DESIGNING for EMERGENCE

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Designing for emergence:
Planning for Continued Urban Adaptation

Master thesis 2026
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“Lively, diverse, intense cities contain the seeds of their own regeneration.”

— Jane Jacobs, The Death and Life of Great American Cities, 1961.

Abstract

Contemporary urban development is often shaped by large-scale projects that prioritise stability and predictability. While such approaches can deliver efficiency, they may also reduce the diversity and adaptability that allow cities to evolve over time. This thesis explores how urban design can support ongoing urban processes rather than prescribe fixed urban forms.

Building on theories of self-organisation and spatial configuration, the study uses configurational spatial analysis to examine how spatial structure relates to patterns of movement and materialisation in three case studies: Vauban, Tsukishima, and Bijlmermeer. Based on these analyses, the thesis formulates a framework that translates identified spatial conditions into design-relevant parameters.

The framework outlines spatial conditions intended to maintain openness and adaptability within contemporary development contexts. It is applied to a site in Gothenburg to explore its relevance in practice.

By shifting attention from predefined urban forms to the spatial conditions that support interaction and change, the thesis proposes an approach to urban design that seeks to balance development with long-term adaptability.

Keywords
self-organisation, emergence, urban planning, urban design, spatial configuration, space syntax, configurational analysis, co-presence

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Table of contents

	Abstract	05
	Acknowledgements	06
	Student background	07
	Table of contents	08
	Glossary	09
Chapter 01 I Introduction		**11**
01.01	Prologue	12
01.02	Background and problem description	13
01.03	Aim and research questions	14
01.04	Delimitations	14
01.05	Thesis process	15
Chapter 02 I Theoretical framework		**17**
02.01	Theoretical framework	18
Chapter 03 I Case study analyses		**21**
03.01	Methodology	22
03.02	Case studies presentation	25
03.03	Interaction potential	28
03.04	Reinforcement	32
03.05	Functional differentiation	35
03.06	Balance	39
03.07	From analysis to framework	43
Chapter 04 I Emergence framework		**45**
04.01	Implementation site analysis	46
04.01	Design proposal	54
04.01	Speculative outcomes	60
Chapter 05 I Conclusion		**69**
05.01	Discussion	70
05.02	Conclusion	72
References & AI appendix		**75**
	References	76
	AI appendix	79

Glossary

Co-presence
Simultaneous presence of people within the same spatial environment, creating opportunities for encounter, observation, and interaction.
(Hillier, 1996; Hillier et al., 1993; Jacobs, 1961/1992)

Emergence
Process through which larger-scale patterns materialise as a result of the ongoing dynamics of self-organisation.
(Batty, 2007; Buš, 2016; Porțugali, 2000)

Emergent urbanism
Urban structures that arise from the collective behaviour of agents pursuing their own interests rather than from central coordination.
(Batty, 2007; Buš, 2016; Jacobs, 1961/1992)

Space syntax
A method for analysing how the arrangement of spaces influences movement, accessibility, and social interactions.
(Hillier, 1996; Hillier & Hanson, 1984/2005)

Spatial Configuration
The pattern of relationships between spaces that shapes movement, visibility, and interactions, independently of what occupies them.
(Batty, 2007; Buš, 2016; Hillier, 1996)

Self-organisation
Continuous process through which order and structure arise in a system from interactions among its components. While patterns emerge internally through these interactions, external conditions may influence system dynamics and trigger organisational change.
(Batty, 2007; Porțugali, 2000)

Sustainability
The capacity of a system to continue functioning over time.

Chapter 01 | Introduction

01.01	**Prologue**	12
01.02	**Background and problem description**	13
01.03	**Aim and research questions**	14
01.04	**Delimitations**	14
01.05	**Thesis process**	15

01.01 Prologue

Cities and space have always fascinated me. The overwhelming number of interactions we take for granted, and the complexity behind everyday decisions, reveal layers that are easy to overlook. Trying to understand how the things around me come to be has long been a journey I wanted to pursue.

Being introduced to space syntax and urban morphology at Chalmers was therefore eye-opening. Using analytical tools to approach cities through measurable patterns and relationships allowed me to see urban systems through numbers, while remaining aware of their limitations. This immediately felt like the right direction for me.

At the same time, I was trying to pursue a truly holistic approach to architecture and urban design. Architecture and planning often present themselves as holistic disciplines, yet in practice we frequently see compromises made to maintain the status quo.

This pursuit led me to the topic of self-organisation and emergence. Designers remain necessary as trained professionals capable of approaching problems holistically. At times, however, it seems that we overestimate our knowledge and underestimate our power.

As much as this thesis is a critique of the way we plan cities today, it is also a search for a realistic and implementable approach to planning for a future that is increasingly uncertain.

01.02 Background and problem description

It feels meaningful to be places where others are present, active and engaged. Such environments with visible life generate a sense of safety and belonging. This quality, described by Jane Jacobs as the “sidewalk ballet” (Jacobs, 1961/1992, p. 50) is, however, not incidental, but spatially conditioned. Mixed uses, short blocks and permeable street networks support continuous overlap between movement and occupation (Jacobs, 1961/1992). This spatially structured condition of shared presence, organised through accessibility and visibility, can be understood as co-presence (Hillier, 1996). Co-presence increases the probability of encounter and interaction, but does not guarantee them. Urban buzz emerges when spatial configuration maintains high probabilities of encounter, reinforcing feedback between local activity and movement flows.

Beyond its experiential value, sustained co-presence also increases adaptive capacity of urban systems. Resilience can be understood as the capacity of a system to absorb disturbance while maintaining and adapting its core processes over time. Environments that support repeated interactions are less vulnerable to single-pattern dominance or failure (Porțugali, 2000). In this sense, interaction is not only socially desirable, but also structurally necessary for long-term stability. Since co-presence is conditioned by spatial configuration that maintains probabilities for repeated encounter, interventions that prematurely stabilise one organising logic risk reducing a system’s capacity for continued self-organisation.

This position is in contrast to today’s development practices. Large-scale projects led by powerful actors can be understood as a form of spatial dominance, in which a single organising pattern stabilises and therefore suppresses the diversity of parallel self-organisation processes. In these conditions, emergence has little opportunity to materialise in the built environment as a driver of development. Additionally, the scale and capital intensity of these projects reinforce reliance on long-term planning. As described by just-in-case planning, rigid planning methods must be fulfilled to maintain relevance, which can lead to development that does not respond to the ever-changing needs of a city (Porțugali, 2000). Such rigidity also risks suppressing the feedback loops through which co-presence and urban adaptation can be sustained over time. When urban development prematurely stabilises a single spatial logic, it risks producing spatial surplus and underused structure, increasing material consumption and embodied carbon. Given that the construction industry is among the largest contributors to global CO_2 emissions, reducing unnecessary materialisation is central to mitigating the climate impact of the built environment (United Nations Environment Programme, 2025).

01.03 Aim and research questions

The aim of this thesis is to develop a spatial framework for supporting emergence in urban environments. The framework is constructed by identifying configurational conditions associated with sustained co-presence and adaptive capacity and is subsequently applied to a site in Gothenburg.

How can urban planning structure spatial conditions that enable and sustain emergence through self-organisation?

What are the key spatial conditions that support emergence and self-organisation in cities?

How can they inform planning approaches that allow for ongoing adaptation rather than fixed outcomes?

01.04 Delimitations

In this thesis, the internal dynamics of urban systems are treated as a black box. The focus is on spatial conditions that can support continued self-organising processes and their materialisation in the built environment, rather than analysing the internal mechanisms themselves. Consequently, the analysis does not assume direct causality between spatial conditions and emergent urban patterns (Batty, 2007; Portugali, 2000).

Institutional and economic instruments, such as development incentives, funding schemes, taxation, or administrative prioritisation, can influence how urban development unfolds. While acknowledging their importance, these mechanisms are not analysed directly; the thesis instead focuses on spatial conditions observable in the built environment.

Plot structure is also recognised as an important factor in the evolution of urban form. Parcel size and subdivision patterns can influence the adaptability and incremental transformation of urban environments. In this thesis, however, plot systems are treated as contextual conditions influencing the materialisation of self-organising processes rather than as objects of analysis (Bobkova, 2019; Conzen, 1960).

01.05 Thesis process

The thesis develops through three stages that partially overlap.

The first stage establishes a theoretical basis for understanding self-organisation and spatial configuration through literature. It defines the conceptual boundaries of the investigation and clarifies what is understood as spatial conditions capable of supporting emergence.

The second stage investigates these conditions through configurational spatial analysis. It examines relationships between spatial structure, movement potential, and materialisation in selected case studies. The detailed methodological procedures for these analyses are described separately.

The third stage synthesises the identified spatial conditions and relationships into a framework. The framework translates these spatial conditions into design-relevant parameters and is applied to a site in Gothenburg to explore how they can inform urban planning and design

Chapter 02 | Theoretical framework

02.01 Theoretical framework 18

02.01 Theoretical framework

About our understanding of cities

To begin looking for conditions supporting emergent urbanism, we must first have a common understanding of what it is and what its outcomes should be. Cities are often approached as objects that can be designed towards predefined outcomes, yet they rarely behave in such a deterministic manner. In this sense it is incorrect to speak of outcomes, as cities are systems that continuously evolve through the interactions of many agents (Batty, 2007; Porțugali, 2000) and often develop beyond our intentions. If we, as designers, want to keep our role of adjusting conditions that communities can grow into, we must think of outcomes as sustainable properties of ongoing processes, not as an end state.

How do cities grow?

As people move through space, they interact with one another and respond to the existing urban fabric. Through these interactions between heterogeneous agents, urban patterns such as concentrations of activity, commercial corridors, or neighbourhood identities can emerge. Therefore, urban patterns do not arise primarily from central coordination, but from repeated local interactions among actors, as these accumulate over time (Batty, 2007; Jacobs, 1961/1992; Porțugali, 2000). Self-organisation describes the parallel processes through which these interactions generate order within the system.

Does this happen all the time?

Yes, however, the sustainability of these processes is not guaranteed. For urban systems to remain adaptive, they must maintain a balance between insufficiency and over-order. If interactions are too weak, feedback cannot accumulate, and patterns fail to develop. If reinforcing mechanisms become too strong and counteracting mechanisms are absent, positive feedback can accumulate excessively, allowing a single pattern to dominate, reducing the system's capacity to adapt (Porțugali, 2000).

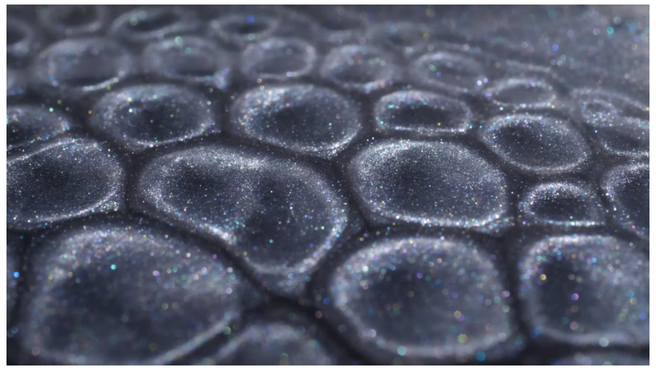


Fig. 1: When a liquid heated from below reaches a critical temperature difference, random molecular motion becomes unstable and spontaneously organises into coherent cells. The rising hot liquid and descending cooler liquid form a pattern, showing how ordered structures can emerge from local interactions without external control, driven by external input.
Note. From Smith (2024). CC BY 4.0.

How can it be supported?

The spatial configuration of the built environment influences how people move through the city and where their paths intersect. By organising probabilities of movement and co-presence, spatial configuration can affect the intensity and distribution of interactions (Hillier, 1996; Hillier et al., 1993). Space thus becomes central, as the medium through which the interactions sustaining self-organisation occur.

The task of designers therefore shifts from prescribing final forms to shaping the conditions under which urban systems can remain adaptive.

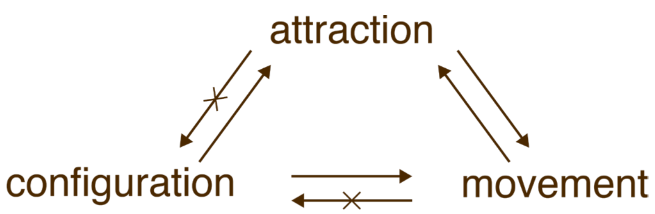


Fig. 2: An example of a feedback loop, between attraction and movement.
Note. Adapted from Hillier et al. (1993).

What are the conditions?

Two types of conditions can be distinguished. The first concerns the materialisation of self-organisation processes. These conditions determine whether multiple actors are able to participate in shaping the built environment and whether incremental development can occur. Elements such as plot sizes, development accessibility, or supportive policy and economic instruments influence whether urban processes can materialise in the first place.

The second concerns the sustainability of self-organising processes once space has been built. For urban systems to remain adaptive, spatial conditions must continue to support movement, co-presence, and diversity of uses over time. These conditions support feedback loops between spatial configuration, movement, and urban activities through which self-organising processes can persist over time.

What is the role of design?

Urban planning should operate less by determining final spatial forms than by shaping the environment within which urban processes unfold. Portugali (2000) describes this approach as *just-in-time* planning, where interventions respond to evolving dynamics rather than imposing predetermined spatial outcomes. Designers thus act less as authors of urban form than as stewards of the conditions that allow cities to evolve.

Chapter 03 | Case study analyses

03.01	**Methodology**	22
03.02	**Case studies presentation**	25
03.03	**Interaction potential**	28
03.04	**Reinforcement**	32
03.05	**Functional differentiation**	35
03.06	**Balance**	39
03.07	**From analyses to framework**	43

03.01 Methodology

Data sources

For non-motorised network analyses, objects with the key “highway” were downloaded through the Quick query function in the QuickOSM plugin. The used values were: ”footway, pedestrian, steps, path, track, cycleway, living_street, service, secondary, tertiary, residential.” The query was run with the “OR” operator. Any missing data was manually added, using Google Streetview or literature.

Data processing - buildings data

For the analyses, the following datasets were used: function, ground-floor interface, footprint area, number of floors.

Function, or primary use, has been simplified, due to the vast number of building categories in OpenStreetMap (OSM) data. This has been done by merging values in the “building” field. Table 1 describes the primary uses used in the analyses, along with the OSM values that were assigned in the initial data. If a building within the scope of the analysis had a value of “yes” assigned, it was assigned to one of the functions manually.

Ground-floor interface is used as a simplified binary indicator of a building’s capacity to support street-edge co-presence through ground-floor activity. Due to limited and inconsistent data across OSM fields, the indicator was primarily derived from values in the “building” field associated with public or commercial functions. These include: “commercial, retail, kiosk, train_station, and transportation.” Because these tags generally represent the primary building function and may not capture secondary ground-floor activities, additional uses were identified through “points of interest” (POI) data, using non-zero values in the “amenity” and “shop” fields to supplement the dataset.

For number of floors, the “building:levels” and “roof:levels” were used. In case of missing data, the values were added manually. For “roof:levels” an inconsistency was found, where buildings were assigned values of 2,3 or 4, despite having only one roof level. Due to this, any value of “roof:level” higher than 1 was treated as 1. Total number of floors in a building is equal to the sum of “building:levels” and “roof:levels”.

Data processing - network data

Non-motorised network data required several adjustments before analysis. Pedestrian-accessible routes were not sufficiently represented through objects tagged as pedestrian, therefore additional road classes such as “secondary” and “tertiary” were included to account for missing sidewalks. In some cases, this resulted in duplicated representations where sidewalks were already mapped alongside streets, which were corrected to ensure consistent representation. Streets are represented axially where crossing does not constitute a significant barrier, and through sidewalks where major roads act as barriers

Table 1: Classification of primary uses based on OSM tags.

Function	OSM Value
Residential	apartments, residential, dormitory, house, detached, terrace, semidetached_house, semi_detached, bungalow
Commercial	commercial, retail, office, hotel, kiosk
Public	public, civic, government, courthouse, hospital, school, kindergarten, university, college, fire_station, sports_centre, sports_hall, church, chapel, cathedral, temple, monastery
Productive	industrial, warehouse, farm, farm_auxiliary, barn, stable, greenhouse
Mobility	train_station, transportation, garage, garages, parking, carport, bridge, gatehouse
Other	*empty, other values*

to pedestrian movement. Additional corrections were made where the mapped network did not correspond to visibility conditions, ensuring the network better reflects pedestrian lines of sight. An “unlinks” layer was created to represent multi-level crossings. A segment map was then created using the PST plugin, based on the respective network and unlink layers.

Data analyses

Spatial analyses were carried out to examine spatial conditions associated with interaction, reinforcement, differentiation and balance. QGIS served as the analytical environment, while the PST plugin was used to perform configurational network analysis. Together, they were used to identify materialised spatial patterns consistent with self-organising processes.

Angular betweenness centrality was used to describe centrality within the street network, as it captures the movement potential of particular routes within the network. The measure reflects how often a street segment lies on the shortest angular paths between other segments in the network and is therefore commonly used to approximate potential movement flows. Because movement potential influences opportunities for encounter and interaction, angular betweenness is useful for identifying parts of the network where conditions for co-presence are more likely to occur. It was calculated at multiple radii in order to capture different spatial scales of movement potential within the network. Radii of 1km, 2km, and 5km were used, representing local neighbourhood conditions, intermediate district-scale structure, and the broader urban network structure respectively. These multiple radii allow comparison between different scales of movement potential and provide insight into how local and larger-scale network structures relate to one another.

The configurational network analysis was performed on the whole city, to prevent influence by edge effects, however it was read locally. The reading was done in an area that consisted of the study area boundary being offset by 300m outwords, to capture not only the study area itself, but also its role within the immediate urban fabric. Building-related analyses were done on the study area, as they examine materialised spatial conditions within the study area.

Within the study area, Ground Space Index (GSI) and Floor Space Index (FSI) were calculated using building footprint and floor numbers data. These indicators describe the intensity of built form by measuring the proportion of land covered by building footprints (GSI) and the relationship between total floor area and land area (FSI).

Buildings smaller than 20 m² were excluded from the analyses in order to remove minor structures such as sheds or service buildings that do not significantly influence built intensity, spatial configuration or movement potential.

Summary of methods

The analyses are structured around four categories: interaction potential, reinforcement, functional differentiation and balance. Together, these categories are used to examine conditions and materialised spatial patterns consistent with self-organising urban processes and to identify spatial conditions that can inform the framework.

Interaction potential addresses how spatial configuration supports movement and co-presence. Reinforcement examines whether spatial centrality and urban activity strengthen one another. Functional differentiation considers whether different spatial conditions correspond to different urban roles, rather than producing uniform or isolated patterns. Balance addresses whether the urban system appears to operate between insufficiency and over-order, supporting variation and continuity rather than deadness, dominance, or concentration.

Together, the analyses are used to assess how the study area and its immediate surroundings relate as one urban system. Rather than evaluating the study area in isolation, the method examines whether this broader relation supports conditions associated with lively, resilient, and adaptable urban environments.

Table 2: Summary of analyses.

Category	Type	Dataset	Question	Analysis	Indicator	Method	Read on	Output
Interaction potential	Conditions	AB (1km, 2km, 5km), segment length	Does the area have sufficient potential for movement and repeated co-presence?	Multiscalar centrality	Share of high-centrality segments	Non-zero AB classified into L/M/H using Jenks per radius, length-weighted % of H segments	Study area +300m	% of network length in H per radius
Reinforcement	Relationship	AB (2 km), ground-floor interface, segment length	Are active uses aligned with movment potential?	Active edges per centrality class	Share of active edges per centrality class	Non-zero AB classified into L/M/H using quantiles, length-weighted % of active edges within each centrality class	Study area	% of active edges in different centrality streets
Functional differentiation	Materialisation	Primary uses	What range of fuctions has materialised?	Primary uses mix (entropy)	Shannon entropy	Shannon entropy (0-1)	Study area	Differentiation value
		Active edge share, segment length	Is the materliased diversity active at the street level?	Active edges share	Share of active edges	Length-weighted %	Study area	% of active edges
Balance	Conditions	AB (2km), segment length	Is movement potential distributed within a range that avoids both insufficiency and dominance?	Distribution of movement potential	Top 20% share, IQR/median	Value-based ranking (20%) + quartile-based spread (length-weighted)	Study area +300m	% of centrality in top 20%, relative IQR
		FSI	Is built intensity distributed within a range that avoids both insufficiency and dominance?	Distribution of built intensity	Top 20% share, IQR/median	Value-based ranking (20%) + quartile-based spread	Study area	% of FSI in top 20%, relative IQR

03.02 Case studies presentation

Vauban, Freiburg, Germany

Vauban is a neighbourhood in Freiburg developed from the late 1990s on the site of a former French military base. The planning process combined municipal planning with strong citizen participation, resulting in a district characterised by high residential density, mixed uses, limited car access, and a fine-grained street network prioritising pedestrians and cyclists. Many housing projects were organised through cooperative or collective building groups (Baugruppen), in which future residents collectively commissioned and developed their own buildings. This process enabled the participation of many smaller actors in the development of the district and contributed to a diverse built environment and incremental variation in building types.

Vauban was selected as a case study because it represents a planned neighbourhood that nevertheless incorporates conditions often associated with emergent urban processes, such as fine-grained spatial structure, mixed functions, and strong pedestrian connectivity. The involvement of building groups and other small actors in the development process makes it a useful example of how planning frameworks can allow a degree of bottom-up development within a structured planning framework.

Fig. 3: Freiburg-Vauban aerial view.
Note. From Schwarzkopf (2020). CC BY-SA 4.0.

Fig. 4: Residential street in Freiburg-Vauban.
Note. From Chung (2011). CC BY 2.0.

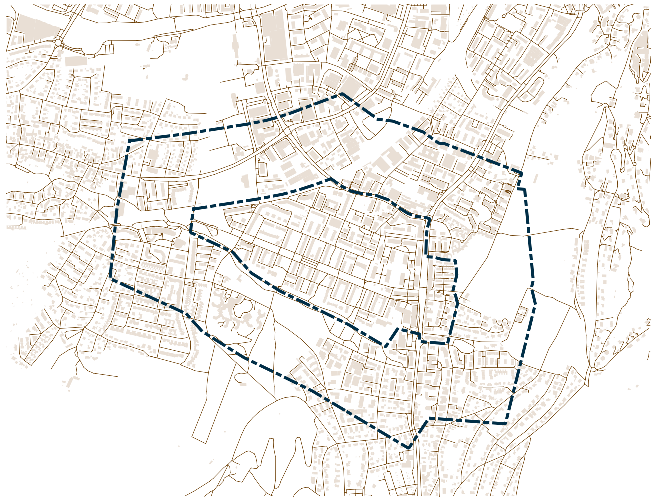


Fig. 5: Map of Freiburg-Vauban.

Tsukishima, Tokyo, Japan

Tsukishima is a district in Tokyo created through land reclamation in the late nineteenth century. The street network was planned early as a grid-like structure with streets of varying widths, establishing the basic spatial framework of the area. Within this framework, however, the development of the built fabric occurred gradually through the actions of many individual landowners and small-scale builders. Over time, the district evolved through incremental subdivision and redevelopment of small plots, resulting in a dense urban fabric with narrow streets, small parcels, and a high degree of functional mix.

Tsukishima was selected because it represents a case in which the street structure was planned in advance, while the built form itself was largely left to develop over time through the actions of numerous small actors. This makes it a useful example of how a relatively simple spatial framework can support long-term incremental development and sustained urban activity.

Fig. 6: Aerial view of Tsukishima, Tokyo.
Note. Adapted from Ha'Eri (2008). CC BY 3.0.

Fig. 7: Street in Tsukishima, Tokyo.
Note. Adapted from Futo (2017). CC BY 2.0.

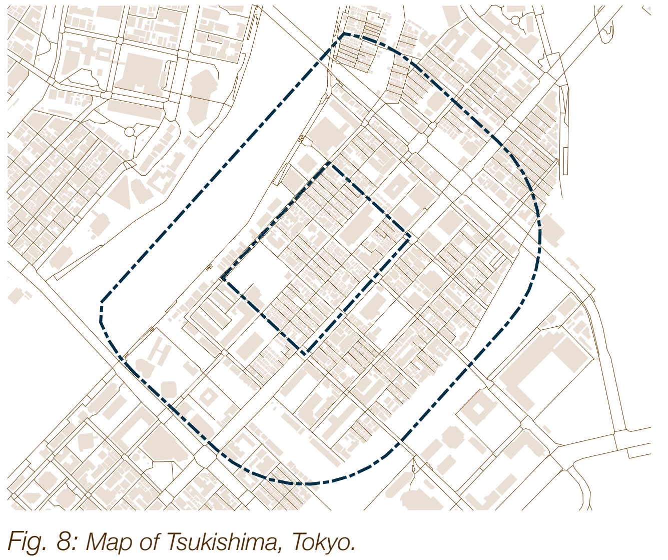


Fig. 8: Map of Tsukishima, Tokyo.

Bijlmermeer, Amsterdam, the Netherlands

Bijlmermeer was developed in the late 1960s and early 1970s as a large-scale modernist housing district based on principles of functional separation and large superblocks. The original plan consisted of high-rise residential buildings arranged in a honeycomb pattern, with strict separation between pedestrian and vehicular circulation and extensive open space between buildings. The district was designed through a highly centralised planning process that prescribed both the spatial structure and the form of development. Approximately two thirds of the original buildings were later demolished or substantially transformed during large-scale renewal programmes beginning in the 1990s, which replaced parts of the high-rise stock with lower-density and more conventional urban forms.

Bijlmermeer was selected as a contrasting case study representing a condition of strong top-down planning and spatial over-order. The highly controlled spatial structure, large building complexes, and limited plot subdivision restrict opportunities for incremental development and adaptation by smaller actors. As such, the district provides an example of how strongly prescribed planning frameworks can produce spatial conditions associated with over-order.

Fig. 9: View from Gooioord in Bijlmer.
Note. Adapted from Teper (2008). CC BY-SA 3.0.

Fig. 10: Bijlmermeer in 1973, during the construction of the metro.
Note. Adapted from Stadsarchief Amsterdam (1973). Public domain.

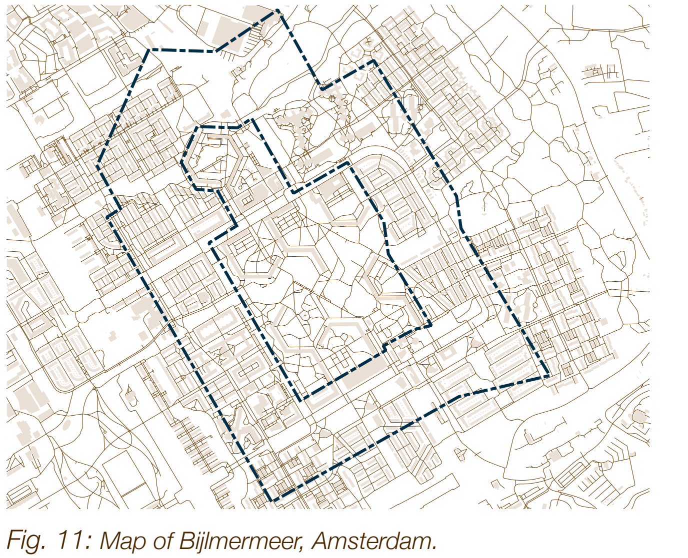


Fig. 11: Map of Bijlmermeer, Amsterdam.

03.03 Interaction potential

Do the study area and its surroundings together create conditions for movement and repeated co-presence?

Since opportunities for encounter are influenced in part by how the street network structures accessibility and movement potential, this category focuses on the configurational capacity of the urban system. The analysis addresses the question of to what extent the study area and its immediate surroundings form a spatial structure capable of supporting movement and conditions for repeated encounter. To examine this, angular betweenness centrality is read as an indicator of movement potential across scales and as an indicator of the role of the study area within the wider movement structure. Together, these readings make it possible to assess both whether interaction potential is sufficient and how the expanded study area relates to its surroundings, including the extent to which it is open to wider movement flows, which supports conditions for continued interaction over time.

Angular betweenness centrality was calculated on the non-motorised network at radii of 1 km, 2 km, and 5 km using the full network extent. The street segments with non-zero centrality values were classified using natural breaks (Jenks) into three categories (low, medium, high) for each radius. Natural breaks were used to reflect the internal distribution of each system, allowing the classification to reflect the internal hierarchy of each network. The Jenks classification method is used primarily for visualisation and interpretative comparison and should not be understood as representing absolute thresholds within the urban system

The resulting maps are used to interpret the spatial distribution and continuity of movement potential, focusing on continuity, distribution and overlap of high-centrality segments.

To quantify interaction potential, only segment classified as high ("H") are considered, and their length-weighted share within the enlarged study area is calculated. This measure captures the proportion of the network associated with higher movement potential.

Table 3: Percentage of network length classified as "H" in each radius.

Case study	1km	2km	5km
Vauban	2,2%	2,5%	0,0%
Tsukishima	5,2%	0,5%	2,1%
Bijlmermeer	12,8%	7,8%	3,0%

Reading and interpretation

In Vauban (Fig. 12), higher centrality is limited and largely located at the edges, with almost no presence at the 5 km scale. This reflects its origin as a redeveloped military site, inserted into the city rather than gradually integrated into it. The internal network is fine-grained and permeable, but its connection to Freiburg's wider movement structure remains relatively weak. The result is a system that supports local movement but remains relatively weakly connected to wider movement structures.

In Tsukishima (Fig. 13), centrality is distributed across the grid without forming a dominant structure. This relates to its early planned street framework combined with long-term incremental development. The grid distributes movement potential across multiple routes, but without strong hierarchy. As a result, interaction potential is supported through accumulated local overlaps rather than strong global integration.

In Bijlmermeer (Fig. 14), centrality is present across scales but concentrated along a small number of routes. This reflects the modernist planning logic of superblocks and separated traffic systems, where movement is intentionally structured through specific corridors. While these routes exhibit higher movement potential, the overall system lacks continuity, and large parts remain weakly integrated.

Design implications

The intervention will use centrality to structure how movement operates across scales. It should ensure that movement potential is not only present locally but also integrated into the wider network structure, while avoiding conditions where it is restricted to isolated parts of the system.

If centrality remains primarily internal, the area remains weakly integrated into the wider movement structure. If it is concentrated in limited parts of the network, movement potential becomes spatially concentrated, limiting its presence across the system.

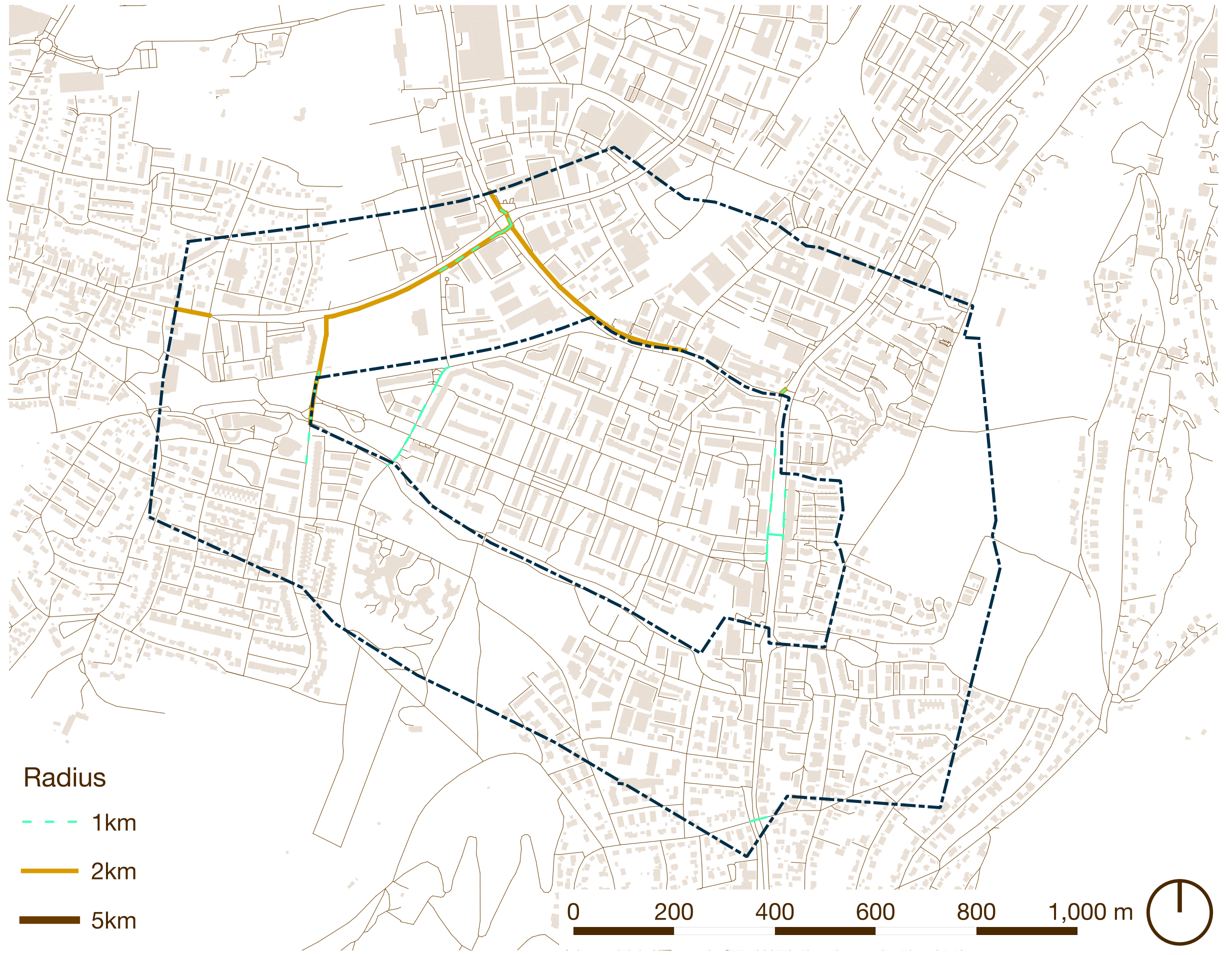


Fig. 12: Map of Vauban, Freiburg, highlighting segments classified as high in each radius.

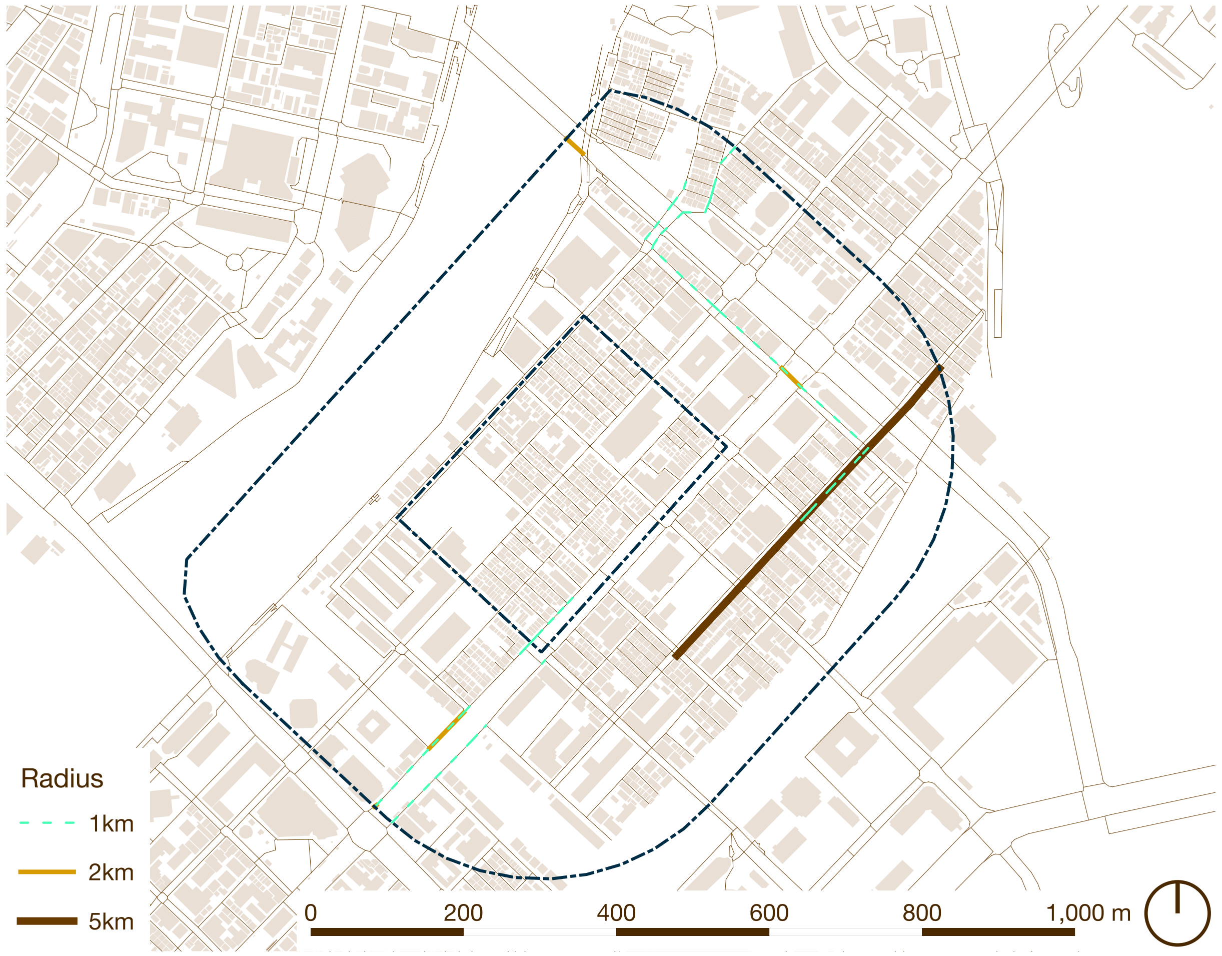


Fig. 13: Map of Tsukishima,Tokyo, highlighting segments classified as high in each radius.

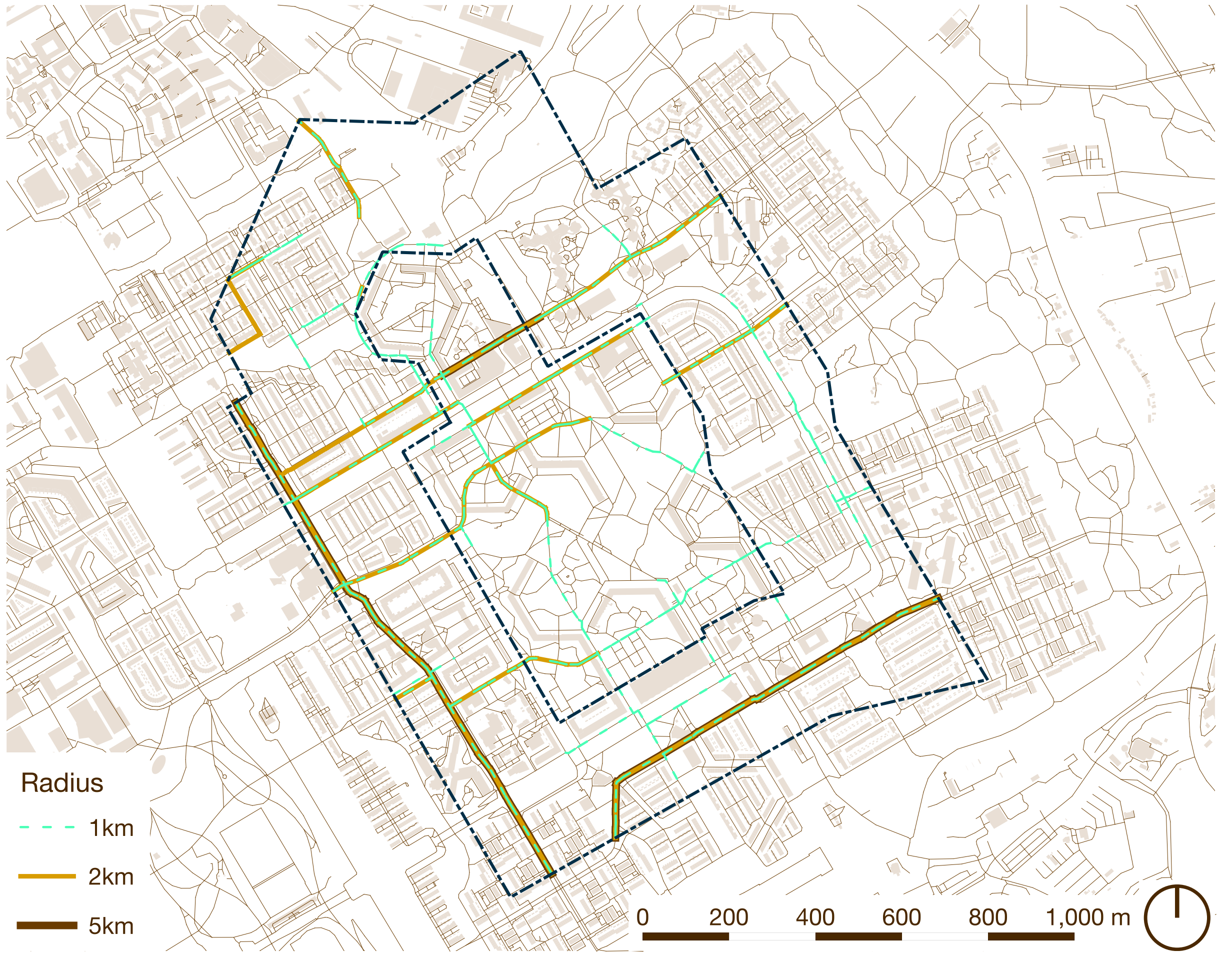


Fig. 14: Map of Bijlmermeer, Amsterdam, highlighting segments classified as high in each radius.

03.04 Reinforcement

To what extent is movement potential reinforced by built intensity and street-level activity?

While configurational measures describe the potential for movement, reinforcement captures whether this potential is supported by built intensity and active uses, allowing stable relationships between movement and occupation to emerge.

To examine this, angular betweenness at a radius of 2 km is related to ground-floor activation. The 2 km radius is used for the scale of everyday urban movement, at which both local accessibility and wider system integration influence patterns of use. Ground-floor activation represents the presence of active interfaces at the street level.

Street segments with non-zero centrality values were classified into three categories (low, medium, high) using quantiles. For each class, length-weighted proportion of active edges was calculated within the study area. Active edge share is calculated as the ratio between active frontage length and total segment length within each centrality class. This allows comparison of how activity is distributed across different levels of movement potential.

Interpretation focuses on the consistency of alignment between centrality and ground-floor activity. Strong reinforcement is indicated where higher centrality is associated with both higher shares of active edges, suggesting a strong spatial correspondence between movement potential and activity. Weak reinforcement is indicated where this relationship is absent or inconsistent, while inverse relationships suggest a mismatch between spatial configuration and materialisation.

Table 4: Percentage of active street segments in each class.

Case study	L	M	H
Vauban	2,8%	3,8%	13,0%
Tsukishima	20,1%	42,1%	67,9%
Bijlmermeer	3,4%	4,8%	5,2%

Reading and interpretation

In Vauban (Fig. 15), active edges increase with centrality but remain low overall. Although some alignment exists, the relationship between movement potential and activity remains relatively weak. This reflects the predominantly residential character of the area and the way many ground floors are organised, often without continuous active interfaces. Movement potential therefore corresponds only partially with street-level activity

In Tsukishima (Fig. 16), a strong alignment is visible, with active edges increasing significantly with centrality. While entropy suggests dominance of a single use, this is largely due to the prevalence of residential buildings in the dataset. In reality, small-scale commercial and service functions are embedded within these structures and directly accessible from the street. The metric underrepresents this condition, but the high share of active edges captures it. This suggests strong reinforcement between movement and activity.

In Bijlmermeer (Fig. 17), active edges remain low across all centrality classes, despite the presence of higher movement potential. This reflects the spatial separation of functions and the inward-facing organisation of buildings, where entrances and uses are not consistently oriented towards the street. As a result, movement potential does not strongly correspond with street-level activity

Design implications

The intervention will address the spatial relationship between movement and activity. It should ensure that areas with higher movement potential are able to support active uses, allowing higher centrality to correspond with street-level activity.

If activity is absent where movement is strong, centrality remains underutilised. If activity does not relate to movement potential, it remains spatially disconnected.

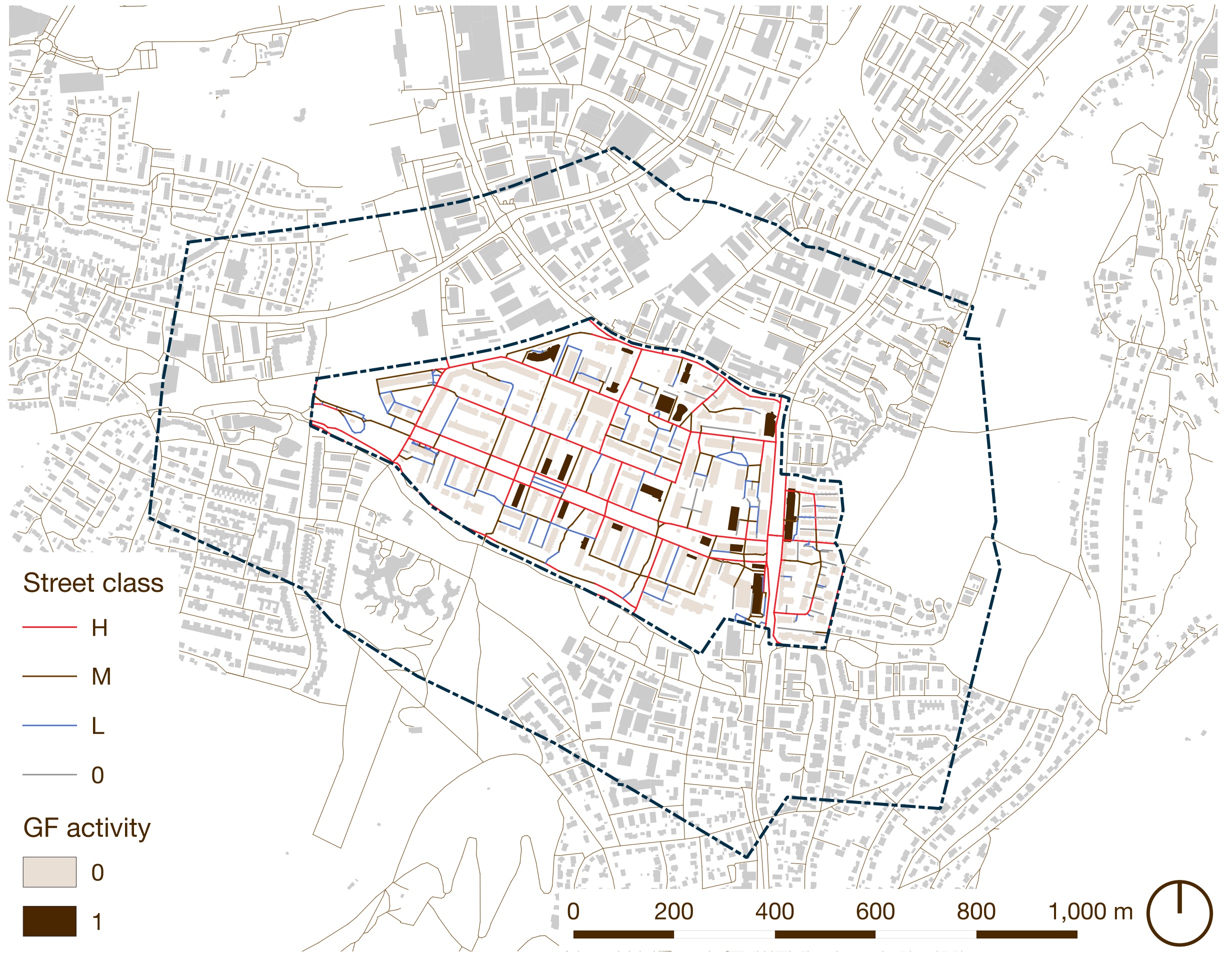


Fig. 15: Map of Vauban, Freiburg, highlighting buildings with an active ground floor, and segment centrality classes.

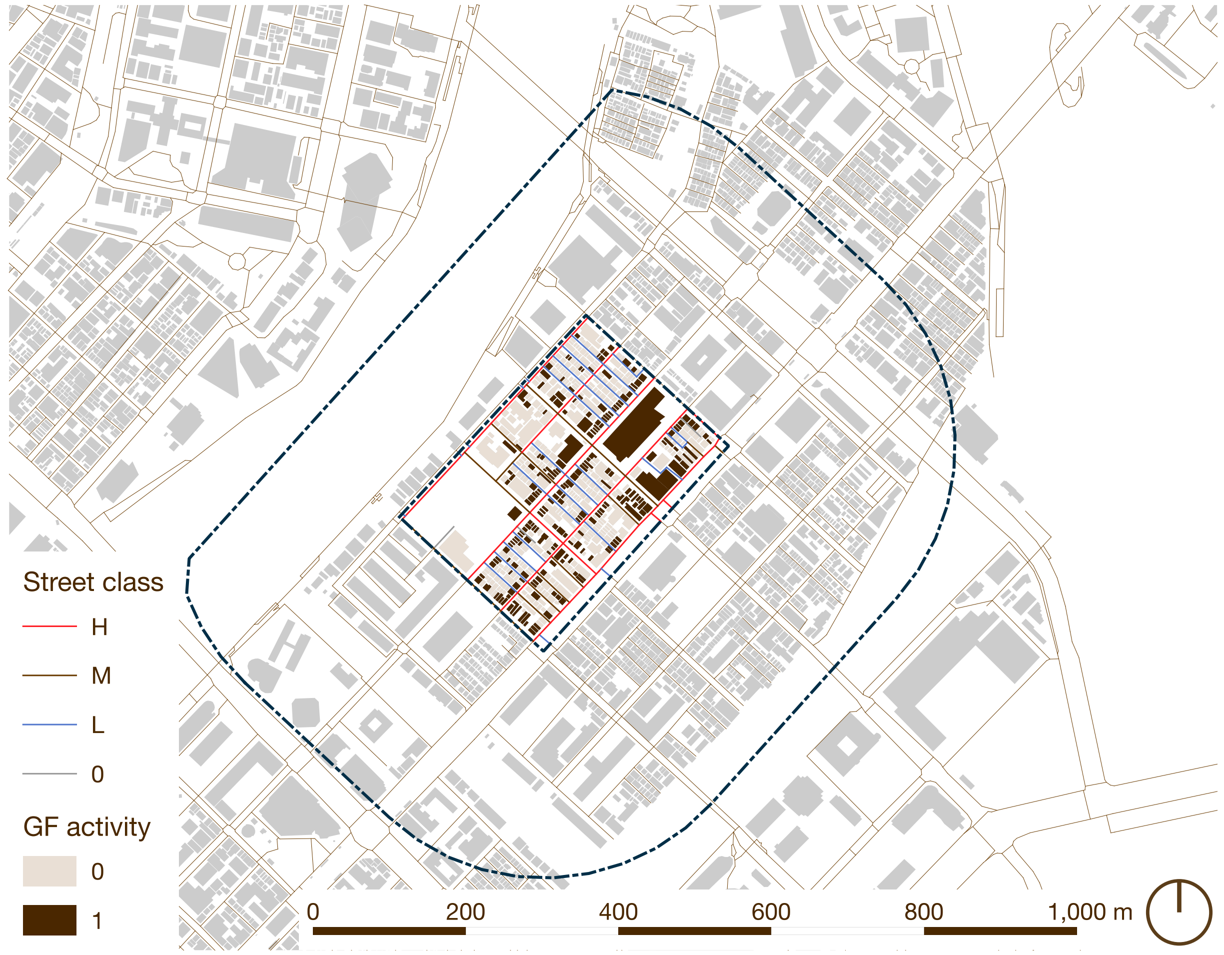


Fig. 16: Map of Tsukishima, Tokyo, highlighting buildings with an active ground floor, and segment centrality classes.

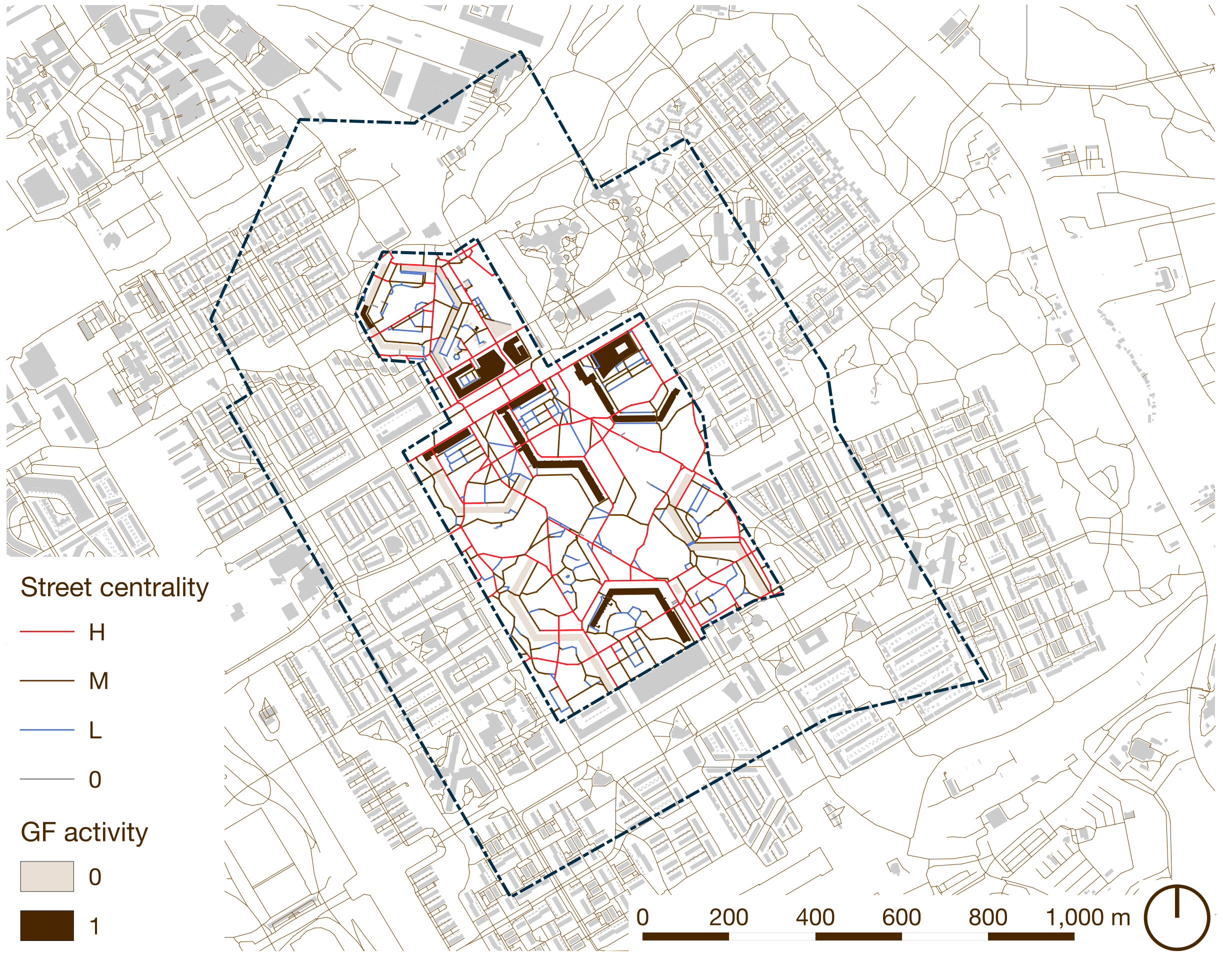


Fig. 17: Map of Bijlmermeer, Amsterdam, highlighting buildings with an active ground floor, and segment centrality classes.

03.05 Functional differentiation

What range of functions has materialised within the study area, and to what extent is this diversity expressed at the street level?

Differentiation captures the diversity of uses present in the system and their manifestation on the street level.A higher degree of differentiation can support varied activities and co-presence, supporting conditions for interaction and adaptation over time.

Primary building uses are analysed using Shannon entropy, which captures both the number of different functions and their relative proportions. Values range from 0 (single dominant use) to 1 (even distribution across categories), allowing comparison between areas with varying degrees of functional diversity. As entropy is calculated from counts rather than floor area, smaller non-residential uses may be overrepresented relative to large residential buildings.

The presence of active uses at the street level is assessed through the share of active edges, calculated as the length-weighted proportion of segments with active ground-floor interfaces.

Reading and interpretation

In Vauban (Fig. 18 and 19), entropy indicates a relatively even distribution of functions, but this diversity is weakly expressed at the street level. While different uses are present, they are often contained within buildings or organised in ways that limit their exposure to public space. The result is a system where diversity exists but remains weakly expressed at the street level.

In Tsukishima (Fig. 20 and 21), entropy indicates low diversity, but this is misleading when read in isolation. The dominance of residential use reflects how functions are recorded, not how they operate. In practice, many buildings combine residential and commercial uses, with small businesses embedded at ground level. The high share of active edges reflects this condition, suggesting that diversity is strongly expressed at the interface despite limited formal differentiation in the dataset.

In Bijlmermeer (Fig. 22 and 23), entropy suggests a mix of functions, but very low active edges indicate that this diversity is not accessible at the street level. Uses are spatially separated and often internalised within large structures, reducing their interaction with public space. This suggests a disconnect between formal diversity and its spatial expression.

Design implications

The intervention will use functional differentiation to guide both the distribution of uses and their expression at the street level. It will aim to ensure that diversity, where present, is accessible and related to movement.

If functions remain internal, diversity does not correspond with street-level activity. If diversity is limited but expressed at the interface, activity can still be present. The intervention will therefore focus on supporting conditions where uses are able to engage with the street, allowing differentiation to support interaction rather than remain contained.

Table 5: Functional differentiation described by Shannon entropy.

Case study	Within study area
Vauban	0,49
Tsukishima	0,11
Bijlmermeer	0,57

Table 6: Percentage of active edges in the study area.

Case study	Within study area
Vauban	7,3%
Tsukishima	46,5%
Bijlmermeer	4,6%

Fig. 18: Map of Vauban, Freiburg, showing primary uses of buildings

Fig. 20: Map of Tsukishima, Tokyo, showing primary uses of buildings.

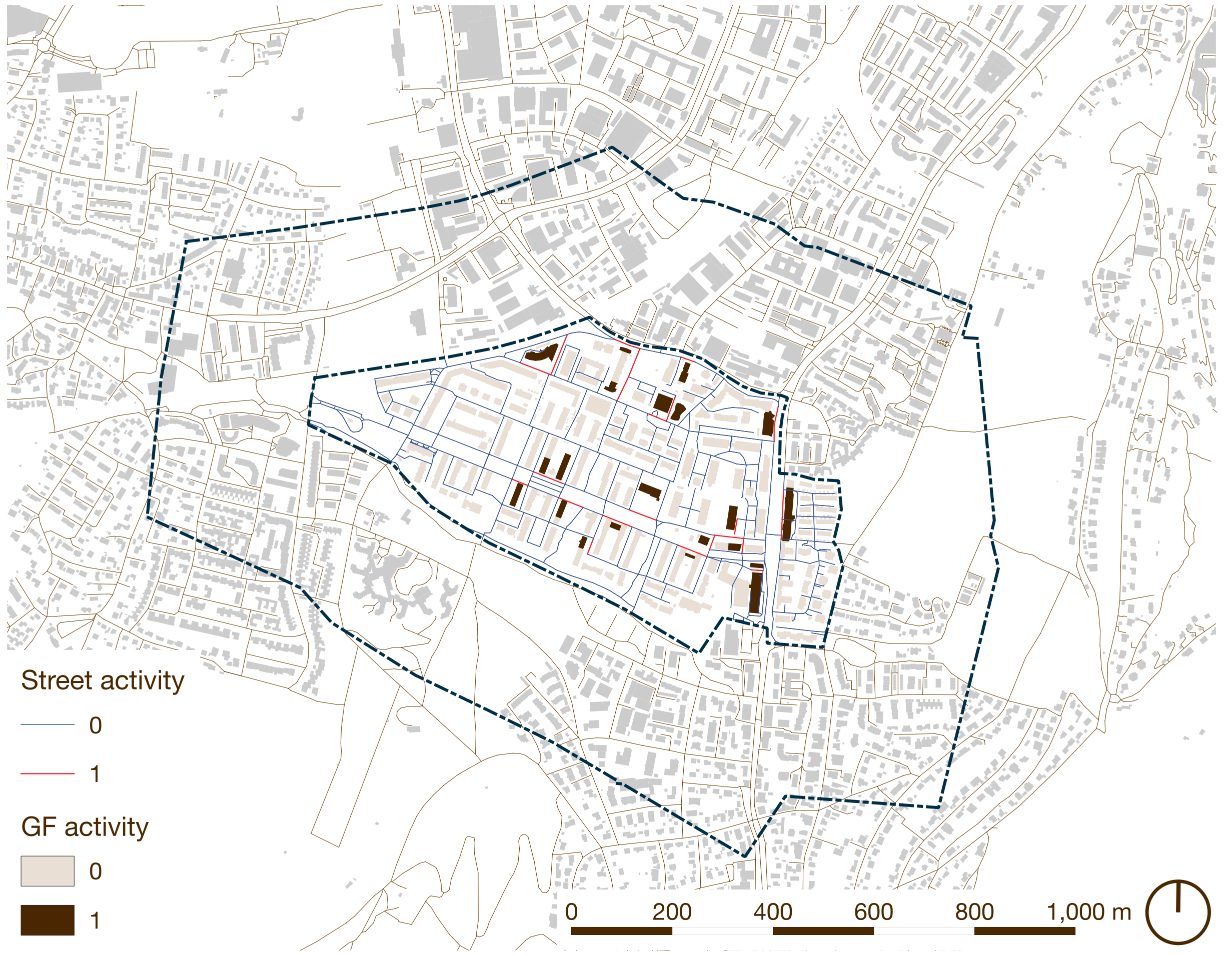


Fig. 19: Map of Vauban, Freiburg, highlighting active street segments

Fig. 21: Map of Tsukishima, Tokyo,highlighting active street segments.

Fig. 22: Map of Bijlmermeer, Amsterdam, showing primary uses of buildings.

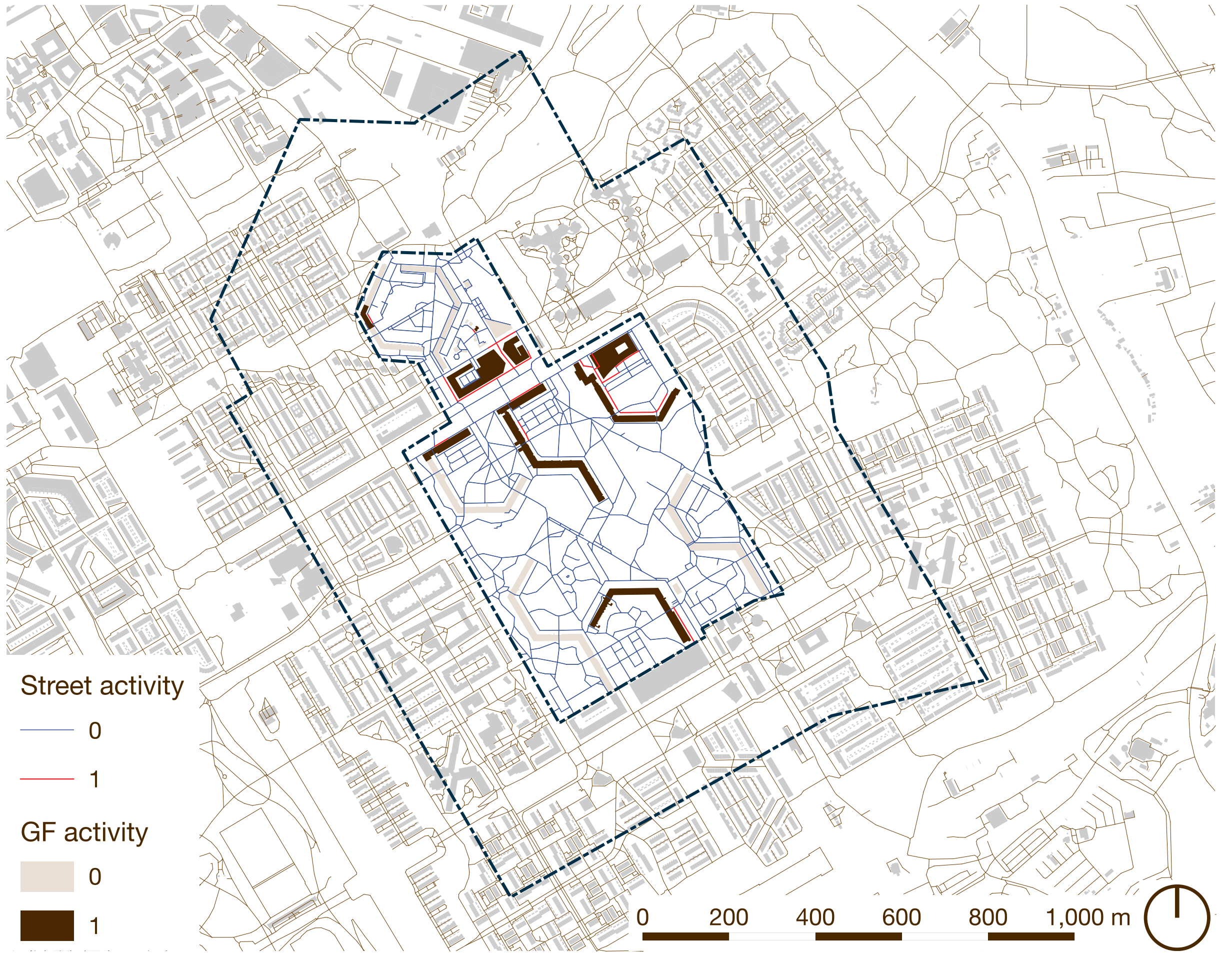


Fig. 23: Map of Bijlmermeer, Amsterdam, highlighting active street segments.

03.06 Balance

Are spatial conditions distributed within a range that avoids over-concentration?

To examine this, the distribution of angular betweenness centrality (2 km) and floor space index (FSI) is analysed within the study area. For each variable, two measures are calculated. First, concentration is assessed through the share of total values held by the top 20% of elements, capturing the extent to which a small part of the system dominates. Second, spread is measured using the interquartile range (IQR) normalised by the median, capturing the degree of variation within the typical range of values.

Interpretation focuses on the combined reading of these measures. Low spread and low concentration indicate insufficient differentiation, limiting conditions for interaction. High concentration indicates over-order, where a small number of elements dominate the system. A balanced condition is indicated by moderate spread and limited concentration, where variation is present without dominance, allowing feedback loops to persist without becoming locked into rigid patterns.

Reading and interpretation

In Vauban (Fig. 24 and 25), concentration in centrality is relatively high, but variation is still distributed across the system. While certain segments are more prominent, the overall structure allows differences to coexist without complete dominance. This suggests a system where differentiation is present without strong dominance.

In Tsukishima (Fig. 26 and 27), both centrality and built intensity are relatively evenly distributed, resulting in a compressed structure with limited variation. This reflects the regularity of the grid and the relatively consistent scale of development. While this supports continuity, stronger differentiation remains limited.

In Bijlmermeer (Fig. 28 and 29), both centrality and built intensity show high concentration alongside large variation. A small number of elements dominate, while others remain significantly less connected or intense. This reflects the contrast between large-scale structures and less integrated spaces, suggesting an uneven spatial structure.

Design implications

The intervention will address how spatial conditions are distributed across the system. It should support variation while avoiding conditions where values become overly uniform or concentrated.

If variation is weak, the spatial differentiation remains limited. If values are concentrated in a limited number of elements, the system becomes increasingly dependent on them.

Table 7: Percentage of values held by the top 20% elements.

Case study	AB	GFA
Vauban	86,6%	65,7%
Tsukishima	66,4%	85,0%
Bijlmermeer	85,5%	75,2%

Table 8: IQR normalised by the median.

Case study	AB	GFA
Vauban	4,51	4,01
Tsukishima	1,59	1,03
Bijlmermeer	4,07	13,00

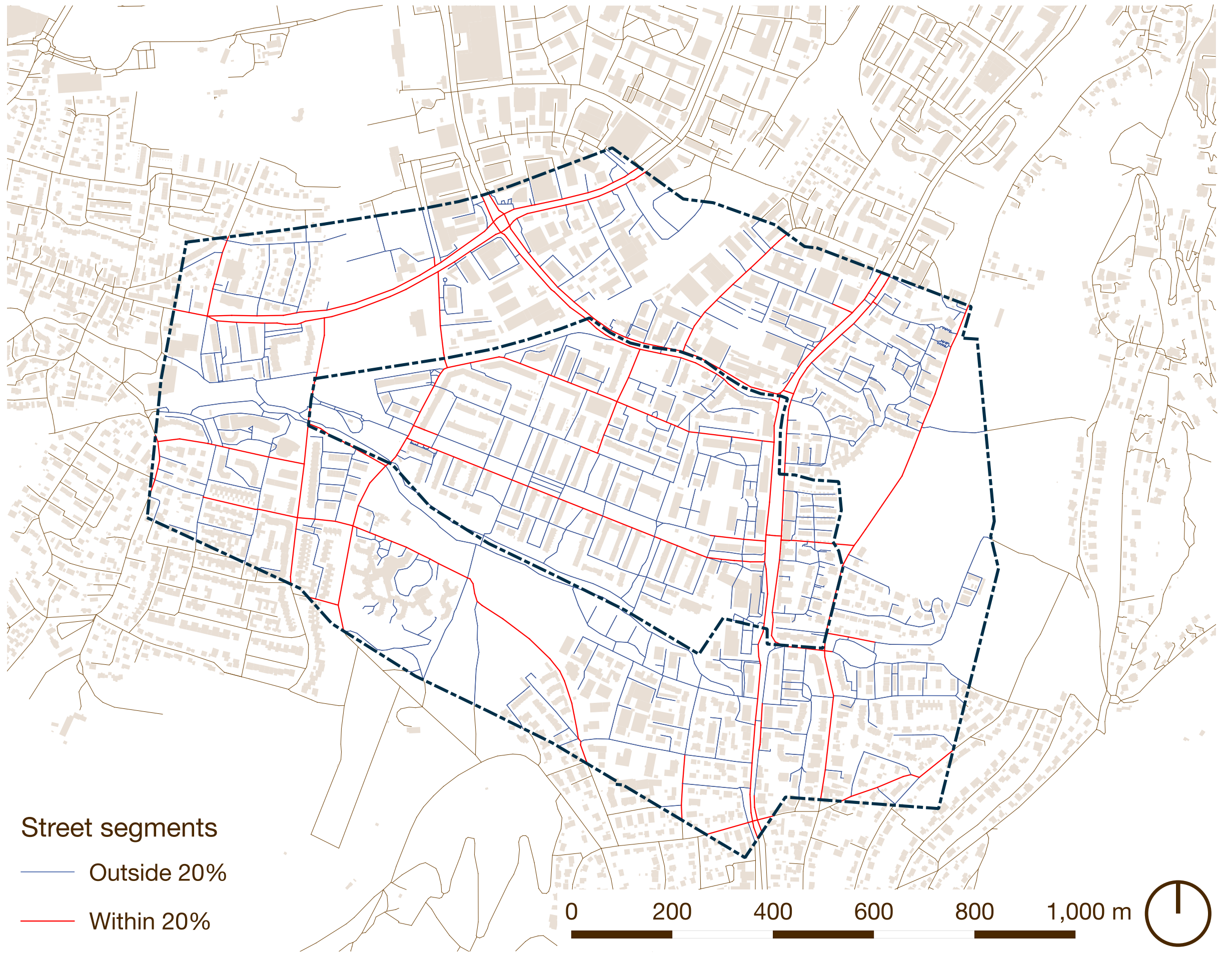


Fig. 24: Map of Vauban, Freiburg, highlighting the top 20% street segments by centrality value.

Fig. 25: Map of Vauban, Freiburg, highlighting the top 20% buildings by GFA.

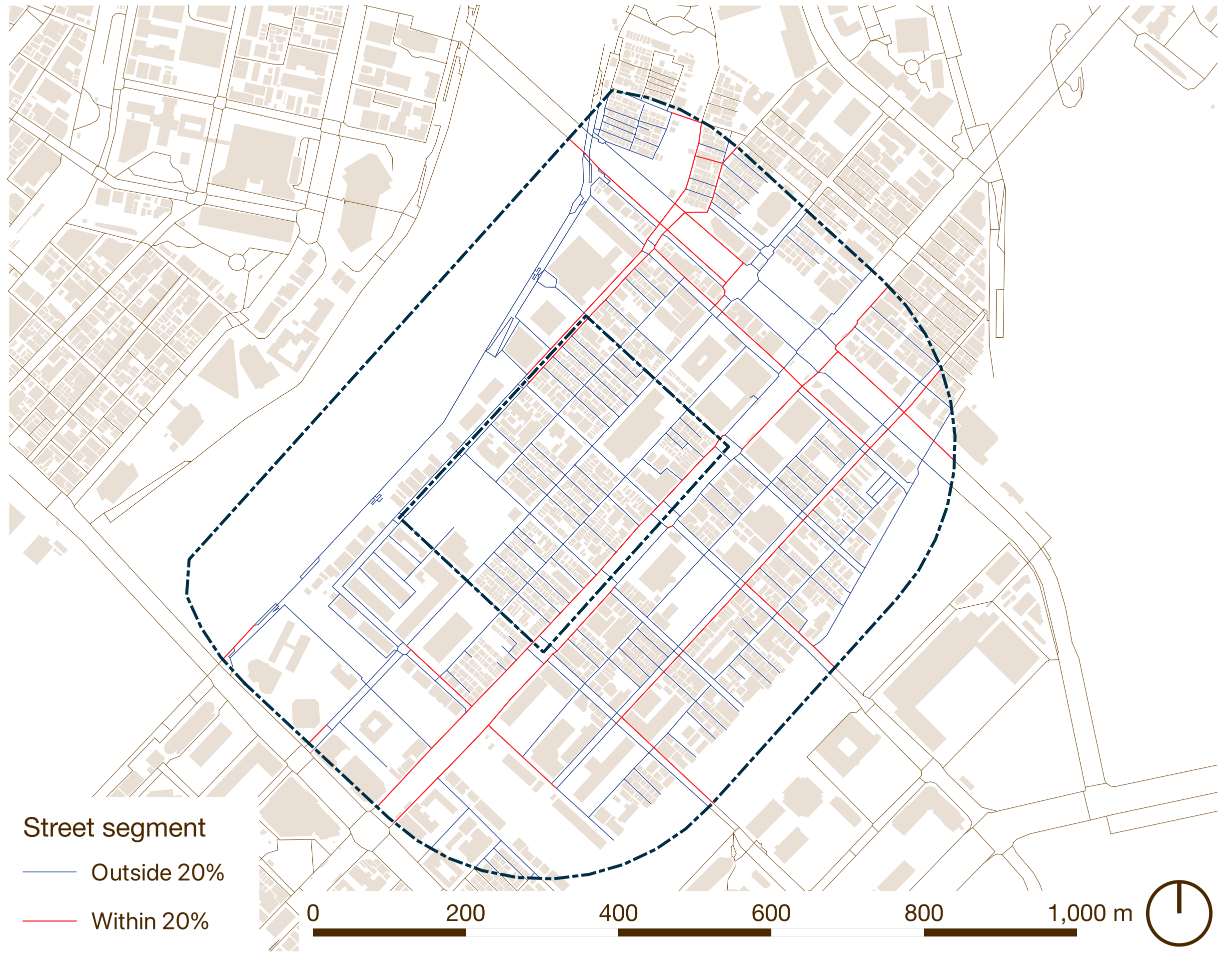


Fig. 26: Map of Tsukishima, Tokyo, highlighting the top 20% street segments by centrality value.

Fig. 27: Map of Tsukishima, Tokyo, highlighting the top 20% buildings by GFA.

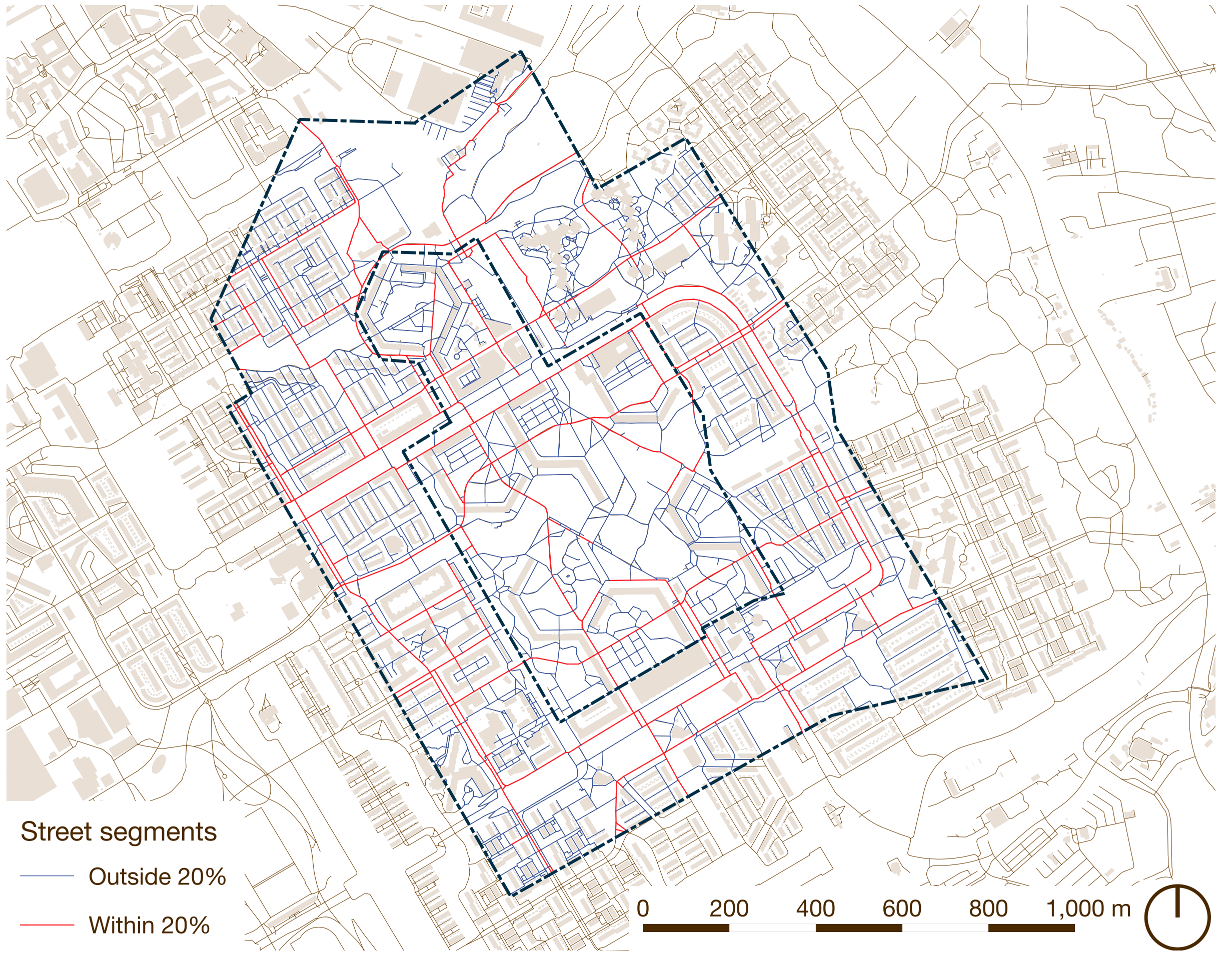


Fig. 28: Map of Bijlmermeer, Amsterdam, highlighting the top 20% street segments by centrality value.

Fig. 29: Map of Bijlmermeer, Amsterdam, highlighting the top 20% buildings by GFA.

03.07 From analysis to framework

The case study analyses suggested several recurring relationships between spatial configuration, movement structure, and materialisation. The analyses were used to examine how different spatial structures relate to movement potential and the materialisation of urban activity across the selected cases.

Across the cases, environments supporting sustained urban intensity generally combined local accessibility with integration into wider movement structures. This relationship appeared important not only for movement patterns, but also for maintaining exposure to flows beyond the immediate neighbourhood scale. The analyses also suggested that configurational accessibility alone was insufficient. In cases where active interfaces and urban functions were weakly aligned with the movement structure, the spatial potential associated with accessibility appeared less reflected in the materialisation of urban activity.

The analyses further indicated that differentiated spatial conditions may support a wider range of urban processes. Variation in accessibility, intensity, and urban functions appeared connected to the coexistence of different forms of occupation and activity. In contrast, highly separated or overly uniform structures appeared to reduce overlap between urban processes and limit configurational continuity across the urban system.

The statistical indicators used throughout the analyses should be understood as simplified proxies rather than direct representations of urban complexity. Measures such as entropy, concentration, and dispersion are sensitive to study-area definition, aggregation methods, categorisation choices, and analytical scale. Their interpretation therefore remains comparative and relational rather than absolute, intended to support the reading of broader spatial tendencies rather than establish universal thresholds.

Several observations also highlighted the importance of interpretation beyond numerical outputs alone. Tsukishima, for example, demonstrated relatively low measured functional differentiation despite extensive street-level activity, illustrating limitations in the categorisation of building functions. Vauban suggested that favourable local movement conditions do not necessarily correspond to continuous urban intensity when reinforcement between movement and active uses remains limited. Bijlmermeer illustrated how highly ordered and separated spatial structures may reduce overlap between movement, occupation, and urban functions despite substantial spatial capacity.

The analyses did not produce universal thresholds or fixed spatial models for successful urban environments. Instead, they highlighted recurring relationships between movement structure, urban activity, differentiation, and spatial distribution across the selected cases. These observations suggested that supporting continued urban adaptation depends less on prescribing final urban forms and more on maintaining spatial conditions capable of sustaining interaction, overlap, and differentiation over time. The following chapter expands these relationships into a framework of design-relevant spatial conditions and explores their application within the implementation site.

Chapter 04 | Emergence framework

04.01	**Implementation site analysis**	46
04.02	**Design proposal**	54
04.03	**Speculative outcomes**	60

04.01 Implementation site analysis

Litteraturgatan, Gothenburg

The implementation area is located along Litteraturgatan in northern Gothenburg, within a post-war suburban landscape largely developed during the 1960s and 1970s. As part of the Million Programme, the area follows a planning logic based on large-scale housing, separation of traffic systems, and functional zoning. Litteraturgatan acts as a primary infrastructural corridor, while surrounding residential areas are organised into superblocks and inward-oriented structures.

This results in a spatial condition where movement is structured along a limited number of routes, but the overall network remains weakly connected to the wider urban system. The street structure supports certain local flows, yet lacks continuity across scales, limiting its integration into broader movement patterns. At the same time, ground-floor activity is minimal and functions are often internally organised, reducing the presence of uses at the street level. Recent planning directions in Gothenburg identify the area as a site for transformation and densification, with ambitions to introduce mixed uses and a more continuous urban fabric, despite the limited support provided by the existing spatial structure in terms of movement capacity and its relationship to activity.

Fig. 30: View of Litteraturgatan.

Fig. 31: View of Litteraturgatan.

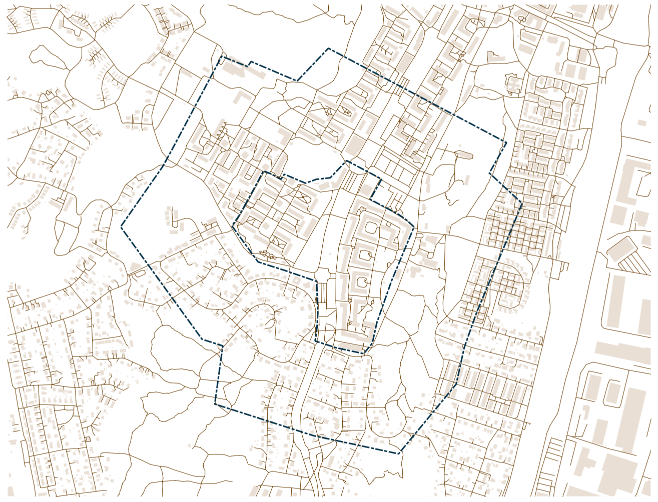


Fig. 32: Map of the implementation site.

Interaction potential

In the implementation area, high centrality segments are present at the intermediate scale but remains limited at larger scales, indicating a system that supports local movement but is only weakly integrated into the wider urban structure. Movement potential exists, but its continuity across scales is limited, and parts of the network remain weakly connected to larger flows. The intervention will therefore focus on strengthening the relationship between local and larger-scale movement, improving connections that allow the area to participate in the wider network while ensuring that centrality is not restricted to isolated segments.

Table 9: Percentage of network length classified as "H" in each radius. (Interaction potential)

Case study	1km	2km	5km
Vauban	2,2%	2,5%	0,0%
Tsukishima	5,2%	0,5%	2,1%
Bijlmermeer	12,8%	7,8%	3,0%
Gothenburg	**3,8%**	**2,6%**	**0,0%**

Reinforcement

Active edges are almost entirely absent across all centrality levels. Even where centrality is present, it is not translated into active use, resulting in a system where the relationship between movement potential and activity remains weakly reinforced. The intervention will focus on establishing conditions for activity to relate to movement, particularly in areas where centrality is already present, so that movement can be expressed and supported through street-level uses.

Table 10: Percentage of active street segments in each class. (Reinforcement)

Case study	L	M	H
Vauban	2,8%	3,8%	13,0%
Tsukishima	20,1%	42,1%	67,9%
Bijlmermeer	3,4%	4,8%	5,2%
Gothenburg	**0,0%**	**0,0%**	**0,2%**

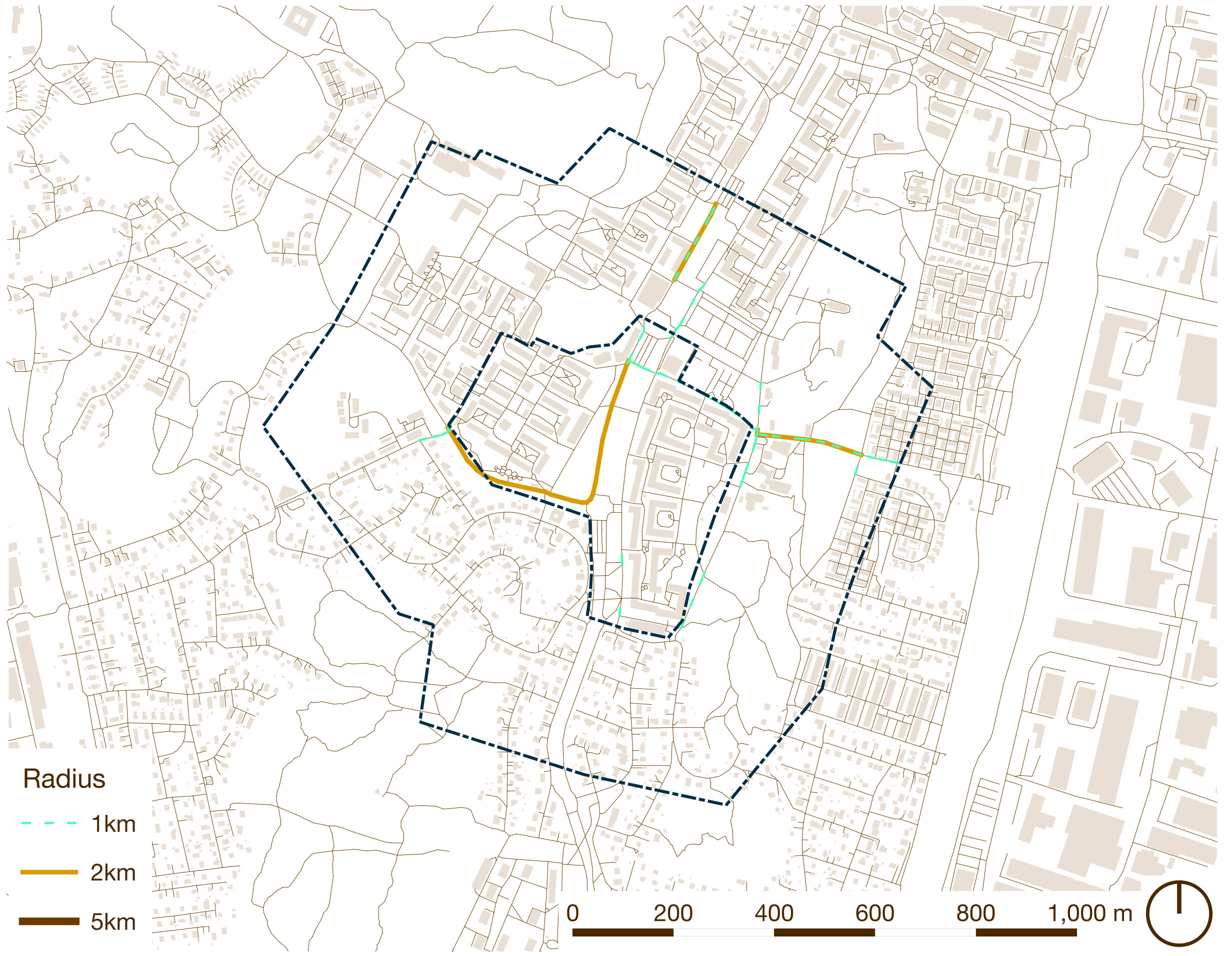


Fig. 33: Map of Gothenburg, highlighting segments classified as high in each radius.

Functional differentiation

Entropy indicates a relatively high degree of functional diversity, but the absence of active edges shows that this diversity is not expressed at the street level. Functions may be present in the dataset, but they remain internal or disconnected from public space, limiting their contribution to activity. The intervention will therefore prioritise the expression of uses at the interface, ensuring that diversity, where present, is accessible and related to movement.

Table 11: Functional differentiation described by Shannon entropy. (Functional differentiation)

Case study	Within study area
Vauban	0,49
Tsukishima	0,11
Bijlmermeer	0,57
Gothenburg	**0,60**

Table 12: Percentage of active edges in the study area. (Functional differentiation)

Case study	Within study area
Vauban	7,3%
Tsukishima	46,5%
Bijlmermeer	4,6%
Gothenburg	**0,0%**

Balance

Centrality shows high concentration, indicating that movement is dominated by a limited number of elements, while built intensity remains relatively evenly distributed. At the same time, the level of spread indicates that variation is present in both, but is unevenly structured, with centrality concentrated in limited parts of the network and built intensity more uniformly distributed. The intervention will therefore focus on reducing concentration in centrality while maintaining sufficient spread in both centrality and built intensity. This involves redistributing movement potential so that it is not limited to a small number of dominant elements, while allowing built intensity to support variation across the system.

Fig. 34: Map of Gothenburg, highlighting buildings with an active ground floor, and segment centrality classes.

Fig. 35: Map of Gothenburg, showing primary uses of buildings.

Fig. 36: Map of Gothenburg, highlighting active street segments.

Table 13: Percentage of values held by the top 20% elements. (Balance)

Case study	AB	GFA
Vauban	86,6%	65,7%
Tsukishima	66,4%	85,0%
Bijlmermeer	85,5%	75,2%
Gothenburg	**85,4%**	**52,2%**

Table 14: IQR normalised by the median. (Balance)

Case study	AB	GFA
Vauban	4,51	4,01
Tsukishima	1,59	1,03
Bijlmermeer	4,07	13,00
Gothenburg	**5,14**	**1,34**

Current detajlplan

The current detailed development plan for the area, adopted by the City of Gothenburg in 2022, proposes a large-scale redevelopment of the Litteraturgatan corridor through mixed-use densification, new perimeter block structures. The proposal introduces a relatively continuous urban frontage along the main corridor while concentrating much of the new development within a limited number of interventions. Building heights, land use distribution, street alignments, and development structure are predefined within the plan, reflecting a comprehensive and centrally controlled approach to urban transformation. Within this thesis, the detailed plan serves as a reference point for exploring how alternative spatial approaches could engage with the same area.

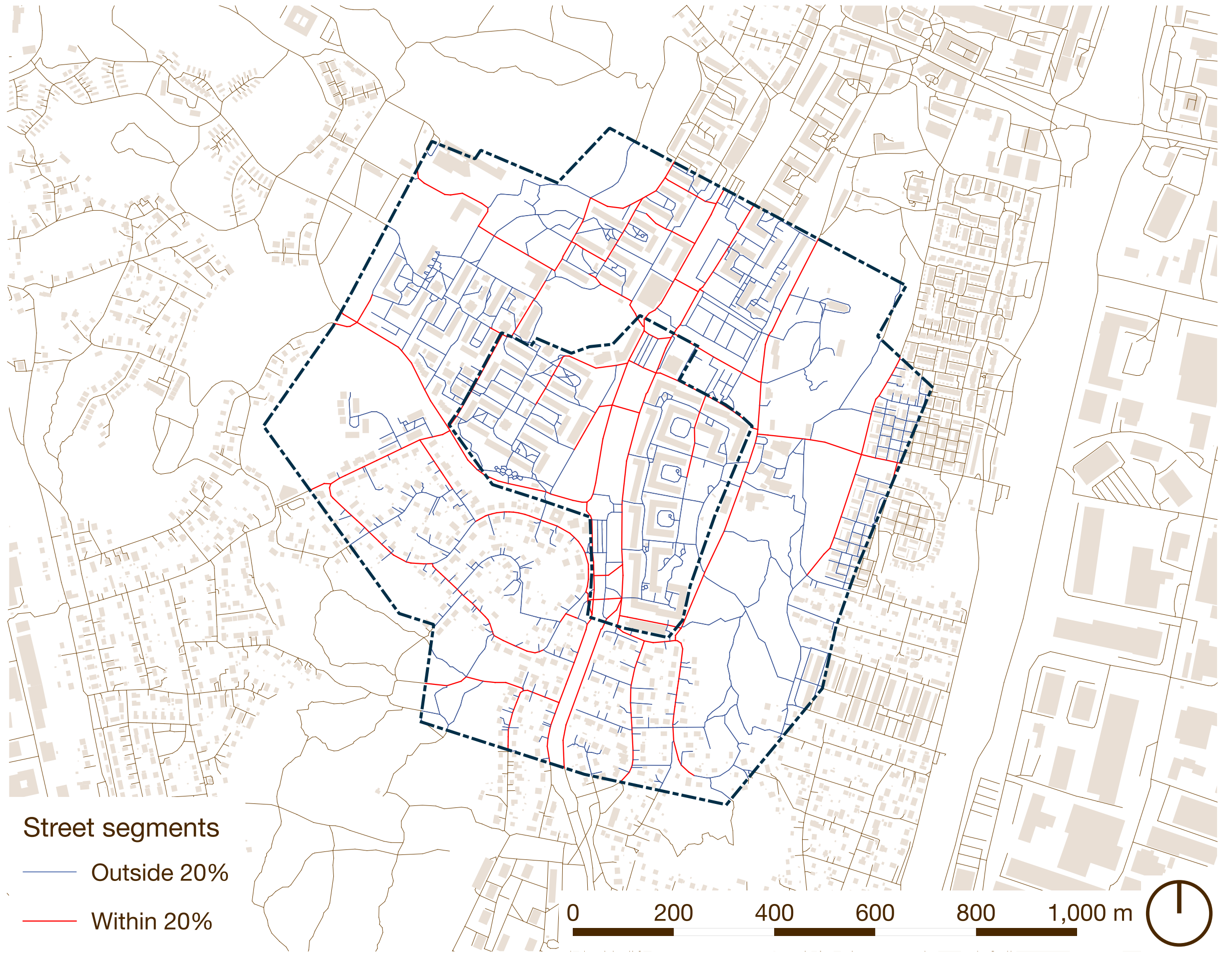
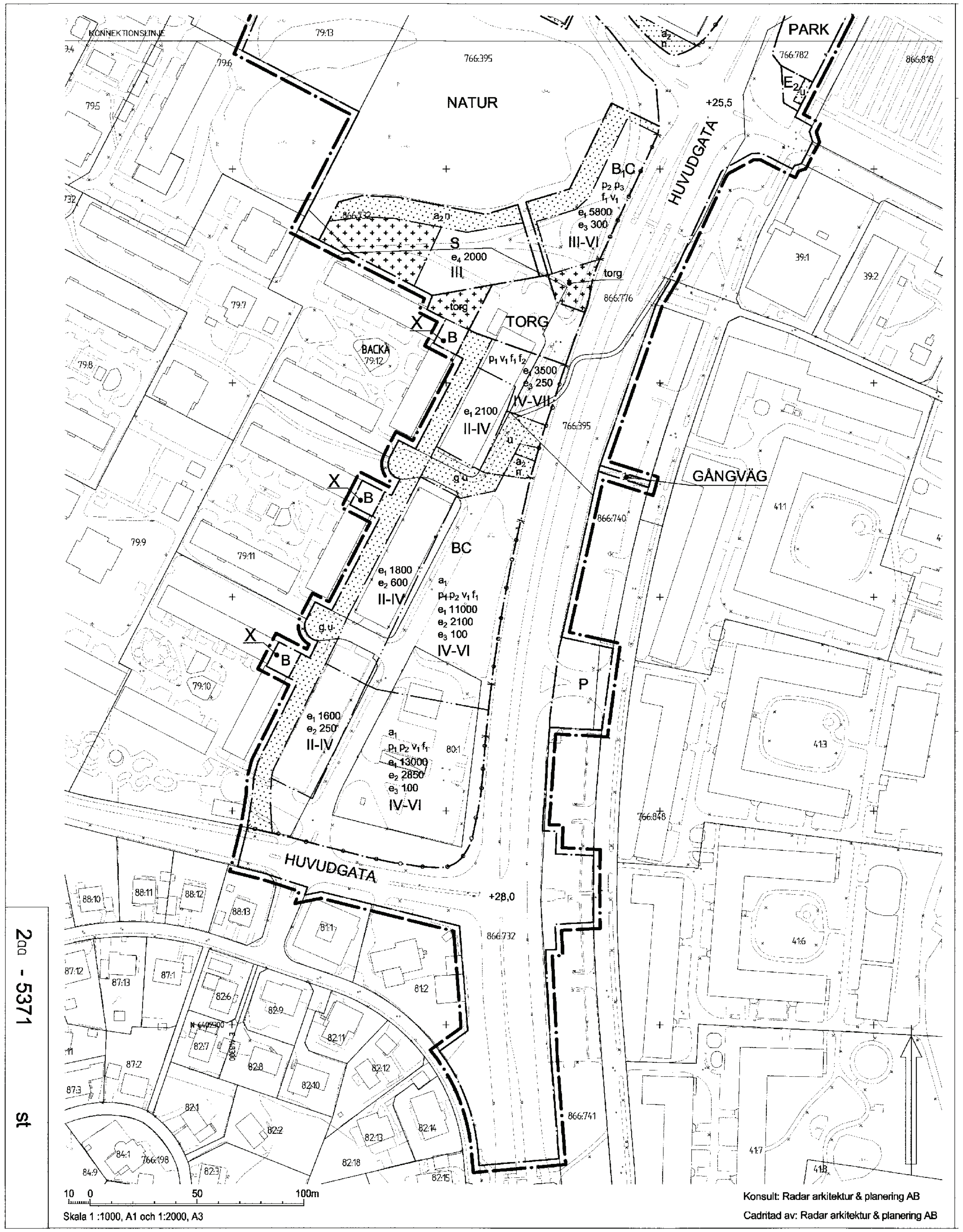
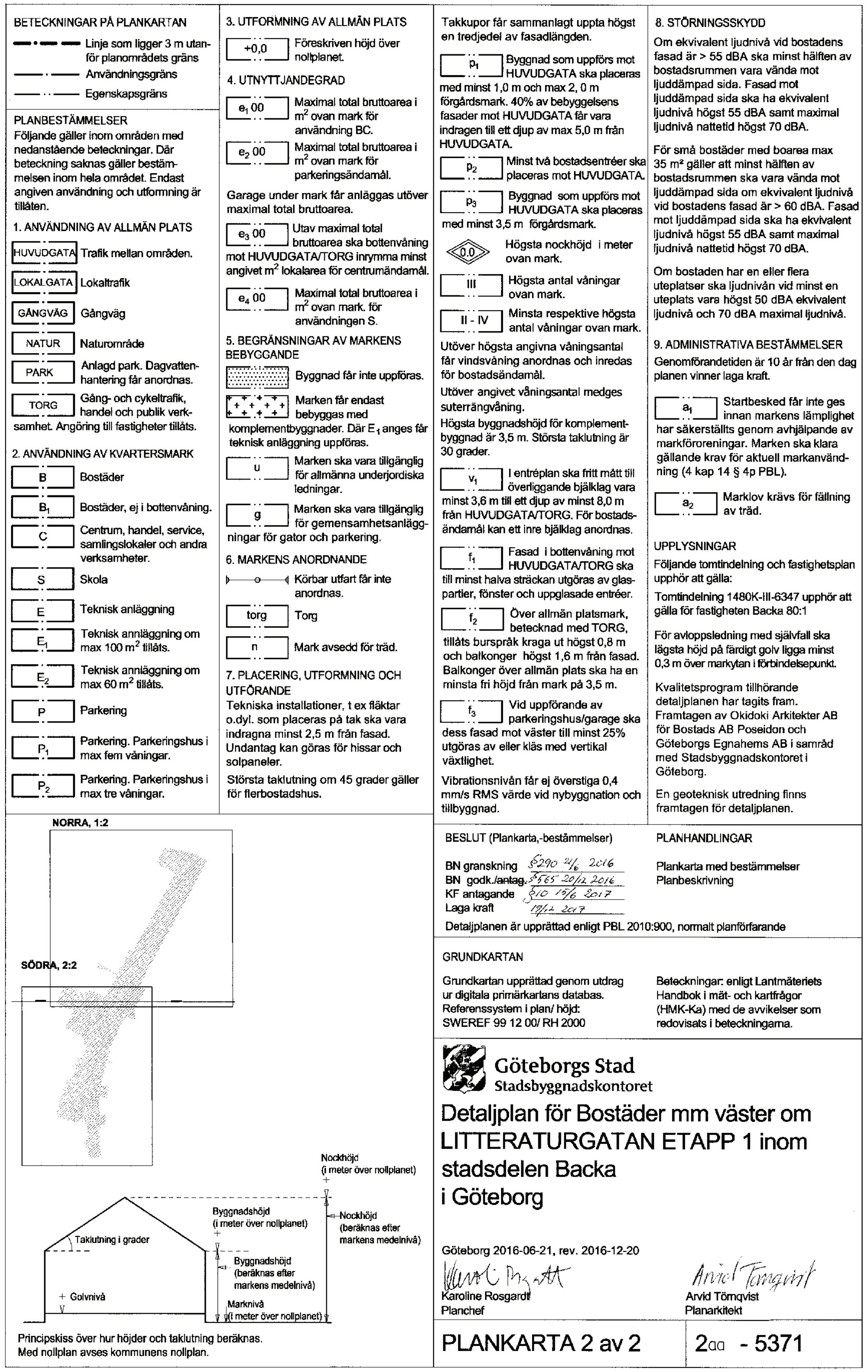


Fig. 37: Map of Gothenburg, highlighting the top 20% street segments by centrality value.

Fig. 38: Map of Gothenburg, highlighting the top 20% buildings by GFA.





BETECKNINGAR PÅ PLANKARTAN

Linje som ligger 3 m utanför planområdets gräns
Användningsgräns
Egenskapsgräns

PLANBESTÄMMELSER

Följande gäller inom områden med nedanstående beteckningar. Där beteckning saknas gäller bestämmelsen inom hela området. Endast angiven användning och utformning är tillåten.

1. ANVÄNDNING AV ALLMÄN PLATS

HUVUDGATA Trafik mellan områden.
LOKALGATA Lokaltrafik
GÅNGVÄG Gångväg
NATUR Naturområde
PARK Anlagd park. Dagvattenhantering får anordnas.
TORG Gång- och cykeltrafik, handel och publik verksamhet. Angöring till fastigheter tillåts.

2. ANVÄNDNING AV KVARTERSMARK

B Bostäder
B_1 Bostäder, ej i bottenvåning.
C Centrum, handel, service, samlingslokaler och andra verksamheter.
S Skola
E Teknisk anläggning
E_1 Teknisk annläggning om max 100 m^2 tillåts.
E_2 Teknisk annläggning om max 60 m^2 tillåts.
P Parkering
P_1 Parkering. Parkeringshus i max fem våningar.
P_2 Parkering. Parkeringshus i max tre våningar.

3. UTFORMNING AV ALLMÄN PLATS

+0,0 Föreskriven höjd över nollplanet.

4. UTNYTTJANDEGRAD

e_1 00 Maximal total bruttoarea i m^2 ovan mark för användning BC.
e_2 00 Maximal total bruttoarea i m^2 ovan mark för parkeringsändamål.

Garage under mark får anläggas utöver maximal total bruttoarea.

e_3 00 Utav maximal total bruttoarea ska bottenvåning mot HUVUDGATA/TORG inrymma minst angivet m^2 lokalarea för centrumändamål.
e_4 00 Maximal total bruttoarea i m^2 ovan mark. för användningen S.

5. BEGRÄNSNINGAR AV MARKENS BEBYGGANDE

Byggnad får inte uppföras.
Marken får endast bebyggas med komplementbyggnader. Där E_1 anges får teknisk anläggning uppföras.
u Marken ska vara tillgänglig för allmänna underjordiska ledningar.
g Marken ska vara tillgänglig för gemensamhetsanläggningar för gator och parkering.

6. MARKENS ANORDNANDE

Körbar utfart får inte anordnas.
torg Torg
n Mark avsedd för träd.

7. PLACERING, UTFORMNING OCH UTFÖRANDE

Tekniska installationer, t ex fläktar o.dyl. som placeras på tak ska vara indragna minst 2,5 m från fasad. Undantag kan göras för hissar och solpaneler.

Största taklutning om 45 grader gäller för flerbostadshus.

Takkupor får sammanlagt uppta högst en tredjedel av fasadlängden.

p_1 Byggnad som uppförs mot HUVUDGATA ska placeras med minst 1,0 m och max 2, 0 m förgårdsmark. 40% av bebyggelsens fasader mot HUVUDGATA får vara indragen till ett djup av max 5,0 m från HUVUDGATA.
p_2 Minst två bostadsentréer ska placeras mot HUVUDGATA.
p_3 Byggnad som uppförs mot HUVUDGATA ska placeras med minst 3,5 m förgårdsmark.
0.0 Högsta nockhöjd i meter ovan mark.
III Högsta antal våningar ovan mark.
II - IV Minsta respektive högsta antal våningar ovan mark.

Utöver högsta angivna våningsantal får vindsvåning anordnas och inredas för bostadsändamål.

Utöver angivet våningsantal medges suterrängvåning.

Högsta byggnadshöjd för komplementbyggnad är 3,5 m. Största taklutning är 30 grader.

v_1 I entréplan ska fritt mått till överliggande bjälklag vara minst 3,6 m till ett djup av minst 8,0 m från HUVUDGATA/TORG. För bostadsändamål kan ett inre bjälklag anordnas.
f_1 Fasad i bottenvåning mot HUVUDGATA/TORG ska till minst halva sträckan utgöras av glaspartier, fönster och uppglasade entréer.
f_2 Över allmän platsmark, betecknad med TORG, tillåts burspråk kraga ut högst 0,8 m och balkonger högst 1,6 m från fasad. Balkonger över allmän plats ska ha en minsta fri höjd från mark på 3,5 m.
f_3 Vid uppförande av parkeringshus/garage ska dess fasad mot väster till minst 25% utgöras av eller kläs med vertikal växtlighet.

Vibrationsnivån får ej överstiga 0,4 mm/s RMS värde vid nybyggnation och tillbyggnad.

8. STÖRNINGSSKYDD

Om ekvivalent ljudnivå vid bostadens fasad är > 55 dBA ska minst hälften av bostadsrummen vara vända mot ljuddämpad sida. Fasad mot ljuddämpad sida ska ha ekvivalent ljudnivå högst 55 dBA samt maximal ljudnivå nattetid högst 70 dBA.

För små bostäder med boarea max 35 m^2 gäller att minst hälften av bostadsrummen ska vara vända mot ljuddämpad sida om ekvivalent ljudnivå vid bostadens fasad är > 60 dBA. Fasad mot ljuddämpad sida ska ha ekvivalent ljudnivå högst 55 dBA samt maximal ljudnivå nattetid högst 70 dBA.

Om bostaden har en eller flera uteplatser ska ljudnivån vid minst en uteplats vara högst 50 dBA ekvivalent ljudnivå och 70 dBA maximal ljudnivå.

9. ADMINISTRATIVA BESTÄMMELSER

Genomförandetiden är 10 år från den dag planen vinner laga kraft.

a_1 Startbesked får inte ges innan markens lämplighet har säkerställts genom avhjälpande av markföroreningar. Marken ska klara gällande krav för aktuell markanvändning (4 kap 14 § 4p PBL).
a_2 Marklov krävs för fällning av träd.

UPPLYSNINGAR

Följande tomtindelning och fastighetsplan upphör att gälla:

Tomtindelning 1480K-III-6347 upphör att gälla för fastigheten Backa 80:1

För avloppsledning med självfall ska lägsta höjd på färdigt golv ligga minst 0,3 m över markytan i förbindelsepunkt.

Kvalitetsprogram tillhörande detaljplanen har tagits fram. Framtagen av Okidoki Arkitekter AB för Bostads AB Poseidon och Göteborgs Egnahems AB i samråd med Stadsbyggnadskontoret i Göteborg.

En geoteknisk utredning finns framtagen för detaljplanen.

NORRA, 1:2

SÖDRA, 2:2

Nockhöjd (i meter över nollplanet)
Byggnadshöjd (i meter över nollplanet)
Nockhöjd (beräknas efter markens medelnivå)
Taklutning i grader
Byggnadshöjd (beräknas efter markens medelnivå)
Golvnivå
Marknivå (i meter över nollplanet)

Principskiss över hur höjder och taklutning beräknas.
Med nollplan avses kommunens nollplan.

BESLUT (Plankarta,-bestämmelser)

BN granskning §290 21/6 2016
BN godk./~~antag.~~ §565 20/12 2016
KF antagande §10 15/6 2017
Laga kraft 19/12 2017

Detaljplanen är upprättad enligt PBL 2010:900, normalt planförfarande

PLANHANDLINGAR

Plankarta med bestämmelser
Planbeskrivning

GRUNDKARTAN

Grundkartan upprättad genom utdrag ur digitala primärkartans databas. Referenssystem i plan/ höjd: SWEREF 99 12 00/ RH 2000

Beteckningar: enligt Lantmäteriets Handbok i mät- och kartfrågor (HMK-Ka) med de avvikelser som redovisats i beteckningarna.

Göteborgs Stad
Stadsbyggnadskontoret

Detaljplan för Bostäder mm väster om LITTERATURGATAN ETAPP 1 inom stadsdelen Backa i Göteborg

Göteborg 2016-06-21, rev. 2016-12-20

Karoline Rosgardt
Planchef

Arvid Törnqvist
Planarkitekt

PLANKARTA 2 av 2

2aa - 5371

Fig. 39: Current detailed development plan for Litteraturgatan.
Note. Adapted from Göteborgs Stad (2017).

04.02 Design proposal

Design process

The design proposal is developed in two stages.

The first stage focuses on modifications to the street network intended to address the shortcomings identified in the site analysis. Because the street network structures movement and co-presence directly, it serves as the primary spatial condition through which the proposal is developed.

The second stage translates the adjusted network into a detaljplan. This stage uses the analyses of the modified network together with the relationships identified in the materialisation analyses to inform decisions regarding building intensity, land-use distribution and the location of active ground-floor functions.

Adjustments to the network

The network modifications build on the City of Gothenburg's plans to strengthen connections between Gulbergsvass, Ringön and the northern parts of the city. These changes increase the integration of Litteraturgatan into wider city-scale movement flows.

Additional interventions concentrate movement potential on the western side of Litteraturgatan in order to strengthen the street's capacity to support reinforcing feedback between movement and urban activity. This was achieved by removing a sparsely connected and poorly constituted street on the eastern side.
The final set of interventions focuses on the implementation area itself. Here, local connections are adjusted to redistribute movement potential towards selected corridors and to remove links that are not continued beyond the study area.

Table 15: Percentage of network length classified as "H" in each radius. (Interaction potential)

Case study	1km	2km	5km
Got. *(before)*	3,6%	2,8%	0,0%
Got. *(after)*	**5,3%**	**3,0%**	**0,0%**

Table 16: Percentage of values held by the top 20% elements. (Balance)

Case study	AB
Gothenburg *(before)*	85,4%
Gothenburg *(after)*	**83,6%**

Table 17: IQR normalised by the median. (Balance)

Case study	AB
Got. (before)	5,14
Gothenburg *(after)*	**4,72**

Analysis of the interventions

The adjusted network shows an increase in interaction potential at the 1 km and 2 km radii, indicating that the area has become better connected to its immediate surroundings and that the local street structure is more capable of supporting everyday movement and repeated co-presence. This suggests that the proposed connections improve the conditions for local interaction and increase the likelihood that movement flows can reinforce urban activity over time.

At the 5 km radius, the study area remains relatively weak in relation to the wider city structure. Despite the new connections to Ringön and Gulbergsvass, no street segment within the study area is classified as high. This indicates that the area does not function as a major component of city-wide movement flows and that its interaction potential is primarily dependent on local and district-scale accessibility. It may also suggest that the classification method is not sensitive enough for suburban areas.

The balance analysis shows only minor changes. Although several interventions were intended to

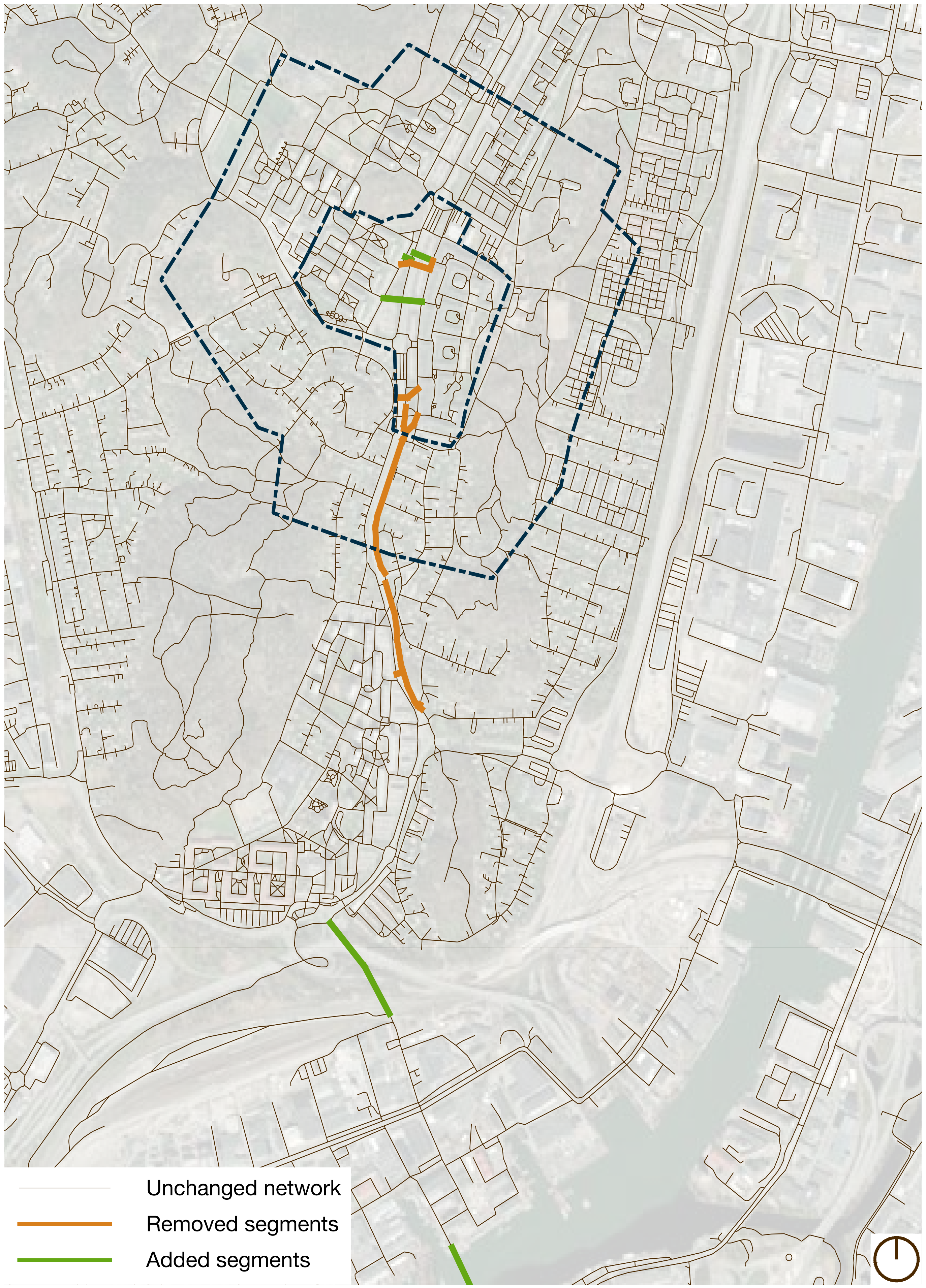


Fig. 40: Highlighted adjustments to the street network.
Note. Base imagery © Bing Maps. Map by author.

strengthen the role of Litteraturgatan, the concentration of movement potential in the most central segments decreased slightly, while the IQR-based spread measure also became lower. This is a positive outcome, as it suggests that the increased prominence of the spine did not lead to greater dependence on a single corridor. Instead, the network retains a similar degree of balance while modestly reinforcing the intended street hierarchy.

Overall, the results indicate that the proposed changes improve the spatial conditions of the area without substantially altering its role within the wider urban system. The effects are relatively small, but they move the network in the intended direction and do so without creating an overdependence on Litteraturgatan.

Proposed detajlplan

The proposed detaljplan builds on the adjusted street network and establishes the regulations guiding future development of the area.

It defines permitted land uses, building heights, development intensity, frontage conditions and the structure of public space. These provisions are used to align built form and urban activity with the underlying movement structure.

The highest densities and the strongest requirements for active ground-floor uses are concentrated along Litteraturgatan and other streets with higher movement potential. These corridors are expected to accommodate the greatest overlap between movement and occupation and are therefore assigned the most urban character. Setback limits and active frontage requirements are used to ensure that these streets are defined by continuous building edges capable of supporting street life. Moving away from them, building heights and activity requirements are gradually reduced, allowing a transition towards predominantly residential areas.

The proposal is supported by an indicative subdivision into smaller plots. Although these plot boundaries are not part of the statutory plan, they illustrate how the area could be developed incrementally by multiple actors rather than through a small number of large-scale projects. The dimensions of the plots were informed by the parcel structures observed in Vauban and Tsukishima, where relatively small plot sizes contribute to a more diverse and adaptable urban fabric.

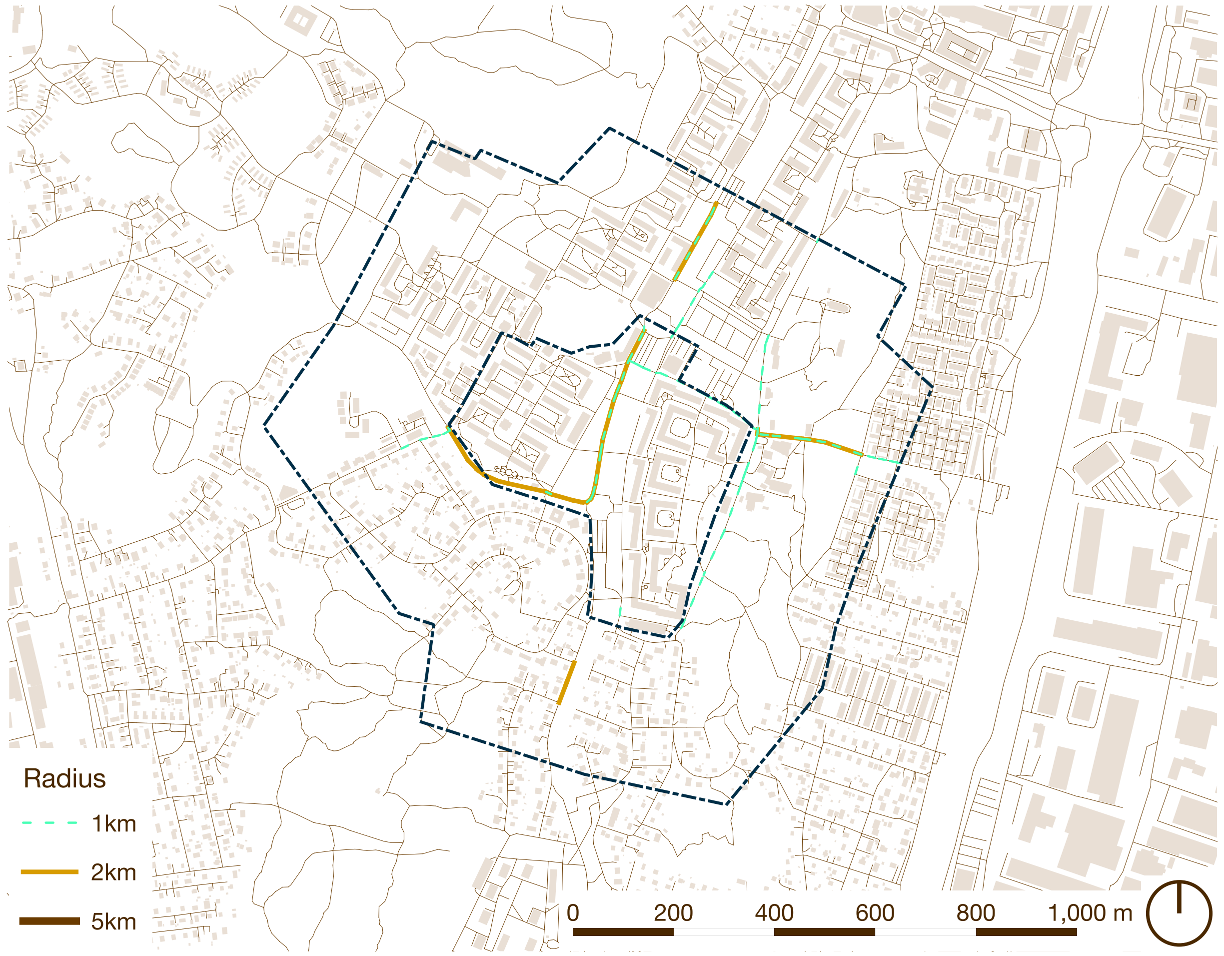


Fig. 41: Map of Gothenburg, highlighting segments classified as high in each radius.

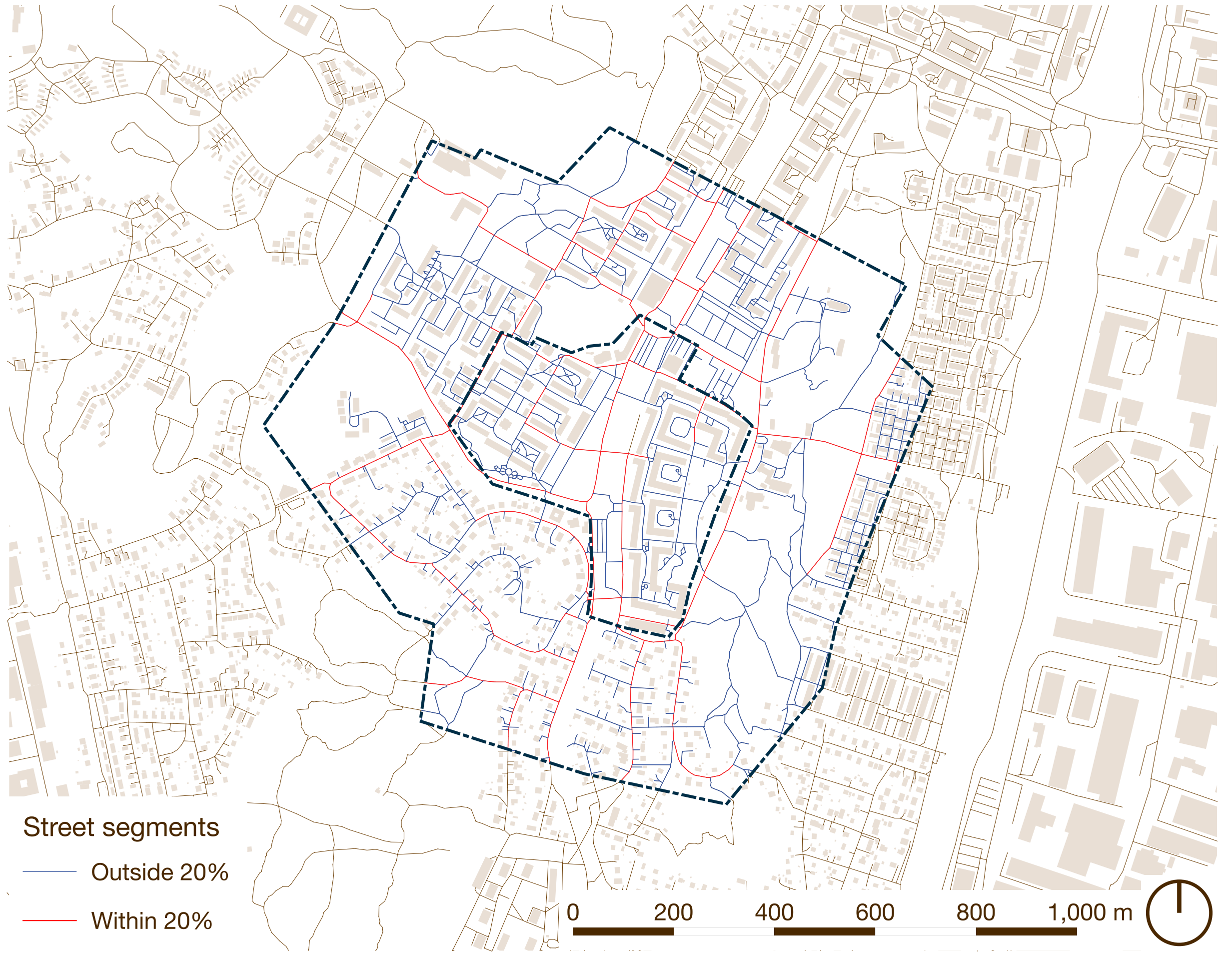


Fig. 42: Map of Gothenburg, highlighting the top 20% street segments by centrality value.

Fig. 43: Proposed detajlplan.

Symbols

Implementation site

Unbuilt area

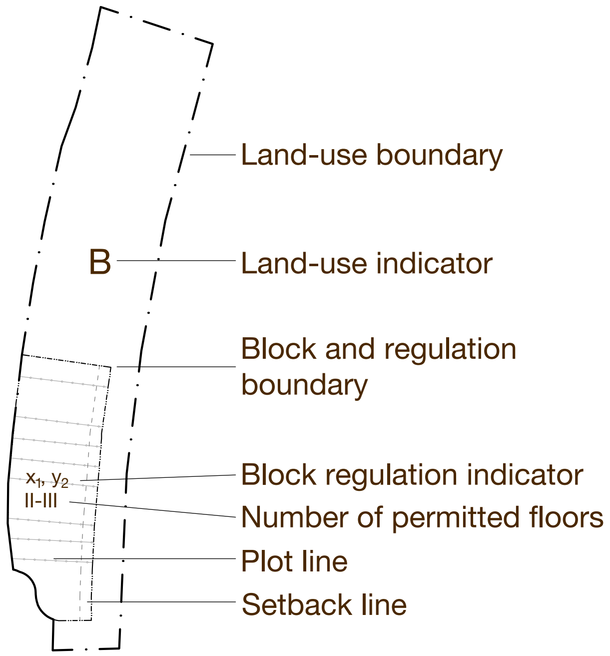
Main road

Land-use boundary

Regulation boundary - block

Plot line

Setback line



Land use

B — Residential use on minimum 80% of plots per block

BC_1 — Residential and centre use. Residential use on minimum 80% of plots. Minimum 3 active ground-floor uses per block.

BC_2 — Residential and centre use. Residential use on minimum 80% of plots. Maximum 2 active ground-floor uses per block.

Block regulation boundary

p_1	All entrances facing side streets
p_2	Active ground-floor uses with at least one entrance facing main street
e_1	Maximum 60% plot coverage
e_2	Maximum 70% plot coverage
f_1	Building frontage not behind designated setback line
f_2	Building frontage maximum 2 m from main street boundary

04.03 Speculative outcomes

Speculative outcomes

The proposed detaljplan is used to illustrate two possible development scenarios. Their purpose is to explore how different outcomes may emerge within the framework established by the plan. Both scenarios were developed through a series of illustrative decisions. They do not represent a predicted outcome, but provide a basis for testing the implications of the proposal.

Analyses of outcomes

The speculative outcomes introduce a substantial increase in built form and street-level activity, particularly along the most central streets. The share of active edges increases in both scenarios, suggesting that the proposed relationship between accessibility and active uses is capable of reinforcing the underlying movement structure.

Although the greater flexibility in land use creates opportunities for a broader range of uses, the Shannon entropy value decreases slightly. This is primarily a result of the count-based method, which is sensitive to the introduction of many small residential buildings.

The balance indicators change only moderately. Concentration and variance both increase, indicating a somewhat stronger differentiation of the urban structure, while remaining within a range that does not suggest excessive dependence on a limited number of elements.
Overall, the results suggest that the proposal can support increased activity and a more differentiated urban environment, while also highlighting the limitations of some of the applied metrics.

Table 18: Percentage of active street segments in each class. (Reinforcement)

Case study	L	M	H
Got. (before)	0,0%	0,0%	0,2%
Got. (s. o. 1)	**0,2%**	**0,0%**	**3,2%**
Got. (s. o. 2)	**0,2%**	**0,0%**	**2,7%**

Table 19: Functional differentiation described by Shannon entropy. (Functional differentiation)

Case study	Within study area
Gothenburg (before)	0,60
Gothenburg (s. o. 1)	**0,47**
Gothenburg (s. o. 2)	**0,55**

Table 20: Percentage of active edges in the study area. (Functional differentiation)

Case study	Within study area
Gothenburg (before)	0,0%
Gothenburg (s. o. 1)	**3,4%**
Gothenburg (s. o. 2)	**2,9%**

Table 21: Percentage of values held by the top 20% elements. (Balance)

Case study	GFA
Gothenburg *(before)*	52,2%
Gothenburg (s. o. 1)	**67,1%**
Gothenburg (s. o. 2)	**67,3%**

Table 22: IQR normalised by the median. (Balance)

Case study	GFA
Gothenburg (before)	1,34
Gothenburg (s. o. 1)	**4,00**
Gothenburg (s. o. 2)	**4,51**

Fig. 44: Speculative outcome 1.

Fig. 45: Speculative outcome 2.

Fig. 46: Map of Gothenburg, highlighting buildings with an active ground floor, and segment centrality classes, speculative outcome 1.

Fig. 47: Map of Gothenburg, highlighting buildings with an active ground floor, and segment centrality classes, speculative outcome 2.

Fig. 48: Map of Gothenburg, showing primary uses of buildings, speculative outcome 1.

Fig. 49: Map of Gothenburg, showing primary uses of buildings, speculative outcome 2.

Fig. 50: Map of Gothenburg, highlighting active street segments, speculative outcome 1.

Fig. 51: Map of Gothenburg, highlighting active street segments, speculative outcome 2.

Fig. 52: Map of Gothenburg, highlighting the top 20% buildings by GFA, speculative outcome 1.

Fig. 53: Map of Gothenburg, highlighting the top 20% buildings by GFA, speculative outcome 2.

Fig. 54: Visualisation of a speculative outcome.
Note. Author's montage. Detailed image credits provided in references.

Chapter 05 | Conclusion

05.01 **Discussion** 70
05.02 **Conclusion** 72

05.01 Discussion

This thesis set out to explore how urban design can support emergence by identifying spatial conditions associated with urban environments that remain active, differentiated, and adaptable over time. The findings suggest that interaction potential, reinforcement, functional differentiation, and balance provide a useful structure for analysing such environments and translating the resulting insights into design decisions. At the same time, the study raises several methodological and theoretical questions.

The four analytical categories should be understood as proxies for a much more complex phenomenon. Self-organisation cannot be measured directly, and the selected categories represent an attempt to operationalise observable spatial characteristics that appear to be associated with urban environments capable of continued adaptation.

This simplification is also present in the individual indicators. Angular betweenness centrality is used as a proxy for movement potential, active ground-floor uses as a proxy for opportunities for encounter, and Shannon entropy as a proxy for functional differentiation. Each captures only part of the phenomenon in question.

Shannon entropy is particularly sensitive to how land-use data are structured and should be interpreted with caution. A value of 1 represents a perfectly even distribution across all use categories, while a value of 0 indicates complete dominance by a single use. In practice, however, urban areas are rarely evenly distributed, and such a condition is neither common nor necessarily desirable. The limitations of the measure are particularly visible in Tsukishima, where the entropy value suggests very low functional diversity despite the evident presence of a rich and active urban environment. This reflects both the use of count-based primary land-use data and the inability of the metric to capture mixed-use buildings and small-scale activities embedded within predominantly residential structures.

The use of active commercial functions as an indicator of interaction also requires qualification. Not all meaningful encounters occur in commercial settings, and many important forms of co-presence take place in public institutions, community facilities, or informal spaces. Nevertheless, commercial and service uses generally provide one of the most robust and consistently observable spatial forms through which repeated encounters are generated and sustained. Their use as a proxy therefore captures an important, although incomplete, dimension of urban interaction.

The results should be interpreted as correlations rather than evidence of causation. The selected case studies indicate that certain spatial conditions are associated with urban environments that appear capable of continued adaptation, but they do not demonstrate that these conditions alone generate self-organisation. Urban development is shaped by a wide range of interacting factors, many of which lie beyond the spatial domain.

At a broader level, the thesis relates to the search for more general principles linking spatial structure and urban life. As Bill Hillier argued, the fact that cities differ does not preclude the existence of underlying regularities, since human behaviour is governed by shared spatial and social logics. The search for a more unified theory is therefore both legitimate and necessary. At the same time, translating such general principles into analytical methods proves more difficult than it may initially appear, and any framework must balance explanatory ambition with methodological simplification.
The thesis also highlights a tension between central planning and emergence. Large-scale urban development requires coordination. Infrastructure, public space, utilities, and legal frameworks cannot emerge solely through decentralised action and depend on some form of central planning. At the same time, overly prescriptive planning can stabilise a single organising logic and reduce the capacity of urban environments to evolve. The approach proposed in this thesis attempts to address this tension by focusing planning on the definition of enabling conditions rather than predetermined final forms. In this sense, planning remains essential, but its role shifts from designing complete outcomes to structuring the spatial framework within which multiple outcomes can emerge over time.

The design proposal demonstrates both the potential and the limitations of this approach. Research by design makes it possible to test how theoretical insights can be translated into concrete planning decisions. However, improvements in analytical indicators do not guarantee that similar outcomes would materialise in practice. Spatial interventions also redistribute movement and development potential, meaning that strengthening one part of the system may weaken another.

Finally, the framework should not be understood as a universal formula capable of producing successful urban environments irrespective of context. Its contribution lies in offering a structured way of thinking about how spatial conditions may support continued adaptation, while recognising that the ways in which these conditions are expressed will vary according to circumstances. In this sense, the thesis should be understood as an exploratory framework and a foundation for further research rather than a definitive model of emergent urban development.

05.02 Conclusion

The aim of this thesis was to explore how urban planning can structure spatial conditions that enable and sustain emergence through self-organisation.

From theoretical framework, four analytical categories were developed to examine spatial conditions associated with urban environments capable of continued adaptation were: interaction potential, reinforcement, functional differentiation, and balance. Together, these categories suggest that emergence is supported by urban environments that generate sufficient opportunities for repeated co-presence, align movement patterns with active uses, accommodate a differentiated mix of functions, and avoid both excessive uniformity and over-concentration.

Through the comparative analysis of Vauban, Tsukishima, and Bijlmermeer, these analytical categories were translated into a spatial framework and applied to Litteraturgatan in Gothenburg. The application illustrates how the identified conditions can inform planning decisions by guiding adjustments to the street network, the distribution of development intensity, and the location of active ground-floor uses.

The results suggest that planning can support emergence by focusing on the spatial conditions that influence urban development. In the Swedish context, this implies that the detaljplan can be used not only to regulate what may be built, but also to structure the conditions within which urban development can continue to evolve over time.

The thesis does not establish causal relationships between spatial conditions and self-organisation. Its contribution lies in translating theories of self-organisation and spatial configuration into an operational framework that connects analysis and design and offers a structured approach to planning for continued urban adaptation.

The work presented in this thesis suggests several opportunities for further research. Future studies could test the framework in additional urban contexts and compare the results across a larger number of cases. The analytical methods could be refined by testing alternative indicators and evaluating whether some of the selected measures can be simplified or replaced. Plot structure could be incorporated more explicitly, given its importance for subdivision and incremental development over time. The framework could also be expanded to include ownership patterns, development economics, and institutional conditions in order to better understand how spatial and non-spatial factors interact in shaping urban transformation. A particularly valuable extension would be a longitudinal analysis tracing how the identified spatial conditions relate to actual development over time.

By linking theories of self-organisation and spatial configuration to urban design practice, the thesis points towards a way of thinking about planning that focuses less on prescribing final outcomes and more on shaping the conditions through which urban environments can continue to evolve over time.

References & AI appendix

References 76
AI appendix 79

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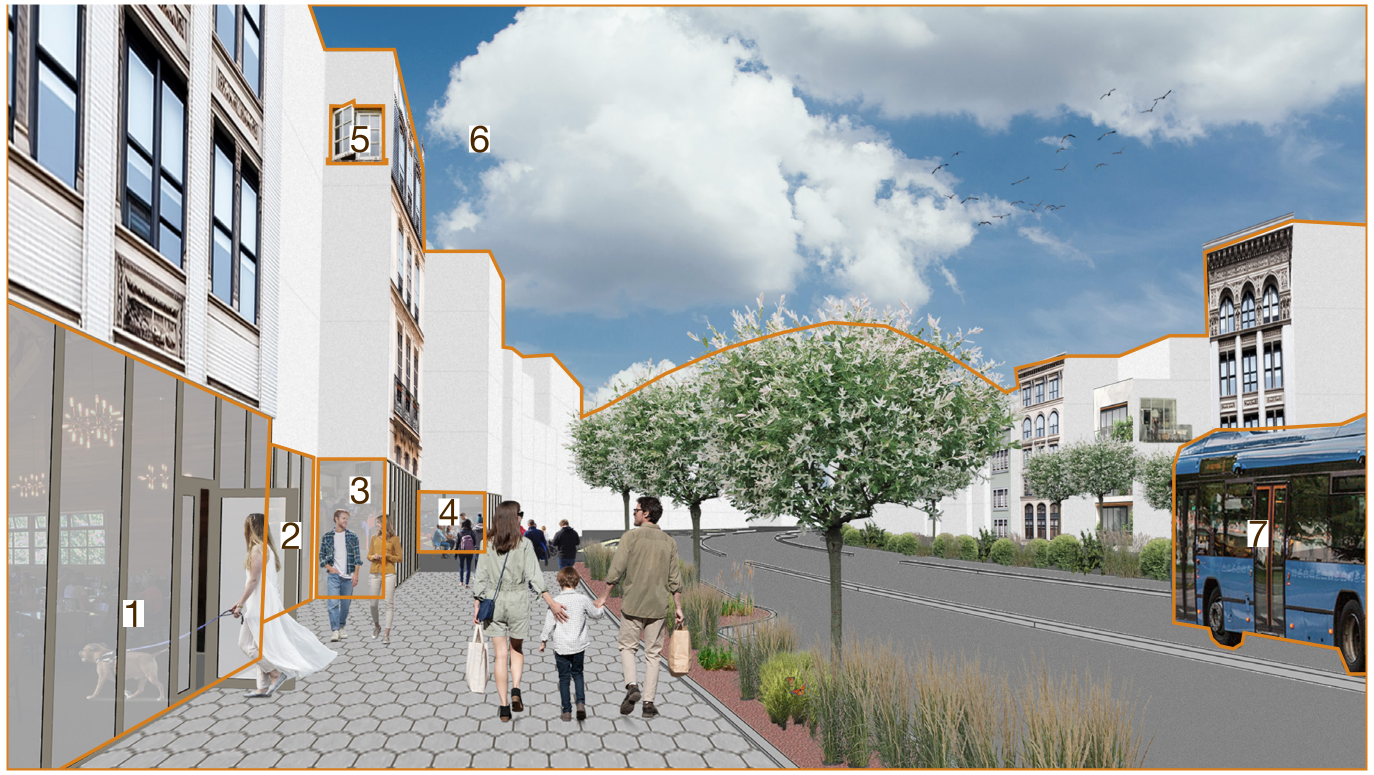

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Textures adapted from Architextures
Façade assets adapted from Magnific

AI appendix

Artificial intelligence tools (ChatGPT 5.2 Plus) were used in a supporting role during the preparation of this thesis.

The tool was used to assist with literature orientation, concept clarification, methodological discussion, language review, and verification. Specifically, AI was used to identify potentially relevant literature and suggest relevant chapters or sections in sources, to discuss theoretical concepts and methodological choices during the research process, and to review selected paragraphs for grammar, clarity, and structure.

AI was also used to provide feedback on the coherence of arguments, the alignment between research questions and conclusions, and the overall structure of the thesis. In addition, it was used to support technical tasks related to data analysis and visualisation, such as the development and review of expressions and scripts used in QGIS.

All outputs were treated as suggestions and were evaluated by the author. References, interpretations, analyses, and citations included in the thesis were verified by reviewing the original sources before inclusion.