object and the abilities of the individual.

Co-presence: The potential to meet people from various parts of the city in one place.

Detailed plan: A legally binding document that regulates the land use of places.

Evidence-based design: A design approach where design decisions are based on scientific evidence.

Functional form: The functional form of built-up land is interlinked with its affordances, meaning it is about the possibilities it gives its users and how it enables different uses.

Habitat connectivity: How well different habitats for a specific species is connected.

Core value habitats: areas or places with particularly high ecological values and are a central part of several ecosystems. Often reproduction sites for species.

Dispersal zones: The distance a certain species can travel from its reproduction site.

Dispersal corridors: Green corridors that connect core value habitats.

Local scale: How both humans and animals perceive and interact with the urban environment.

Social-ecological urbanism: An approach that examines how processes at a global scale affect social and ecological processes at a local scale.

Space syntax: A spatial analysis that examines the street network through the variables of integration and betweenness centrality.

- Integration: A measure of how well a street segment is integrated into the street network
- Betweenness: A measure of how often a street segment is used if you walk from each segment to all other segments.

Strategic planning: The municipality's long-term planning for the management of land and water resources.

System scale: Processes and spatial configurations at a global (city) scale, such as street network centrality, density, and habitat connectivity.

02. Methodology

Methodology is the theoretical framework that guides how the research is conducted, while methods are the specific tools or techniques used during the process.

Theoretical approach

Evidence based design (EBD)

Evidence-based design means that the impact of the built environment on humans and animals is analysed based on measurable studies and research results (Boverket, 2022b). Within EBD, evidence is not regarded as absolute truth, but rather as gradual levels of scientific support. Only the highest levels of evidence, such as results from large, well-controlled and replicable studies, are considered to demonstrate cause and effect (Berghauser Pont, 2024). Studying complex urban landscapes requires both theoretical tools and methodological approaches that enable a deeper understanding of how the physical forms, structures, and functions of cities interact with human behaviours and usage patterns (Kamiri 2023, pp. 20–21). EBD is rooted in an interdisciplinary approach and can include sciences such as environmental psychology, ecology and architecture (Boverket, 2022b). EBD aims to ensure that actions and decisions in a design process are based on evidence from research or proven experience and local and contextual knowledge. EBD emphasises the importance of gathering knowledge and facts about the areas and contexts of projects. Both qualitative and quantitative knowledge is important. In many cases, different knowledge bases can conflict with each other, which is why it is important to account for and openly discuss the choices made in the design process so that they can be followed up and analysed.

Social-ecological urbanism

Social-ecological urbanism is a theoretical approach to the relationship between social and ecological systems and values in the city (Colding et al, 2022). The built environment and nature are not seen as two dichotomies, but as closely intertwined and mutually influential. The approach is based on using a systems approach and spatial analysis to understand how micro-level processes in the city are linked to overarching systems and structures. An example of this could be a city designed to encourage walking and cycling, which has positive health benefits and also allows road users to interact with their surroundings. This may promote social cohesion or better conditions for economic trade. In contrast, areas where interaction with the local environment is limited, for example by barriers such as roads and topography, can lead to segregation and exclusion.

Affordance

The theory of affordance has its origins in psychologist James J. Gibson’s research on visual perception and people’s interaction with their surroundings (Marcus 2022, pp. 22–25). According to Gibson, affordance refers to the possibilities for action that an environment or object offers an individual, depending on both the characteristics of the object and the abilities of the individual. It is therefore not just about what something is, but what it invites you to do. For example, a chair invites you to sit, a path invites you to walk, and a playground invites you to play, provided you can perceive and act on these possibilities. This theoretical approach also relates to what Marcus calls the functional form off the city.

Affordance and the functional form of the city is linked to how we perceive the environment around us through visual impressions (Marcus 2022, pp. 22–25). This perception often leads directly to action, we act according to the possibilities created by our surroundings. In an urban context, this means that the physical form and design of the city influence how people move, spend time, and interact. Buildings, streets, squares, and green spaces offer different types of affordances that shape our behaviour and our experiences of the place.

EBD is based on three different types of knowledge bases:

- Evidence - research and scientific basis
- Practice and proven experience
- Context - what is given in the specific situation, the local conditions.

Methodology

Bill Hillier (1996, p. 2), one of the founders of space syntax and the theory of natural movement, argues that many of the architectural theories that emerged during the 20th century have two main weaknesses: they have been overly normative and insufficiently analytical. A normative theory is a type of theory that deals with how something should be, rather than how it actually is. It expresses values, ideals, or goals, often with the aim of influencing future decisions or actions. In architecture, this means that a normative theory prescribes which forms, structures, or urban planning principles are considered good or right, without necessarily examining why they work, when they work, or whether they work in practice.

To overcome this, Hillier (1996, pp. 27–29) calls for more analytical architectural theories that deepen our understanding of architecture as a phenomenon. Hillier argues that architectural theory can be understood as an attempt to put into words things in architecture that we otherwise find difficult to talk about, such as spatial patterns, forms, and relationships that are not easily described. By translating these into concepts, language, and numbers, we can understand and work with them in a more systematic way. In this way, theories help us understand the underlying spatial principles of architecture, rather than simply judging whether something is “right” or “wrong.”

Evidence based design

In line with this, the methodology is based on an evidence-based design process, where the methods of Space- and Places syntax, Space matrix, and habitat network connectivity have been chosen as an analytical framework. These methods provide objective descriptions of system relationships in the built environment, enabling us to understand the underlying spatial logic of different environments without imposing a normative description of them.

Further, the EBD methodology will be divided into two steps, as suggested by Karimi (2023, p. 1). In the first stage, a series of analyses are carried out at both local and global levels, examining the spatial networks. These analyses reveal various structural patterns in the city that govern human activity and urban functions, which also creates a contextual understanding. This understanding is an important part of identifying challenges and opportunities within the area or city. It also has the potential to create improved or more contextually relevant design concepts and solutions.

The second step in the EBD methodology involves creating analytical models of different design proposals at an early stage of the process. These models serve as tools for reviewing and evaluating design ideas and alternative solutions. This approach not only enables the integration of the city’s morphological structure into the design work but also deepens the iterative process of testing and evaluation that is central to design. It is particularly important that this evaluation is carried out in an objective and quantitative manner, which steers the design process towards a more analytical and evidence-based approach.

Research by design

To support the design and outline of the EBD methodology in the study, it’s further complemented by a “Research by design” framework. Research by design is about how to generate new knowledge through creative and practical processes. Johan Verbeke (1991) describes in the book ‘Design research in architecture’ that a key in this type of research is the reflection and review of the creative process to

provide new knowledge and insights. Therefore, it is important that this process is clearly communicated so that it can be understood and valued by others. Furthermore, Verbeke provides examples of methods and criteria for knowledge production in design-based research, presenting a design scheme to support the structuring of research. The scheme contains four following phases:

Input: In this phase, information and knowledge on which the research is based is collected: this can be through, for example, literature studies, experiences, interviews or design projects that relate to the focus area.

Operations: In this phase, the material collected in the input phase is processed to create new insights by, for example, conducting new interviews or experiments or combining the material in new ways.

Output/Knowledge: In this phase, the material from the operations phase is evaluated against the data in the input phase to create a result of the study.

Delivery: In this phase, a concrete manifestation of the result of the Output phase is made through, for example, designs, design tools, articles or exhibitions.

Verbeke emphasises that design, and practice should be a key component throughout the project to create new understanding and knowledge, calling this the ‘in the medium’ of architecture. This is because it allows knowledge to be produced from and through the design actions.

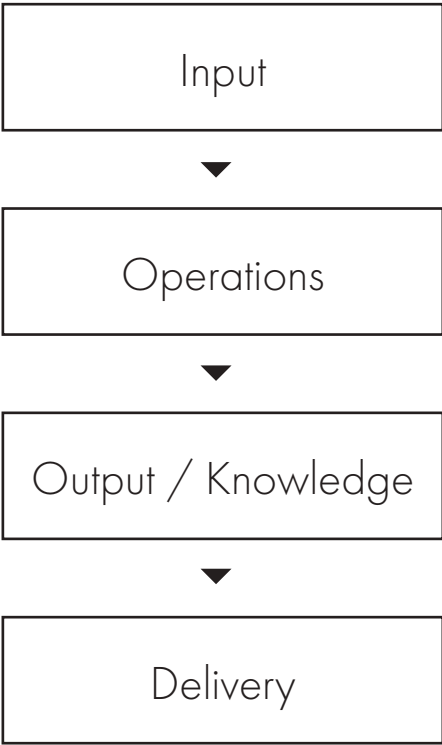
Discussion

Hillier (1996, pp. 59–61) argues that a problem with architectural theories that are more normative than analytical is that they only work for certain types of architecture. For example, a theory based on geometric proportions cannot explain buildings that do not follow these proportions. Similarly, this means that these theories are limited and cannot be used as general tools for understanding or analysing all types of architecture.

This study aims to combine theories about how different system configurations in the city create different system conditions for places within the city, with theories about how the functional form of cities can be used to reinforce positive and mitigate negative systemic effects. By integrating these perspectives, the study aims to develop a design methodology that not only explains how and why the built environment works the way it does but also identifies more precise and contextual design criteria.

The methodology functions as an analytical tool that can be applied in different urban contexts to identify spatial networks and system aspects within the city. These elements influence human activity, biodiversity, and urban functions, and their analysis contributes to building a contextual understanding of the city.

Based on this understanding, the methodology helps define normative design criteria that respond to both the identified system characteristics and the local context. These criteria aim to guide the development of the built environment toward more desirable outcomes in terms of its functional form, ecological performance, and social dynamics. While the design criteria are grounded in the specific context from which they are drawn, they can also be adapted and applied in other urban settings that share similar system conditions, increasing the generalization of the findings.

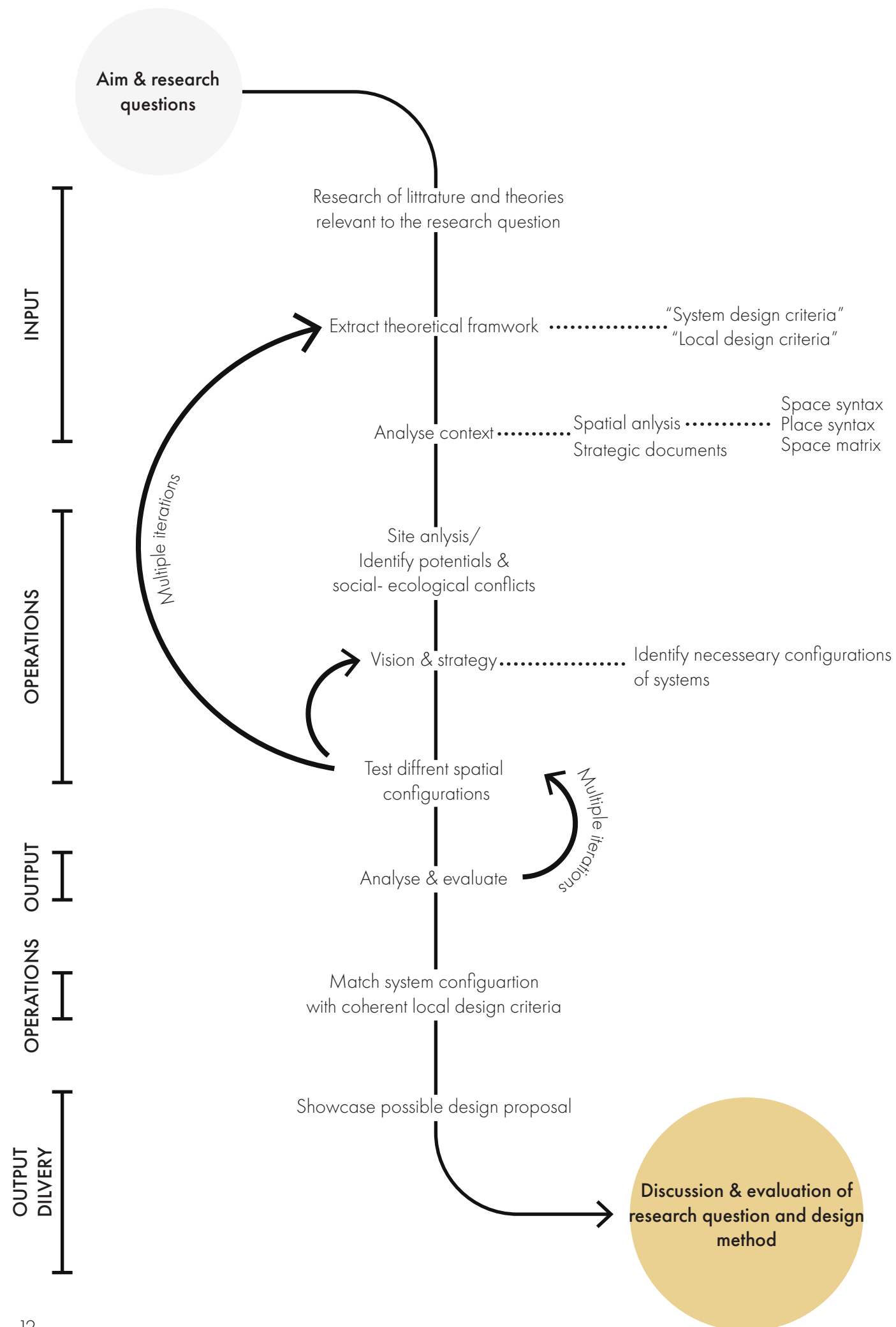


The four steps of Verbeke (1991) suggested design scheme

Process

By using these two theoretical frameworks it enables an iterative design process where different spatial configurations are tested and evaluated using analytical methods, and where the results of these are compared with important aspects that emerge in the studies theory chapter in accordance with EBD. The iterative design process itself contributes to knowledge production in the study by investigating how different configurations relate to different outcomes with different system effects. The process in this study is divided in the following steps:

1. A relevant knowledge base is collected based on the research question of the paper.
2. The city of Varberg is analysed through spatial analyses and theoretical frameworks to create an understanding of the current context and to highlight different system conditions
3. The results are then weighed against Varberg’s municipal planning strategies to identify different suitable sites for development.
4. A site is then chosen and analysed by different spatial analysis. Risks and potentials are identified for the site based on its system conditions and morphological attributes.
5. A vision is formulated for how the site could be developed to generate positive system effects and to mitigate conflicts between social and ecological aspects.
6. Different spatial strategies based on the theoretical part of the thesis ‘System effects’ are developed for how the system conditions of the sites can be configured to enable the opportunities identified in the site analysis.
7. The configurations are tested through spatial analyses to enable an evaluation between different configurations to compare their outcomes.
8. Based on the chosen strategies, different design criteria are then selected based on the theoretical part ‘Local”. The purpose of the design criteria is to design the site in a way that both mitigates the conflict between different systems and can enhance positive system effects.
9. A final design proposal is produced for each site showing how the design criteria can be implemented.



Methods

Literature Studies

The aim is to provide a deeper understanding of theoretical concepts in urban morphology and their relationship to social and ecological systems within the built environment. This knowledge is essential for the Evidence-Based Design (EBD) approach to be meaningful, as it requires a comprehensive understanding of both the morphological characteristics of urban form and the social contexts shaped by it (Karimi 2023, pp. 22-23). The focus extends the analysis of physical elements such as streets, blocks, and buildings, to include the ways in which these structures interact with social, economic, and cultural dynamics.

These insights will form the analytical foundation for developing design criteria at both the system scale and the local scale. By grounding design decisions in this multi-scalar analysis, the study aims to more accurately anticipate the implications of urban form and enhance the functionality of the proposed design interventions.

Space- and Place syntax

A range of spatial analyses will be conducted using GIS to investigate how different spatial configurations influence human behaviour, social interaction, and habitat connectivity. This approach is essential for moving from a descriptive analysis toward a more quantitative framework capable of predicting, evaluating, and assessing the effects of different spatial configurations (Karimi, 2023, p. 1). It also supports the integration of evidence-based design by incorporating predictive modelling into design processes.

The primary analytical tools employed will be Place Syntax and the Habitat Network Analysis Tool, which together will support a nuanced understanding of how spatial form shapes both ecological and social dynamics. Place Syntax is a QGIS plug-in that combines space syntax analysis of the road network with other tools such as attraction and accessibility analysis (Stavroulaki et al, 2023). The space syntax analysis is a critical part of the tool, and it shows the relative position of each road segment in the road network. This allows it to produce two different measurements: Angular Integration (AI) and Angular Betweenness (AB). Angular integration shows how well the road segment is connected to all other road segments in the network, and angular betweenness shows how often a segment is used when you go from each segment to all other segments.

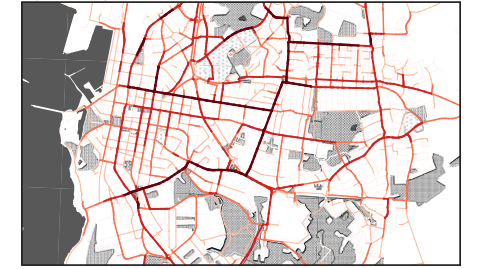
Space matrix

The model provides a holistic picture of building density where it combines the Floor Space Index (FSI) with the Ground Space Index (GSI).

The Habitat Network Analysis

The Habitat Network Analysis (Hnat) tool uses a biotope map as the basis for a multi-species analysis to show where species' reproductive habitats are located (functional map) and how well these habitats are connected (dispersal map) (Berghauser Pont et al, 2022). In this study the functionality and dispersal qualities for the species solitary tree living bee's and the assessment of the habitats will be based on the parameters available through Chalmers Spatial Morphology Group (n.d).

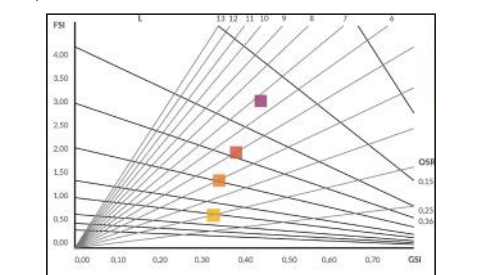
Space syntax



Place syntax



Space matrix



Floor Space Index (FSI)

The total floor area of the building in relation to the plot area. Measures the volume of the building in relation to land use.

Ground Space Index (GSI)

The footprint of the building in relation to the plot area. Shows how much land is occupied by buildings.

Open Space Ratio (OSR)

Proportion of unoccupied land on the plot. Calculated as: $OSR = 1 - GSI$. Determines the availability of green spaces, courtyards, etc.

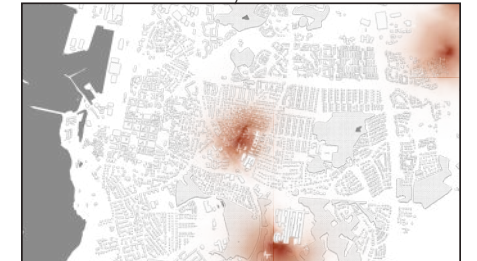
Layers (L)

Average number of floors. Provides an indication of the height of the building.

Ax

Area of aggregation (District, fabric, block, parcel).

Habitat network analysis



03. Theory

The theory chapter is structured in two parts: “System Scale” and “Local Scale.” The first part, System Scale, focuses on the broader urban systems examined in the study, such as spatial networks, density, and green infrastructure. These components are analysed to understand how they shape the structural and functional conditions of the city.

The second part, Local Scale, explores how both humans and animals perceive and interact with the urban environment. It considers how the built environment can be designed to align with these system conditions and how design interventions can be used to strengthen positive system effects at the local level.

System scale

Urban morphology

Urban morphology is the study of the physical structure of cities and how it changes over time (Carmona 2021, p. 196). The form of a city refers to the main physical elements that give the city its structure and shape. These elements can be divided into five categories:

- Districts
- Street networks
- Neighbourhoods
- Properties
- Buildings

These elements influence each other: the street network determines the size of the blocks, which in turn shapes the division of properties and the density of development. This interaction then determines how buildings are located and designed.

Lars Marcus (2020, pp. 86–90) distinguishes between the city’s functional and representative form in his study of urban morphology. The functional form is about how the built city provides its users with uses and opportunities and whether the physical elements fulfil their practical purpose. Marcus (2022, pp. 23, 96) describes how the physical environment has a function as an “enabler” for human actions and, in doing so, highlights the relationship between the environment and humans. Cities and buildings are not built for their own sake, but to enable different land uses, which in turn affects how we use the city. Marcus relates this to the term “affordance” which means what possibilities and functions the built environment gives its users. The built environment and its spatial layout govern both where and how we move, where we choose to sit, and where we meet other people. The city’s representative form is instead about the aesthetic and symbolic design of the city.

This distinction is illustrated by Marcus (2020, pp. 86–90) comparing the neighbourhoods of Skarpnäck in Stockholm and Baronbackarna in Örebro. Skarpnäck was built as a traditional neighbourhood with the ambition of creating life and mixed functions, while Baronbackarna follows modernist ideals with functional separation and open development. Paradoxically, both areas exhibit similarly low levels of urban life. Marcus (2022, p. 97) explains this by saying that, despite their different representative forms, both areas share the same structures in their functional form:

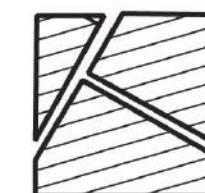
- Large-scale property structures with few housing associations, leading to less diversified land use.
- Building entrances from inner courtyards, which shield the buildings from the street scape.
- Isolated road networks that are not integrated with surrounding neighbourhoods. This structure breaks with classic urban planning traditions, where interconnected street networks create natural flows between neighbourhoods, which is a prerequisite for creating vibrant urban environments.

The street network

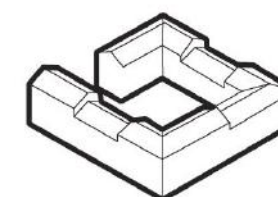
There are several different structures for organizing street networks, for example, through a block structure or a more organically developed structure. The design of the street network greatly influences how individual street segments relate to each other within the city’s



Buildings



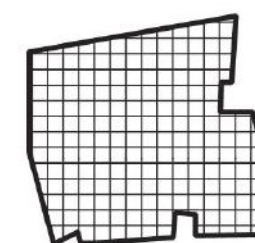
Plots



Blocks / fabric



Street network



District

Figure 5: Morphological elements

spatial system. One way to analyse these relationships is through a so-called J-graph (Hillier 1996, p. 72). In a J-graph, each street segment is represented as a point (node), and a line is drawn between points that are directly connected to each other in physical space. This graph serves as an analytical tool for understanding a segment's relative position in the entire street network. Segments that are weakly connected to the rest of the network end up far out in the graph with few connections, while segments that are centrally located and strongly integrated with others appear as nodes with many connections.

Lars Marcus (2022, p. 47) distinguishes between two types of spatial systems of the street network: tree structures and network structures.

- In a tree structure, there is often a main line from which branches lead out to different clusters. This type of structure is associated with the functional zoning that was typical of modernist urban planning, where different parts of the city were assigned specific functions such as housing, work, or commerce. The result is a system with limited integration between functions.
- In a network structure, on the other hand, street segments are more evenly distributed and more mutually integrated. This allows for greater accessibility and mixing of functions, which often promotes urban life, interaction, and flexibility in the use of urban space.

Carmona (2021, p. 203) also emphasizes how urban morphology affects people's movement and choices. An important factor is the connectivity of the street network, how the city's street network is interwoven, which determines the ability to create context and movement opportunities. Carmona highlights two important dimensions of accessibility:

- *Visual*: How clear the route choices are
- *Physical*: The actual possibilities for movement

Carmona (2021, p. 206) argues that a fine-mesh street network with small blocks provides more route choices and makes it easier to find your way around the city. This is also related to the fact that long blocks often lead to detours that lack functional meaning, while a street network with a high density of intersections helps to connect neighbourhoods and create natural flows (Jacobs 1961, pp. 179–180). The report "Måta stad" (Measure city) emphasize that at least 150 street intersections per square kilometre is a good benchmark for good connectivity (Spacescape 2016, p. 38). This also affects the size of neighbourhoods, which on average should not exceed 7,000 square metres which corresponding, for example, to 84 x 84 metres or 50 x 140 metres.

Furthermore, street layouts do not change often but tend to remain the same over time (Carmona 2021, p. 234). On the other hand, land use and city life are changing at a faster pace, so it's important that the built environment and street network can accommodate this change. This can be achieved by creating structures that tolerate changes in function by avoiding overly functional zoning and allowing for flexibility where the built environment can adapt to new needs. Modernist urban planning is a counterexample to this, where the separation of functions has created areas that are difficult to convert when society's needs change (Marcus 2022, p. 173).

The theory of natural movement suggests that the configuration of

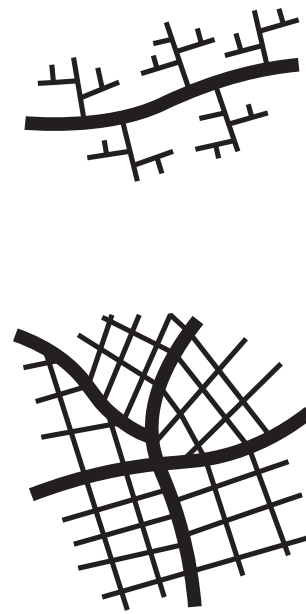


Figure 6: Tree and network structure

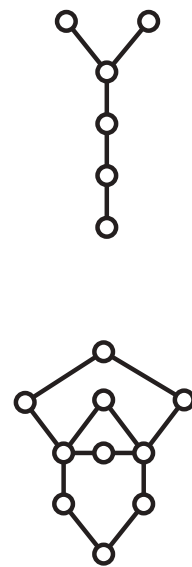


Figure 7: J-graphs

the street network can be used to predict people's movements in urban environments (Hillier, 2015). This can be achieved through a space syntax analysis which can measure what is known as angular integration and betweenness integration. Both these are topological measures that describes the relative position of a street system segment by analysing angle changes between it and other segments in the network. It is therefore not a geographical measure based on actual distances, but rather a way of counting the number of typological steps based on changes in direction. In this way, it is possible to analyse how many such steps are required to reach a given segment from all others in the system. Research shows that the amount of the movement in the city the analysis can explain varies in different cases, but the mean value is that it can explain 65% of the movement in a city (Stavroulaki et al 2019, p. 16).

Angular integration examines the relationship between each street segment and all other street segments, where a street segment that is more integrated with all other street segments is given a higher value. Betweenness integration assesses how often a street segment is passed when moving from one street segment to all others in the city. However, angular integration and betweenness can be distinguished by considering that the former measures "to movement", which is how accessible the street segment is from all other street segments. Betweenness, on the other hand, shows the potential for "through movement", which is the flows through the city. The analysis can be done on different scales, often two and five kilometres, to understand the street network locally and globally (the entire city). The purpose of the analysis is to evaluate the degree of integration between different neighbourhoods in the city, as well as how residents are integrated with the rest of the urban environment.

In terms of space syntax, the concept of multiplier effect is also relevant (Hillier 1993, p. 113). This means that streets with high centrality create greater flows. These flows make it more attractive for various businesses, functions, and activities to locate themselves near the flows, which then attracts an even greater flow.

At the same time, the centrality of a street segment can be controlled. For example, by breaking up the segment, it can be given a lower centrality, which may be desirable for a recreational area where more seclusion and privacy are sought. In contrast, the centrality of a street segment can be increased by integrating it more with the rest of the network and reducing the number of typological steps needed to reach it, which may be desirable for streets where a higher flow of people is desired.

An important aspect that can be measured using space syntax analysis is the potential for creating co-presence. Ann Legeby (2013, pp. 337–338) defines co-presence as "the presence of different people in the same public space, creating potential for social interaction and community". If the same street segment has a high betweenness centrality value at both the local and global levels, there is potential for the people moving there to come from different parts of the city, both locally and globally. This means that there is potential to meet people from all over the city in the same place. At the same time, large areas with low closeness centrality can become socially isolated, as they are not integrated with the rest of the city and therefore people from other parts of the city do not go there.

Density

Density is a central but vague concept that can be defined and measured in different ways but has a major impact on the function and

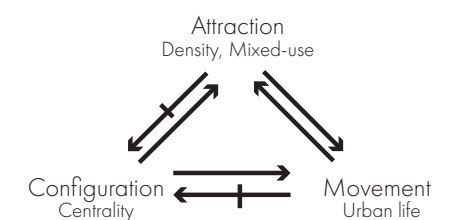
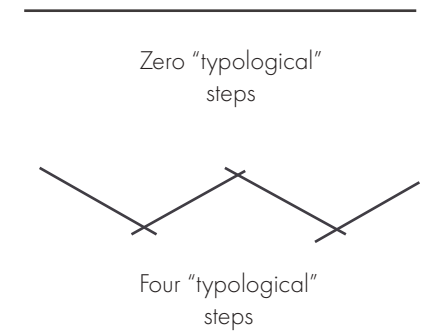


Figure 8: Multiplier effect

character of a city. Jane Jacobs (1961, p. 201) argues that sufficient population density is a necessary foundation for creating a vibrant and diverse city. According to Jacobs’ analysis, a certain level of density is required to enable economic diversity, as there must be enough residents to support various activities and functions in the city. A larger population also provides a basis for creating flows in the city and thus promoting social interaction, as this is one of the cornerstones of spontaneous encounters and community.

At the same time, too low or too high a population density can have several negative consequences. If it is too low, it limits the availability of services and cultural offerings, public transportation, and walkability, and risks leading to fragmented urban spaces with poor resource management. An urban form associated with low density is known as “urban sprawl,” where large residential areas spread out over large areas of land (Rafferty, n.d). This urban form has often led to greater car dependency due to the population base for well-functioning public transport becoming too low, a lack of public meeting places, and higher resource use. Excessive population density can instead lead to increased congestion and stress among residents, which risks increasing mental ill health and excessive pressure on public spaces and green areas. In addition, research shows that high-rise buildings often lead to lower population density than medium-density, dense neighbourhood development (Salat 2021, p. 2). High-rise buildings require wider streets, larger technical spaces (elevators, ventilation), and more undeveloped land around the buildings. For example, Paris, with its 6–7-story buildings in continuous neighbourhoods, achieves the same density as parts of Manhattan.

There are different guidelines for what is considered a reasonable population density. For example, UN Habitat’s report on strategic densification compares the population density of ten cities ranked among the top 10 in several liveability indexes (Salat 2021, p. 7–11). The benchmark shows that sustainable density is usually between 12,000 and 14,000 people/km², but that it can vary between 4,700 and 24,000 people/km². At the same time, the report emphasizes that it is important for density to be context specific. Density does not necessarily have to be the same as in the surrounding area, but new buildings must respect their surroundings in terms of scale, design, and typology.

Population density depends on building density, which can be measured in several different ways. Common measures are gross floor area and floor space index. Gross floor area is the sum of the size of all floors, that is, the total built area. The floor space index is a measure where the gross floor area is divided by the size of the surrounding area, for example, the property area. The measure can also be used at the neighbourhood level to get a bigger picture of the density of the area. It is calculated by dividing the gross floor area of the buildings in the neighbourhood by the land area on which the neighbourhood stands plus half of the surrounding street space.

However, both gross floor area and floor space index are vague measures of density, as they do not say anything about the typology or design of the buildings (Berghauser Pont & Haupt 2020, pp. 7–11). This is a clear weakness when areas are developed after achieving a certain gross floor area or floor space index, as these can be achieved in several separate ways, as illustrated in Figure 9. The Space Matrix model can provide a more comprehensive picture. The model combines the floor space index with the building area (the building’s footprint on the ground), which also shows the number of floors and the ratio be-

tween built-up and undeveloped land in the model’s graph.

The model provides a more holistic picture of building density and makes it possible to compare the density of cities, identify typical density patterns (traditional neighbourhoods or modernist high-rise areas), and evaluate different planning proposals by analysing their density and the effects it may have on the urban environment. The analysis can be performed at different scales: plot, island, fabric, district. Depending on the scale, different results are also generated in the model, where smaller scales such as parcel and block often generate higher fsi and gsi than in higher scales such as fabric and district. This is important to consider when comparing different density analyses.

Another way to measure building density is accessible FSI & GSI, which measures how much built-up area is accessible from a specific location (Marcus & Berghauser Pont 2022, p. 18). Measuring only FSI and GSI within a defined area provides a vague picture of how the city’s density affects the experience and use of a place. Measuring accessibility-based metrics instead provides a greater understanding of the urban context and the place’s relationship to the rest of the city. According to Marcus & Berghauser Pont (2022, p. 18) this enables questions such as: “If I am standing here, what can I reach within a ten-minute walk?”. In this way, the city’s form and spatial organization have a direct impact on how density is perceived and functions.

Aspects that promote diversity and closeness

A finely divided property structure enables a wider range of property uses, thereby promoting diversified land use (Marcus 2022, pp. 41–43). For instance, one housing association may prioritise low monthly costs for its apartments, whereas another may prefer to have a restaurant or shop on the ground floor. When ownership is divided between several parties, the area becomes more resilient to change. If a company moves or closes, the effect is limited to a smaller area.

Marcus (2010, pp. 36–38) links this to what he terms “spatial capacity” and “capital.” Spatial capacity refers to access to properties, that is, how many properties can be reached from a given point, area or street segment. Spatial capital, on the other hand, is defined as the socio-spatial value generated by the urban form. Spatial capital has both an exchange value, for example land or property values, and a use value, such as social, cultural and environmental benefits for everyday urban life. This concept emphasises that cities provide spatial capital by enabling access to different uses and functions, thereby promoting social, cultural and economic development.

A finely divided property structure is particularly relevant in city centres, where land values are high. Dividing plots into smaller properties lowers financial barriers, enabling a broader range of investors and entrepreneurs to participate. In opposition, large properties limit ownership to those with higher capital, reducing the variety of uses and thereby limiting urban diversity.

Another important aspect is land use in the city. A vibrant and diverse city requires not only concentrated development, but also efficient and diversified land use. Jane Jacobs (1961, pp. 214–217) highlights Greenwich Village in Manhattan as a model for vibrant urban life. According to Jacobs, a key factor is how land is allocated. In this area, 60 to 80% of the neighbourhood is occupied by residential buildings, while the remaining 20 to 40% is used for courtyards and common areas. This high proportion of buildings, according to Jacobs, enables

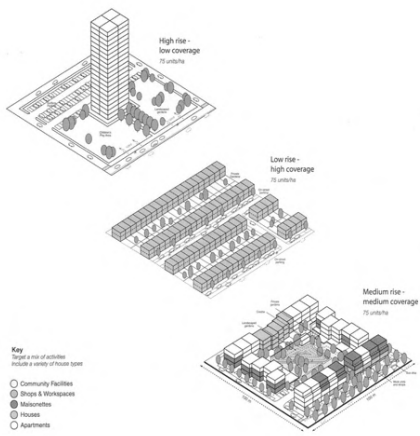


Figure 9: Building typologies with the same GFA density (Berghauser Pont., Haupt 2023)

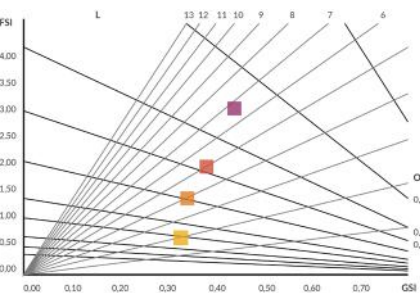


Figure 10: Space matrix (Berghauser Pont., Haupt 2023)

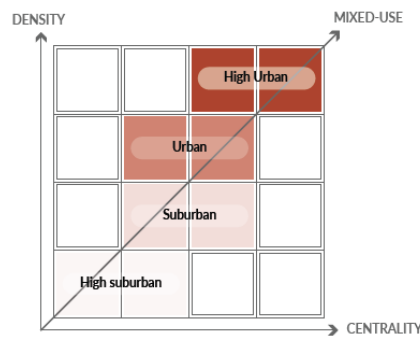


Figure 11: High centrality and density related to mixed-use urban areas (Nes., Berghauser Pont., & Mashhoodi, 2012)

intensive land use, which means that buildings do not need to be used intensively but can accommodate a variety of functions. A more inefficient use of land, with larger open spaces and fewer buildings, would lead to a more inefficient use of land. Each building would then have to be used more efficiently, which often limits its use to residential purposes at the expense of other activities. At the same time, Jacobs warns that excessive building density can create rigid and unattractive environments unless the buildings are balanced with well integrated streets, squares, and green spaces.

Ecosystem services and biodiversity

Ecosystem services are benefits and resources provided by nature that support the life and well-being of plants, animals, and humans (Naturvårdsverket, 2024). Ecosystem services are divided into four categories:

- Provisioning services, such as food and water.
- Regulating services, such as climate regulation and water purification.
- Cultural services, such as recreation and aesthetic values.
- Support services, such as nutrient cycling and soil formation

Some ecosystem services are essential to our life on Earth, such as how trees and plants capture carbon dioxide and provide us with oxygen, or how pollination enables us to produce fruit and vegetables. In cities, ecosystems have both visible and invisible consequences. For example, trees provide shade during heat waves, and parks can act as floodplains during heavy rainfall. At the same time, the ecosystems behind services are often complex, with several different underlying interactions and mutual dependencies between animals and plants that are crucial to the functioning of the ecosystem. The Swedish Environmental Protection Agency (Naturvårdsverket 2024) describes ecosystems as a web in which every animal or plant is a thread. If the threads disappear, the net is eventually destroyed. In the same way, our ecosystems are affected or destroyed when species and plants disappear, which is why species diversity is important for creating stability. Biodiversity is therefore a vital part of promoting ecosystem services and ensuring that they are viable. To promote biodiversity and create robust ecosystems, it is important to create a rich variety of habitats in cities and to create connected green spaces, known as green infrastructure.

Green infrastructure

When the city’s various green areas are connected and form networks, this is referred to as green infrastructure (Boverket 2023). It is therefore important to map important habitats, green contexts, and qualities in the city. In this way, different measures can be assessed so that the right measures are implemented in the right place. To ensure this, the green structure must be analysed on a larger scale to create an understanding of the various systems as a whole. The measures must also be adapted to the type of habitats and species distribution to be promoted. Green infrastructure can be divided into different categories, but four important categories are core values, dispersal zones, dispersal corridors, and barriers.

Core values are areas or places with particularly high natural values and are a central part of several ecosystems. One of the reasons for this is that they are often habitats for species to reproduce (Naturvårdsverket 2017, p. 3). In Sweden, classifications such as key biotopes, biotope protection, and regionally and nationally valuable

UN-Habitat proposes the following guidelines for balanced land use (Salat 2021):

- Housing: 25%
- Community services/economy: 25%
- Streets: 25–30%
- Parks & open spaces: 20–25%

Spacescape (2016, pp. 23-33) has supplemented this with additional guidelines for land use. They believe that public spaces should meet the following criteria:

- At least 15% of the total land area (of which 10% should be green areas and 5% parks).
- 10 m² of public space per resident, a level that has passed the accessibility and load test.

watercourses are examples of core values. A key biotope that is common and important in urban environments is “valuable trees,” which refers to giant trees, very old trees, and large hollow trees.

Dispersal zone
Dispersal zone refers to the range of a species from its core area where it is likely to spread. The dispersal zone varies between species and habitats, but a guideline for the dispersal zone is between 0–2 km.

Dispersal corridor
A dispersal corridor is an area with a habitat that can serve as a corridor between different core areas for a species, thereby increasing the dispersal zone. When several core areas are connected so that species can spread between them, this creates what is known as a value network.

Barriers
Barriers are different land uses or habitats that are obstacles in a species’ dispersal zone or corridor. These can include water areas or hard surfaces such as roads, buildings, and parking lots.

Green spaces and greenery in cities are not only important for ecosystems, but also for our psychological and mental health. Research shows that access to everyday nature experiences have a positive impact on public health, as for example helps lower blood pressure, slow the heart rate, and reduce levels of the stress hormone cortisol in the blood. It also helps strengthen short-term memory and prevent dementia. Green areas encourage physical activity, which in turn helps prevent obesity, cardiovascular disease, diabetes, and mental illness (Boverket 2022).

Spacescape (2016, pp. 23–33) has compiled guidelines for access to green spaces and parks based on urban analyses and reports from municipalities, the Swedish National Board of Housing, Building and Planning, and the Norwegian Environment Agency.

- **Green areas**
Public green areas of at least 0.2 hectares must be accessible within 200 meters.
- **Park**
A maximum distance of 500 meters to a park area that is at least 1 hectare and 50 meters wide. The park area must have a flat grassy area of at least 0.5 hectares.

Local scale

The street – a central part of public life

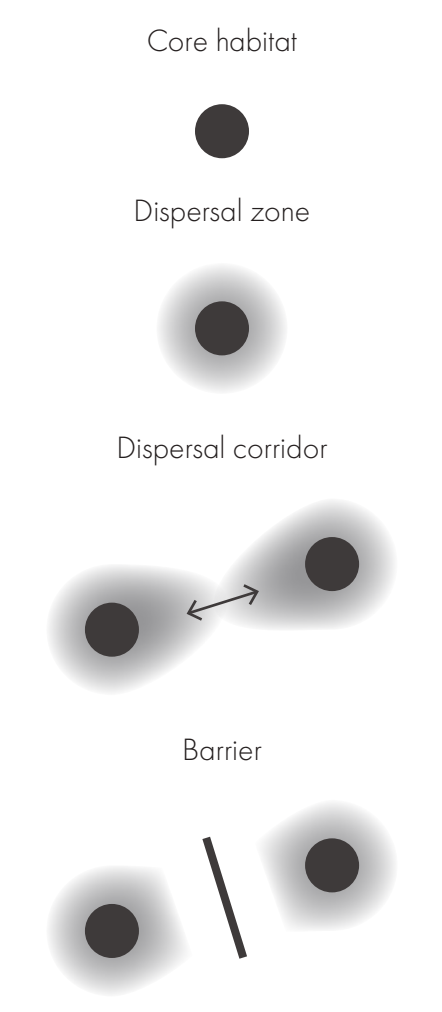
It is on the streets of a city that much of urban life takes place, and they constitute a large part of the city’s public spaces (Stähle et al 2020, p. 150). Streets have several important functions in the city: they are central to how we move around, they create flows of people that can generate social and economic activities, and they can also provide space for green corridors in the city and manage storm water. The city’s technical infrastructure, such as culverts, district heating, and fibre, often runs beneath the streets.

Since the 1950s, cars have become increasingly dominant in the street space, leading to monotonous spaces without social, economic, or

Giant trees
Living or dead trees that are thicker than one meter in diameter.

Very old trees
Living or dead spruce, pine, oak, and beech trees that are older than 200 years. Other tree species that are older than 140 years.

Hollow trees
Living or dead trees with developed cavities and a trunk diameter greater than 40 centimetres.



cultural exchanges (Camrona 2021, p. 241). Where cars have taken over the street space at high speeds, this has often led to the creation of a monotonous space without social, economic, or cultural exchanges. A high proportion of car traffic and increased speeds in public spaces tend to weaken the social potential of places. When car traffic dominates, opportunities for spontaneous interactions decrease, while streets with lower speeds create conditions for a richer urban life. According to Jacobs (1961, p. 148), slower traffic environments promote both social and economic exchanges, as pedestrians and cyclists can more easily stop, observe their surroundings, and participate in public life.

These types of environments often become attractive hubs, not only as destinations in themselves but also as part of larger movement patterns. People are often drawn to places with high levels of activity and opportunities for “people watching”, a form of passive social interaction that strengthens the connection to the city. Such places serve as both destinations and thoroughfares, further enhancing their importance to urban life. Several major players in urban planning in Sweden have jointly compiled the report “Smarta gator” (Smart streets). The report explores how street spaces can be transformed in terms of their function and design to create better social, traffic, ecological, economic, and technical conditions (Stähle et al 2020). The report categorizes roads into four different types and highlights important aspects of their design, key requirements, how they can be adapted to different contexts, and suitable intersection types.

Aspects in the built environment that promotes social life

According to Jan Gehl’s (1996, pp. 11–14) research, human activities in urban environments can be categorized into three basic types:

- **Mandatory activities**
Basic movements and commitments such as commuting to work and school. Performed regardless of the quality of the environment because they are necessary
- **Voluntary activities**
Recreational and pleasure-oriented activities such as walking or visiting a café. These require attractive public spaces and favourable external conditions such as a good microclimate and accessibility.
- **Social interactions**
Spontaneous encounters and conversations that arise when people find themselves together in urban spaces, which is a secondary effect of the first two types of activities.

Gehl (1996, p. 11–14) highlights a clear link between the design of the physical environment and activity patterns, where under stimulated public spaces limit use to only necessary activities. Well-designed urban spaces, on the other hand, encourage mandatory, voluntary, and social activities and interactions. Based on his observations and studies, Gehl (2010, p. 249) has developed twelve design principles for people-centered urban design that can promote voluntary activities and social interactions.

In his book Soft City, architect David Sim (2019, pp. 290–305) also presents nine urban design criteria for creating more vibrant and adaptable cities. Six of these criteria are particularly relevant for understanding how the built environment can interact with various system effects:

- **Pedestrian street**
This type of street is designed so that all types of traffic move on the same surface at a speed of between 5 and 10 km/h. This type of street should be prioritized in cities as it creates several added values and is both multifunctional and flexible. Walking streets are suitable when there is a demand or need for people to spend time in an area and can therefore be suitable for residential areas, shopping and activity streets, and near schools, sports facilities, or parks.
- **Low-speed street**
Low-speed streets are designed so that vehicles must travel at low speeds, max. 20 km/h. Pedestrians move and stay on separate pedestrian areas and in flexible areas. Vehicles travel on the carriageway in the middle and can pull over onto the carriageway or into flexible areas. Low-speed streets are also known as bicycle streets or cycle streets. Important aspects of the design include even and permeable road surfaces, wide bicycle lanes, frequent crossings, and several flexible and green areas.
- **Multi-speed street**
The design of multi-speed streets is based on the inner carriageways being adapted to a higher speed (40 km/h) while the outer ones have a lower speed (20 km/h). The carriageways in the middle are reserved for public transport, while cars and cyclists share the outer ones. Pedestrians are directed to pedestrian and flexible areas. This type of street allows for large-scale public transport and has greater capacity for vehicle flows.
- **High-speed street**
The high-speed road is designed so that vehicles can travel at higher speeds (max. 40 km/h). Public transport runs in the middle, while cyclists travel on separate lanes. Esplanades, where pedestrian and bicycle traffic are concentrated in the middle, are not recommended as they become inaccessible and make it difficult to change traffic patterns.

- In order for a city to offer a variety of activities, it needs a variety of building types, different sizes, shapes, and spatial qualities. Sim emphasizes the importance of avoiding homogeneous large scale buildings and instead promoting a mix of small and medium sized properties.
- A diversity of outdoor environments, where different types of public and private spaces create opportunities for varying uses and needs.
- Flexibility, because cities are constantly changing. The built environment must therefore be adaptable and responsive to new demands over time.
- By designing the city on a human scale, taking into account microclimate, convenience, and experiential values, places are created that encourage people to stay and interact. Density should be designed to promote human well-being rather than efficiency alone.
- Walkability is another key principle, where a well connected street structure with good accessibility facilitates movement between different places.
- Finally, the city needs to offer a sense of control and identity through clearly defined places with a distinct character. This not only supports orientation but also contributes to a sense of belonging and place identity.

Protection	Protection against traffic and accidents Feeling of safety in relation to the traffic	Protection against criminality and violence Feeling of safety Lively public spaces Both day and night activities Good lightning	Protection against unpleasant impact on the senses Windy Rain/snow Cold/heat Noise Pollution
	Walkability Place for pedestrians Interesting façades Public access Good spaces	Ability to stand Hang out spaces Supporting points to stand next to Façades that are welcoming	Ability to sit Good seating Good furniture Multifunctional
	Visual connection Good sight distances Sight lines Interesting panoramas Visibility from lightning	Being able to talk and hear Low noise level Conversation friendly seating	Opportunities for recreation and activities Encouraging physical activity Day and night Summer and winter
Happiness values	Scale The buildings and spaces adjust to a human scale in relation to different senses, abilities and behaviours	Micro climate Sun / shade Heat / cold Calm / light breeze	Aesthetics and positive impact on senses Details Sight lines Materials Trees, vegetation and water

Jan Gehl’s (2010, p. 249) 12 criteria for a human centric urban development.

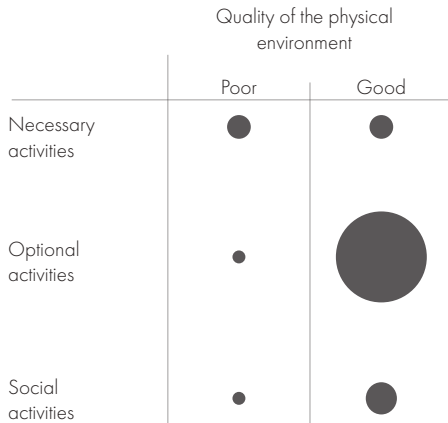
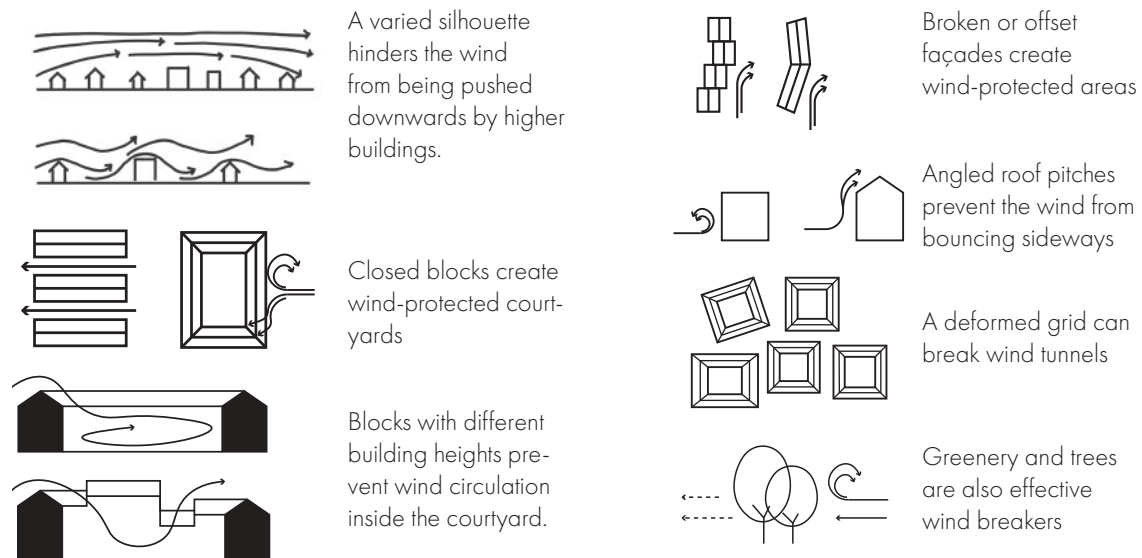


Figure 12: Relation between quality of environment and activities (Gehl 1996, p. 11-14)



The building typology affects the wind patterns and thus also the microclimate of its surroundings (Esch 2015, pp. 161-165; Du & Zhu 2023, p. 2).

Lively ground floors

In her thesis “Walls of the Public Realm,” Johanna Gimfjord Nielsen (2023) examined important aspects of creating lively ground floors, especially in areas where commercial activity is not possible. First, she looked at different morphological structures and relative locations in the system and related them to suitable functions, then assessed important aspects of the facade design to support these functions.

	Permeability	Transparency
Public	Easy accessible Large and clear entrances	High transparency High degree of glazed facade
Semi-public	Directed access The accessibility is directed towards specific groups as working places and schools	Visual exchange The façades enable a visual exchange between the inside of the building and the street. Functions such as workplaces are protected from insight.
Private	Restricted access The accessibility is restricted to only but a few, as housing	Transparency but no visual exchange The façades allow for daylight and sight lines but does not allow insight
Blank	Impermeable Function that are not used regularly, such as a emergency exit.	No connection Storage, parking

Territoriality and courtyards

Another important aspect of urban space concerns territoriality and the interface between private and public land (Minoura 2016, p. 13-14). Territoriality refers to the claim of an individual or group to a space. Moving through the city involves a constant process of interpreting territorial markers, where not only the presence of people but also physical elements such as furnishings, boundaries, and vegetation signal the social values and usage patterns of places. In her study

Demand for movement

High: retail, serving
Mid-high: Services, cultural, exercise
Mid-low: Public functions, occupational
Low: Accommodation, utility, logistics

Permeability

Permeability refers to how accessible the interior of the building is from the street, which affects the interaction between the street and the building.

Transparency

Transparency refers to the visual connection between the ground floor and the street.

Strategies for façade design strategies (Gimfjord Nielsen 2023, pp. 59-60):

- Soft boundaries
Carefully designed boundaries or buffers between public and private spaces
- Rhythm
Break up the façade into smaller sections
- Diversity
Create variation in the design of the façades to create a more stimulating street environment
- Affordance
Façades that create affordance by enabling physical interaction, such as seating.

“Uncommon Ground Urban Form and Social Territory,” Minoura has investigated how spatial elements interact to create territorial structures in urban spaces, with a particular focus on residential courtyards. The study shows that a high degree of territoriality is related to an increased sense of control for users, which strengthens their sense of belonging and security. The size of residential courtyards also relates to their capacity for different functions, activities, and uses.

In her study, Minoura (2016, pp. 338-342) develops an understanding of how different building typologies relate to degrees of territoriality and identifies design principles that can strengthen the function and perceived sense of belonging of residential courtyards. The study shows that spacious courtyards, with a benchmark of 10 to 12 square meters of courtyard space per 100 square meters of gross floor area, tend to be used more often and by more residents. However, unclear boundaries between private and communal spaces lead to fewer signs of use and can be linked to an increased feeling of insecurity. Clear framing of the courtyard, on the other hand, strengthens both security and a sense of belonging.

Courtyards that are used as thoroughfares often lose both their use and their identity, which should be avoided. At the same time, courtyards that leave room for residents’ own initiatives, the “unfinished”, can encourage engagement, provided that basic spatial qualities such as size, clarity, and space are in place.

Three key factors that influence the usability and attractiveness of courtyards are:

- The design of the interface, and the degree of openness (fences, vegetation)
- Spatial proportions, where a balance between space and density plays an important role
- Functional diversity, which enables different types of use and strengthens the social life of the place.

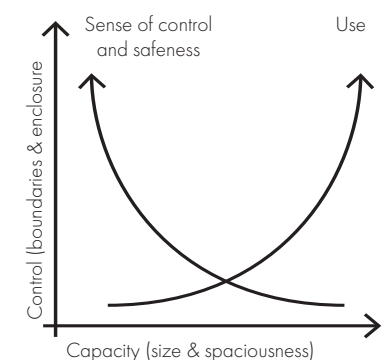


Figure 13: Relation between the usage of courtyard and the sense of control and size (Minoura 2016)

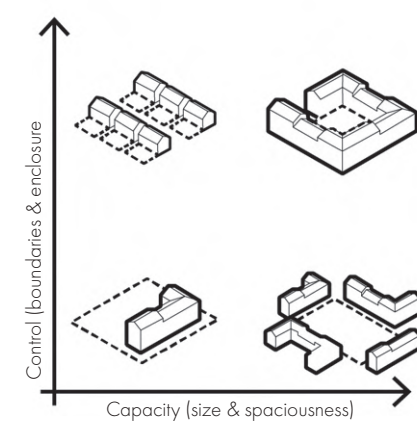


Figure 14: Relation between the capacity and the sense of control of a courtyard (Minoura 2016)

04. Design framework

This chapter summarises a design framework based on the key aspects identified in the theory chapter. The framework is intended to serve as a guide to designing and assembling different configurations to achieve and reinforce desirable system effects. It also highlights potential conflicts within and between different design elements.

System



Ground Space Index (GSI)
Shows how much land is occupied by buildings. As with FSI, the Accessibility to GSI can also be a good way to investigate the local context.

LowHigh

Positive

- More open spaces, providing good opportunities for recreation through parks, gardens, greenery, and better natural storm water management.

Positive

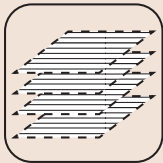
- Dense urban structure, can promote city life and urban qualities.
- Clear interface between public and private spaces

Negative

- Inefficient use of space.
- Weak urban identity and difficulty in creating urban environments.
- May make it difficult to create pedestrian- and bicycle-friendly environments if buildings are sparsely located.

Negative

- Risk of insufficient space for green spaces, play areas or recreation.
- Risk of poor storm water management and increased heat island effect.
- May reduce opportunities for flexibility in land use.



Floor Space Index (FSI)
Measures the volume of the building in relation to land use. To generate a population density of 15000 residents / km2, which UN Habitat has identified as a mean value for cities with the highest liveability index in Europe, an FSI of 2.0 on block scale (Salat 2021; Spacescape 2016). UN-Habitat emphasises the importance of starting from the local context in order to achieve sustainable densification. This can be achieved by examining accessibility to FSI within a certain radius.

LowHigh

Positive

- Sparsely populated and quieter residential environments with larger private spaces.
- Better access to greenery, daylight, and air.

Positive

- Efficient land use
- Enables high population density, which supports higher flows, public transport and local services.

Negative

- Inefficient land use, may lead to urban sprawl.
- Difficult to provide the area with public transport or local services.
- May contribute to increased car dependency

Negative

- Risk of congestion, lack of green spaces and daylight if paired with high GSI.
- Can create a feeling of anonymity and large scale.
- Requires more advanced infrastructure (sewage, transportation, ventilation).



Population density
UN Habitat has identified a population density of 12 000-15 000 residents / km2 as a mean value for cities with the highest liveability index in Europe (Salat 2020). They emphasises the importance of the local context in order to achieve sustainable population density. Spacescape (2016) argues that this population density may be difficult to achieve on a larger scale, but believes it is desirable within 800 m walking distance of a major public transport hub.

LowHigh

Positive

- Quiet and low stress: A more peaceful living environment with less traffic and noise.
- More space per person: Larger private plots, more greenery, easier access to nature.

Positive

- Better population base for public transport, shops, schools, and culture.
- More movement, better conditions for social interaction.
- Shorter distances and opportunities for sustainable transport solutions.

Negative

- Inefficient land use: May lead to urban sprawl and higher infrastructure costs.
- Increased car dependency: Long distances make walking, cycling, and public transportation less attractive.
- Weak service base for local businesses, schools, and public transportation.

Negative

- Risk of congestion: Risk leading to increase stress, noise, and competition for public spaces.
- Pressure on infrastructure: Sewage systems, transportation, and healthcare may become overburdened.



Plots

A finely divided property structure enables a wider range of property uses, thereby promoting diversified land use (Marcus 2022, pp. 41–43; Marcus 2010, pp. 36-38). Marcus links this to what he terms “spatial capacity”, which refers to how many properties can be reached from a given point, area, or street segment. This in turn impact the “spatial capital”, which Marcus mean is defined as the socio-spatial value generated by the urban form.

Small

Positive

- Enables more economic efficient land use, as the land is divided into smaller units.
- Higher property density, opportunities for increased mixed use.

Negative

- May pose challenges in the coordination of larger urban development projects or infrastructure investments.
- Cannot accommodate space-intensive activities.

Large

Positive

- Capacity to accommodate space demanding such as industry, logistics or food stores
- Can provide a certain degree of flexibility

Negative

- Tend to reduce urban mixed use, as larger units are often dominated by a single function.
- Higher price per unit.



Betweenness centrality

It is often measured at local (neighbourhood) scale using a 2 km analysis, and at global (city) scale using a 5 km analysis.

Betweenness centrality shows through movement, while integration centrality shows to movement.

If the same street segment has a high betweenness centrality value at both local and global levels, it is possible to meet people from all over the city in the same place, thereby increasing co-presence.

Low

Positive

- Privacy and tranquillity: Suitable for residential areas, parks, or retreats.
- Controlled access: Useful in areas requiring security or limited flow (e.g., private campuses, sensitive facilities).
- Character and exploration: Can create a sense of mystery or uniqueness, often seen in historic urban environments.

Negative

- Poor accessibility: These areas can be harder to find or get to, which can lead to underused or neglect.
- In large areas they can led to isolation, social exclusion or crime if they're too secluded.
- Economic decline: lack of customer footfall.

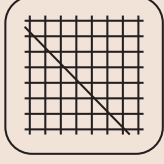
High

Positive

- Easy navigation: Areas are easier to reach with fewer direction changes – intuitive for users.
- High pedestrian traffic: beneficial for retail and social activities.
- Natural surveillance: More people can increase safety by “keeping an eye on the street.”

Negative

- Congestion: High integration can lead to overcrowding and traffic (vehicles or pedestrians).
- Lack of privacy: Overly exposed spaces may be unsuitable for residential or contemplative purposes.
- May increase noise and pollution



Street network

150 junctions / km²
Distance between junction: 50-150
High permeability for pedestrian and cyclist

Tree structure: A main line with branches leading to separate zones for specific functions (housing, work), resulting in limited integration.

Network structure: Evenly distributed, inter-connected streets, enabling better accessibility, functional mixing.



Land-use

The following thresholds are suggested for creating a good balance between different land uses (Salat 2021; Spacescape 2016). Housing: 25%, Community services/economy: 25%, Streets: 25–30%, Parks & open spaces: 20–25%

Public spaces should meet the following criteria: At least 15% of the total land area (of which 10% should be green areas and 5% parks). 10 m² of public space per resident (Space Scape 2016, pp. 23-33)

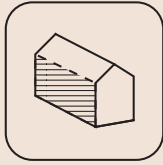


Green structure

Green areas
Public green areas of at least 0.2 hectares must be accessible within 200 meters.

Park
A maximum distance of 500 meters to a park area that is at least 1 hectare and 50 meters wide. The park area must have a flat grassy area of at least 0.5 hectares.

Local



Facade & Lively ground floor

In her master’s thesis, Johanna Gimfjord Nielsen (2023) has investigated how ground floors can be programmed based on function, demand of flow, transparency, and permeability.

To create flexibility between apartments and facilities, the ground floor ceiling height can be raised to 4 meter.

At least 5 entrances per 100 m in mixed-use developments (Spacescape 2016).

Demand of flow

High
Retail, serving

Mid-high
Care, culture, services, exercise

Mid- low
Gatherings, public functions, occupational

Low
Accommodation, utility, logistics

Function

Public
Retail, serving

Semi-public
Schools, Workplaces

Private
Accommodation

Transparency

Full exposure
Public

Visual exchange
Semi-public

Visibility, no exposure
Private

Enclosed
No visual connection

Permeability

Open access
Public

Addressed access
Semi-public

Restricted access
Private

Impermeable
Ex emergency exits



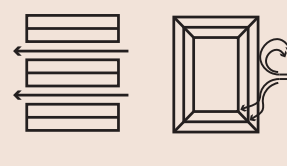
Microclimate

Wind is often the most problematic aspect of creating a comfortable microclimate. A sunny February day can be pleasant outside if it’s no cold wind and a rainy summer day will be more bearable if it’s not windy.

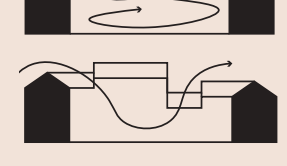
The building typology affects the wind patterns and thus also the microclimate of its surroundings (Esch 2015, pp. 161-165; Du & Zhu 2023, p. 2).



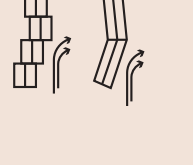
A varied silhouette hinders the wind from being pushed downwards by higher buildings.



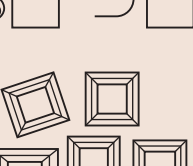
Closed blocks create wind-protected courtyards



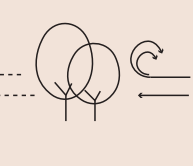
Blocks with different building heights prevent wind circulation inside the courtyard.



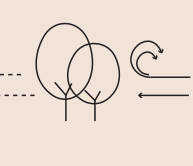
Broken or offset façades create wind-protected areas



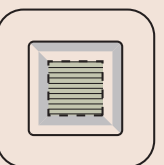
Angled roof pitches prevent the wind from bouncing sideways



A deformed grid pattern can break wind tunnels



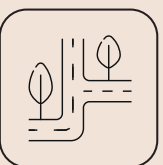
Trees and greenery are also effective wind blockers



Enclosure & courtyards

Higher enclosure can increase the user’s sense of control and belonging to the place. Minimum courtyard size 1500 m², ideally between 3000 too 4000 m² (Minoura 2016).

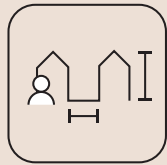
Individual ownership: High (85-100 %)
Collective ownership: Minimum 85%
Collective ownership and use :Minimum 85%
Collective use: Flexible
Use (Public): Low (0-20 %)



Streets

The following street types are based on the guide “Design guide för smarta gator” (Design guide for smart streets) (Stähle et al., 2022):

- Pedestrian street (highest priority)
- Low-speed street
- Multi-lane street
- High-speed street (lowest priority)



Human oriented cities

Based on the works of Jan Gehl (1996; 2010), David Sim (2019), and Carmona (2010) the following aspects could foster a greater human well-being in the built environment.



Design considerations



Design of building façades at eye level to stimulate experience



Boundaries between public and private

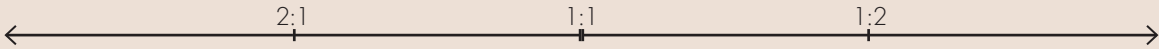


The interaction between the inside and outside of a building



Connection between the building and the street. Floors above the fifth floor have a reduced connection.

Ratio between street width and building height



>2:1 is The street feels very wide and expansive. Very low enclosure where pedestrians may feel exposed. More likely to be auto-oriented, with reduced human scale.

A ratio of 2:1 feels open and spacious. It has a low sense of enclosure – the sky dominates the view. May reduce walkability and comfort unless well-landscaped.

A ratio of 1:1 is often considered the minimum for comfortable urban streets. A street wall height that equals the street width severely limits any sky view and gives a strong sense of enclosure.

If the ratio is 1:2 the sky equal the amount of visual field devoted to the street wall. Provides a good sense of enclosure in a street.

>1:2.5. May cause feelings of claustrophobia and will reduce light penetration. Can create dramatic contrast combination with other street profiles.



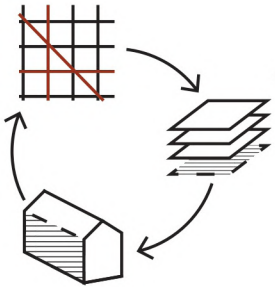
Habitat parameters for bees (Berghauser Pont et al, 2022)

	Arable land	Roads and railways	Artificial surface, excluding built-up areas and roads	Built-up areas	Non-vegetated other open land	Vegetated open land	Flower rich vegetation	Inland water surface	Ponds	Marine water surface	Open wetland	Valuable trees	Valuable trees with holes	Pine forest	Spruce forest	Mixed coniferous forest	Deciduous forest	Deciduous hardwood forest	Deciduous forest with deciduous	Hardwood forest	Temporarily non forest
Biotope code	118	7	116	115	114	113	112	111	701	700	2	62	63	61	43	42	41	51	52	53	3
Quality	7	117	2	2	2	2	2	3	6	5	5	0	2	1	8	7	2	0	0	0	2
Reproduction	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0
Friction	1	1	1	1	1	1	1	2	1	1	1	20	1	1	1	1	2	50	3	5	2

DESIGN FRAMEWORK

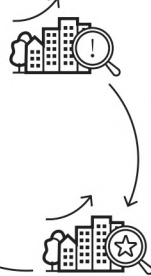
Analytical understanding

Develop an analytical understanding of urban morphological elements. This refers to how the underlying spatial principles affect function and use.



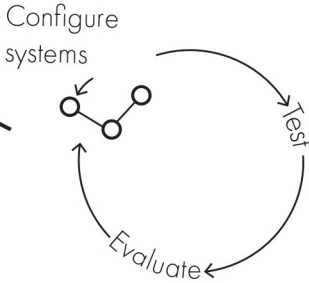
Context

Analyse the context through spatial analyses and theoretical frameworks to create an understanding of the current context and to highlight different system conditions



Match with coherent design

Match system configuration with local design that enhance positive system effects and mitigate social-ecological conflicts



Identify potentials

Risks and potentials are identified for the site based on its system conditions and morphological attributes. A vision is formulated for how the site could be developed to generate positive system effects and to mitigate conflicts between social and ecological aspects.

Reconfigure, test, evaluate

Test and evaluate spatial configurations using analytical methods to ensure the design hold the potential to fulfil the vision.

05. Context

In this chapter the context of Varberg is explored a variation of spatial analysis.

Context

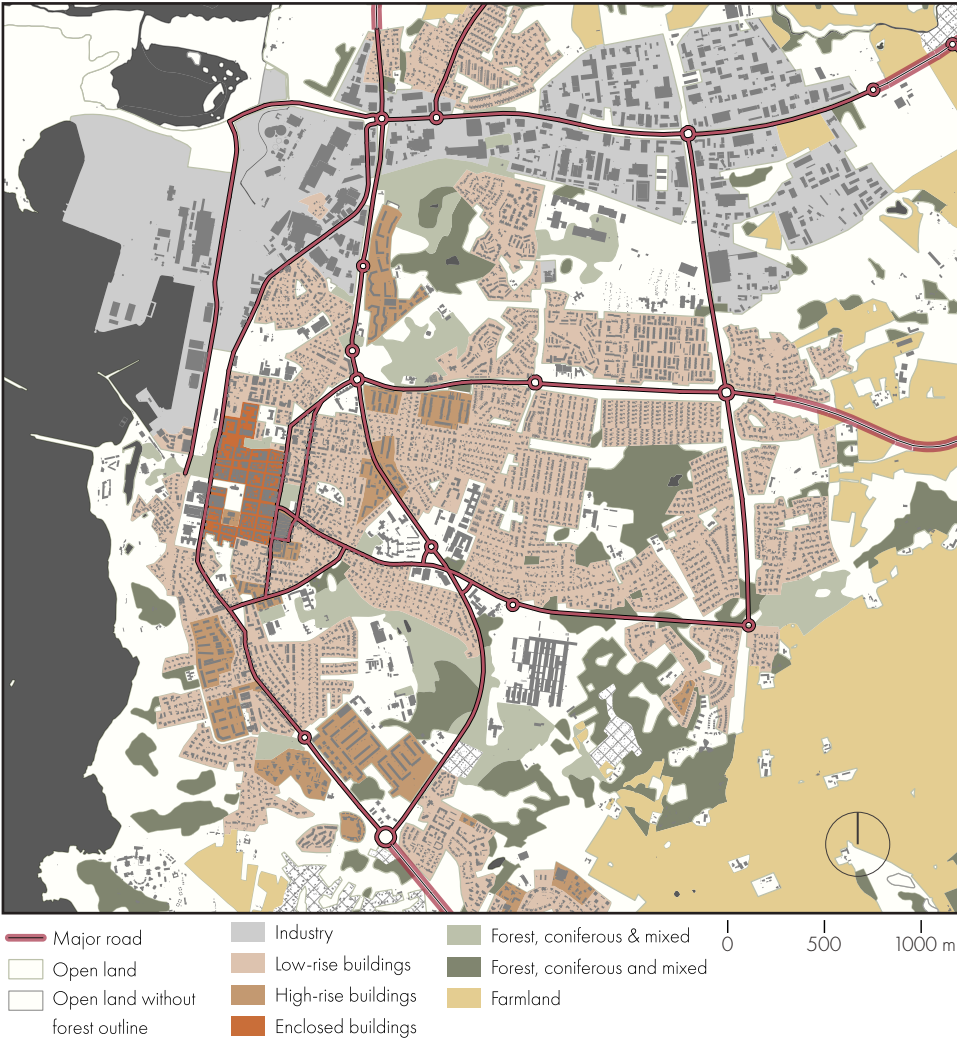
Varberg is a coastal city located in Halland County, on the west coast of Sweden, approximately 75 kilometres south of Gothenburg and 140 kilometres north of Malmö. The municipality has a population of around 65,000 inhabitants, where around 36 00 live in the city. Varberg has become a know destination for tourism, wellness, and commerce.

The current strategy in Varberg (2018) for urban development is densification, partially to protect the surrounding farmland, partially to add new values to already built-up areas. The densification plan has three priority strategies that propose different areas for densifying the city with new housing, services, and facilities:

- Develop Västerport to a mix use urban district.
- Transforming Trädlyckevägen and Österängsvägen to create urban corridors.
- Densify near local squares.

Land-use map

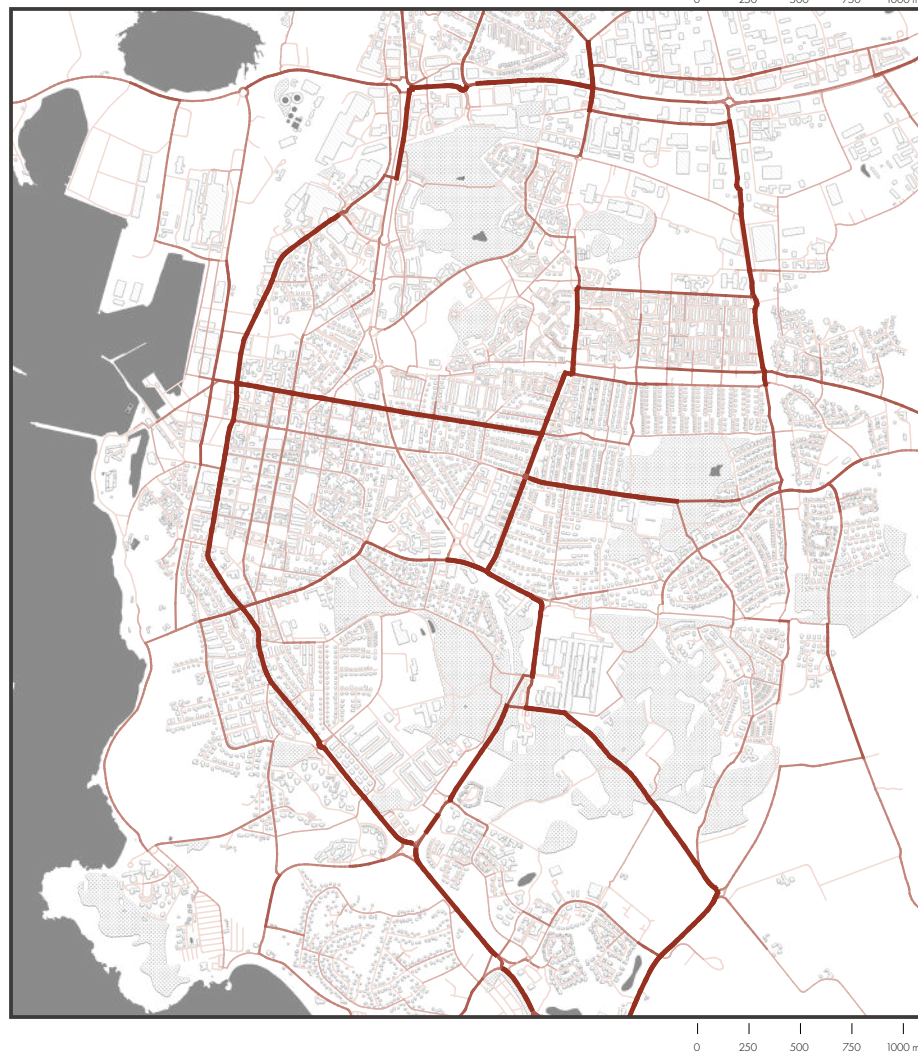
The land-use map shows the current extent of Varberg’s urban area. The city centre is still made up of closed blocks dating back to the city’s beginnings, while the built-up area is gradually becoming less dense and turning into villa areas with an urban sprawl character. The populated areas Varberg is mainly surrounded by high quality farmland. This imposes challenges for Varbergs future development, as the farmland is seen as a natural resource and is of national importance, therefore a hindrance for urban extension.





Angular betweenness, 2km

The analysis shows the betweenness centrality on a local scale. In the centre, there are several similar street segments, which means that none of them stand out. Outside the centre, Ringvägen and Magasinsgatan have higher centrality, which is then connected via Föreningsgatan.



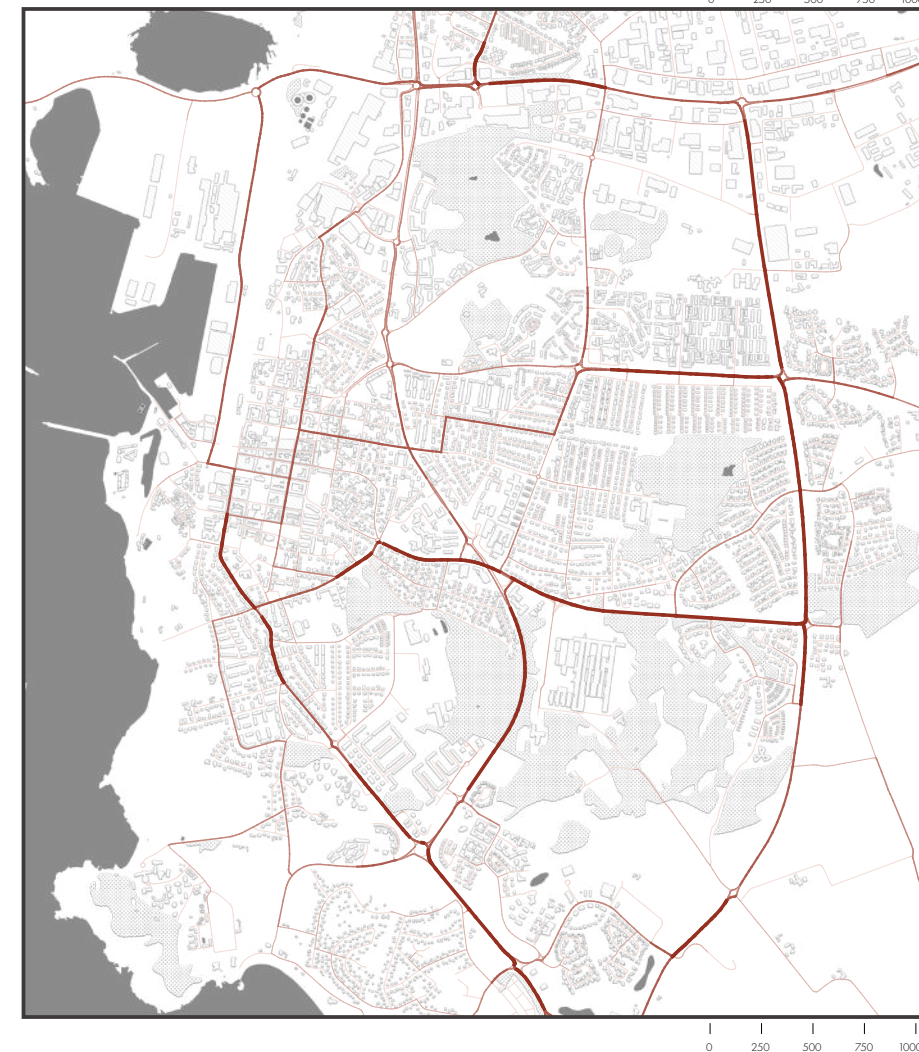
Angular betweenness, 5km

The analysis shows betweenness centrality at a global level. Here, Västra Vallgatan/Birger Svenssonsväg has a higher centrality in the city centre. At the same time, Magasinsgatan still has a high centrality, while Ringvägen disappears. Instead, Föreningsgatan is reinforced, which then leads on to Södra Vägen in the south and Österleden in the east.



Motorized angular betweenness, 2km

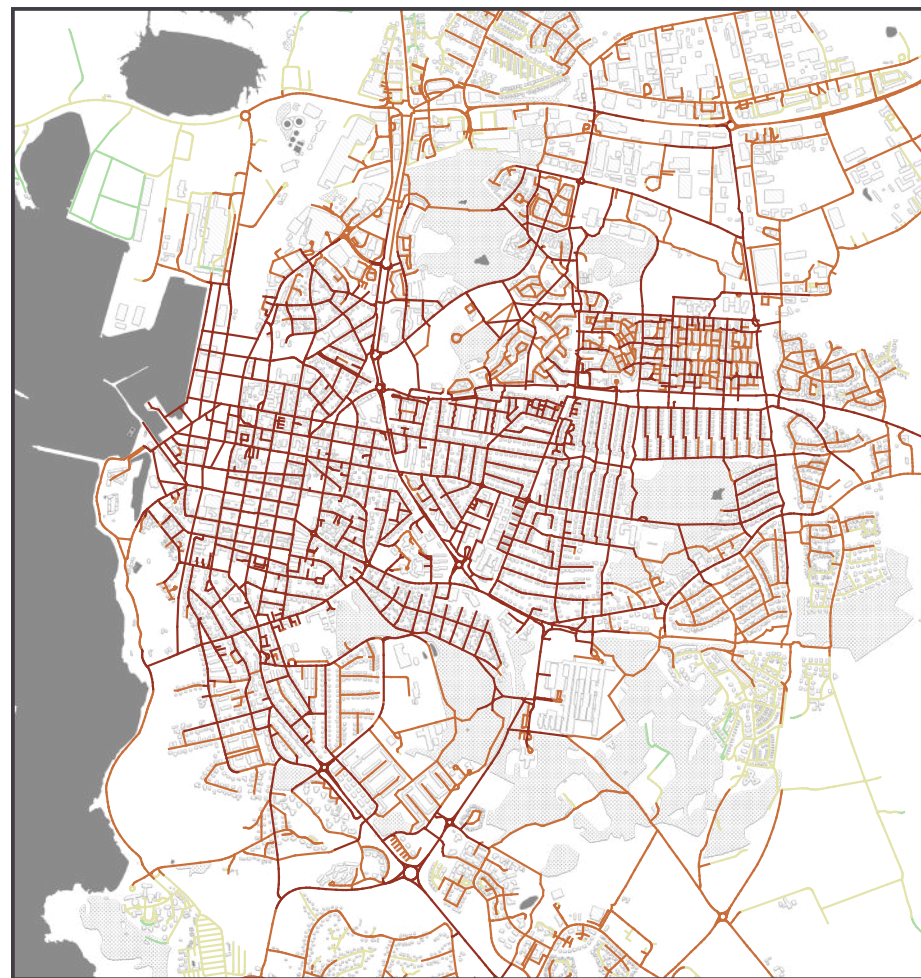
The map shows the motorized betweenness centrality on a local (neighbourhood) scale. The analysis shows that the route from Ringvägen up to Föreningsgatan is a segment with high frequency for motorized traffic. This also coincides with the analysis for non-motorized betweenness centrality on the same scale.



Motorized angular betweenness, 5km

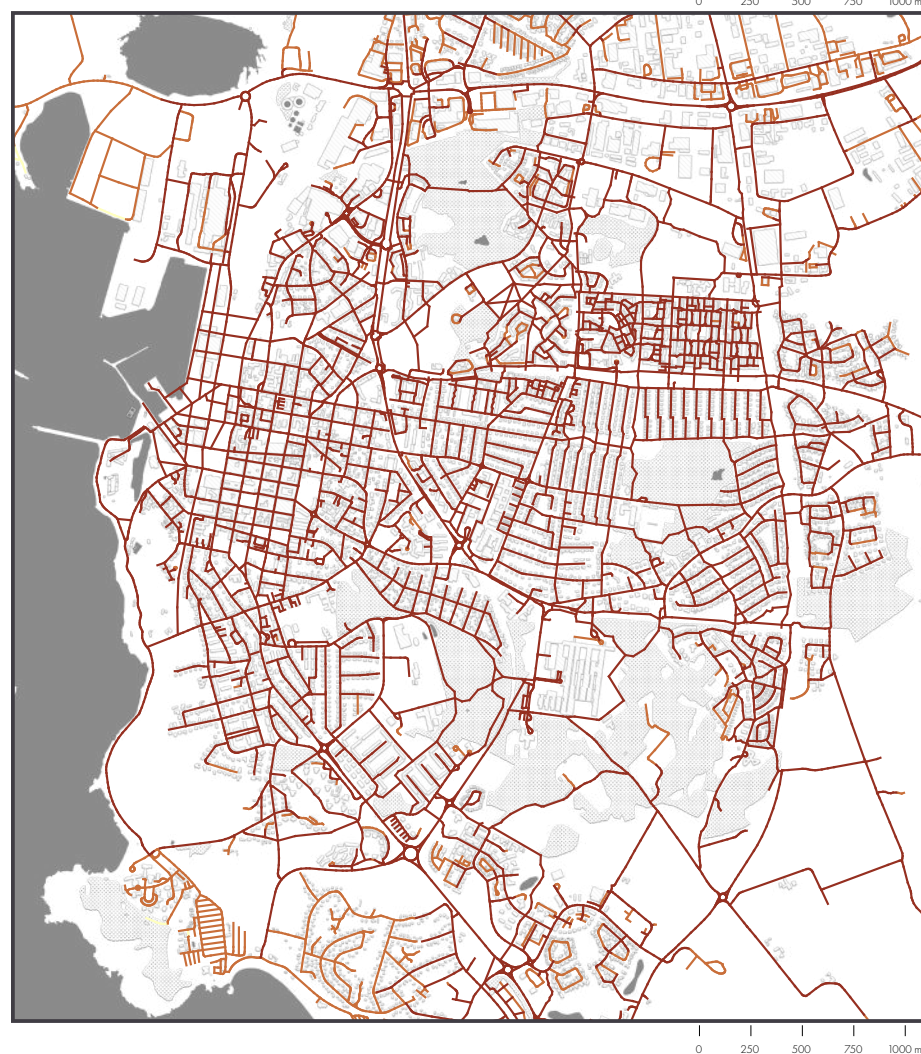
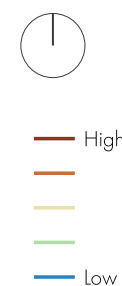
The map shows the motorized betweenness centrality on a global (city) scale. The analysis shows a clearer hierarchy than the other maps, where two prominent roads, Ringvägen and Österängsvägen, have high centrality and meet in the center of the city.





Angular integration, 2km

The map shows integration centrality at a local level. The analysis shows that the central parts of the city are well integrated, with integration decreasing towards the outskirts. There are no major areas with low integration within the city.



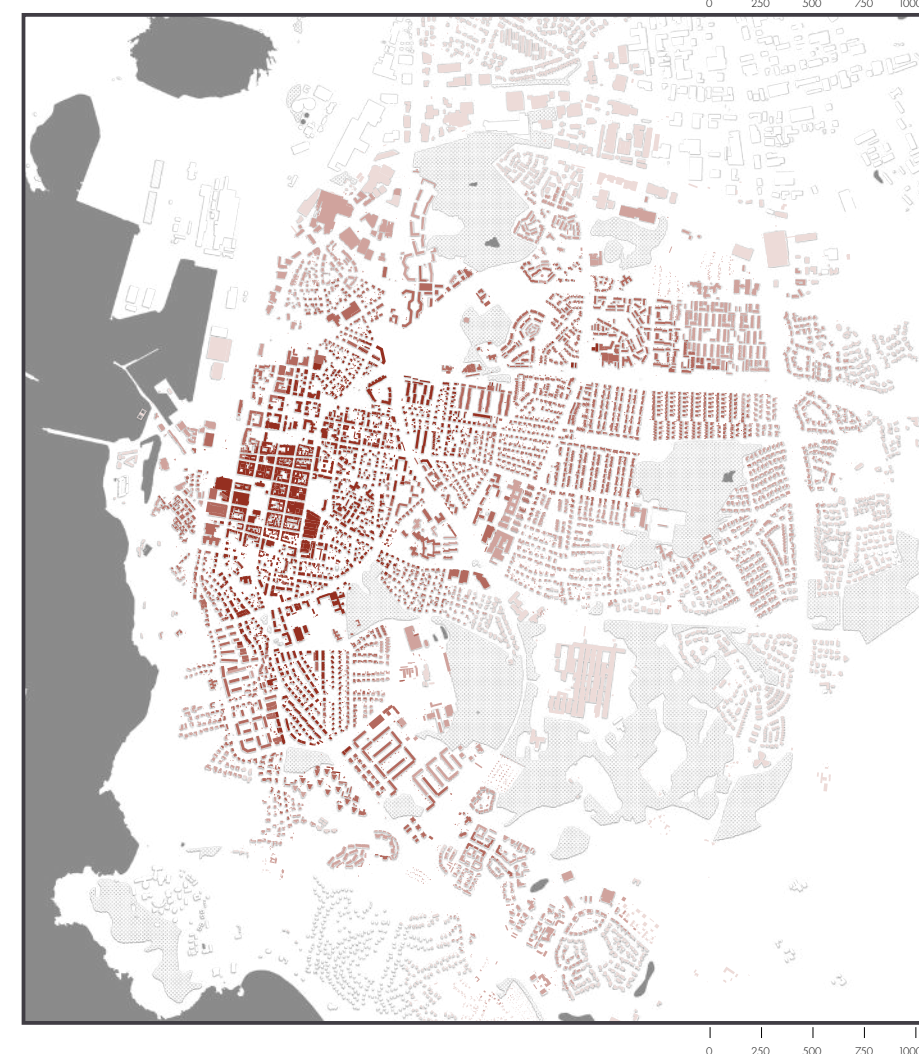
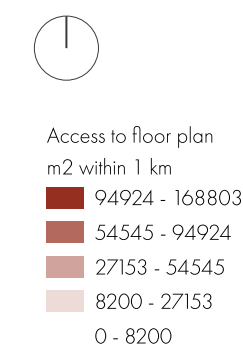
Angular integration, 5km

The map shows integration centrality at a global level. The analysis shows that the whole city is well integrated.



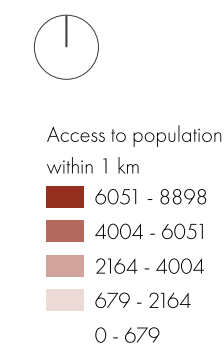
Sqm of floorplan area within 1km

The map shows how much ground floor that can be reached from each building. The analysis shows highest level within the city centre with a few hotspots dispersed in the city.



Access to population within 1km

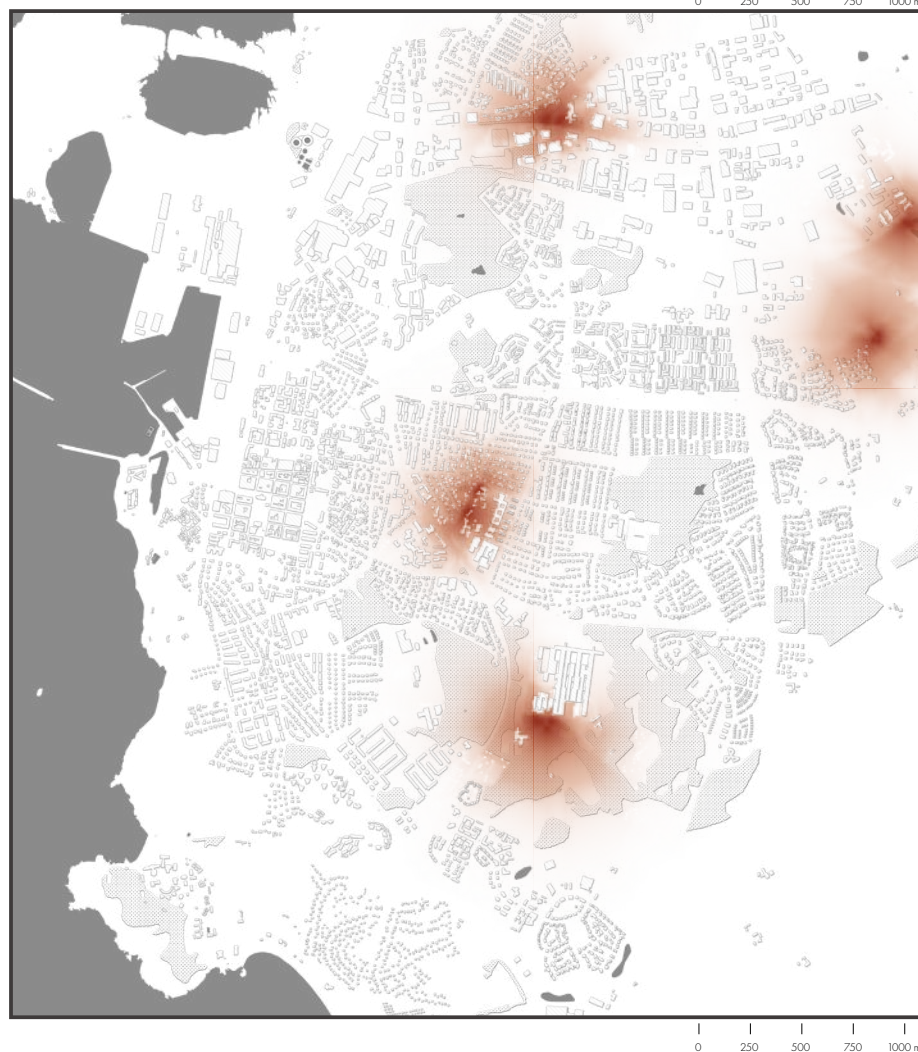
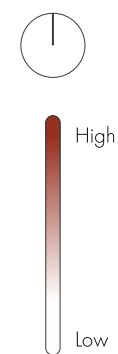
The map shows how much of the population that can be reached from each building. The analysis shows highest level within the city centre that stretches out towards the south and north east. In the middle of the city, along Österängvägen, there's a lower value than the surrounding areas. This can be explained by that a large hospital is located there.





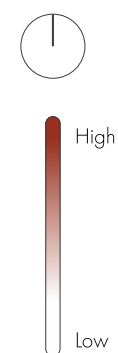
Functional map

The map illustrate the distribution of valuable trees in Varberg, which is a core habitat for the tree living bees. The analysis shows that these trees are unevenly distributed throughout the city. There is potential to create a core habitat network by connecting them through green corridors.



Dispersion map

The map show the dispersal for tree living bees from valuable trees in Varberg. The analysis shows that non of the core value habitats are connected.



Access to green areas

The map show which buildings have access to a green area larger than 0.2 hectares within 200 metres. Several buildings in the city do not meet the threshold today. One disadvantage of the threshold is that it does not take into account how large the green spaces are, which is unfavourable for Varberg, which has several large green areas throughout the city. The map shows that the up-take area is quite small, which could indicate the need for larger portions of small and pocket parks at neighbourhood level.



● Buildings with access to a green area > 0.2 ha within 200m



Parks

The map show which buildings have access to a park larger than 1 ha within a 500 m walking radius. Most of the parks are located in the central and southern parts of the city, leaving the eastern and northern areas without access to a park within the threshold. It is important to note that much of the northern area consists of industrial zones.



● Buildings with access to park > 1 ha within 500 m



Squares

The map show which buildings have access to a square within an 800 m walking radius. As there are only two squares in the city, “Varbergs Square” in the centre and “Breared Square” in the south, much of the city has limited access to a local square.



● Buildings with access to squares within 800 m

Restaurants, cafés and bar

The map show the accessibility of restaurants, cafés and bars within 500 metres walking distance from buildings. These are concentrated in the city centre, though some are also located throughout the city. A large proportion of the city does not have access to restaurants, cafés and bars within a 1 km walking distance.



● Buildings with access to over two restaurants, cafés or bars
● Buildings with access to one or two restaurants, cafés or bars

Densities

The area consists of town houses and apartments. It is on a small scale and can be described as a low-rise striped development.

The area consists of an older neighbourhood with buildings arranged in a block structure. However, the façades are broken up between the properties and are not continuous. The building typology is classified as a hybrid low-rise stripe/block type.

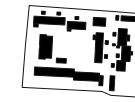
The neighbourhood consists of both older and newer buildings, with the latter being taller. The new buildings have 5–6 floors, whereas the older buildings have 2–3. The building typology is classified as a hybrid low-rise stripe/block type.

The neighbourhood consists of a collection of single-family homes, ranging from one-and-a-half to two storeys. The buildings are classified as low-rise point type.

Block

Low-rise stripe (A)

A	1.03 ha
FSI	0.4
GSI	0.23
OSR	1.8
L	1.7



Hybrid low-rise stripe/block type (B)

A	1.03 ha
FSI	0.87
GSI	0.3
OSR	0.8
L	2.8



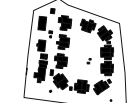
Hybrid low-rise stripe/block type (C)

A	1.9 ha
FSI	1.05
GSI	0.31
OSR	0.64
L	3.3



Low rise point type (D)

A	1.3 ha
FSI	0.36
GSI	0.21
OSR	2.1
L	1.7



District

A	21.34 ha
FSI	0.48
GSI	0.28
OSR	1.5
L	1.71



A	7.18 ha
FSI	0.66
GSI	0.27
OSR	1
L	2.4



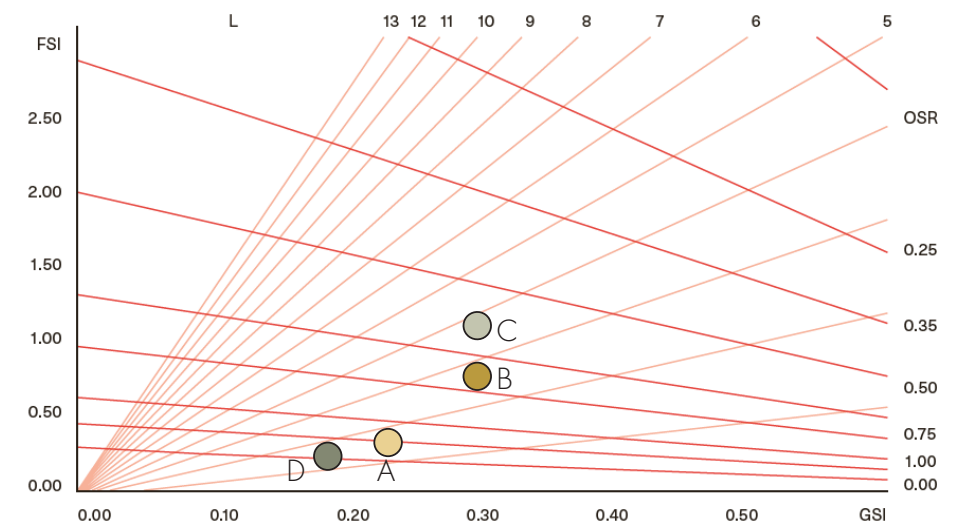
A	8.84 ha
FSI	0.75
GSI	0.22
OSR	1
L	2.4



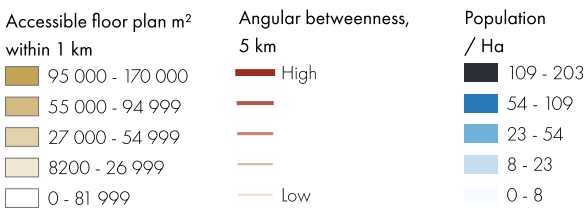
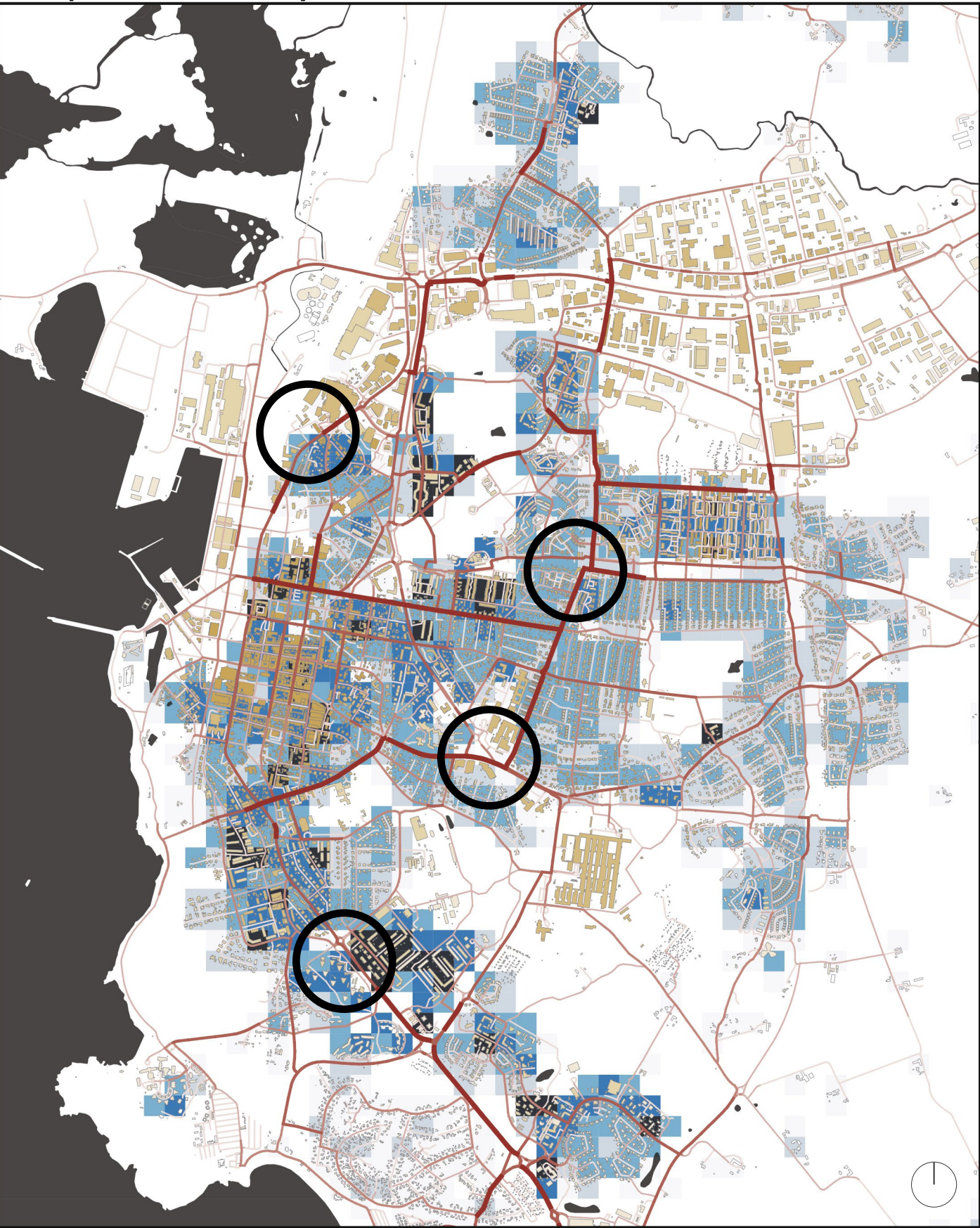
A	23.33 ha
FSI	0.18
GSI	0.13
OSR	4.6
L	1.4



Fig 13: Aerial photos from Slagboom en Peeters (2024)



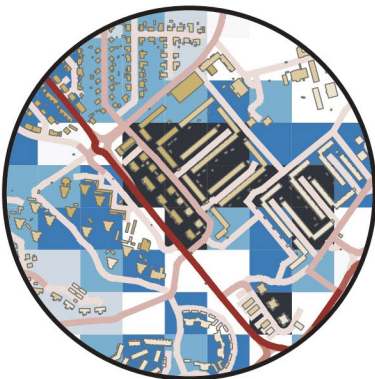
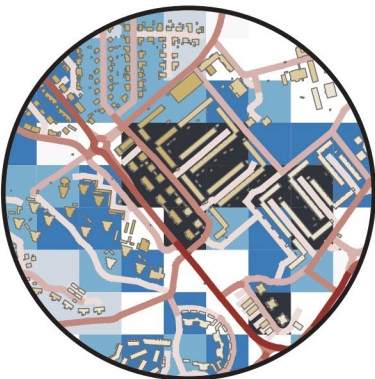
Comprehensive analysis



AB 2km

AB 5km

Mismatch 1



Mismatch 1
The combined analysis suggests there's a mismatch in the area's spatial configuration. Both the betweenness centrality is high on both scales and population density are high, which indicating an opportunity to create movement, the access to ground floors is relatively limited. This points to an underutilization of available potential. The spatial configuration has a potential of creating a more mixed-use neighbourhood and support more active ground floor uses with a wider range of functions, but this capacity is not realized by the building typology and the street scape.

Mismatch 2



Mismatch 2-4
The combined analysis indicates a spatial and functional mismatch in the area. Both local and global scales show high betweenness centrality, suggesting the area holds a potential of creating both a higher flow of people and co-presence. There's also a relative high accessibility to ground floor area. However, there's a relatively low degree of accessible population, meaning that the number of people within walking distance is limited.

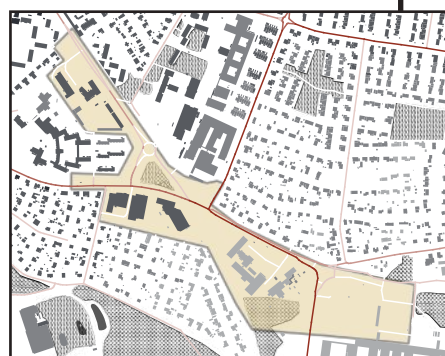
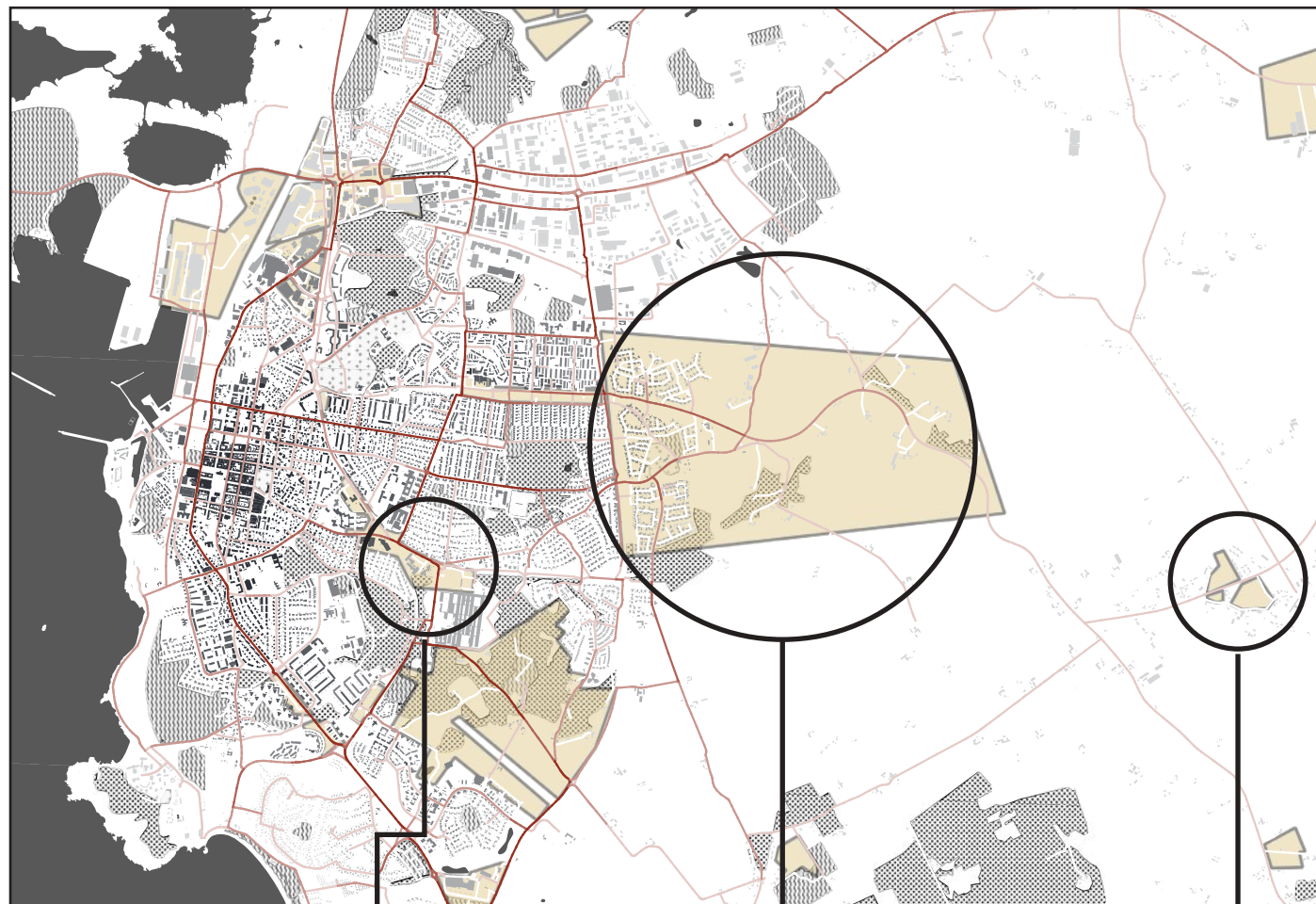
Mismatch 3



This mismatch suggests that the area's spatial potential is not currently matched by its level of everyday use. Increasing population density in the surrounding context could contribute to higher levels of co-presence and pedestrian flow. In turn, this may support more consistent use of ground floor spaces and improve the conditions for local businesses. While population density alone may not address all aspects of the mismatch, it represents one possible factor in supporting a better alignment between spatial configuration and actual use.

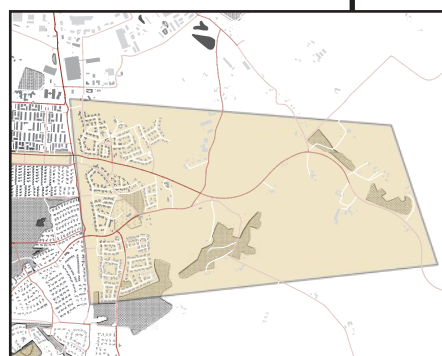
Mismatch 4





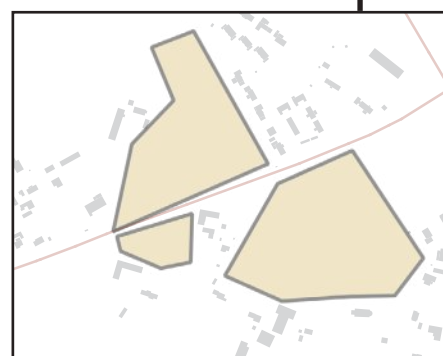
Infill

High centrality & medium density



Edge

Medium centrality & low density



Rural

Low centrality & low density

06. Design study

This chapter focuses on the 'infill' the site. First, a series of spatial analyses are carried out to understand the current morphological elements and system conditions, and to identify the potentials and risks of developing the site. The identified potentials are then matched with coherent design criteria on a system scale to spatially reconfigure the site. Finally, local design criteria are identified for important aspects of the functional form of the built environment to enhance system effects.

Based on the overall analysis, three different locations with different system conditions have been identified: infill, edge, and rural. Infill is geographically central in the city with high connectivity but with moderate to low access to building land. Edge is located on the outskirts of the urban area and has thoroughfares with higher connectivity but low access to building land. Rural is located in the countryside and has access to low connectivity and low building land.

Site analysis - Infill

The area is currently characterized by the dominance of cars in the streets, large industries and businesses, and several schools. Within 500 meters walking distance from the site, there are various building types on different scales. Two prominent building types are detached houses and lamella houses. The area is also characterized by larger buildings, mainly Varberg Hospital, but also Peder Skrivares School and retirement homes. Since Vaskustvägen is a grade-separated road and therefore does not connect to several local streets in the west, these are not within 500 m walking distance even though they are located right next to the area. Based on the space matrix analysis, the area can be interpreted as low-scale street development with low pressure on open spaces.



Area + 500m

Population	Area	Population/km2	GSI	FSI	OSR	L
4453	1.07	4200	0.25	0.53	1.4	2.1

Villas (A)

A	0.4
FSI	0.3
GSI	0.2
OSR	1.2
L	1.8

Town houses (B)

A	0.2
FSI	0.4
GSI	0.35
OSR	0.8
L	2

Lamella houses (C)

A	0.73 ha
FSI	0.45
GSI	0.19
OSR	1.8
L	2.4

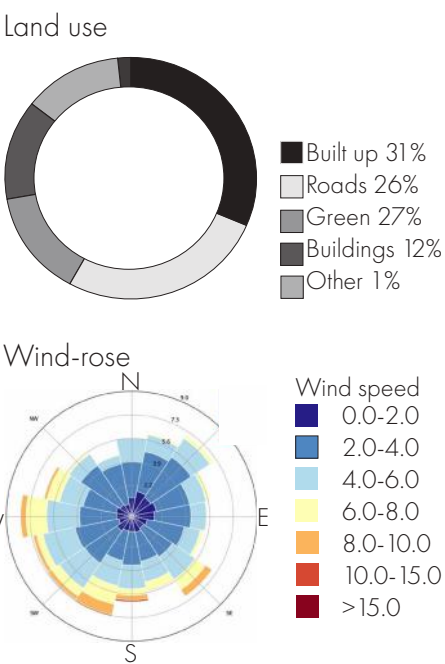
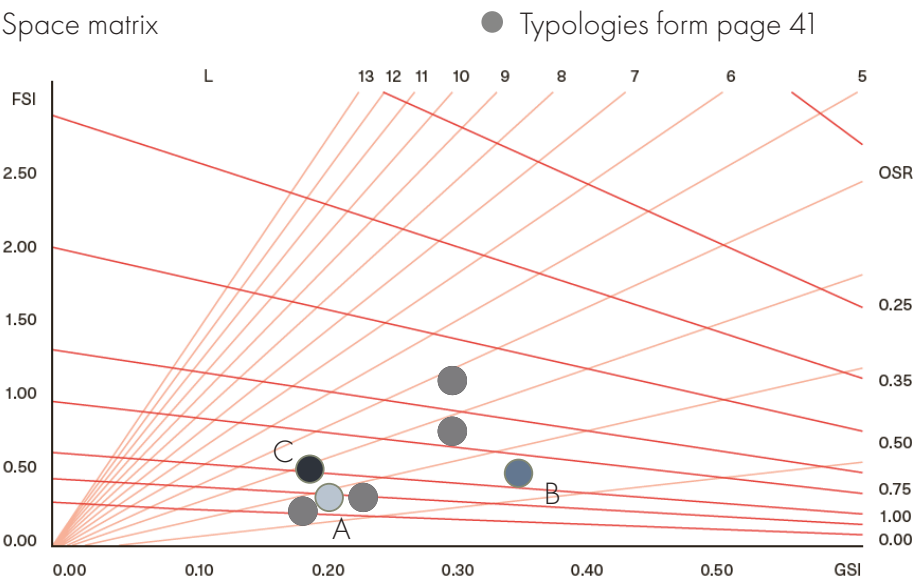


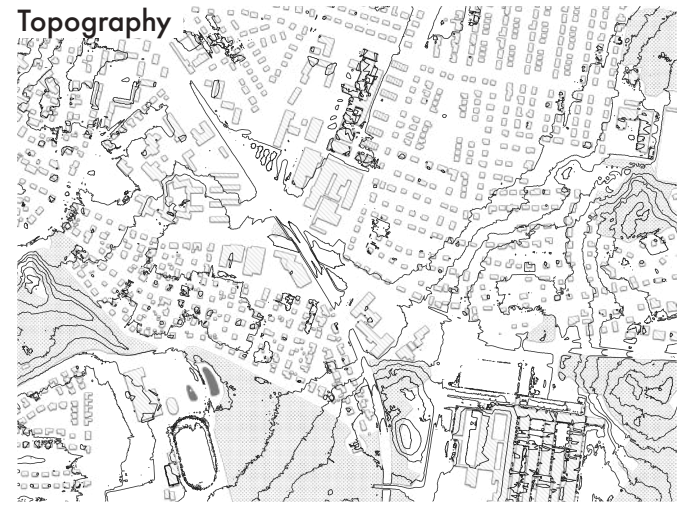
Fig 14: Stormhuset (n.d)



The planning area currently consists of buildings with a large floor area but lower building heights and a large-scale property division. The area is divided into three building clusters.



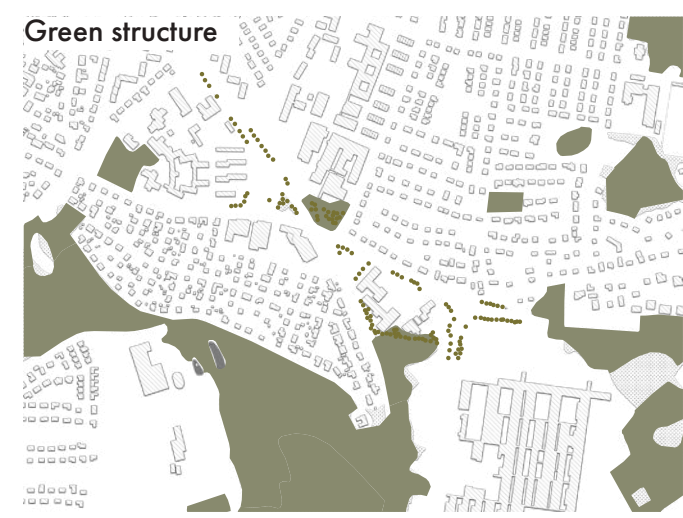
There are large parking lots adjacent to the buildings, and the grade-separated intersection creates two large unused areas between the roads and their entrances and exits. This leads to inefficient land use in the area, with several neglected spaces.



The planning area is largely flat, but the grade-separated intersection creates a low point in the area. To the south of the area, adjacent to Österängsvägen, the area becomes more hilly.



Two main roads run through the planning area, Vaskustvägen and Träslövsvägen, which then merge into Österängsvägen. This road also leads to Varberg Hospital, which is located on the border of the area. The grade-separated intersection between the two roads creates barriers in the area. Along Träslövsvägen, several properties have their driveway.



Although the planning area is dominated by hardened ground, there are also clear elements of greenery, which create conditions for green corridors through the area.



The residential cluster to the north west is currently occupied by Varbergs Energi. The central area consists of three schools, a solarium, and a large grocery store. The cluster to the east consists of a newly built preschool and warehouse and office premises.



Current conflicts

- Low FSI - inefficient land use
- Fragmented green spaces
- Hard-packed soil / Parking - Ineffective land use & heat islands
- Car dominated - barriers to walking and cycling



Potential conflicts

- Increased stress
- Removal of green infrastructure
- Storm water management
- Increased pressure on public spaces



Potentials



Public life

Meeting places, flow of people



Silent retreat

Recreation and nature experience



Diversity of uses

Diversity of functions and activities



Biodiversity

Foster biodiversity to support ecosystem services



Pedestrian and bicycle

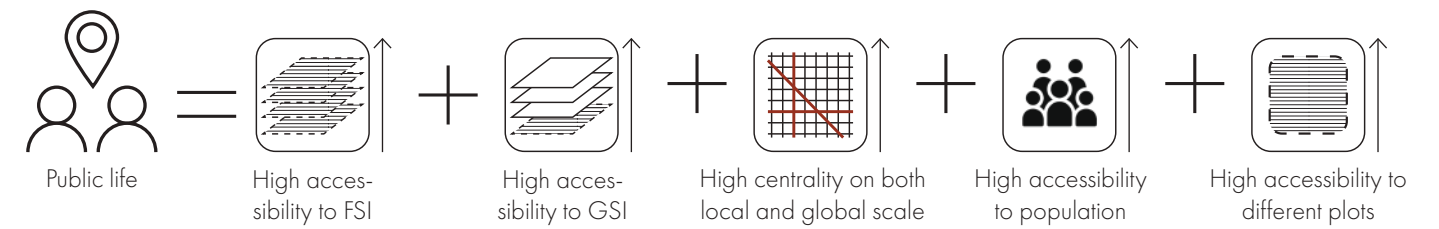
Shift towards sustainable modes of travel

Vision

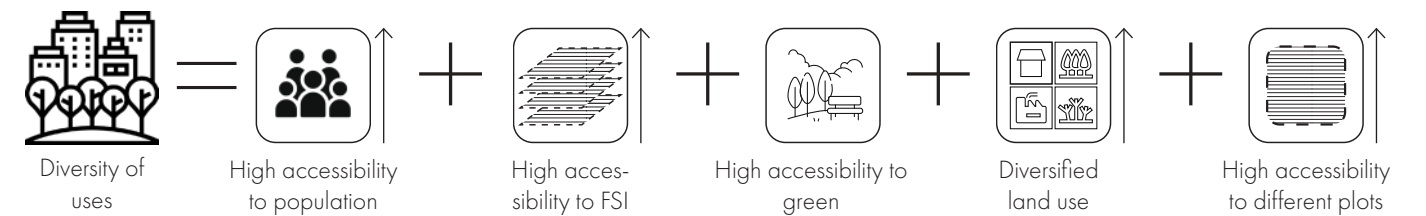
The vision outlines the development of a new mixed-use area that combines housing, services, and green spaces. A central aspect of the proposal is the re-routing of Västkvägen to Österängsvägen, next to Varberg Hospital. This change is intended to release land for more diverse uses, reduce physical barriers, and enhance efficiency of both the land use and of the existing road network.

The plan proposes integrating the intersection between Västkvägen and Träslövsvägen. In addition, the removal of the grade-separated section of Österängsvägen supports the creation of urban corridors, aligning with Varberg Municipality's broader urban development strategy.

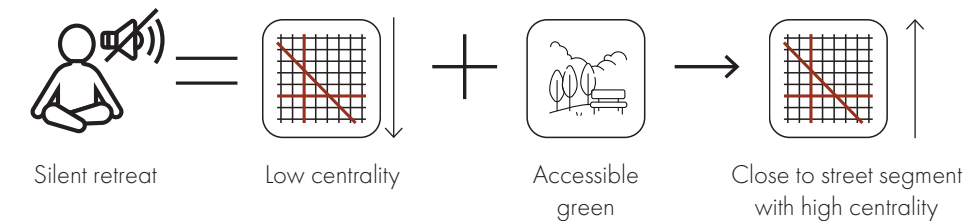
The natural area surrounding Påskbergets Forest will be extended northwards, forming a green corridor between the new buildings. This will also contribute to a better habitat connectivity by linking important habitats for tree-living bees that can support local biodiversity.



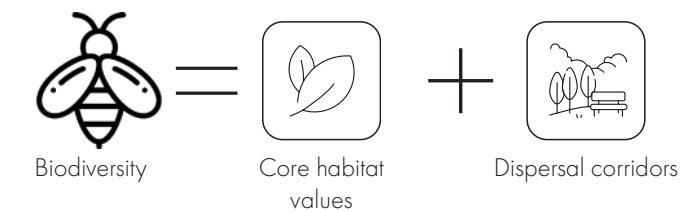
Combining high centrality with higher population density creates the potential to generate a flow of people through the site. To further promote urbanity in the area with active ground floors and a variety of functions, this should be combined with high property density along the urban corridors with high access to ground floors.



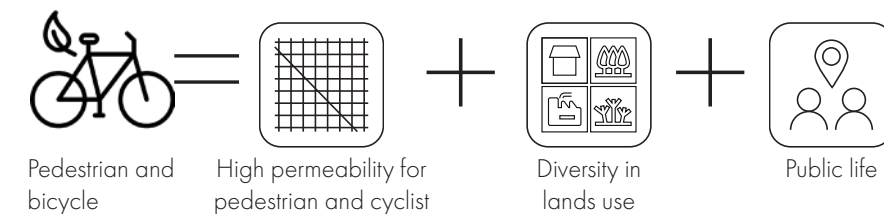
By planning for efficient and diverse land use, the area can accommodate multiple functions. To enable this, there should be a population density that can support these functions, as well as a high property density that can accommodate the various functions.



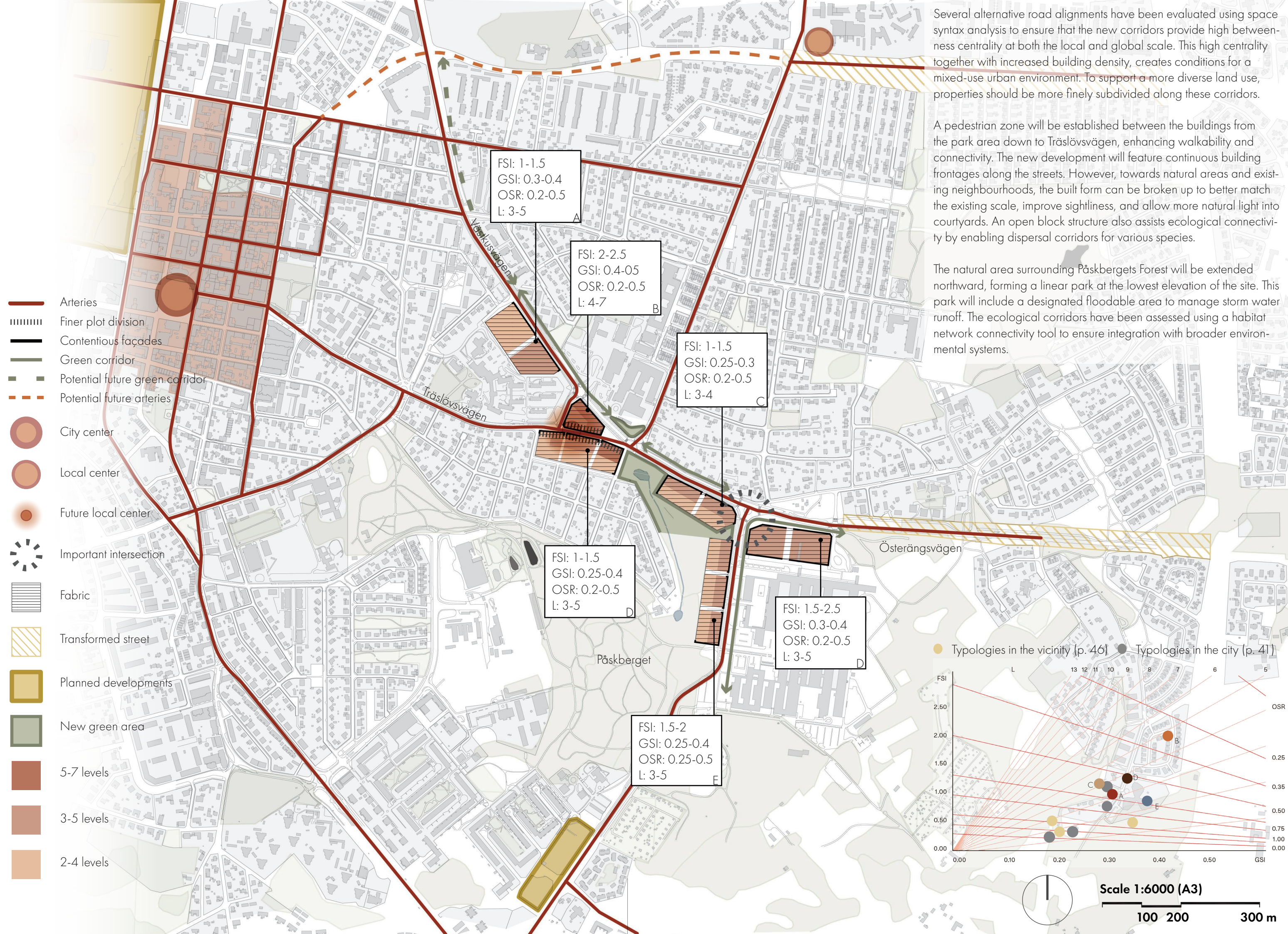
Creating places with low centrality and access to greenery, located close to well-integrated routes, provides opportunities for silent retreats with space for recreation and nature-based activities.



By connecting core areas for bees in the area with green corridors, this can support their spread and reproduction. This benefits pollination in the area and thus also the biodiversity in the area.



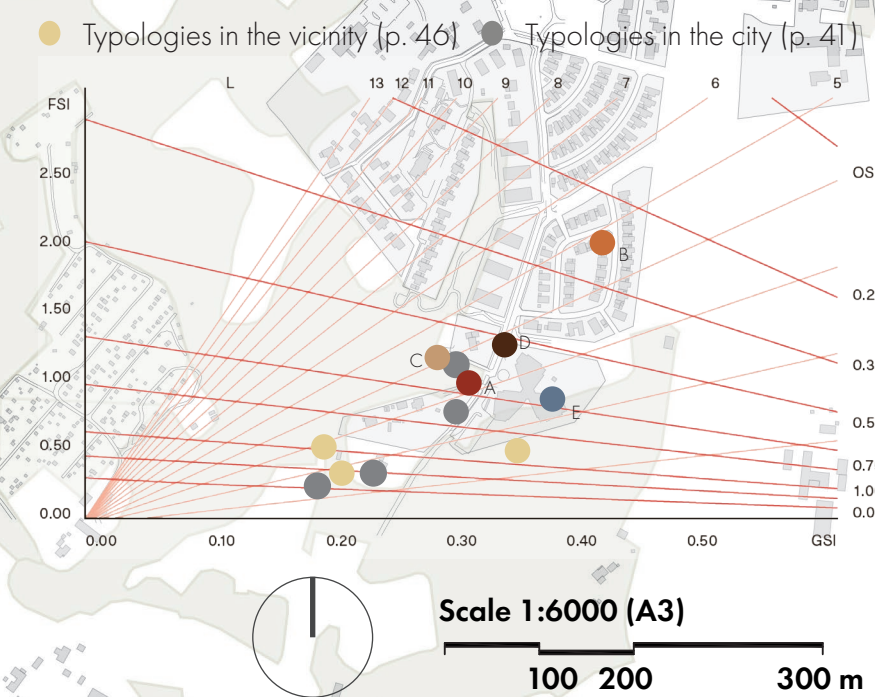
By generating high permeability in the street network, combined with a higher flow of people, which, for example, increases activity in the areas, thereby promoting passive safety and enabling people watching, this encourages increased travel on foot or by bicycle.



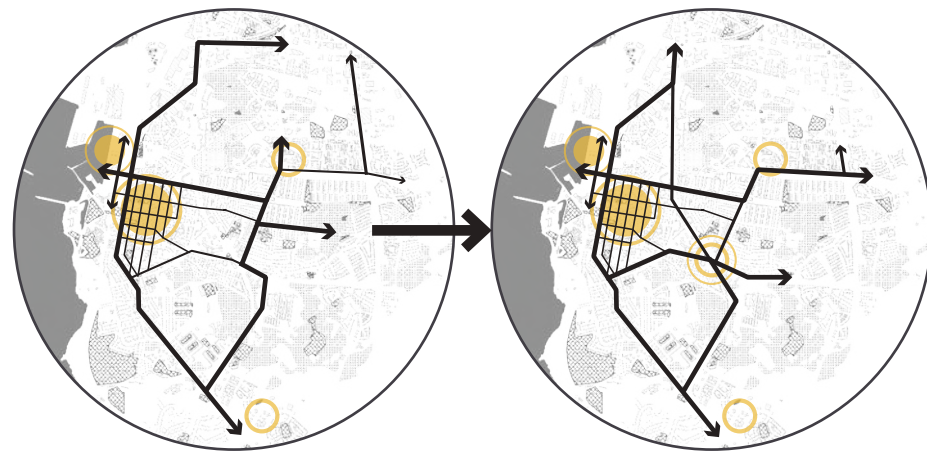
Several alternative road alignments have been evaluated using space syntax analysis to ensure that the new corridors provide high betweenness centrality at both the local and global scale. This high centrality together with increased building density, creates conditions for a mixed-use urban environment. To support a more diverse land use, properties should be more finely subdivided along these corridors.

A pedestrian zone will be established between the buildings from the park area down to Träslövsvägen, enhancing walkability and connectivity. The new development will feature continuous building frontages along the streets. However, towards natural areas and existing neighbourhoods, the built form can be broken up to better match the existing scale, improve sightliness, and allow more natural light into courtyards. An open block structure also assists ecological connectivity by enabling dispersal corridors for various species.

The natural area surrounding Paskbergets Forest will be extended northward, forming a linear park at the lowest elevation of the site. This park will include a designated floodable area to manage storm water runoff. The ecological corridors have been assessed using a habitat network connectivity tool to ensure integration with broader environmental systems.



Design strategies



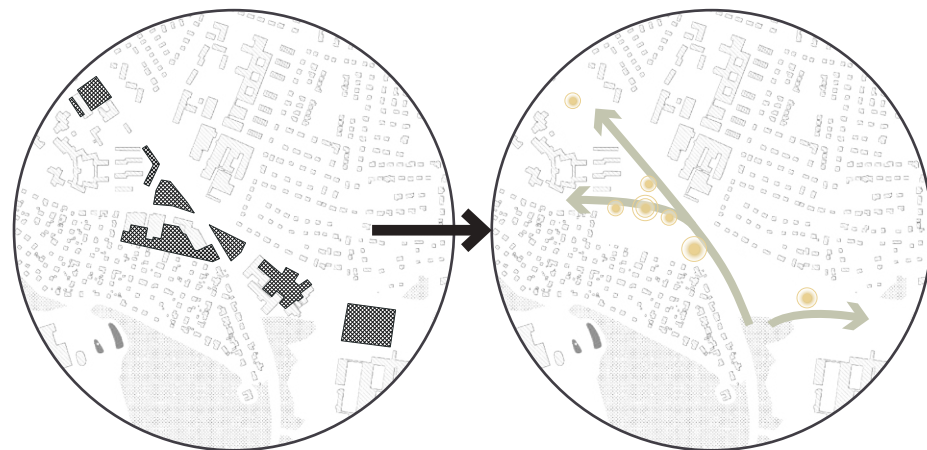
Connect the city with urban corridors

By removing barriers in the city, such as grade separated intersections and roads, new arteries can be created to connect the city and create new flows.



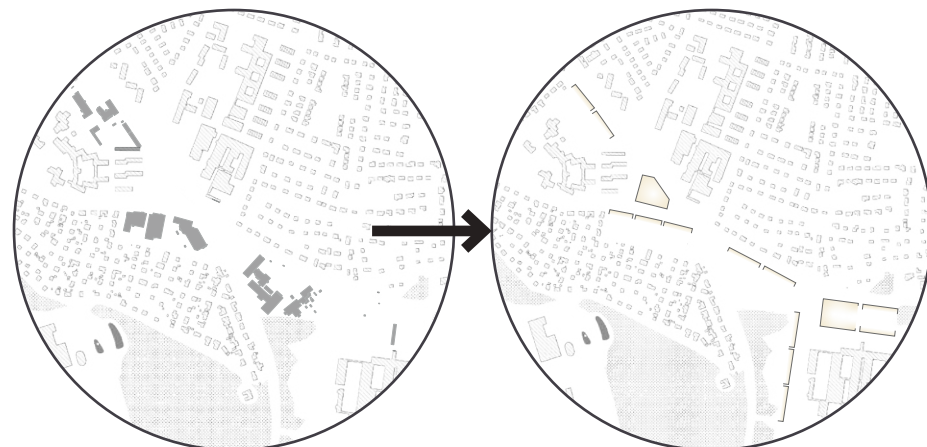
From car-dominated to pedestrian-friendly

By streamlining the existing road network, Västkustvägen can be rerouted, freeing up space for housing and greenery while removing a barrier to pedestrian and bicycle traffic.



Change and optimize land use

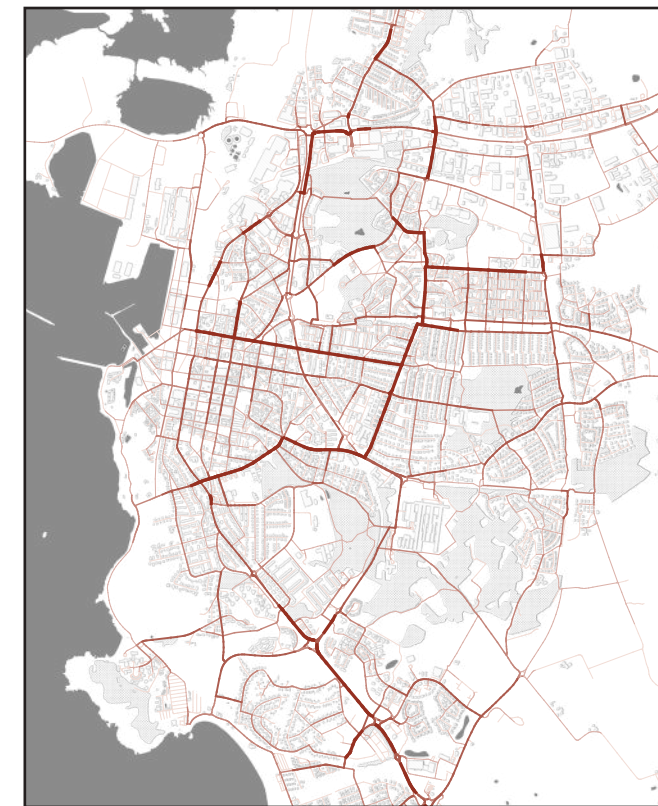
Move from large parking lots and traffic areas to diversified land use with green spaces and meeting places.



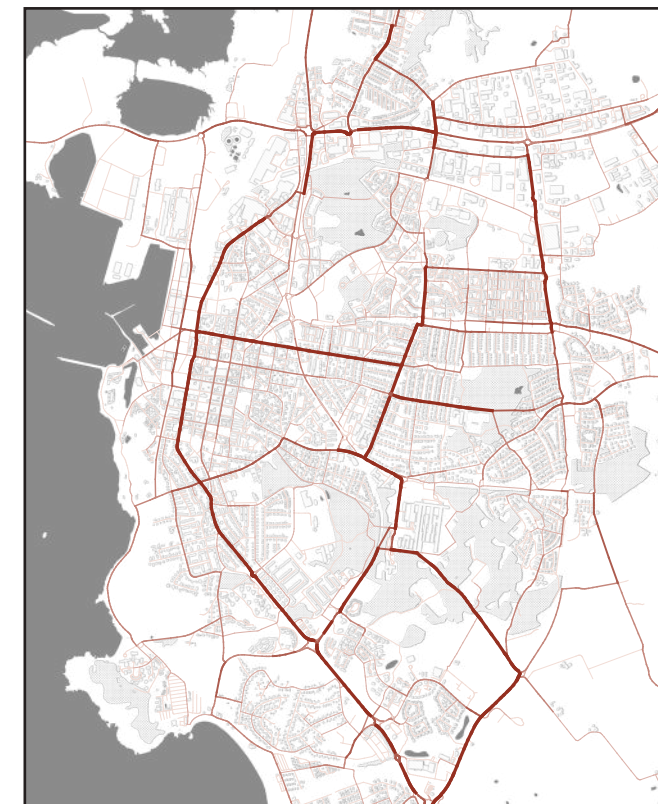
Create vibrant neighbourhoods

Instead of facing large parking lots, the new buildings will face city streets with greenery, continuous façades, and active ground floors.

Angular betweenness, 2 km

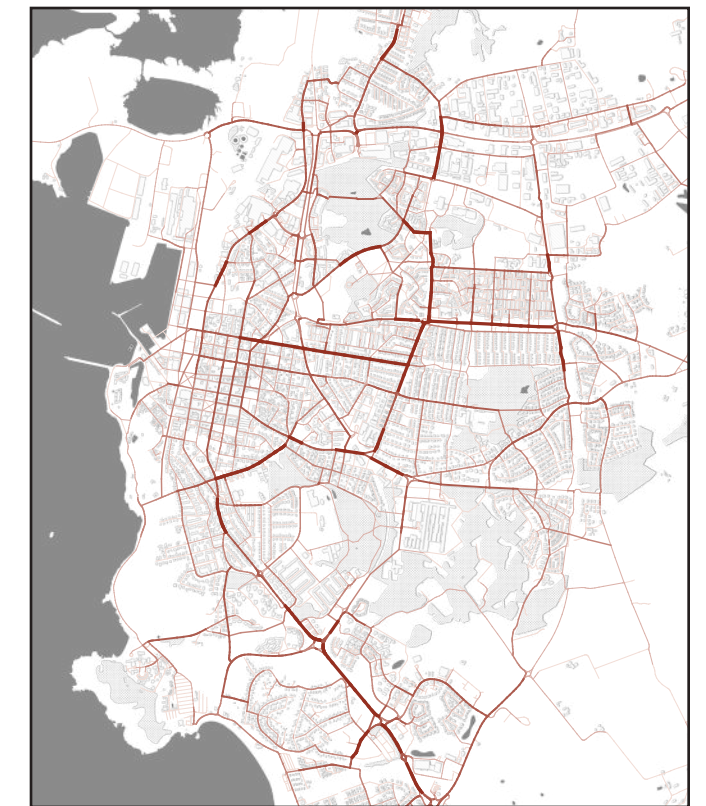


Angular betweenness, 5 km



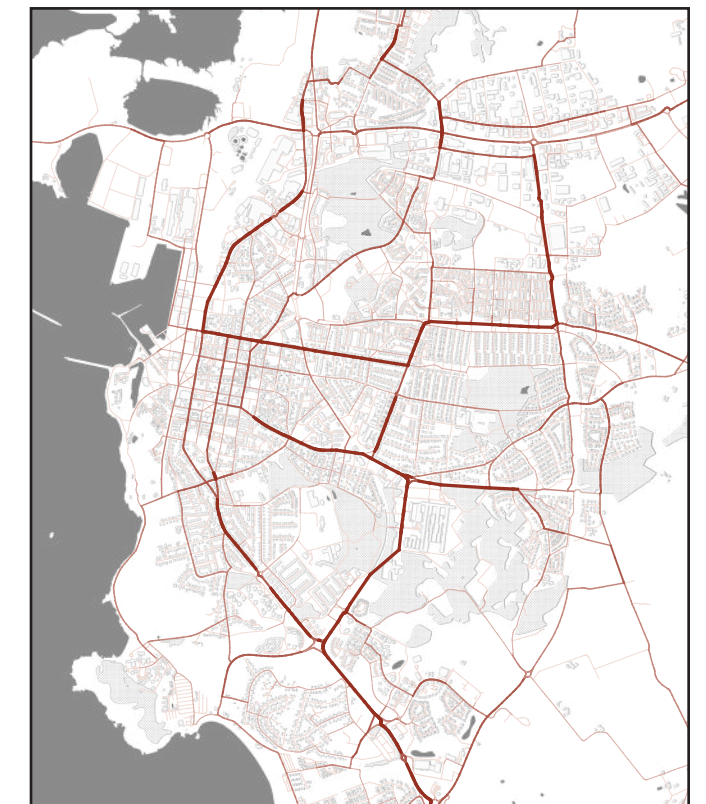
New angular betweenness, 2 km

Same classes

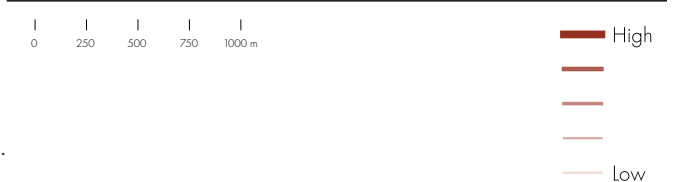


New angular betweenness, 5 km

Same classes



Through an iterative design process in which street configurations were tested using space syntax analyses, a final proposal was produced in which the main corridors have high betweenness centrality on both a local and global scale. This increases the potential for creating co-presence in the area, as people moving around there can come from both the immediate vicinity and other parts of the city.



Angular betweenness, 2 km



New angular betweenness, 2 km

Same classes



Angular betweenness, 5 km

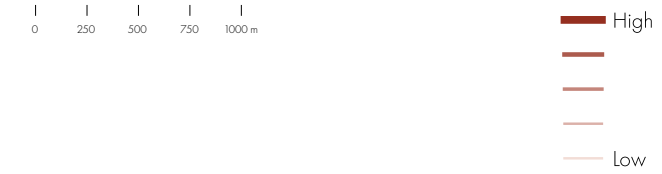


New angular betweenness, 5 km

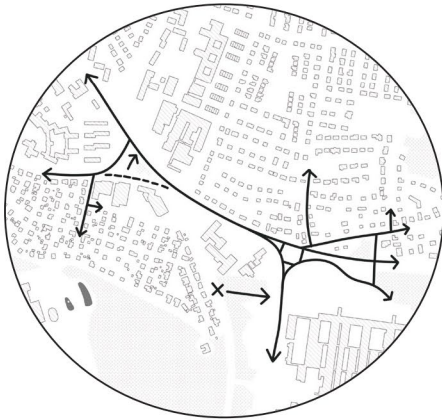
Same classes



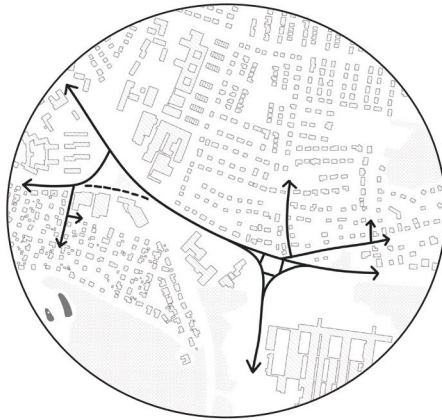
The proposal gives the motorized road network a clearer hierarchy and concentrates it on existing roads, which reduces barriers in the area and allows for more efficient land use.



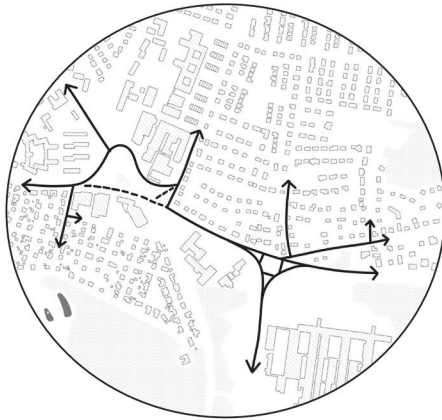
Intervention 1



Intervention 2



Intervention 3



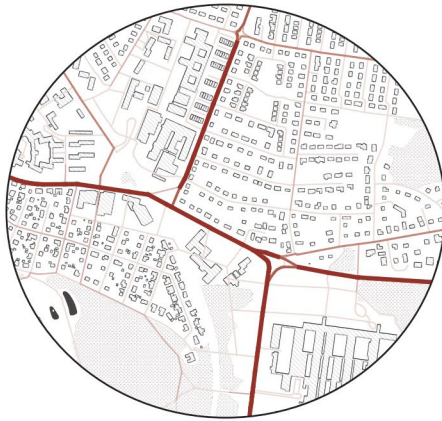
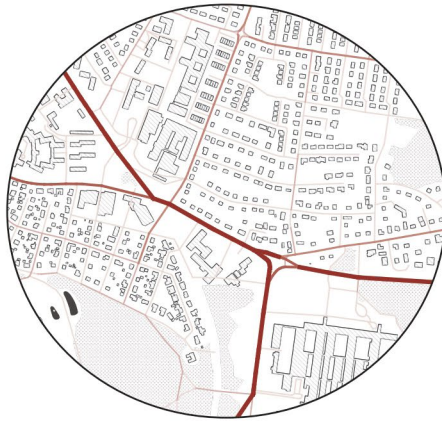
Angular betweenness, 2 km

Same classes



Angular betweenness, 5 km

Same classes

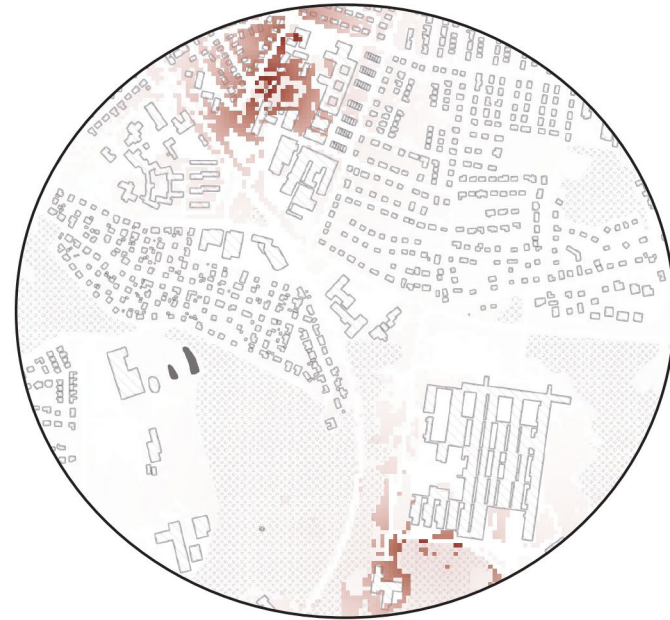


By merging the West Coast Road with Österängsvägen, the existing motorized road network will be streamlined and space will be freed up in the area. However, there is a gap between angular betweenness centrality on the different scales, which risks overlooking the potential for achieving co-presence in the area.

In the next stage, Österängsvägen will be converted from a traffic-separated street to a mixed-traffic street. This is to strengthen the route through the area by making it more direct and thereby increasing its betweenness centrality. Here, the two scales begin to interact with each other, but centrality is now higher on Västkvägen instead of Träslövsvägen, which leads to the city center.

By breaking up the street segments leading to Västkvägen, Träslövsvägen is given clearer priority, and the area gains a betweenness centrality that is consistent on both scales. This creates the conditions for greater flow through the area and thus increased co-presence.

Current reproduction habitats - bees



By extending the natural area around Påskberget northwards and designing the new green space to replicate the core habitats for solitary bees, such as insect hotels, the site can promote the reproductive capacity of bees in the area and thereby also strengthen pollination and biodiversity (Naturskyddsföreningen 2021).

New reproduction habitats - bees

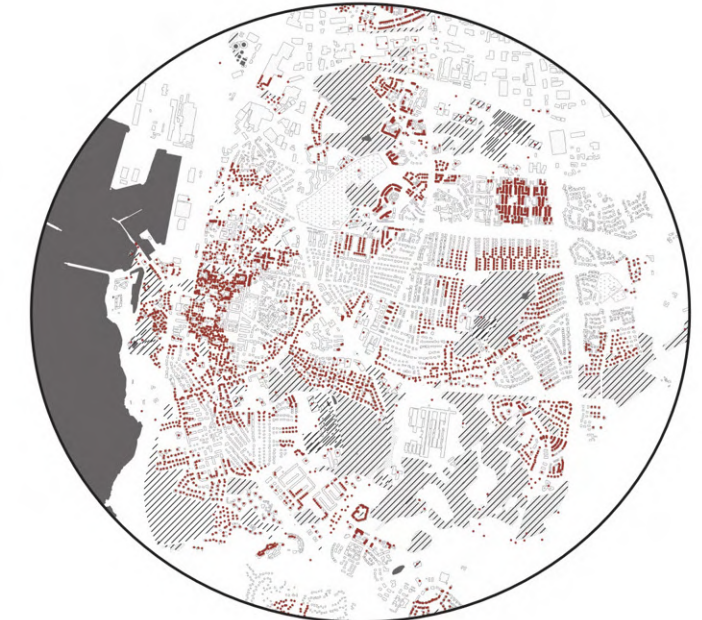


Current access to green areas

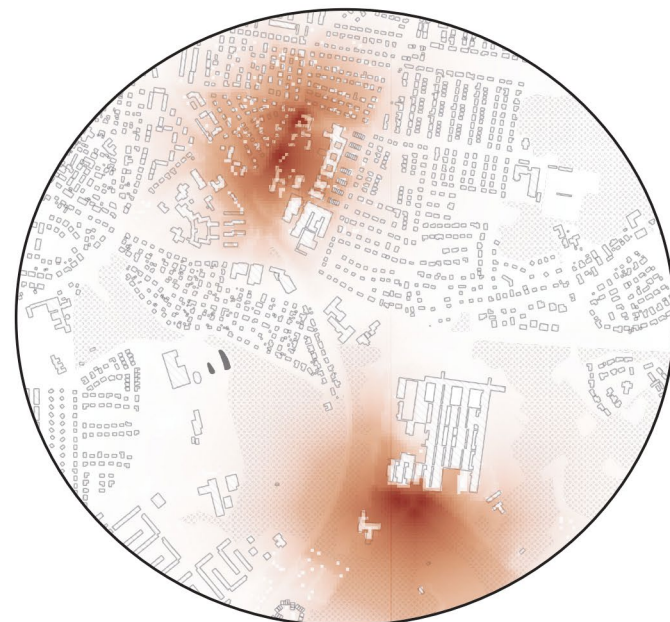


As the catchment area for green spaces is relatively small, 200 meters, the plan proposal will not result in any major changes to their accessibility on a global scale. The buildings around the plan area already have good access to green spaces through the nature area around Påskberget.

New access to green areas

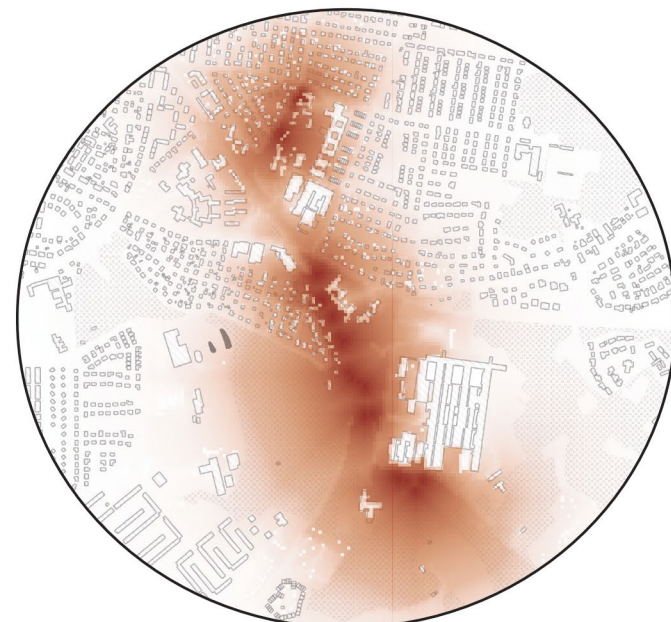


Current dispersal - bees



The surrounding core values (valuable trees) for solitary bees around the hospital area and Peder Skrivare's school can be linked together by green corridors. This can increase the dispersal distance and transforms the site into a core value network for bees.

New dispersal - bees

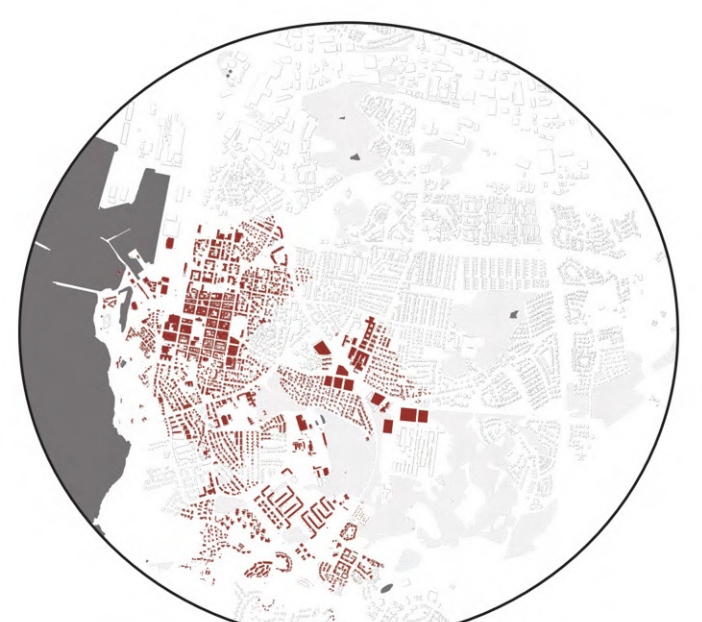


Current access to park



The access to parks will improve for the housing to the north of the area, but the effects will be limited here too due to the restricted 500 m catchment area. One alternative that was considered was placing the park in the north-western part of the plan area, which would have had a marginally better impact. However, as Väst-

New access to park



kustvägen remains grade-separated, new connections to the road would require demolition of existing buildings. As Västskustvägen is relatively busy, this alternative was considered to have too negative an impact on the quality of the park.

Current access to squares



The new square has a major positive impact on access to squares in the city, largely because there is currently a shortage of them.

New access to square



Current access to population



The area will be densified, and the street network's connectivity enhanced, expanding the 1 km walking catchment area. This will improve accessibility to the local population, with parts of the area that share at the same level as the city center. These changes will support the development of diverse functions and services within the area.

New access to population



Design criteria - local

Public life = Facade + Microclimate

+ Scale + Street types

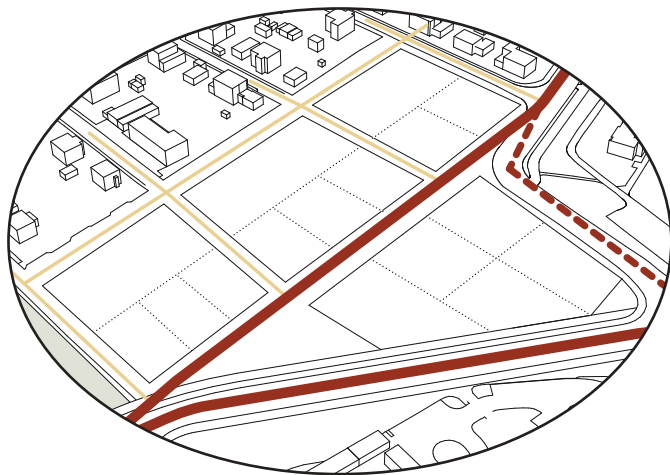
Facade = Function + Need of transparency

+ Need of permeability

Bees = Programming green areas - Barriers

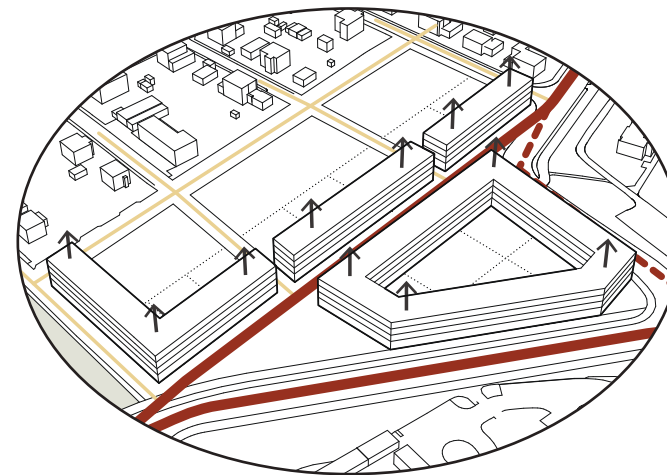
Pedestrian and bicycle = Street types + Public life

Private retreat = Transparency + Courtyards & Enclosure



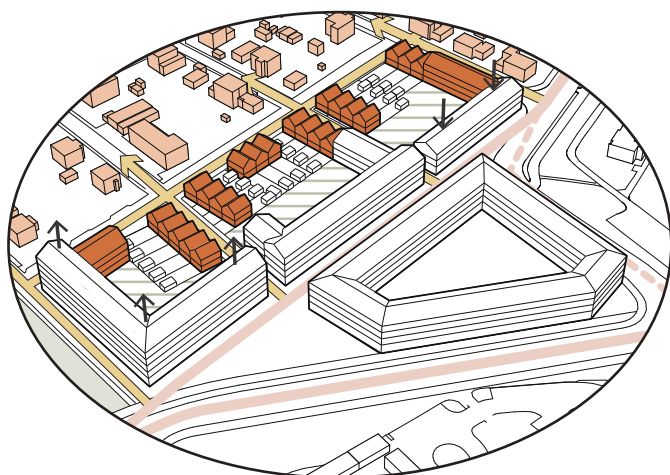
Plots & islands

Configure the islands to match existing fabric and have a higher plot density towards streets with a high betweenness centrality and access to high density



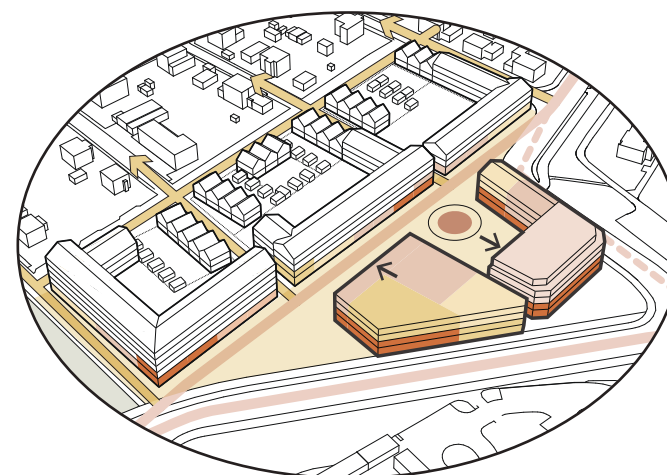
Continuous façades

Continuous façades along street with high betweenness centrality



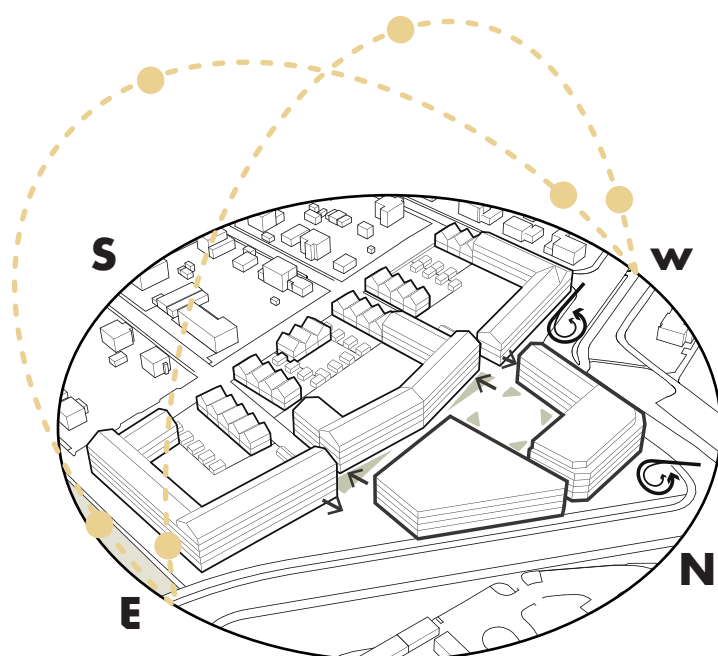
Connect to the existing scale

Connect to the existing scale to create the desired effect



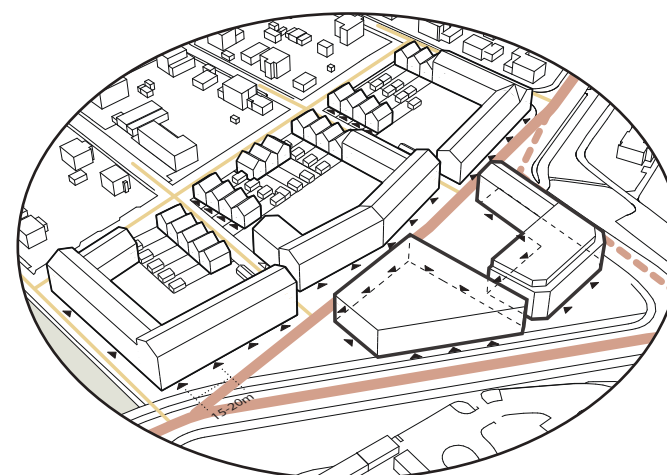
Plan for social meetings and different functions

Take height for the area to hold multiple of functions, make spaces flexible so their use can change over time



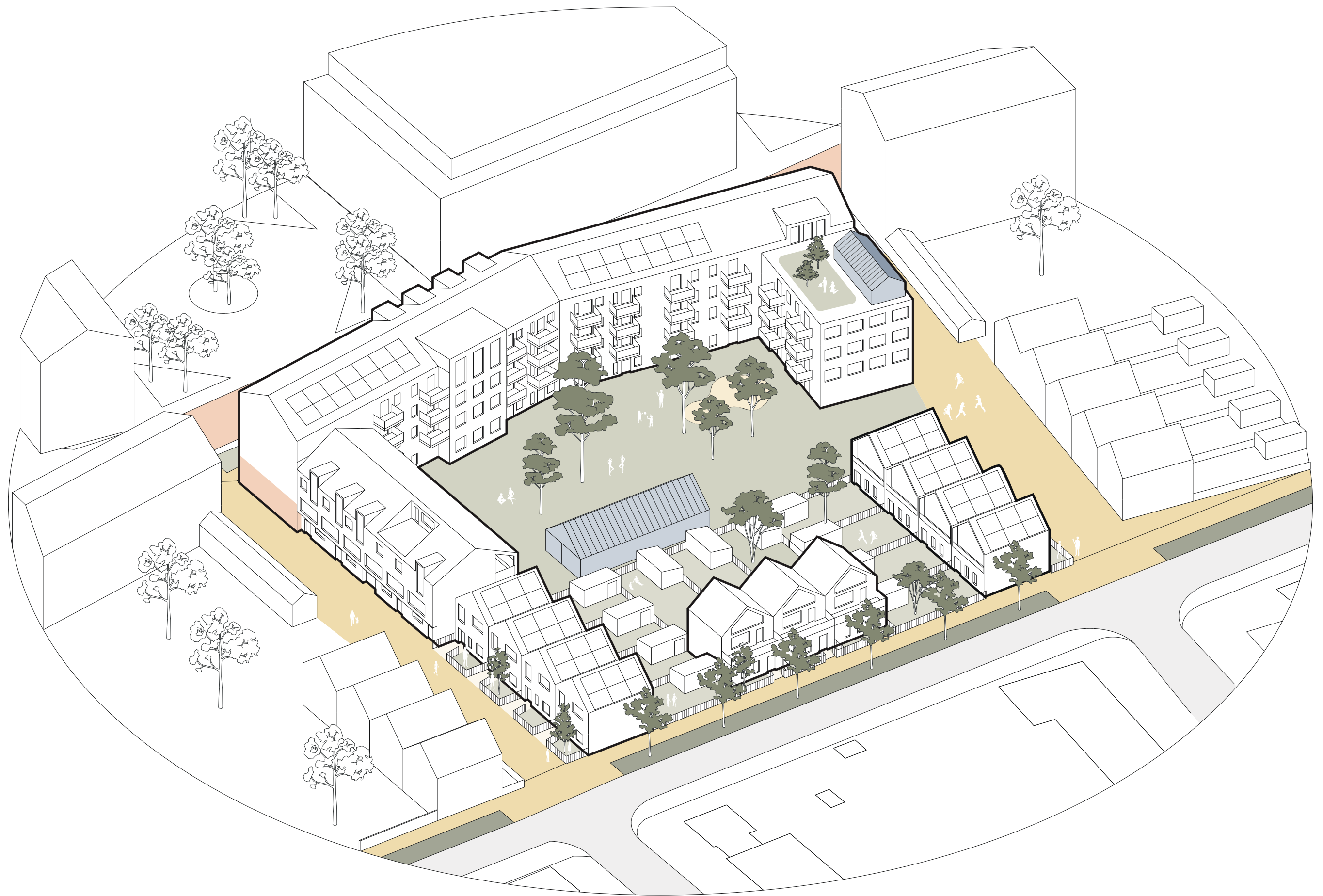
Break the façades to create a better microclimate and to make space for greenery

Breaking the façades can stop wind tunnels and give space for greenery which helps mitigate the heat islands effect



Entrances

Have the entrances towards the streets and with a maximum distance between them of 20 m towards activity streets to activate them



Traffic & sections

The street types have been adapted to the centrality of the street segments and their potential to create flows, the need for movement and access to population density and built-up land.

- High speed road
- Local street
- Low speed street
- Pedestrian zone
- Fabric
- Transformed street



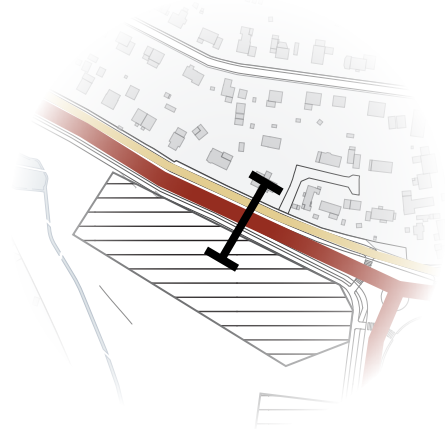
Scale 1:6000 (A3)

100 200 300 m

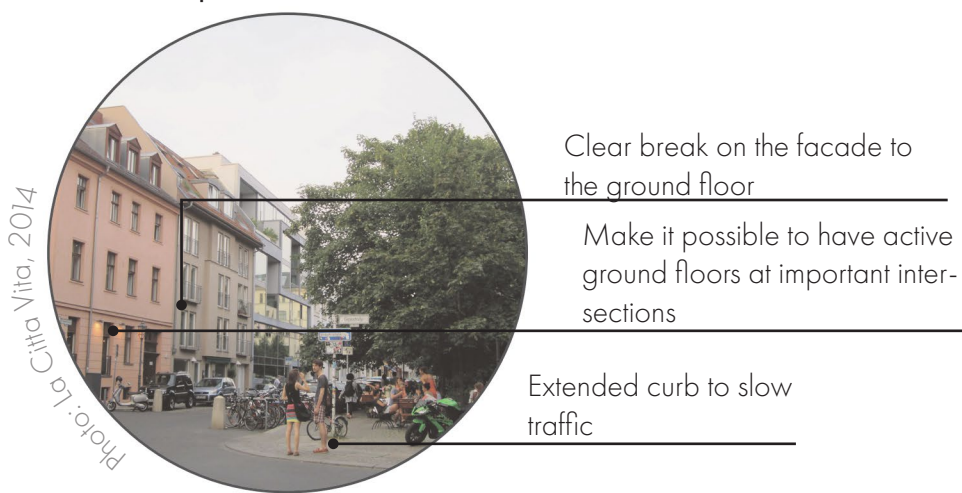
High-speed street (A-A)

The street is designed on the principles for "high-speed road" in "smart street" and adjusted so that vehicles can travel at higher speeds (max. 40 km/h) (Stähle et al, 2022). Public transport runs in the middle, while cyclists travel on separate lanes inside the flexible areas. Pedestrians move around and stay on pedestrian areas and in flexible areas. Important design principles are that sidewalks, bike paths, and flexible areas should have a level surface but be differentiated by different materials for clear guidance. For universal accessibility, sidewalks along the edges of streets must be at least 3 meters wide, with lowered curbs to facilitate access for wheelchairs and strollers. Left turns are minimized, especially near bus stops.

Since Västervägen and Träslövsvägen are being merged with Österängsvägen, this will generate a higher combined traffic flow, while at the same time making the road an important route for emergency vehicles from the hospital. At the same time, several properties currently have their exits onto Österängsvägen, which is not optimal in terms of traffic flows and ensuring high accessibility for emergency vehicles. Therefore, two separate lanes will be created next to these properties as a low-speed street that prioritizes the accessibility of cyclists, but also handles residential exits..



Important intersection



Street segment low betweenness centrality and access to low population density



Street segment with high betweenness centrality and access to high population density



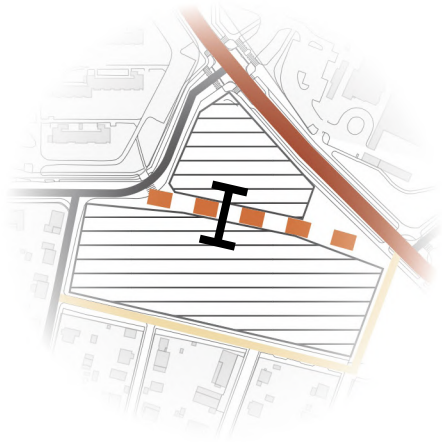
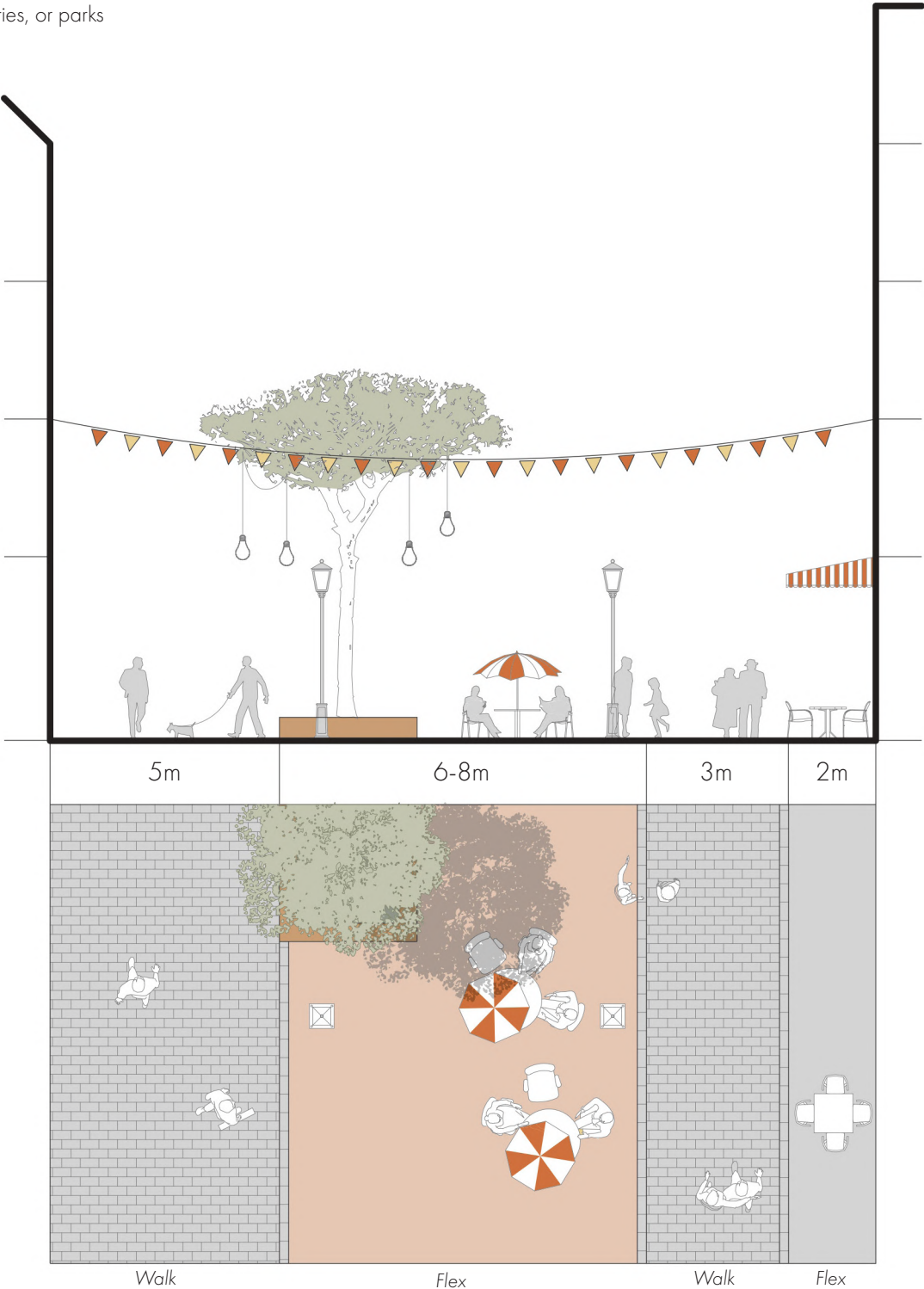
Low-speed street (B-B)

Low-speed streets are designed so that vehicles must travel at low speeds, max. 20 km/h (Stähle et al 2022). Pedestrians move and stay on separate pedestrian areas and in flexible areas. Low-speed streets are also known as bicycle streets or cycle streets. Important aspects of the design include even and permeable road surfaces, wide bicycle lanes, frequent crossings, and several flexible and green areas.



Pedestrian zone (C-C)

The design of the street is based on the street type "Pedestrian street" in Smarta gator (stähle at al, 2020). Important aspects of the design include flat paving with clear speed bumps at the beginning and end of the street to indicate that pedestrians have priority. Street furniture, flexible spaces, playgrounds, and maximizing green spaces and permeable paving materials to manage storm water locally. Walking streets are suitable when there is a demand or need for people to spend time in an area and can therefore be suitable for residential areas, shopping and activity streets, and near schools, sports facilities, or parks



Clear break to ground floor on the facade to the ground floor

Make it possible to have active ground floors at important intersections



Greater detail at eye level

Interaction between the inside and outside of the building

Weather protected outdoor places



Tree's help break wind and gives shade

Dense between entrances. 15-20 m

Extended curb allows for a flexible use
Soft borders makes visitors feel safe

Sections

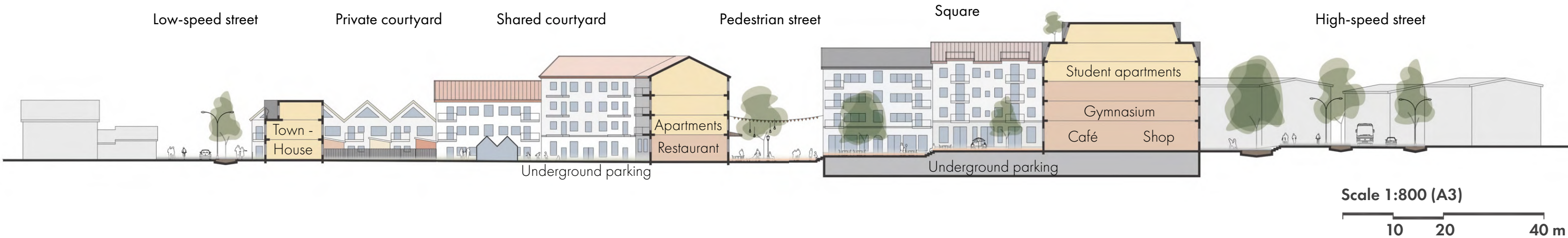


The sections and the following master plan show how the area might be developed if the design criteria is followed.

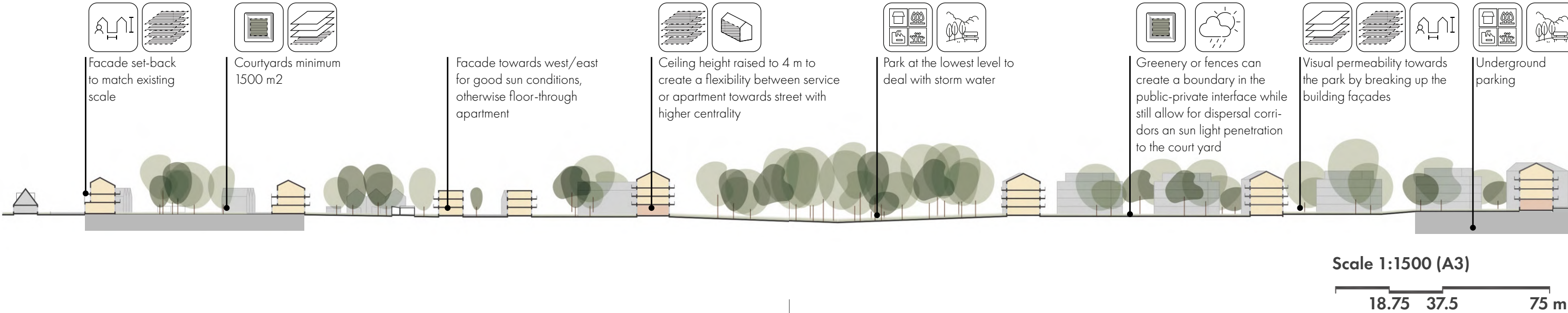
Bee's core habitats and dispersal (D-D)



North - South (E-E)



East - West (F-F)





Shared courtyard

Shared courtyard

Services
Mobility hub
VI Serving
Schools

Shared courtyard

Shared courtyard

Shared courtyard

Shared courtyard

Shared courtyard

Services
Mobility hub

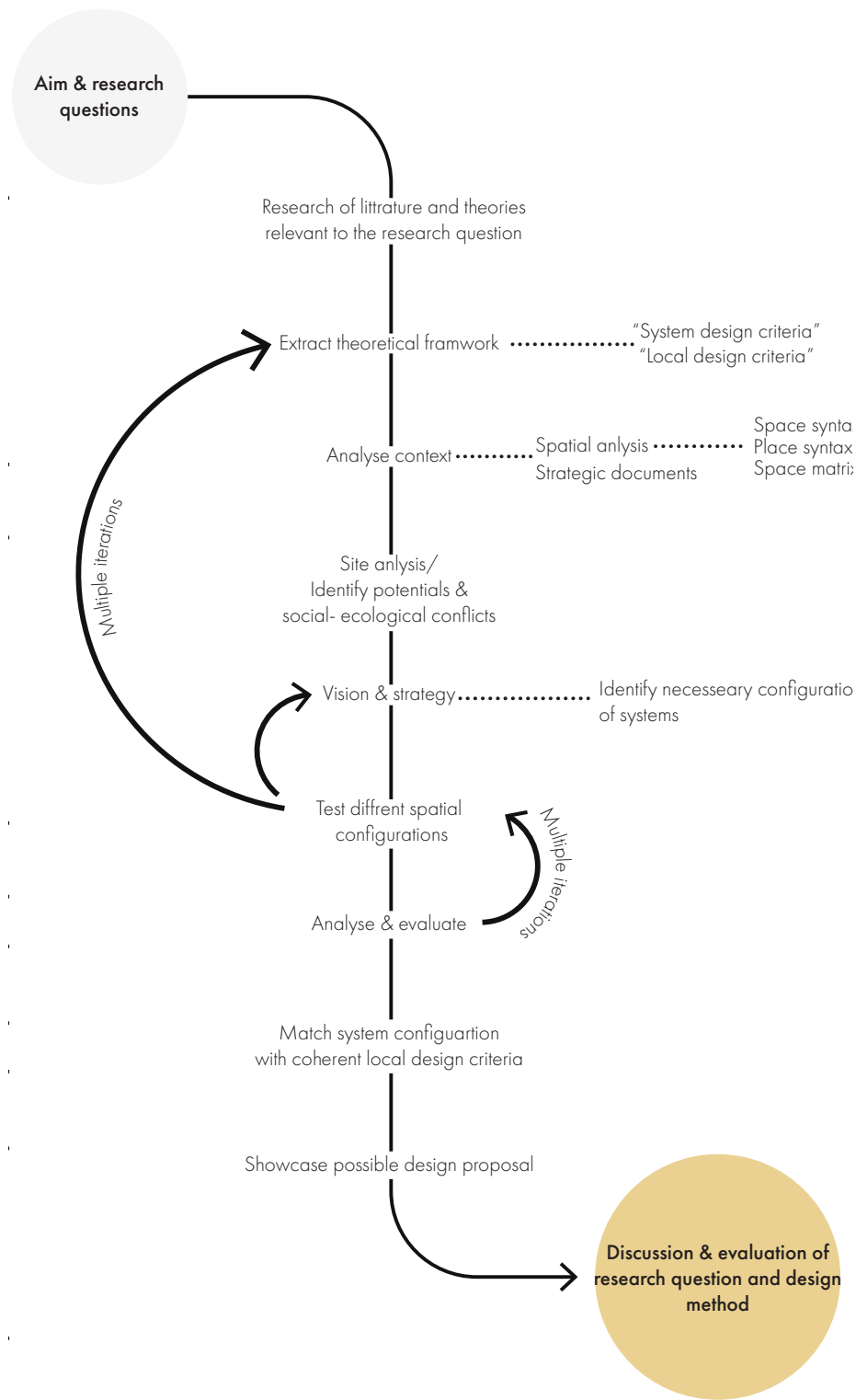
Shared courtyard

Scale 1:2000 (A3)

25 50 100 m

08. Discussion

Under development



Discussion

The purpose of this thesis has been to investigate a design methodology and develop a framework that can bridge the gap between strategic planning and detailed planning in municipal urban planning. The goal is to contribute a tool that supports more system-oriented and multi-scale planning processes. Two central research questions have guided the work:

1. How can a design methodology identify design criteria for how a place can be designed and developed based on system aspects?
2. How can a design methodology identify design criteria to mitigate socio-ecological conflicts and thereby support planning processes in medium sized Swedish cities?

To answer these questions, the thesis takes an EBD approach that combines analytical and normative theory. Analytical theory was used to understand how the city's overall structures, such as the composition of different morphological elements and spatial configurations, create different conditions for system effects at both the local and city-wide levels. The normative theory was then used to formulate guidelines for how these configurations and places can be designed and combined to reinforce desired effects and reduce conflicts between social and ecological interests. The thesis thus also provides an evidence-based design process, thereby creating a more systematically grounded and multi-scale urban planning. This can also be seen as a contribution to the need to make research results more understandable, accessible, and practically useful for planners and decision-makers in urban planning (Berghauser Pont, 2024).

Although the design methodology has been the main focus of this thesis, the compilation of the identified design criteria can also be a positive contribution. Since these are based on an analytical foundation and linked to measurable variables, such as the centrality, density, and land use of street networks, they can also be generalized and applied in other urban contexts.

The design methodology also shows how to balance multiple goals in urban development. By integrating factors that promote human well-being, ecosystem services, and biodiversity, while densifying the city to reduce energy consumption and preserve natural and agricultural land, it is possible to identify design criteria that help mitigate conflicts between social and ecological aspects.

What difficulties have emerged?

One challenge in the work has been to balance conflicting criteria during the design phase, such as contextual conditions, population density targets, and the need to work from a human scale. Balancing conflicting aspects is often one of the main challenges of urban planning. The method presented in this thesis aims to highlight these conflicts at an early stage, leading to more informed decisions in the planning process.

General guidelines for density have proven difficult to apply directly, as each location has unique characteristics and conditions. Density guidelines therefore need to be flexible and adaptable to varying needs, for example with regard to functions such as schools and public spaces. Tools such as Space Matrix have been valuable as they provide a non-normative understanding of density, where variables such as accessible FSI and GSI help to interpret what density may be desirable in relation to the specific context.

Another challenge in the work has been to identify the right level of detail, i.e., to determine which aspects need to be clearly regulated in the plan and which should be left open for flexibility. The aim has been to create a plan that is flexible enough to allow for adaptation over time and in different implementation phases, while ensuring the functional qualities of the area, i.e., its affordance, as well as the desired system effects at both the local and city-wide levels.

What are the limitations of the method?

The design method is not a comprehensive answer to many of the challenges facing our cities today. Nor do the identified design criteria guarantee that the area will actually live up to the opportunities and strengths identified in the site analysis, as other factors, such as socioeconomic and democratic issues, have a significant impact on how the area develops. To believe that it is enough to adapt urban planning to a certain number of measures and criteria in order to achieve complex phenomena such as urbanity and social cohesion is to simplify urban planning, as it is also largely about how people use and develop places. However, what the design method shows is how these phenomena can be promoted through the physical and economic structure of the city, both at the local and global level.

What would I have done differently?

One aspect that could have been improved in retrospect is how the boundaries of the planning area were handled. In this case, a more flexible and diffuse plan area boundary could have created better conditions for achieving the desired system effects. In order to influence functions and flows within a specific area, it may be necessary to also work with physical interventions outside the plan area. In the design study, this was illustrated, for example, by configuring the street network outside the plan area. By creating more connections leading through the area, the betweenness centrality of the routes increased, which in turn increased the potential for movement flows and activity within the actual planning area.

However, a similar system based and large scale strategy was not applied to the same extent when it came to the green structure, which could have yielded a more desirable result. The guidelines for green spaces and parks are based on relatively small catchment areas, which means that the effects of the plan proposal were limited for several parts of the city that have poor access to green spaces. By working on a larger scale, it would have been possible to create a more comprehensive and significant impact.

How can the method be further developed?

For further research and to further develop the design method, it would be both interesting and relevant to include economic aspects to a greater extent. Co-presence, ecosystem services, and flows of people have an exchange value (their economic impact on food production or property values). By identifying and including these, the method could also support economic implementation issues in the plan and strengthen the argument for why these aspects must be given a greater place in how we plan our cities.

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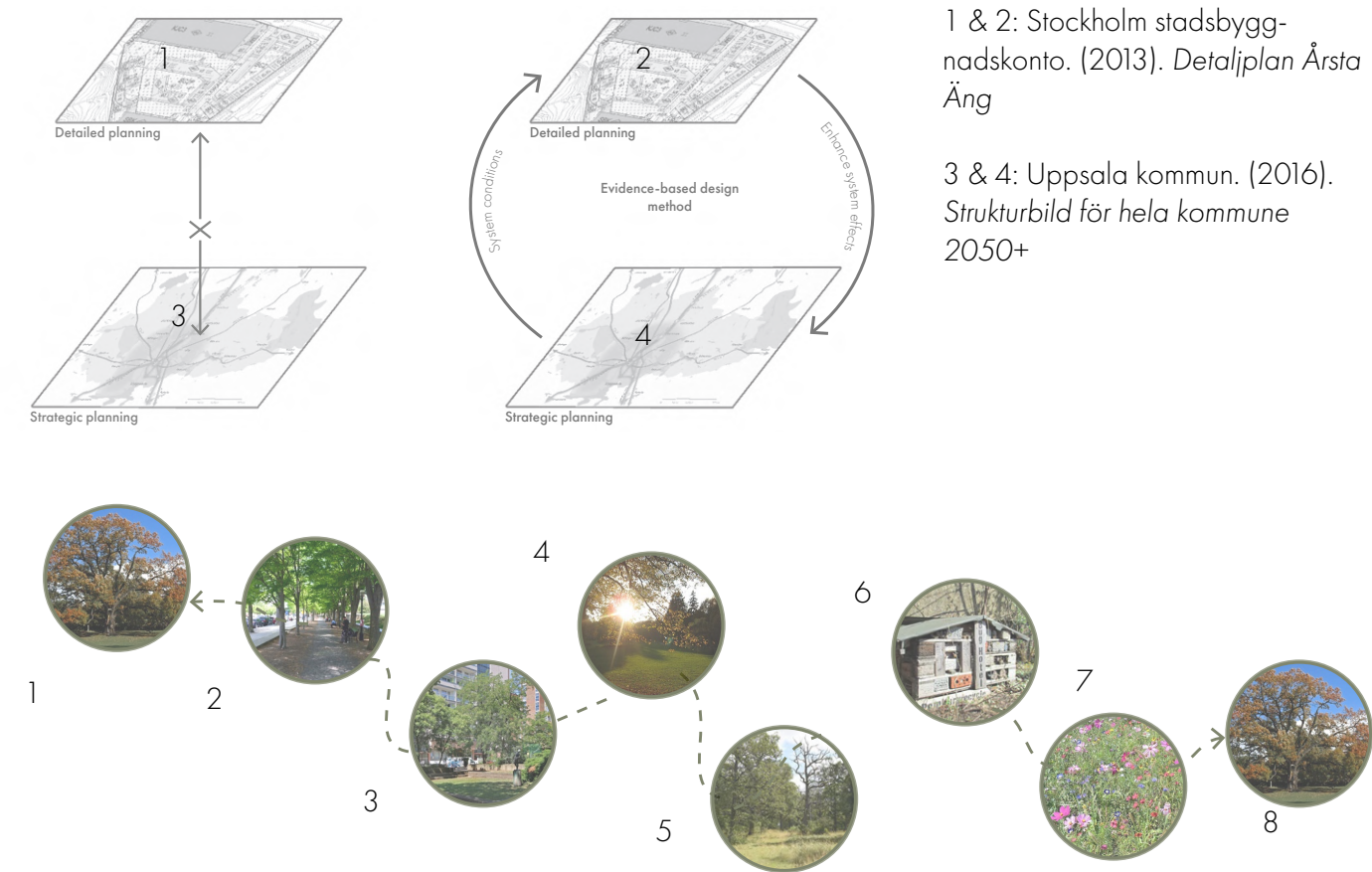
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AI-appendix

ChatGTP (OpenAI 2025) was used as a tool in the spatial analyses by generating explanations of how geodata should be processed to enable the analyses. AI was also used as a testing ground in an initial phase to discuss methodology and process issues and, to some extent, to find relevant sources on specific issues.

Prompt: How can I calculate building heights based on digital surface models (DSM) and digital elevation models (DEM) using Qgis?

Asnwer: To calculate building heights using Digital Surface Models (DSM) and Digital Elevation Models (DEM) in QGIS, you simply subtract the ground elevation (DEM) from the surface elevation (DSM). Here’s a step-by-step guide:

- DSM: Includes elevations of buildings, trees, etc.
 - DEM: Includes only ground elevation (bare earth).
 - Both layers must:
 - o Be in the same CRS (Coordinate Reference System).
 - o Have the same resolution and alignment (you can resample if needed).
1. Load the DSM and DEM
- Use Layer > Add Layer > Add Raster Layer to load both DSM and DEM into your project.
2. Align DSM and DEM (if needed)
- If they’re not the same resolution or extent:
- Use: Raster > Align Rasters (plugin may be required).
 - Set the same pixel size, extent, and alignment.
3. Subtract DEM from DSM
- Use the Raster Calculator:
- Go to Raster > Raster Calculator
 - Use this expression:
"DSM@1" - "DEM@1"
- Replace "DSM@1" and "DEM@1" with the actual layer names as shown in the calculator.
- Name the output (e.g., Building_Height.tif)
 - Set output CRS and location
 - Click OK

This produces a new raster where each pixel value represents the building height (or vegetation height, if present).

If you have a building footprint layer:

1. Use Raster > Extraction > Clip Raster by Mask Layer with your building polygons.

2. Alternatively, use Zonal Statistics:
 - o Raster > Zonal Statistics
 - o Input: the height raster
 - o Polygon layer: your building footprints
 - o Output: mean, max, or min height per building.

Prompt: How can land use be calculated as a percentage in QGIS based on land cover data?

Answer: To calculate land use as a percentage in QGIS based on land cover data, follow these general steps. This process typically uses raster or vector land cover datasets where each class corresponds to a specific land use/land cover type (e.g., forest, urban, agriculture).

1. Load your land cover raster
 - Add the raster dataset to QGIS. Each pixel should represent a land cover class (usually with integer values).
2. Reclassify if needed (optional)
 - If the land cover classes need grouping (e.g., multiple codes for different forest types), reclassify using:
 - o Raster > Raster Calculator or
 - o Processing Toolbox > Reclassify by table
3. Calculate area per land cover class
 - Go to Processing Toolbox search for "Raster Layer Unique Values Report".
 - This generates a table with each land cover class and the number of pixels.
4. Convert pixel count to area
 - Multiply the number of pixels by the pixel size (resolution).
 - o Example: If resolution is 30m x 30m, each pixel = 900 m² = 0.09 ha.
 - o Use Field Calculator to add a new field: plaintext
KopieraRedigera
area_ha = pixel_count * (pixel_size_x * pixel_size_y) / 10,000
5. Calculate total area
 - Sum all areas (can use the Statistics Panel or export the table to Excel).
6. Calculate percentage per class
 - In the attribute table, use Field Calculator: percentage = ("area_ha" / total_area_ha) * 100

Prompt: How do i use las tools in Qgis do idetify whats buildings in lidar data?

Answer: To use LAStools in QGIS to identify buildings

in LiDAR data, follow these steps. LAStools is a powerful set of tools for processing LiDAR data (.las/.laz), and QGIS can integrate them via the LAStools plugin.

Step-by-Step: Identify Buildings from LiDAR in QGIS using LAStools

1. Install LAStools and the QGIS Plugin
 - A. Download LAStools
 - Get it from: <https://rapidlasso.com/lastools/>
 - Extract it to a folder, e.g., C:\LAStools.
 - B. Install the LAStools Plugin in QGIS
 - Open QGIS
 - Go to Plugins > Manage and Install Plugins
 - Search for LAStools, and install it
- LAStools is free for academic/non-commercial use; a license is needed for full commercial functionality.

2. Load Your LiDAR Data
 - Go to Layer > Add Layer > Add Vector Layer
 - o Or use Add LAZ/LAZ file via LAStools toolbar.
 - Select your .las or .laz file (LAS = LiDAR data format)

3. Classify the Point Cloud to Identify Buildings
- Use the lasclassify tool:
- How:
- Open the Processing Toolbox (Panel)
 - Search for lasclassify and open it
 - Set parameters:
 - o Input LAS/LAZ files – your LiDAR file
 - o Point Source ID – optional
 - o Extra Options – you can add:
 - fine or -ground for better results depending on the data
 - o Output Directory – choose where to save output
 - Run it
- This classifies points into ground (2), vegetation (3–5), buildings (6), etc.

4. Filter Points to Show Buildings Only
- Use las2las to extract only buildings:
- How:
- Search for las2las in the Processing Toolbox
 - Set parameters:
 - o Input – classified .las/.laz file from previous step
 - o Filter – keep_class 6 (building class)
 - o Output – path to save filtered file
 - Run it

You now have a building-only point cloud.

5. Visualize or Convert to Vector (Optional)
- If you want building footprints (polygon shapes):
- Option A: Convert to Raster (DEM of buildings)
- Use lasgrid or las2dem to make a raster surface from the buildings
 - o Set step (grid resolution), e.g., 1.0 meter
 - o Use -keep_class 6 to include only buildings
- Option B: Vectorize the Raster
- Use Raster > Conversion > Polygonize (Raster to Vector) in QGIS
 - Clean and simplify polygons if needed

Summary of Tools Used:	
Purpose	Tool
Classify point cloud	lasclassify
Filter buildings only	las2las
Create building raster	lasgrid or las2dem
Convert raster to vector	QGIS Polygonize

Prompt: Please provide me with tips and relevant sources for a thesis in architecture and urban planning that aims to identify design criteria for places through a systems approach where places are examined based on their relative locations in the larger urban system.

Answer: That’s a rich and forward-thinking thesis topic—using a systems approach to identify design criteria based on a place’s relative location in the larger urban system can bridge architectural design with urban morphology, complexity science, and spatial analysis. Here’s a comprehensive guide with tips, themes, and sources to help you structure your research effectively:

Key Themes and Framing Tips

1. Define the Systems Approach in Urban Contexts
 - Acknowledge cities as complex adaptive systems.
 - Examine multi-scalar relationships: how local places relate to and are shaped by city-wide systems (transport, land use, economy, ecology).

2. Classify Places by Network Position (Not Just Typology)
 - Traditional design looks at use or typology (e.g., park, plaza).
 - Your focus is positionality — how central, peripheral, connected, or isolated a place is within the urban fabric.
- Analytical tools:
- Space Syntax (for spatial configuration and

- visibility)
- Centrality Metrics from Network Analysis (betweenness, closeness, eigenvector)
 - Urban Morphology tools (e.g., plot-based morphometrics)

3. Develop Criteria Based on System Roles
Each place type (by position) might need different design responses:

- A central node might prioritize high capacity, visibility, and mixed-use.
- A peripheral connector might need to facilitate transitions or buffer zones.
- A network bridge could emphasize integration and continuity.

Use the system’s function to inform rather than impose design logic.

Key Literature & Sources

Theoretical Foundations

- Batty, M. (2005). Cities and Complexity. [Great intro to complexity and systems in urbanism]
- Alexander, C. (1965). A City is Not a Tree. [Critique of rigid hierarchies; supports systems thinking]
- Hillier, B., & Hanson, J. (1984). The Social Logic of Space. [Space Syntax theory and tools]
- Lynch, K. (1960). The Image of the City. [Foundational for cognitive mapping of places in systems]
- Jacobs, J. (1961). The Death and Life of Great American Cities. [Early systems thinker in disguise—importance of diversity, flow, and emergent order]

Methodological Tools

- Space Syntax: UCL’s Bartlett Lab (spacesyntax.com)
- Urban Network Analysis Toolbox (MIT, in Rhino/Grasshopper or ArcGIS)
 - o Sevtsuk, A., Mekonnen, M. (2012). Urban network analysis. Environment and Planning B.
- Morphological Approaches:
 - o Kropf, K. (2018). The Handbook of Urban Morphology.
 - o Oliveira, V. (2016). Urban Morphology: An Introduction to the Study of the Physical Form of Cities.

Case Studies & Applications

- Transit-Oriented Developments and how node-place relationships (Bertolini, 1999) guide design.
- The Node-Place Model:
 - o Bertolini, L. (1999). Spatial development patterns and public transport: the application of an

analytical model in the Netherlands. Planning Practice and Research.

Recommended Structure for Thesis

1. Introduction

- Problem definition: current place-based design lacks systemic awareness.
- Objective: identify design criteria based on systemic roles.

2. Literature Review

- Systems theory, complexity, space syntax, urban morphology.
- Place theory and design evaluation.

3. Methodology

- Select city/area.
- Apply network-based positional analysis (Space Syntax, UNA).
- Categorize place types by systemic role.

4. Case Studies

- Select diverse urban locations within different positions in the system.
- Analyze spatial metrics + field observation.

5. Derive Design Criteria

- Translate systemic insights into practical design recommendations.
- Possibly create a design decision matrix based on place function in the system.

6. Conclusions and Implications

- For practice, planning, and future design research.

Tools You Might Use

- Rhino + Grasshopper (for visual scripting + Urban Network Analysis plugin)
- DepthmapX (Space Syntax analysis)
- GIS (ArcGIS or QGIS for mapping networks)
- R or Python (for complex spatial network analysis)

Additional Reading/Resources

- Journal of Urban Design
- Environment and Planning B: Urban Analytics and City Science
- ISOCARP, AESOP, and CITIES journal

Prompt: What is important to consider when developing an evidence-based design methodology in a thesis in architecture?

Answer: When developing an evidence-based design (EBD) methodology in an architecture thesis, it’s critical to approach the process with academic rigor, clear structure, and relevance to both design and research.

Below are the key considerations:

1. Clarify the Research Question

- Define a specific, focused question or hypothesis that guides the design exploration.
- Ensure it’s a question that benefits from empirical data and measurable outcomes, e.g., “How does classroom layout affect student concentration in primary schools?”

2. Understand What “Evidence” Means in Your Context

- Evidence can be quantitative (e.g., daylight levels, acoustic performance, user surveys) or qualitative (e.g., interviews, post-occupancy evaluations, case studies).
- Choose evidence types relevant to your design goals and research objectives.

3. Develop a Theoretical Framework

- Ground your methodology in existing theories or models (e.g., environmental psychology, human-centered design, sustainability frameworks).
- This creates a bridge between research and design, and justifies your choice of evidence.

4. Use a Mixed-Methods Approach (if appropriate)

- Combine quantitative data (e.g., spatial metrics, usage statistics) and qualitative insights (e.g., user feedback, observational studies).
- Mixed-methods increase validity and provide a more holistic understanding.

5. Identify and Analyze Precedents

- Use case studies of built projects that used EBD, analyzing what data was collected, how it informed the design, and what results were achieved.
- Critically assess their relevance and applicability to your own design problem.

6. Design Testing and Simulation

- Use tools such as simulation software (e.g., daylight analysis, energy modeling, CFD) to test design hypotheses.
- These tools generate evidence during the design process, allowing iterative development.

7. User Involvement and Feedback

- Involve stakeholders or users through interviews, surveys, participatory workshops, or focus groups.

- Incorporate their needs, behaviors, and preferences into your design rationale.

8. Evaluate Outcomes with Metrics

- Define measurable criteria for success: comfort, usability, performance, satisfaction, etc.
- These should align with the original hypothesis and be testable through your design.

9. Document the Process

- Transparently show how evidence informed key design decisions at each stage.
- Include both the successes and limitations of using EBD in your thesis.

10. Ethical and Practical Considerations

- Ensure ethical data collection, particularly with human subjects (e.g., informed consent).
- Consider the feasibility and scalability of your methods.

Bonus: Example Methodology Structure

1. Introduction & Problem Statement
2. Literature Review (Theories, Precedents, Evidence Standards)
3. Methodology (Data Collection + Evaluation Framework)
4. Design Exploration (Informed Iteration + Evidence Application)
5. Results (Evaluation of Design Outcomes)
6. Conclusion (Findings, Limitations, Future Work)

Prompt: Can you give me two sources that explain what population density urban sprawl causes?

Answer: Urban sprawl typically results in lower population densities as cities expand outward into suburban and rural areas. This expansion often leads to dispersed development patterns, characterized by single-use zoning and a reliance on automobiles. Such patterns can have significant implications for infrastructure, environmental sustainability, and community cohesion.

Here are two sources that delve into the relationship between urban sprawl and population density:

1. OECD – “Rethinking Urban Sprawl: Moving Towards Sustainable Cities”
2. ScienceDirect – “Measuring Sprawl with Density-Allocation Indicators”

These sources offer comprehensive analyses of how urban sprawl influences population density and the broader implications for urban planning and sustainability.

Prompt: Can you give me two sources that explain how building typology affects wind and microclimate?

Answer: Certainly! Here are two scholarly sources that delve into how building typology influences wind patterns and microclimate in urban environments:

1. Designing the Urban Microclimate: A Framework for Integrating Climate Knowledge into Urban Design
tical design guidance.

2. The Contribution of Urban Morphology to the Formation of the Microclimate in Compact Urban Cores: A Study in the City Center of Thessaloniki

These studies provide valuable insights into how building typology and urban design influence wind patterns and microclimate, informing strategies for creating more comfortable and sustainable urban environments.