Densification Beyond Housing Units

Re-thinking Post-War Residential Neighborhoods in Eindhoven through Integrated Densification Strategies

AR4AE020: Architectural Engineering Graduation Studio

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by

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Abstract

Eindhoven has shifted from an industrial city to a technology-oriented city, while many post-war residential neighborhoods remain insufficiently adapted to contemporary housing and social needs. This project aims to explore how post-war residential blocks can be densified without relying on large-scale demolition or simply increasing the number of housing units. Pre-design research shows that Eindhoven faces housing shortages, social challenges, and increasing pressure for urban densification, while existing post-war neighborhoods reveal different transformation potentials through communal spaces, housing upgrades, and new construction. Focusing on a portiekflat neighborhood with an L-shaped block layout in Eindhoven, the project combines rooftop extension, courtyard infill, improved access systems, and shared public functions into a hybrid transformation strategy. The final proposal supports a more inclusive and adaptive neighborhood transformation by adding new dwellings while improving accessibility, collective space, construction feasibility, and the living quality of existing residents. For application in reality, the paper recommends a transferable design logic that can be adapted to comparable housing blocks according to their specific spatial, structural, and social conditions.

Keywords: Post-war neighborhood; Densification; Portiekflat; Hybrid transformation strategy; Collective use

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1

Introduction

Eindhoven developed rapidly during the twentieth century as an industrial city, strongly shaped by the urban expansion dominated by big manufacture and industrial corporations like Philips. They played a decisive role in structuring the spatial and social fabric of the city, stimulating the construction of post-war residential neighborhoods, infrastructures and social facilities to accommodate a growing workforce. These developments resulted in extensive mono-functional housing areas characterized by standardized building typologies, rapid construction methods, and a strong separation between living, working, and recreational spaces. As a result, a large proportion of housing stocks in Eindhoven consists of post-war working-class neighborhoods developed during this period of industrial expansion.



Figure 1.1: 1969 Map and photo show general layout of Eindhoven and the post-war residential districts (Topotijdreis, n.d.) (Abrahamse et al., 2021, p. 58)

From the late twentieth century, Eindhoven entered a period of economic restructuring, transforming from an industrial-oriented city into a technology-oriented innovation hub gradually. The rise of high-tech industries, research institutions, and design-led development reshaped the urban identity of Eindhoven and stimulated continued population growth, increasing pressure to expand housing supply and urban densification.

1.1 Problem Statement

Although many post-war residential neighborhoods remain structurally and socially important parts of Eindhoven, their limited spatial and programmatic capacity makes it difficult to respond to contemporary housing demand and changing social needs.

At the same time, these neighborhoods cannot simply be treated as empty sites for redevelopment. They are still inhabited, and their repetitive building typologies are part of the everyday residential fabric of the city. Large-scale demolition would risk disrupting current communities, erasing existing structures, and replacing one form of spatial rigidity with another.

The central problem of this project is therefore how post-war residential areas can be densified without limiting densification only into the addition of housing units. The challenge is to develop architectural strategies that increase residential capacity while also improving collective space, accessibility, environmental comfort, and the everyday living conditions of existing residents.

1.2 Relevance

This research is relevant in the context of increasing housing demand and the need to use existing urban land more carefully. Post-war residential areas represent a significant part of the housing stocks in many Dutch cities, including Eindhoven. Their repetitive layouts, open spaces, and relatively low density create potential for transformation, but also raise questions about privacy, daylight, accessibility, construction feasibility, and social impact.

The project is also relevant because many densification strategies focus mainly on quantitative housing production. In mono-functional post-war neighborhoods, however, adding dwellings without improving collective space, public functions, and accessibility may reinforce existing spatial and social weaknesses. Densification should therefore be evaluated not only by the number of new units, but also by the benefits it can bring to current residents and the surrounding neighborhood.

For this reason, the project tries to explore densification as a combined spatial, social, and technical strategy. It asks how additional housing can be integrated into existing residential structures while also supporting more usable collective spaces and more adaptable construction methods.

1.3 Objective and Motivation

The objective of this graduation project is to explore how post-war residential areas in Eindhoven can be densified and transformed through architectural design. The project aims to develop a strategy that adds new housing units while improving the spatial quality, accessibility, and collective life of the existing residential environment.

Instead of approaching densification as a purely numerical increase in housing units, the research examines it as a qualitative transformation of the living environment. It focuses on how new residential volumes, shared circulation, collective functions, open spaces, and lightweight construction systems can work together within the constraints of existing post-war housing blocks.

The motivation for this research comes from the belief that ordinary residential neighborhoods should not be overlooked in urban transformation. Post-war housing areas are often seen as technically outdated or socially problematic, but they continue to house many residents and remain an important part of the city. This project therefore seeks to show how architectural design can work with their existing spatial logic rather than simply replacing it.

The ambition is to produce not only a site-specific design proposal, but also a transferable design approach for similar post-war residential typologies. By combining pre-design research (chapter 3), site analysis (chapter 4), design testing and final proposal development (chapter 5), the project investigates how densification can become a tool for both housing provision and broader residential improvement.

1.4 Research Questions

Main Research Question

How can post-war residential areas in Eindhoven be spatially densified and transformed through architectural interventions that work with the existing residential fabric, while contributing to housing capacity and everyday collective life?

Sub-questions

SQ 1. What spatial, typological, and social conditions characterize post-war residential areas in Eindhoven, and how do they influence their potential for transformation?

SQ 2. What design principles can be learned from local transformation projects, adaptive construction approaches, and collective spatial precedents?

SQ 3. What spatial potentials and constraints emerge when post-war residential blocks are examined as sites for densification?

SQ 4. How can design exploration help to compare different approaches to densifying post-war residential blocks?

SQ 5. How can the findings be translated into a hybrid architectural strategy for transforming a post-war residential block?

1.5 Research Scope

This research focuses on the spatial and architectural transformation capacity of post-war residential areas in Eindhoven, operating primarily at the neighborhood, building-block, and building scale. The urban scale is used to understand the broader context of transformation in Eindhoven, while the detailed building scale is used to test how new interventions can connect with existing structures. The main emphasis remains on the architectural strategy between these scales.

The project focuses on densification strategies that work with the existing residential fabric. Therefore, it excludes approaches based on large-scale demolition and complete replacement. Instead, the research concentrates on addition, adaptation, selective transformation, and incremental construction.

The scope includes architectural and construction-related considerations, such as typological compatibility, accessibility, structural feasibility, material strategy, and resident impact. However, it does not provide a full structural engineering calculation, detailed cost analysis, housing policy model, or long-term management plan. These issues are addressed as design considerations but remain outside the technical scope of the thesis.

2

Research Approach

This chapter explains how the research scope defined in chapter 1 is translated into an operational framework for analysis and design. The research is structured as a gradual narrowing process: from the broader context of post-war residential areas, to typological and block-scale analysis, and finally to design exploration and proposal development.

The chapter is organized into four parts. First, the research framing and selection logic define the spatial scales, transformation approaches, and housing typologies investigated in the project. Second, the methodology introduces the tools and techniques used for analysis and design testing. Third, the workflow explains how research and design develop in parallel. Finally, the theoretical framework identifies the main conceptual lenses that guide the interpretation of the research and design outcomes.

2.1 Research Framing and Selection Logic

The research focuses on post-war residential areas as existing urban fabrics with both limitations and transformation potential. The selection logic does not aim to cover all forms of urban renewal, but to define a clear architectural field in which densification can be explored through spatial, typological, social, and construction-related questions.

2.1.1 Analytical and Spatial Scale Selection

The research operates primarily at the neighborhood and building-block scales. The neighborhood scale helps identify recurring spatial patterns, relationships between residential areas and infrastructure, and broader conditions for densification. The building-block scale allows a more detailed reading of housing typology, courtyard space, access systems, and collective spatial structures.

The urban scale is used mainly to understand the broader context of urban transformation in Eindhoven, while the building scale is used to test how interventions can connect with existing structures. In this way, the selected scales provide a balance between contextual understanding and architectural specificity.

2.1.2 Selection of Transformation Approaches

The research focuses on transformation approaches that work with the existing residential fabric. These include addition, adaptation, spatial reorganization, access improvement, and the insertion of collective or public functions.

Large-scale demolition, complete reconstruction, and greenfield expansion are excluded from the main scope. They represent different modes of urban development and do not directly address the potential of existing post-war residential structures. By focusing on renovation-based and incremental strategies, the research investigates how existing housing areas can accommodate change while maintaining social, material, and spatial continuity.

2.1.3 Typology Selection

The portiekflat typology is selected as the main architectural focus because it is a recurring post-war housing type in Eindhoven and other Dutch cities. Its repetitive structure, flat roof condition, shared stair cores, and open spaces between blocks provide clear opportunities for densification and adaptation.

Compared with row housing or fully detached housing, portiekflat blocks offer stronger potential for block-scale intervention. Their regular structural rhythm and collective spatial conditions make them suitable for testing rooftop additions, courtyard infill, shared access systems, and collective functions.

2.1.4 Social and Technical Investigation

Social and technical aspects are treated as spatially mediated conditions. Social issues are not approached as abstract problems, but through their relationship with access, public-private thresholds, collective space, and everyday use. Technical questions are also considered through architectural design, especially in relation to structural capacity, construction method, material choice, phasing, and resident disturbance.

This allows the research to connect social ambition and technical feasibility without treating either as a separate or purely specialized field.

2.2 Research Methodology

The research uses a design-based methodology. Analysis and design are developed in parallel: research findings inform design decisions, while design testing helps reveal spatial conflicts, potentials, and trade-offs that are not visible through analysis alone.

2.2.1 Research Techniques and Tools

The main techniques and tools include:

- **Literature and precedent study:** to understand post-war housing transformation, adaptive construction, and collective spatial strategies.
- **Contextual and site analysis:** to examine the physical, social, and spatial conditions of selected post-war residential areas.
- **Mapping and spatial analysis:** to study neighborhood structure, block configuration, open space, circulation, accessibility, and infrastructural boundaries.
- **Typological analysis:** to identify recurring housing layouts, structural systems, and opportunities for adaptation.
- **Design exploration and iteration:** to test alternative densification strategies through sketches, diagrams, drawings, models, and spatial prototypes.
- **Prototyping:** to translate abstract design concepts into concrete architectural interventions through iterative testing and refinement across different scales.
- **Evaluation matrix:** to compare design options through a series of criteria, such as housing capacity, courtyard quality, resident impact, and construction feasibility.

2.2.2 Expected Output

The expected output is not only a final architectural proposal, but also a set of transferable design principles for post-war residential transformation. The research aims to clarify how densification can work with existing housing typologies, how collective spaces can be strengthened, and how new additions can be introduced with limited disruption. Therefore, the final design proposal is understood as both a site-specific project and a prototype for comparable post-war residential blocks.

2.3 Timeline and Workflow

The project follows a sequential but iterative workflow within 7 months.

First, the research phase establishes the urban context, typological focus, and theoretical framework. This includes local neighborhood comparison and precedent analysis.

Second, the site analysis phase examines the selected residential block in more detail, focusing on identifying potential design starting points within the existing spatial, social, and technical conditions.

Third, the design exploration phase tests different densification strategies. These design options are used to compare spatial consequences and evaluate trade-offs among design strategies and options.

Finally, the proposal phase consolidates the most relevant findings into a hybrid design strategy. The final proposal is then evaluated and reflected upon in relation to the original research aim.

2.4 Theoretical Framework

This section establishes the theoretical framework for understanding the transformation of post-war residential environments. Rather than relying on a single perspective, the framework integrates spatial, technical, and social dimensions to examine how existing residential structures can accommodate incremental change. It does not prescribe fixed design solutions, but provides conceptual lenses through which post-war housing can be interpreted, its capacity for densification can be assessed, and architectural interventions can be positioned within broader discussions on housing transformation.

The framework is structured around three interrelated perspectives. First, **post-war housing and typological transformation** provide the basis for understanding standardized residential layouts, portiekflat structures, repetitive block configurations, and the spatial logic of post-war neighborhoods. This perspective helps identify how existing housing typologies can both constrain and support future adaptation.

Second, **adaptive and incremental construction** informs how new additions can be introduced within occupied and structurally limited environments. Flexible systems, prefabrication, phased implementation, and reversible connections are considered as architectural tools that can reduce disruption while enabling gradual transformation.

Third, **collective space and social infrastructure** frame densification as more than the addition of housing units. Shared spaces, public functions, access systems, courtyard structures, and thresholds between private and collective domains are understood as important elements in improving the everyday quality of post-war residential areas.

Together, these perspectives form the analytical basis for the pre-design research in chapter 3, the site analysis in chapter 4, and the evaluation of design options in chapter 5. They allow the project to assess densification not only through housing quantity, but also through spatial quality, social value, and construction feasibility.

3

Pre-design Research

This chapter presents the pre-design research that informs the subsequent design development. It combines an analysis of urban history and socio-spatial conditions in Eindhoven with case studies structured around the theoretical framework established in chapter 2. The aim is to understand how post-war residential areas in Eindhoven have evolved, how their spatial and social characteristics influence their capacity for transformation, and how similar contexts or cases have been addressed through architectural interventions. By linking contextual analysis with typological and strategic insights, this chapter establishes a grounded basis for design potential.

The findings of this chapter directly inform the site selection process in the following chapter, ensuring that the chosen site reflects both the broader urban conditions and the specific spatial opportunities identified through the research.

3.1 Urban Development and Transformation of Eindhoven

Industrial Origins and Fragmented Urban Growth (1900–1940)

Since the early twentieth century, the development of Eindhoven has been closely intertwined with the expansion of Philips, which played a decisive role in shaping the city's spatial and socio-economic structure. Rapid industrialization generated employment growth and attracted a large influx of workers, leading to the construction of factory complexes, residential areas, and supporting facilities. As surrounding municipalities were gradually annexed, Eindhoven expanded quickly into a larger urban entity (Valk, 2020).

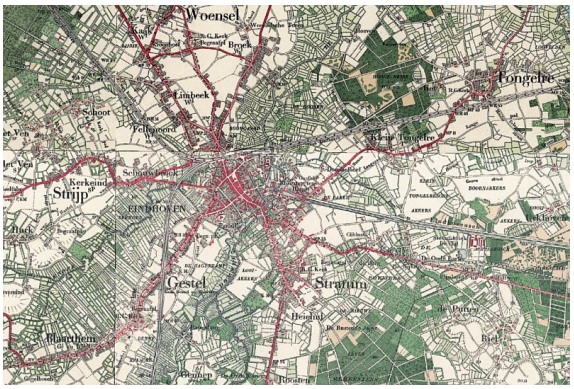


Figure 3.1. Eindhoven in 1920

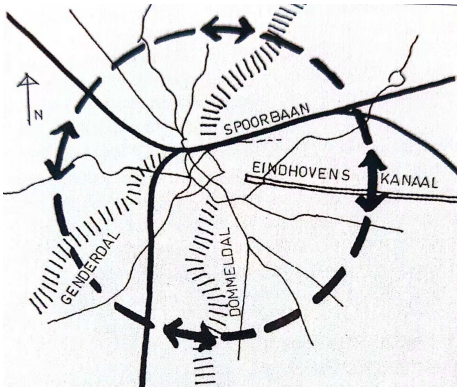


Figure 3.2. Schematic diagram of Greater Eindhoven

Figure 3.1. In 1920, the municipalities of Woensel, Tongelre, Stratum, Gestel, Strijp, and Eindhoven have been united into one, achieving further urban expansion (Valk, 2020).

Figure 3.2. The diagram demonstrates the relationship between stream valleys (natural barriers), railways and canals (artificial partitions), and the ring road (linking feature) in Greater Eindhoven (Abrahamse et al., 2021, p. 39).

However, this growth occurred without a coherent overarching urban vision. Residential areas were often developed based on land availability and affordability rather than as part of an integrated spatial strategy. As a result, the urban fabric resembled a collection of disconnected fragments rather than a harmonious whole. Issues related to central expansion, accessibility, and the spatial integration of annexed areas remained largely unresolved until the Second World War (Abrahamse et al., 2021).

Post-War Reconstruction and Mass Housing (1945–1960s)

Although the Second World War caused significant destruction, it also created an opportunity to address long-standing structural problems that had previously seemed insoluble due to entrenched interests and existing building stocks. After the war, urban development in Eindhoven was guided by the flower model, which was widely applied across Europe. In this model, the city center formed the core, residential districts functioned as petals, and access routes acted as connecting veins, as shown in Figure 3.4. District centers were planned at intersections with the ring road, reinforcing a structured yet decentralized urban form (Abrahamse et al., 2021).

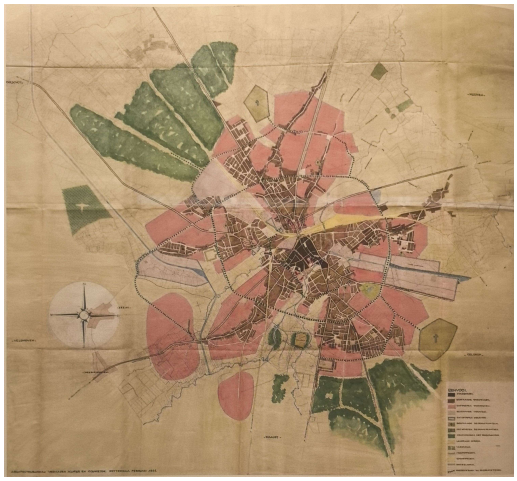


Figure 3.3. Reconstruction plan of Einhoven

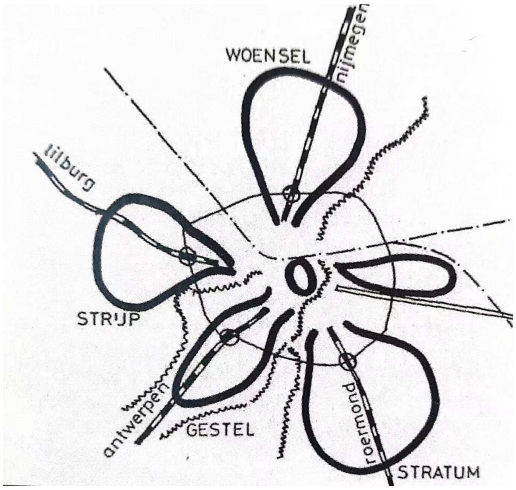


Figure 3.4. Diagram of flower model

Figure 3.3. This initial Schedule Plan from 1944 became the basis for the later reconstruction and expansion in Eindhoven, achieving coherence in the urban expansion and traffic structure (Abrahamse et al., 2021, p. 56).

Figure 3.4. The diagram demonstrates flower model, which can be seen clearly as the abstraction of the reconstruction plan in 1944 (Abrahamse et al., 2021, p. 57).

At the same time, Philips continued to expand its industrial facilities, particularly along railway corridors, further intensifying the demand for labor and housing (Groenendijk & Vollaard, 2019). The post-war housing shortage was acute not only due to war damage, but also because construction had stagnated for years while population growth was expected to continue (Abrahamse et al., 2021). This urgency prompted a shift toward large-scale, rapid residential development on the city's outskirts .

Collaboration between the municipality, housing corporations, and large enterprises was formalized in new ways. Following the allocation of additional building capacity in 1955, a housing pool system was introduced, distributing public and subsidized housing among Philips-affiliated corporations, Christian housing organizations, and municipal bodies. This coordinated approach proved highly effective, enabling Eindhoven's housing stock to grow at a faster rate than in cities such as Amsterdam and Rotterdam (Aussems & Horsten, 2022).

Critique, Adaptation, and Changing Planning Ideals (1960s–1980s)

From the 1960s onward, modernist urban planning increasingly came under criticism. Expansion districts were faulted for their lack of social mixing, limited housing variety, and dominance of car-oriented infrastructure. Areas such as Woensel were described as suffering from a "complete lack of spatial seclusion," reflecting broader dissatisfaction with anonymous and uniform urban environments (Abrahamse et al., 2021).

In response, new neighborhoods introduced greater variation in spatial structure, architectural expression, and housing typologies, alongside a reduced emphasis on through traffic. Examples include Oude

Gracht-Oost and 't Hool, as well as more recent renovation initiatives in Woensel-West (Groenendijk & Vollaard, 2019). These developments marked the emergence of the Bloemkoolwijk model, characterized by village-like intimacy, hierarchical traffic systems, looped or dead-end streets connected to a main ring road, ground-level housing with private gardens, and abundant green public space (Abrahamse et al., 2021).

From Industrial City to Knowledge-Based Region (1990-Now)

From the late twentieth century onward, Eindhoven underwent a profound socio-economic transformation. As traditional manufacturing industries declined or relocated, the city repositioned itself as a knowledge-based and technology-driven urban region (Abrahamse et al., 2021). The development of research campuses, innovation districts, and high-tech infrastructure reshaped the economic profile in Eindhoven and reinforced its international competitiveness.

A key spatial shift occurred in the southern part of the city, where Philips developed a new research center after the original NatLab in Strijp became insufficient (Groenendijk & Vollaard, 2019). This process culminated in the establishment of the High-Tech Campus Eindhoven in 1998, which later opened to other companies and evolved into the nucleus of the Brainport region (Figure 3.6), which is now recognized as one of the main economic engines in the Netherlands, alongside the Port of Rotterdam and the Amsterdam-Schiphol region (Abrahamse et al., 2021).

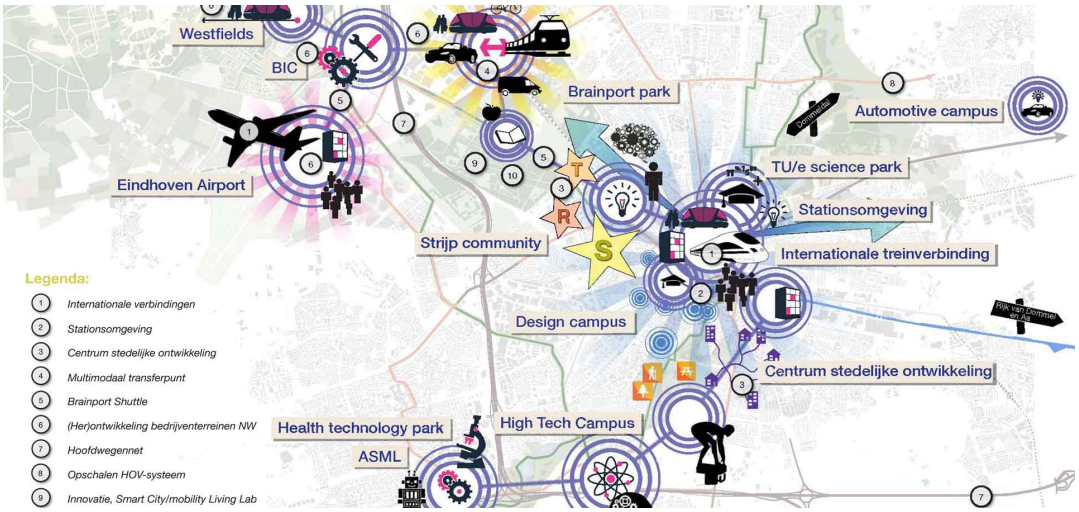


Figure 3.5: Brainport Eindhoven schematic map (BVR, n.d.)



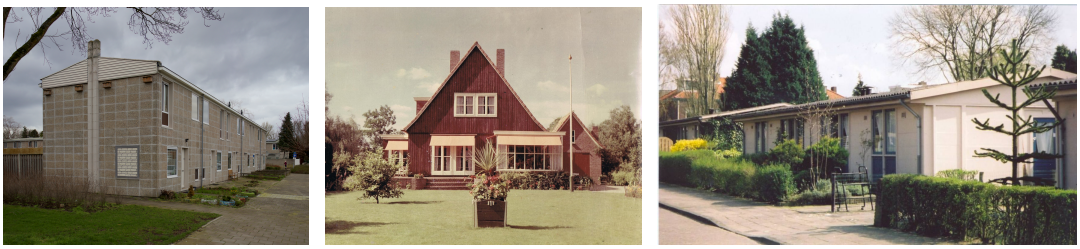
Figure 3.6: Brainport Eindhoven (Brainport Eindhoven, n.d.)

However, deindustrialization also produced significant social and spatial consequences. The liquidation of DAF in 1993 and Philips' restructuring under Operation Centurion led to large-scale job losses and the vacancy of industrial buildings (Abrahamse et al., 2021). While many former industrial sites have been successfully transformed into cultural and creative hubs, such as those in Strijp (Van Onna, 2016), residential neighborhoods have remained more resistant to change.

3.2 Post-war Housing: Standardization and Fragmentation

Post-war residential neighborhoods in Eindhoven were primarily developed to accommodate a growing industrial workforce. Their spatial structure was shaped by principles of efficiency, affordability, and rapid construction. Housing, traffic, industry, and supporting facilities were often planned as separate zones, resulting in a clear functional division between living, working, and production areas. While this planning logic helped to address urgent housing shortages after the war, it also produced standardized and mono-functional residential environments with limited spatial and programmatic diversity (Abrahamse et al., 2021).

Housing construction in these areas was characterized by repetitive typologies and rational layouts. Typical developments included two-storey terraced houses, single-family houses, and mid-rise apartment blocks with shared entrances or access galleries (Abrahamse et al., 2021). Many neighborhoods relied on standardized and prefabricated construction systems, which enabled fast and relatively low-cost production (Figure 3.7). Buildings were arranged in repetitive patterns with green spaces in between, reflecting post-war ideals of light, air, openness, and separation from traffic (Abrahamse et al., 2021). However, these open spaces were often conceived more as residual green infrastructure than as active, collective, or socially programmed spaces. As a result, many post-war neighborhoods were internally ordered but spatially monotonous and weakly connected to their wider urban context.



(a) Airey housing (Grotevriendelijkereus, 2020)

(b) Austrian emergency housing (de Boer architecten, 2022)

(c) Maycrete woningen (Erfgoedweb Breda, n.d.)

Figure 3.7: Post-war pre-fabricated housing systems

From the late twentieth century onward, Eindhoven underwent a major economic transition from a regional industrial center to a nationally and internationally oriented technology hub. Former industrial areas close to the center, such as Strijp, were gradually transformed, while new innovation landscapes reinforced the Brainport identity of the city (Van Onna, 2016). However, this transformation did not benefit all parts of the city equally. Many post-war residential areas remained largely unchanged, even though their demographic composition, housing needs, and social conditions have changed significantly over time. As a consequence, many neighborhoods continue to function as relatively isolated enclaves within a rapidly transforming city.

This uneven development has produced a growing contrast between innovation-driven urban transformation and the relative stagnation of many post-war residential neighborhoods. Some of these areas are located close to zones of economic productivity, but physical barriers such as infrastructure, waterways, and landscape buffers continue to limit accessibility and social integration (Elshout & Vermeeren, 2019). This condition becomes more critical in relation to the future growth of Eindhoven. Current development strategies anticipate a substantial population increase, with approximately 40,000 new dwellings planned up to 2040 (Abrahamse et al., 2021). However, compared with other Dutch cities, a relatively small proportion of population in Eindhoven currently lives within the ring road (Abrahamse et al., 2021). Therefore, while inner-city densification remains important, the long-term accommodation of population growth also depends on the transformation capacity of peripheral residential areas. In this context, post-war residential districts should be understood not only as areas of social and spatial vulnerability, but also as important sites for future densification and urban repair.

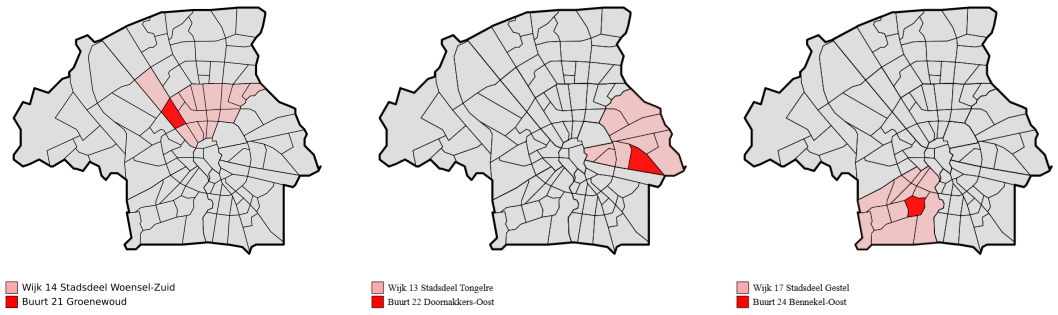
Therefore, densification in post-war residential areas should be understood as more than the addition of housing units. It should also support collective space, public functions, accessibility, and the everyday living conditions of existing residents.

3.3 Transformation Trajectories in Eindhoven Post-war Districts

To understand how uneven urban development appears at the neighborhood scale, three post-war residential districts in Eindhoven are compared: Woensel-West, Doornakkers, and Bennekel. These areas share similar origins as working-class residential neighborhoods, but they have followed different transformation trajectories. The comparison is not intended as a full case study, but as a local reference for understanding how post-war neighborhoods can be renewed through different combinations of housing renovation, public functions, spatial restructuring, and social programmes.

Table 3.1: Comparison of local transformation trajectories in Eindhoven post-war districts

District	Existing Conditions	Case Studies	Transformation Path	Key words
Woensel West	Social vulnerability; poor image; mono-functional	Volta Galvani; Waaggebouw; Edisonplein Reno	Programme diversification; community facilities; public space activation	Renewal beyond housing
Doornakkers	Low-rise fabric; strong boundaries; village-like character	Rustenburgstraat Renovation; Sectie-C	Housing-led densification; technical upgrading; ecological renewal	Incremental improvement
Bennekel	Standardized units; social vulnerability; uneven development; underused space	Cornelis Dopperstraat Construction	Social stabilization; limited transformation; modest housing renewal	Need for hybrid densification



(a) Woensel West **(b)** Doornakkers (Oost) **(c)** Bennekel (Oost)

Figure 3.8: Maps of 3 districts (Topografische Dienst Kadaster, 2008)



(a) Volta Galvani with colorful facades (Trudo, 2015) **(b)** Waaggebouw with iconic orange facade (NEXT-Architects, 2022)

Figure 3.9: Case Studies in Woensel West

Woensel West demonstrates a relatively advanced model of post-war neighborhood transformation. In this district, architectural interventions extend beyond housing improvement toward programmatic diversification and collective spatial activation. Community centers, mixed-use insertions, and visible

restructuring of the built fabric contribute to a gradual redefinition of the neighborhood's identity (Muis, 2023). Projects such as Volta Galvani and the Waaggebouw (Figure 3.9) operates not only through housing upgrade but through the introduction of new social infrastructures, supporting a more active relationship between housing, street life, and collective neighborhood identity. In this sense, Woensel-West illustrates how architectural intervention can contribute to social and programmatic diversification.

Doornakkers represents a different trajectory. Its transformation has been more housing-led and incremental, with a stronger emphasis on preserving the low-rise residential character ("village character") of the area (Samen Doornakkers, n.d.). Recent projects on Rustenburgstraat (Figure 3.10) focus on replacing deteriorated dwellings, increasing housing diversity, and improving technical and environmental performance (Trudo, n.d.). Compared with Woensel West, the spatial and programmatic restructuring remains more limited. The neighborhood shows how post-war districts can be upgraded without fundamentally changing their existing morphology.



Figure 3.10: Rustenburgstraat Demolition and Reconstruction Project in Doornakkers (Trudo, n.d.)

Bennekel presents another condition, where long-term policy attention has focused predominantly on social stabilization rather than on spatial transformation (Elshout, 2009). The area still contains standardized residential blocks, limited public functions, and underused collective open spaces. Recent construction projects introduce affordable apartments within an already dense residential fabric, but do not significantly alter the mono-functional character of the area. The proximity to Eindhoven's innovation institutions highlights a broader urban divide (Elshout & Vermeeren, 2019). However, architectural responses remain modest in scale and primarily housing-oriented. Physical restructuring plays a limited role compared to institutional and social interventions.



(a) Overview of 89 addresses on Cornelis Dopperstraat **(b)** Rendering Image of the apartment

Figure 3.11: New apartments in Cornelis Dopperstraat in Bennekel (KadastraleKaart, n.d.) (Damen, 2023)

The comparison shows that there is no single model for transforming post-war residential areas in Eindhoven. Woensel-West emphasizes programmatic diversification, Doornakkers demonstrates incremental housing-led renewal, and Bennekel reveals the need for a more spatially and socially integrated approach. For the selected site, this suggests that densification should not be limited to adding new dwellings. Instead, it should combine housing addition with collective space, public functions, improved access, and limited disruption to existing residents. This forms the basis for a hybrid densification strategy in the following site analysis and design development.

3.4 Adaptive and Incremental Approaches to Densification

Beyond spatial restructuring at the neighborhood scale, densification in post-war residential areas also requires a reconsideration of construction logic. Since many existing residential buildings are still occupied and structurally limited, transformation cannot depend only on demolition, replacement, or heavy new construction. Instead, it requires incremental and lightweight strategies that can add housing, collective functions, and new access systems while reducing disruption to existing residents.

This need for adaptability also reframes the role of modular and prefabricated construction. In the post-war period, standardization was mainly used to accelerate mass housing production. In contemporary renovation, however, modularity can be reinterpreted as a more flexible and reversible system. Rather than producing uniform housing environments, adaptive construction can support phased addition, future modification, and a clearer separation between existing structures and new interventions.

Several recent pavilion projects illustrate this shift from efficiency-driven standardization to adaptive construction systems. The Modular Pavilion in Amsterdam (Figure 3.12) demonstrates a kit-of-parts logic based on standardized dimensions and reusable components. The Natural Pavilion in Almere (Figure 3.13) shows how a lightweight timber framework can be combined with interchangeable infill elements and bio-based materials. The People's Pavilion in Eindhoven (Figure 3.14) further emphasizes reversibility through borrowed materials and dry assembly methods. Although these projects are not direct models for residential densification, they provide useful principles for designing additions to existing post-war housing environments (Table 3.2).

Table 3.2: Potential construction principles for adaptive densification

Principle	Construction Meaning	Relevance to this Project
Lightweight Addition	Reduced structural load	Suitable for additions on existing buildings, especially for the rooftop extension
Prefabricated Modules	Faster assembly, controlled dimensions	Limits construction time and disturbance
Independent Structure	New frame separated from existing load-bearing system	Minimizes impact on the existing structural system
Reversible Connections	Bolted or mechanically fixed joints	Supports future adaptation and change
Layered Construction	Structure, envelope, and infill treated separately	Allows different parts to change over time
Phased Implementation	Construction in smaller steps	Reduces disruption during the transformation of existing housing blocks

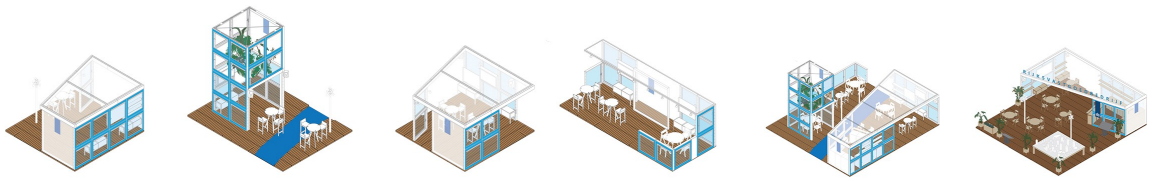


Figure 3.12: Axon diagrams of Modular Pavilion (Bygg Architecture, n.d.)



Figure 3.13: Photos of the Natural Pavilion (DP6, 2022) (Pintos, 2022)

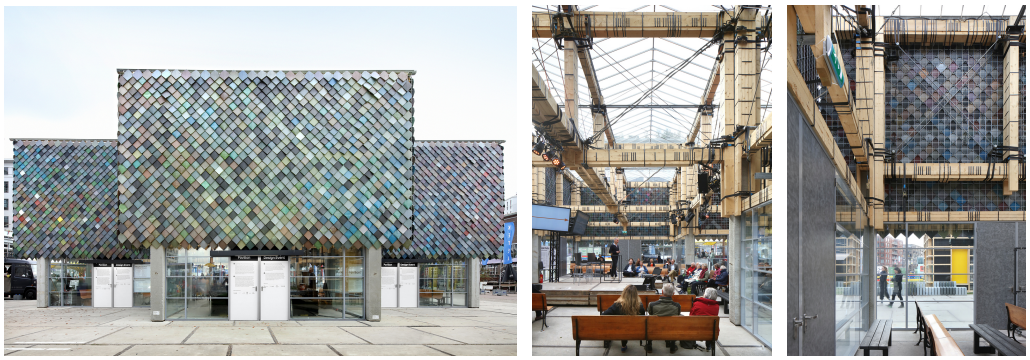


Figure 3.14: Photos of the Natural Pavilion (Pintos, 2017)

For this project, the relevance of these precedents lies less in their pavilion form and more in their construction attitude. They suggest that densification can be understood as an incremental process rather than a single, complete replacement of the existing fabric. New additions should therefore be structurally light, partly independent, and compatible with prefabricated assembly. This is especially important for rooftop extensions and collective facilities, where construction must respond to existing structural capacity and the daily life of current residents.

The adaptive construction logic supports the broader ambition of hybrid densification by making transformation more incremental and less disruptive. It allows density, accessibility, and collective life to be strengthened within the existing residential environment, without replacing it through a single heavy intervention. In this sense, construction becomes part of the social and spatial strategy of the project.

3.5 Collective Space and Architectural Densification Precedents

Beyond construction systems, the transformation of post-war residential areas also depends on how new collective spatial structures are introduced into existing housing environments. Densification should therefore not be understood only as the addition of new dwellings, but also as the reorganization of access, shared space, public functions, and the relationship between private housing and collective life. The following precedents show how existing residential structures can be upgraded through additional spatial layers, improved circulation, and collective programmes without relying on full demolition.

DeFlat Kleiburg, Amsterdam

DeFlat Kleiburg demonstrates how a large post-war housing block can be transformed by retaining its main structure while reworking its collective systems. Instead of demolishing the building, the project preserved the primary structural frame, elevators, galleries, and technical infrastructure, while leaving individual dwellings as unfinished shells for future residents to adapt (ArchDaily, 2016). This strategy reduced the initial intervention while allowing residents to participate in the long-term transformation of the building.



Figure 3.15: General layout of Kleiburg (ArchDaily, 2016)

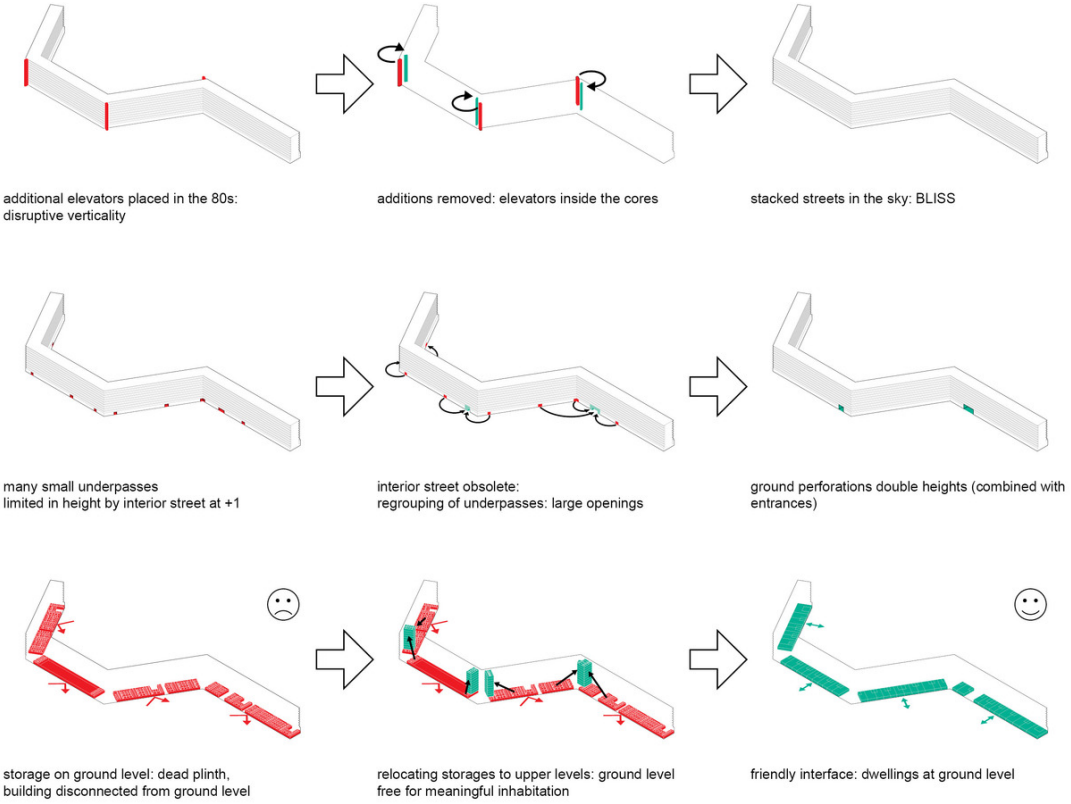


Figure 3.16: Renovation process diagram (ArchDaily, 2016)



Figure 3.17: Reconstruction process and final outcomes (ArchDaily, 2016)

The most relevant aspect of Kleiburg is the reinterpretation of the collective structure. The intervention did not try to erase the repetitive character of the slab block, but reorganized its access, ground

floor, and shared circulation (Figure 3.16). Storage spaces were removed from the ground level, underpasses were enlarged, and the plinth was opened to create a more active connection with the surrounding public space. In this way, the existing collective system was transformed from a closed and inefficient structure into a more open framework for access, adaptation, and shared use (Figure 3.17).

For this project, Kleiburg is relevant because it shows that the transformation of post-war housing can begin from the existing building logic. Rather than replacing the whole structure, access systems, ground-floor conditions, and collective interfaces can be selectively reconfigured to improve both existing dwellings and new additions.

Transformation of 530 Dwellings, Bordeaux

The transformation of 530 dwellings in Bordeaux offers another approach to upgrading housing units without demolition. Instead of altering the existing structural system extensively, the project adds a new spatial layer of winter gardens and balconies to the existing residential blocks (Figure 3.18). This outward extension improves the quality of each dwelling by increasing usable space, daylight, ventilation, and the relationship between interior and exterior.

The importance of this project lies in the idea of extension as improvement rather than replacement. The added facade layer creates intermediate spaces between private interiors and the external environment. At the same time, the existing housing structure remains largely intact, allowing the transformation to take place with limited disruption to residents (Pintos, 2016). Collective improvement is therefore achieved not through a complete reorganization of the building, but through a continuous additional layer that upgrades everyday living conditions.



Figure 3.18: Photos and construction diagram of the building and winter gardens (Pintos, 2016)

For this project, the Bordeaux case is relevant to the treatment of existing facades and balconies. It supports the idea that new spatial layers can improve insulation, access, privacy, and living quality while preserving the existing structural fabric. This is especially important for the proposed transformation of the balcony side into a secondary entrance and insulated façade layer.

Waaggebouw and Woensel-West, Eindhoven

The Waaggebouw in Woensel West provides a local example of how collective space and public functions can act as catalysts for neighborhood transformation. Unlike the previous two cases, its relevance is not mainly about renovating an existing slab block, but about inserting a new collective programme into a post-war residential district. The building combines housing with a community-oriented plinth, shared facilities, and a strong relationship to the public square (ArchDaily, 2023).

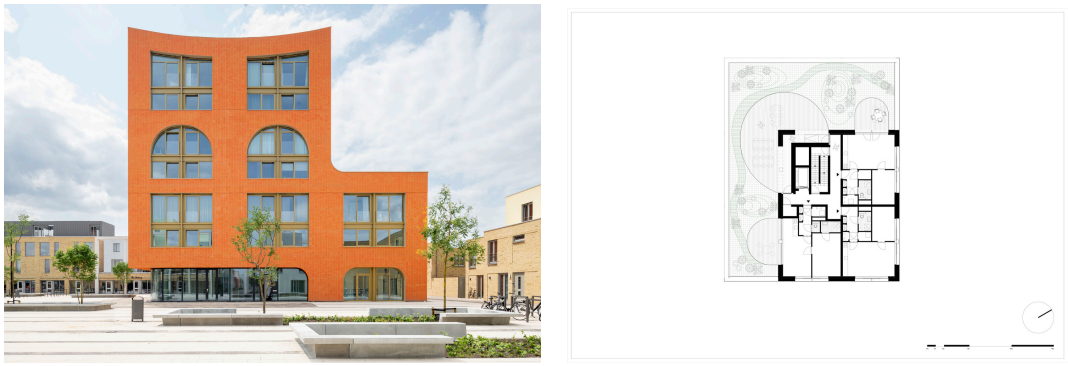


Figure 3.19: Waaggebouw Weighing House with iconic orange facade and its ground floor plan (NEXT-Architects, 2022)

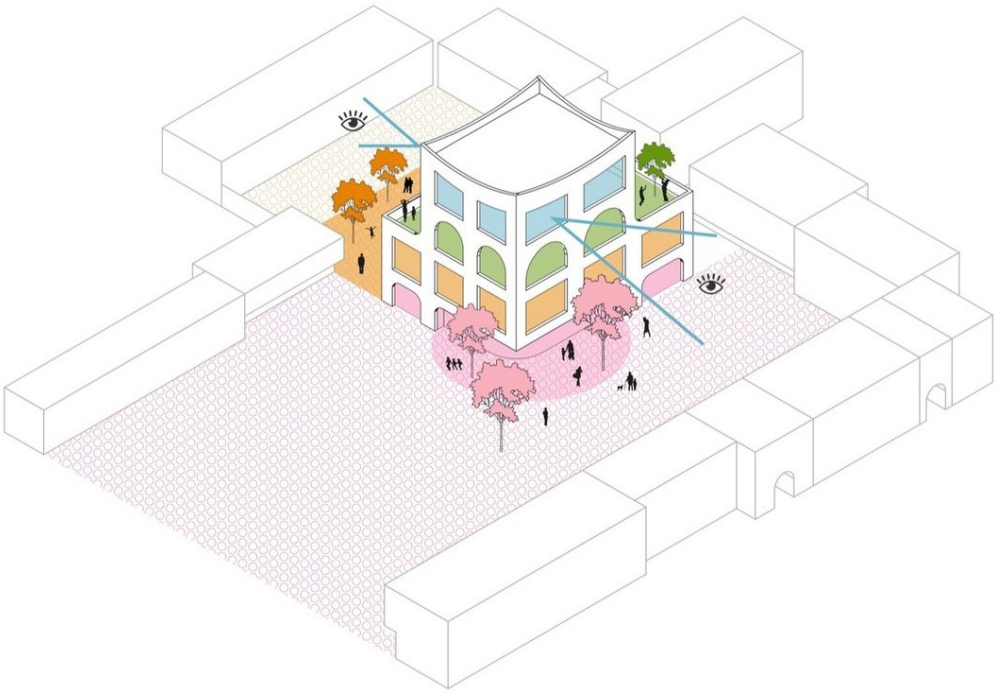


Figure 3.20: Axonometric diagram of Waaggebouw demosntrates the building-context relationship (ArchDaily, 2023)

This case is important because it shows that densification can support neighborhood life when public functions are integrated into the spatial strategy. The open plinth and collective facilities do not simply serve the building itself, but contribute to a broader network of public and communal spaces (Figure 3.20). In this sense, the project demonstrates how architectural intervention can strengthen the relationship between housing, public space, and local identity.

For this project, the Waaggebouw is relevant as a local reference for combining housing densification with neighborhood-oriented functions. It supports the idea that new buildings in post-war residential areas should not only provide additional units, but also introduce shared spaces, public programmes, and more active ground-floor conditions.

Implication for the project

These precedents are used as references for understanding how collective space can support architectural densification. Rather than treating densification only as the addition of housing units, they show how existing structures, access systems, facade extensions, and public programmes can become part of a broader spatial transformation. The comparison is summarized in Table 3.3.

Table 3.3: Collective spatial strategies in selected precedents

Case Studies	Main Strategy	Collective Spatial Element	Relevance to this project
DeFlat Kleiburg	Retain and rework on the existing structure	Galleries, plinth, entrances, access system	Existing structure and circulation transformation
530 Dwellings	Add external spatial layer	Winter gardens, balconies, facade depth, lifts	Extension as improvement, not replacement
Waaggebouw	Insert collective programmes in residential area	Open plinth, community facilities, public square	Public functional spaces as neighborhood catalyst

Overall, these cases support a layered understanding of densification. They provide a basis for the later design strategy, where housing addition, collective space, access, and building improvement are combined into one hybrid transformation.

3.6 Extraction and Translation of Design Principles

Based on the previous analysis of post-war residential areas in Eindhoven, local transformation trajectories, adaptive construction systems, and collective spatial precedent cases, several design principles can be extracted. At this stage, these principles do not define a fixed design solution. Instead, they provide a framework for selecting a relevant site, identifying spatial potentials, and guiding the later design development.

I. Densification beyond housing quantity

Densification should not be understood only as the numerical increase of dwellings. New housing should be combined with collective facilities, shared outdoor spaces, and communal functions. In this way, densification becomes a tool for improving both housing supply and social infrastructure.

II. Retention and minimum disruption

Post-war residential areas often contain repetitive but still usable building structures. Transformation should therefore begin from the existing urban and architectural fabric rather than from full replacement. The aim is to identify where addition, adaptation, or reorganization can improve the area while retaining valuable existing structures and reducing unnecessary demolition.

III. Collective space as a transformation resource

Many post-war neighborhoods contain open, residual, or weakly programmed spaces. These spaces should not be seen only as leftover land for future construction, but as potential collective infrastructure. Their transformation can support shared use, social interaction, pedestrian movement, and a stronger relationship between buildings and public space.

IV. Accessibility and spatial connection

The quality of post-war residential areas is strongly influenced by how buildings, open spaces, routes, and public facilities are connected. Future interventions should therefore consider accessibility and connectivity as one of the central design issues. This includes not only physical access to dwellings, but also the relationship between private, collective, and public domains.

V. Typological and contextual responsiveness

New interventions should respond to the scale, rhythm, and spatial logic of the existing neighborhood. However, this does not mean simply repeating existing patterns. Instead, the design should identify which aspects of the existing typology can be preserved, adapted, or challenged in order to support contemporary housing needs and collective life.

VI. Incremental and feasible construction

Transformation in existing residential areas requires construction strategies that are realistic, phased, and compatible with occupied environments. Lightweight, prefabricated, and adaptable systems can support gradual change while limiting disruption. Construction should be considered not only as a technical issue, but also as a condition for social and spatial feasibility.

These principles form the basis for the following site selection and site analysis. They will be used to evaluate where post-war residential areas offer the strongest potential for hybrid densification, and how future design interventions can balance additional housing, collective space, accessibility, existing fabric, and construction feasibility.

4

Site Analysis

4.1 Site Selection

The selection of the site is based on the objective of identifying a representative post-war residential environment in Eindhoven, ensuring that some of the proposed design strategies in the previous chapter are relevant and applicable. Rather than selecting a site based only on availability of space, the process focuses on spatial, structural, and social criteria that justify the need and feasibility of intervention. The criteria are stated below:

I. Relevance to post-war housing typologies

The site should be characterized by portiekflat or slab housing with repetitive and standardized layouts, representing a typical condition of post-war neighborhoods in Eindhoven. This ensures that the project addresses a representative and scalable context, aligning with the research focus on the transformation of post-war housing rather than a site-specific or isolated condition.

II. Presence of underused open space

The site should contain large open space with low spatial quality, characterized by lack of clear function and use, failing to operate as an effective public or communal space in the current situation. This ensures that the open space has the potential to be reprogrammed with public and communal functions.

III. Spatial capacity for densification

The existing configuration needs to provide sufficient distance between buildings and maintains a relatively low density, demonstrating potentials for additional volumes or spatial layers to be introduced.

IV. Existing structural and spatial logic

The existing buildings should exhibit a clear structural grid and repetitive organization, providing the possibility that the intervention can build upon an existing modular logic and enabling the integration of new and existing elements.

V. Social and functional deficiency

The site should be predominantly residential, lacking diversity in program and inactive ground-level spaces. This ensures that the site provides the potential to improve social interaction and enhance overall spatial quality.

VI. Strategic urban position

The site should be located within a typical post-war residential area, ideally in proximity to the three representative communities in Eindhoven discussed previously. It should also be located near the ring road and be well connected to the broader urban network, reflecting typical post-war areas undergoing processes of expansion and transformation. This ensures that the project operates within a representative urban context and can be considered scalable to similar post-war neighborhoods.

Conclusion

Based on the criteria outlined above, the selected site is the 6 building blocks on Offenbachlaan in Eindhoven, as shown in Figure 4.1. The site meets the key requirements of typological relevance, spatial capacity, and urban positioning, providing a suitable context for testing strategies of densification within post-war residential environments.



Figure 4.1: Aerial view of selected site

4.2 Urban-scale Context Analysis

The selected site is located in the Gestel district of Eindhoven, in close proximity to the Bennekel area, and forms part of a typical post-war residential expansion developed in the early 1960s. The site lies just outside the Eindhoven ring road, at an approximate distance of 350 meters, situating it within a well-connected urban context while retaining characteristics of peripheral residential areas. This positioning reflects common conditions of post-war neighborhoods that were planned as predominantly mono-functional residential area, with a certain distance to the local urban center where larger amenities such as supermarkets, healthcare facilities, and fitness centers are located. This spatial separation highlights a lack of programmatic diversity and limited access to daily services within walking distance (Figure 4.2). The surrounding building fabric is mainly composed of low- and mid-rise residential buildings, while taller volumes are generally associated with public functions or institutional complexes.

Zooming in from broader urban context to the site, it consists of a linear composition of six residential building blocks arranged in a row. Each block follows an L-shaped configuration, although not strictly orthogonal, resulting in a slightly irregular spatial geometry. The buildings are not physically connected along the two wings of the L-shape, creating a series of semi-enclosed open spaces between them. The overall site extends approximately 450 meters in length and 90 meters in width, with green strips and internal roads separating the individual blocks.

Similar repetitive L-shaped residential configurations can also be observed in the surrounding area. Across the main road, another series of L-shaped residential buildings combines garages on the ground floor with four residential floors above. Unlike the selected site, these buildings are connected at the corner, producing a stronger sense of courtyard enclosure. On the other side of the selected site, row housings are also arranged in L-shaped configurations, with private gardens and public green spaces facing the inner side of the layout. These surrounding examples suggest that the selected site is not an isolated case, but part of a broader spatial pattern of post-war residential development.



Figure 4.2: Site analysis map with programmatic distribution

Overall, the urban-scale analysis reveals a site with strong layout clarity and generous open space provision, yet limited spatial activation and integration. The combination of underutilized courtyards, clear block organization, and accessible urban positioning suggests a significant potential for transformation through the introduction of new spatial and programmatic layers.

4.3 Block and Building-scale Analysis

At the block scale, the selected site is composed of six L-shaped residential blocks made up of portiek-flat buildings. These blocks follow a repetitive spatial and structural logic, but each block operates as a semi-independent unit within the larger linear site composition. The analysis at this scale therefore focuses on the relationship between circulation, parking, courtyard space, building access, and the existing architectural condition.

The spatial organization of the block is characterized by a clear distinction between circulation and open space. Vehicle access and open-air parking are positioned along the edges of the buildings, closely following the built footprint. Pedestrian circulation is partially integrated within the block structure, with access paths located at the corners of the L-shaped buildings. Permeability between adjacent blocks is limited to narrow passages of approximately 2.5 meters and small gaps around garage structures. Overall, vehicular circulation primarily connects each block to the surrounding street network, while pedestrian routes create internal links between the blocks and provide access towards the main road.

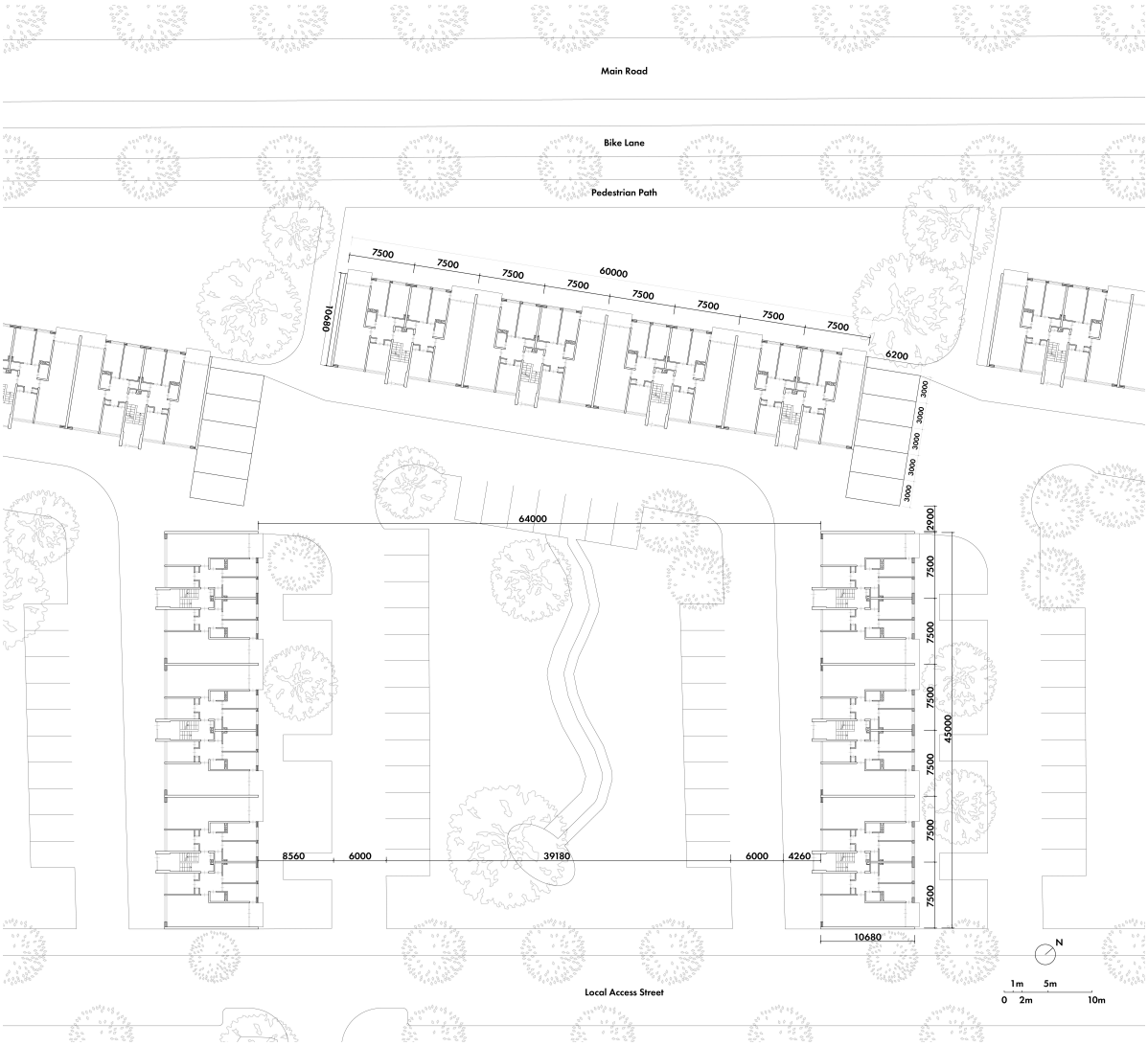


Figure 4.3: General plan layout of building blocks

The L-shaped configuration of the buildings creates a sequence of semi-enclosed courtyards. Defined by inward-facing facades, these courtyards form the primary collective open spaces within each block. The distance between opposing facades is approximately 65 meters, and one representative green space in the middle of the block measures approximately 1,350 square meters (45 × 30 meters), indicating substantial spatial capacity.

The entrances to the residential staircase cores are oriented towards the courtyards, further reinforcing their role as shared spaces for residents. In addition, the entrance-side facades are oriented towards the southwest. As a result, both these facades and the open courtyard benefit from sufficient daylight, suggesting favorable environmental conditions for potential spatial extension or activation. In contrast, the opposite facades, including the balcony side, receive limited sunlight during the day. This becomes an important factor for future facade interventions and spatial extensions.

However, despite their generous size, clear spatial enclosure, and favorable daylight conditions, the courtyards lack clearly defined functions and supporting infrastructure (Figure 4.5). This limits their effectiveness as active communal environments and suggests that future interventions should not only introduce additional spatial capacity, but also strengthen the social and functional role of the courtyard.



Figure 4.4: Section demonstrates the spatial relationship between the buildings and courtyard



Figure 4.5: Site photos demonstrate the underused green space with some randomly placed furniture or private facilities

At the building scale, the overall composition is consistent but asymmetrical. The longer wing of the L-shaped block accommodates four staircase cores across three floors, while the shorter wing contains three staircase cores across four floors. Despite this asymmetry, both wings follow a repeated layout principle: each staircase core serves two mirrored residential units, together forming a compact module of approximately 15 by 10 meters. This configuration creates an efficient access system while maintaining a higher degree of privacy for individual units compared with a public gallery system.

At ground level, the buildings are slightly elevated, with a base of approximately one meter above grade. This allows basement windows to remain above ground level and creates a subtle threshold between public space and private dwellings, improving privacy for the lower-floor units. Above this base, the residential floors follow a consistent floor height of approximately 2.9 meters and are covered by flat roofs, indicating potential for lightweight vertical extension.

Although the six building blocks share a common typological and structural logic, they have undergone different renovation interventions over time. These include the repainting of exterior walls (Figure 4.6), enlarged entrance portals with glass facades at staircase cores (Figure 4.7), replacement of window frames, and the concealment of collective exhaust shafts on the facade (Figure 4.8). However, these interventions remain fragmented and are mostly limited to the building envelope. They do not form a coherent strategy for improving the quality of courtyard spaces or introducing additional spatial capacity.




Figure 4.6: Site photos demonstrate different building elevations




Figure 4.7: Site photos demonstrate different entrance portals and limited bike parking area




Figure 4.8: Site photos demonstrate different treatment on collective exhaust shafts

Overall, the block and building-scale analysis reveals a strong structural and spatial framework with clear modular logic and generous open space, but also with limited activation and coherence. The combination of underutilized courtyards, repetitive building systems, and fragmented renovation approaches suggests a significant potential for densification and the improvement of the spatial coherence between buildings, circulation, and collective open space.

4.4 Unit-scale Site Analysis

At the unit scale, the dwellings follow a compact and standardized layout typical of post-war portiekflat housing. Each unit has an interior area of approximately 61 to 65 square meters, with an overall structural dimension of around 10 by 7.5 meters. This repeated unit dimension reflects the modular logic of the building system and contributes to the overall regularity of the residential blocks.

Upon entering the unit (Figure 4.9), a small foyer provides access to two bedrooms located on either side. The bathroom and toilet are separated and positioned adjacent to the entrance space. The kitchen is arranged as a closed room, independent from the living area. Beyond the foyer, a door leads to the living room, which forms the largest space in the unit and is connected to the balcony. Unlike more contemporary layouts, where the living space is often visually connected to the entrance, the living room here remains a separate and enclosed room. This reinforces a compartmentalized spatial organization with limited internal flexibility.

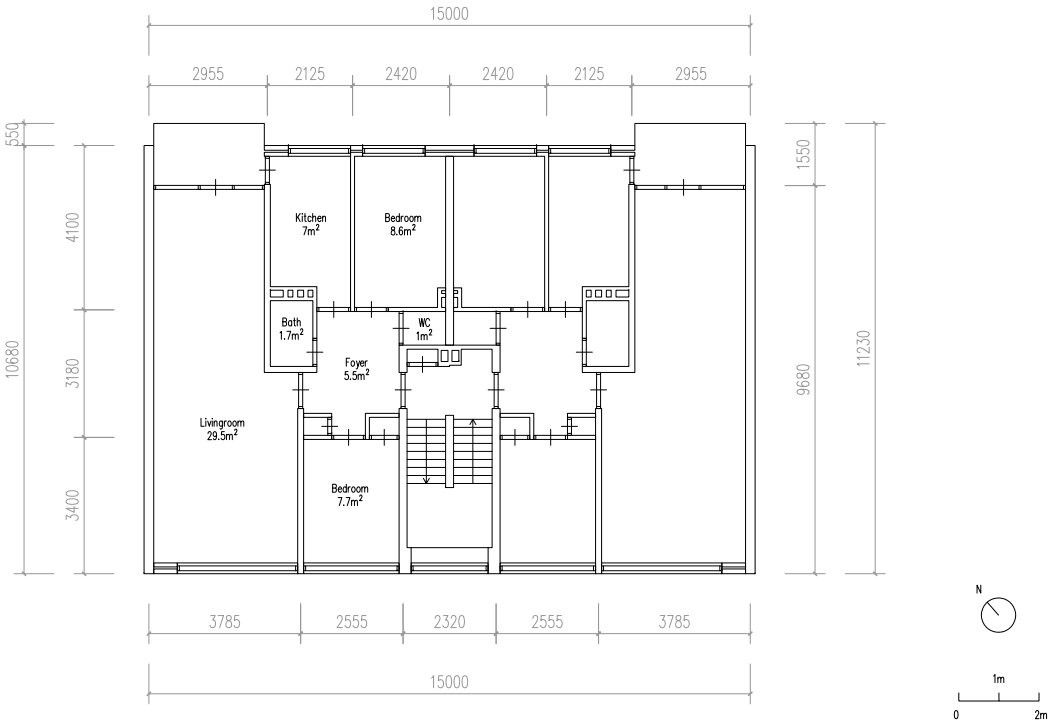


Figure 4.9: Unit plan with dimensions

The environmental performance of the unit is closely related to its orientation and spatial configuration. The balcony is positioned on the northeast facade, resulting in limited sunlight exposure and reduced outdoor usability during the day. While the entrance-side facades receive more favorable daylight conditions, the internal layout does not fully optimize natural light distribution within the dwelling. As a result, the unit presents an asymmetrical relationship between interior living spaces, balcony orientation, and daylight access.

From a construction perspective, the building follows the Baksteen-Montage-Bouw (BMB) system, in

which many structural and envelope components are prefabricated. The primary structure consists of precast concrete load-bearing walls and floor slabs. The external envelope is formed by prefabricated facade panels, composed of an outer brick layer and an inner concrete panel separated by a cavity and connected through galvanized steel ties (Figure 4.10). This system reflects the industrialized building methods of the post-war period and provides a clear structural logic. At the same time, it also defines specific constraints for future adaptation, as changes to the facade, structure, and openings must respond to the existing prefabricated system.

In terms of energy performance, the units are predominantly classified within energy labels C and D, with occasional cases of lower ratings such as E, F, and G (AlleCijfers, n.d.). This suggests that, despite previous renovation measures, the overall environmental performance remains moderate to poor. The existing condition therefore indicates a need for improvement in thermal performance and living comfort.

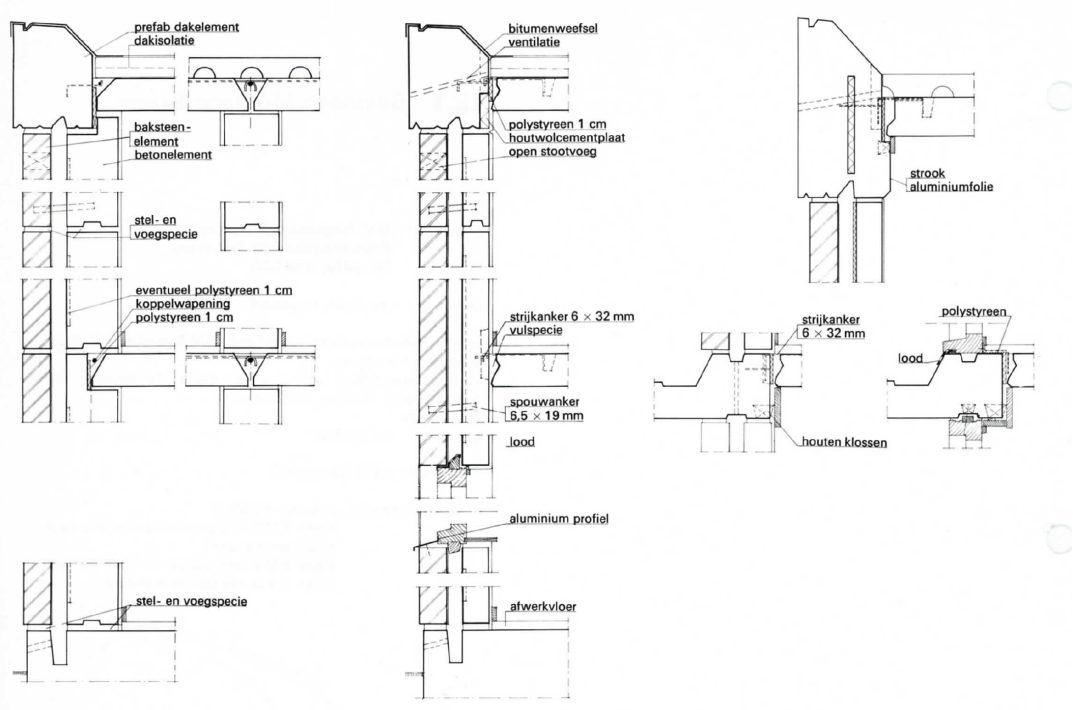


Figure 4.10: Baksteen-Montage-Bouw (BMB) cosntruction detail drawings

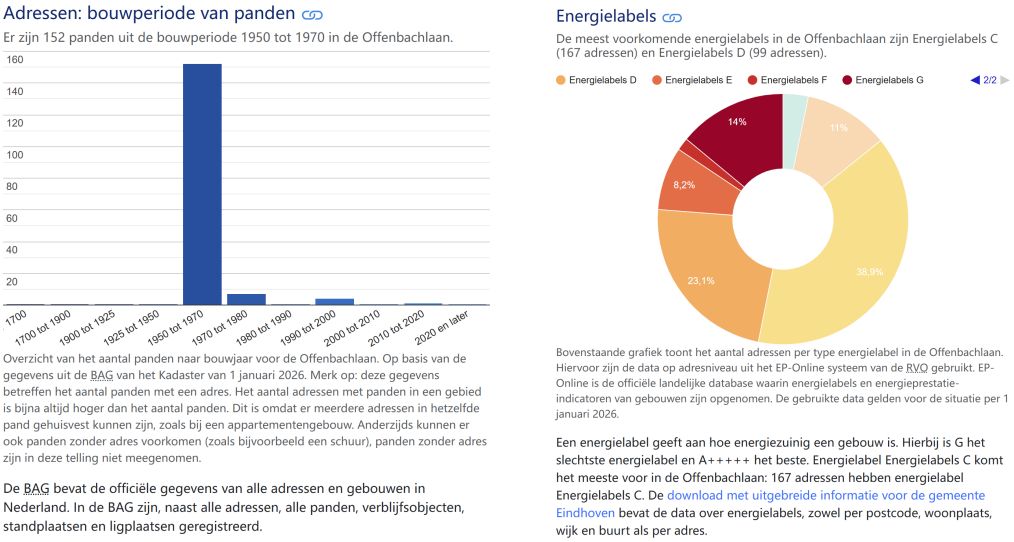


Figure 4.11: Site area construction period and energy label distribution (AlleCijfers, n.d.)

Overall, the unit-scale analysis reveals a rigid and compartmentalized spatial organization, limited environmental performance, and a lack of spatial flexibility. These characteristics indicate both constraints and opportunities for intervention, particularly in relation to spatial extension, improved daylight conditions, and the potential integration of more adaptable living arrangements.

4.5 Initial Opportunities and Constraints Synthesis

The analysis across urban, site, block, building, and unit scales reveals a residential environment with clear potential for transformation, but also with several constraints that must guide future intervention. Rather than defining a fixed design solution, these findings establish the initial spatial, social, and architectural conditions for the following design exploration.

I.Spatial Capacity for Densification

The semi-enclosed courtyards offer considerable spatial capacity for new interventions. With a distance of approximately 65 meters between opposing facades and a building height of around 13 meters, the existing courtyard proportion is far more generous than the commonly recommended ratio of building spacing to height. This suggests that new structures could be inserted without necessarily compromising daylight access or overall spatial quality. However, this capacity should not be understood simply as vacant space for construction. Any intervention must carefully balance densification with courtyard openness, daylight, views, and privacy for existing residents.

II. Repetitive Block and Structural Logic

The repetitive organization of the six L-shaped blocks provides a clear basis for systematic intervention. The portiekflat typology, repeated staircase cores, modular unit arrangement, and prefabricated construction system create a recognizable spatial and structural rhythm. This repetition allows design strategies to respond to an existing logic rather than operating as isolated additions. At the same time, this repetition also exposes the limitations of the existing system, particularly its fragmented vertical access and limited capacity to adapt to a broader urban context.

III. Potential for Lightweight Vertical Adaptation

The buildings show potential for lightweight vertical adaptation. The flat roof configuration, consistent floor heights, and possible residual structural capacity indicate that rooftop extension could become one of the possible densification strategies (HA-HA Design Development, 2025). However, this potential remains limited by the existing load-bearing system and would require further structural verification. Therefore, vertical densification should be approached as a selective and lightweight intervention rather than as an unlimited increase in building height.

IV. Underused Collective Space

The courtyards and ground-level spaces are currently underused despite their generous dimensions and favorable spatial enclosure. The lack of clearly defined collective functions, supporting infrastructure, and programmatic diversity limits the role of these spaces as active communal environments. This indicates an opportunity to strengthen the relationship between open space, everyday use, and collective life within the block.

V. Constraints Related to Existing Residents

The main constraints concern the living quality of current residents. The existing dwellings have compact and compartmentalized layouts, uneven daylight distribution, limited balcony usability, and moderate energy performance. At the same time, new interventions must avoid excessive obstruction of daylight and views, reduce privacy conflicts between opposing facades, and minimize disruption to existing dwelling layouts and daily life. These constraints suggest that densification cannot be treated as a purely quantitative increase in housing units, but must be negotiated with environmental quality and the needs of existing residents.

Overall, the site analysis identifies a fundamental tension between spatial capacity and collective potential. The site offers sufficient room and structural logic for transformation, but its existing environmental and social conditions require a careful balance between adding new density, improving shared spaces, and preserving the quality of life for current residents. These initial opportunities and constraints provide the basis for the design exploration in the following chapter.

5

Design Development

This chapter translates the opportunities and constraints identified in the site analysis into a series of spatial explorations and design decisions. The ambition is to achieve densification in post-war residential blocks not only by adding housing units, but also by improving collective space, accessibility, environmental quality, and the relationship between existing and new residents. Rather than beginning with a fixed solution, the design process starts with a set of exploratory strategies, which are tested, compared, and gradually refined into a more site-specific hybrid intervention.

5.1 Early Design Explorations and Their Limitations

5.1.1 From Site Conditions to Design Questions

The first stage of the design process explored three broad spatial directions for densifying and activating the block, as conceptual tests to understand how different forms of intervention could respond to the existing courtyard, rooftop, and building structure.

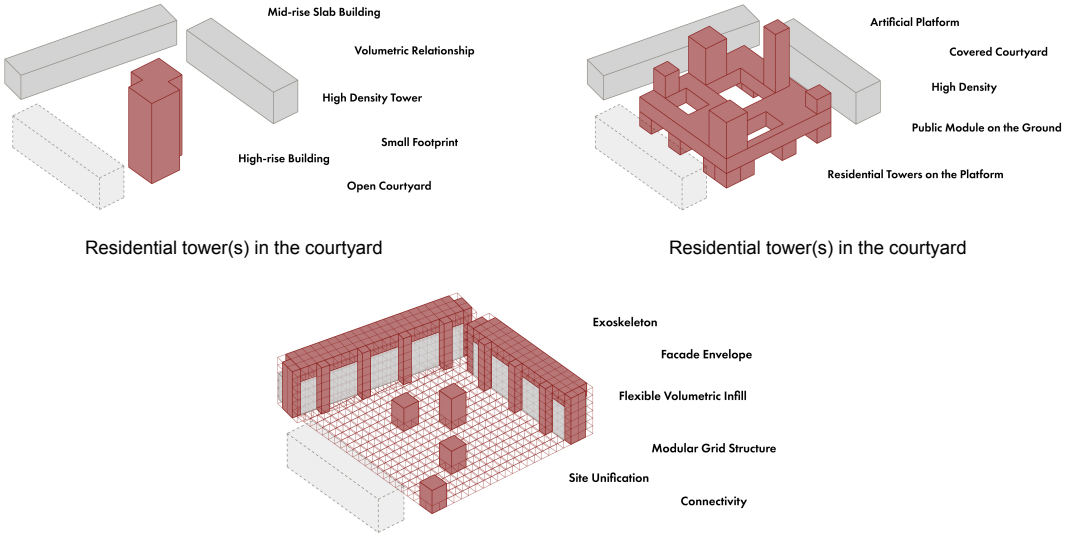


Figure 5.3: Exoskeleton on the facade as infrastructure layer to carry the modular infill

The first direction investigates the insertion of free-standing residential towers within the courtyard, examining the relationship between a minimal ground footprint and increased building height. By concentrating new housing in vertical volumes, it aims to preserve part of the open courtyard while introducing a strong contrast between the new towers and the existing low-rise slab buildings.

The second direction proposes an artificial platform spanning the courtyard. In this strategy, public

or collective functions are positioned beneath the platform, while new residential volumes are placed above. This creates a vertically stratified spatial organization, in which ground-level activation and housing densification are combined within a single structural system.

The third direction explores an exoskeleton strategy. A modular structural framework is introduced to wrap around the existing buildings, allowing new infill volumes, circulation elements, and possible extensions to be attached to the existing block. This approach tests whether densification can be achieved through an added infrastructural layer rather than through independent new buildings.

Together, these three directions reveal different ways of interpreting the site as:

- An open courtyard with capacity for insertion,
- A layered ground and roof system,
- An existing structure that can be extended through an additional framework.

Together, these three initial directions show that the design problem cannot be addressed only through the form of a single intervention. Although the tower, platform, and exoskeleton strategies differ in spatial logic, they collectively reveal that densification involves multiple parts of the existing block rather than one isolated architectural object.

5.1.2 From Formal Strategies to Layered Thinking

In this part, the design process shifted from testing independent formal strategies to understanding the block as a multi-layered spatial system (Figure 5.4). The comparison of the initial strategies led to a layered interpretation of the site.

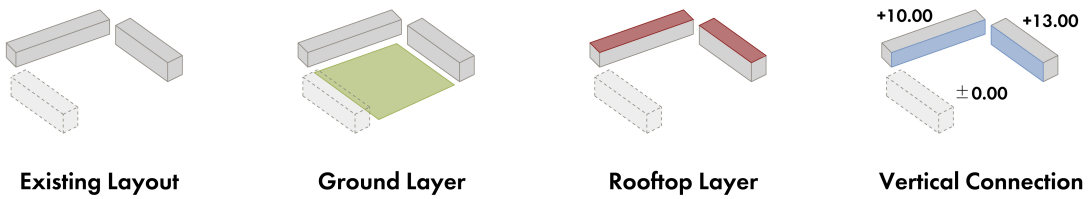


Figure 5.4: Layered interpretation diagram of the existing site

The first layer is the **ground layer**, formed by the courtyard, entrances, parking areas, pedestrian routes, and residual green spaces. This layer is directly related to everyday collective life within the block. It provides the main opportunity for introducing public or communal functions.

The second layer is the **rooftop layer**. The flat roofs suggests the possibility of lightweight vertical extension. This feasibility depends on the structural capacity of the existing buildings, and the height relationship with the surrounding context.

The third layer is the **vertical connection**, which is essential for connecting different levels, improving accessibility, and coordinating circulation between the ground, rooftop, and new added volumes.

By interpreting the site through these three layers, the design process moved from a comparison of independent forms toward a more systematic framework. The courtyard, rooftop, and vertical connection layers became components of one spatial system. Any intervention in one layer affects the others: adding housing changes the demand for access, introducing public functions influences the use of the courtyard, and new vertical connections reshape the relationship between existing residents and future users. This layered understanding became the basis for the following design explorations.

5.1.3 Design Exploration Framework

Following the layered interpretation developed in the previous section, a design exploration framework was established to structure the development of design options. Instead of directly proposing complete design solutions, the process first explores a series of layer-specific prototypes. In this context, a prototype is understood as a simplified spatial test for one specific intervention logic. These prototypes are not final designs, but tools for testing spatial and environmental qualities. Design options are then generated through the combination of these layer-specific prototypes.

Courtyard Layer Prototypes

The courtyard layer focuses on the relationship between new ground-level interventions and the existing open space. Prototypes in this layer test different building types and placement strategies in the courtyard, as listed in the following image. The aim is not only to identify where new space can be added, but also to understand how new interventions can strengthen the social and spatial role of the courtyard.

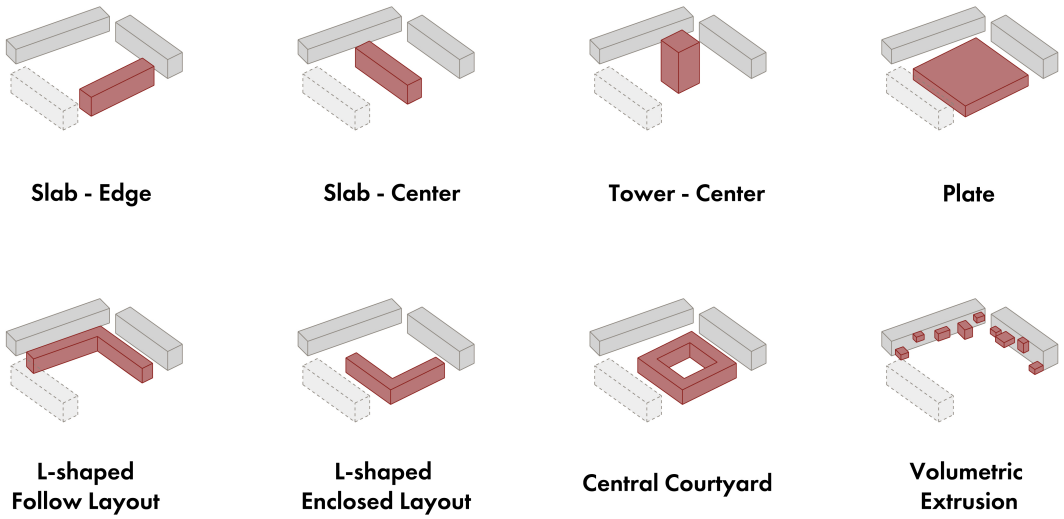


Figure 5.5: Initial prototyping for the courtyard layer

Vertical Layer Prototypes

The prototypes of vertical layer addresses both spatial placement and the degree of connectivity, ranging from minimal intervention to systems that connect multiple units or even multiple buildings.

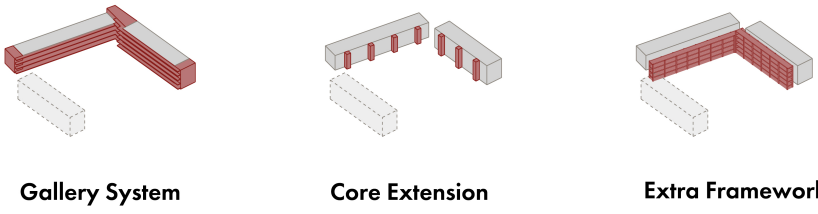


Figure 5.6: Initial prototyping for the vertical layer, which connects courtyard and rooftop layers

Rooftop Layer Prototypes

The rooftop layer explores the potential for vertical extension above the existing buildings. Prototypes in this layer test variations in added height, structural alignment, and the positioning of new residential units in relation to the existing footprint. These studies help to clarify the relationship between densification capacity, structural feasibility and visual impact.

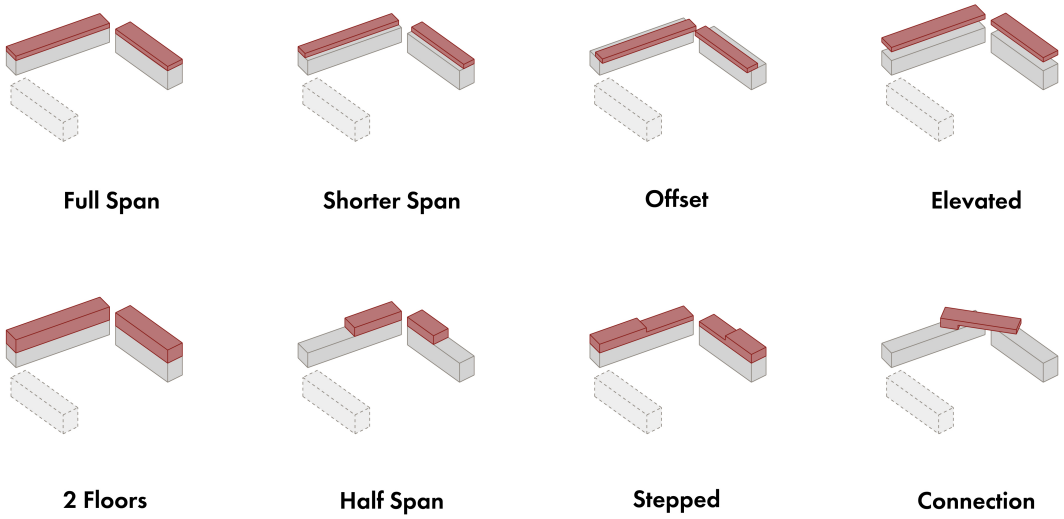


Figure 5.7: Initial prototyping for the rooftop layer

By combining selected prototypes across the three layers, different design options can be generated and systematically compared. These combinations are not arbitrary compositions, but structured tests of spatial and functional limits.

5.1.4 Testing Extreme Design Strategies

From the possible combinations of layer-specific prototypes identified in the previous section, four extreme design strategies were selected for further testing. Each strategy combines the courtyard, rooftop, and vertical connection layers in a different way, while deliberately emphasizing one dominant design focus. Rather than proposing final solutions, these strategies are critical probes to reveal the potentials and limitations of different intervention approaches.

A. Linear Circulation

The first strategy is based on a linear circulation logic. It combines gallery access along the existing facades, rooftop extensions following the same linear rhythm, and a slab building positioned along the edge of the courtyard. In this approach, the gallery becomes the main connective device, linking existing dwellings, new rooftop units, and vertical circulation points into a continuous horizontal system (Figure 5.8).

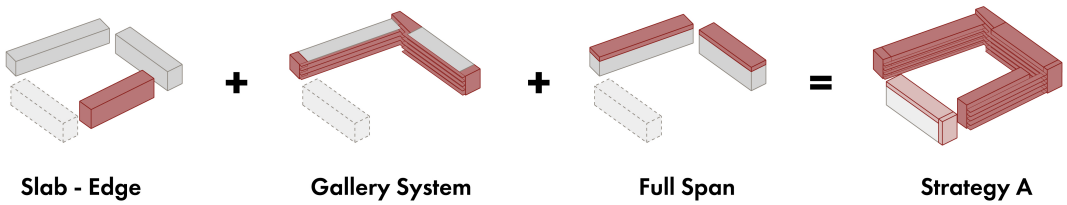
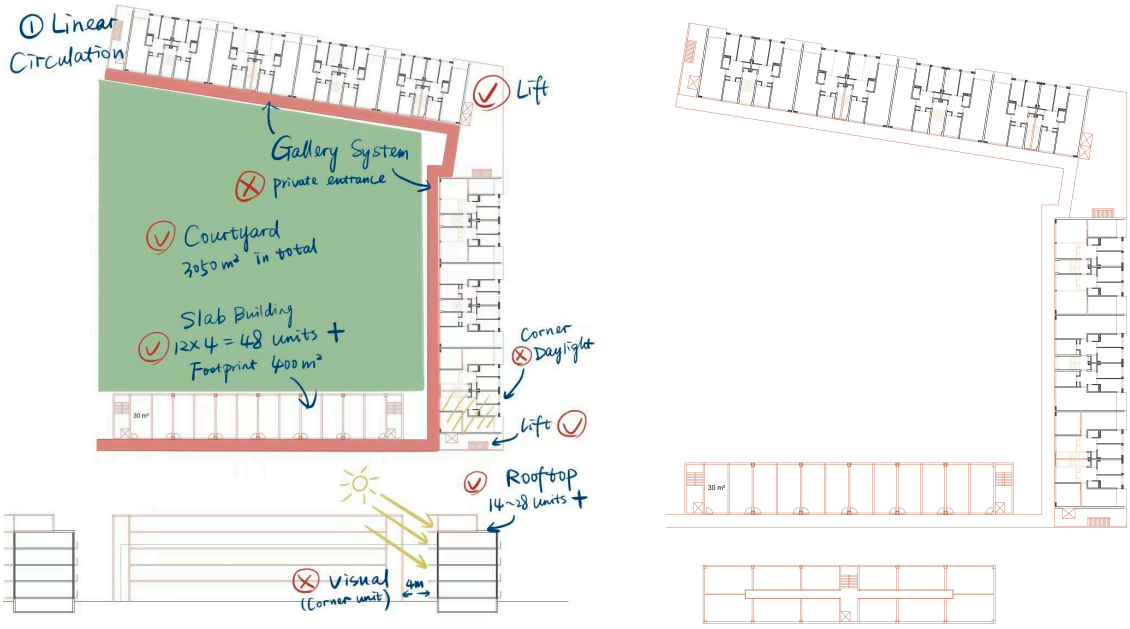


Figure 5.8: Prototypes combination diagram to form Strategy A. Linear Circulation

This strategy tests whether the fragmented portiekflat access system can be transformed into a more continuous collective circulation structure. It performs well in terms of connectivity and spatial coherence, and it allows the courtyard to remain largely open. However, the public circulation path is placed directly in front of existing dwellings, creating potential privacy conflicts and changing the relationship between dwelling and facade.



(a) Analysis diagram **(b)** Plan arrangement

Figure 5.9: Linear Circulation Strategy Analysis

B. Central Tower with Peripheral Frame

The second strategy maximizes densification through a centralized vertical intervention. A high-rise residential tower is inserted within the courtyard, while a lower peripheral frame is introduced around it as a transitional structure (Figure 5.10). The tower provides a large amount of new housing within a relatively small footprint, while the peripheral frame accommodates public or collective functions at ground level and mediates the scale difference between the tower and the existing low-rise blocks.

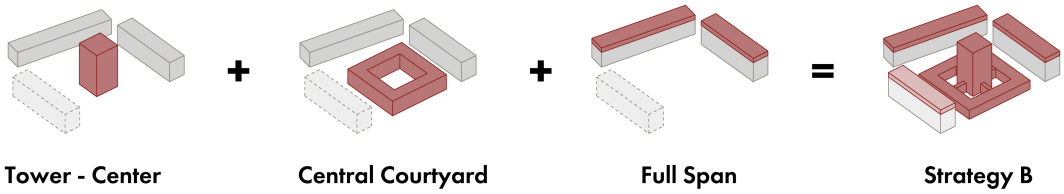
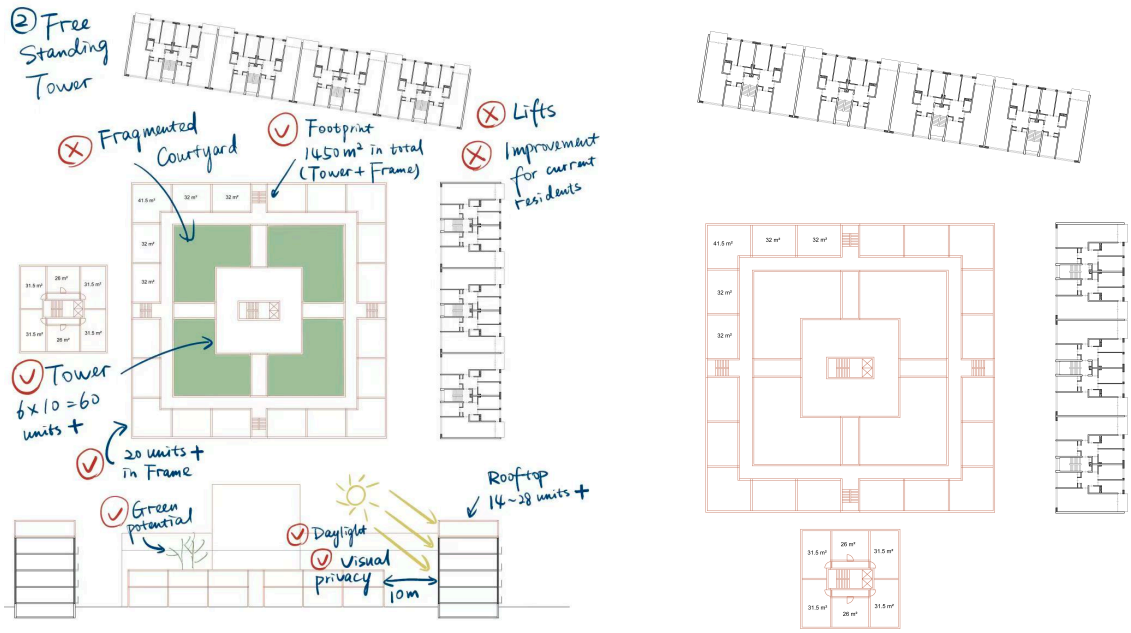


Figure 5.10: Prototypes combination diagram to form Strategy B. Central Tower with Peripheral Frame

This strategy tests the maximum densification capacity of the block. It demonstrates that the courtyard can technically accommodate a much higher spatial intensity, but also reveals the environmental and spatial cost of such an approach. The central tower fragments the open courtyard, increases visual impact, and risks reducing daylight and openness for existing dwellings. At the same time, because the tower remains largely independent from the existing buildings, it offers limited improvement to the daily living conditions of current residents.



(a) Analysis diagram **(b)** Plan arrangement

Figure 5.11: Central Tower with Peripheral Frame Strategy Analysis

C. Independent Transitional Structural Frame

The third strategy introduces an independent structural frame along the facades of the existing buildings (Figure 5.12). This frame accommodates new vertical circulation, possible collective spaces, and limited infill volumes, while keeping the original staircase cores and existing dwelling layouts largely intact. Instead of directly modifying the existing structure, the new system works as an additional layer attached to or positioned alongside the current buildings.

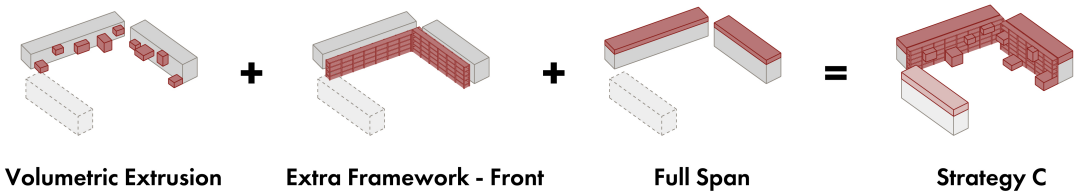
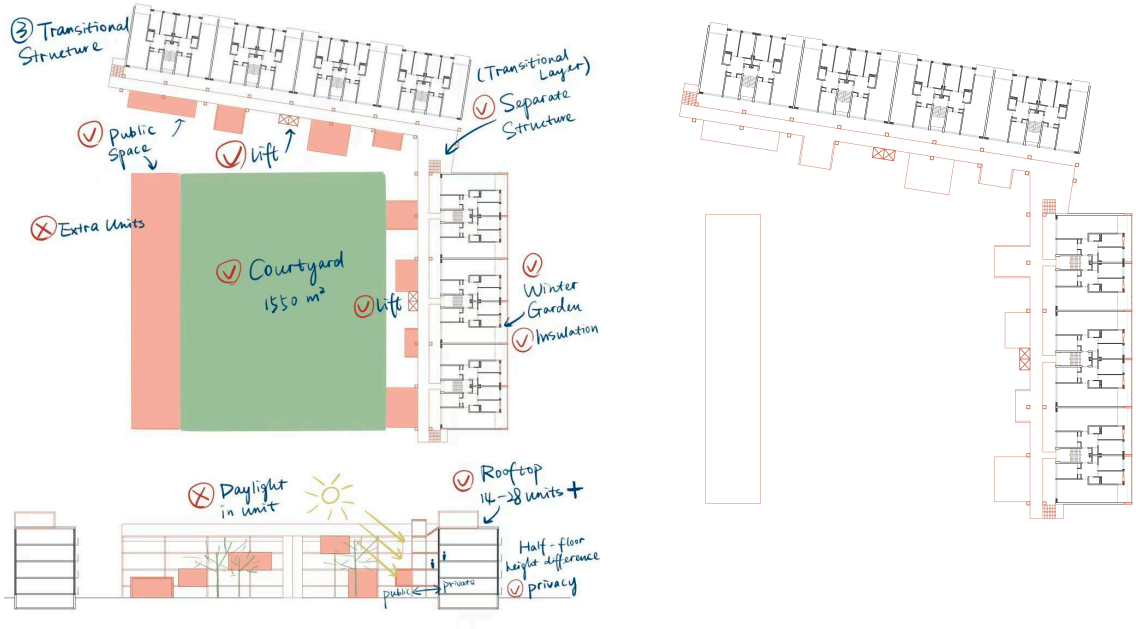


Figure 5.12: Prototypes combination diagram to form Strategy C. Independent Transitional Structural Frame

This strategy tests whether accessibility and spatial upgrading can be achieved with minimal disruption to the existing residents. Its main advantage lies in technical feasibility and phasing: because the new structure is relatively independent, construction can be organized without major intervention in the existing dwellings. However, the strategy contributes less to densification, and the added frame may increase visual density along the facades. It therefore raises questions about the balance between construction feasibility, spatial quality, and actual residential benefit.



(a) Analysis diagram **(b)** Plan arrangement

Figure 5.13: Independent Transitional Structural Frame Strategy Analysis

D. Core Extension

The fourth strategy focuses on extending the existing staircase cores. New access spaces are directly connected to the existing portiek system, and additional housing volumes are organized around these expanded vertical nodes (Figure 5.14). This strategy tests whether the existing access structure can be upgraded in its own logic. It offers a direct way to improve accessibility and connect new volumes to the existing buildings. However, because each portiek core serves only a limited number of dwellings, the system requires multiple separate interventions across the block. This reduces circulation efficiency and increases construction complexity. In addition, the close relationship between new volumes and existing facades can reduce openness, limit layout flexibility, and create privacy issues to current residents.

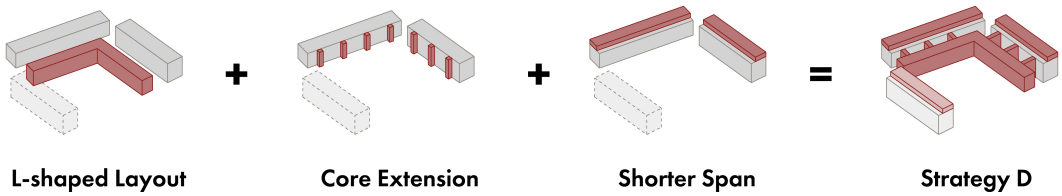
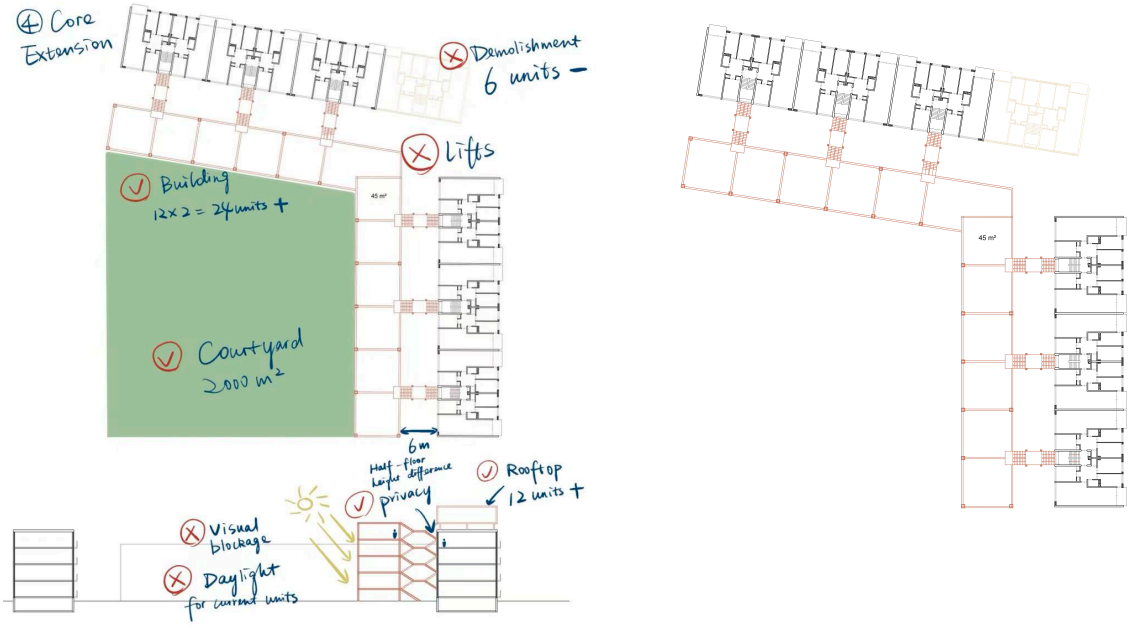


Figure 5.14: Prototypes combination diagram to form Strategy D. Core Extension



(a) Analysis diagram

(b) Plan arrangement

Figure 5.15: Core Extension Strategy Analysis

5.1.5 Comparative Reflection and Trade-off

To support a systematic comparison among the 4 strategies, an evaluation matrix with a consistent set of criteria is listed below:

Table 5.1: Evaluation Matrix of 4 Extreme Design Strategies

	Densification Capacity		Environmental Quality		Impact on Current Residents			Technical Feasibility	
	Units (Number)	Public Space (m^2)	Courtyard	Daylight	Visual Openness	Circulation (Lift)	Privacy	Keep Existing Layout	Phased Construction
Linear Circulation	60	400	++	+	++	+	- -	-	+
Central Tower	100	1450	- -	++	+	- -	+	++	++
Transitional Layer	28	140	++	- -	- -	++	+	+	++
Core Extension	30	640	++	-	- -	- -	+	++	++

From the matrix, it can be analyzed that:

The Central Tower strategy achieves the highest densification capacity, with the largest number of additional units and significant spatial intensity. However, this comes at the expense of courtyard quality and environmental performance, as indicated by strong negative impacts on daylight and visual openness of current units.

In contrast, the Linear Circulation strategy maintains a high level of courtyard quality, preserving openness and spatial continuity. It also introduces improvements in accessibility through added lifts. However, this strategy compromises privacy due to the gallery system and achieves only moderate densification compared to the tower approach.

The Independent Structural Frame (Transitional Layer) performs strongly in terms of technical feasibility and accessibility improvements, particularly through the introduction of lifts and phased construction potential. However, its contribution to densification is minimal, and it negatively affects daylight and visual openness due to the added structural mass.

The Core Extension strategy maintains the existing layout and allows for phased construction, but introduces significant spatial drawbacks, including reduced daylight and visual openness, as well as limited flexibility in new housing configurations. Its densification capacity remains relatively low, while requiring higher levels of intervention.

The matrix reveals that no single strategy performs well across all criteria. Instead, each option achieves strong performance in certain aspects while significantly compromising others. This indicates that the design problem is not defined by isolated weaknesses, but by a fundamental conflict between three core objectives:

- **Densification capacity** (increasing housing units and spatial intensity)
- **Courtyard and environmental quality** (daylight, openness, and usable collective space)
- **Impact on current residents** (preserving privacy, layout, and minimizing disruption)

These three objectives form a triangular relationship of mutual constraint. The matrix makes it evident that these three objectives cannot be maximized simultaneously.

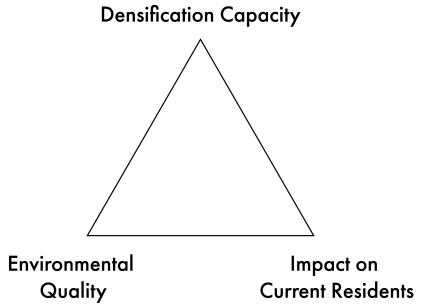


Figure 5.16: Triangular relationship between 3 core design objectives

This triangular trade-off also exposes the limitation of the initial functional separation between the three intervention layers. In the early framework, the courtyard layer was mainly assigned to public and collective functions, the rooftop layer to additional housing units, and the vertical layer to circulation and accessibility. While this separation provided a clear starting point, it proved too rigid during the design exploration (Figure 5.17):

- The transformation of the courtyard into a public domain does not directly improve the living conditions of existing residents. While new functions may increase activity, they do not necessarily address key residential qualities such as accessibility, privacy, or spatial comfort within the existing buildings.
- The feasibility of introducing public functions at this scale raises practical concerns. Public or semi-public programs require long-term operational support, including funding, management, and consistent usage. Without a sufficient financial support, such spaces risk becoming underused or unsustainable over time.
- Public functions alone cannot sustain themselves without a certain population density and stable user base. The introduction of additional housing units becomes necessary not only as a densification strategy, but also as a supporting mechanism to generate sufficient users and social vitality for the proposed collective spaces.



Figure 5.17: Limitations of the separation of 3 layers

The discussion of functional separation does not replace the triangular relationship, but extends it. While the triangular relationship focuses mainly on the impact on existing residents, the failure of rigid functional separation shows that new residents and public users must also be considered as active participants in the future block. Without a sufficient user base and everyday use, public and collective functions cannot be sustained.

Therefore, the conclusion from the comparative reflection is that the three layers cannot be treated as separate functional zones, since in reality, they support each other as part of an integrated system. The design challenge is no longer simply how to activate an underused courtyard or how to add new housing units, but how to coordinate multiple spatial interventions so that densification capacity, environmental quality, and the living conditions of existing residents can be negotiated together, while also creating a sufficient user base for new collective and public spaces.

This reflection shifts the process from singular extreme strategies toward a design-driven re-reading of the existing block. Although each strategy reveals useful spatial possibilities, none of them can be directly developed further because each also produces clear and significant drawbacks. Therefore, the following section returns to the block scale and examines the current site conditions to identify more promising points of further intervention.

5.2 Reframing the Building Block

Following the comparative reflection on the extreme design strategies, the design process returns to the block scale analysis. Rather than repeating the general site analysis, this re-reading examines the block through design-oriented questions, focusing on previously overlooked entry points for the design.

5.2.1 Site Characteristics and Potentials

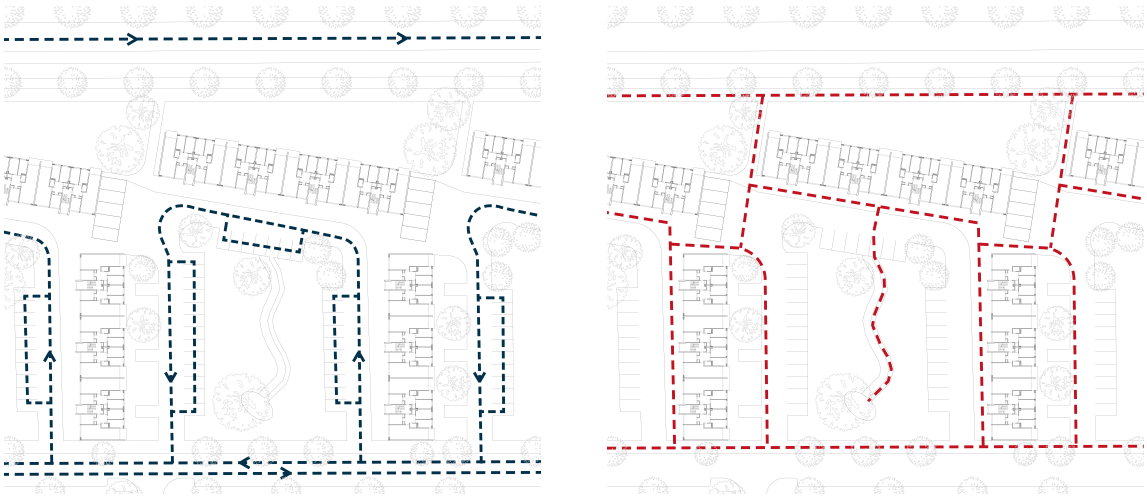
Circulation and Access

The vehicular circulation of the site is organized as a series of separate access systems. Each residential block has its own car access connected to the local access street, but these internal vehicular routes are not directly connected to the main road leading towards the ring road (Figure 5.18a). As a result, cars need to circulate through the local street network before reaching the main road. In addition, the vehicular routes and parking areas within each block are not connected to those of adjacent blocks, creating a relatively fragmented car circulation system.

Within each block, the vehicular routes and open-air parking spaces are positioned close to the buildings. However, the relationship between parking and residential entrances is uneven. Approximately one third of the parking spaces are located on the left side of the block, relatively far from the staircase entrances and therefore less convenient for daily access.

In contrast, pedestrian circulation shows a higher degree of permeability. Aside from the routes that overlap with car access, the unconnected corners of the L-shaped blocks allow pedestrians to pass through and move between adjacent blocks. Additional gaps between the longer wings also provide direct pedestrian connections from the internal block space towards the main road and the nearby bus stop (Figure 5.18b). This makes the pedestrian network more continuous than the vehicular system.

The entrances to the residential staircase cores are oriented towards the inner side of the L-shaped layout and face the courtyards. This entrance orientation reinforces the role of the courtyard as the primary shared space of each block. At the same time, it indicates that any future intervention should carefully consider the relationship between pedestrian movement, courtyard activation, and access to existing dwellings.



(a) Car Circulation Routes **(b)** Pedestrian Circulation Routes

Figure 5.18: Analysis diagrams of circulation routing in the block

Green Space and Open Area

The main green space within each block is enclosed on three sides by parking spaces and internal access routes. At present, this green space remains largely unused. In some areas, it contains simple or damaged outdoor furniture and informal paths, but these elements do not form a coherent landscape or support stable collective use. As a result, the courtyard functions more as residual green space than as an active communal environment.

In addition to the courtyard green space, the long wing facing the main road is bordered by a strip of lawn and mature trees. This green edge acts as a buffer between the residential building and the main road, reducing visual exposure and traffic noise. The trees also contribute to the spatial definition of the block entrance when viewed from the main road side (Figure 5.19).

Smaller pieces of greenery are distributed along the building edges, helping to organize the internal circulation and create distance between public routes and ground-floor dwellings, maintaining privacy and creating a softer transition between public movement and residential interiors.

This condition suggests that the green structure of the block is not uniform. It includes different types of open space: the courtyard as a potential collective core, the main-road-facing green strip as a protective buffer, and smaller residual green areas as privacy thresholds, as shown in Figure 5.19a. These different roles need to be distinguished in the following design development.



Figure 5.19: Photos of different green spaces in the building block



(a) Green Space Distribution **(b)** Sun Path Diagram

Figure 5.19: Analysis diagrams of green spaces and orientation in the block

Orientation and Environmental Performance

The block has a clear asymmetrical environmental condition. The entrance facades and the main courtyard spaces are oriented towards the southwest and therefore benefit from sufficient sunlight (Figure 5.19b). This is also reflected in the existing facade condition, where simple sun screens are installed on the entrance-side facades. The courtyard therefore has favorable conditions for outdoor use, collective activity, and potential spatial activation.

In contrast, the opposite facades, including the balconies of the dwellings, are oriented towards the northeast. These balconies receive limited direct sunlight during the day. Combined with the generally poor energy performance of the existing units mentioned before (Figure 4.11), this condition limits the environmental quality and everyday use value of the current balconies.

The orientation analysis therefore reveals a tension between the two sides of the building. The entrance side has better sunlight and stronger collective potential, while the balcony side is environmentally weaker but remains important for the living quality of the individual units. This asymmetry becomes an important consideration for later decisions concerning facade treatment, outdoor space, and the relationship between existing dwellings and new interventions.

Differences between the Short Wing and the Long Wing

Although each block is read as one repetitive L-shaped composition, the two wings of the block do not have the same spatial role. The short wing is approximately 45 meters long and 13 meters high, containing three staircase cores. Both the entrance side and balcony side face courtyard, while the windowless short end faces the local access street. Because of this position, the short wing operates more as an internal element within the residential blocks.

The long wing is approximately 60 meters long and 10 meters high, containing three staircase cores. Its entrance side faces the internal courtyard, while its balcony side faces the green buffer and main road. This gives the long wing a more transitional role. It is not only part of the courtyard enclosure, but also forms the boundary between the residential block and the main road.

The two wings are also not strictly perpendicular. The angle between them is approximately 100 degrees, creating an approximately 12 meters spatial offset between the two adjacent long wings. From the main road side, this displacement strengthens the perception of the entrance and gives the block a more recognizable spatial threshold.

The different roles between the short and long wings suggests that the block should not be treated as a completely uniform structure, since the two wings have different relationships with the courtyard, the main road, pedestrian movement, and environmental exposure. These differences help guide the following design strategy and interventions.

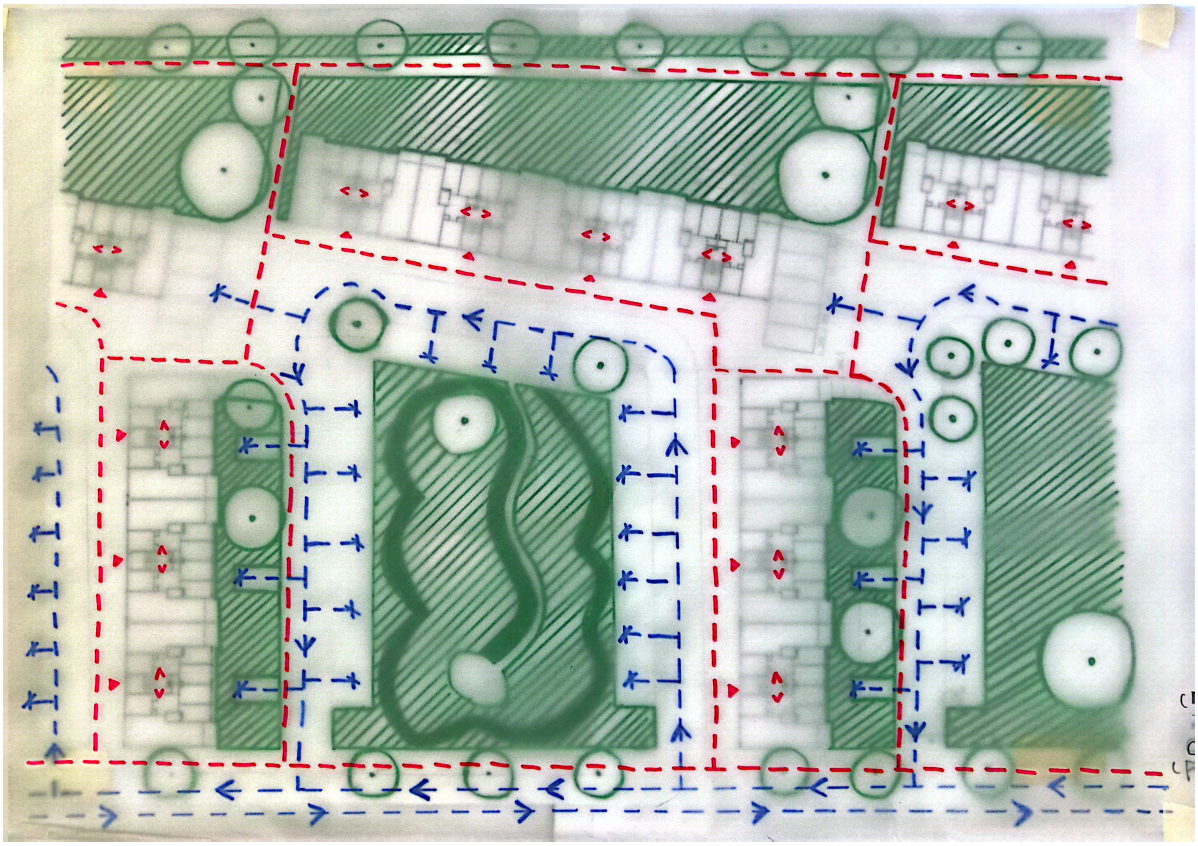


Figure 5.20: General block-scale study on tracing paper

5.2.2 Design Principles from Site Potentials

Based on the comparative evaluation of the extreme design strategies and the design-driven re-reading of the building block, a set of site-specific and differentiated design principles was established to guide the next stage of the proposal.

I. Preserve the Courtyard as an Open Collective Space

The courtyard should remain as the collective open space of the block, since high density in the courtyard and fragmented open spaces can significantly compromise openness, daylight, and visual comfort for the residents. Therefore, the courtyard should not be treated simply as available land for construction. Instead, its existing spatial capacity should be used to transform the underused green area into a more active collective landscape. The design should preserve the openness of the courtyard while introducing usable outdoor areas and collective functions that support everyday life.

II. Separate Car Parking from Public and Collective Open Space

The current block is strongly affected by car circulation and parking, which occupy important edges of the courtyard and weaken its potential as a shared environment. At the same time, the pedestrian network already shows a higher degree of permeability than the vehicular system. The design should therefore reduce the dominance of cars within the courtyard and strengthen pedestrian continuity.

New construction within the courtyard can play a role in separating parking areas from public and collective open space, creating a clearer distinction between car circulation and communal use spaces. In this way, the courtyard can also shift from a residual space into a more structured and accessible collective landscape.

III. Improve Accessibility without Replacing Existing Cores

The existing portiekflat buildings are characterized by fragmented vertical access, with each staircase core serving only 2 dwellings on each floor. The comparison of the gallery and core-extension strategies shows that accessibility cannot be solved by simply replacing all existing cores or by adding a continuous public corridor along the facade. The design should improve accessibility by adding lifts and shared vertical nodes where they are most effective, while keeping the existing staircase cores and dwelling layouts as much as possible. This approach reduces construction disruption, preserves the existing residential structure, and allows accessibility upgrades to be integrated more selectively.

IV. Respond Differently to the Short Wing and the Long Wing

The two wings in the building block have different spatial qualities and roles. The short wing is more internally oriented between two courtyards, while the long wing forms a boundary between the courtyard and the main road. The design should therefore avoid treating both wings as identical. Interventions on the short wing should respond to its internal courtyard condition, while interventions on the long wing should address its boundary role, its relationship to the main road, and its potential to define the entrance and edge of the block.

V. Use Orientation to Guide the Improvement of Existing Dwellings

The existing residential quality is uneven, partly due to orientation-related differences in daylight access and living comfort. The entrance and courtyard side faces southwest and benefits from better sunlight, while the balcony side faces northeast and receives limited direct sunlight. This condition should guide the placement and character of future interventions.

The design should take advantage of the sunny courtyard side for collective activity and open-space activation, while also addressing the weaker environmental performance on the balcony side. Orientation should become a basis for deciding where to intensify public use, where to protect privacy, and where to improve the relationship between interior living spaces and outdoor areas.

Together, these principles transform the design approach from a singular formal strategy into a more differentiated and negotiated system, where multiple interdependent conditions inform the final hybrid design strategy.

5.2.3 Initial Design Development

Based on the block-scale analysis, the transformation strategy shifts its focus from an overall regulation of the six blocks to the development of a repeatable block-scale intervention. At present, every courtyard contains comparable elements such as parking areas, pedestrian access, and green spaces. Therefore, the repetition of the block layout becomes not only a problem to be improved, but also a basis for developing a design strategy that can be tested, adapted and potentially repeated.

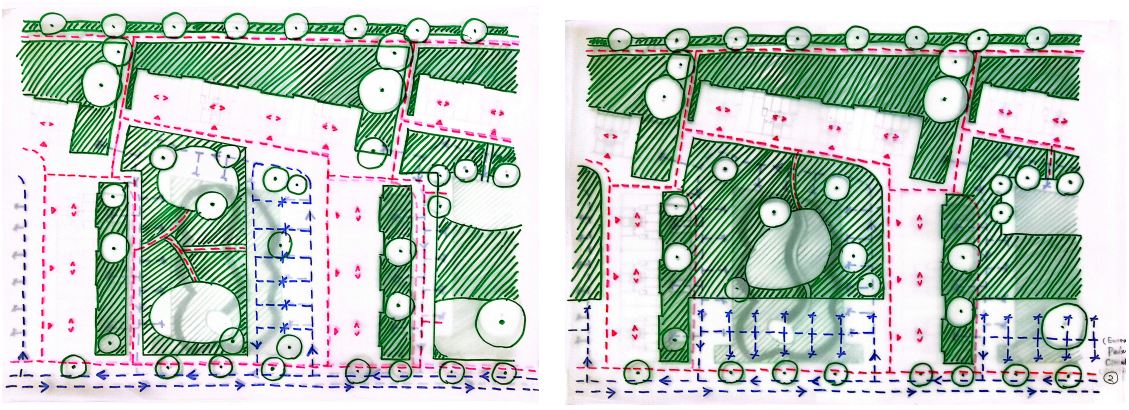
A larger-scale redistribution strategy, such as concentrating all car parking in one courtyard and placing communal activities in another, was considered less appropriate for this project. Although such a strategy could create clearer functional zoning at the neighborhood scale, it would also introduce new inequalities between residents. Some blocks would gain direct access to public or communal facilities, while others would mainly carry the burden of parking, traffic or service functions. In this sense, the intervention would not necessarily provide more choices and opportunities for all residents, but create uneven benefits and potential conflicts between blocks.

For this reason, the following draft design development focuses on how one representative block can be transformed from within. Several design options are tested at block scale, exploring different relationships between circulation, new construction and the existing residential buildings.

Car Circulation Design Options

The first step of the draft design development focuses on the reorganization of car circulation within the courtyard. Before introducing new buildings or public programs, the aim is to test how the underused central green space can be liberated by adjusting the position of vehicular routes and parking areas. In this way, car circulation becomes the first layer of spatial transformation, defining the basic relationship between parking, pedestrian movement, communal space and the existing residential buildings.

The first option divides the courtyard into two parts. Car circulation and parking are concentrated on the right side of the block, where the existing residential entrances are located. This maintains a relatively direct connection between parking spaces and building access. Meanwhile, the left side of the courtyard, which is closer to the balcony façades, is transformed into a greener and pedestrian-friendly area. By reducing car movement on this side, the green space can act as a buffer zone for the residential units, improving privacy, reducing disturbance and enhancing the overall living quality.



(a) Option 1 **(b)** Option 2

Figure 5.21: Car circulation rearrangement options

The second option places car circulation and parking along the side of the local access street. As a result, the internal part of the courtyard can be arranged as a more pedestrian-friendly space for communal activities. Compared with the first option, this strategy creates a more introverted courtyard condition, where the residential buildings and the parking edge together form a clearer spatial boundary. The courtyard is therefore strengthened as an inner communal space, with car access kept closer to the external street condition.

These two options show that the position of car circulation can directly influence the character of the courtyard. While the first option balances parking convenience with a greener residential buffer, the second option creates a stronger separation between vehicular access and communal courtyard life.

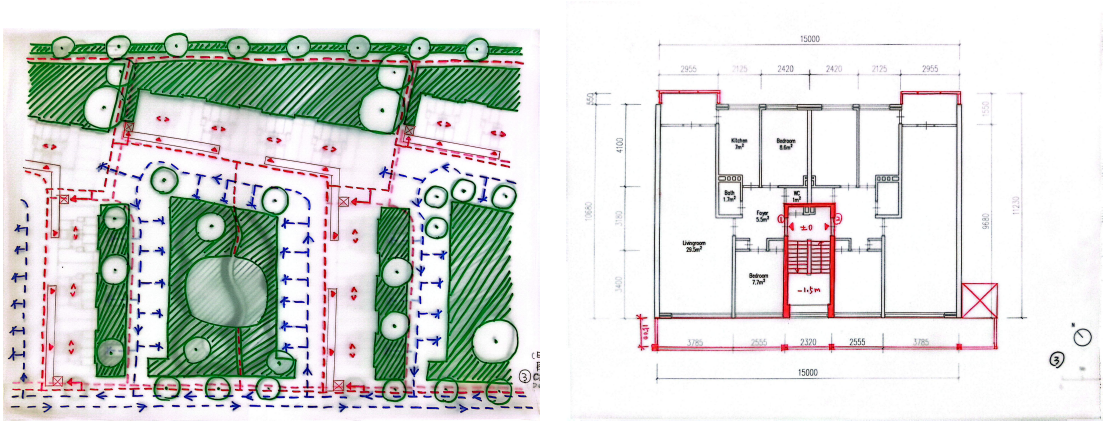
However, both options remain limited to circulation adjustment and do not yet fully address the potential of densification or new public programs within the block.

Pedestrian Circulation Design Options

The second step of the draft design development keeps the car circulation and courtyard layout largely untouched and focuses on the potential reorganization of pedestrian circulation. This study includes both the movement between different blocks and the way residents enter the existing buildings. Therefore, this part is not only about the ground-level circulation in the courtyard, but also about the possible transformation of the existing residential buildings and their access systems.

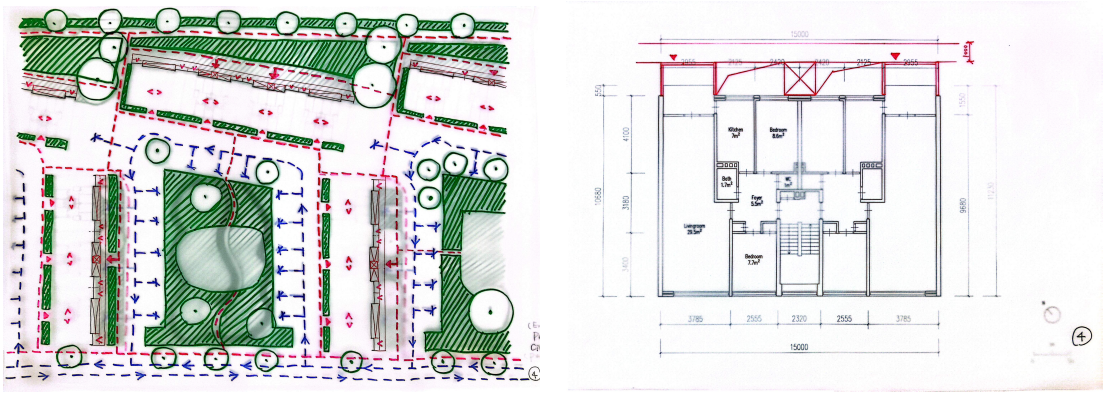
The first option adds shared lifts and galleries to the existing entrance facade. This option follows the original access logic of the portiekflat, where the main entrances are already concentrated on one side of the building. However, the galleries cannot extend along the full length of the building, as the earlier analysis showed that long continuous galleries would negatively affect residential privacy. A shorter gallery system was therefore tested as a more limited intervention.

Nevertheless, the 3D study shows that this option is difficult to integrate with the existing facade. Because of the existing floor levels and window positions, the new galleries would overlap with the residential windows rather than align properly with the entrance level. In addition, as discussed in the early design exploration, adding external circulation structures to the existing entrance façade would reduce daylight, block views and disturb the original spatial quality of the portiekflat. For these reasons, the entrance-side gallery option is not developed further.



(a) Pedestrian circulation rearrangement 1 **(b)** Changes on unit scale

Figure 5.22: Pedestrian circulation option 1



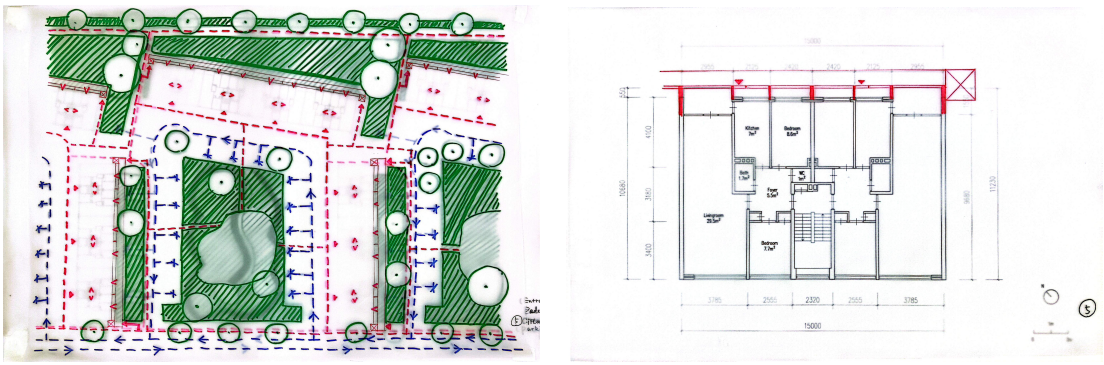
(a) Pedestrian circulation rearrangement 2 **(b)** Changes on unit scale

Figure 5.23: Pedestrian circulation option 2

The second option therefore starts to explore the possibility of introducing a secondary entrance system on the balcony side of the existing buildings. Compared with the entrance facade, this side is less critical for the existing access structure and has fewer conflicts with the original portiek logic. By shifting

the new access system to the balcony side, the impact on daylight, views and the existing entrance condition can be reduced. The main design challenge then becomes how the existing balconies can be transformed into a new entrance layer.

Options 2 and 3 are both based on this logic of introducing a secondary entrance system for the existing units. The difference between them lies in how the balcony zone is transformed and connected to the new circulation structure, as shown in Figure 5.23. Through these options, the balcony side is no longer treated only as a private outdoor space, but begins to operate as an intermediate layer between the existing units and the shared lift system.



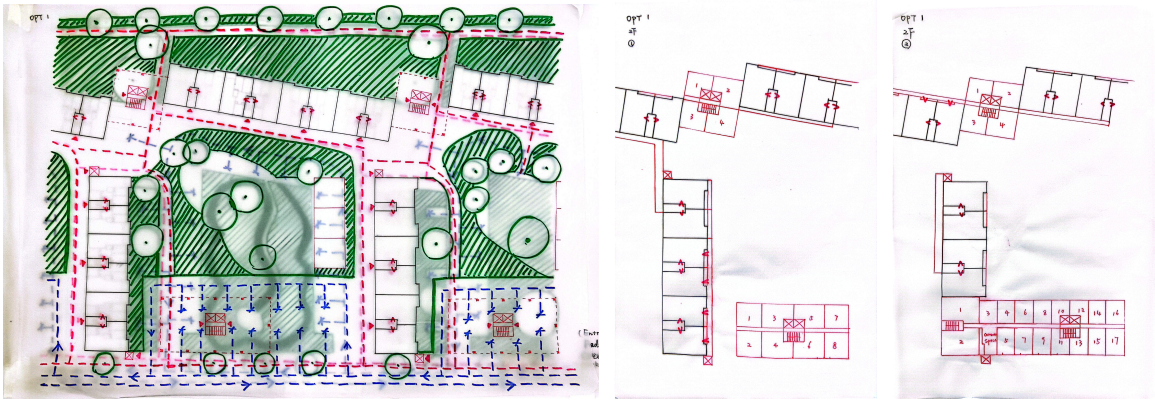
(a) Pedestrian circulation rearrangement 3 **(b)** Changes on unit scale

Figure 5.24: Pedestrian circulation option 3

These options show that the balcony side offers more potential for a new access system than the existing entrance façade. It allows the intervention to improve accessibility while preserving the main entrance condition, daylight quality and typological advantages of the original portiekflat.

Block-Scale Design Options

Based on the circulation studies in the previous sections, several comprehensive block-scale design options were developed. These options combine the reorganization of car circulation, pedestrian access, new housing volumes, shared lift systems and the possible transformation of the existing buildings. They are not treated as final proposals, but as design tests that help to clarify the spatial, technical and social consequences of different intervention strategies. Several architectural references were used at this stage as design prompts rather than direct models.



(a) General G/F plan **(b)** Independent new building **(c)** Intersected with existing

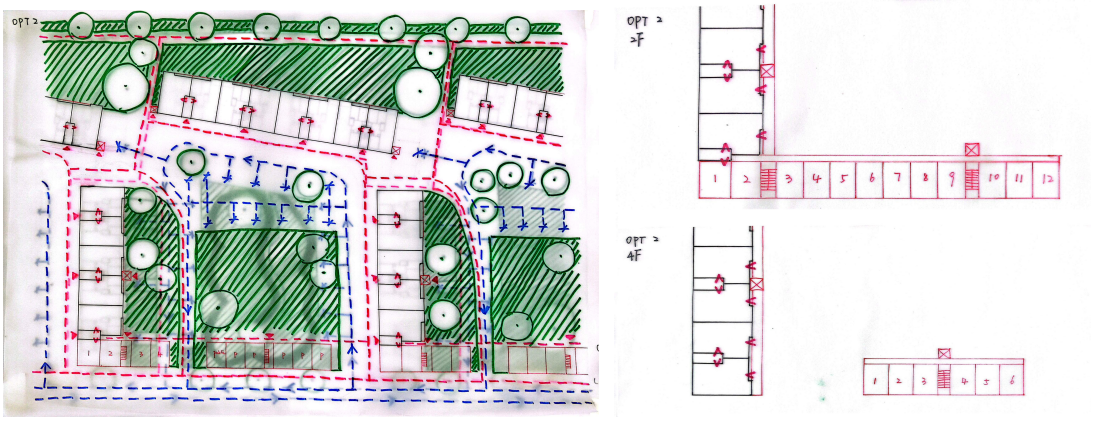
Figure 5.25: Block design proposal 1

Option 1 places car circulation and parking along the side of the local access street. The new housing volume is then arranged above this parking strip, forming a slab building with a lifted ground floor. This strategy keeps vehicular movement close to the street and attempts to liberate the inner courtyard for more pedestrian and communal use. The new slab building is organized with a central lift core and corridor, with housing units arranged on both sides. Between the two long wings of the existing block, a more compact square volume is inserted to connect the buildings and provide a shared lift system.

This option also follows the earlier idea of avoiding full-span galleries on the existing buildings. Instead of adding one continuous gallery along the entire façade, shorter gallery segments are tested in order to reduce the impact on residential privacy. However, the study also reveals a major limitation. As discussed in the pedestrian circulation options, galleries cannot be properly added to the existing entrance facade because of the conflict with floor levels and window positions. Therefore, the gallery shown on the entrance side in this option is not technically and spatially convincing. The balcony-side access has more potential, but it also requires a careful transformation of the existing balcony zone. In addition, the new building can either remain fully free-standing or intersect with the existing building. The second approach would allow the new and existing buildings to share a staircase or lift core, but it would also require partial demolition or significant transformation of the existing structure.

Option 2 keeps most of the existing car circulation structure and concentrates the parking spaces further away from the local access street. The new slab building is still placed along the edge of the block, where it forms a clearer boundary between the courtyard and the street. In this option, however, the ground floor is no longer used as pilotis or parking space. Instead, it is developed as a layer of public and communal functions, while the parking remains open-air within the courtyard.

This shift was influenced by the idea that densification can also create a more active collective edge. The 81 Housing Units project provides a reference for how a residential block can mediate between public space, shared outdoor areas, and private dwellings through massing variation and semi-outdoor spaces (Figure 5.27). In this option, the new slab building is therefore tested as both a housing addition and a programmatic boundary that can activate the edge of the courtyard.



(a) General G/F plan **(b)** 2F and 4F floor plan arrangements

Figure 5.26: Block design proposal 2

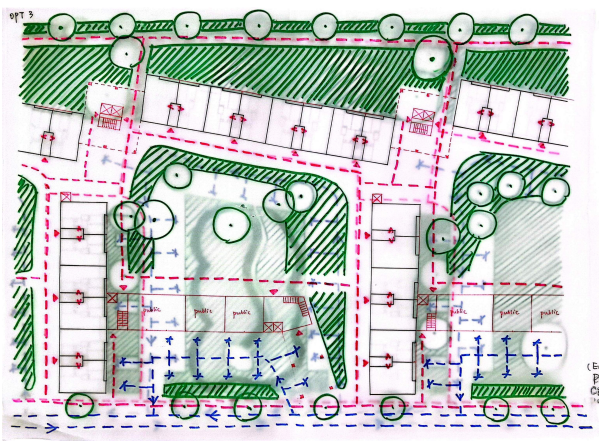


Figure 5.27: Photos of 81 Housing Units project show the ground floor arrangements (Al Koshta, 2026)

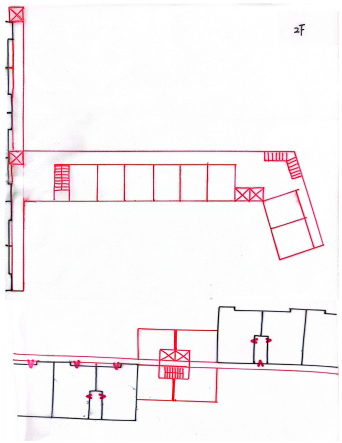
Compared with Option 1, this proposal gives more importance to the programmatic activation of the ground floor. The slab building becomes not only a housing addition, but also a spatial edge that supports communal activities. This option also tests a stronger integration between the new and existing

buildings through partial transformation of the existing structure. The long gallery building is connected to the existing block, and part of the existing building may need to be modified in order to create shared access and circulation. At the same time, the option explores a stepped building profile, where one part of the new volume rises to around five floors while the other part remains lower, around two to three floors. This creates a more varied massing strategy, but also increases the complexity of structure, circulation and daylight control.

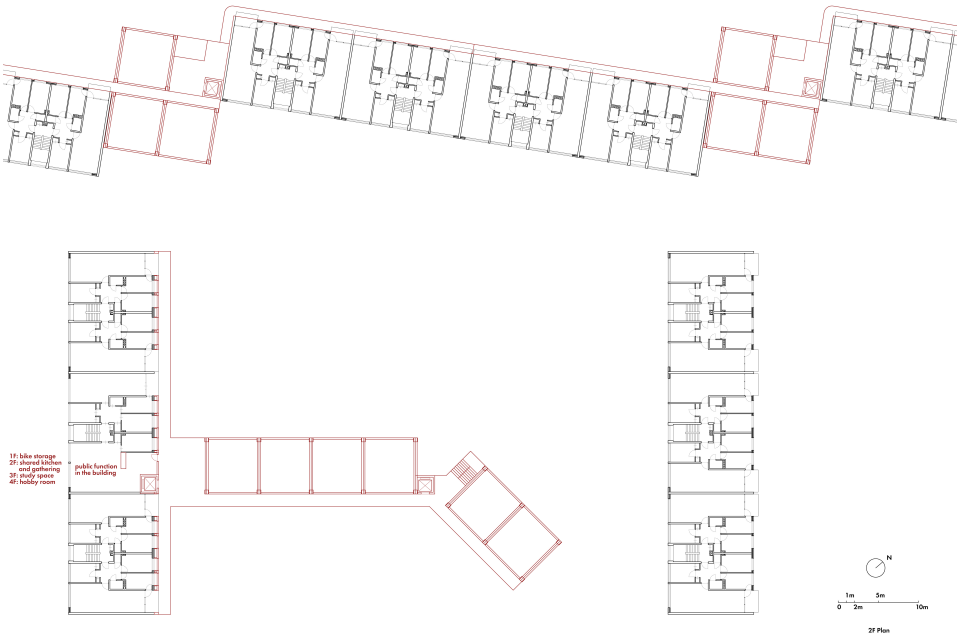
Option 3 learns from the limitations of the previous two options. It adopts the idea of using the new construction itself to divide the courtyard into two clearer zones: a car circulation zone and a pedestrian-oriented courtyard space. Instead of placing the new slab as a simple linear boundary, the building turns at an angle to form a more defined entrance towards the inner courtyard. This angled configuration creates a pedestrian gateway and helps to guide movement from the street side into the communal courtyard behind.



(a) General G/F plan



(b) 2F floor plan arrangements



(c) 2F Plan development of Option 3

Figure 5.28: Block design proposal 3

In this option, the new building shares a lift system with the short wing of the existing building. This strengthens the connection between the new intervention and the existing residential structure, while avoiding the need for a continuous gallery along the entrance facade. However, the angled turn also creates a less regular structural grid, which makes the proposal more complex in terms of construction and modular coordination. The compact building inserted between the long wings follows the logic of the first option, providing an additional shared lift and connection point between the existing buildings.

In a later iteration, the angled volume was replaced by an open framework intended to accommodate a public function for the community. This idea was partly informed by open structural references such as the Münchwilen school proposal (Figure 5.30), where a lightweight timber framework defines a sheltered collective space and creates a permeable threshold between building and landscape (Figure 5.29). In the block-scale test, this strategy created a more open entrance condition and introduced a clearer collective ambition at ground level. However, the spatial result was not fully convincing. The framework appeared more as an independent object than as an integrated component of the block. Its relationship with the existing buildings, the new housing volume, and the courtyard circulation remained unclear. It also risked competing with the main residential additions instead of strengthening the overall block structure. For this reason, the open framework was not developed further in the final proposal. Instead, the final design uses ground-floor arrangement, paving, planting, and small enclosed public functions to organize movement and collective use in a more continuous way.

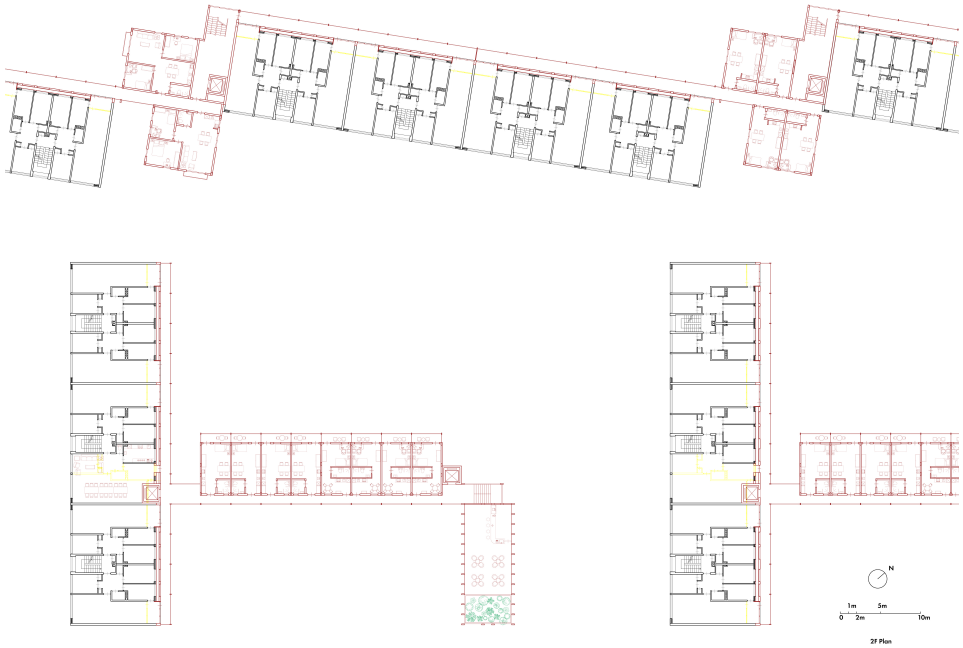


Figure 5.29: 2F plan arrangement shows the open framework structure in the courtyard



Figure 5.30: Photos of Münchwilen school show timber construction and spatial qualities (BETA Architecture, 2018)

Together, these three options show a gradual shift in the design development. The first option focuses on lifting housing above parking and testing shorter access galleries. The second option emphasizes the activation of the ground floor and the integration between new and existing structures. The third option combines these lessons by using the new building as both a spatial boundary and a circulation device. These studies provide the basis for the final design proposal, where the most effective elements are further refined and combined.

5.3 Final Design Proposal

The final proposal takes Option 3 from the previous section as its starting point, but further develops it into a more differentiated block-scale strategy. Rather than applying one identical intervention to the whole site, the design responds to the specific conditions of the short wing, the long wing, the courtyard and the existing residential facades.

The strategy is structured through three main operations: rooftop extension, courtyard-edge slab insertion beside the short wings, and mid-rise tower insertion between the long wings. Together, these interventions translate the principles developed in the pre-design research into a negotiated design system, increasing housing capacity while balancing spatial quality, accessibility, resident continuity, and construction feasibility.

5.3.1 Modularity as the Basis for New Additions

The existing portiekflat blocks are based on a repetitive modular structure, and this modular logic is continued in the new constructions. Instead of introducing an unrelated building system, the new units follow the rhythm and dimensional logic of the existing housing blocks. This allows the proposal to remain compatible with the existing fabric while enabling new housing types to be added.

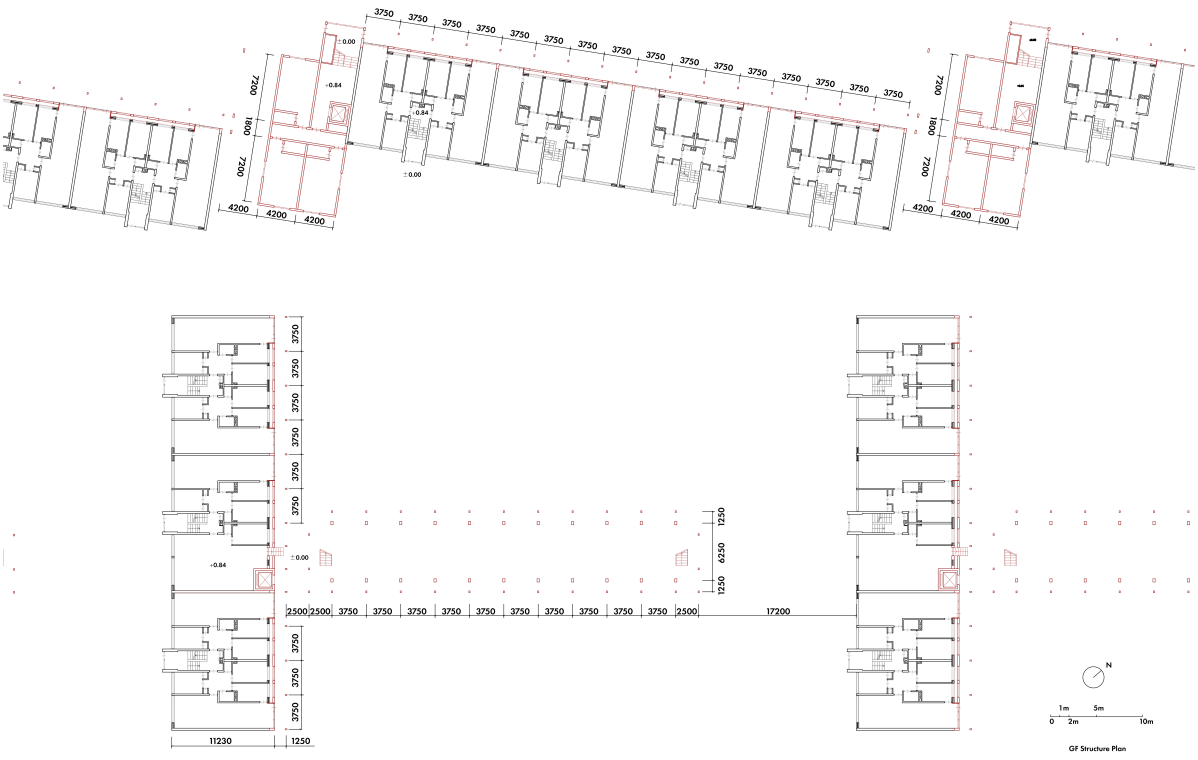


Figure 5.31: New construction structures with dimensions

The new slab building is organized based on 1.25 m. Its main structural grid is 3.75 m × 6.25 m, with 1.25 m-deep balconies and galleries. The overall slab contains 10 bays in the 3.75 m direction, resulting in a length of approximately 45 meters with staircase and connection gallery to the lift. This dimension

allows the new volume to align with the existing modular rhythm while maintaining sufficient distance from the surrounding buildings.

At the same time, the new housing types differ from the original dwellings. The existing units are mainly family-oriented apartments, while the new additions provide smaller and more diverse units, including studios and one-bedroom apartments. In this way, densification is not only a quantitative increase in housing numbers, but also a qualitative diversification of the housing mix.

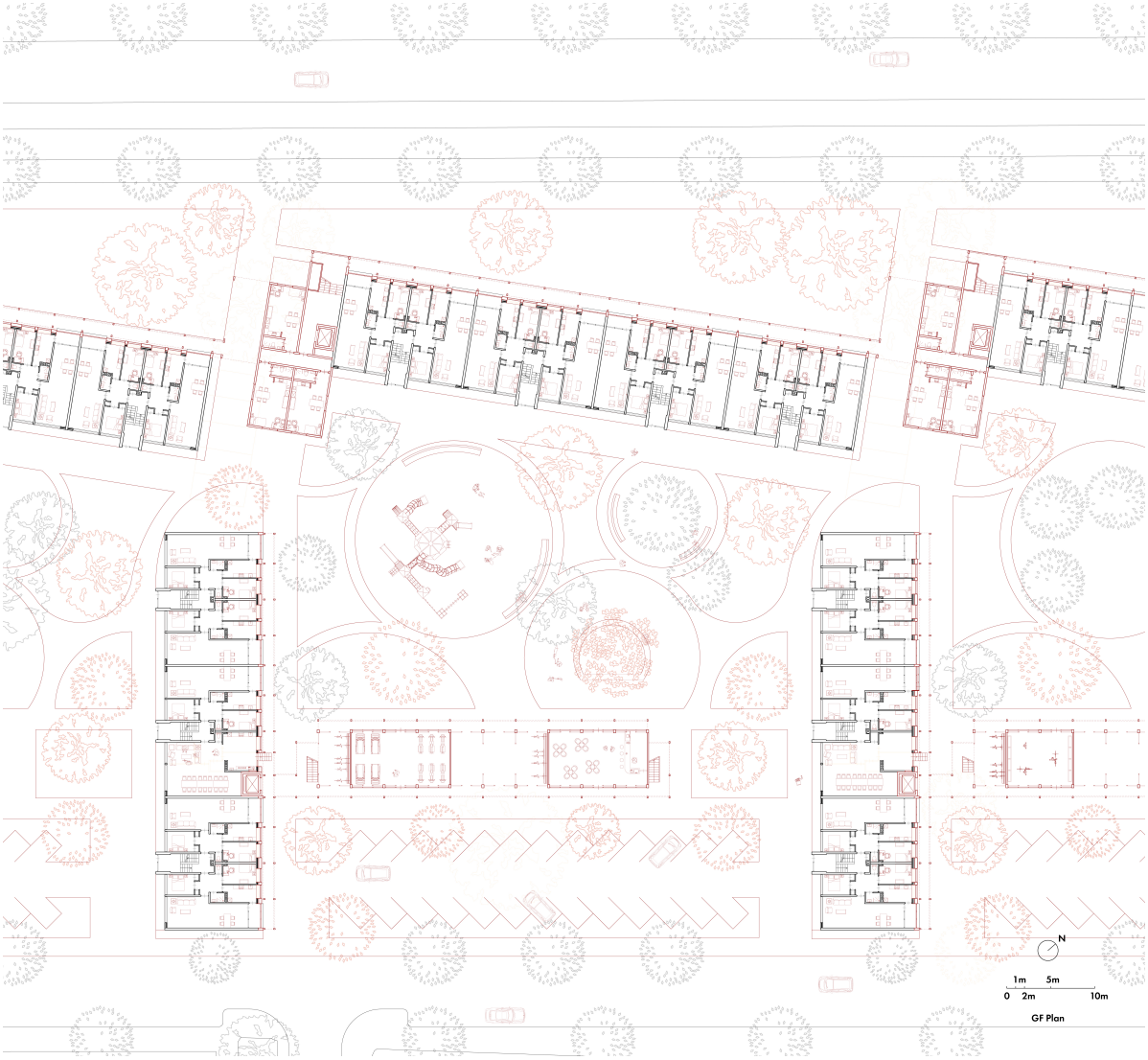


Figure 5.32: Ground Floor Plan

5.3.2 Shared Accessibility and Secondary Circulation

A central aim of the design is to improve accessibility for both existing and new dwellings. The existing staircase cores are retained, but their dimensions do not allow lifts to be inserted internally. Adding an individual lift to every staircase core would also be spatially and economically inefficient. Therefore, the proposal introduces shared lifts that can serve both the existing and new housing units.

The design avoids using long continuous galleries, because they would create privacy problems. Instead, lifts are positioned at strategic intermediate points, so that the length of gallery can be reduced. This allows more residents to share vertical access without a continuous external corridor.

In the short wing, the introduction of shared lifts is combined with a selective adaptation of the existing building. One existing unit is transformed into a shared access space and lift hall, creating a vertical node that connects the new and existing circulation systems (Figure 5.33). This intervention also intro-

duces a sequence of collective functions distributed across the floors: shared kitchens and gathering spaces on the first and second floor, a study space on the third floor, and a hobby room on the fourth floor. In this way, the accessibility upgrade is not treated as a purely technical addition, but as an opportunity to insert shared facilities into the existing residential structure.

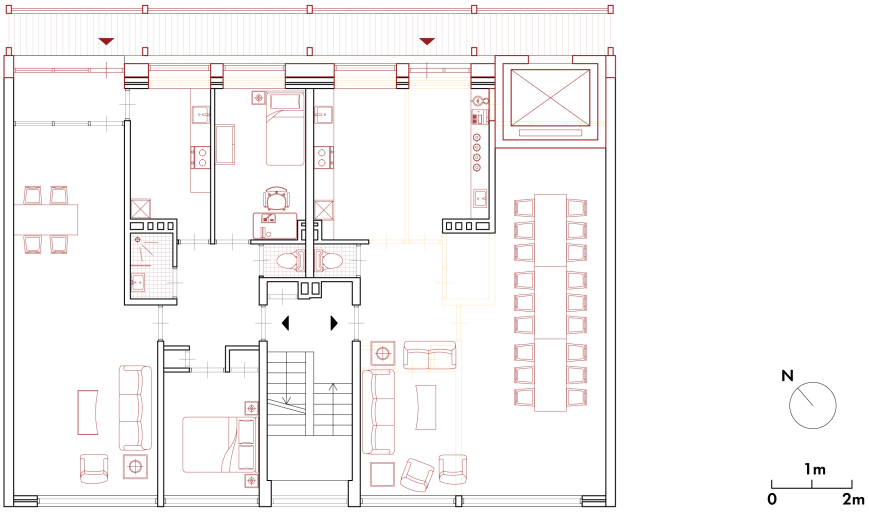


Figure 5.33: Housing unit changes into lift and public space

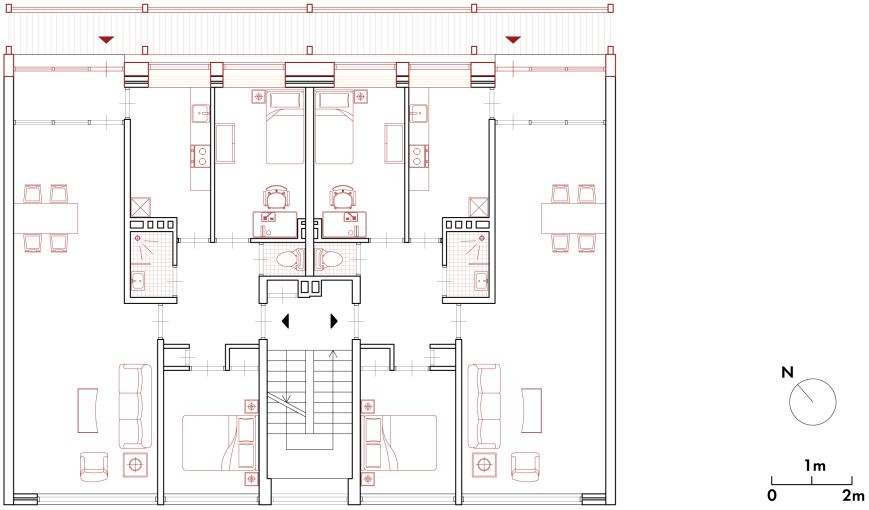


Figure 5.34: Existing units enclose the balcony and introduce secondary entrance

The original entrance facade is kept largely unchanged. As shown in the earlier design explorations, adding external lifts and galleries to this side would negatively affect daylight, views, and the existing access condition, thereby reducing the residential quality of the current units. The new circulation is therefore placed on the balcony side, creating a secondary entrance system for the existing dwellings (Figure 5.34). This allows the existing balconies to be enclosed and transformed into buffer zones that also function as secondary entrance spaces. This strategy recalls the precedent logic discussed earlier, especially the use of added spatial layers to upgrade existing housing without full replacement. Similar

to the winter garden strategy in the transformation of 530 dwellings (Figure 3.18), the new balcony-side layer is not only a circulation device, but also a buffer space that improves privacy, thermal performance, and the relationship between the existing dwelling and the new collective access system.

Table 5.2: Thermal resistance of existing and added facade layers

Layer	Position	Thickness	Rc value
Pre-fab Concrete Slab	Existing	140 mm	0.08
Cavity	Existing	50 mm	0.18
Pre-fab Brick Facade Component	Existing	100 mm	0.13
OSB (Sheathing Board)	New	15 mm	0.12
Mineral Wool Thermal Insulation	New	250 mm	7.14
Fiberboard (Sheathing Board)	New	15 mm	0.30
Ventilated Cavity	New	40 mm	0.00
Accoya Cladding	New	20 mm	0.15

The existing facade consists of a 140 mm prefabricated concrete inner leaf, a 50 mm cavity with galvanized steel connectors, and a 100 mm prefabricated brick outer leaf. On the balcony side, a new external insulation layer and Accoya timber cladding are added as part of the transformation. This intervention improves the thermal performance of the facade while giving the secondary access side a more coherent architectural expression.

According to the Dutch Bbl, a new-built residential facade or major renovation requires a minimum Rc Value of 5.7 m^2K/W. As shown in Table 5.2, the existing façade has an Rc value of approximately 0.4 m^2K/W. The added insulation system increases the Rc value by approximately 7.7 m^2K/W, which is higher than the required additional Rc value of 5.7 m^2K/W. The retrofit significantly improves the insulating performance of the existing facade and effectively enhances indoor thermal comfort. Detailed construction drawings of this upgraded facade and balcony conversion are presented in the following detail drawing (Figure 5.35).

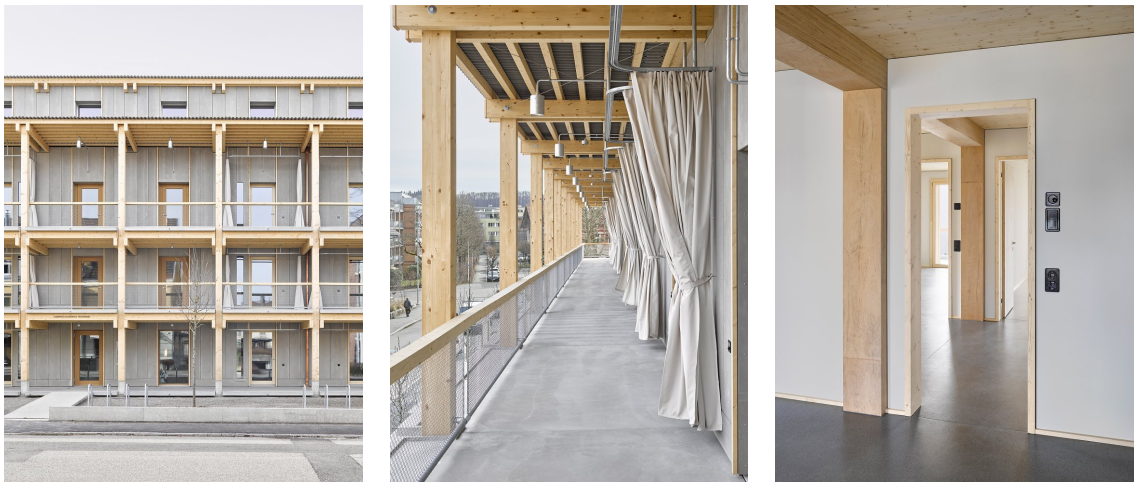


Figure 5.36: Laubenhaus apartments photos show the timber structures (SUBTILITAS, 2024)

The new galleries are designed as lightweight timber structures with dry mechanical connections, taking reference from Laubenhaus apartments studied in the design process (SUBTILITAS, 2024). Instead of being treated as a heavy extension of the existing building, the gallery is added as an independent structural layer. Timber columns, beams, and deck elements define the circulation space, while bolted or mechanically fixed joints allow efficient assembly and reduce disruption to current structure can be learnt (Figure 5.36). This construction approach supports the broader strategy of incremental densification: accessibility is improved through an added layer that remains structurally clear, lightweight, and potentially adaptable over time.

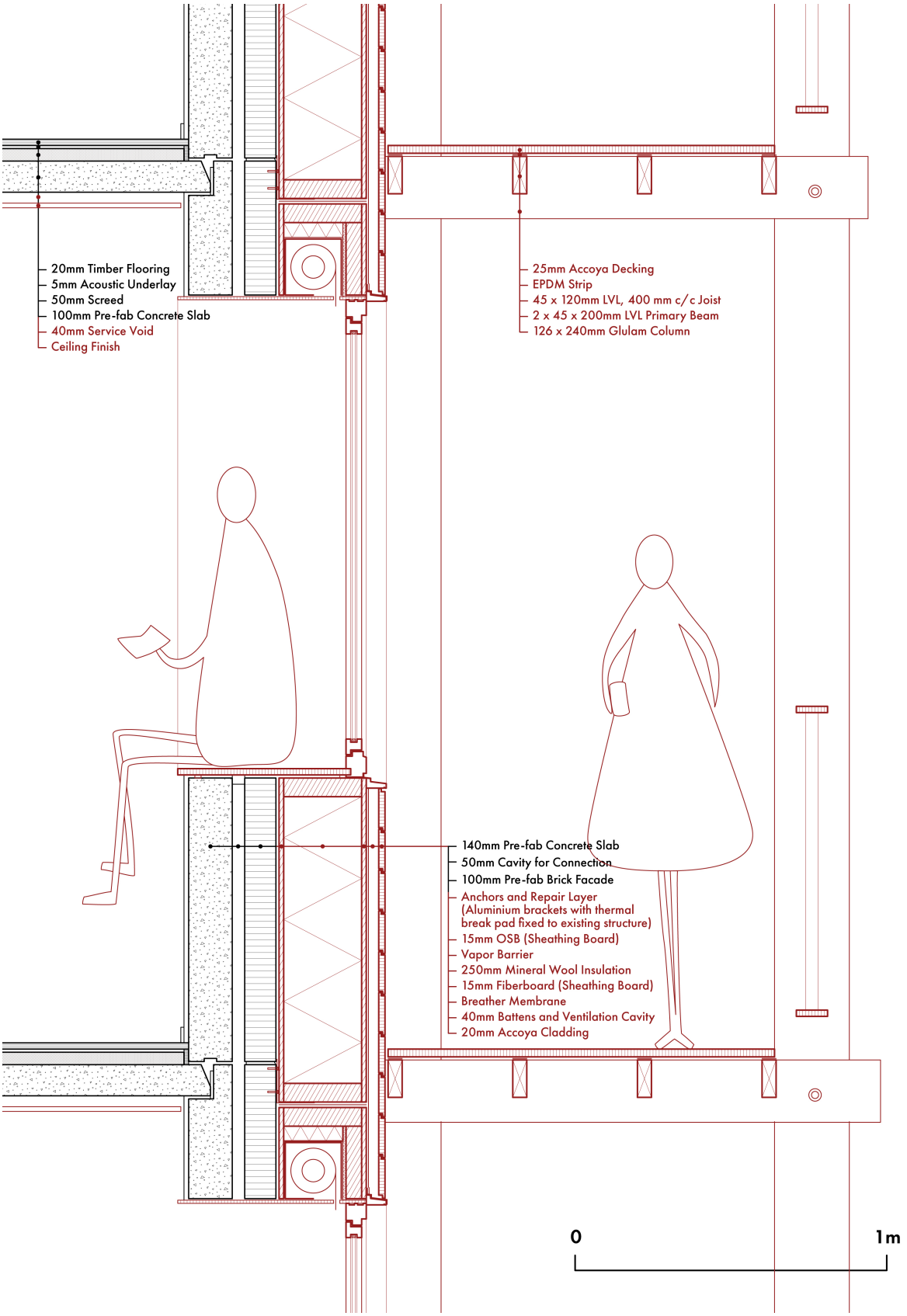


Figure 5.35: Detail construction of additional insulation layer and Accoya cladding on balcony-side facade

The existing staircase cores are retained and continue to function as the primary escape routes for the existing dwellings. The new lifts and galleries are therefore introduced as an additional layer for daily accessibility, rather than as a replacement of the existing escape system. The new slab buildings, towers, and rooftop extensions are designed with their own compliant escape routes, allowing the accessibility upgrade to remain independent from the basic fire safety logic of the existing blocks.

5.3.3 Short Wing Strategy: Courtyard Slab Building

The short wing is connected to the new courtyard slab building. This strategy responds to the wider courtyard condition and the need to separate vehicular space from the collective courtyard. The slab building is positioned between the parking area and the inner courtyard, acting both as a residential volume and as a spatial boundary.

On the side closer to the local access street, car parking and vehicular circulation are reorganized. Behind the slab building, the inner courtyard becomes a car-free collective landscape. This improves the comfort and usability of the courtyard and reduces the dominance of cars within the block. The slab building therefore does not only add dwellings; it also restructures the relationship between access, parking, and open space.

The slab building also responds to an orientation trade-off. Although the more sun-exposed facade faces the parking area, the balconies are placed on the courtyard side to benefit from a quieter environment, better privacy, and a closer relationship with the collective open space, while the gallery circulation is placed on the parking side.

The ground floor of the slab building is lifted on pilotis to keep the courtyard edge visually and physically permeable. This allows pedestrians to move from the parking side into the inner courtyard, while avoiding a closed building edge that would separate the two spaces. The ground floor therefore acts as a threshold between parking, pedestrian movement, and the collective courtyard.

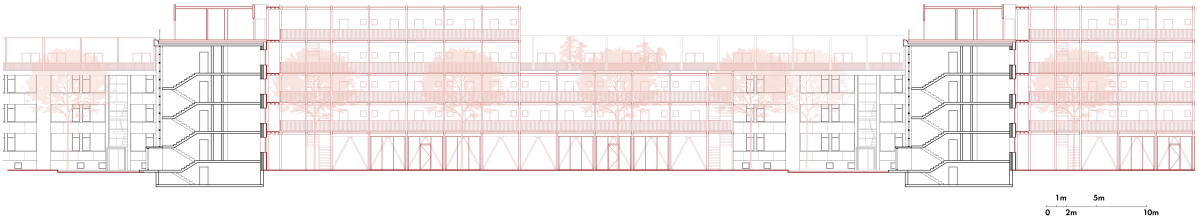


Figure 5.37: Elevation of the slab building in the courtyard shows the relationship between existing and new buildings

To maintain structural stability without losing this openness, the pilotis level is selectively reinforced with bracing bays. These structural elements are combined with several enclosed ground-floor spaces for community-oriented uses, such as a fitness room, café, bike repair station, or flexible activity room. The spaces are intended to serve both residents and the wider neighborhood, and can be managed at the neighborhood level (Figure 5.32).

In this way, the slab building follows the local lesson drawn from the Waaggebouw in Woensel West: densification becomes more meaningful when new housing is combined with collective and communal functions. The ground floor mainly operates during regular daytime hours, but can also support weekend events and community activities. Therefore, it contributes to courtyard activation while creating small-scale local employment opportunities.

The massing of the slab building is differentiated. The 5 bays closer to the shared lift are developed as a 5-storey volume, aligning with the height of the existing building after rooftop extension. The remaining five bays are limited to 3 storeys and finished with a green roof. The stepped profile is used to reduce the perceived mass of the new volume in relation to the adjacent dwellings. On the entrance side, the lower and more open configuration maintains visual permeability and allows the right-side existing residents to remain visually connected to the courtyard. Meanwhile, the green roof surface improves the view from the upper floors, replacing the image of a hard roof with a softer planted landscape.

The lower residential floors follow the existing 2.9 m floor height and mainly contain one-bay studio units. The fourth and fifth floors have a higher floor height of approximately 3.3 m and contain larger two-bay apartment units (Figure 5.38). This creates a more varied residential section while maintaining the overall modular logic of the design.

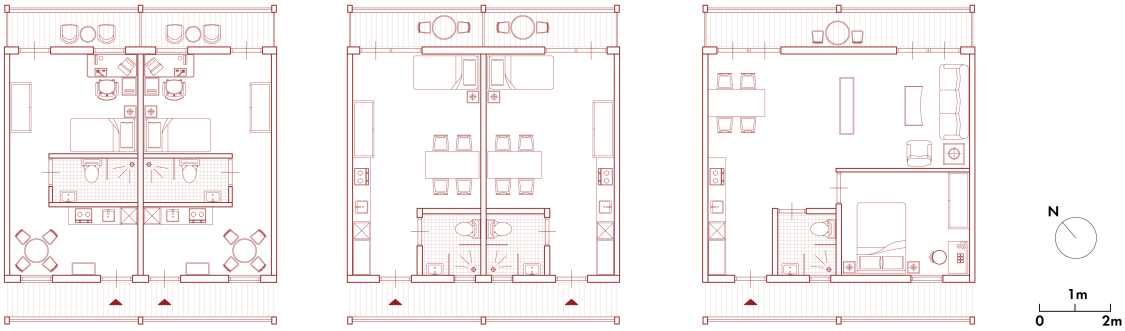


Figure 5.38: Unit types in the slab building

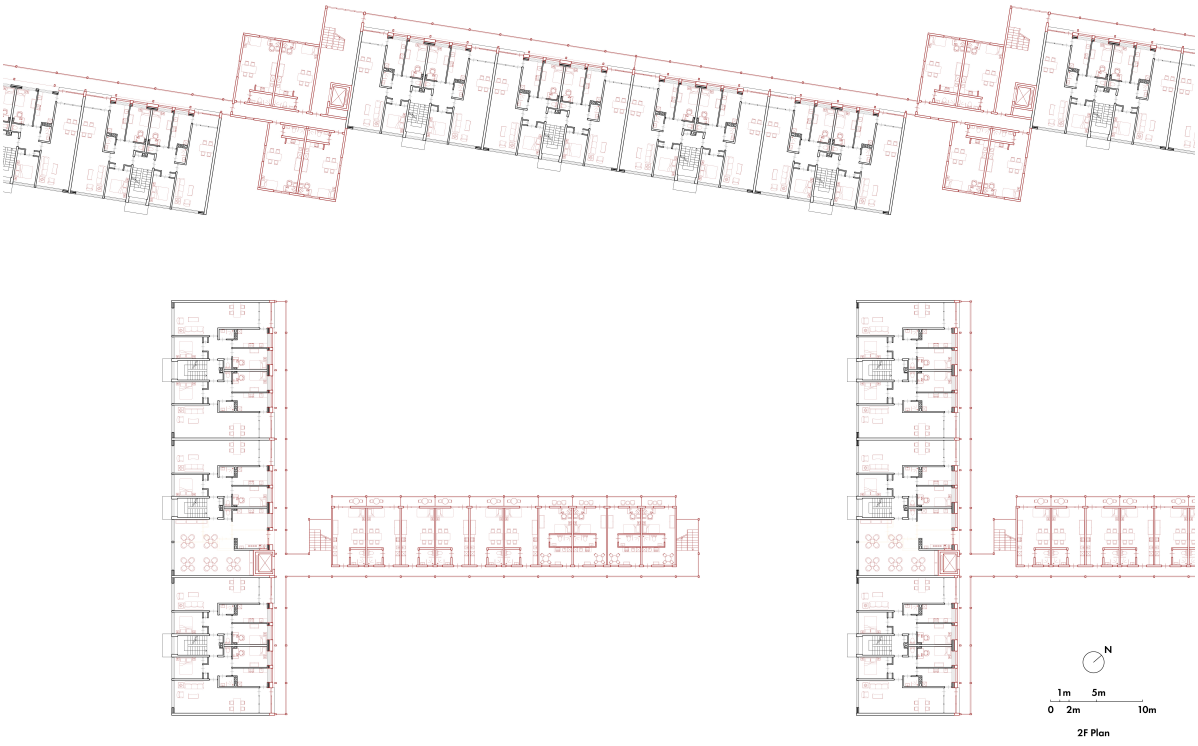


Figure 5.39: 2F Plan demonstrates the relationship among the existing building, courtyard slab building and the mid-rise tower

5.3.4 Long Wing Strategy: Mid-Rise Tower

The long wing is treated differently from the short wing because it has a different relationship to the broader context. Instead of using a courtyard slab building, the long wing is connected to a mid-rise tower placed between adjacent existing buildings.

The tower was initially considered as an 8 to 10-storey volume. However, the final design limits it to 5 storeys in order to maintain a more coherent relationship with the surrounding buildings. Its height therefore aligns with the existing short wing buildings after 1 floor rooftop extension, creating a more balanced overall composition.

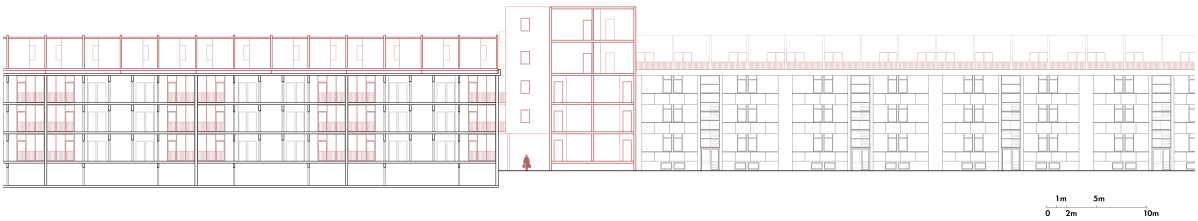


Figure 5.40: Elevation of the mid-rise tower shows the relationship between existing and new buildings

At ground level, the tower preserves the existing pedestrian connection between the residential blocks, the main road, and the bus stop. For this reason, the ground floor contains only three studio units, leaving space for the main passage through the block (Figure 5.32). This keeps the tower from blocking an important route and allows it to support, rather than interrupt, the existing pedestrian structure.

From the second floor upwards, the lift core in the tower connects to the balcony-side galleries of the adjacent long wing buildings (Figure 5.39). In this way, the tower serves not only the new tower dwellings, but also some existing units on both sides. Each tower can provide access to the neighboring long wings while avoiding an excessively long gallery. This follows the same principle as the short wing strategy: accessibility is improved through shared vertical circulation, but the impact on privacy and facade quality is limited.

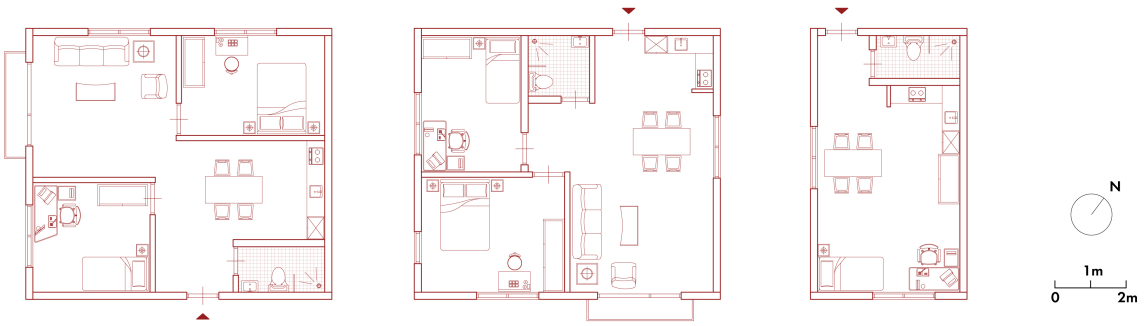


Figure 5.41: Unit types in the mid-rise tower

The tower follows the same housing logic as the slab building. The lower floors use the 2.9 m floor height and mainly contain studio units, while the upper floors increase to approximately 3.3 m and provide larger two-bay apartments (Figure 5.41). This creates consistency between the different new housing types while allowing the tower to respond to its specific urban position. However, unlike the slab building, the structural grid of the tower is adjusted to 3.6 m × 4.2 m according to the limited distance between the existing long wings, as labeled in Figure 5.31.

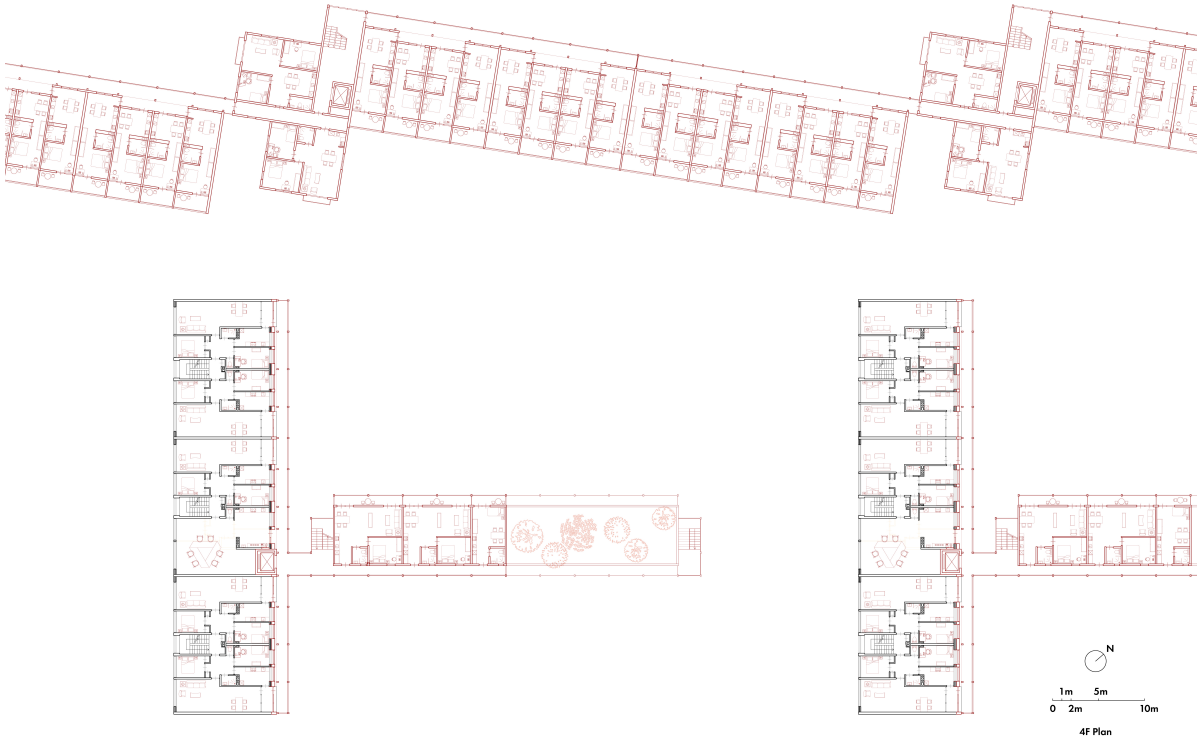


Figure 5.42: 4F Plan demonstrates the relationship among existing and all the new unit types

5.3.5 Rooftop Extension of Existing Buildings

All existing residential buildings receive one additional rooftop floor. This intervention adds new dwellings while preserving the existing building structure. Based on the structural assessment, the current foundation and load-bearing system are assumed to retain approximately 15% residual structural capacity. Under this condition, the additional load that can be introduced is limited, allowing only a modest rooftop extension of 1 storey. A larger extension of up to 3 floors would only become possible if the existing structure were substantially replaced or reconstructed with a lighter structural system, thereby releasing additional load-bearing capacity (HA-HA Design Development, 2025).

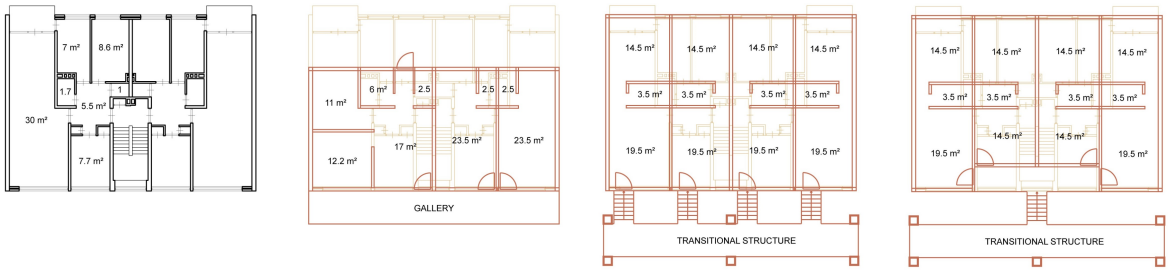


Figure 5.43: Design process of the rooftop extension units

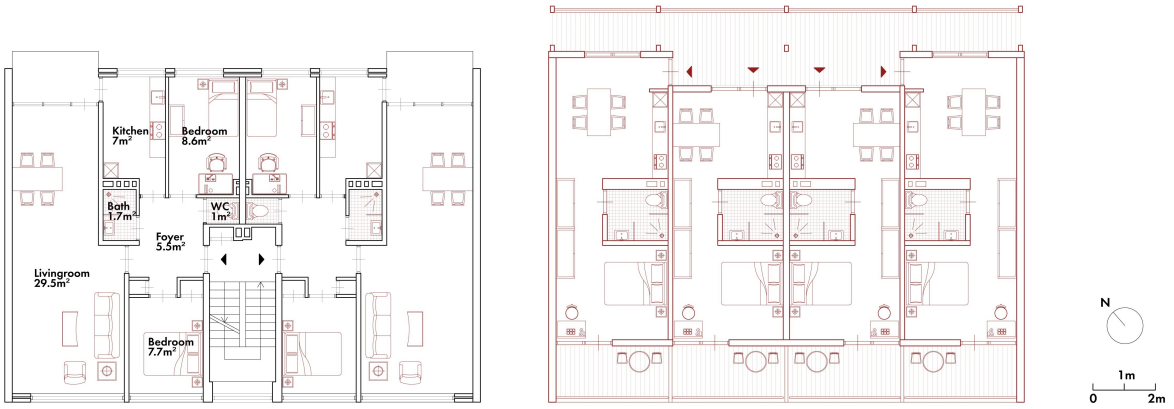


Figure 5.44: Comparison between the existing unit and the rooftop extension unit

The rooftop extension follows the rhythm and spatial quality of the original portiekflat, since every 4 new units share a portiek (Figure 5.44). The new units are aligned with the existing structural logic, and the positions of toilets and kitchens are kept almost the same to the existing wet-core locations. Also, the area of one original unit is divided into two smaller units, allowing the rooftop layer to contribute to both densification and housing diversification.

Structurally, the rooftop extension is conceived as a lightweight steel-supported addition placed above the existing flat roof. The new steel grid sits on the positions of existing load-bearing walls as much as possible, so that the additional loads can be transferred through the existing structural logic rather than creating unnecessary point loads on the roof slab. IPE 270 steel beams are used as the primary supporting component for the new rooftop layer. Between the steel beams, additional insulation is inserted to upgrade the roof build-up while keeping the structural depth compact (Figure 5.45). In this way, the rooftop extension combines the principle of lightweight addition with a direct structural response to the existing portiekflat system.

5.3.6 Parking, Bicycle Access, and Courtyard Privacy

The parking strategy is reorganized together with the courtyard intervention. In the existing condition, the number of parking spaces varies between 20 and 35 spaces per block. In the proposal, each block provides 26 car parking spaces, creating a more consistent and organized parking condition. Although parking is separated from the inner courtyard, it remains close to the lift cores and staircase entrances, making daily access more convenient than in the existing fragmented arrangement.

The proposal also introduces approximately 70 dedicated bicycle parking spaces per block. These are distributed near the new lifts and existing staircase entrances, supporting everyday accessibility and encouraging slower and more sustainable mobility within the block.

The transformation of the courtyard into a more active collective space requires careful mediation between public activity and residential privacy. This is addressed through planting buffers, subtle level differences, and the existing raised ground-floor condition. The original ground-floor units are already elevated approximately 0.84 m above the courtyard level, creating a degree of separation from public activity. The new slab building is also lifted on pilotis, allowing visual permeability and pedestrian continuity between the parking side and the inner courtyard.

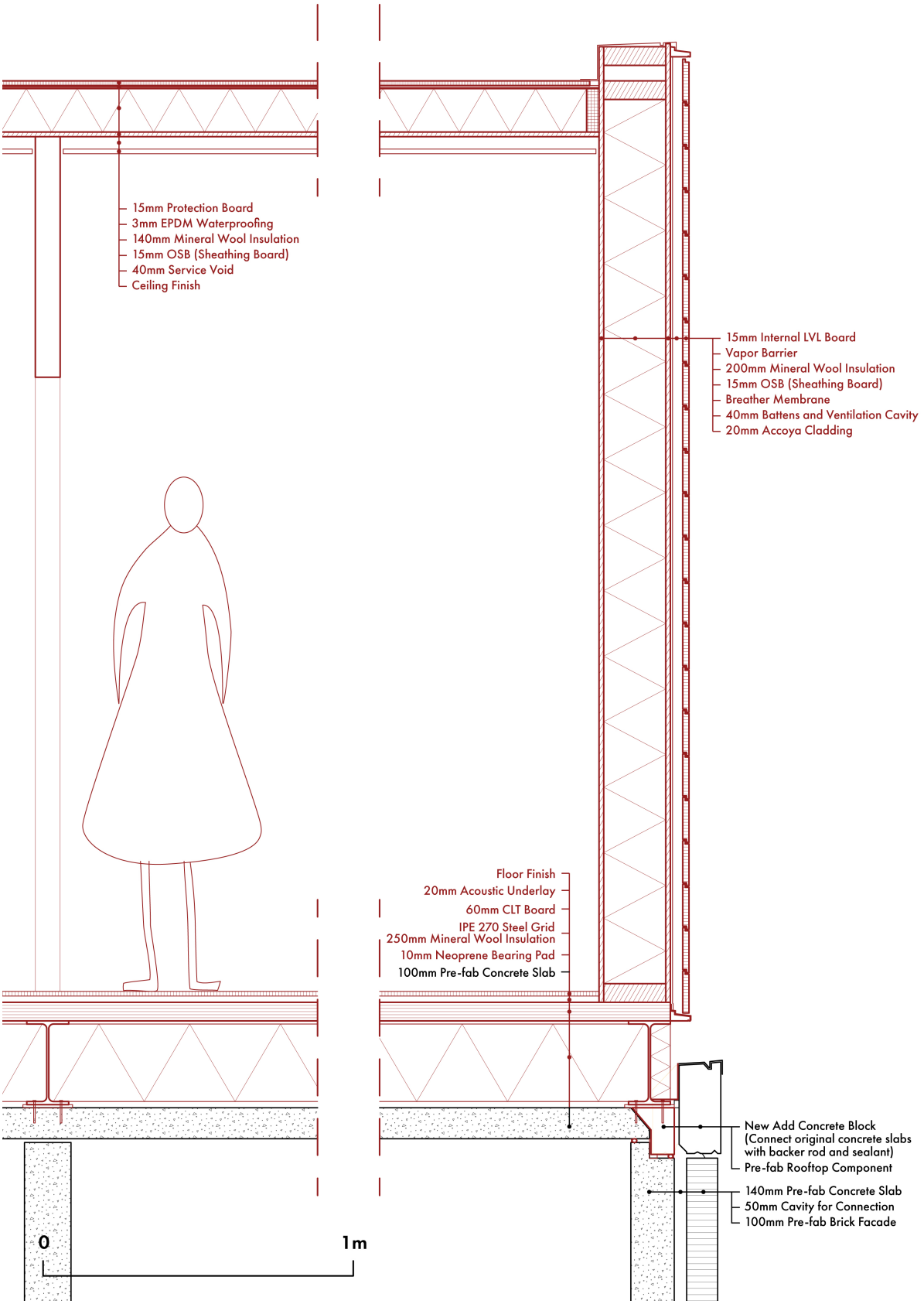


Figure 5.45: Detail construction of 1-storey rooftop extension

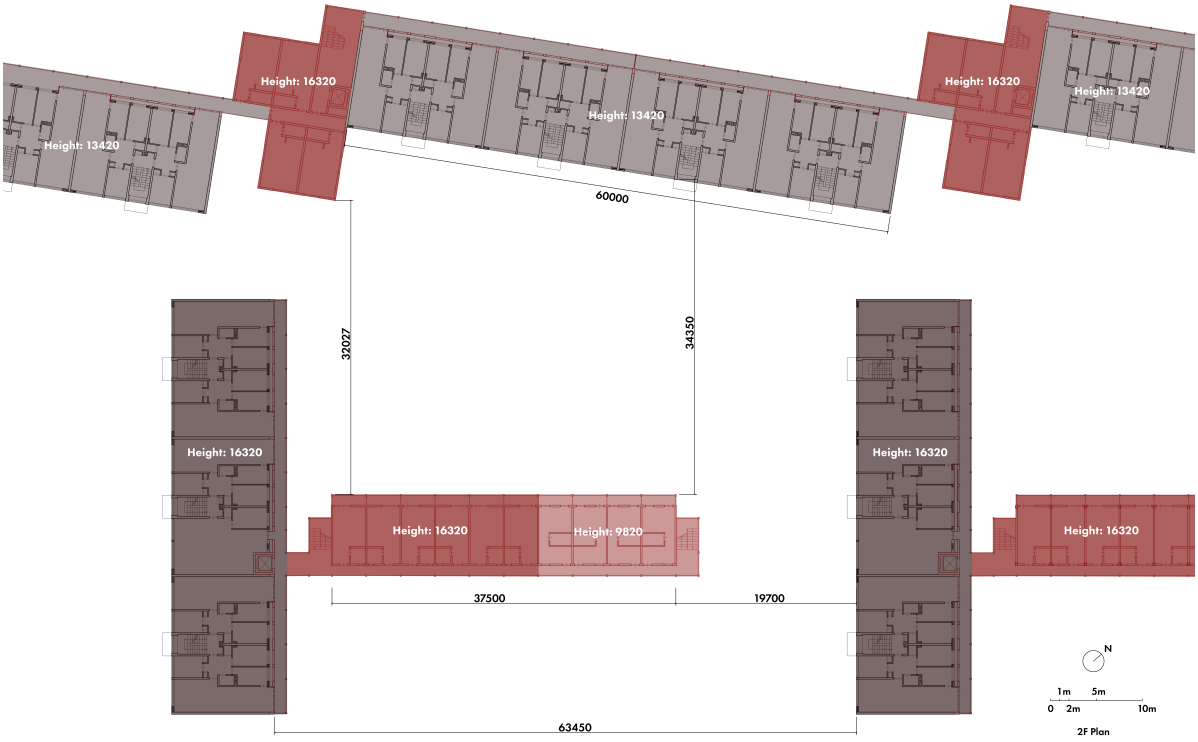


Figure 5.46: Distance and height dimensions

The spatial proportion of the courtyard is also checked through the relationship between building distance and building height. As a preliminary design benchmark, a D/H ratio of around 2 or higher helps to maintain a comfortable degree of openness in courtyard spaces, where D refers to the clear distance between facing building edges and H refers to the height of the enclosing buildings. This ratio is not used as a fixed rule, but as a proportional check for daylight potential, visual openness, and the avoidance of an overly compressed courtyard condition. It is also consistent with daylight guidance based on obstruction angles: when the angle from a lower window to the top of an opposite building remains around or below 25 degrees (Littlefair et al., 2022), the effect on diffuse daylight is generally considered limited. This corresponds roughly to a distance-to-height relationship slightly above 2:1.

Privacy is assessed together with this proportional condition. Planning guidance commonly recommends separation distances of approximately 20 meters between facing habitable-room windows as a reference for avoiding direct overlooking. In this proposal, the courtyard layout combines building spacing, facade orientation, planting buffers, raised ground-floor levels, and the absence of direct facing windows in critical positions. Therefore, privacy is not addressed by distance alone, but through a combination of section, orientation, and landscape mediation.



(a) Current elevation



(b) New elevation with secondary entrance

Figure 5.47: Comparison between the balcony-side facade before and after transformation

5.3.7 Structure, Materiality, and Architectural Expression

The new residential additions are proposed as lightweight timber structures. Compared with the existing prefabricated concrete and brick construction, timber reduces structural load, supports prefabrication, and allows faster assembly with less disruption to residents.

This material strategy directly follows the adaptive construction principles discussed in the pre-design research: The new additions are not conceived as heavy replacements of the existing buildings, but as lightweight and partly independent layers that can be assembled with limited disruption. The use of timber and prefabricated components supports a phased construction process, while the independent foundations of new buildings reduce structural dependence on the existing residential blocks.

The new slab buildings and towers have independent foundations. This means that their structural loads are not transferred to the existing buildings. At the pilotis level of the slab building, the column-beam structure alone is not sufficient to resist horizontal forces. Therefore, selected bays are reinforced with inverted V-bracing. This bracing system improves the lateral stability of the open ground floor while maintaining sufficient passage height and visual permeability. Compared with full diagonal bracing, the inverted V configuration has less impact on everyday movement through the pilotis level, allowing the ground floor to remain open for pedestrian circulation and courtyard access. By contrast, the rooftop extensions are lightweight additions placed on the existing structural system with steel grid structure.

Architecturally, the relationship between old and new is based on both continuity and contrast. At the level of spatial organization, the new timber additions continue the modular rhythm of the existing portiekflat blocks. However, at the level of material expression, they deliberately contrast with the existing brick and concrete (Figure 5.47). Timber gives the new volumes a lighter character, making them readable as contemporary additions rather than imitations of the original buildings.

Overall, the hybrid design strategy integrates rooftop additions, courtyard infill, access upgrades, and ground-floor reorganization into one spatial system. Rather than applying a uniform solution, the interventions respond to the different roles of the short wing, long wing, and courtyard. In doing so, the proposal translates the earlier research principles into a negotiated strategy that balances densification with courtyard quality, construction feasibility, and the living qualities of existing and future residents.

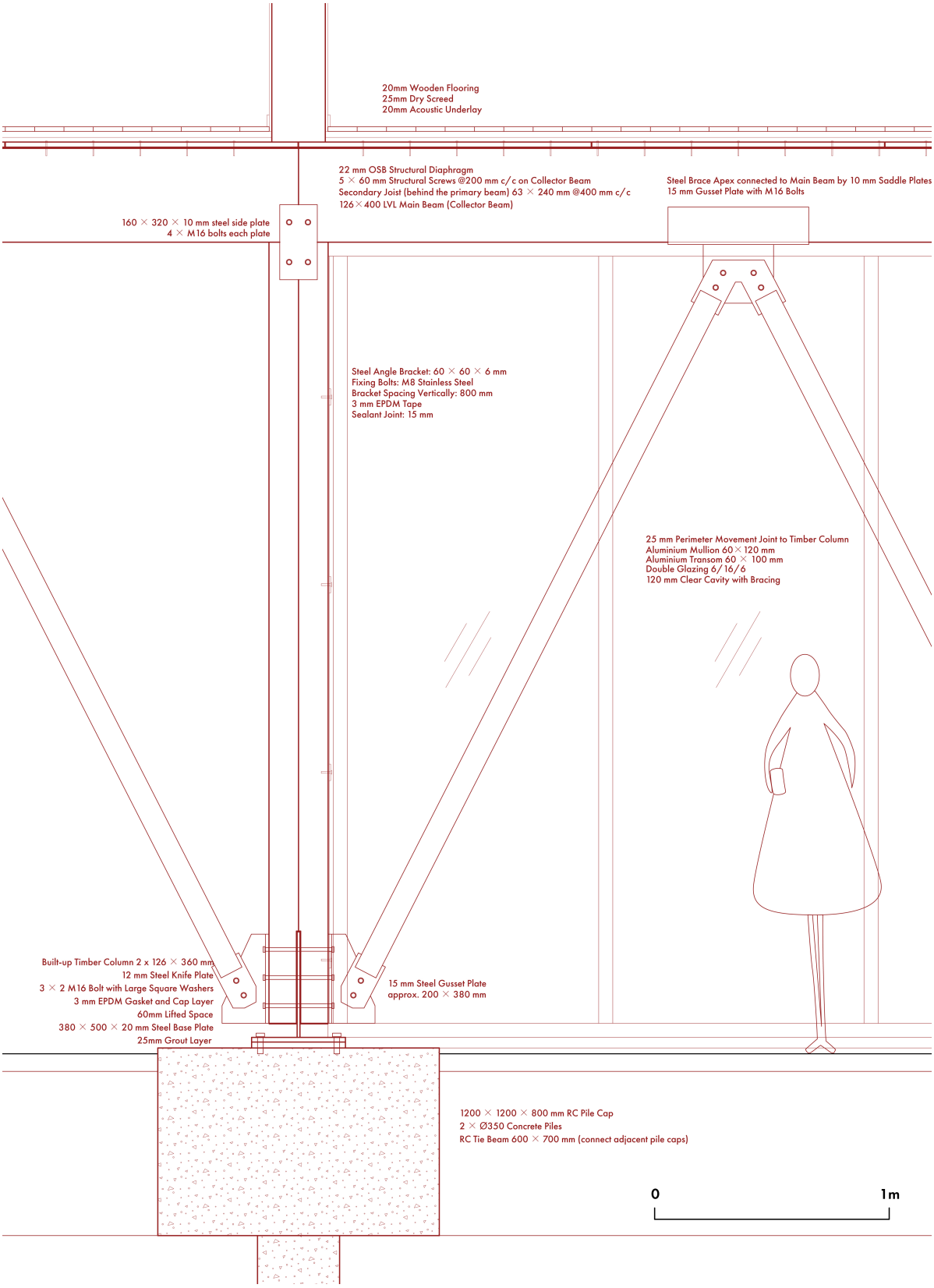


Figure 5.48: Detail construction of structure and bracing at the pilotis level

5.4 Design Evaluation

The evaluation is structured around the key trade-offs identified during the design exploration: densification capacity, environmental quality, and the impacts on existing residents. Construction feasibility is also included, as it directly influences the implementation of the hybrid strategy.

5.4.1 Densification and Programmatic Capacity

In a representative block where the full set of interventions is applied, the original condition contains 48 dwellings. The proposal removes 4 existing dwellings to accommodate shared access and public or collective functions, while adding 68 new dwellings through the combination of slab building, rooftop extension, and tower-related interventions. This results in a net increase of 64 dwellings within the representative block.

Table 5.3: Unit type distribution in one typical block

Unit Layout	Position	Area	Height	Number	Target Group
Original Unit	Existing	61 m^2	2.9 m	44	Family
Changed Unit	Existing	61 m^2	2.9 m	4	Public Space
Studio 1	Slab Building 2-3F	27.5 m^2	2.9 m	12	Single
Studio 1	Slab Building 4-5F	27.5 m^2	3.3 m	2	Single
Studio 2	Slab Building 2-3F	27.5 m^2	2.9 m	8	Single
Studio 3	Tower 1-3F	29 m^2	2.9 m	11	Single
Studio 4	Rooftop	39.5 m^2	3.3 m	14	Single/Couple
Studio 5	Rooftop	35 m^2	3.3 m	13	Single/Couple
Apartment 1	Slab Building 4-5F	55.6 m^2	3.3 m	4	Couple/Family
Apartment 2	Tower 4-5F	61 m^2	3.3 m	2	Couple/Family
Apartment 3	Tower 4-5F	61 m^2	3.3 m	2	Couple/Family

However, the density outcome should not be understood as a simple repetition of one identical block. The six blocks have different local conditions, and the full combination of slab building and tower is therefore not applied to every block. Across the full site, only five slab buildings and towers are introduced. As a result, the total number of new units is lower than the result of direct multiplication of the representative block figure.

Across the full site, the existing condition contains 280 dwellings. The proposal removes 20 existing dwellings, while 363 new dwellings are added. This means that 260 existing dwellings are retained, and the final number of dwellings reaches 623. The net increase is therefore 343 dwellings across the full site. In this sense, the proposal significantly increases housing capacity while retaining most of the existing residential stock. At the same time, it diversifies the housing mix by adding new unit types that differ from the standardized size and layout of the original dwellings.

In addition to residential capacity, the proposal introduces new public and collective functions at ground level. These functions are not treated as separate additions, but are integrated with the reorganization of access, courtyard space, parking, and shared facilities. In each block, 2 or 3 public spaces are inserted within the pilotis level of the slab building, occupying 5 to 6 structural bays in total. The potential communal spaces include fitness room, café, bike repair station, workshop space, self-study room, etc.

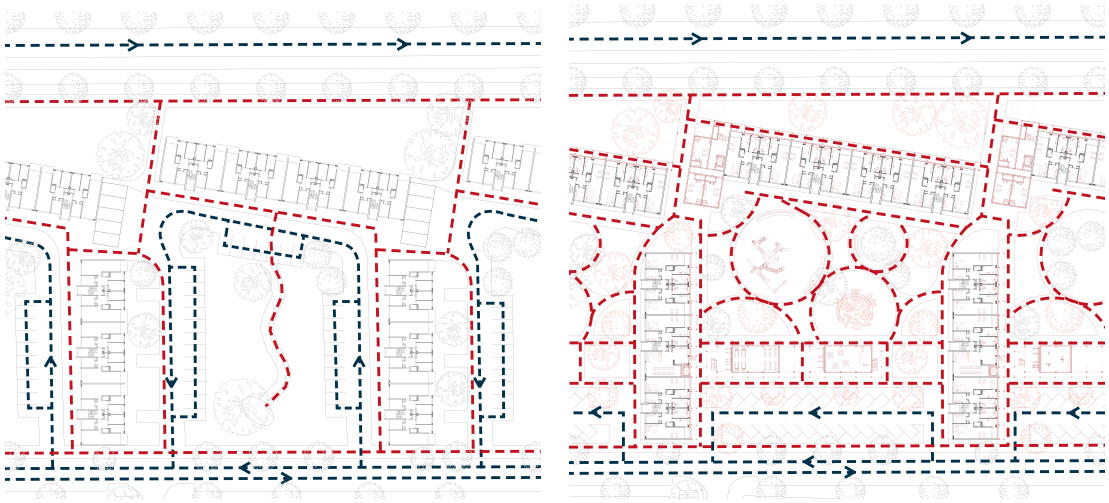
Therefore, the densification capacity of the project should be understood not only through the number of added dwellings, but also through the increased programmatic capacity of the block.

5.4.2 Environmental Quality and Courtyard Performance

In the existing condition, the courtyards are generous in size but remain largely underused. Although they have sufficient openness and favorable spatial proportions, they do not yet function as active communal landscapes. The proposal improves this condition by preserving the main courtyard as the spatial core of the block, rather than treating it as empty land for maximum construction. New volumes are introduced to define the courtyard edge, while landscape reorganization strengthens its connection

to entrances, bicycle facilities, shared functions, and pedestrian routes. In this way, the courtyard is transformed from residual green space into a more legible and usable communal garden.

A key improvement is the clearer separation between car parking and public open space. In the existing situation, parking areas occupy the courtyard edges and weaken the pedestrian experience. In the proposal, parking is reorganized and partially screened by new construction volumes, reducing its visual and spatial dominance. This allows the courtyard to become more pedestrian-oriented and strengthens its role as a shared outdoor space rather than a leftover area between buildings and cars.



(a) Original courtyard circulation **(b)** New courtyard circulation

Figure 5.49: Courtyard circulation comparison diagrams demonstrate a more permeable and pedestrian friendly courtyard

The proposal also responds to daylight, openness, and privacy conditions. The courtyard remains generous due to the large distance between the new and existing buildings, which helps preserve the openness of the collective landscape and maintain sufficient daylight access. This spacing also reduces direct visual conflicts between facing facades and supports the privacy of existing residents. At the edge of main road, the existing green buffer zones with mature trees are mostly retained and strengthened, maintaining separation between the residential block and traffic corridor.

In conclusion, the proposal improves environmental quality by reorganizing rather than simply filling the open space. Compared with the existing condition, the proposal develops the courtyard as a more usable collective space, improves the organization of pedestrian circulation, and safeguards residential privacy through planting buffers, level differences, and the careful placement of new volumes.

5.4.3 Impact on Current Residents

Since the project aims to densify an occupied post-war residential environment, the proposal cannot be assessed only by the number of new units added. It must also consider whether the existing residents can benefit from the intervention without being excessively displaced or disturbed.

A key aspect of the proposal is the retention of most of the existing residential stock. Across the full site, 260 out of 280 existing units are preserved. This means that the existing buildings remain the primary structure of the project, rather than being replaced by a completely new development. The intervention therefore works with the current residential fabric and limits the degree of direct transformation to existing units.

The proposal improves accessibility by introducing new lifts and shared vertical connections to the existing portiekflat buildings. In the original condition, the absence of lifts restricts accessibility, especially for elderly residents, families with children, and people with reduced mobility. By adding lift access without fully replacing the existing staircase cores, the design upgrades the everyday usability of the buildings while preserving the basic access logic of the portiekflat typology.

The existing entrance side is deliberately kept largely unchanged. As learned from the earlier design explorations, adding new galleries to this facade would create conflicts with the existing windows. It

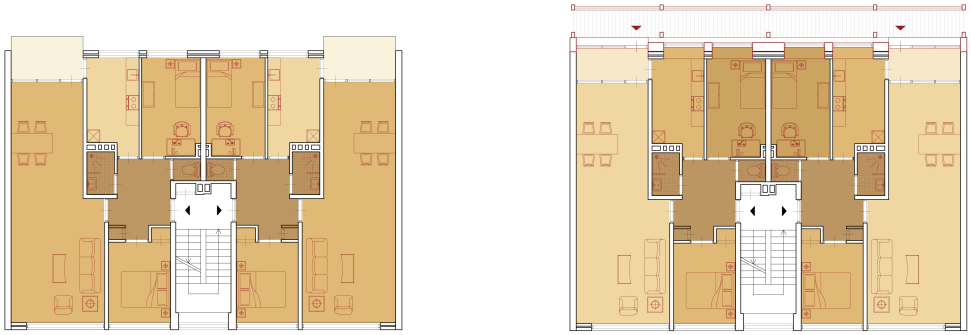
would also risk weakening the daylight quality and identity of the original entrance portals. Therefore, the proposal does not treat the two facades symmetrically. Instead, the main spatial and environmental upgrade is concentrated on the shaded balcony side, where thermal improvement is more necessary and the intervention has less impact on the existing entrance side with abundant sunlight.

For the existing dwellings, the strategy aims to improve daily living quality while limiting direct spatial intrusion. Privacy is protected by avoiding a continuous gallery in front of all existing units; instead, new access points and circulation routes are placed selectively, and the distance between new and existing volumes is controlled to reduce direct visual conflicts. On the balcony side, the new secondary access system and the possible enclosure of existing balconies create a clearer threshold between shared circulation and private interiors, while also offering opportunities to improve insulation and environmental performance.

The energy retrofit is therefore applied asymmetrically. The shaded balcony facade receives a new external insulation and cladding layer to reduce heat loss and improve winter comfort, while the sun-facing entrance side is retained to preserve the existing material expression and daylight condition. This selective strategy does not perform as a complete full-envelope retrofit, but it directly addresses the coldest and least comfortable side of the dwelling. Additional measures, such as upgraded glazing, airtight window frames, and careful treatment of thermal bridges at slab edges and corners, remain necessary to make the energy strategy coherent.

The use of glass doors for the secondary entrances is also a deliberate choice. These doors lead to the living room, where a stronger visual relationship with the access gallery is more acceptable than in bedrooms or other more private rooms. The glass door emphasizes the new entrance clearly from the gallery and allows the secondary access layer to feel less enclosed. At the same time, it means that the improvement of thermal comfort is not uniform across the whole dwelling. Bedrooms on the more insulated side benefit from a higher level of protection, while the living room remains more connected to the shared access layer and therefore has a different level of comfort and openness.

In this way, the retrofit does not only improve energy performance, but also reinforces the existing internal organization of the dwelling. It creates different comfort zones within the same unit and clarifies the relationship between more private rooms, shared circulation, and the semi-public threshold of the new gallery.



(a) Original interior comfort zones **(b)** New interior comfort zones

Figure 5.50: Different comfort zones distribution comparison between before and after renovation

Landscape buffers, level differences, and spatial thresholds further mediate between collective movement and domestic space. In this way, the existing units gain improved accessibility, better environmental conditions, and a more controlled relationship with shared outdoor areas, without requiring a complete restructuring of their layouts.

Overall, the proposal seeks to make densification beneficial to current residents. Although some existing units are removed and the daily environment of residents will inevitably change, the intervention is designed to reduce displacement, avoid unnecessary internal restructuring, and support a more inclu-

sive transformation of the block.

5.4.4 Construction Phasing and Resident Disruption

The construction sequence is organized to reduce disruption to existing residents and to allow most of the current dwellings to remain occupied during the transformation. Since the proposal combines independent new structures with selective interventions to the existing buildings, the construction process can be divided into several phases rather than carried out as one complete redevelopment.

First, the project focuses on site preparation, parking reorganization, temporary access routes, and the relocation of outdoor facilities. This allows the main construction zones to be separated from daily residential circulation as much as possible.

The second phase introduces the independent timber structures, including the courtyard slab buildings and tower volumes. Because these structures are largely independent from the existing load-bearing system, they can be constructed with limited direct intervention in the existing dwellings.

After part of the new housing capacity is completed, the shared lifts, galleries, and public functions in the existing buildings are introduced. This sequence allows the dwellings that need to be removed or transformed to be addressed more carefully, as affected residents could be relocated within the newly added housing stock where possible. The existing staircase cores are largely retained, reducing the need for major internal restructuring. The lightweight rooftop extensions are added at a later stage, requiring structural preparation and temporary construction access from above.

Finally, the landscape, bicycle parking, courtyard surfaces, and public open spaces are completed once the major construction works have finished.

Overall, the phasing strategy aims to make densification possible without large-scale demolition or full resident displacement. Most new volumes are built as independent or lightweight additions, while interventions to the existing buildings are kept selective. Although noise, temporary access changes, and local disturbance are unavoidable, the proposal minimizes resident disruption by preserving most existing dwellings, maintaining the basic access system during construction, and limiting relocation to the units directly affected by new shared access and public functions.

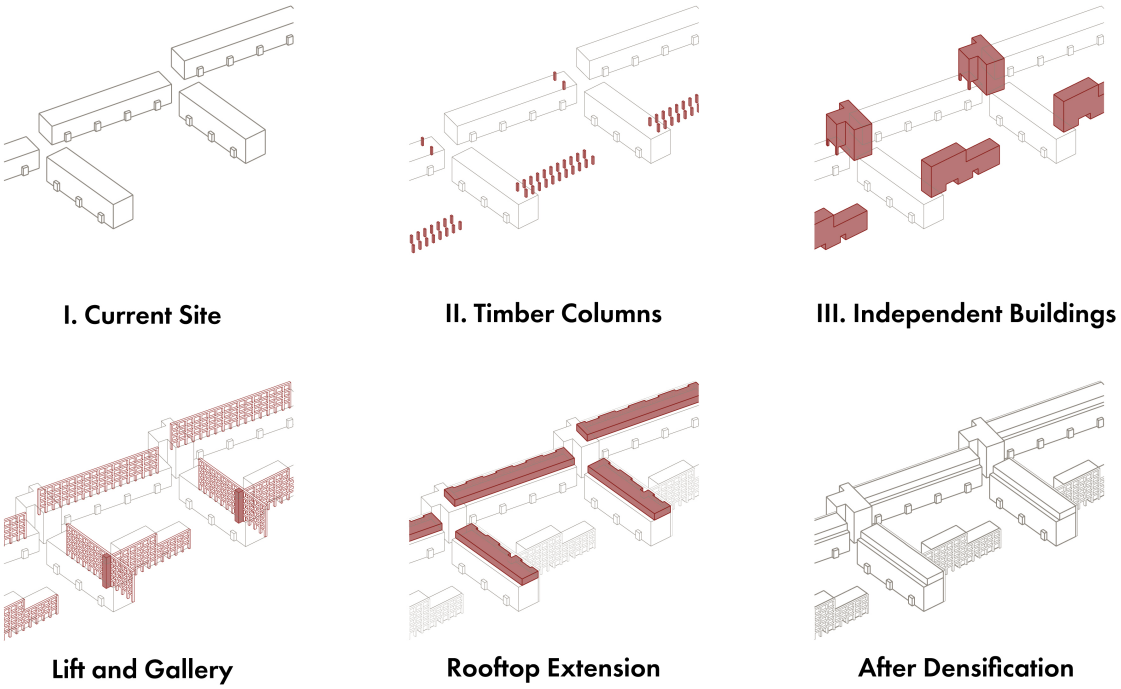


Figure 5.51: Construction phasing diagram

6

Conclusion

6.1 Answer to the Research Aim

This research explored how post-war residential areas in Eindhoven can be spatially densified and transformed through architectural interventions that engage with the existing residential fabric. It addresses both housing capacity and everyday collective life, examining how additional housing can contribute to a broader spatial transformation of existing post-war neighborhoods.

The study shows that post-war residential areas should not be understood only as outdated housing environments or as empty land for redevelopment. Their repetitive layouts, standardized building typologies, open spaces, and existing access structures create both constraints and opportunities. Therefore, the project treats the existing fabric as a resource. Instead of replacing them, the design works with the structural rhythm, block organization, courtyard spaces, and existing residential use,

The final proposal responds to the research aim through a hybrid architectural strategy, combining several forms of addition and transformation. New dwellings are introduced through rooftop extensions, courtyard slab buildings, and tower insertions. The proposal also reorganizes ground-floor relationships, improves access, introduces collective and public functions, and selectively upgrades existing dwellings. Together, these interventions show how densification can operate across different parts of the block without large-scale demolition.

The project demonstrates that densification beyond housing units can be understood as a spatial strategy. Housing capacity is increased, but the value of the proposal lies in its connection with communal space, circulation accessibility, environmental improvement, and residential quality. The design therefore contributes to a broader understanding of post-war residential transformation. It works with existing buildings, supports incremental change, and uses densification as a tool to improve the general residential environment.

6.2 Main Findings

The research and design process led to several main findings.

1. Post-war residential areas are not only areas of physical or social weakness, but also contain latent capacity for transformation. Their standardized layouts, repetitive housing typologies, and generous open spaces have often produced mono-functional and spatially fragmented environments. At the same time, these characteristics also create a clear spatial framework within which additions, adaptations, and collective improvements can be tested.

2. Densification needs to be understood as both a quantitative and qualitative process. Increasing the number of dwellings is important, but housing addition alone is not sufficient. In post-war residential areas, densification becomes more meaningful when it is connected to collective space, public functions, accessibility, environmental improvement, and the everyday use of the neighborhood.

3. The design explorations revealed that densification always involves trade-offs. Strategies that maximize the number of new dwellings tend to place more pressure on daylight, courtyard openness, privacy, and the living qualities. More cautious strategies preserve existing qualities but may produce limited housing capacity. The evaluation process therefore showed that no single extreme strategy can resolve all design criteria equally.

4. The selected block contains different spatial conditions within the apparently repetitive typology. The short wing, long wing, courtyard, entrance facade, balcony, rooftop, and ground floor each offer different possibilities and constraints. This finding explains why the final proposal developed into a differentiated block-scale strategy rather than one repeated intervention.

5. Technical and social feasibility are closely connected. Structural capacity, construction method, fire escape logic, resident disturbance, and phasing are not secondary issues added after the design. They directly influence which forms of densification are possible and how far the existing residential fabric can be transformed without becoming a replacement project.

6.3 Design Contribution and Recommendations

The main contribution of this thesis is the development of a hybrid densification strategy for post-war L-shaped residential blocks. Rather than treating the selected site as an isolated design object, the proposal demonstrates how a standardized housing typology can be re-read as a framework for broader transformation. The strategy combines housing addition, access improvement, courtyard redefinition, environmental upgrading, and lightweight construction into one integrated approach.

Its value therefore lies not only in the number of new dwellings, but in showing how densification can also improve the living conditions of existing residents and strengthen collective space. Since many post-war residential areas in the Netherlands share similar spatial conditions, such as repetitive portiekflat structures, underused courtyards, limited accessibility, and fragmented open space, the design proposal can be understood as a transferable strategy. It does not provide a fixed model to be copied directly, but a design logic that can be adapted to comparable housing blocks according to their specific spatial, structural, and social conditions.

Based on this proposal, several recommendations can be drawn:

I. Start from the existing typology
Densification should begin with a careful reading of the existing block structure, access system, facade orientation, courtyard openness, and current structures. These existing conditions can guide where new housing, circulation, and collective functions could be possibly added.

II. Use a hybrid strategy rather than a single intervention
Rooftop additions, courtyard infill, vertical access upgrades, facade improvements, and ground-floor reorganization should be combined according to the specific role of each part of the block.

III. Treat courtyard space as a collective asset
Open space should not be seen simply as available land for new construction. Its value for daylight, privacy, landscape, and communal space for social interactions should be protected and strengthened.

IV. Connect densification with benefits for current residents
New housing additions should also improve the everyday living conditions of existing residents, for example through better accessibility, environmental comfort, public-private thresholds, and collective spaces.

V. Apply lightweight and phased construction
Prefabricated timber components, dry connections, and independent structures can reduce disturbance and make transformation more feasible in occupied residential environments.

6.4 Reflections

Although the proposal shows the potential of hybrid densification, several aspects require further development before the strategy can be applied in practice.

I. Structural Verification
The assumptions about rooftop extension, residual load-bearing capacity, foundations, and connections between existing and new added construction need to be tested through detailed engineering analysis.

II. Environmental Performance
The selective facade retrofit requires further energy calculations, thermal bridge analysis, air tightness studies, and detailed testing of windows, slab edges, and glass secondary entrance doors.

III. Privacy and Microclimate
The design should be further examined through the studies on direct sun hours, seasonal shadow simulations, privacy-view analysis, and courtyard wind or comfort studies.

IV. Management of Collective Spaces
The long-term use of shared facilities, courtyard programmes, public functions, and secondary circulation spaces requires clearer governance and maintenance models involving residents, housing associations, municipalities, and local organizations.

V. Construction and Economic Feasibility
Further work is needed to define the construction sequence, temporary access, resident communication, funding structure, and cost distribution, especially if residents are expected to remain in place during transformation.

The proposal also requires a clearer development model, including who would finance, construct, own, and maintain the new additions, since the project requires cooperation between housing associations, municipalities, private developers, and public subsidy programmes.

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