

# APPOSITION

Architecture beside uncertainty.

Advanced Housing Design  
Ecologies of Inclusion

Don van den Burg

5545315

Supervisors:  
Robbert Guis & Olv Klijn

# 00 FOREWORD

This graduation report marks the conclusion of my graduation project within the studio Advanced Housing Design – Ecologies of Inclusion. The project, titled Apposition, investigates how architecture can function in a place where permanent construction is not self-evident. The starting point for this research lies in Midden-Delfland, where the transition between city and landscape, productivity, ecology and spatial pressure come together in a particular way.

Throughout the process, my focus increasingly shifted towards the question of how architecture can respond to uncertainty. The contaminated ground within Region 2 became not only a technical limitation, but also an opportunity to question fundamental assumptions about building, permanence and the quality of dwelling. Rather than avoiding the complexity of the site, this project seeks to develop an architectural strategy from within that complexity.

Apposition therefore emerged as an investigation into the coexistence of conditions that may initially seem contradictory: contaminated ground and dwelling, temporality and quality, individual homes and collective structures, landscape and building. The project does not search for a definitive solution that removes all uncertainty, but for an architecture that can engage with uncertainty in a careful and meaningful way.

I would like to thank my mentors, Robbert Guis and Olv Klijn, for their critical questions, guidance and trust throughout the process. I would also like to thank my fellow students within the studio for the conversations, feedback and shared exploration of new forms of living within a changing landscape. Finally, I would like to thank the people close to me for their support, patience and encouragement during this intensive graduation trajectory.

This report documents not only the final design, but also the way in which research, theory, analysis and design influenced each other throughout the process. It is therefore a record of a search for an architecture that does not depend on permanence in order to become meaningful.

# CONTENTS

<u>01</u> <b>ABSTRACT</b>	<b>5</b>	<u>04</u> <b>RESULTS</b>	<b>23</b>
		4.1 Introduction	23
		4.2 The site as conflict	24
		4.3 The paradox	30
		4.4 From object to system	30
		4.5 From system to landscape	32
		4.6 Life inside the system	36
		4.7 Material logic and building detail	45
<u>02</u> <b>INTRODUCTION</b>	<b>7</b>	<u>05</u> <b>CONCLUSION</b>	<b>61</b>
2.1 Problem field and relevance	7	5.1 Conclusion	61
2.2 Objective and project position	11	5.2 Discussion	66
2.3 Research and design questions	12	5.3 Limitations and further development	67
2.4 Scope	13	5.4 Reflection	68
		5.5 Final statement	69
<u>03</u> <b>APPROACH</b>	<b>15</b>	<u>06</u> <b>BIBLIOGRAPHY</b>	<b>71</b>
3.1.1 Design and research strategy	15	<u>07</u> <b>LIST OF FIGURES</b>	<b>73</b>
3.1.2 Techniques and tools	15	<u>08</u> <b>APENDIX</b>	<b>77</b>
3.1.3 Expected output	16	8.2 Calculations	93
3.1.4 Planning	16	8.3 Sketches	97
3.2.1 Theoretical framework	16	8.4 Design drawings	99
3.2.2 Permanence	17	8.5 Technical drawings	117
3.2.3 Landscape	17		
3.2.4 Layers	20		
3.2.5 Adaptability	20		
3.2.6 Mobility, demountability and prefabrication	20		
3.2.7 Collective space and social adaptability	21		
3.2.8 Framework of change	21		

# ABSTRACT

This graduation project investigates how architecture can function in a place where permanent construction is not self-evident. The starting point for this research lies in Midden-Delfland, where the transition between city and landscape is under pressure from housing demand, infrastructure, climate adaptation and changing patterns of land use. Within the larger urban development plan, Region 2, the Definitieve OpslagPlaats NoordOost-Abtspolder (DOP NOAB), forms a critical point of tension. The presence of contaminated ground, technical restrictions and a maintenance-dependent cover system make conventional forms of construction problematic.

The project, titled Apposition, starts from the question of how an adaptive architectural system can be designed for contaminated ground. Rather than hiding the uncertainty of the site or attempting to resolve it completely, this uncertainty is used as the starting point for the design. Apposition describes an architectural attitude in which different conditions are organised alongside one another: contaminated ground and dwelling, temporality and residential quality, individual homes and collective structures, landscape and building.

The design develops a modular and reversible housing system that can be placed, adapted, dismantled and reused. Compact dwellings are supported by collective spaces, shared outdoor areas and a landscape strategy that softens the hard transition between the city and Midden-Delfland. At the level of material and detail, the project investigates how demountable connections, biobased materials and reused components can contribute to an architecture that touches the ground lightly.

The project shows that contaminated ground does not only have to be understood as a limitation, but can also become the starting point for another form of architecture: adaptive, collective, reversible and conscious of time. In doing so, Apposition proposes a way of building that can become meaningful without being fully dependent on permanence.

# INTRODUCTION

“Any permanent detachment is deluded.”  
Jeremy Till

# 02 INTRODUCTION

## 2.1 Problem field and relevance

The Dutch housing challenge is under increasing pressure. According to ABF Research, the statistical housing shortage in the Netherlands rose to approximately 401,000 dwellings in 2024, as shown in figure 02. At the same time, the national government aims to realise 900,000 new homes by 2030, of which approximately 247,000 are planned in the province of South Holland, shown in figure 01 (ABF Research, 2024; Rijksoverheid, n.d.). As a result of this national building programme, the housing shortage is expected to decrease to around 300,000 dwellings by 2030.

However, this projected decline does not resolve the spatial dilemma. In a densely urbanised province such as South Holland, the question is not only how many homes should be built, but also where they can be accommodated. The limited availability of conventional development sites makes it increasingly necessary to reconsider places that are currently perceived as difficult, temporary, contaminated or unsuitable for housing.

At the same time, the Netherlands continues to deal with a substantial legacy of soil contamination. The Compendium voor de Leefomgeving identifies approximately 250,000 locations with potentially contaminated soil, of which around 1,500 are classified as urgent cases of soil contamination (CLO, 2015). This is illustrated in figure 03.

Through Bodemloket and the Atlas Leefomgeving, it becomes visible that soil investigation and remediation are spread across the country, and that contaminated ground can impose restrictions

on future land use (Bodemloket, n.d.; Atlas Leefomgeving, n.d.). This creates an important spatial paradox: while pressure on space and housing increases, many technically complex or contaminated sites remain underused.

Within the studio Advanced Housing Design – Ecologies of Inclusion, housing is not approached as an isolated task, but as part of a broader ecological, social and spatial transformation. The studio investigates how housing design can contribute to inclusion, reduce the ecological footprint of residents, and connect climate adaptation, water, dwelling, working and collectivity (Klijn and Guis, 2025). The assignment focuses on Midden-Delfland (figure 04), where an urban micro-system is developed within the broader context of the Dutch Delta. As the housing crisis intensifies, this landscape comes under increasing spatial pressure.

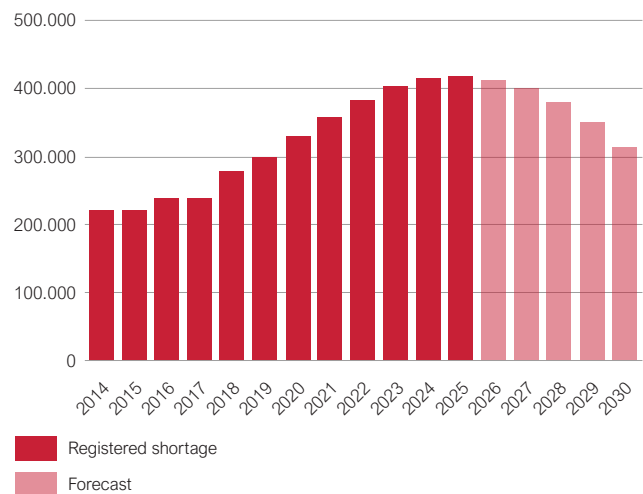


figure 01. Development of the housing shortage in the Netherlands, 2014–2030.

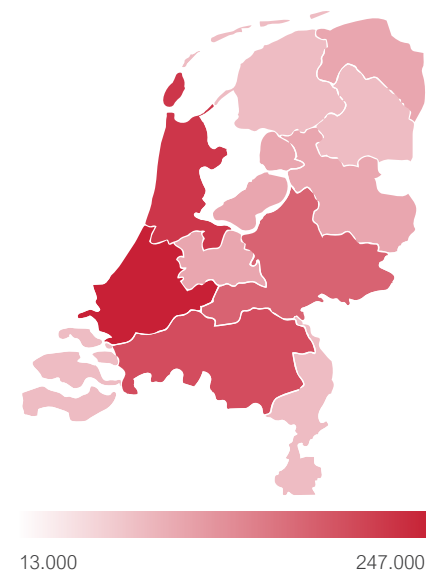


figure 02. Distribution of homes to be built by province 2023-2030.

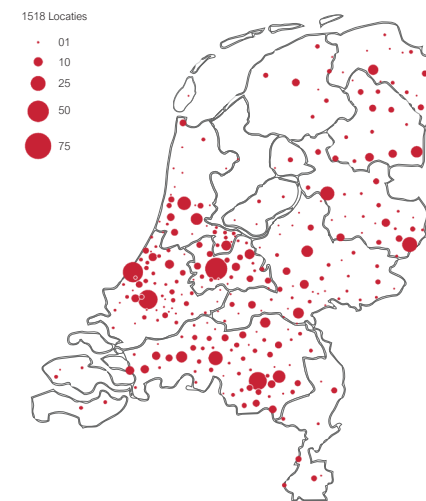


figure 03. Urgent soil contamination sites in the Netherlands.



figure 04. Pressure on Midden-Delfland.

This project originates from a larger urban development plan for Midden-Delfland, in which the transition between city and landscape is reorganised through five regions. Within that plan, this graduation project focuses on Region 2.

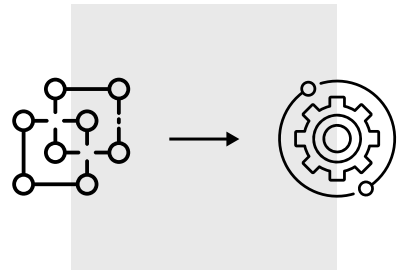
Region 2 is the Definitieve OpslagPlaats NoordOost-Abtspolder (DOP NOAB), a place where contaminated ground, housing pressure and the landscape transition come together. The ground is part of a layered system of covering, drainage, maintenance and aftercare. As a result, the location cannot be understood as a stable and permanent basis for conventional construction.

Yet this place is not simply unusable. The existing cover layer and the sand package above it make building possible under specific conditions, provided that architecture adapts to the restrictions of the ground. The central task therefore shifts from the question of whether building is possible, to the question of how architecture can function when permanence, foundation and stability are no longer self-evident.

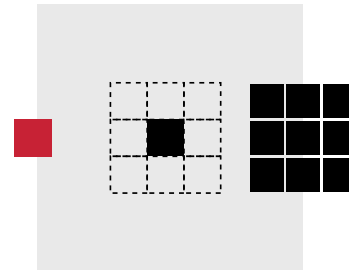
This task touches upon a fundamental architectural debate about time, adaptability and reversibility. Architecture is traditionally often designed as a long-lasting object, firmly anchored in the ground. In this project, however, the question is how architecture can become meaningful without being fully dependent on permanence. In doing so, the project contributes to current discussions on circularity, temporary land use and building within ecologically or technically complex conditions.



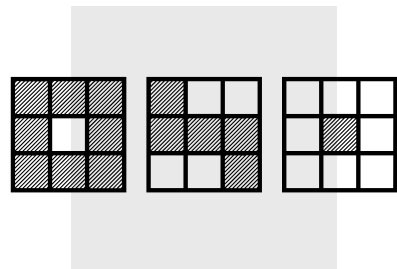
figure 05. Project location and 5 regions Midden-Delfland.



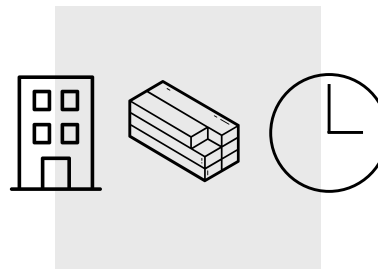
Architecture conceived as a system rather than an object



Ability to place, relocate, combine, and remove elements



Support for both individual and collective configurations



Building as a resource for the future

## 2.2 Objective and project position

The aim of this graduation project is to develop an adaptive architectural system that can function within the uncertainty of contaminated and temporary ground. The project investigates how dwellings and collective structures can be designed without relying on permanent anchoring in the soil. Flexibility, demountability and adaptability are therefore not treated as technical additions afterwards, but as integral parts of the architectural task.

The architectural ambition lies in designing a building as a system rather than as a fixed object. The building is not approached as a definitive final image, but as a composition of parts, relationships and scales. This system must be able to respond to different conditions: from the individual dwelling to the collective residential building, from the building composition to its landscape integration, and from the construction module to the demountable detail.

The project therefore focuses not only on the design of housing, but on the development of a spatial and material logic that can function within changing circumstances. The system must be able to place, relocate, combine and remove elements, so that it can respond to the restrictions of the ground and to different forms of use. At the same time, it must support both individual and collective configurations: compact dwellings are connected to shared spaces, collective outdoor areas and social infrastructure.

An important starting point is that the building is not only designed for its first application, but is also understood as a future source of material and use value. Components must be able to be adapted, dismantled or reused. In this way, the building is not seen as an endpoint, but as a temporary configuration within a longer cycle of use, change and reuse ( figure 06 ).

This attitude forms the basis for Apposition. Rather than hiding the uncertainty of the site or attempting to resolve it completely, this project investigates how different conditions can exist alongside one another: contaminated ground and dwelling, temporality and residential quality, individual home and collective system, landscape and building. Apposition is therefore used as an architectural strategy for a place where building is only possible when architecture adapts to uncertainty, time and change.

The personal motivation for this project stems from an interest in architecture that responds to real physical conditions and limitations. Instead of ignoring or masking the complexity of the site, the project seeks a design strategy that begins precisely from these limitations. The uncertainty of the ground is therefore not only a problem, but also an opportunity to question existing assumptions about building, dwelling and permanence.

## 2.3 Research and design questions

### Main design question

- How can an adaptive architectural system be designed for contaminated ground, in a context where permanent construction is not self-evident?

### Research and design questions

- What are the spatial and architectural consequences of contaminated and temporary ground for building and dwelling?
- How can an adaptive architectural system function across different scales, from individual housing units to collective structures and building compositions?
- How can collective housing contribute to an inclusive living environment within a temporary and technically restricted site?
- How can the uncertainty of the ground be translated into a spatial, constructive and material design strategy?

## 2.4 Scope

This research originates from the urban development plan for Midden-Delfland and Rotterdam and focuses specifically on Region 2: the DOP NOAB. The main focus lies on the architectural scale of the building and its related construction system, while also addressing the relationship between building, site and landscape.

The project operates across four interconnected scales. At the regional scale, it relates to the broader ambition of understanding Midden-Delfland as a productive and ecological landscape. At the site scale, it focuses on the contaminated triangle as a transition zone between city and landscape. At the building scale, the project develops collective housing as a spatial and social system. At the detail scale, it investigates how reversibility, demountability and materiality can be translated into construction.

Housing forms the central programme, because Region 2 is positioned as a transition zone where the hard edge between city and landscape can be softened. The housing typologies and collective functions are developed in relation to the modular character of the construction system and the specific conditions of the site. Because the contaminated triangle does not allow for standard architectural assumptions, the project investigates both individual and collective forms of dwelling.

The research is limited to architectural, spatial, constructive and climatic aspects. It is developed through concepts, diagrams, plans, sections, façade fragments and construction details. The

climatic and material logic of the building are included insofar as they contribute to the architectural concept of an adaptive and reversible system.

Legal, financial and policy frameworks are relevant to contaminated sites, but do not form the main focus of this graduation project. The aim is to develop a clear architectural concept and design strategy within a defined but relevant context. The project is intended as a specific proposal for Region 2, while also investigating how similar principles could be relevant for other contaminated or underused sites where conventional permanent construction is not self-evident.

# APPROACH

How is the research translated into design?

# 03 APPROACH

## 3.1.1 Design and research strategy

This project uses research by design and design by research as its central methodological approach. Analysis and design are not treated as separate processes, but are developed in parallel in order to investigate spatial questions through both reflection and design testing.

The design process starts from the larger urban framework and gradually zooms in towards the architectural scale. Literature research, case-study analysis and design experiments are combined and confronted with one another. Through diagrams, sketches, models and scenarios, the project investigates how architecture can function under conditions of uncertainty ( figure 07 ).

## 3.1.2 Techniques and tools

This graduation project uses a combination of analytical and design-based techniques to investigate the architectural implications of building on contaminated and temporary ground. The process starts with an analysis of the site and its immediate surroundings. This includes spatial structures, scale, accessibility and the relationship to the surrounding urban and landscape systems. The ground condition and the presence of contaminated soil are also analysed. This site analysis forms the basis for understanding the specific conditions within which the architectural system has to operate.

Diagrammatic research is then used to spatially explore abstract concepts such as adaptability, scale and temporality. Through diagrams, the relationships between individual units and collective structures are tested, as well as the possible configurations that can emerge from them. These diagrams function as design tools, allowing different spatial logics to be explored without immediately moving towards a fixed architectural outcome.

Case studies of temporary, modular and adaptive architecture are used to gain insight into existing approaches and strategies. These studies are not used as examples to copy, but as a way to identify underlying principles, such as demountability, reconfigurability and flexibility in use. The knowledge gained from these case studies is then translated to the specific context of contaminated ground.

Based on these analyses, design experiments are carried out in which different configurations of the modular system are tested. By combining, separating and rearranging units, the project explores how the architectural system can respond to different conditions and scales. These experiments make it possible to refine the system iteratively and to make the spatial consequences of design decisions visible.

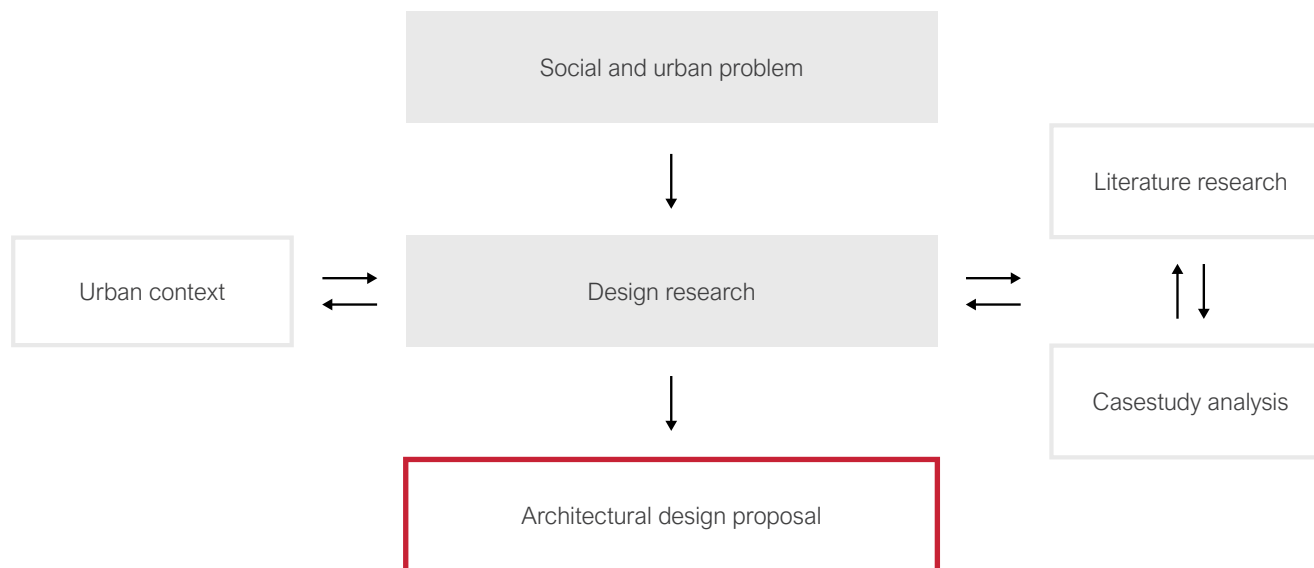


figure 07. Research and design strategy diagram.

### 3.1.3 Expected output

The expected outcome of this graduation project is a coherent architectural design for an adaptive housing system on contaminated ground. The design does not consist of one autonomous building object, but of a spatial system that responds to the specific conditions of the site: the contaminated ground, the landscape transition, the need for housing and the ambition to create collective residential quality.

The project develops a design strategy in which different scales are connected. At the scale of the site, the project investigates how the DOP NOAB can be organised without treating it as a conventional building plot. At the scale of the building, a collective residential structure is developed in which compact dwellings, shared spaces, circulation and outdoor space together form an inclusive living environment. At the scale of the dwelling, a modular system is developed that allows for variation in use and housing typology. At the scale of the detail, the project investigates how reversibility, demountability and materiality can be translated into a constructive and architectural logic.

The results are documented through diagrams, maps, plans, sections, elevations, façade fragments, construction details and spatial visualisations. These representations do not only present the design, but also support and explain the design decisions. They make visible how the spatial, social, constructive and material principles of the project come together in one architectural system.

### 3.1.4 Planning

The research and design process is carried out within the timeframe of the A1, A2 and A3 assessment moments.

In the first phase, A1, the emphasis lies on formulating the research assignment. This phase marks the beginning of the graduation project. Its outcomes form the basis for the theoretical framework, the problem definition and the main structure of the research to be developed further.

In the second phase, A2, the analytical findings are developed in more depth and connected to design research. Insights from case studies and building analyses are translated into spatial and programmatic principles, which are explored through schematic design studies. During this phase, the design proposal gradually takes shape and is supported by initial constructive and material considerations.

The third phase, A3, focuses on coherence and refinement. The design and research are integrated into a consistent whole, in which the relationships between building, programme, construction and urban context are explicitly developed. At the same time, the research outcomes are analysed and summarised in conclusions and recommendations.

### 3.2.1 Theoretical framework

Jeremy Till criticises the idea of architectural autonomy and argues that architecture is often presented as a linear process from problem to solution, while in reality it is continuously dependent on external forces (Till, 2009, p. 14). Architecture does not operate in a pure or fully controllable world; every attempt to abstract reality is eventually confronted with social, material and political complexity (Till, 2009, p. 25).

From this perspective, uncertainty is not a disturbance of the design process, but a structural condition. This requires an architecture that is not only focused on the moment of completion, but also on use, maintenance, change, disassembly and reuse.

### 3.2.2 Permanence

Architecture is often associated with order, stability and permanence. Yet Till shows that buildings are always part of contingent circumstances: they emerge and function within a field of users, interests, materials, regulations and changing social values (Till, 2009, p. 46). Architecture is therefore never fully predictable or autonomous.

This idea also challenges the notion of permanence. Buildings are often designed as if they will remain stable over time, but in reality they are subject to wear, adaptation, reuse, changing value and eventually demolition. Till makes this explicit by describing architecture as “waste in transit”: construction and demolition are not opposites, but parts of the same material cycle (Till, 2009, p. 67). As a result, the question shifts from how a building can be designed as a definitive object, to how architecture can engage with its own temporality. A building is not only construction, but also future transformation, maintenance and potential waste. This approach makes it necessary to understand architecture as a process in time.

### 3.2.3 Landscape

Landscape is not always a stable or natural ground condition. In many contemporary situations, landscape is a technical construction, shaped by earthworks, infrastructure, water management, contamination, drainage and maintenance. The Oost-Abtspolder demonstrates how landscape, technology and time can become closely intertwined.

The entire Oost-Abtspolder was raised between 1967 and 1985 from NAP -6 to -7 metres to approximately NAP +1.25 to +2.00 metres, using a heavily contaminated layer of class 4 dredged material from the Port of Rotterdam and sludge from the Overschie Plassen (dS+V, 2010, pp. 31–33). The northern point of the Oost-Abtspolder was subsequently used for the storage of dredged sludge and later as a definitive storage site for contaminated soil. The DOP NOAB was in use from 1992 to 2001 as a landfill for moderately to heavily contaminated soil. During this period, approximately 2,500,000 m<sup>3</sup> of soil was deposited (dS+V, 2010, pp. 31–33). After the closure of the landfill, a capping construction was installed between 2001 and 2003 (dS+V, 2010, pp. 31–33).

After the landfill activities ended, the Definitieve OpslagPlaats (DOP) was organised as a technical system of cover layers, drainage and water discharge. This is shown in (figure 09). Rainwater falling on the DOP is collected through the drainage system and discharged towards the edge zones, which have an important water-buffering function (dS+V, 2010, p. 12; p. 213). The site therefore does not function as ordinary ground, but as a constructed landscape in which contamination, capping, water management and aftercare are interconnected.

This technical structure brings clear restrictions. Earthworks, deep-rooting vegetation and foundations are only possible to a limited extent, in principle, excavation is prohibited, and inspection chambers, monitoring wells and other aftercare facilities must remain accessible (dS+V, 2010, p. 12). The top sealing construction consists of several layers, including vegetation, a cover layer, a drainage layer, HDPE foil, Trisoplast and a support layer. Although the top sealing construction has a permanent function, its lifespan is defined as 75 years, making periodic replacement necessary (dS+V, 2010, p. 200).

The DOP can therefore not be understood as a stable or natural basis for development, but as a maintenance-dependent system. The landscape is not an end state, but a layered technical condition with different lifespans, restrictions and management regimes.

■ 1992-2001

The DOP NOAB functioned as a landfill for moderately to heavily contaminated soil. During this period, approximately 2,500,000 m<sup>3</sup> of soil was deposited on the site.

---

■ 1967-1985

The entire Oost-Abtspolder was raised from approximately NAP -6 / -7 metres to around NAP +1.25 / +2.00 metres. This was done using heavily contaminated class 4 dredged material from the Port of Rotterdam and sludge from the Overschie Plassen.

■ 2001-2003

After the landfill was closed, a capping construction was installed to seal the contaminated ground and create a controlled technical landscape.

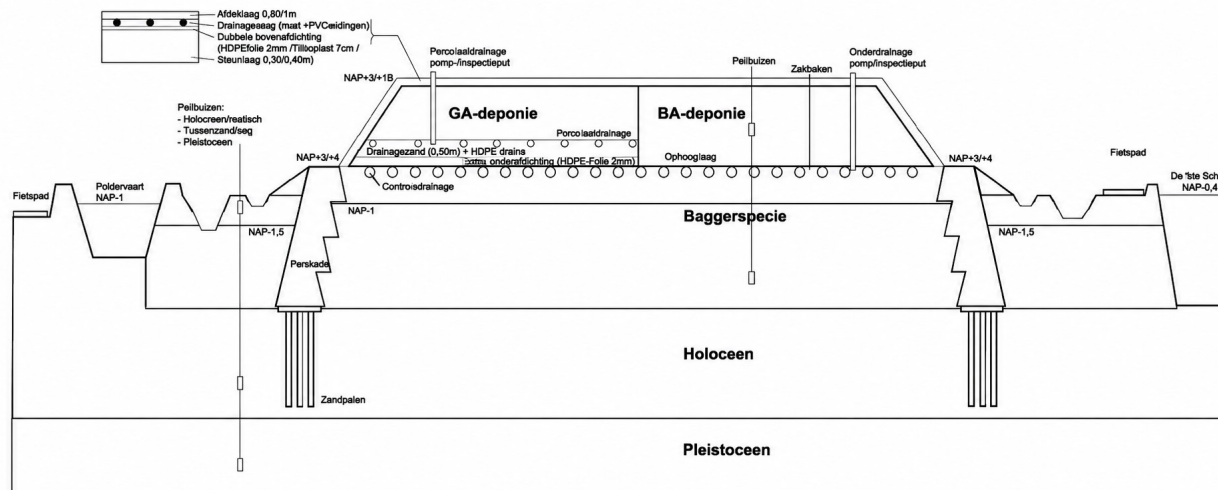


figure 09. Cross-section structure DOP NOAB East West.

### 3.2.4 Layers

Stewart Brand describes buildings as systems composed of layers with different rates of change. Elements such as furniture, spatial layout, services, façade, structure and site do not change at the same pace and each has a different relationship to the user, manager and wider community (Brand, 1994, p. 17). This layered approach makes clear that a building is not a homogeneous object. Some elements need to be able to change quickly, while others are more long-lasting. A successful building is therefore not a building that remains unchanged, but a building that can absorb change without losing its usability ( figure 10 ).

Brand argues that an adapted state is never a final state; a building must be maintained, challenged and renewed over time (Brand, 1994, p. 209). He therefore argues that architecture should no longer be understood only as “the art of building”, but as “the design-science of the life of buildings” (Brand, 1994, p. 210).

This shift moves the focus from the building as an end product to the building as a life process. Designing therefore also means considering use, maintenance, replacement, adaptation and future transformation.

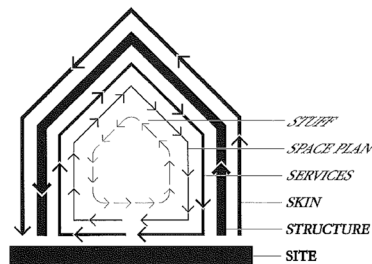


figure 10. Shearing layers of change.

### 3.2.5 Adaptability

Adaptability offers a theoretical response to the changing nature of buildings and their contexts. Askar, Bragança and Gervásio describe adaptability as a strategy to counter obsolescence, loss of function and redundancy in buildings. They connect the concept to open building, the separation between support and infill, shearing layers, circularity and resilience (Askar et al., 2021).

Adaptability is therefore not only about flexibility in use, but also about the organisation of building components. By consciously distinguishing between systems with different lifespans, buildings can be more easily adapted, maintained or reused in the future.

Kronenburg approaches flexibility through the relationship between building and user. According to him, dwellings must be able to respond to changing residents and circumstances; flexibility enables users to transform an anonymous space into a specific place (Kronenburg, 2007, p. 55). Flexible architecture is not neutral or characterless architecture. Kronenburg emphasises that flexibility requires carefully designed systems that give future users room to make appropriate decisions when circumstances change (Kronenburg, 2007, p. 110). Adaptability is therefore both technical and social: it concerns changeable structures, but also use, appropriation and involvement.

### 3.2.6 Mobility, demountability and prefabrication

Mobility and demountability form a specific development within flexible architecture. Although buildings are often seen as permanent artefacts, Kronenburg shows that movable buildings are historically and typologically more common than is often assumed (Kronenburg, 2007, p. 175).

A demountable strategy makes it possible to transport buildings in parts and assemble them quickly on site. According to Kronenburg, this offers freedom in form, scale and location, without architecture losing its meaning (Kronenburg, 2007, p. 181). Temporary or movable architecture can still create a sense of place, use value and memory (Kronenburg, 2007, p. 207).

Prefabrication and modularity provide technical and organisational means to support this approach. Smith argues that prefabrication is not automatically cheaper, but can contribute to better planning, material control, predictability and production quality when applied intentionally (Smith, 2010, p. 81). Prefabrication is therefore not synonymous with standardisation, but a production method that requires quality in both design and execution (Smith, 2010, p. 90).

Kieran and Timberlake place prefabrication within a broader shift towards integrated components and assemblies. When design and production are organised around larger coherent components, quality can increase while time and costs can be reduced (Kieran & Timberlake, 2004, p. 45). Off-site production also enables better integration of services, structure and building systems (Kieran & Timberlake, 2004, p. 129).

Recent literature confirms that prefabrication and modularity can contribute to flexibility, sustainability and efficiency in housing, although financial, logistical, regulatory and social barriers remain important for wider implementation (Djukanovic et al., 2025). Modularity is therefore not a solution in itself, but a strategy that only becomes meaningful when connected to spatial, technical and social ambitions.

### 3.2.7 Collective space and social adaptability

Adaptability is not only a matter of construction and material, but also of social space. Architecture organises the relationship between the individual and the collective. In housing, quality is not found only within the private dwelling, but also in the spaces where shared use, encounter and appropriation can take place.

Kronenburg emphasises that societies develop through cooperation and the sharing of skills and resources. Meeting places are therefore fundamental architectural spaces, precisely because they can accommodate different users and activities (Kronenburg, 2007, p. 58).

Collective space can be understood as social infrastructure: a spatial framework that supports changing forms of use. Rather than having one fixed function, such spaces must be able to accommodate multiple activities and intensities. Collectivity therefore becomes a form of adaptability: not through physical relocation, but through social and programmatic multiplicity.

### 3.2.8 Framework of change

The theories discussed above point towards an understanding of architecture as a framework for change. Till shows that architecture is dependent on contingent circumstances and cannot operate as a fully autonomous discipline. dS+V demonstrates that landscape and ground can also be technical and temporal systems. Brand describes buildings as layered structures with different lifespans. Kronenburg connects flexibility to the user, collectivity and mobility. Askar et al. position adaptability within circularity and resilience. Smith, Kieran and Timberlake show that prefabrication and modularity can contribute to quality, planning and reconfigurability when applied intentionally.

Together, these sources form a theoretical framework in which architecture is not understood as a definitive object, but as an organised system of relationships between ground, construction, material, use and time. This approach calls for design strategies that do not exclude uncertainty, but allow space for maintenance, adaptation, disassembly, reuse and changing forms of dwelling. Architecture can therefore create meaning without being fully dependent on permanence. Especially within changing or technically complex conditions, it becomes important to understand buildings as adaptive and responsible systems, designed for their full life cycle.

# RESULTS

“Architecture that is designed for adaptation recognizes that the future is not finite.”  
Robert Kronenburg

# RESULTS

## 4.1 Introduction

This chapter presents the architectural outcome of the research and design process. While the theoretical framework positions architecture as a framework for change, this chapter translates that idea into a concrete design for the DOP NOAB. The results show how theory, case-study insights and design research are translated into a spatial strategy across different scales: from the landscape and the site, to the collective residential building, the housing module and the construction detail. The project is therefore not only a proposal for a building, but a system in which ground, construction, materiality, use and time are brought into relation.

The design is structured around the concept of Apposition: the positioning of different conditions alongside one another without fully merging or resolving them. In this project, this means organising contaminated ground, temporary architecture, collective housing, local material flows and landscape structures within one adaptive architectural system.

## 4.2 The site as conflict

The project originates from the larger urban strategy for Midden-Delfland. In the vision of ZUS ( figure 11 ), Midden-Delfland is approached as a productive landscape in which food, water, ecology and landscape are understood as interconnected systems. Within this graduation project, this productive logic is extended with the production and use of building resources. The landscape therefore becomes not only a place for ecological and agricultural production, but also a potential source for architectural material cycles .

At the same time, the transition between city and landscape remains problematic. The BPL (Bijzonder Provinciaal Landschap) analysis identifies the entrance zones of Midden-Delfland as places where conflicts accumulate: monofunctionality, limited accessibility, fragmented spatial structures and a lack of identity. These conditions make the edge between city and landscape hard rather than gradual. In figure 12 are the different entrance gates shown.

When the two readings are overlaid, the project zooms in on Entrance 3: Poortgebied Schieknoop ( figure 13 ). A closer reading of the site shows that the different areas are largely monofunctional and spatially separated from one another. The relationship with Midden-Delfland is weak, and the transition between urban fabric and open landscape remains fragmented ( figure 14 ).

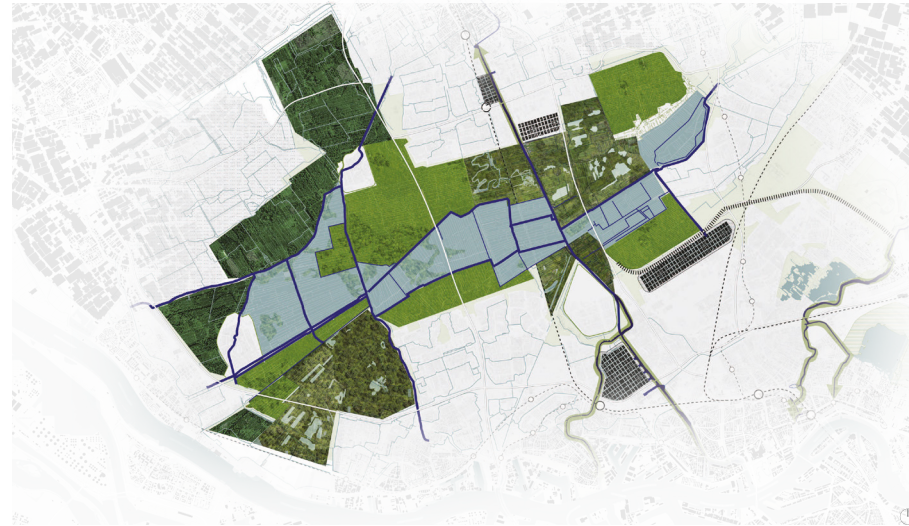


figure 11. ZUS vision for Midden-Delfland as a productive landscape.



figure 12. BPL Entrances Midden-Delfland.

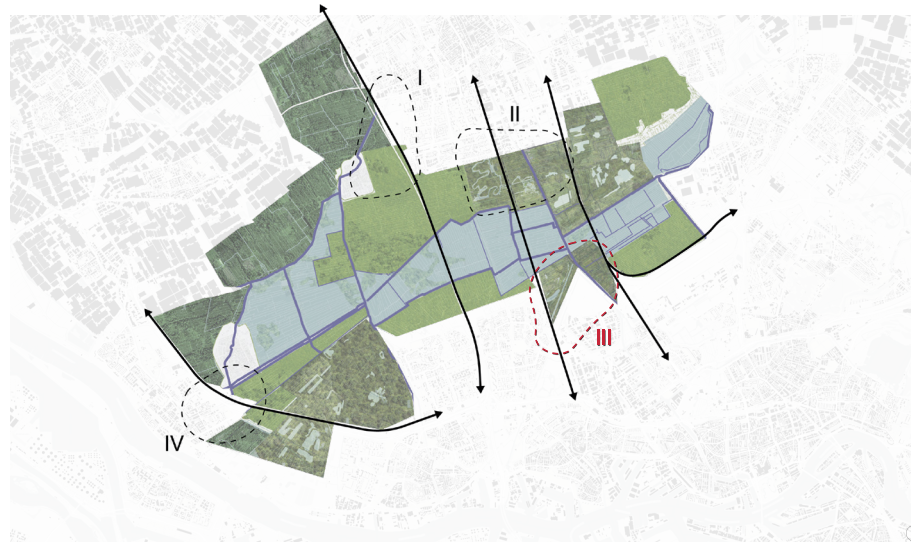


figure 13.Overlay of the ZUS vision and BPL analysis, highlighting Entrance 3: Poortgebied Schieknoop.

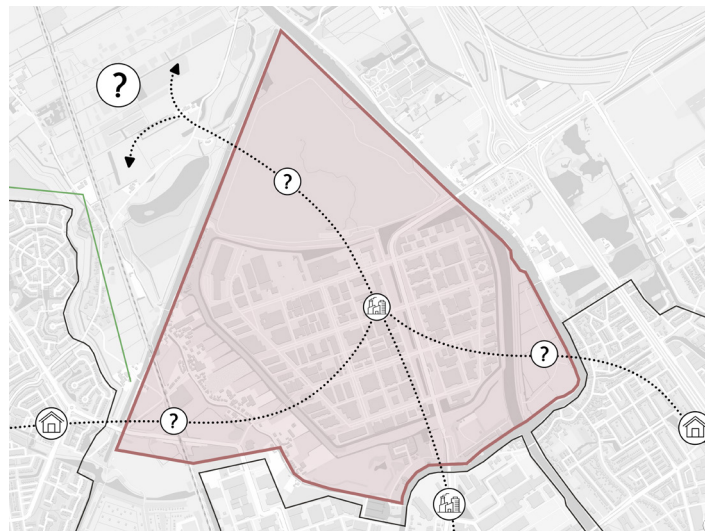


figure 14. Fragmentation analysis of Entrance 3.

From this problem, four ambitions for the masterplan were formulated. First, landscape and urban systems should no longer be treated as separate worlds, but as interwoven systems. Second, Midden-Delfland is understood not only as a productive landscape for food and water, but also as a potential source for building resources. Third, circularity becomes a spatial principle: materials, programmes and buildings should be part of longer cycles. Fourth, hard boundaries between city and landscape are softened into more fluid transition zones ( figure 15 ).

These ambitions are translated into a set of design principles ( figure 16 ). Midden-Delfland is read as a productive landscape. The productive cycle becomes a framework for urban growth: building does not take place separately from the landscape, but from what the landscape can produce, support and connect. At the same time, each sub-area develops a distinct identity based on its specific conditions. Monofunctional zones are transformed into more mixed and active environments, and infrastructure is understood not only as transport, but as a connecting framework between the different sub-areas.

Within the urban development plan, this conflict is addressed through five regions, each responding to a specific condition within the larger system ( figure 17 ). Region 2, the DOP NOAB, forms the focus of this architectural project. This area is located at the transition between the urban edge and the open landscape, but currently functions as a disconnected and underused zone.

From the perspective of the theoretical framework, this location cannot be read as a neutral building plot. Like the Oost-Abtspolder, the site is part of a technical and temporal landscape: a system in which ground, covering, drainage, maintenance and use restrictions are interwoven. The DOP NOAB is therefore not treated as empty space that can simply be filled, but as a layered condition that actively directs the architectural possibilities.

This conflict forms the starting point of the design. The question is not how the site can be fully normalised, but how architecture can operate within a landscape that is technically restricted, time-dependent and spatially underused.

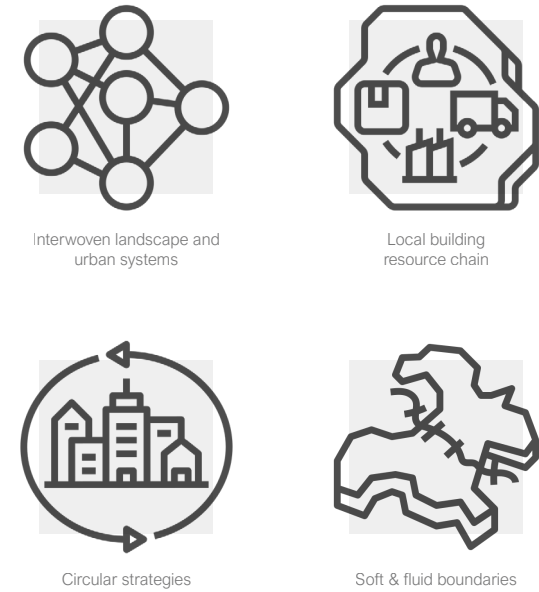


figure 15.Masterplan ambitions.

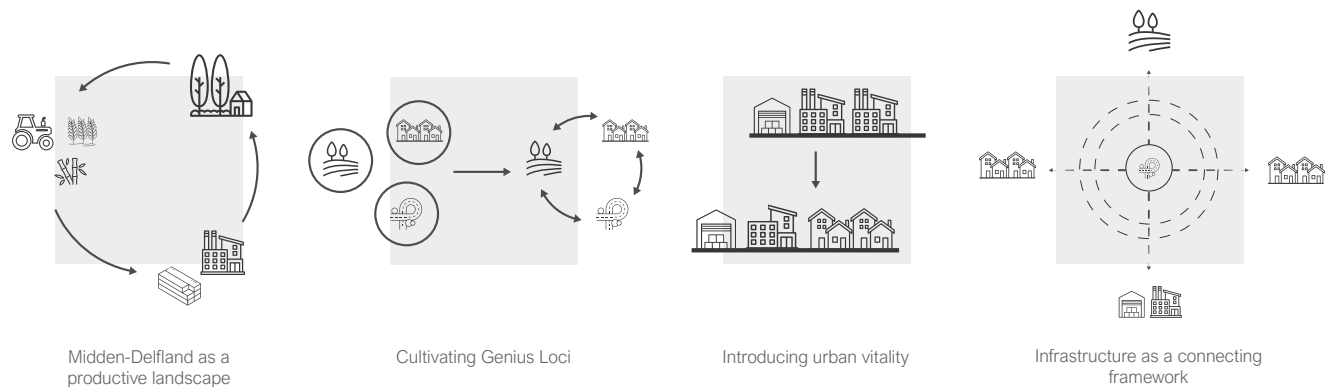


figure 16.Masterplan design principles.

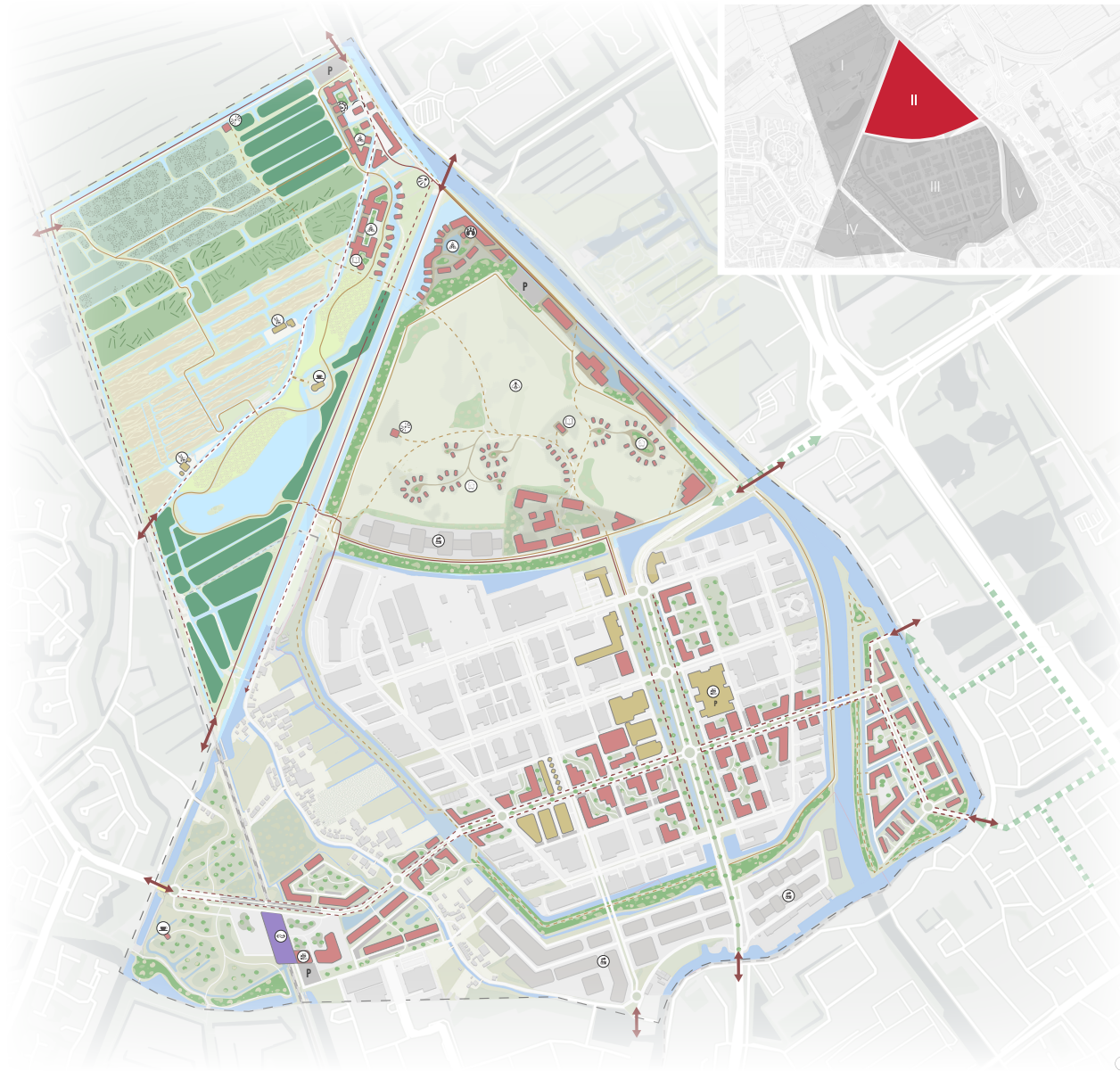


figure 17. Masterplan with focus on region 2.

■ 1992-2001

The DOP NOAB functioned as a landfill for moderately to heavily contaminated soil. During this period, approximately 2,500,000 m<sup>3</sup> of soil was deposited on the site.

■ 2008-Onwards

During the construction of the golf course, approximately 600,000 m<sup>3</sup> of fill soil, sand and topsoil was added above the existing relief and the capping construction. This created landscape undulations of up to approximately 5 metres high.

---

■ 1967-1985

The entire Oost-Abtspolder was raised from approximately NAP -6 / -7 metres to around NAP +1.25 / +2.00 metres. This was done using heavily contaminated class 4 dredged material from the Port of Rotterdam and sludge from the Overschie Plassen.

■ 2001-2003

After the landfill was closed, a capping construction was installed to seal the contaminated ground and create a controlled technical landscape.

The landscape of the DOP NOAB is not a natural or fixed condition, but a constructed terrain shaped by several technical layers. During the development of the golf course, approximately 600,000 m<sup>3</sup> of fill soil, sand and topsoil was added above the existing relief and capping system. This intervention created an artificial topography with height differences of up to approximately five metres. This five meter layer is shown in red in figure 19.

The resulting layer of clean soil creates a surface on which building appears possible. However, this surface cannot be considered permanent. Approximately every 75 years, the clean sand layer must be removed to allow the underlying drainage system to be replaced. The site is therefore temporarily buildable, but cannot provide the stable and permanent foundation generally assumed by conventional architecture.

This time-dependent condition leads to the central paradox of the site.

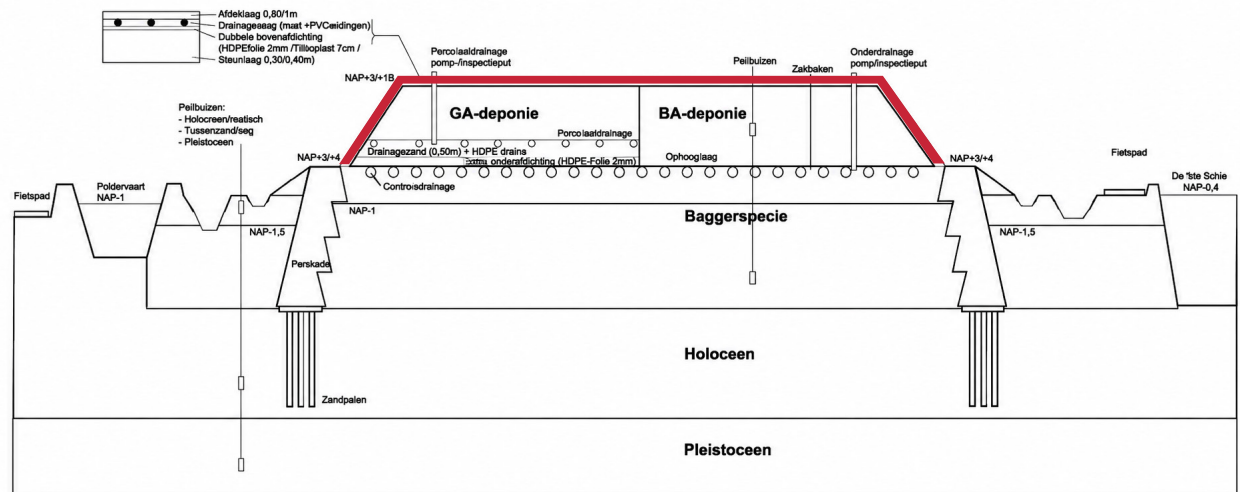


figure 19. Cross-section structure DOP NOAB East West.

### 4.3 The paradox

The central paradox of the site is that it appears both necessary and difficult to use. On one side, the housing challenge calls for new spatial strategies and for the revaluation of underused sites. On the other side, this specific location cannot be approached as a conventional building plot, because the ground cannot be assumed to function as a stable and permanent basis.

This condition shifts the architectural logic from anchoring to reversibility. Instead of designing a building that permanently claims the ground, the site asks for a system that takes into account maintenance, limited interventions in the ground and future change. Time therefore becomes not an external constraint, but an active part of the design.

The design responds with a lightweight and demountable building system that can be placed, adapted and removed when the conditions of the site require it. This relates to the theoretical shift from architecture as a final object to architecture as a life process, in which buildings are designed not only for completion, but also for use, maintenance, adaptation and possible disassembly.

The paradox is therefore not resolved by ignoring the contaminated ground. Instead, it becomes the starting point for another form of architecture: an architecture that can become meaningful without being fully dependent on permanence.

### 4.4 From object to system

The first architectural translation of this approach is the modular housing system. The module is not introduced as a formal preference, but as a means to enable adaptability, demountability and reuse. In this way, the design aligns with the idea that buildings can function better when components with different lifespans are consciously distinguished from one another.

The basic dwelling consists of three modules. One module contains the fixed and service-related functions ( figure 20 ): kitchen, bathroom, technical installations and other utilities. The two other modules remain more open and flexible ( figure 21 ), allowing them to be used as living, sleeping or working space. Together, these three modules form a compact dwelling of approximately 40 m<sup>2</sup> ( figure 23 ). This separation between fixed and flexible components makes the system adaptable. The service module functions as a concentrated core, while the open modules allow for different forms of use. The dwelling is therefore not understood as a static final image, but as a spatial framework that can respond to changing residents, households and patterns of use.

The dimensions of the modules are based on the utility space and the logic of transport by truck. This makes the system suitable for prefabrication, transport and assembly on site. The module is therefore both a spatial and logistical unit. It allows the dwelling to be produced elsewhere, placed on site with limited intervention, and removed or reused in the future.

The system also allows variation. Multiple modules can be combined into larger dwellings or different housing types. This makes it possible to respond to different household compositions and changing needs over time. The architecture is therefore not a fixed typology, but an adaptive system that can support different configurations ( figure 24 ).



figure 20. One functional core.



figure 21. Two open components.

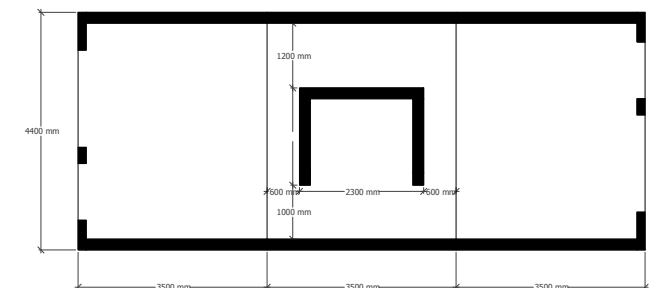


figure 22. Dimensions one module.

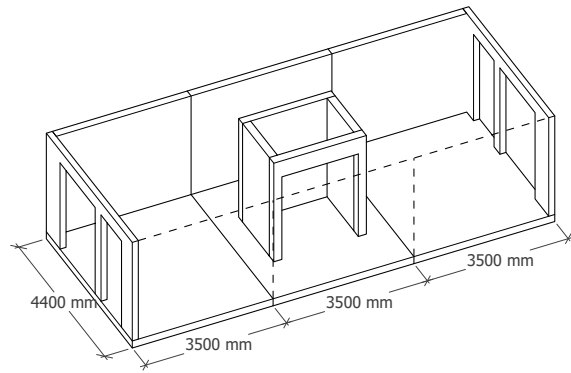


figure 23. Module principle: one service module and two flexible open modules forming a compact dwelling.

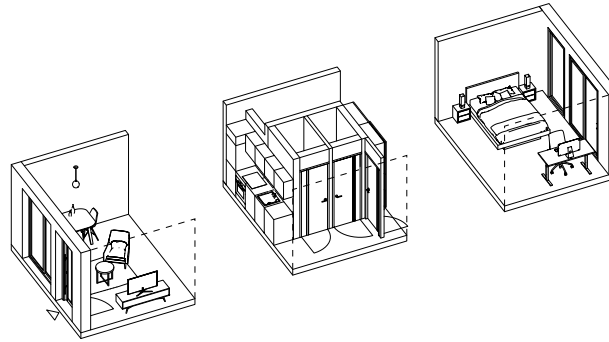


figure 25. Axonometric module gallery.

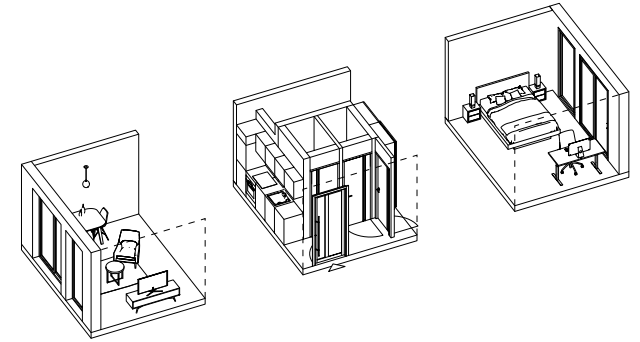


figure 27. Axonometric module portico and corridor.

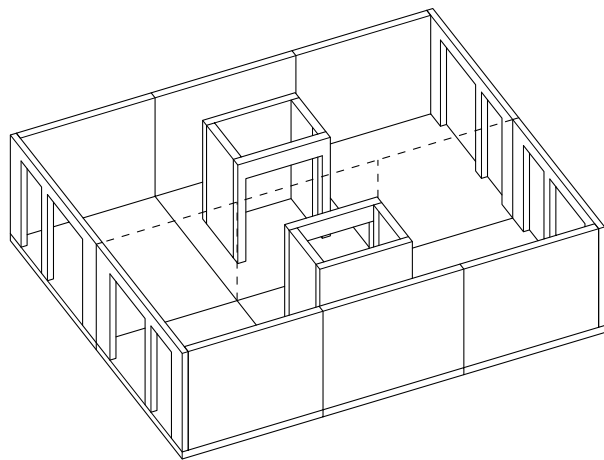


figure 24. Combined module configurations.

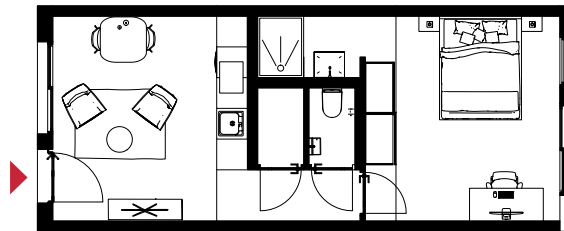


figure 26. Floorplan module gallery.

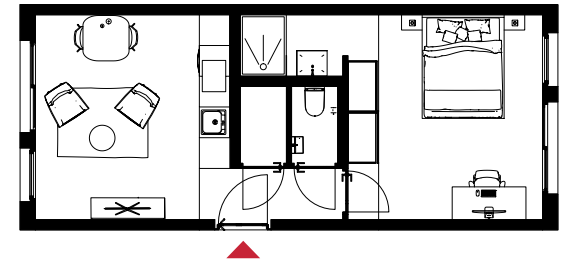


figure 28. Floorplan module portico and corridor.

Two module variants form the basis of the system: one with the entrance positioned on the left ( figure 26 ) and one with a centrally placed entrance ( figure 28 ). By combining these variants in different configurations, multiple building typologies can be created.

At the scale of the building, the modules are assembled into collective residential blocks. Three building typologies can be created: gallery access, portico access and corridor access ( figure 29, figure 30, figure 31 ).

These blocks are not only aggregations of dwellings, but structures in which circulation, collective rooms and outdoor spaces become part of the same architectural system. The project therefore moves from module to dwelling, from dwelling to building, and from building to urban composition.

#### 4.5 From system to landscape

The spatial strategy begins with the existing topography of the DOP NOAB site. Rather than ignoring the terrain, the design uses the differences in height as a starting point. The architecture follows the shape and direction of the landscape, allowing the buildings to respond directly to the existing ground conditions ( figure 32 ).

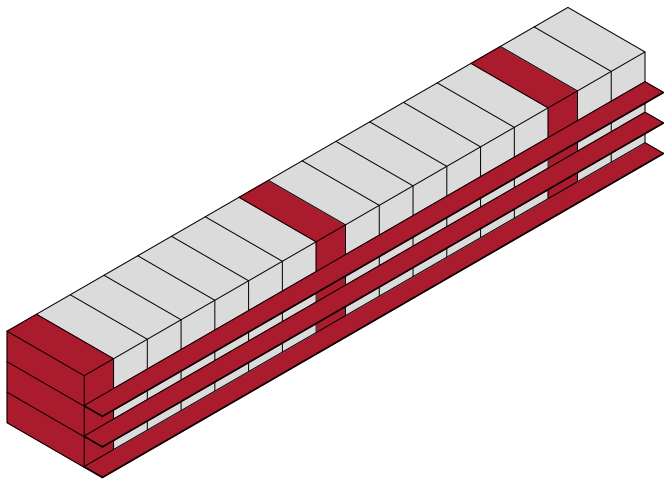


figure 29. Gallery typology.

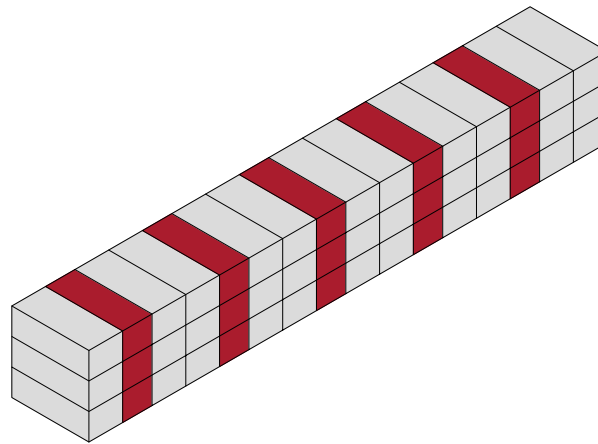


figure 30. Portico typology.

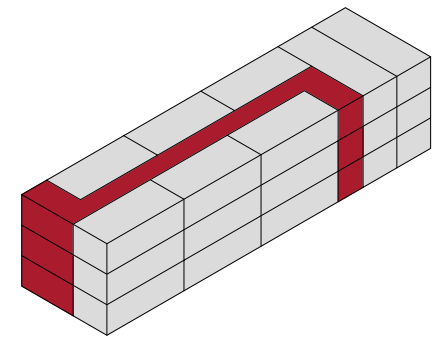


figure 31. Corridor typology.



figure 32. Topography as structure.

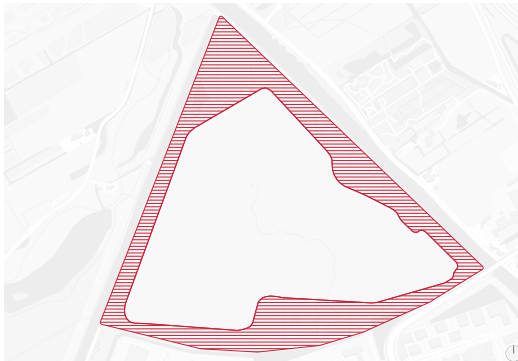


figure 33. Strengthening the green edges.

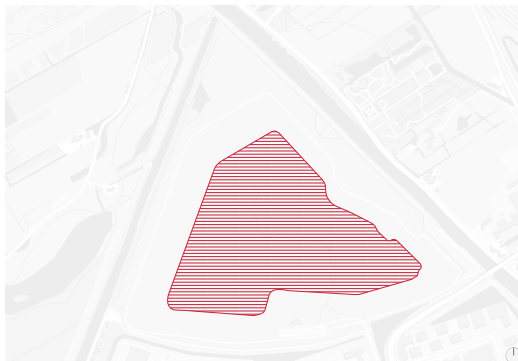


figure 34. open centre as spatial quality.

Around the contaminated triangle, areas of clean and living landscape are preserved. These zones remain unbuilt and are strengthened through vegetation and ecological development ( figure 33). At the same time, the open centre of the site is maintained as one of its defining spatial qualities. By concentrating the buildings along the edges, the openness, views and distinctive landscape identity of the former waste mound remain visible and accessible ( figure 34 ).

The position and orientation of the buildings are guided by the contours of the mound. The outer buildings are placed higher on the slope and follow the direction of the contour lines. The buildings closer to the centre are rotated into the slope, creating a spatial movement towards the open heart of the site. Together, these buildings form a composition that responds to the topography while framing collective outdoor spaces and maintaining a relationship with the central landscape ( figure 35 ).

This spatial building composition is repeated across the triangle ( figure 37 ). Through this repetition, the modular system creates a coherent development pattern that follows the landscape without occupying it entirely. The architecture is positioned as an addition to the existing terrain, preserving the contrast between the built edges and the open centre.

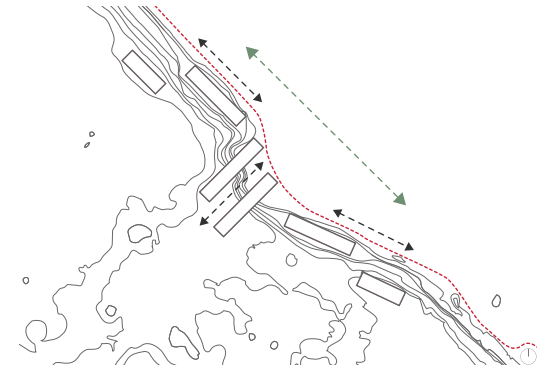


figure 35. Positioning buildings.



figure 36. Spatial building plan.



figure 37. Repetition spatial building plan.

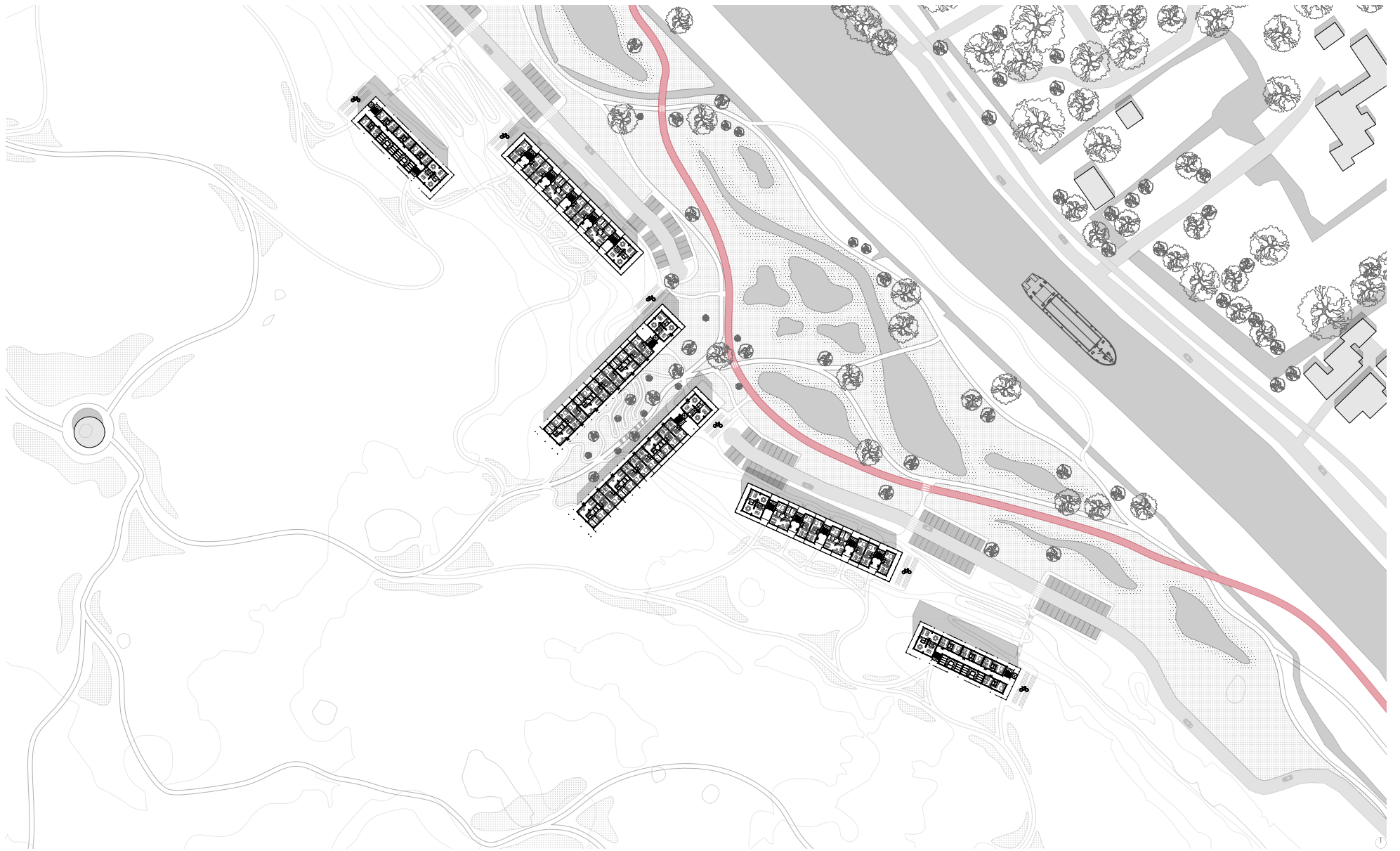


figure 38.Situation.

The site strategy shown in figure 38 strengthens the green edge of the DOP NOAB and uses landscape as the main organising structure. The existing green boundary is reinforced through planted embankments, soft riverbanks and a park route that moves through the site. Instead of treating the contaminated ground as an isolated object, the landscape is opened up through paths, small vegetation and new connections.

The bicycle path is redirected further into the site, drawing visitors along the buildings and past the café located on the ground floor. In this way, mobility is not only treated as circulation, but as a way to activate the edge between the housing system and the surrounding landscape. The existing road is reused for access, limiting the need for additional infrastructure on the sensitive ground. Parking is positioned carefully, so that it does not disturb the views from the dwellings towards the open landscape.

The green park is pulled inward through the collective courtyard between the gallery buildings. These gallery buildings are placed perpendicular to the other building volumes, which follow the line of the mound. This creates a spatial composition in which the buildings frame outdoor spaces while still maintaining a strong relationship with the landscape. The building typologies are positioned in response to the topography: the corridor buildings are located on the outer edge and highest part of the site, the portico buildings occupy the intermediate level, and the gallery buildings are placed at the lowest level.

Accessibility is an important part of the site strategy. The buildings are wheelchair accessible, and the routes are designed in relation to the contour lines of the landscape. These paths connect the housing clusters to the wider park system and lead towards the viewing tower on the western side of the site. At the intersections of the paths, low vegetation is introduced, using planting that can grow within the restrictions of the landfill landscape.

Together, the paths, courtyards and green edges transform the site from a separated technical landscape into a connected living environment. The landscape is not erased or hidden, but becomes the structure through which housing, collective space and public routes are organised.

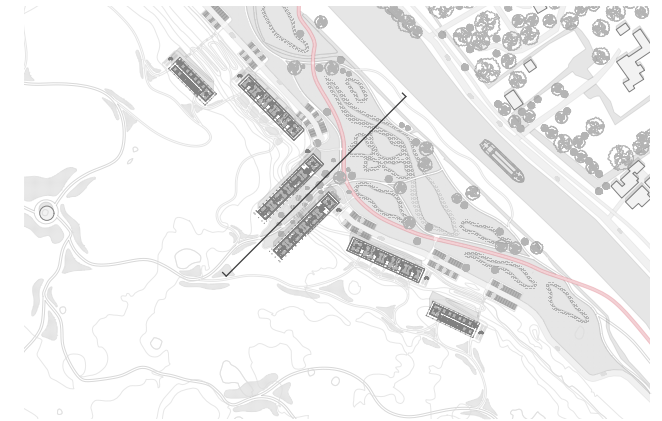


figure 39. Site plan indicating section line.

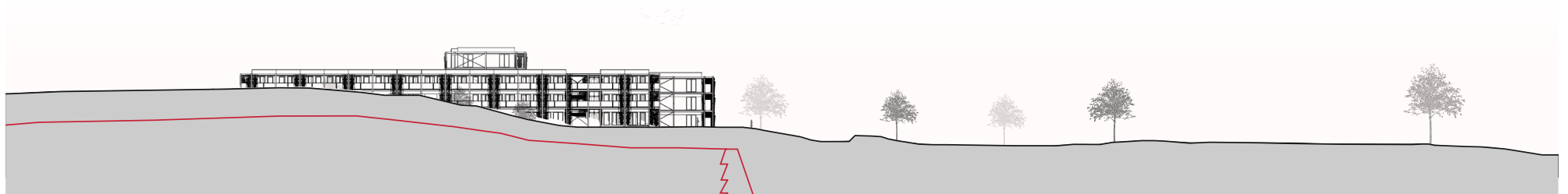


figure 40. Section.

## 4.6 Life inside the system

The two gallery-access buildings are positioned perpendicular to the contour lines of the former waste mound. Rather than following the slope, they cut into the topography and create a strong spatial direction towards the centre of the site. Their orientation draws residents, cyclists and visitors into the landscape and strengthens the connection between the outer route and the interior of the mound. A café is located on the ground floor ( figure 41 ), directly connected to the existing cycling path. It provides a place where passing cyclists can stop for a coffee, while also functioning as an informal meeting place for residents and visitors.

The dwellings are accessed through external galleries, and a lift ensures that all floors are accessible ( figure 42 ). The green space between the buildings is designed as a public park. An accessible ramp runs through this landscape, allowing wheelchair users and people with limited mobility to reach and experience the higher parts of the mound.

Because the individual dwellings are relatively compact, community rooms are integrated into the buildings ( figure 43 ). These spaces extend the private home and provide residents with places to meet, work or organise larger activities. A resident could, for example, celebrate a birthday in a shared room rather than having to accommodate a larger group within a small dwelling.

The portico buildings are accessed through shared staircases ( figure 44 ). This circulation principle creates a more private form of access while maintaining a collective entrance for several dwellings. Shared rooms are also included in these buildings, creating additional space for social interaction and communal activities ( figure 45 ).

The corridor buildings are positioned higher on the mound. Their circulation is organised internally through corridors, stairs and a lift ( figure 46 ). An additional wheelchair-accessible ramp connects these buildings to the surrounding landscape and makes the elevated part of the site accessible to a wider range of users. In figure 47 is the community space shown.

Together, the three building typologies combine different forms of circulation, accessibility and collective living. The shared rooms, public functions and accessible landscape routes support social interaction while allowing residents to maintain the privacy of their own homes.

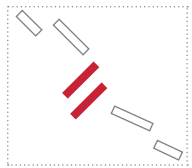


figure 41. Groundfloor gallery café.



figure 42. Second floor gallery access.

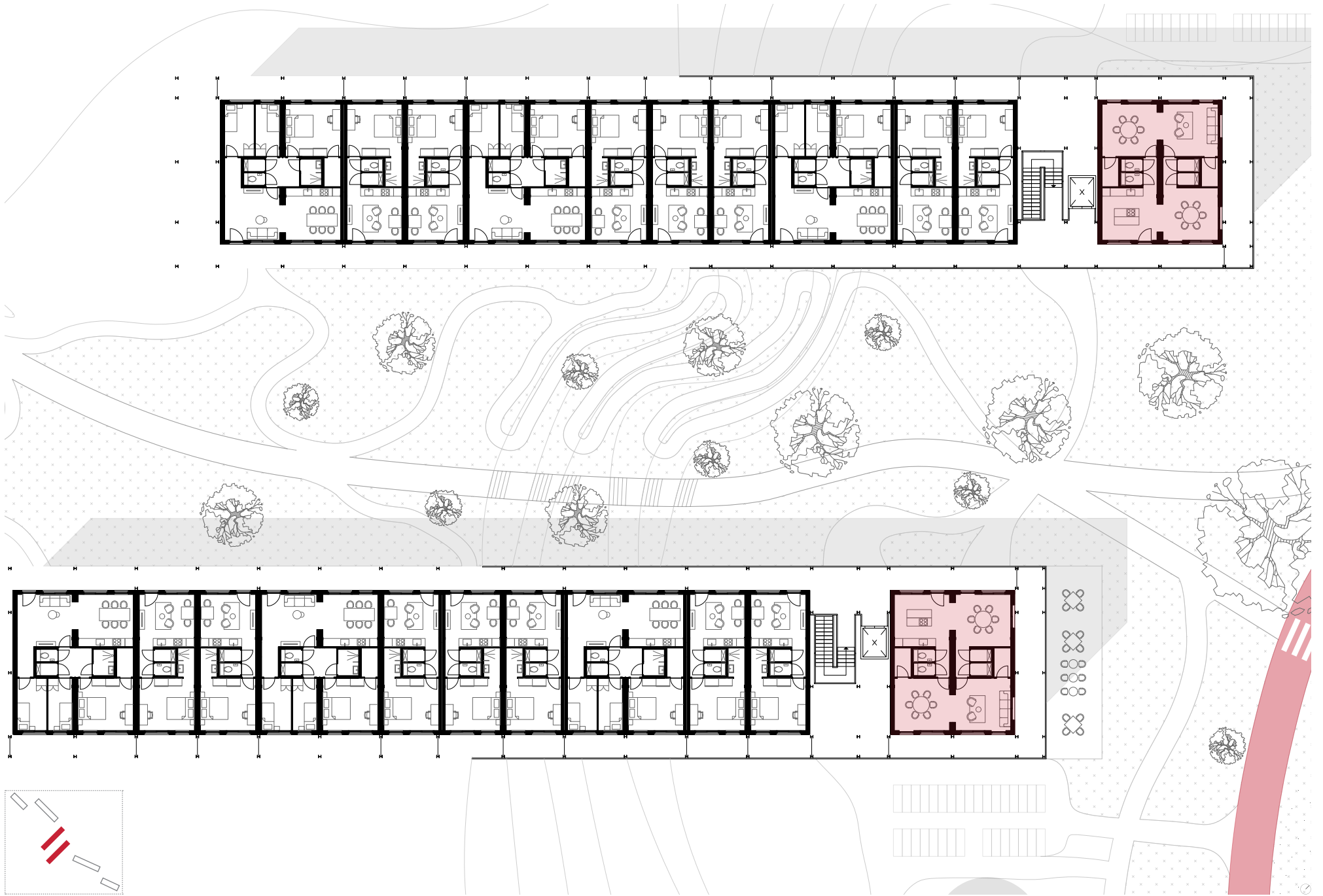


figure 43. Second floor gallery community space.

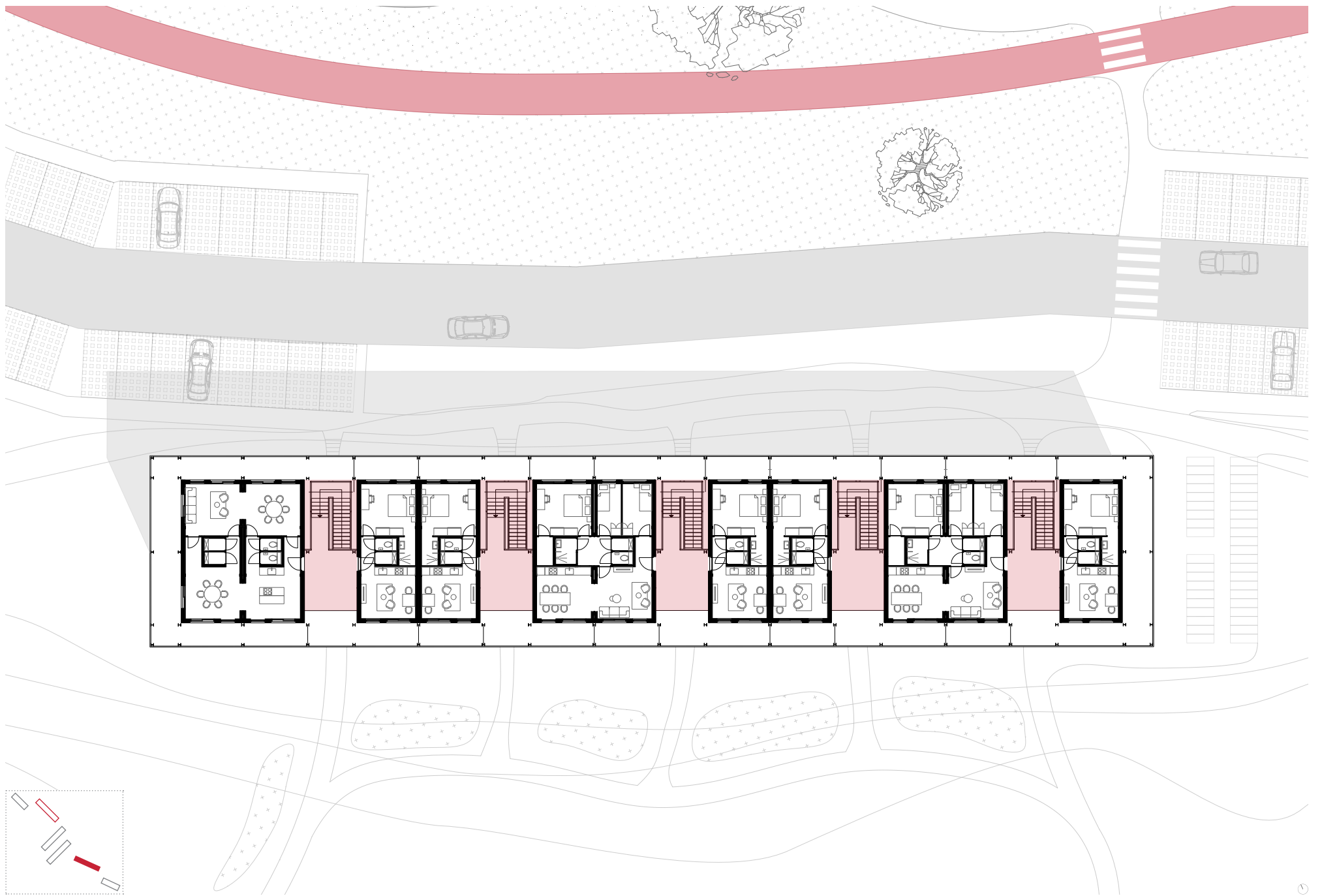


figure 44. Second floor portico access.

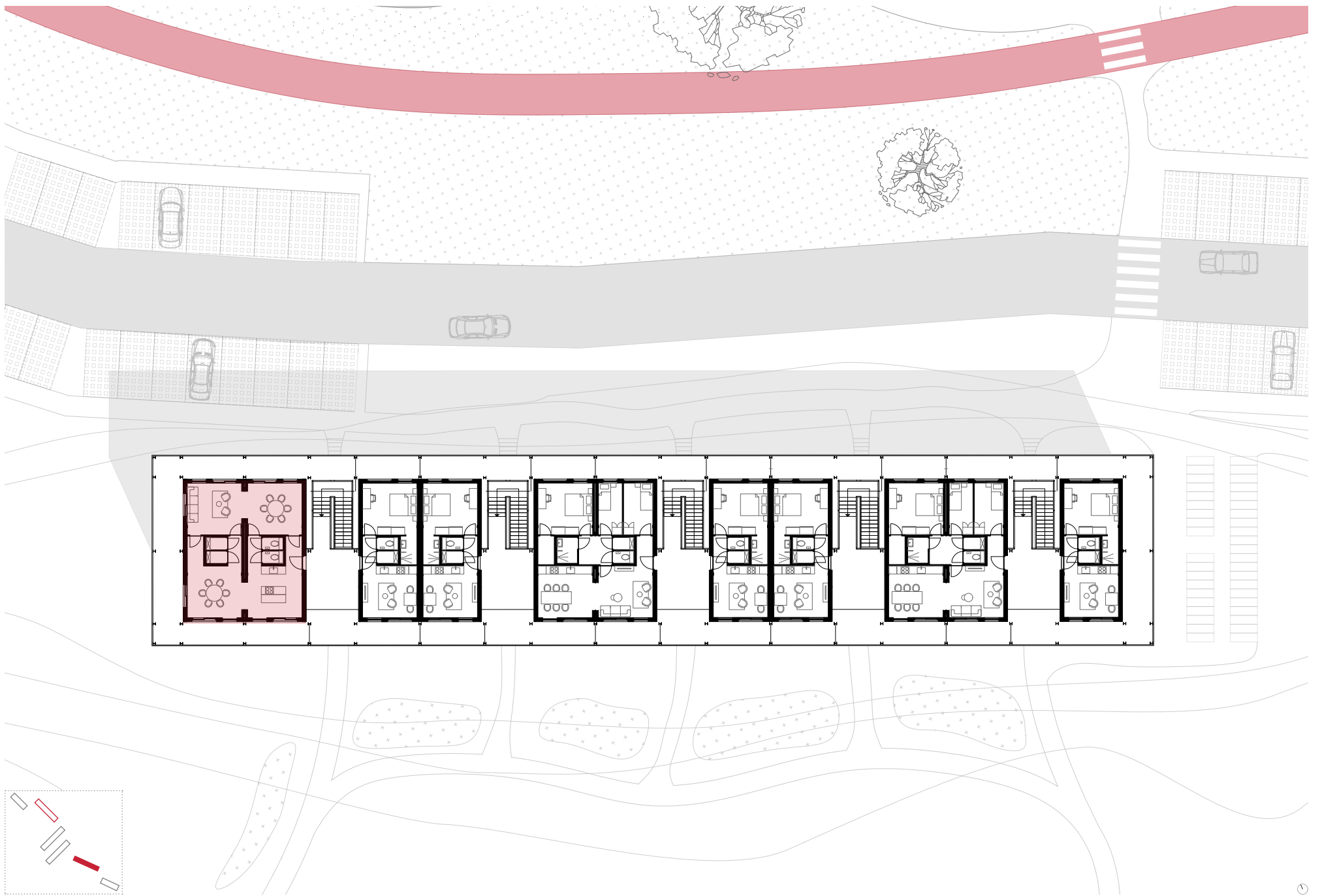


figure 45. Second floor portico community space.

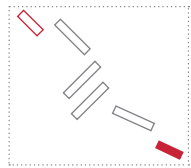
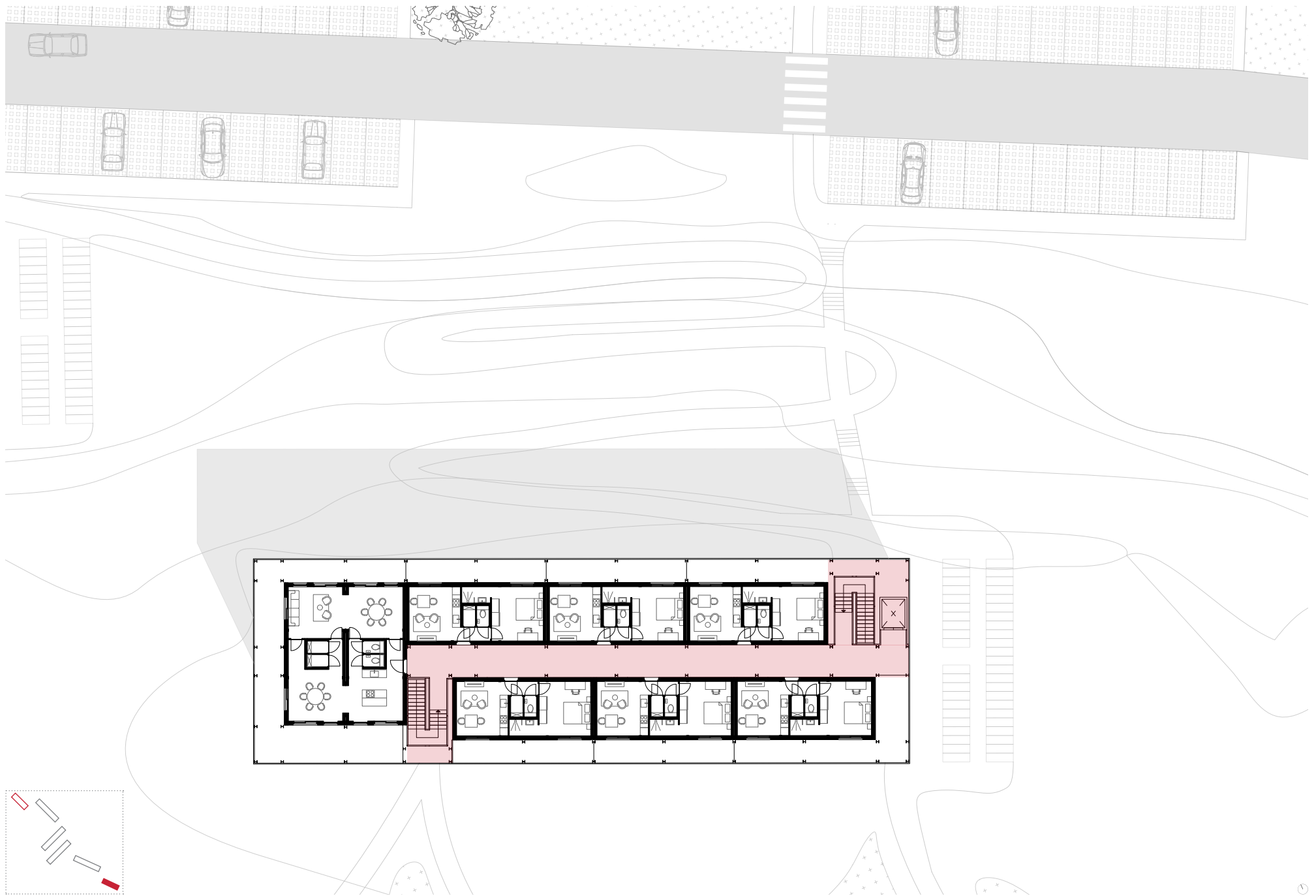


figure 46. Second floor corridor access.

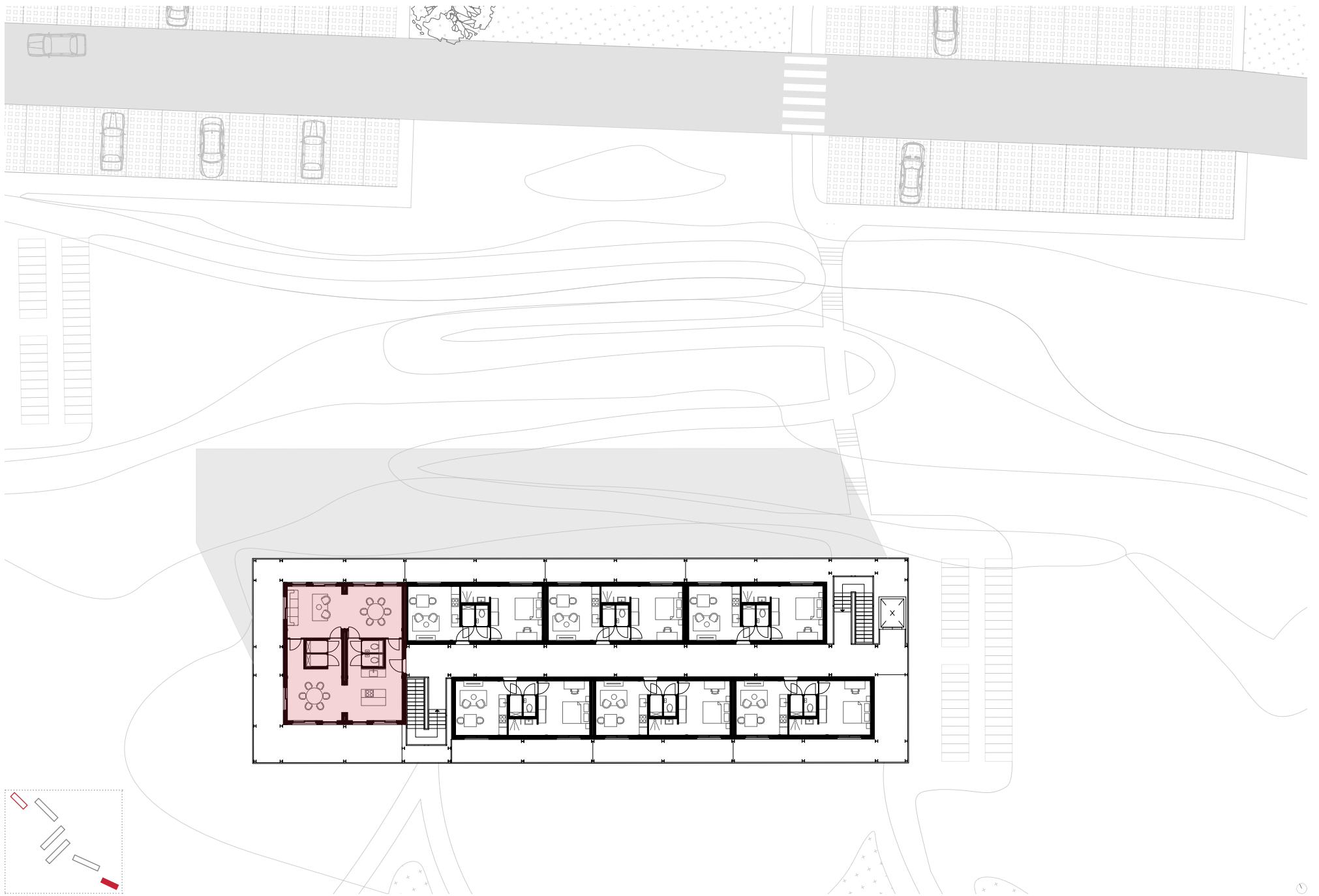


figure 47. Second floor corridor community space.



figure 48.Front elevation.

#### 4.7 Material logic and building detail

The architectural expression of the building reflects the combination of two material systems. The front façade ( figure 48 ) is characterised by warm timber cladding, which gives the housing a domestic and tactile appearance. This contrasts with the more industrial character of the external steel circulation structure. Rather than concealing the technical and demountable character of the building, the façade makes this construction logic visible.

In the vertical section ( figure 49 ), the relationship between the residential modules and the circulation structure becomes clear. The modular timber building and the steel access structure are conceived as separate but connected systems. The accesses are supported by an independent steel frame, allowing them to be assembled, maintained or removed without interfering with the primary CLT structure of the dwellings. Additional structural elements are concentrated around the staircases, where they provide stability to the freestanding circulation structure.

The material distinction also clarifies the different forms of use. The external circulation routes are finished with industrial steel grating, creating a light and permeable structure through which rainwater and daylight can pass. The private balconies, by contrast, are finished with warm timber decking ( figure 51 ). Although both spaces form part of the same external structure, their material treatment distinguishes circulation from inhabitation.

The horizontal section ( figure 50 ) shows how the individual modules are positioned alongside one

another. Each dwelling is organised through the combination of a compact functional core and a more open living area.

The isometric section ( figure 51 ) demonstrates how these functional cores are stacked vertically. This creates a clear installation strategy in which water, ventilation, heating and other building services can be organised through aligned vertical shafts. The stacking of the cores reduces the length and complexity of the installation routes and allows technical maintenance to remain concentrated within accessible zones.

The full-height building section ( figure 52 ) further reveals this relationship between the repeated modules, the aligned service cores and the external circulation system. The building can therefore be understood as an assembly of several coordinated layers: the CLT residential modules, the stacked technical cores, the demountable façade system and the independent steel circulation structure.

A closer view of the steel circulation ( figure 54 ) shows how this secondary structure can be constructed from reused components. Steel elements are sourced, where possible, from donor buildings located on the nearby industrial terrain ( figure 53 ). In this way, the circulation structure is not only technically demountable but also forms part of a larger material cycle. Existing structural components are given a new function instead of being treated as demolition waste.

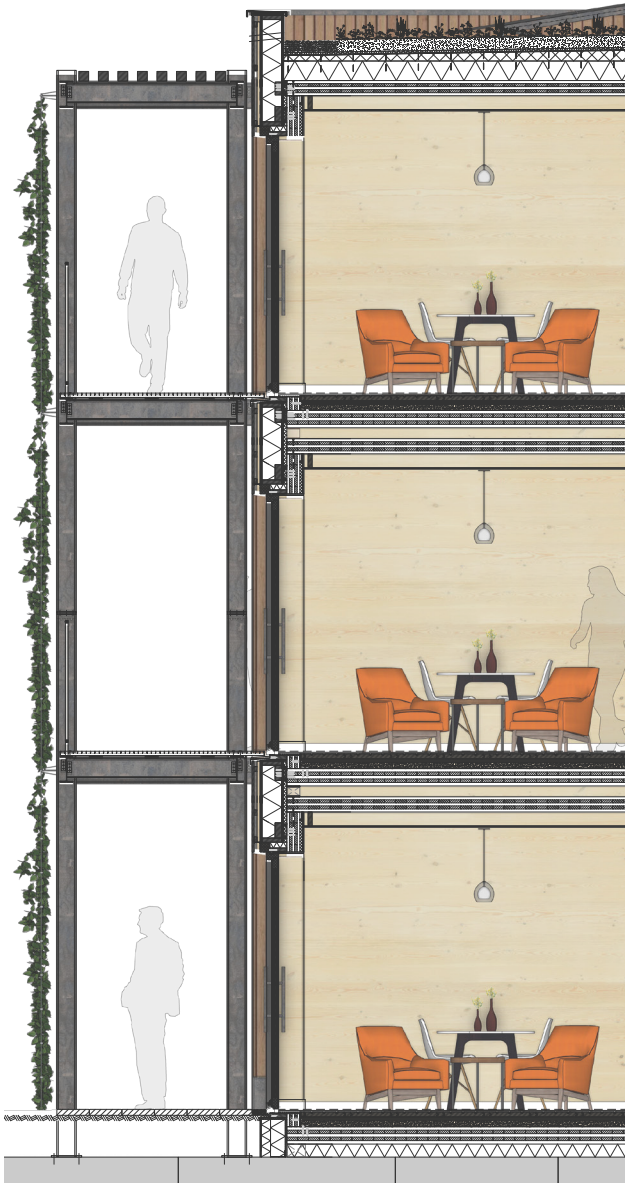


figure 49. Vertical section building.



figure 50.Horizontal isometric section.



figure 51. Isometric section.



figure 52. Vertical section.

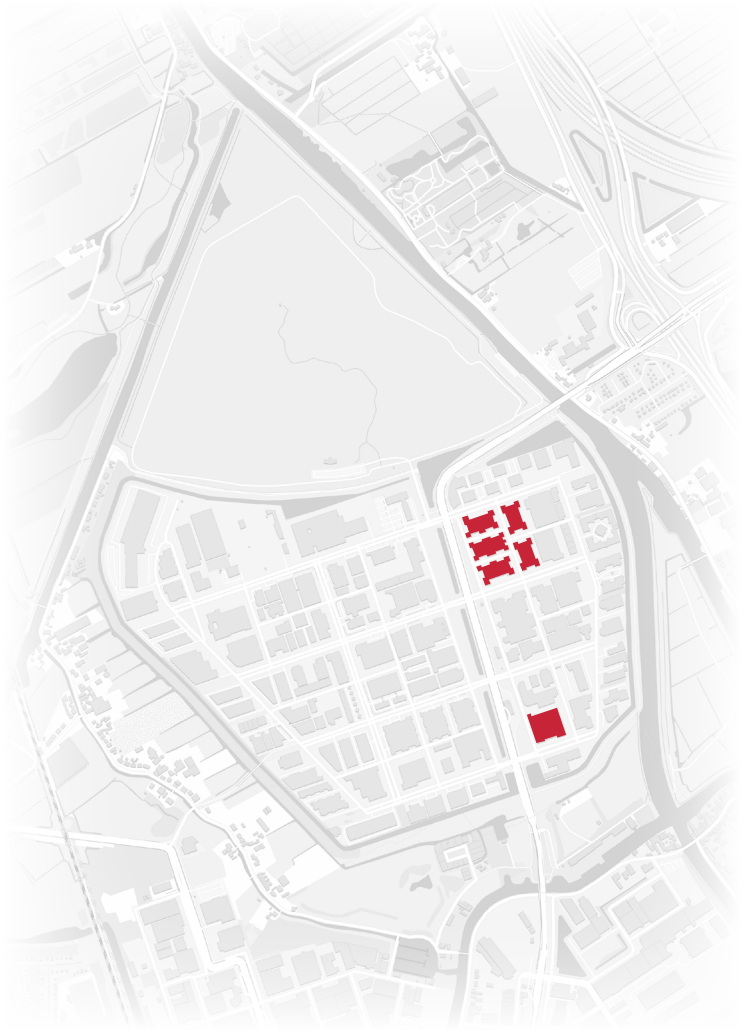
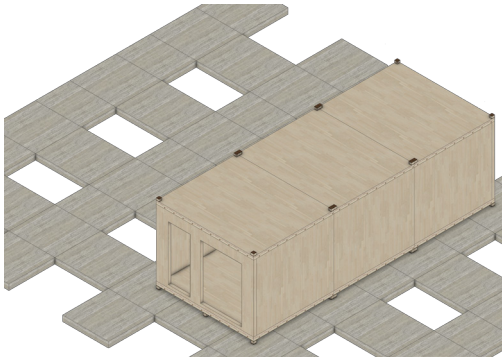


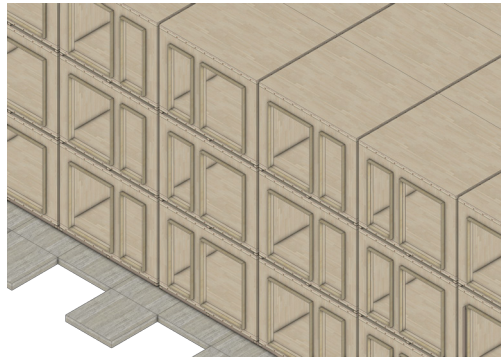
figure 53. Steel from donor buildings region 3.



figure 54. Steel access.



01



04



07



02



05



08



03



06

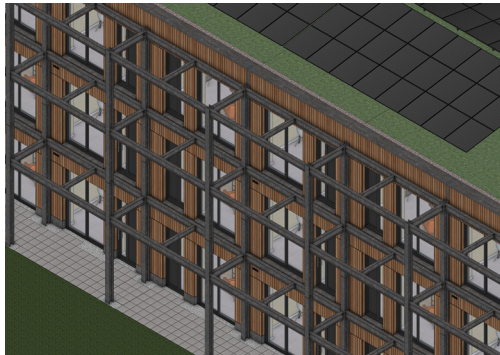


09

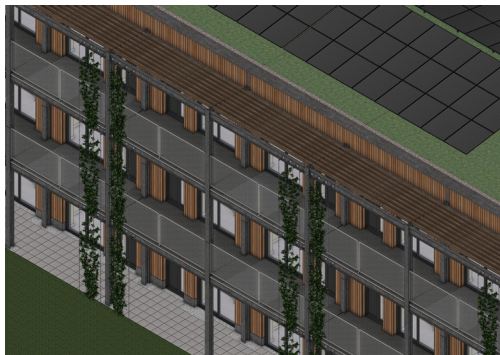
figure 55. Isometric assembly.



10



11



12

The construction process is developed as a sequence of twelve assembly steps ( figure 55 ). This sequence shows that the building is not conceived as one permanent object, but as a collection of components that can be assembled, replaced and eventually dismantled.

In the first step, precast concrete Stelcon slabs are positioned directly on the prepared ground. These slabs create a stable and level foundation without requiring piles or a permanent poured concrete structure. A prefabricated CLT module is then placed on top of this foundation. In the second step, multiple modules are positioned alongside one another to form the ground floor. The dry connections between the modules allow them to be individually assembled and separated. In the third step, additional modules are stacked to create a building of three storeys. The construction is limited to three levels because of the load-bearing capacity and lightweight foundation principle. This restriction is accepted as part of the site-specific design rather than being solved through heavier and more permanent foundations.

In the fourth step, projecting frames are installed around the window and door openings. These elements create depth in the façade and form a clear transition between the prefabricated module and the later façade layers. In the fifth step, the windows, doors and sliding doors are inserted into these prepared openings. Their dimensions are standardised throughout the building, making replacement, reuse and interchangeability easier.

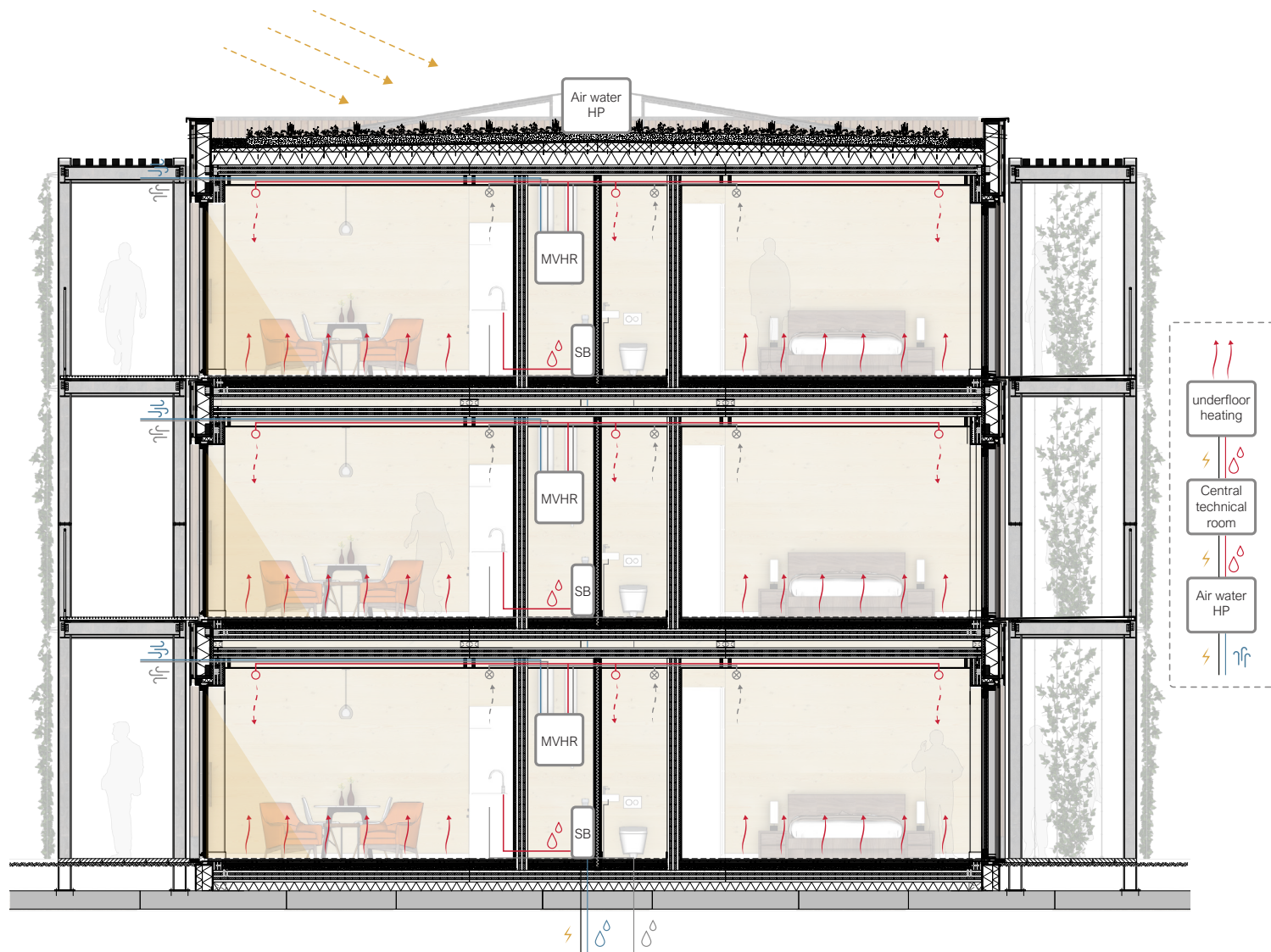
The sixth step introduces the timber-frame façade structure. In this drawing, the internal structure of the timber frame is made visible in order to explain its construction. In practice, these components arrive as prefabricated closed panels, as shown in the seventh step. Prefabrication reduces the amount of work required on site and allows the façade elements to be installed and removed as complete components.

In the eighth step, the vertical and horizontal battens are added. This substructure creates a ventilated cavity and provides the fixing system for the external cladding. Because the cladding is mechanically fixed to the battens, individual components can be replaced without dismantling the complete façade. In the ninth step, the photovoltaic panels, roof-edge elements and plinth are installed. These components complete the technical transitions at the top and bottom of the building.

In the tenth step, the timber façade material is added. The timber creates a warm external appearance while remaining part of a dry and demountable façade system. In the eleventh step, the independent steel structure for the galleries, stairs and balconies is positioned alongside the modular building.

Finally, in the twelfth step, this circulation structure is completed with railings, steel gratings, timber balcony decking and vegetation. The result is a layered building in which the residential modules, façade and access structure remain technically distinguishable and can be adapted independently.

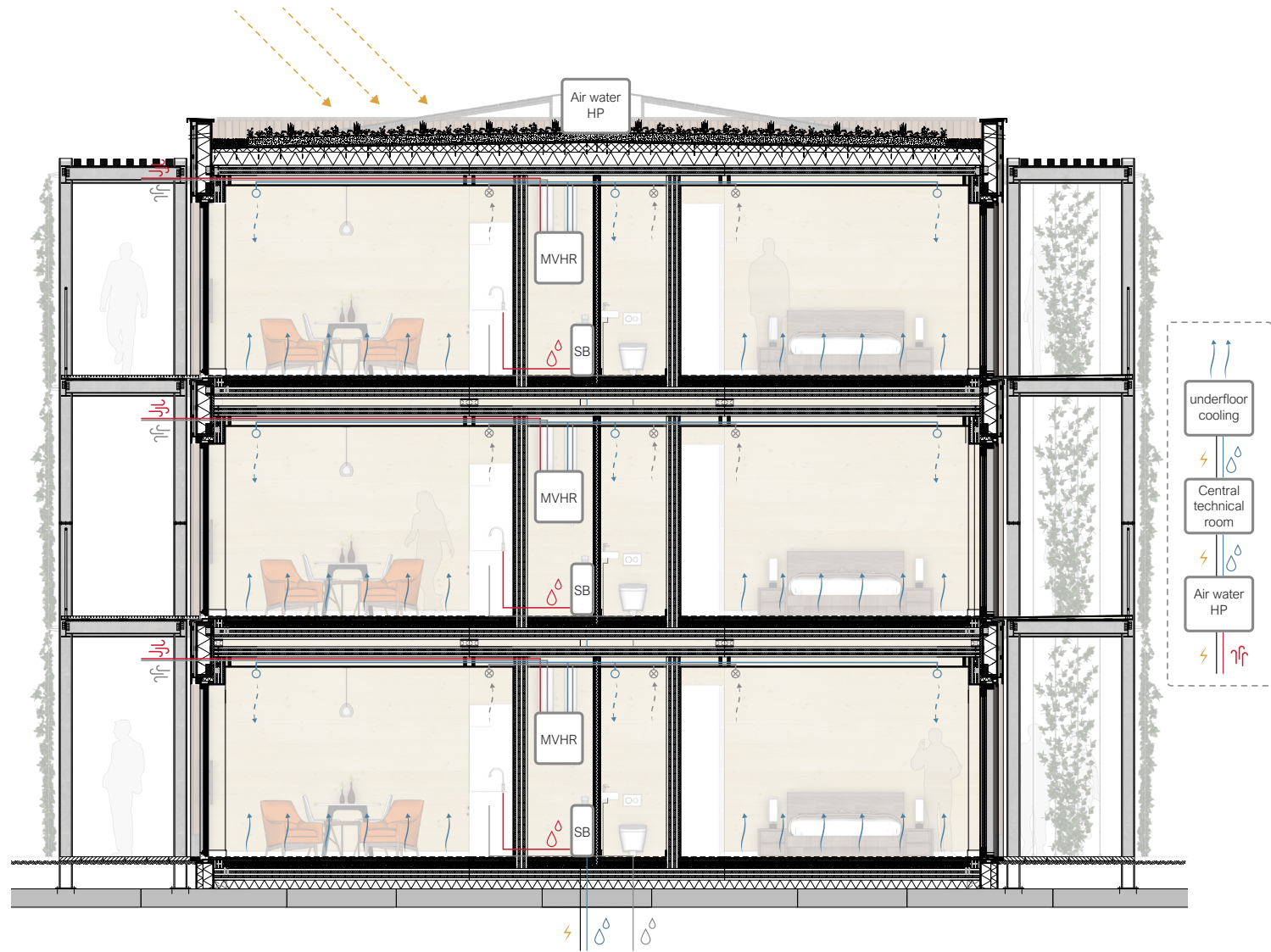
- Photovoltaic panels  
PV panels on the roof generate renewable electricity.
- Green roof  
Improves the microclimate around the solar panels and supports rainwater retention.
- Green façade  
Reduces wind exposure and supports winter thermal comfort.
- Central air-to-water heat pump (HP)  
Central air-to-water heat pump for low-temperature heating
- Type D ventilation with heat recovery (MVHR)  
Mechanical air supply and exhaust with heat recovery
- Winter solar  
Large windows allow winter sun to enter the apartment, providing passive solar gain and reducing heating demand.
- Salt boiler (SB)  
Compact salt-based thermal battery for domestic hot water storage.
- Underfloor heating  
Dry Lithotherm floor with integrated pipes for winter heating



- Service core  
The kitchen, bathroom and technical systems are concentrated within a compact service core, allowing efficient stacking and clear installation routes.
- Fire-rated shaft  
The vertical service shaft is enclosed with fire-rated construction, and all service penetrations are sealed to maintain compartmentation between apartments.
- Reversible construction  
The building is designed as a reversible system, using timber, dry floor build-ups and demountable connections to allow future adaptation or dismantling.
- Roof as technical layer  
The roof combines energy generation and building services, integrating PV panels, heat pump units and maintenance access in one technical zone.
- Low-impact foundation  
The use of stelcon slabs minimises permanent intervention in the ground and supports the temporary character of the building system.
- Dry floor system  
The dry Lithotherm screed contains the underfloor heating pipes without using a wet poured screed. This supports reversibility and reduces construction weight.

figure 56. Climate section winter.

- Photovoltaic panels  
PV panels on the roof generate renewable electricity, especially during periods of high solar radiation.
- Green roof  
Vegetation cools the roof surface, improves the microclimate around the solar panels and supports rainwater retention.
- Green façade  
Vegetation on the façade reduces heat gain, cools the building surface and supports biodiversity.
- Central air-to-water heat pump (HP)  
During summer, the heat pump can operate in reverse mode, it supplies cooled water to the floor system, allowing the apartments to be gently cooled.
- Type D ventilation with heat recovery (MVHR)  
In summer, the ventilation system can use a bypass mode. Cooler fresh air can enter the apartment without being warmed by the outgoing indoor air.
- Solar shading  
Integrated external screens reduce direct solar radiation before it reaches the façade. This limits overheating and improves indoor comfort during warm periods.
- Salt boiler (SB)  
Compact salt-based thermal battery for domestic hot water storage.
- Underfloor cooling  
Dry Litothem floor with integrated pipes summer cooling.



- Service core  
The kitchen, bathroom and technical systems are concentrated within a compact service core, allowing efficient stacking and clear installation routes.
- Fire-rated shaft  
The vertical service shaft is enclosed with fire-rated construction, and all service penetrations are sealed to maintain compartmentation between apartments.
- Reversible construction  
The building is designed as a reversible system, using timber, dry floor build-ups and demountable connections to allow future adaptation or dismantling.
- Roof as technical layer  
The roof combines energy generation and building services, integrating PV panels, heat pump units and maintenance access in one technical zone.
- Low-impact foundation  
The use of stelcon slabs minimises permanent intervention in the ground and supports the temporary character of the building system.
- Dry floor system  
The dry Litothem screed contains the underfloor heating pipes without using a wet poured screed. This supports reversibility and reduces construction weight.

figure 57. Climate section summer.

The winter ( figure 56 ) and summer ( figure 57 ) climate sections show how the technical systems are integrated into the modular organisation of the building. During winter, the highly insulated timber envelope limits heat loss. A balanced mechanical ventilation system with heat recovery provides fresh air while retaining a large part of the heat from the extracted air. The dwellings are heated through a low-temperature underfloor heating system, supplied by a collective air-to-water heat pump located on the roof. The dry Lithotherm floor system distributes the heat while remaining compatible with the lightweight and demountable construction method.

The compact functional core contains the technical components required within each dwelling. By stacking these cores, the apartments can be connected efficiently to the collective installations located at roof level. Photovoltaic panels generate electricity that can contribute to the operation of the heat pump and the shared building systems.

During summer, external screens reduce direct solar radiation before it reaches the glazing. This limits overheating without relying solely on active cooling. The green roof provides additional thermal buffering and contributes to rainwater retention. Together, the shading, insulated envelope and controlled ventilation system support a stable indoor climate throughout the year.

The climate strategy is therefore not added as a separate technical system after the architectural design. It is integrated into the dimensions of the

modules, the organisation of the functional cores, the floor build-ups, the façade and the roof.

The construction details translate the overall principle of reversibility into the individual building connections. The floor, intermediate floor and roof are composed primarily of dry layers. Materials are mechanically assembled or placed as separate components instead of being permanently bonded through wet construction methods.

At ground-floor level ( figure 58 ), the CLT module is placed on load-bearing PIR insulation and precast concrete Stelcon slabs. A water-resistant, vapour-open membrane protects the timber structure from external moisture. Above the CLT floor, a smart vapour-control layer, dry levelling fill, wood-fibre boards and a dry Lithotherm underfloor-heating system create the internal floor build-up. This composition achieves a thermal resistance of approximately  $R_c 6.5 \text{ m}^2\text{K/W}$  while avoiding a conventional poured screed.

The use of a dry levelling layer and removable floor components means that the floor can be opened for maintenance and separated at the end of its use. The Stelcon slabs can also be lifted and reused, allowing the foundation to be removed when access to the ground or drainage layer becomes necessary.

The connection between vertically stacked modules contains ( figure 59 ) both the floor slab of the upper module and the roof slab of the lower module. An intermediate cavity separates the two

CLT elements and can accommodate insulation where required. Below the lower roof slab, a suspended ceiling creates a service zone for ventilation ducts and other installations. This layered construction provides acoustic and technical separation while preserving the identity of each individual module. With a floor-to-ceiling height of 2,600 mm, the design meets the requirements of the Dutch Building Decree.

The roof is similarly designed as a sequence of separable layers ( figure 60 ). A CLT roof slab forms the primary structure, above which the vapour-control layer, thermal insulation, tapered insulation and EPDM waterproofing are positioned. The extensive green roof consists of drainage, substrate and vegetation layers. With a thermal resistance of approximately  $R_c 8.5 \text{ m}^2\text{K/W}$ , the roof contributes to both winter insulation and summer thermal buffering.

The roof functions as more than a protective enclosure. It also accommodates photovoltaic panels, collective installations and the central heat-pump system. Technical systems, water retention, energy generation and thermal protection are therefore combined within one accessible roof zone.

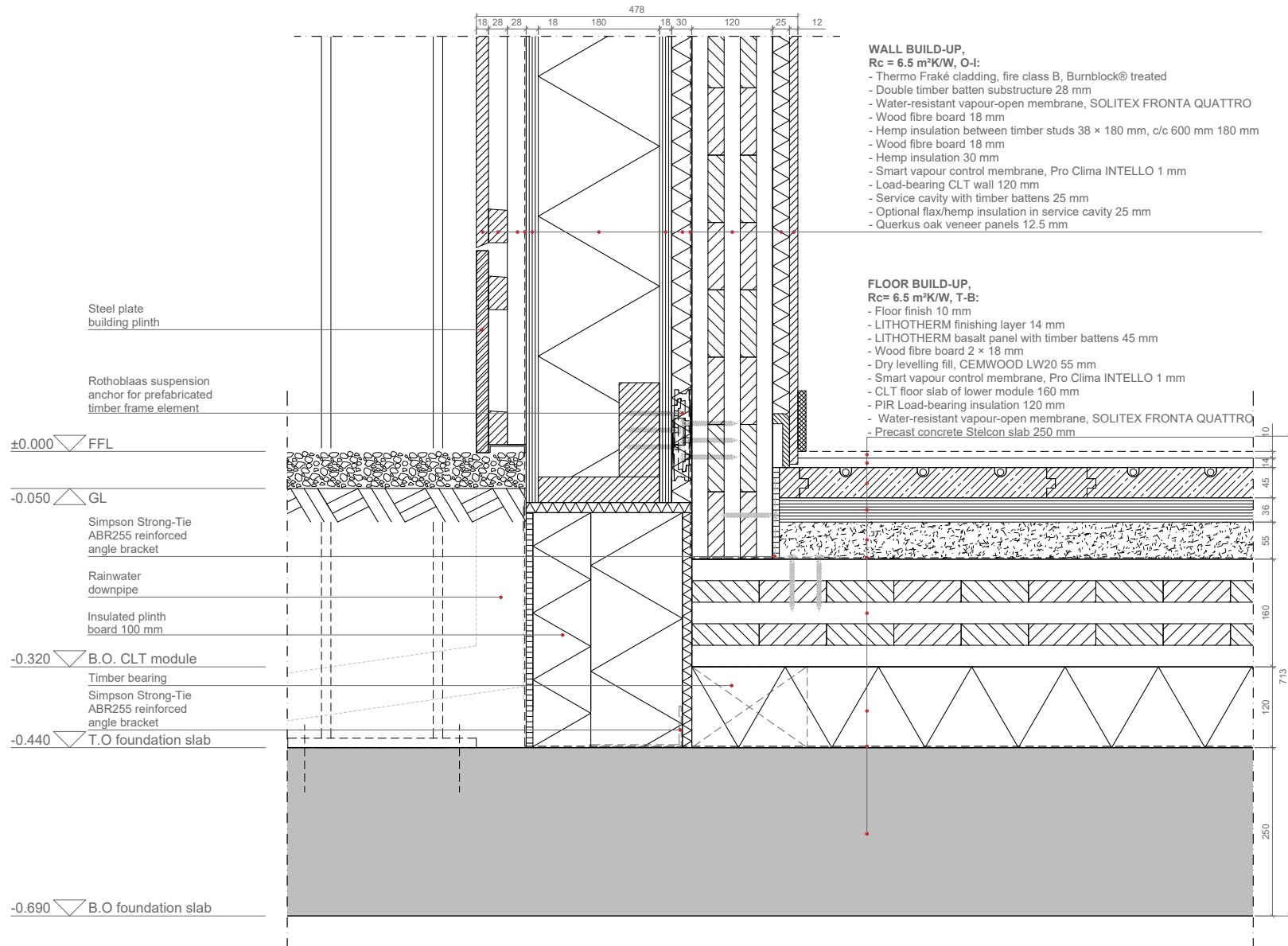


figure 58. Ground floor detail.

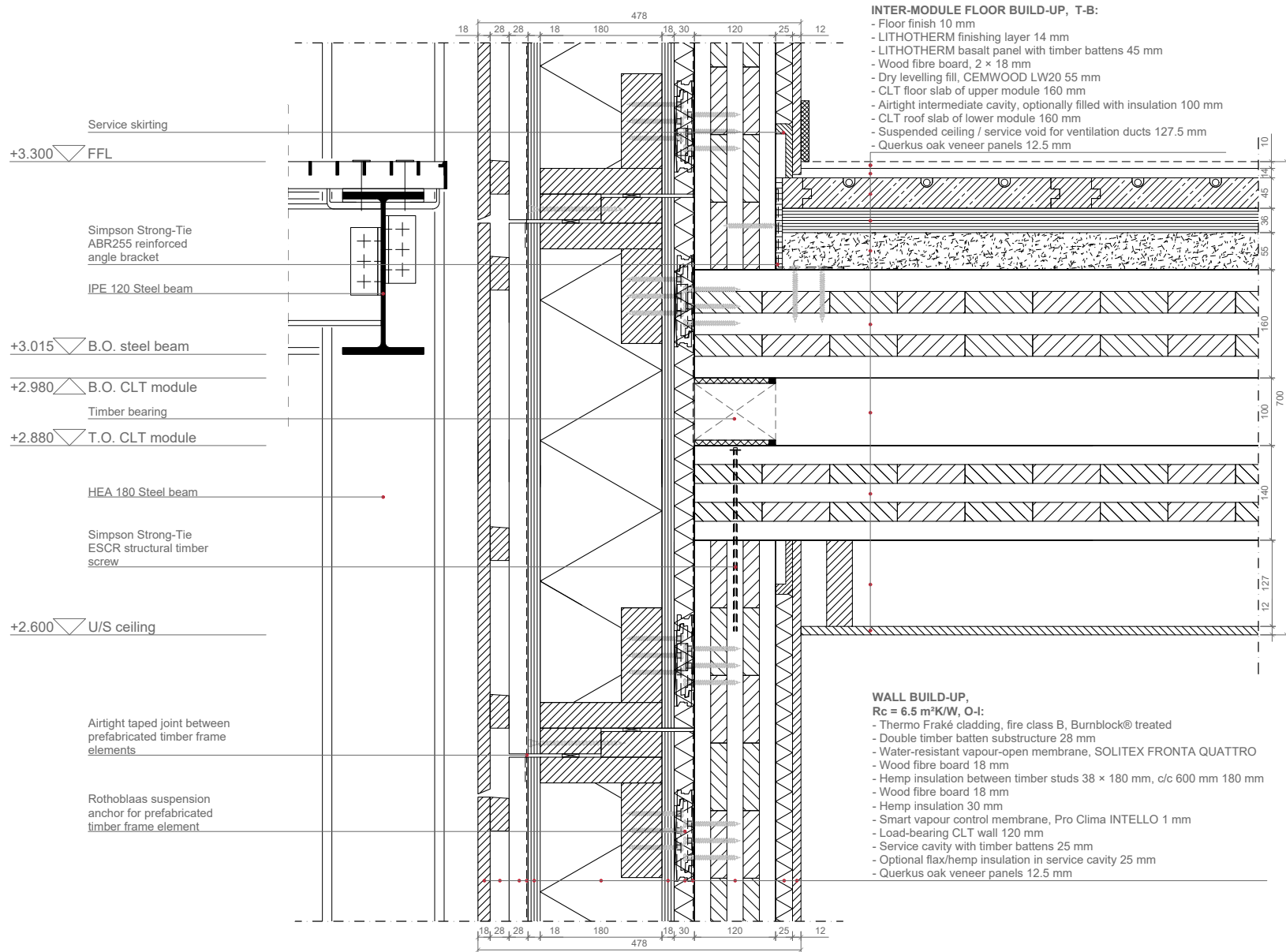


figure 59. Module-to-module connection detail.

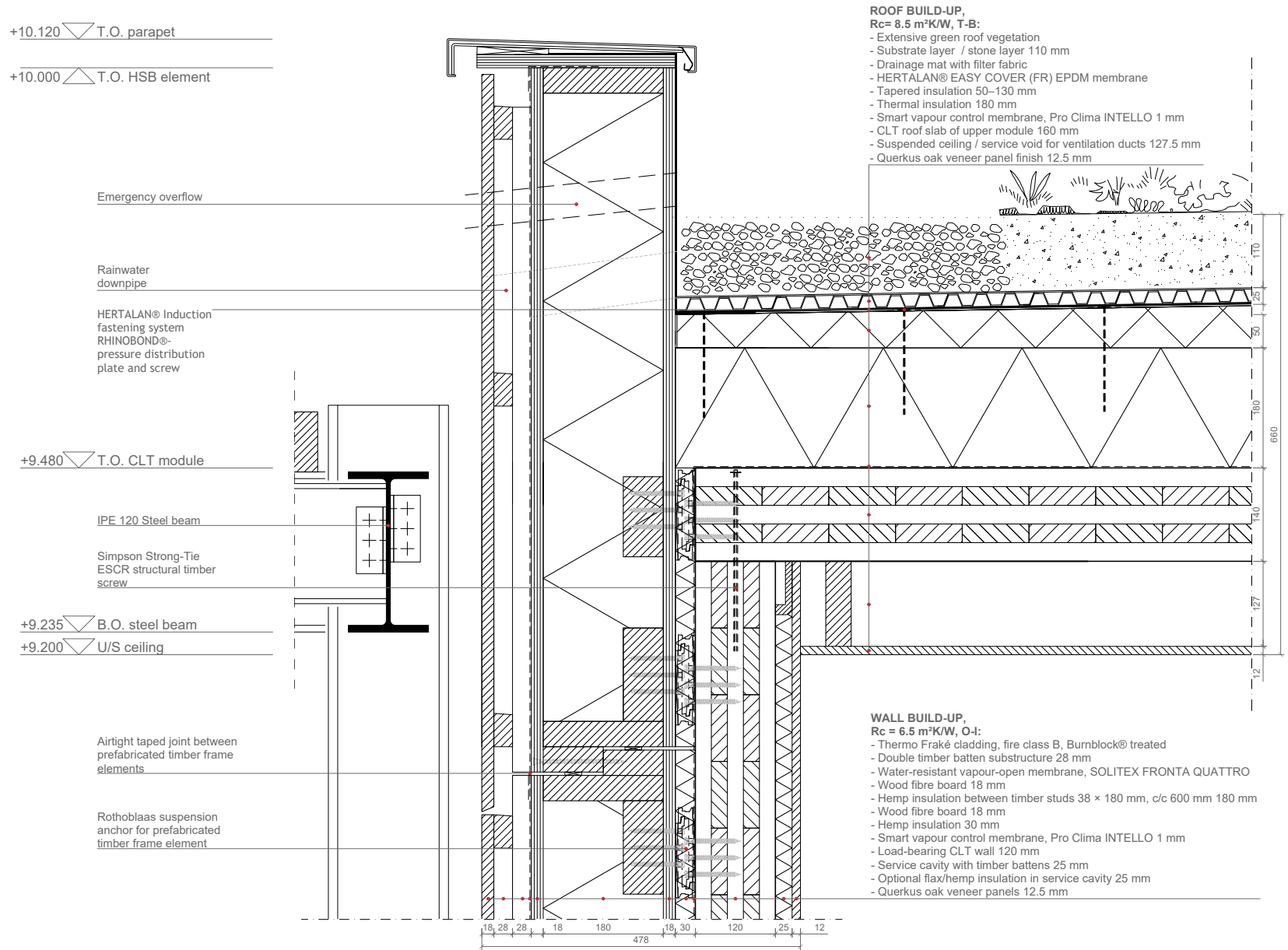


figure 60. Roof detail.

The enlarged façade details show how the projecting frames introduced during the fourth assembly step ( figure 55 ) create depth around the window and door openings. These frames emphasise the thickness of the insulated façade while also protecting the transitions between the openings and the external cladding.

All entrance doors ( figure 62 ), sliding doors ( figure 63 ) and windows ( figure 64 ) are based on a limited number of standard dimensions. This standardisation supports the prefabrication of the modules and façade panels, but it also improves the future adaptability of the building. When an element becomes damaged or obsolete, it can be removed and replaced without redesigning the complete façade.

The openings are therefore not treated as unique and permanently embedded components. They form part of a coordinated kit of parts in which elements can be exchanged, maintained and potentially reused in another configuration.

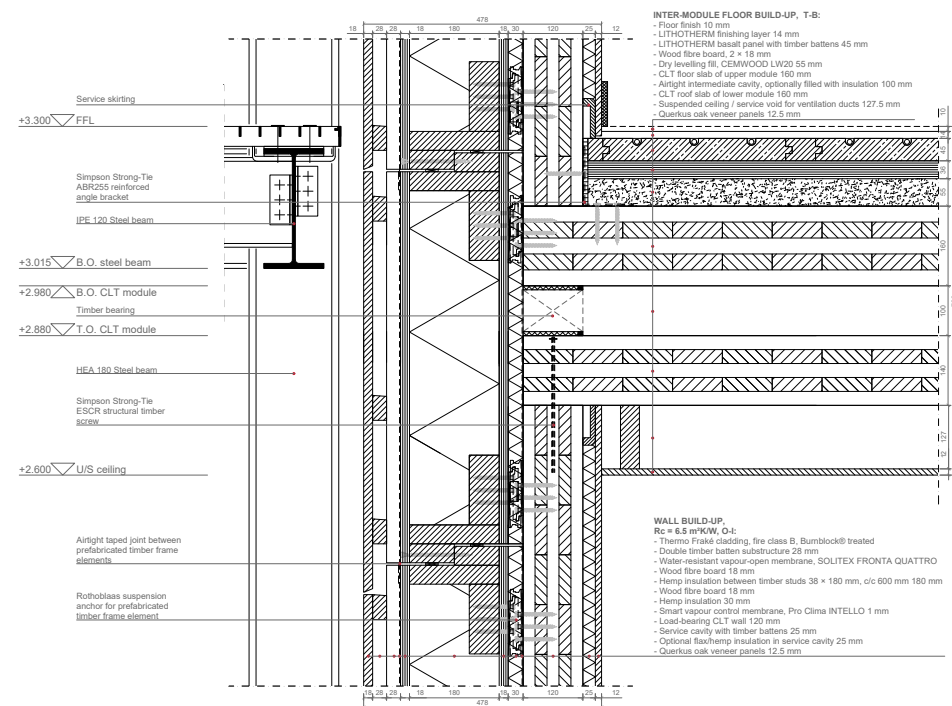


figure 61. Module-to-module connection detail.

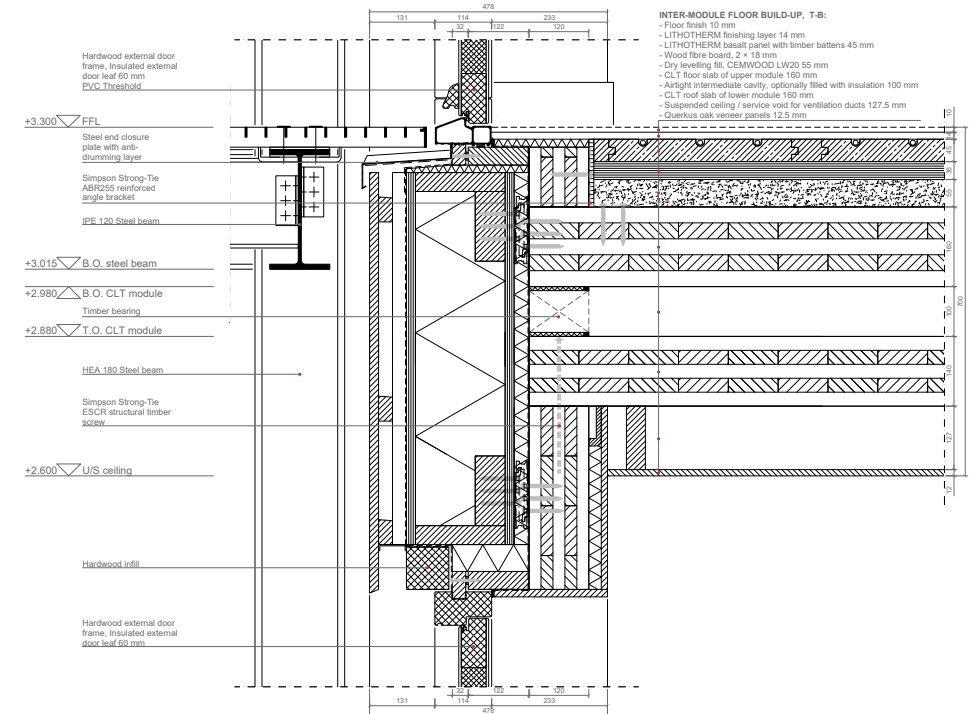


figure 62. Entrance door detail.

Through these construction principles, the architectural concept becomes visible at every scale. The building touches the ground through removable foundation slabs, consists of stackable CLT modules and is enclosed by replaceable façade elements. The steel circulation structure remains independent from the timber volume, while the technical systems are concentrated within vertically aligned cores.

The building is therefore not designed as a finished and irreversible object. It is conceived as a temporary material configuration whose components can continue to have value beyond their first use. Its architecture lies not only in the final appearance of the building, but also in the way it can be assembled, maintained, transformed and eventually taken apart.

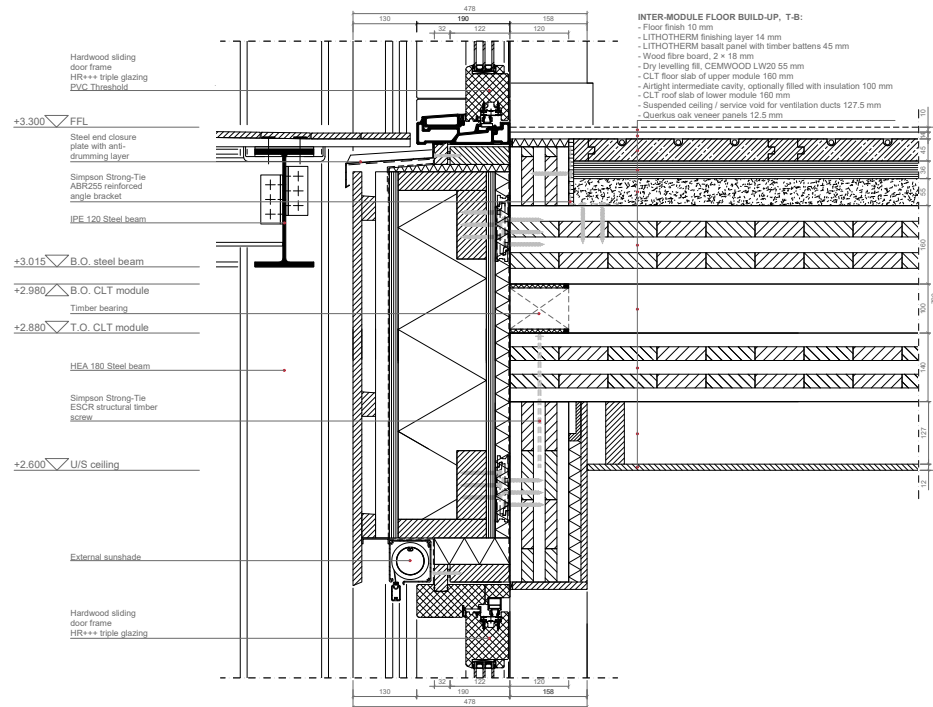


figure 63.Sliding door detail.

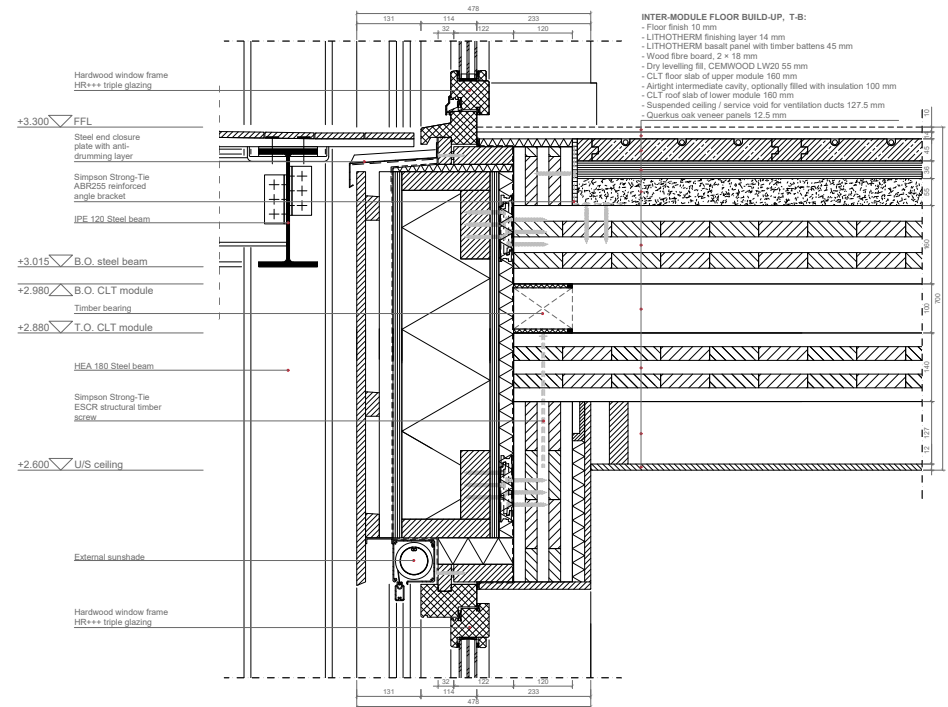


figure 64.Window detail.

# CONCLUSION

“An adapted state is not an end state.”  
Stewart Brand

# CONCLUSION

## 5.1 Conclusion

This graduation project investigated how an adaptive architectural system can be designed for contaminated ground, in a context where permanent construction is not self-evident. The starting point for this question lies in the tension between the Dutch housing challenge, the presence of underused contaminated sites, and the specific condition of the DOP NOAB in Midden-Delfland.

The theoretical framework positions architecture as a framework for change: not as an autonomous and definitive object, but as a system that functions within changing conditions of ground, use, material and time. From this perspective, contaminated ground is not understood only as a technical limitation, but as a design condition that requires a different attitude towards building. The results translate this attitude into an architectural system that is lightweight, adaptive, collective and reversible.

The answer to the main design question is therefore that architecture on contaminated ground should not start from permanent anchoring, but from adaptability. In Apposition, the building is understood as a system that can be placed, used, adapted, dismantled and potentially reused. The architecture does not claim the ground definitively, but positions itself carefully within the restrictions and possibilities of the site.

The first research question focused on the spatial and architectural consequences of contaminated and temporary ground for building and dwelling.

The project shows that such ground cannot be treated as a neutral base. The technical and temporal condition of the site has direct consequences for the spatial strategy: the site is not fully built up, infrastructure is limited, the open centre is maintained, and the buildings are carefully positioned in relation to the edges and the landscape. The ground condition therefore leads not only to technical restrictions, but to a different spatial organisation.

The second research question explored how an adaptive architectural system can function across different scales. The design answers this question by moving from module to dwelling, from dwelling to collective building, and from building to landscape composition. The module forms the smallest spatial and constructive unit. By combining modules, different dwelling types and building forms can emerge. At the scale of the site, the buildings are repeated as compositions around an open landscape. Adaptability is therefore not limited to one detail or one housing type, but is organised across multiple scales at the same time.

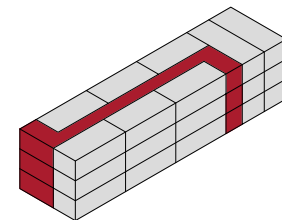
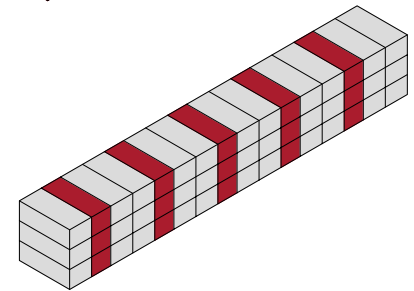
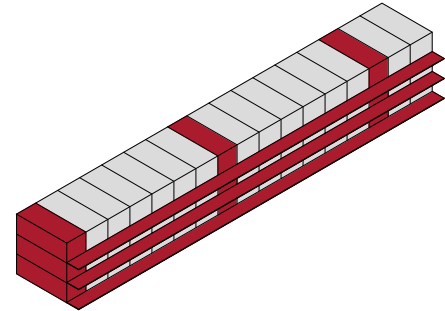
The third research question investigated how collective housing can contribute to an inclusive living environment within a temporary and technically restricted site. The project shows that compact dwellings can gain spatial quality when they are supported by a strong collective structure. Shared spaces, galleries, semi-public outdoor areas and public functions at ground level together form a social infrastructure. This creates a gradient from public to private, in which residents

can participate in collective life while also being able to withdraw into the private dwelling.

The final research question addressed the translation of uncertainty into a spatial, constructive and material design strategy. In the project, uncertainty is translated into reversibility. This is visible in the choice for a lightweight and demountable building system, a modular structure, dry connections and a material strategy in which components can be adapted, replaced or reused in the future. The detail therefore becomes an essential part of the architectural argument: it shows whether the building can truly function as a demountable and adaptable system.

Apposition is therefore not an attempt to fully resolve the uncertainty of the site. Instead, the project organises different conditions alongside one another: contaminated ground and dwelling, temporary construction and long-term landscape, individual homes and collective spaces, local material flows and reusable components. The value of the project lies in this spatial organisation of contradictions.

The conclusion is that architecture can become meaningful without being fully dependent on permanence. In places where the ground is uncertain, technically restricted or temporary, architecture can function as an adaptive system that takes change, maintenance and future disassembly into account. The task therefore shifts from building as a permanent claim to building as a careful, temporary and adaptable presence.



Through apposition, small separate elements are placed together to form larger structures without becoming permanent.  
This creates an adaptive, reversible architectural system for contaminated soil.

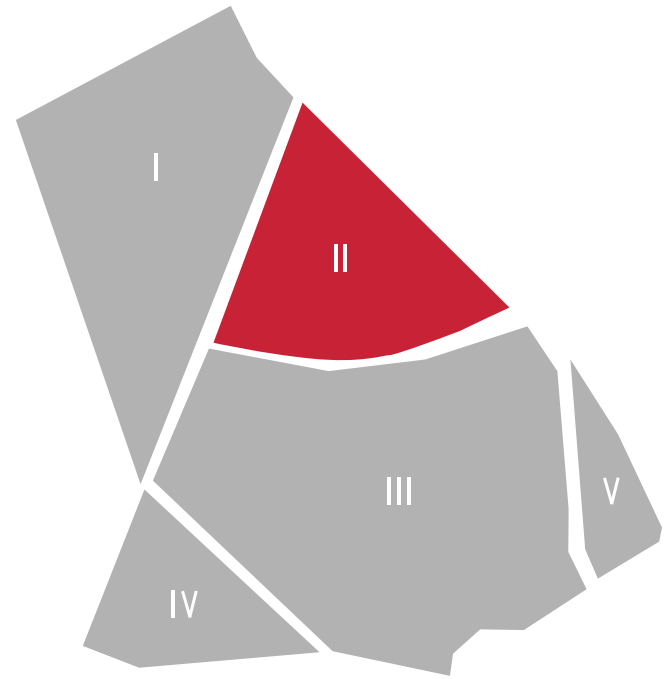
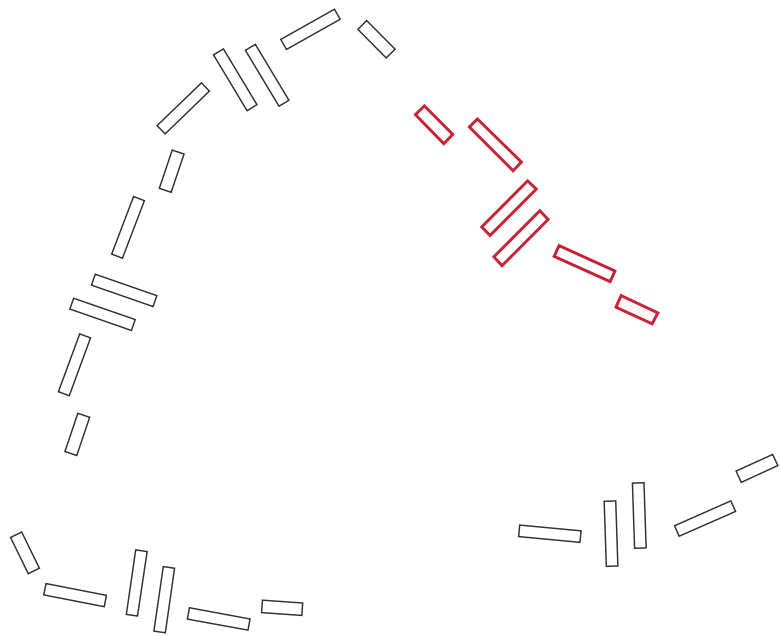






figure 66.Rain render Apposition.

## 5.2 Discussion

The broader relevance of this project lies in the way it engages with underused and contaminated sites. Such places are often seen as difficult to develop, risky or unsuitable for housing. This project shows that this conclusion does not have to be self-evident. Not every contaminated site should be built upon, but some sites can give rise to new architectural strategies in which temporary dwelling, adaptability and reversibility become central.

In this way, the project contributes to the debate on land use in the Netherlands. The housing challenge requires more homes, but also a more careful approach to landscape, soil and existing space. Apposition proposes that difficult sites should not automatically be excluded from spatial development, but critically investigated for their technical, spatial, ecological and social possibilities. The project therefore shifts the discussion from whether such sites can be used, to under which conditions they can be used responsibly.

Architecturally, the project questions the idea of the building as a permanent object. The quality of architecture lies here not only in form, image or programme, but also in the way the building can respond to change. A building that can be adapted, dismantled or reused requires different design principles than a building intended as a permanent anchoring in the ground. The project therefore shifts attention towards lifespan, maintenance, material cycles, demountable detailing and the future value of building components.

The project also has implications for housing design. Temporality does not have to mean a loss of spatial quality. Compact dwellings can become meaningful when they are supported by collective spaces, shared outdoor areas and a clear relationship with the landscape. In this project, collective space is not treated as additional programme, but as social infrastructure. It allows the housing system to support different forms of dwelling, encounter and retreat, while preventing the project from becoming an isolated technical solution.

The transferability of the project lies not in copying the exact modular system or site layout, but in the design attitude it proposes. Other contaminated, temporary or technically restricted sites may require different architectural responses, but the underlying principles can be applied more broadly: reading the ground as an active condition, limiting permanent impact, designing with reversible components, and combining compact private dwellings with collective spatial quality. In that sense, Apposition can be understood as a prototype for thinking about architecture in places where conventional permanence is uncertain.

At the same time, the project also defines the limits of this approach. Building on contaminated ground should never become a generic argument for developing every difficult site. Each location requires careful technical, ecological, legal and social assessment. The value of the project lies precisely in this carefulness: it does not propose to ignore contamination, but to take it seriously as

a condition that changes the way architecture is conceived, constructed and inhabited.

An adaptive building system only becomes architecture when it does more than solve a technical problem. It must also create residential quality, social meaning and a relationship with its surroundings. The contribution of Apposition is therefore not only that it proposes a reversible building system, but that it connects this system to dwelling, collectivity, landscape and future material use.

### 5.3 Limitations and further development

Although the project develops an architectural strategy for building on contaminated ground, several aspects require further development. The technical feasibility of the proposed building method needs to be tested further against specific soil-related, structural and legal conditions. In particular, the precise foundation strategy, the load on the ground, the accessibility of aftercare facilities and the relationship to future maintenance moments require further verification.

The materialisation also requires further specification. The ambition to work with biobased materials, local material flows and reused components is direction-giving, but needs to be made more concrete in a next phase. This includes questions of availability, processing and the potential reuse of building components.

The social model also requires further elaboration. Collective spaces form an important part of the housing concept, but their success depends on management, accessibility, agreements about use and the relationship between residents and visitors. Architecture can enable encounter, but it cannot fully guarantee it. It is therefore important to connect the spatial design in a next phase to questions of ownership, management and affordability.

## 5.4 Reflection

The design process began with a spatial problem, but gradually developed into an investigation of uncertainty, temporality and permanence. The contaminated ground was initially read as a limitation within the site, but became the core of the architectural question. Precisely because the site cannot be built upon in a conventional way, it became necessary to question fundamental assumptions about building, dwelling and land use.

The method of research by design was important in this process. By using analysis, theory, case studies and design research alongside one another, the project could be investigated across different scales. Diagrams, scenarios, module studies, plans, sections and details functioned not only as representations of the design, but also as tools to make the consequences of design decisions visible. This made it possible to test the project as a system rather than as a single building object.

The theoretical framework helped to position the project more broadly than as a technical solution for a difficult site. Concepts such as contingency, layers, adaptability, demountability and collective space made clear that the design is not only about building on contaminated ground, but about architecture as a changeable system. The results translate these concepts into a spatial strategy in which site, building, dwelling and detail are connected.

A key challenge within the process was finding a balance between system and residential quality. The risk of a modular and demountable system is that it becomes too technical, generic or detached from the experience of dwelling. The design therefore continuously searched for ways in which the system could be not only flexible and reversible, but also capable of creating a sense of place, collectivity and spatial quality.

In relation to the studio Advanced Housing Design – Ecologies of Inclusion, the project also raised the question of how inclusion can be understood beyond social accessibility alone. In this project, inclusion is approached as the ability to bring different systems into relation: residents and visitors, private dwellings and collective spaces, building and landscape, contaminated ground and future use. The collective spaces, landscape edges and public-oriented ground floor functions became important tools to prevent the project from becoming an isolated technical solution.

At the same time, the project has clear limitations. The technical feasibility of building on the DOP NOAB requires further testing in relation to soil conditions, foundation strategy, load distribution and long-term maintenance. The material strategy, especially the use of biobased materials and reused steel components, also needs further specification in terms of sourcing, processing and construction. In addition, the success of the collective spaces would depend not only on spatial design, but also on management, accessibility and long-term affordability.

The main reflection is that uncertainty does not have to remain outside architecture. It can become a productive design condition. By accepting the restrictions of the ground, the project developed an architectural position that is less focused on permanent control and more focused on adaptation, care and future transformation. Apposition therefore became not only the name of the project, but also a way of working: placing conflicting conditions next to one another and allowing architecture to operate between them.

## 5.5 Final statement

Apposition shows that contaminated ground does not have to mark the end of architectural possibility. It can also become the beginning of another way of designing: lighter, more adaptive, more collective and more conscious of time.

The project proposes an architecture that does not claim the ground definitively, but is temporarily and carefully present. An architecture that can change when circumstances change. An architecture in which compact dwelling is supported by collective space. And an architecture in which material, detail and construction are designed with disassembly and reuse in mind.

In this way, Apposition shows that architecture can become meaningful without having to be permanent. Precisely by taking uncertainty seriously, the design does not try to fully control the site, but learns to exist alongside its conditions.

This is Apposition, architecture beside uncertainty.



## BIBLIOGRAPHY

ABF Research. (2024). ABF Woningmarktverkenning 2024–2039. <https://abfresearch.nl/2024/12/05/abf-woningmarktverkenning-2024-2039/>

Askar, R., Bragança, L., & Gervásio, H. (2021). Adaptability of buildings: A critical review on the concept evolution. *Applied Sciences*, 11(10), Article 4483. <https://doi.org/10.3390/app11104483>

Atlas Leefomgeving. (n.d.). Bodemverontreiniging en sanering. Retrieved June 1, 2026, from <https://www.atlasleefomgeving.nl/bodemverontreiniging-en-sanering>

Bodemloket. (n.d.). Kaart. Retrieved June 1, 2026, from <https://www.bodemloket.nl/kaart>

Brand, S. (1994). *How buildings learn: What happens after they're built*. Viking Press.

Bureau BUITEN, Urban Synergy, & Feddes/Olthof Landschapsarchitecten. (2024). Entreegebieden van BPL Midden-Delfland: Analyse en nadere uitwerking recreatie-opgave BPL Midden-Delfland. <https://assets.tina.io/d0995fe0-0b45-4662-90e5-3e0b3826fe37/downloads/Entreegebieden%20van%20BPL%20small%20DEF.pdf>

Compendium voor de Leefomgeving. (2015, January 9). Aantal (spoed)locaties bodemverontreiniging: Inventarisatie oktober 2014. <https://www.clo.nl/indicatoren/nl025816-aantal-spoedlocaties-bodemverontreiniging-inventarisatie-oktober-2014>

dS+V Ruimtelijke Ordening, Bureau Bestemmingsplannen. (2010). Bestemmingsplan Golfbaan Oost-Abtspolder. Gemeente Rotterdam. [https://www.planviewer.nl/imro/files/NL.IMRO.0599.BP0626GolfbnOostAb-oh01/t\\_NL.IMRO.0599.BP0626GolfbnOostAb-oh01.pdf](https://www.planviewer.nl/imro/files/NL.IMRO.0599.BP0626GolfbnOostAb-oh01/t_NL.IMRO.0599.BP0626GolfbnOostAb-oh01.pdf)  
Djukanovic, M., Alegre, A., & Bastos, F. T. (2025). Prefabricated solutions for housing: Modular architecture and flexible living spaces. *Buildings*, 15(6), Article 862. <https://doi.org/10.3390/buildings15060862>

Kieran, S., & Timberlake, J. (2004). *Refabricating architecture: How manufacturing methodologies are poised to transform building construction*. McGraw-Hill.

Klijn, O., Guis, R., TU Delft Faculty of Architecture and the Built Environment, & Department of Architecture, Architecture and Dwelling. (2025). *Advanced housing design*.

Kronenburg, R. (2007). *Flexible: Architecture that responds to change*. Laurence King Publishing.  
Rijksoverheid. (n.d.). *Nieuwe woningen*. Retrieved June 1, 2026, from <https://www.rijksoverheid.nl/onderwerpen/volkshuisvesting/nieuwe-woningen>  
Smith, R. E. (2010). *Prefab architecture: A guide to modular design and construction*. John Wiley & Sons.

Till, J. (2009). *Architecture depends*. MIT Press.  
Zarrillo, A. (2020). Adaptive dimension in architecture. In *PROJECT | Essays and researches* (Vol. 3, pp. 112–129). <https://doi.org/10.19229/978-88-5509-096-4/372020>

ZUS [Zones Urbaines Sensibles], Flux, Sweco, & Delta Urbanism. (n.d.). *Redesigning Delta: National Productive Park Delftland*.



# LIST OF FIGURES

figure 01. Development of the housing shortage in the Netherlands, 2014–2030. Source: ABF Research, n.d.	7
figure 02. Distribution of homes to be built by province 2023-2030. Source: own illustration based on Datawonen, 2023.	7
figure 03. Urgent soil contamination sites in the Netherlands. Adapted from RIVM, via Compendium voor de Leefomgeving, 2015.	7
figure 04. Pressure on Midden-Delfland. Source: own illustration based on EduGIS, n.d.; base map data from OpenStreetMap contributors.	8
figure 05. Project location and 5 regions Midden-Delfland. Groupwork.	9
figure 06. Design ambitions. Own drawing.	10
figure 07. Research and design strategy diagram. Own drawing.	15
figure 08. Timeline DOP NOAB. Own drawing.	18
figure 09. Cross-section structure DOP NOAB East West. Source: Municipality of Rotterdam / dS+V, 2010.	19
figure 10. Shearing layers of change. Source: Brand, 1994, p. 13.	20
figure 11. ZUS vision for Midden-Delfland as a productive landscape. Source: own illustration based on ZUS, n.d.	24
figure 12. BPL Entrances Midden-Delfland. Source: own illustration based on BPL, 2024.	24
figure 13. Overlay of the ZUS vision and BPL analysis, highlighting Entrance 3: Poortgebied Schieknoop. Source: own illustration based on ZUS, n.d.	25
figure 14. Fragmentation analysis of Entrance 3. Groupwork.	25
figure 16. Masterplan design principles. Groupwork.	26
figure 15. Masterplan ambitions. Groupwork.	26
figure 17. Masterplan with focus on region 2. Own drawing.	27
figure 18. Timeline DOP NOAB. Own drawing.	28
figure 19. Cross-section structure DOP NOAB East West. Source: Municipality of Rotterdam / dS+V, 2010	29
figure 20. One functional core. Own drawing.	30
figure 21. Two open components. Own drawing.	30
figure 22. Dimensions one module. Own drawing.	30
figure 23. Module principle: one service module and two flexible open modules forming a compact dwelling. Own drawing.	31
figure 24. Combined module configurations. Own drawing.	31
figure 25. Axonometric module gallery. Own drawing.	31
figure 26. Floorplan module gallery. Own drawing.	31
figure 27. Axonometric module portico and corridor. Own drawing.	31
figure 28. Floorplan module portico and corridor. Own drawing.	31
figure 29. Gallery typology. Own drawing.	32
figure 30. Portico typology. Own drawing.	32
figure 31. Corridor typology. Own drawing.	32
figure 32. Topography as structure. Own drawing.	33
figure 33. Strengthening the green edges. Own drawing.	33
figure 34. open centre as spatial quality. Own drawing.	33
figure 35. Positioning buildings. Own drawing.	33
figure 36. Spatial building plan. Own drawing.	33
figure 37. Repetition spatial building plan. Own drawing.	33

figure 38.Situation. Own drawing.	34
figure 40.Section. Own drawing.	35
figure 39.Site plan indicating section line. Own drawing.	35
figure 41.Groundfloor gallery café. Own drawing.	37
figure 42.Second floor gallery access. Own drawing.	38
figure 43.Second floor gallery community space. Own drawing.	39
figure 44.Second floor portico access. Own drawing.	40
figure 45.Second floor portico community space. Own drawing.	41
figure 46.Second floor corridor access. Own drawing.	42
figure 47.Second floor corridor community space. Own drawing.	43
figure 48.Front elevation. Own drawing.	44
figure 49.Vertical section building. Own drawing.	45
figure 50.Horizontal isometric section. Own drawing.	46
figure 51.Isometric section. Own drawing.	47
figure 52.Vertical section. Own drawing.	48
figure 53.Steel from donor buildings region 3. Own drawing.	49
figure 54.Steel access. Own drawing.	49
figure 55.Isometric assembly. Own drawing.	50
figure 56.Climate section winter. Own drawing.	52
figure 57.Climate section summer. Own drawing.	53
figure 58.Ground floor detail. Own drawing.	55
figure 59.Module-to-module connection detail. Own drawing.	56
figure 60.Roof detail. Own drawing.	57
figure 61.Module-to-module connection detail. Own drawing.	58
figure 62.Entrance door detail. Own drawing.	58
figure 63.Sliding door detail. Own drawing.	59
figure 64.Window detail. Own drawing.	59
figure 65.Render Apposition. Own drawing.	64
figure 66.Rain render Apposition. Own drawing.	65
figure 67.Sketches. Own drawing.	97
figure 68.Section. Own drawing.	99
figure 69.Site plan indicating section line. Own drawing.	99
figure 70.Situation. Own drawing.	100
figure 71.Site model 1:1000. Own model.	102
figure 72.Site model 1:1000. Own model.	103
figure 73.Ground floor gallery. Own drawing.	104
figure 74.First floor gallery. Own drawing.	105

figure 75.Second floor gallery. Own drawing.	106
figure 76.Ground floor portico. Own drawing.	107
figure 77.First floor portico. Own drawing.	108
figure 78.Second floor portico. Own drawing.	109
figure 79.Ground floor corridor. Own drawing.	110
figure 80.First floor corridor. Own drawing.	111
figure 81.Second floor corridor. Own drawing.	112
figure 82.Front elevation. Own drawing.	113
figure 83.Back elevation. Own drawing.	113
figure 84.Render Apposition. Own drawing.	114
figure 85.Rain render Apposition. Own drawing.	115
figure 86.Construction model 1:20. Own model.	117
figure 87.Construction model 1:20. Own model.	118
figure 88.Construction model 1:20. Own model.	119
figure 89.Front elevation. Own drawing.	120
figure 90.Vertical section building. Own drawing.	121
figure 91.Steel access. Own drawing.	121
figure 92.Vertical section. Own drawing.	122
figure 93.Isometric section. Own drawing.	123
figure 94.Floor detail. Own drawing.	124
figure 95.Module-to-module detail. Own drawing.	125
figure 96.Roof detail. Own drawing.	126
figure 97.Floor detail front door. Own drawing.	127
figure 98.Module-to-module detail front door. Own drawing.	128
figure 99.Roof detail front door. Own drawing.	129
figure 100.Floor detail sliding door. Own drawing.	130
figure 101.Module-to-module detail sliding door. Own drawing.	131
figure 102.Roof detail sliding door. Own drawing.	132
figure 103.Floor detail window. Own drawing.	133
figure 104.Module-to-module detail window. Own drawing.	134
figure 105.Roof detail window. Own drawing.	135
figure 106.Climate section winter. Own drawing.	136
figure 107.Climate section summer. Own drawing.	137

# APPENDIX

Architecture beside uncertainty.

# APPENDIX

The appendix brings together supporting material that informed the development of Apposition, but is too extensive to include in the main body of the report. While the main chapters present the argument, methodology, design results and conclusions, the appendix provides additional insight into the research and design process behind the project.

It includes the case studies that helped define the architectural principles of the project, focusing on themes such as collective housing, adaptability, modularity, demountability and the relationship between building and landscape.

The appendix also contains process sketches, design explorations and intermediate studies. These drawings show how the project developed through testing, comparison and refinement across different scales: from the site and urban composition to the dwelling module, collective building and construction detail.

Finally, the appendix includes additional architectural and technical drawings that support the final design proposal. These drawings provide further information on spatial organisation, programme, construction, material logic and detail development. Together, the appendix functions as a background document to the main report, making visible the research, testing and technical reasoning that underpin the final architectural proposal.



# CASESTUDIES

## 8.1 Introduction

The case studies in this appendix were used to support the development of the architectural principles behind Apposition. They are not approached as examples to be copied directly, but as references through which specific design strategies could be studied, compared and translated into the context of the DOP NOAB.

The selected projects each address a different aspect of the graduation project. Hotel Jakarta is studied for its material and climatic logic, and for the way a building can combine a strong public interior with a timber-based construction approach. Xylino in Almere is used as a reference for timber construction and the architectural expression of biobased materiality in housing. Remote House by Felipe Assadi is studied for its modular and transportable logic, showing how a building can be conceived as an assembly of parts rather than as a fixed object. La Borda Cooperative Housing by Lacol is included for its collective housing model, in which private dwellings are supported by shared spaces and a strong social structure.

Together, these case studies form a bridge between the theoretical framework and the design proposal. They helped define four main design principles for Apposition: architecture as a system rather than an object, the possibility to place, combine and remove elements, the relationship between individual and collective living, and the understanding of the building as a future material resource.

The following pages present the case studies through drawings, images and short analytical notes. Each case study is read through the lens of the graduation project: what principle does it reveal, and how can that principle inform an adaptive housing system for contaminated ground?

01

HOTEL JAKARTA

02

XYLINO

03

REMOTE HOUSE

04

LA BORDA

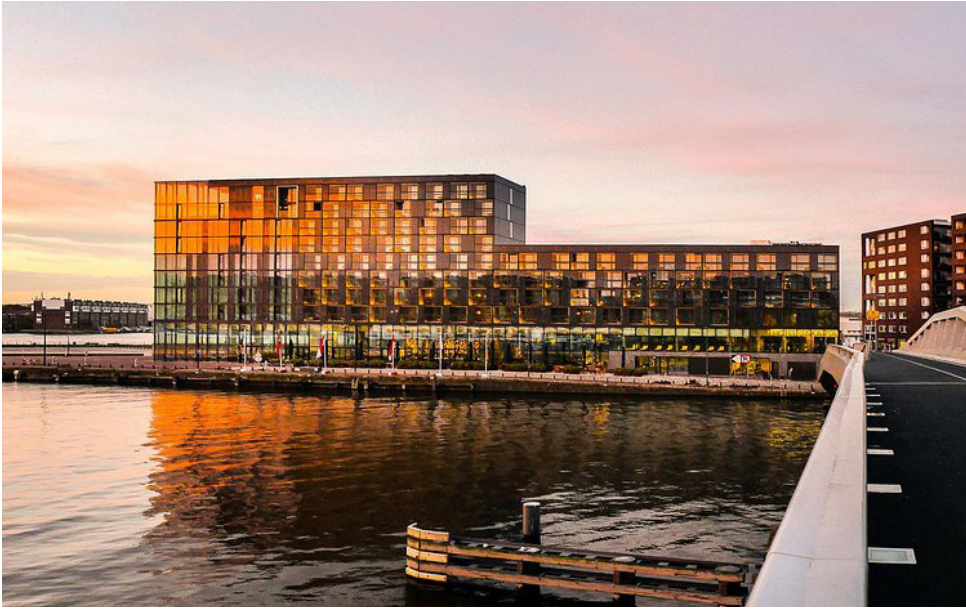


Figure 01. Hotel Jakarta.



Figure 02. Xylino.



Figure 03. Remote House.



Figure 04. La Borda.

# 01 HOTEL JAKARTA

Architect  
SeARCH

Location  
Amsterdam, the Netherlands

Year  
2018

## Why this case?

Hotel Jakarta is studied for its combination of timber-based construction, sustainability and a strong public interior. The project shows how a building can use material expression, climatic performance and collective space together to create a recognisable architectural identity.

## Key principle

A building can use biobased materiality not only as a technical or environmental strategy, but also as a spatial and atmospheric quality.

## What I take from it for Apposition

For Apposition, Hotel Jakarta is relevant because it demonstrates how timber construction and a strong internal collective space can give character to a building. The case supports the idea that material logic should not remain hidden in the technical layer, but can become part of the architectural experience. It also shows how a building can create a sheltered interior environment that connects structure, climate and collective use.

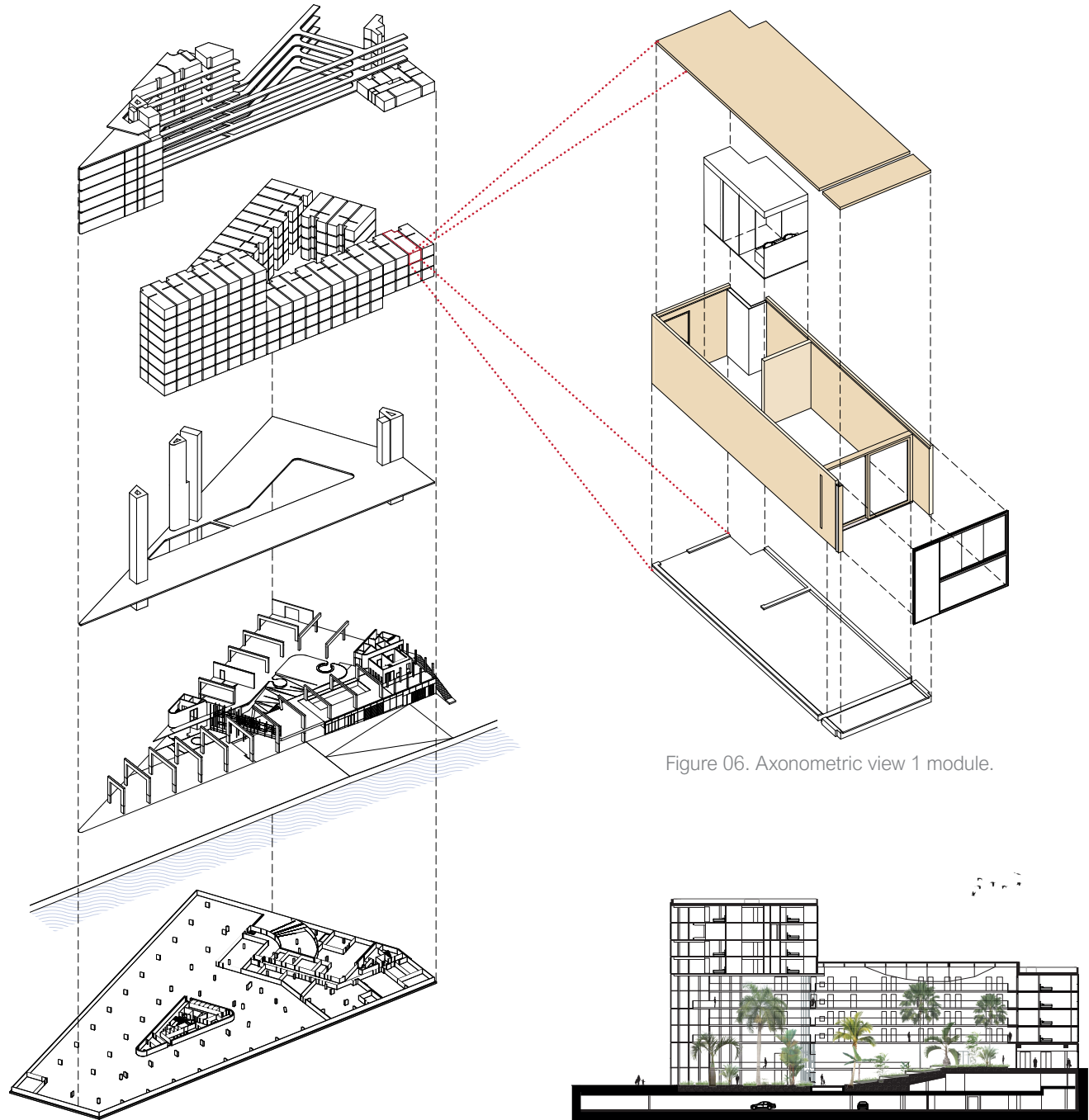


Figure 06. Axonometric view 1 module.

Figure 05. Axonometric view Hotel Jakarta.

Figure 07. Section Hotel Jakarta.

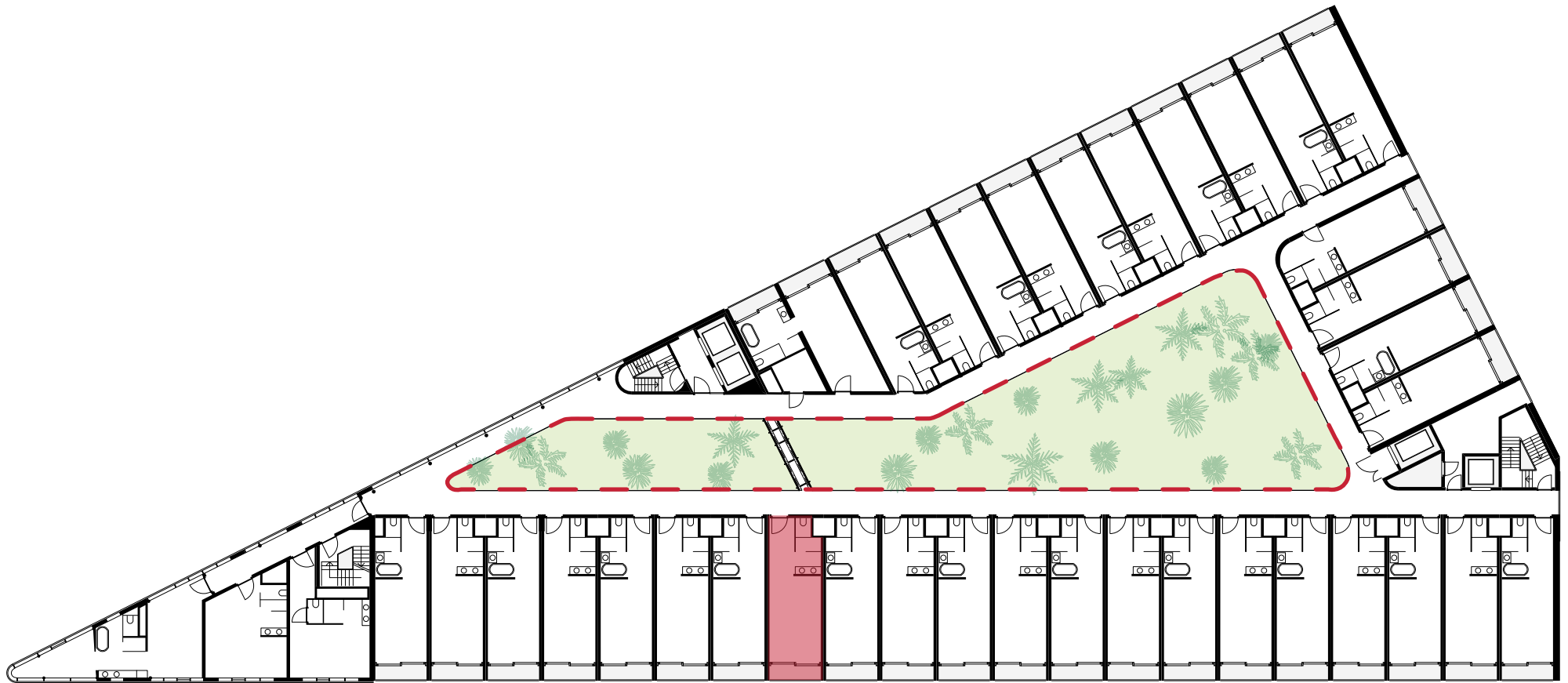


Figure 08. Hotel Jakarta 4th floor, 1 module and courtyard.

## 02 XYLINO

Architect  
Arons & Gelauff Architecten

Location  
Almere, the Netherlands

Year  
2023–2026

### Why this case?

Xylino is studied as a reference for modular timber housing at a larger residential scale. The project is relevant because it combines prefabricated timber modules with stacked housing, showing how modular construction can move beyond the scale of the single dwelling.

### Key principle

A modular timber system can support repetition, speed of construction and variation within a residential building.

### What I take from it for Apposition

For Apposition, Xylino is important because it shows how a modular timber system can be translated into collective housing. The project supports the idea that repetition does not have to result in monotony when modules are combined into different dwelling types and building configurations. It also strengthens the ambition to treat the module as both a spatial and constructive unit.



Figure 09. Axonometric visualisation of Xylino.



Figure 10. Xylino under construction.



Figure 11. Xylino 1th floor, different modules.

# REMOTE HOUSE

Architect  
Felipe Assadi

Location  
Pichicuy, Chile

Year  
2014

## Why this case?

Remote House is studied for its transportable and prefabricated logic. The project is relevant because it treats the house as an assembly of modules that can be produced elsewhere, transported and installed on site within a short time.

## Key principle

Architecture can be conceived as a transportable assembly of parts rather than as a fixed object tied permanently to one location.

## What I take from it for Apposition

For Apposition, Remote House is relevant because it demonstrates the architectural potential of mobility and prefabrication. The project supports the idea that a building can be designed for placement and possible removal from the beginning. This is important for a site where the ground condition does not allow architecture to be understood as a permanent claim.



Figure 12. Remote House during transport and assembly.



Figure 13. Remote House during installation.



Figure 14. Interior view of Remote House.

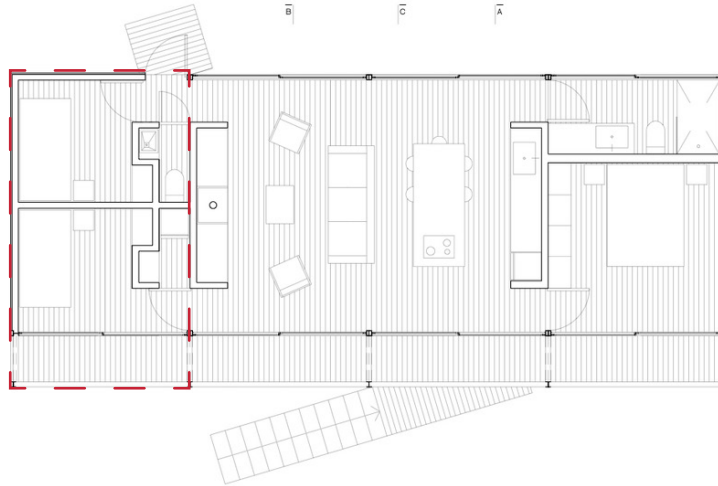


Figure 15. Floor plan Remote House, 1 module.

# 04 LA BORDA

Architect  
Lacol

Location  
Barcelona, Spain

Year  
2018

## Why this case?

La Borda is studied for its collective housing model. The project is relevant because private dwellings are supported by shared spaces, collective ownership and a strong social structure. It shows how housing can be organised as a shared environment rather than as a collection of isolated units.

## Key principle

Collective space can function as social infrastructure, supporting different forms of dwelling, encounter and shared use.

## What I take from it for Apposition

For Apposition, La Borda is important because it shows how compact private dwellings can gain quality through collective spaces. The case supports the idea that residential quality does not only lie within the individual unit, but also in the spaces between dwellings: circulation, shared rooms, outdoor spaces and collective facilities. This directly informs the ambition to create an inclusive living environment within the adaptive housing system.



Figure 16. Housing typologies of La Borda.

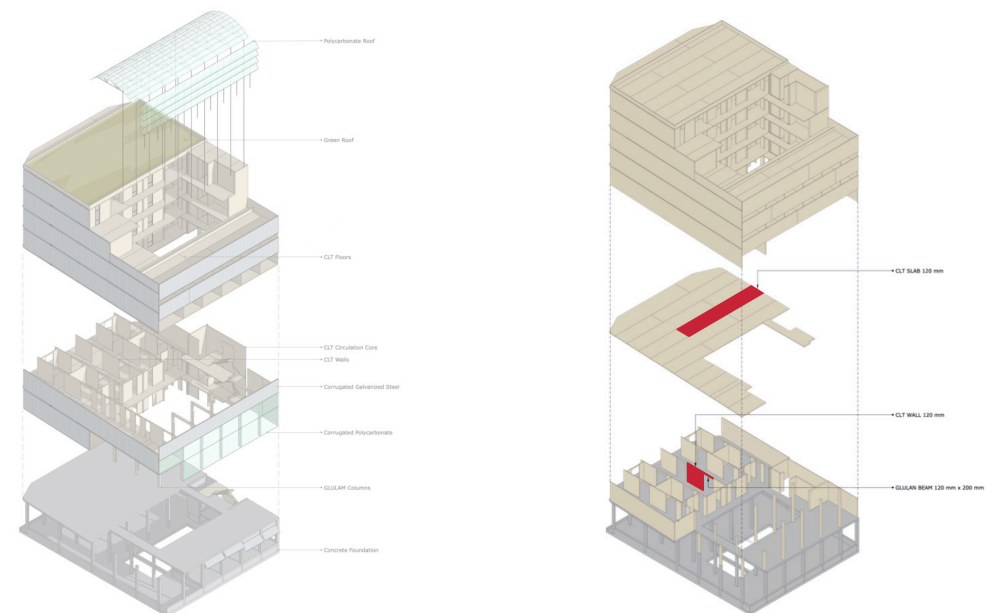


Figure 17. Structural axonometric analysis of La Borda.

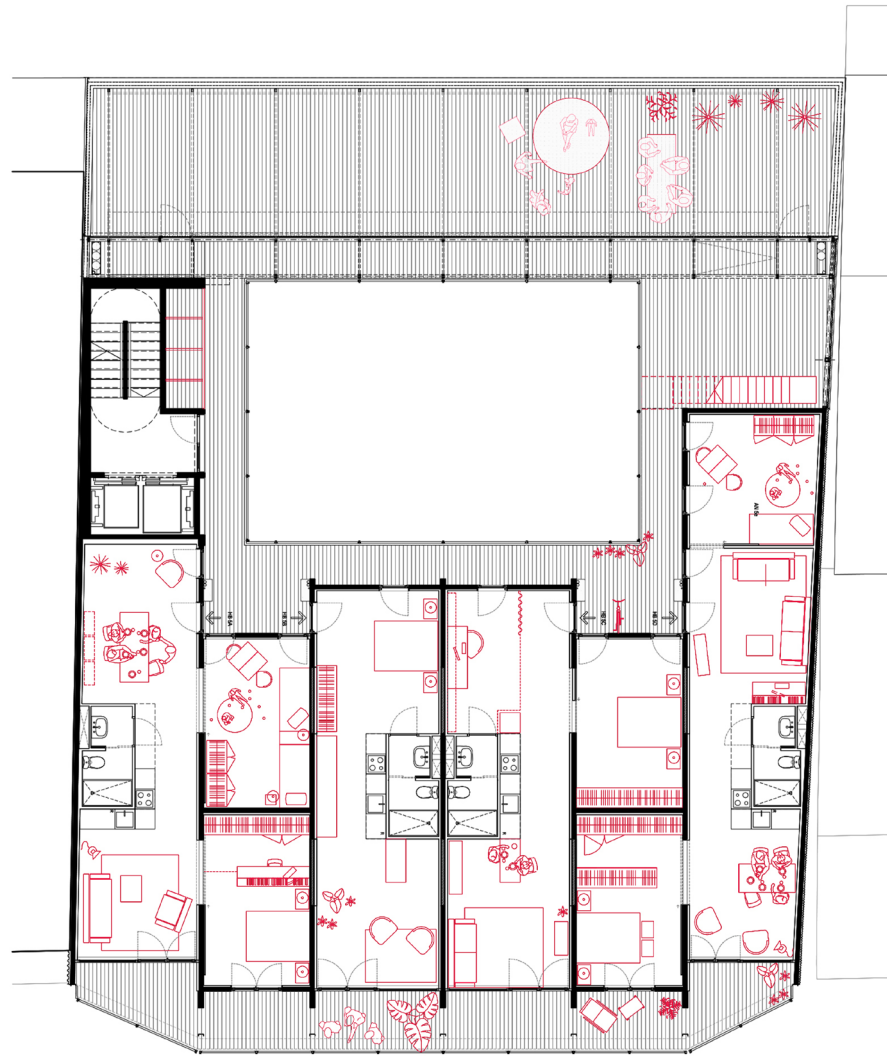


Figure 18. 5th floor La Borda, collective spaces.

## 8.2 Case study synthesis

The four case studies each contribute a different principle to the development of Apposition. Hotel Jakarta informs the relationship between materiality, climate and collective interior space. Xylino demonstrates the potential of modular timber construction at the scale of collective housing. Remote House shows how architecture can be understood as a transportable and demountable assembly. La Borda adds the social dimension, showing how collective spaces can support compact dwellings and create a shared living environment.

Together, these case studies helped define four design principles for Apposition: architecture as a system rather than an object, the ability to place and remove elements, the combination of individual and collective living, and the understanding of the building as a future material resource.

## 8.3 Case study bibliography

ArchDaily. (2015, July 13). Remote House / Felipe Assadi. <https://www.archdaily.com/770102/remote-house-felipe-assadi>

ArchDaily. (2018, July 30). Hotel Jakarta / SeARCH. <https://www.archdaily.com/899081/hotel-jakarta-search>

ArchDaily. (2019, August 5). La Borda / Lacol. <https://www.archdaily.com/922184/la-borda-lacol>  
Arons en Gelauff Architecten. (n.d.). Xylino. <https://aronsengelauff.nl/projecten/xylino/>

Gutiérrez Couto, M. (2016). 150 best tiny home ideas. Harper Design.

Hotel Jakarta. (n.d.). Sustainably built building. <https://hoteljakarta.com/sustainably-built/building/>  
Lacol. (n.d.). La Borda. <https://lacol.coop/en/projectes/la-borda/>

Lacol. (n.d.). La Borda: Architectural project. <https://www.laborada.coop/en/project/architectural-project/>

## 8.4 List of Figures

Figure 01. Hotel Jakarta. Ainali. (2023). Hotel Jakarta Amsterdam [Photograph]. Wikimedia Commons. Licensed under CC BY-SA 3.0.

Figure 02. Xylino. Vivid Vision. (n.d.). Xylino [Architectural render]. Arons en Gelauff architecten.

Figure 03. Remote House. Alda, F. (2016). Remote House [Photograph]. Divisare.

Figure 04. La Borda. Miralles, L. (2020). La Borda, cooperative housing [Photograph]. Divisare.

Figure 05. Axonometric view Hotel Jakarta, SeARCH. (n.d.). Hotel Jakarta architectural drawings. SeARCH.

Figure 06. Axonometric view 1 module, SeARCH. (n.d.). Hotel Jakarta architectural drawings. SeARCH.

Figure 07. Section Hotel Jakarta, SeARCH. (n.d.). Hotel Jakarta architectural drawings. SeARCH.

Figure 08. Hotel Jakarta 4th floor, 1 module and courtyard, SeARCH. (n.d.). Hotel Jakarta architectural drawings. SeARCH.

Figure 09. Axonometric visualisation of Xylino. Vivid Vision. (n.d.). Xylino, Almere [Architectural render]. Arons en Gelauff architecten.

Figure 10. Xylino under construction. Aarts, R., & Klooster, M. (2026). Xylino, Almere [Photograph]. Metsä Wood.

Figure 11. Xylino 1st floor, different modules. de Alliantie. (2025). Xylino, Almere: Verhuurtekeningen [Architectural drawing]. de Alliantie.

Figure 12. Remote House during transport and assembly. Alda, F. (2014). Remote House / Casa Remota: transport and assembly process [Photograph]. Felipe Assadi Arquitectos.

Figure 13. Remote House during installation. Alda, F. (2014). Remote House / Casa Remota: installation process [Photograph]. Felipe Assadi Arquitectos.

Figure 14. Interior view Remote House. Alda, F. (2014). Remote House / Casa Remota, interior view [Photograph]. Felipe Assadi Arquitectos.

Figure 15. Floor plan Remote House, 1 module. Felipe Assadi Arquitectos. (2014). Remote House / Casa Remota, first floor plan [Architectural drawing]. Felipe Assadi Arquitectos.

Figure 16. Housing typologies La Borda. Lacol. (n.d.). La Borda housing typologies [Architectural drawing]. In La Borda [PDF].

Figure 17. Structural axonometric analysis of La Borda. Bugarin, J. (2022). Multi Storey Timber Structure – La Borda: analysis of structural elements [Architectural diagram]. IAAC Blog.

Figure 18. 5th floor La Borda, collective spaces. Lacol. (2019). La Borda cooperative housing, floor plan [Architectural drawing]. ArchDaily.



# CALCULATIONS

## 8.2 Calculations

Overall Housing, Occupancy and Parking Calculation

### 1. Number of dwellings per building type

The project consists of three residential building typologies: corridor buildings, gallery-access buildings, and staircase-access / portico buildings.

Building type	Number of buildings	Dwellings per building	Total dwellings
Corridor	8	18 dwellings of 40 m <sup>2</sup>	144
Gallery	10	12 dwellings of 40 m <sup>2</sup> + 3 dwellings of 80 m <sup>2</sup>	150
Portico	10	15 dwellings of 40 m <sup>2</sup> + 4 dwellings of 80 m <sup>2</sup>	190
Total	28 buildings		484 dwellings

### 2. Distribution of dwelling types

Dwelling type	Number of dwellings	Size per dwelling	Total floor area
Compact dwellings	414	40 m <sup>2</sup>	16,560 m <sup>2</sup>
Larger dwellings	70	80 m <sup>2</sup>	5,600 m <sup>2</sup>
Total	484		22,160 m <sup>2</sup>

The total residential floor area is therefore:

22,160 m<sup>2</sup>

The average dwelling size is:

$22,160 \text{ m}^2 / 484 \text{ dwellings} = 45.8 \text{ m}^2 \text{ per dwelling}$

### 3. Occupancy calculation

The compact 40 m<sup>2</sup> dwellings are designed for 1–2 persons.

The larger 80 m<sup>2</sup> dwellings are designed for 3–4 persons.

Occupancy per dwelling type

Dwelling type	Number of dwellings	Occupancy	Total residents
40 m <sup>2</sup> dwellings	414	1–2 persons	

414–828 residents

80 m<sup>2</sup> dwellings 70 3–4 persons

210–280 residents

Total 484 624–1,108 residents

So the full project can accommodate approximately: 624 to 1,108 residents

A realistic design estimate would be around:

850 to 900 residents

This is because not every compact dwelling will permanently be occupied by two people.

### 4. Occupancy per building type

Building type	Number of buildings	Occupancy per building	Total occupancy
Corridor	8	18–36 residents	144–288 residents
Gallery	10	21–36 residents	210–360 residents
Portico	10	31–46 residents	310–460 residents
Total			664–1,108 residents

### 5. Car parking calculation

For the parking calculation, the following assumptions are used:

Dwelling type	Parking norm	Parking space per dwelling	Parking demand
Compact dwellings under 50 m <sup>2</sup>	1.0 parking space per dwelling		
Larger apartments	1.3 parking spaces per dwelling		
Dwelling type	Number of dwellings	Parking norm	Required parking spaces
40 m <sup>2</sup> dwellings	414	1.0	414
80 m <sup>2</sup> dwellings	70	1.3	91

Total 484 505 parking spaces

The formal parking demand is therefore:

505 parking spaces

### 6. Visitor parking

The parking standard includes visitor parking.

The visitor parking component is usually calculated as:

0.3 parking spaces per dwelling

Calculation	Result
484 dwellings × 0.3	145.2

Rounded up, the project requires approximately:

146 visitor parking spaces

This means the remaining parking demand for residents is:

$505 - 146 = 359 \text{ resident parking spaces}$

So the total can be divided as:

Parking type	Number of spaces
Resident parking	359 spaces
Visitor parking	146 spaces
Total	505 spaces

### 7. Parking surface area

As a design rule of thumb, one parking space including circulation, access lanes and manoeuvring space takes approximately:

25 m<sup>2</sup> per parking space

Scenario	Parking spaces	Area per space	Total parking area
Formal parking demand	505	25 m <sup>2</sup>	12,625 m <sup>2</sup>

So the project would require approximately:

12,625 m<sup>2</sup> of parking area

This equals approximately:

1.26 hectares

### 8. Bicycle parking calculation

For a compact and mobility-conscious housing project, bicycle parking is very important.

Dwelling type	Number of dwellings	Bicycle parking norm	Required bicycle spaces
40 m <sup>2</sup> dwellings	414	1 space per dwelling	414
80 m <sup>2</sup> dwellings	70	3 spaces per dwelling	210

Total resident bicycle parking  
624 spaces

Visitor bicycle parking

Visitor bicycle parking can be calculated as:

0.5–1.0 bicycle spaces per dwelling

Calculation	Result
$484 \times 0.5$	242 spaces
$484 \times 1.0$	484 spaces

The total bicycle parking demand is therefore:

Type	Number of bicycle spaces
Resident bicycle parking	624 spaces
Visitor bicycle parking	242–484 spaces
Total bicycle parking	866–1,108 spaces

### 8. Summary

Category	Result
Total number of buildings	28 buildings
Total number of dwellings	484 dwellings
40 m <sup>2</sup> dwellings	414 dwellings
80 m <sup>2</sup> dwellings	70 dwellings
Total residential floor area	22,160 m <sup>2</sup>
Average dwelling size	45.8 m <sup>2</sup>
Minimum occupancy	624 residents
Maximum occupancy	1,108 residents
Realistic design occupancy	850–900 residents
Required car parking	505 spaces
Resident car parking	359 spaces
Visitor car parking	146 spaces
Estimated parking area	12,625 m <sup>2</sup> / 1.26 ha
Resident bicycle parking	624 spaces
Total bicycle parking incl. visitors	866–1,108 spaces





# 08 SKETCHES

## 8.3 Sketches

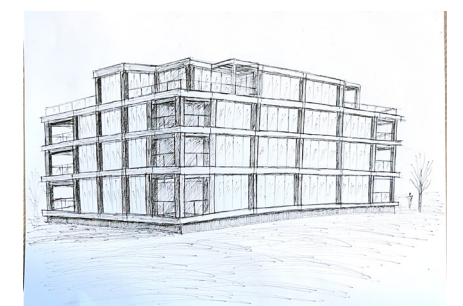
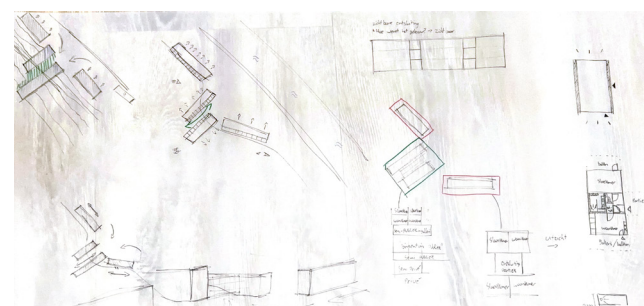
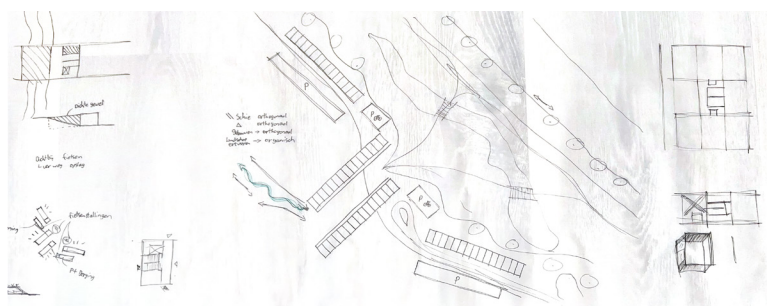
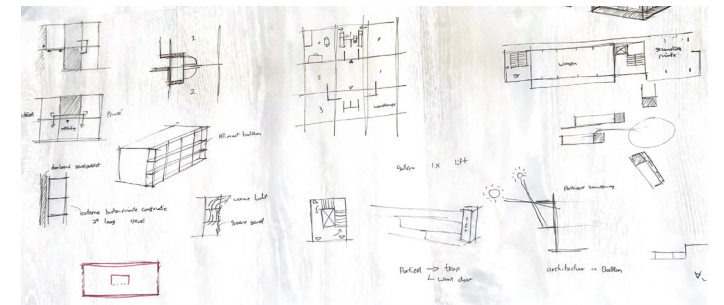
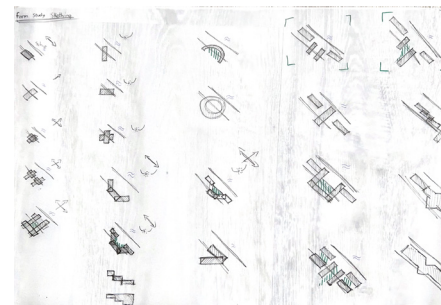
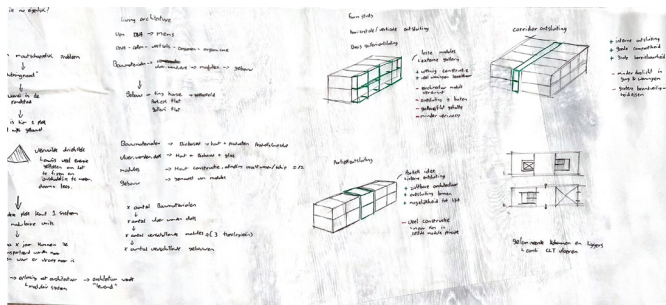
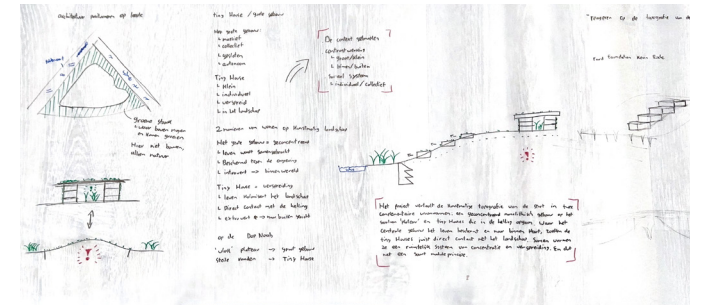
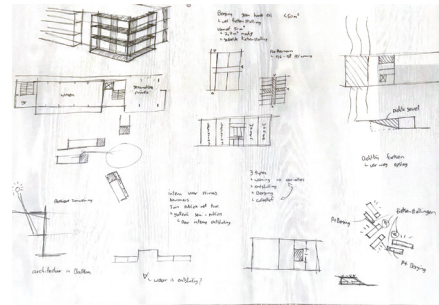
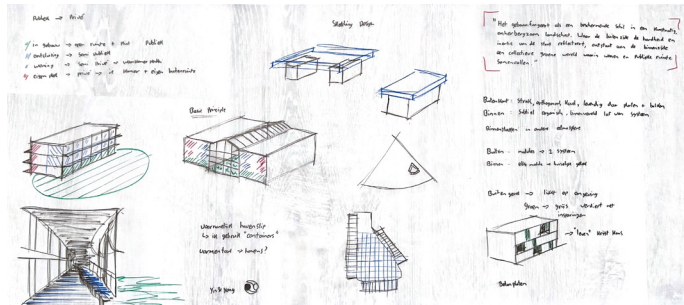


figure 67. Sketches.



# 08 DESIGN DRAWINGS

## 8.4 Design drawings



figure 69.Site plan indicating section line.

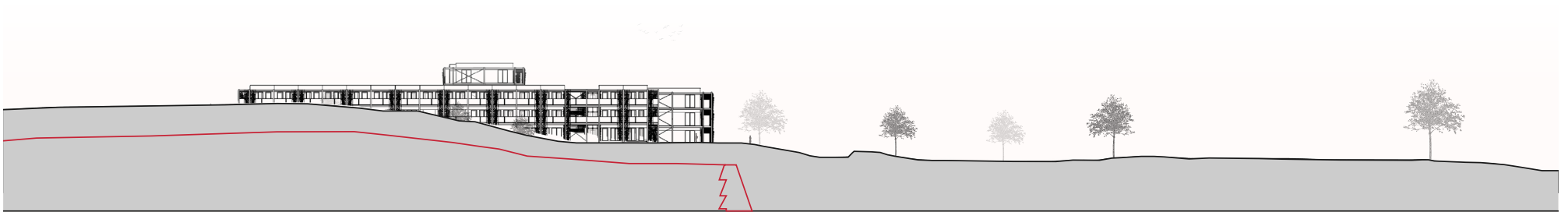


figure 68.Section.

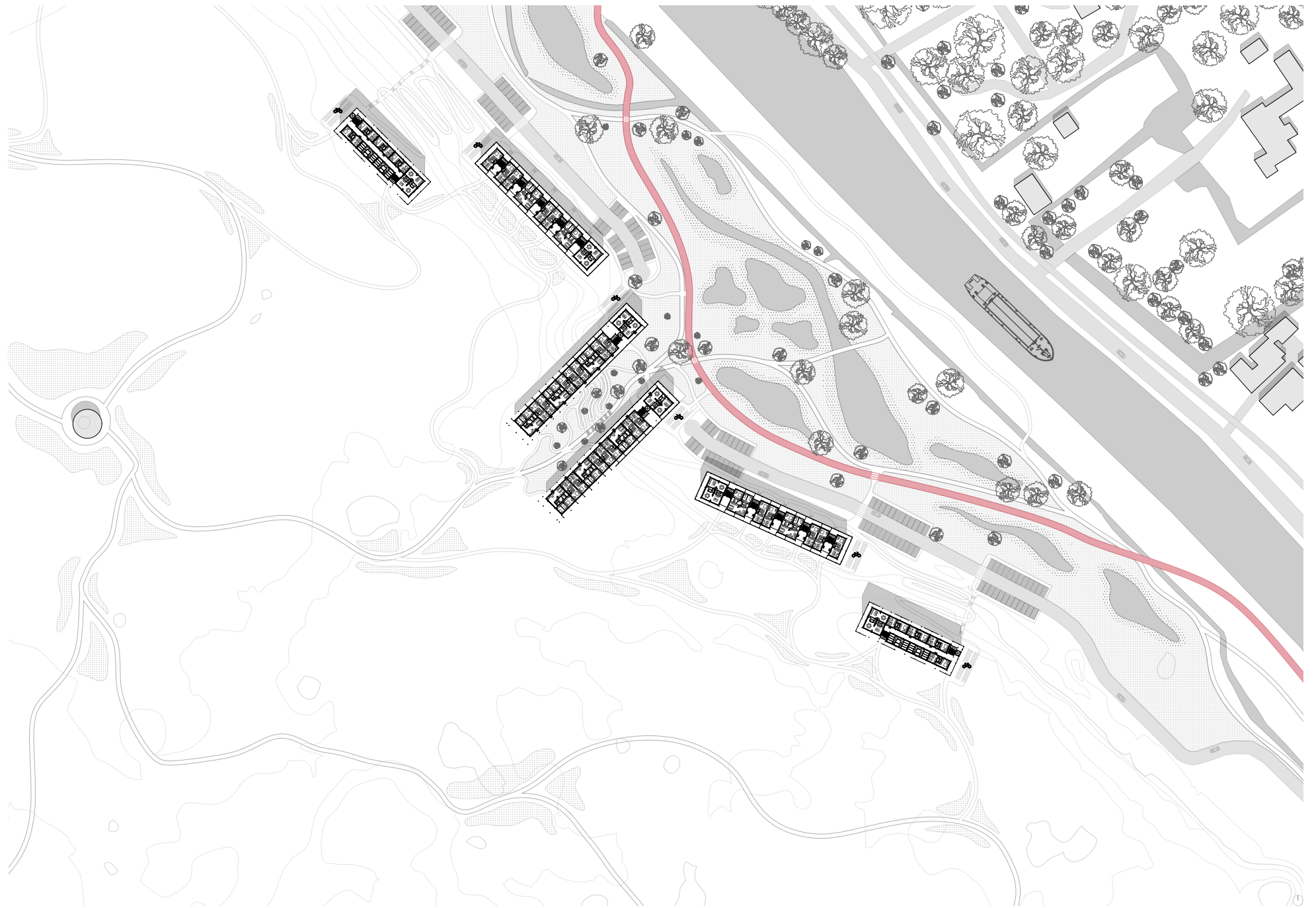


figure 70.Situation.





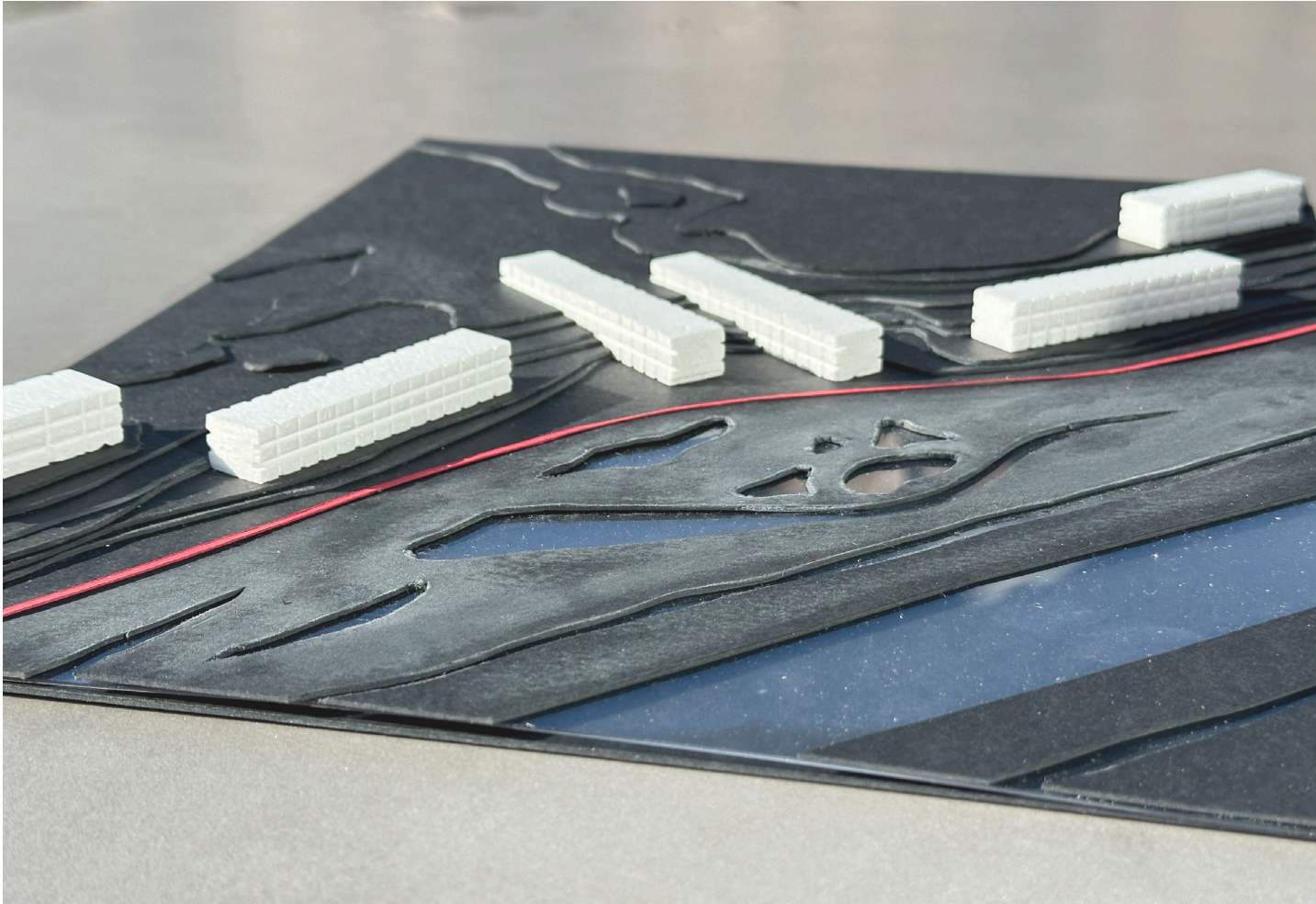
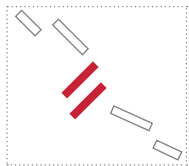


figure 72.Site model 1:1000.



figure 73. Ground floor gallery.



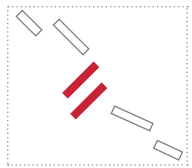


figure 74. First floor gallery.

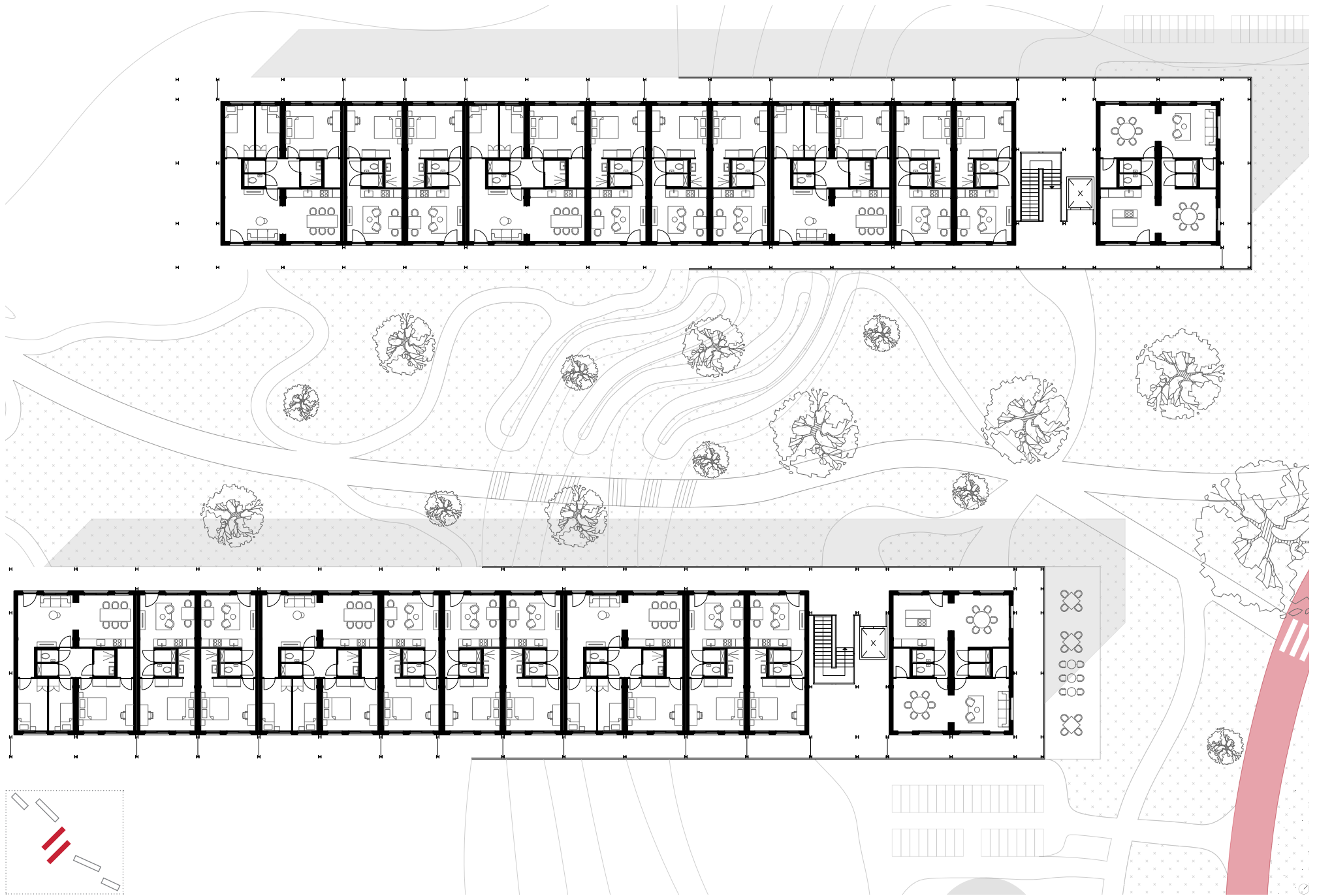


figure 75. Second floor gallery.

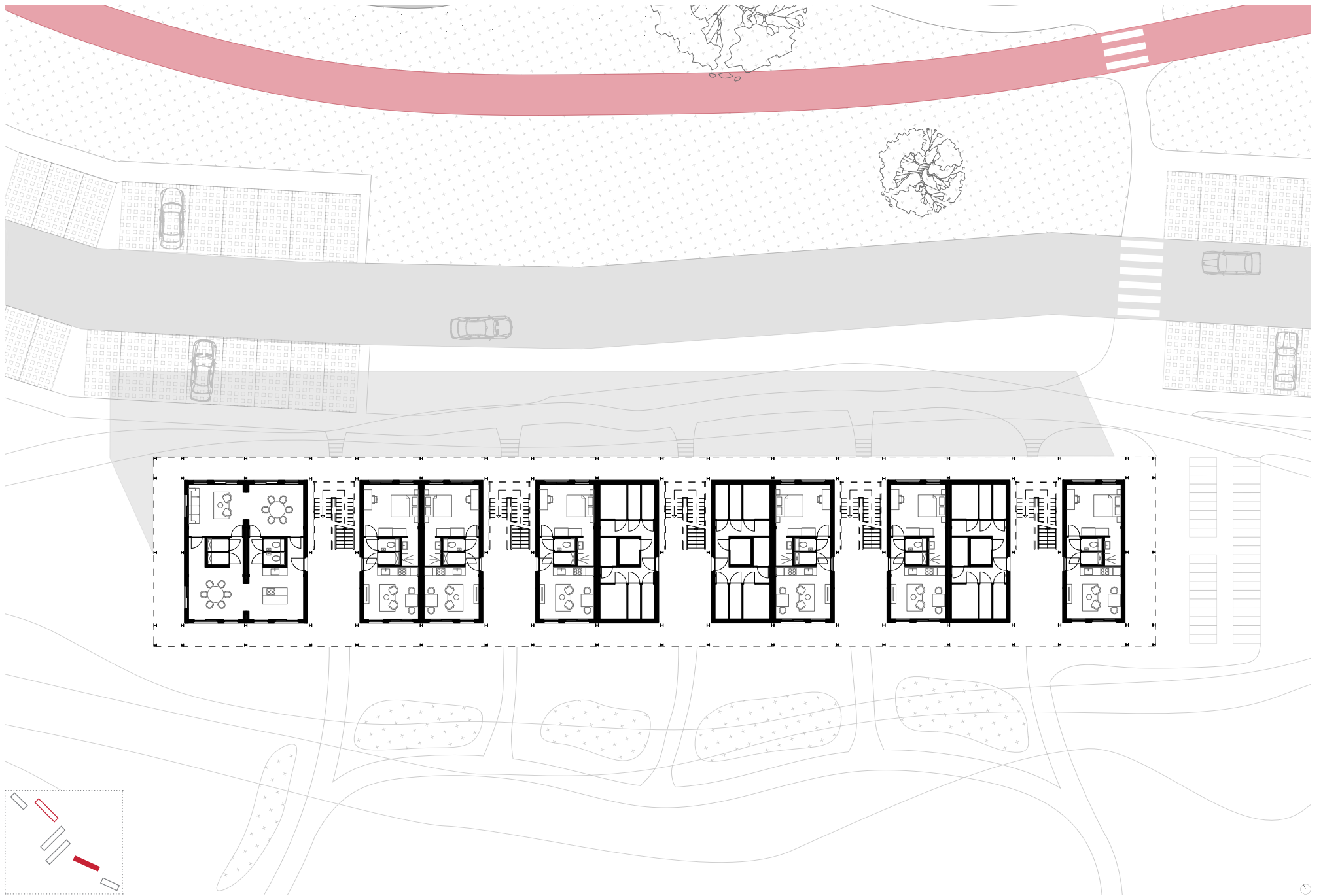


figure 76. Ground floor portico.

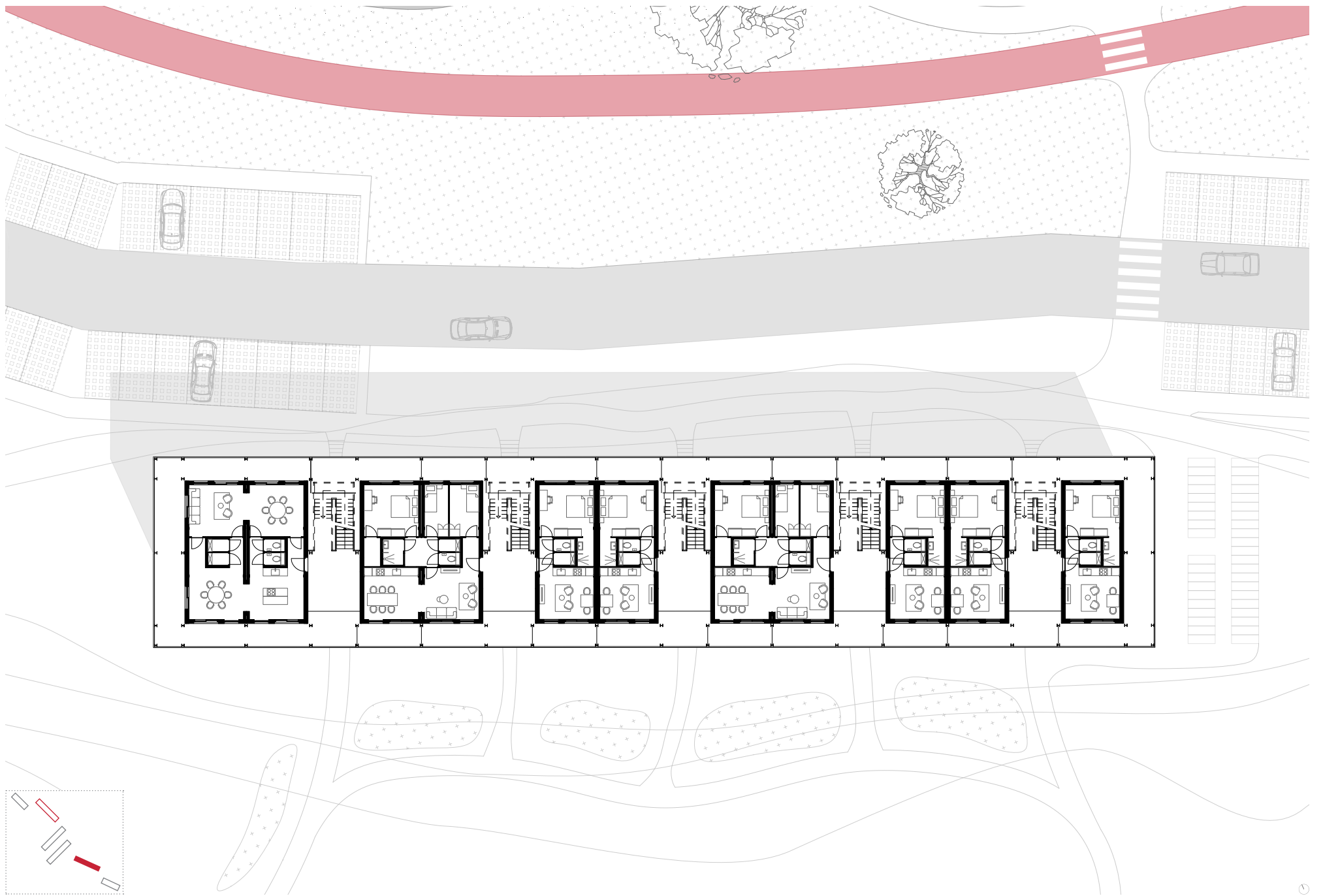


figure 77. First floor portico.

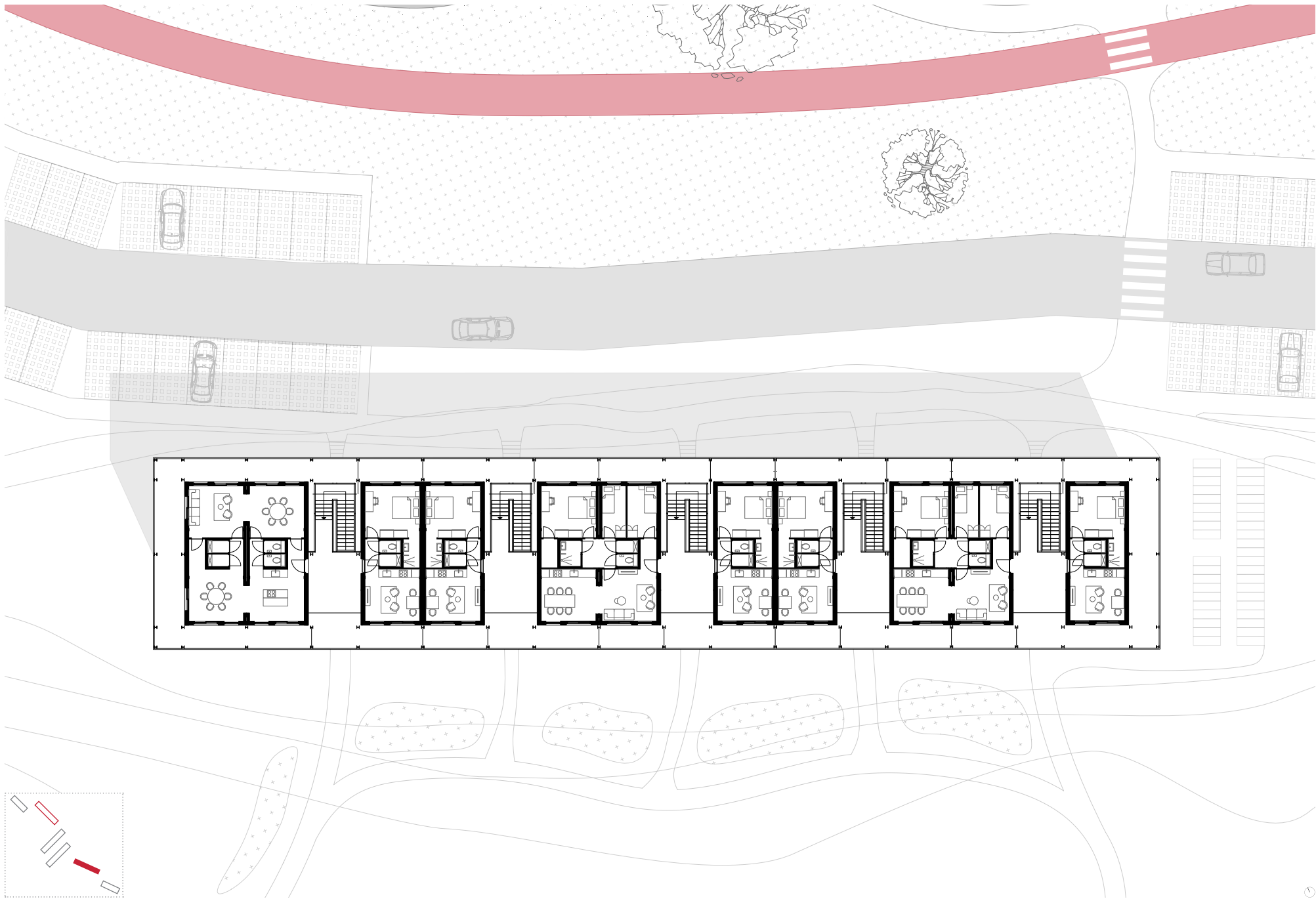
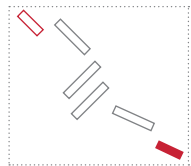
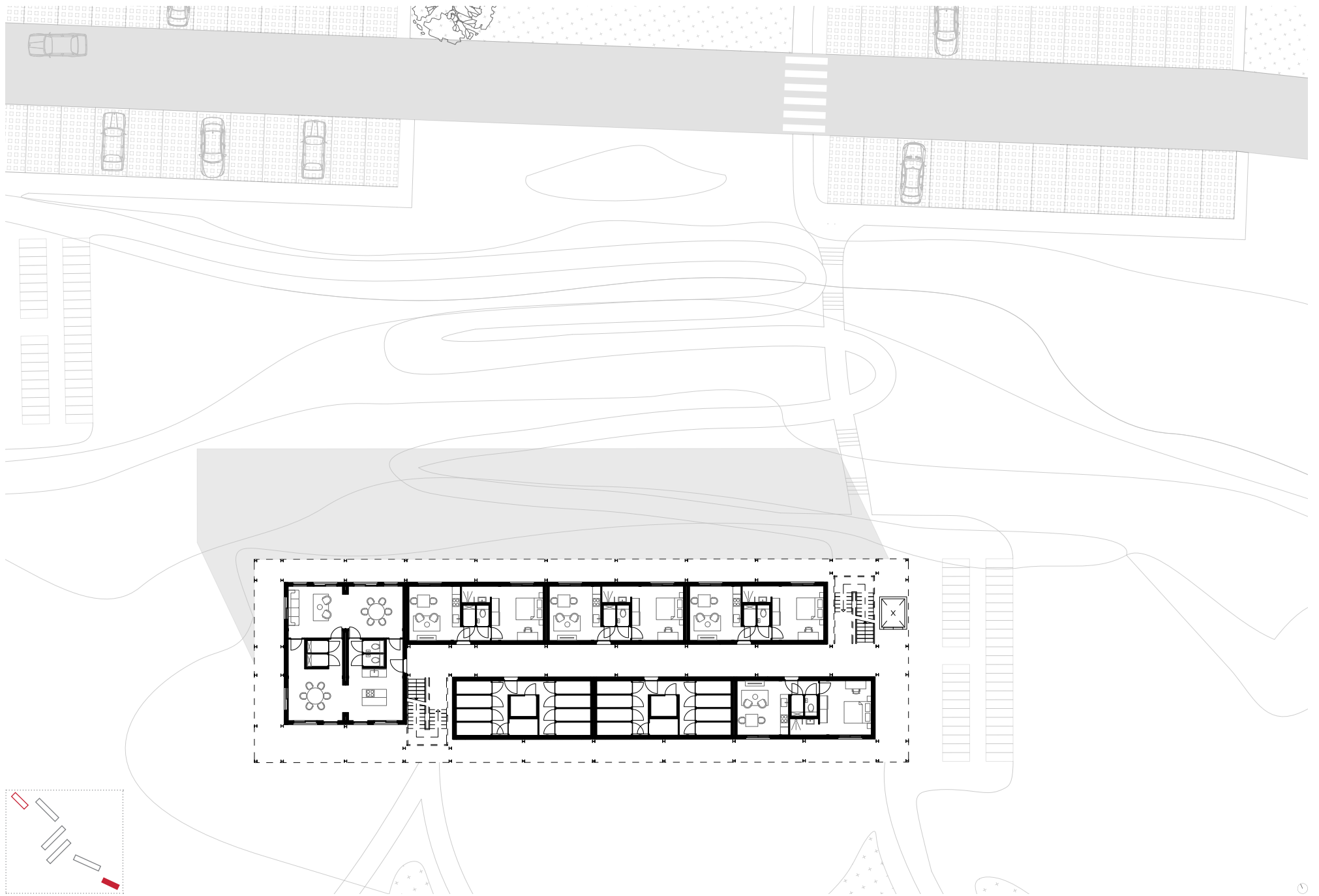


figure 78. Second floor portico.



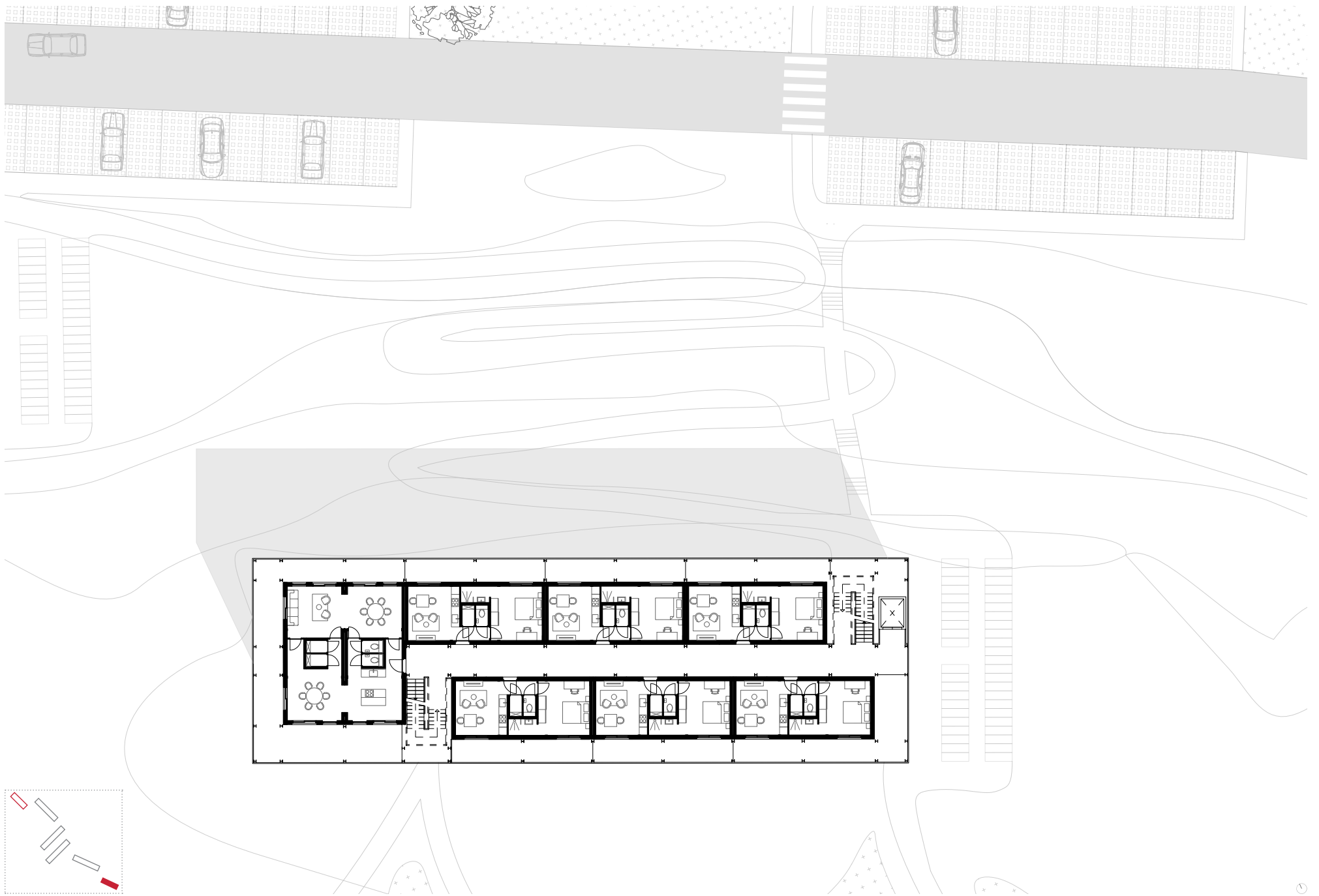


figure 80. First floor corridor.

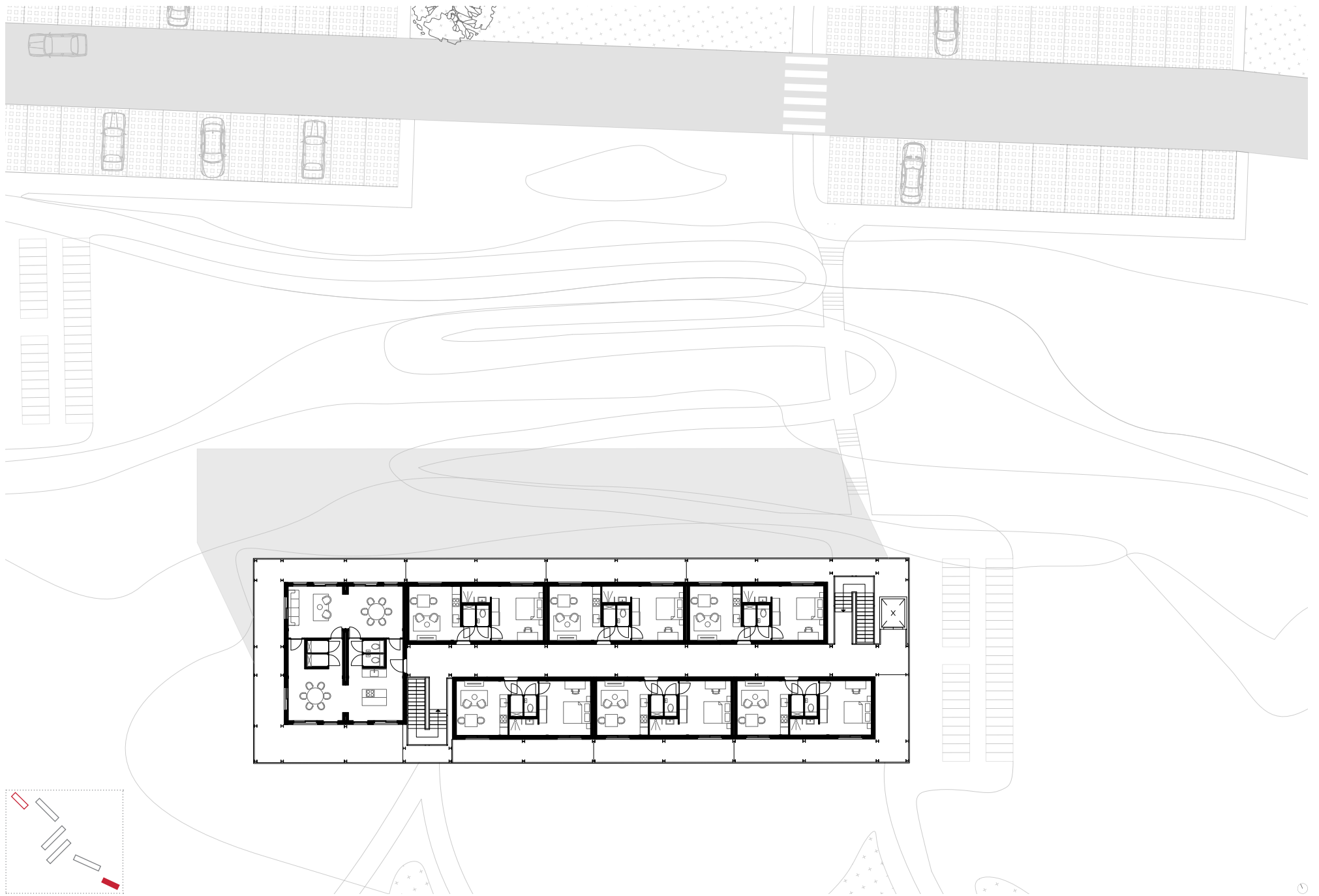


figure 81. Second floor corridor.



figure 82.Front elevation.



figure 83.Back elevation.





figure 85.Rain render Apposition.



# 08 TECHNICAL DRAWINGS

## 8.5 Technical drawings

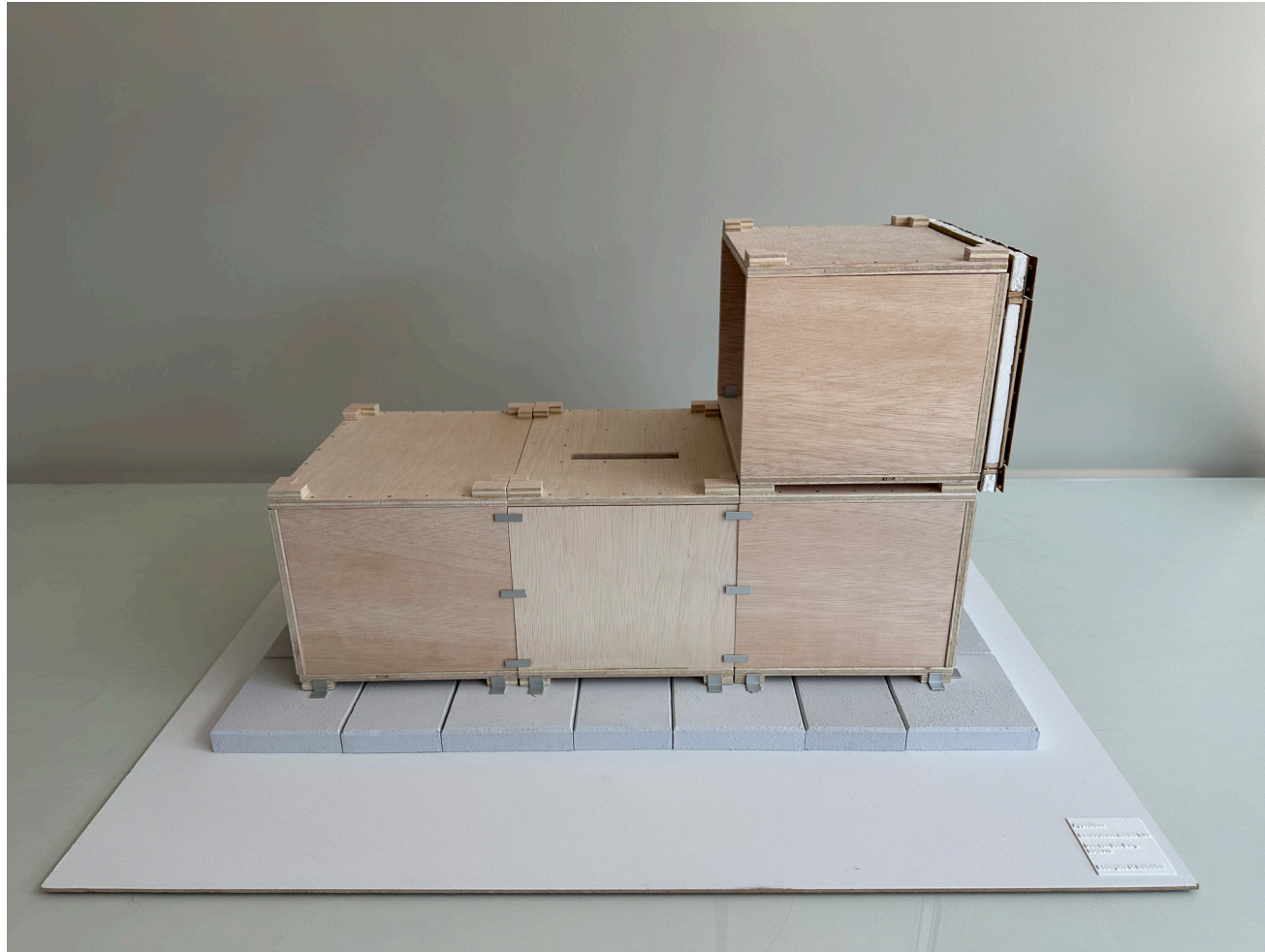


figure 86. Construction model 1:20.





figure 88. Construction model 1:20.



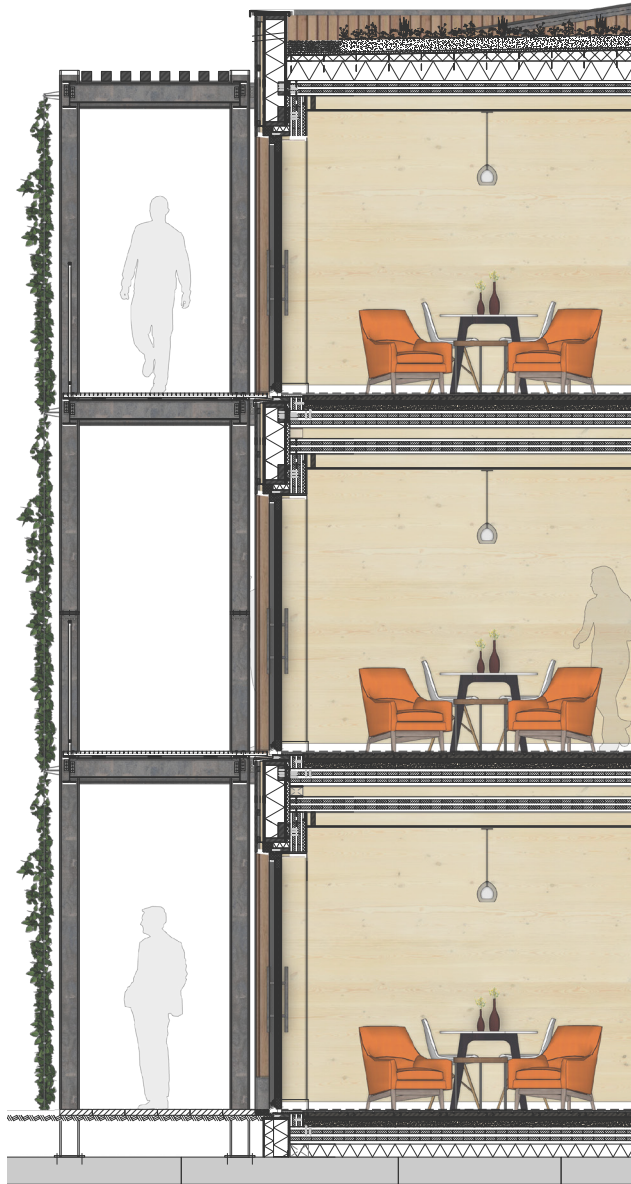


figure 90. Vertical section building.



figure 91. Steel access.





figure 93. Isometric section.

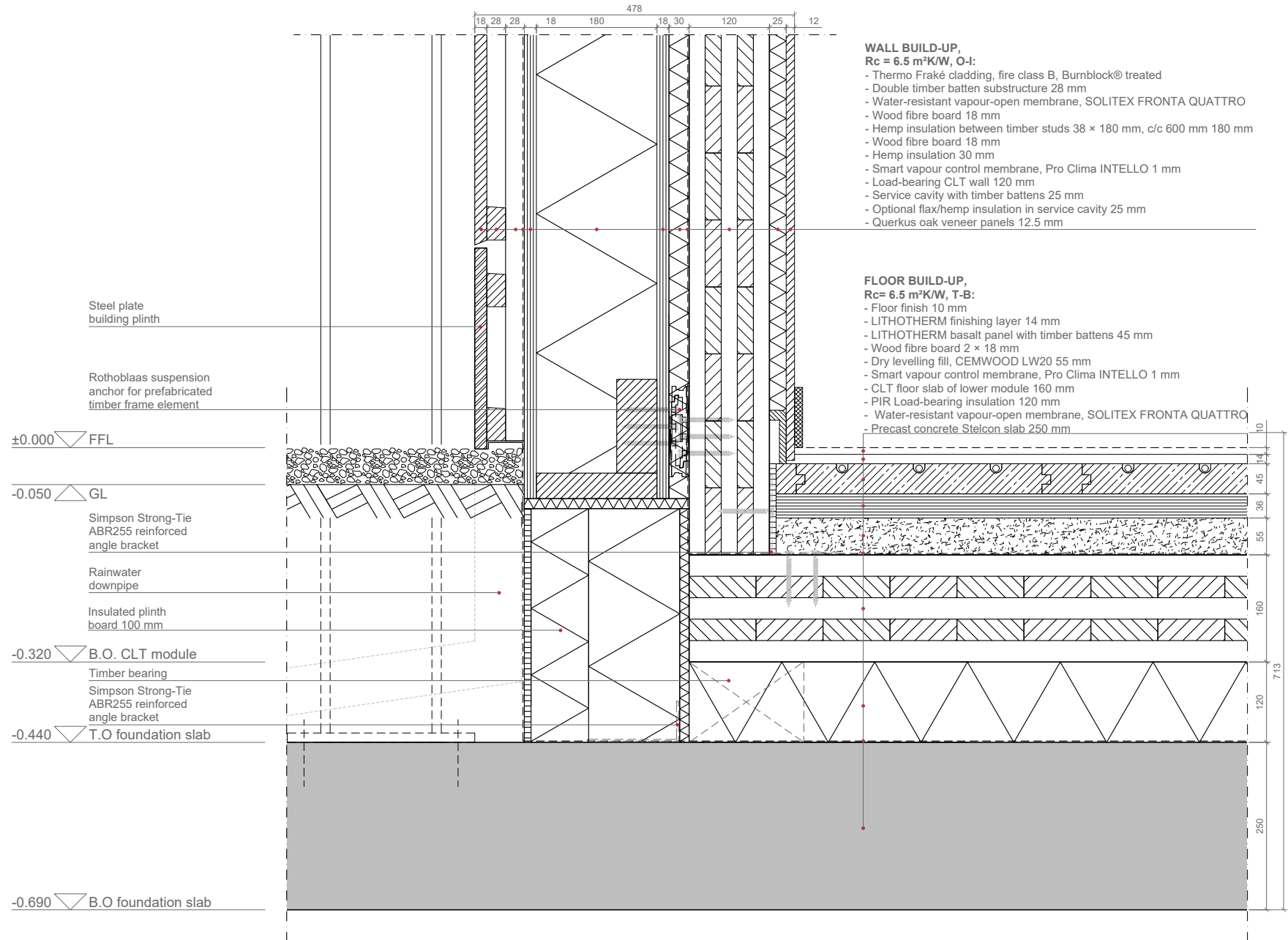


figure 94. Floor detail.

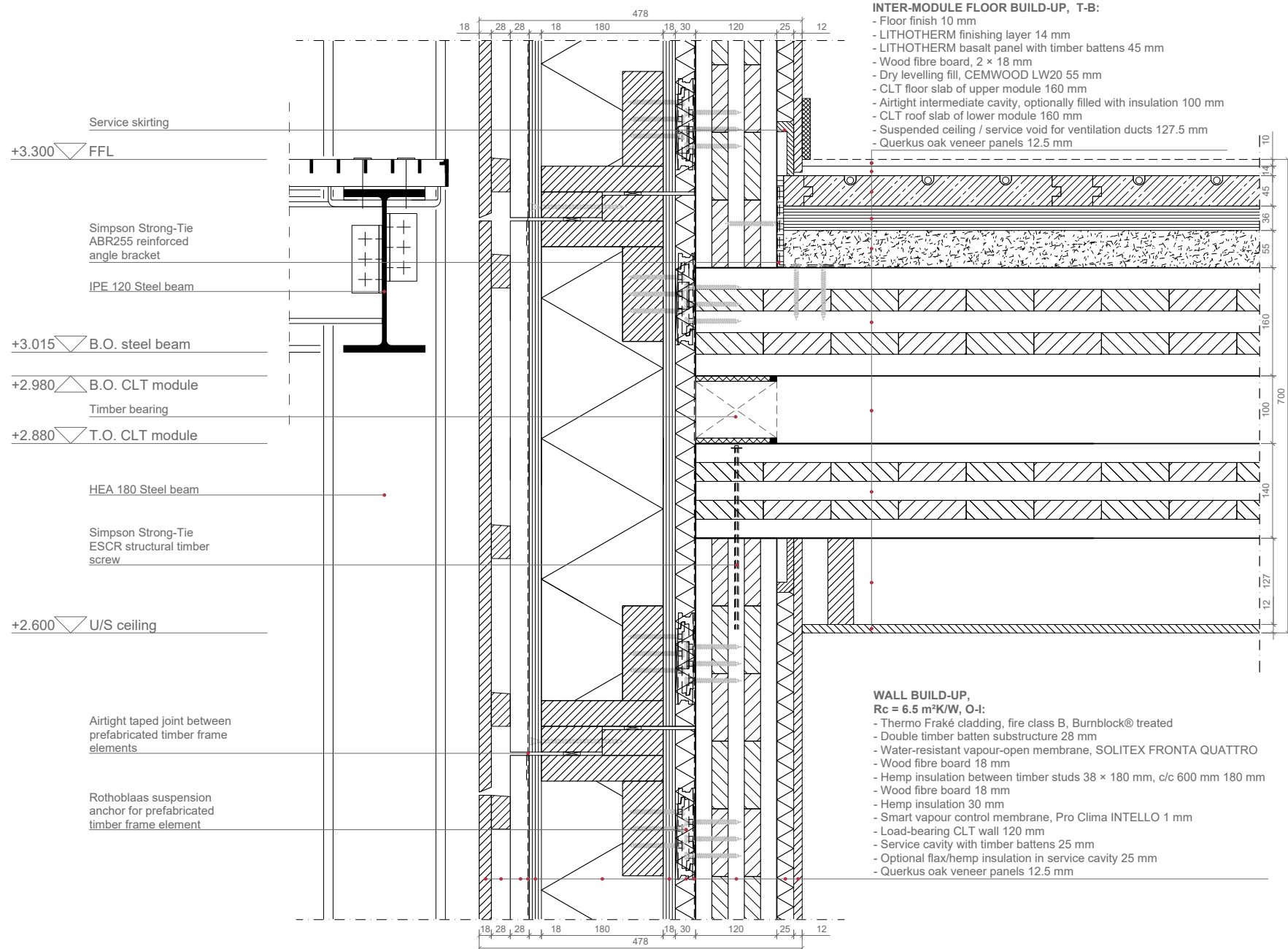


figure 95. Module-to-module detail.

+10.120 ▽ T.O. parapet

+10.000 ▽ T.O. HSB element

Emergency overflow

Rainwater downpipe

HERTALAN® Induction fastening system  
RHINOBOND®-pressure distribution plate and screw

+9.480 ▽ T.O. CLT module

IPE 120 Steel beam

Simpson Strong-Tie  
ESCR structural timber screw

+9.235 ▽ B.O. steel beam

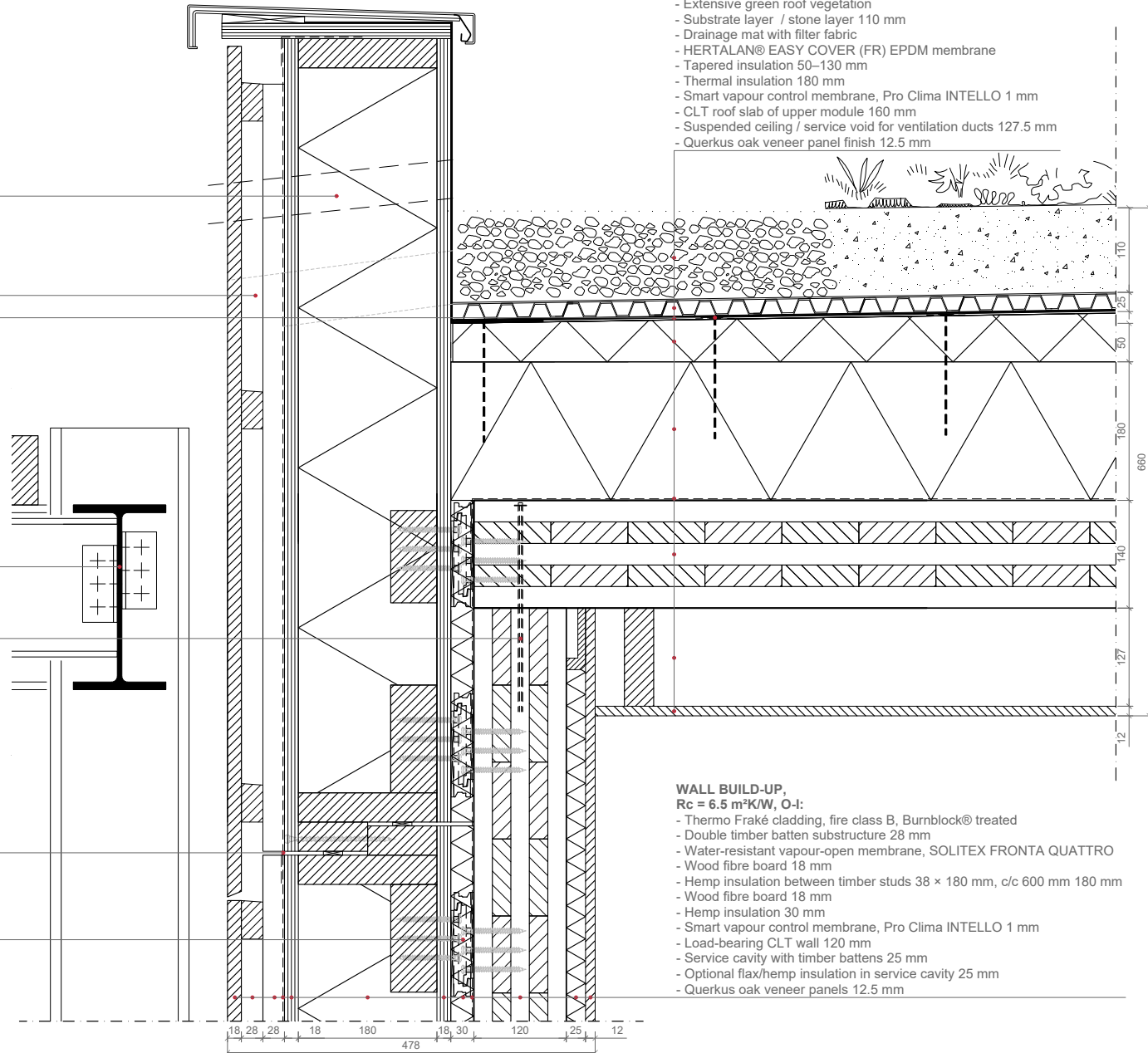
+9.200 ▽ U/S ceiling

Airtight taped joint between prefabricated timber frame elements

Rothoblaas suspension anchor for prefabricated timber frame element

**ROOF BUILD-UP,  
Rc = 8.5 m²K/W, T-B:**

- Extensive green roof vegetation
- Substrate layer / stone layer 110 mm
- Drainage mat with filter fabric
- HERTALAN® EASY COVER (FR) EPDM membrane
- Tapered insulation 50-130 mm
- Thermal insulation 180 mm
- Smart vapour control membrane, Pro Clima INTELLO 1 mm
- CLT roof slab of upper module 160 mm
- Suspended ceiling / service void for ventilation ducts 127.5 mm
- Querkus oak veneer panel finish 12.5 mm



**WALL BUILD-UP,  
Rc = 6.5 m²K/W, O-I:**

- Thermo Fraké cladding, fire class B, Burnblock® treated
- Double timber batten substructure 28 mm
- Water-resistant vapour-open membrane, SOLITEX FRONTA QUATTRO
- Wood fibre board 18 mm
- Hemp insulation between timber studs 38 x 180 mm, c/c 600 mm 180 mm
- Wood fibre board 18 mm
- Hemp insulation 30 mm
- Smart vapour control membrane, Pro Clima INTELLO 1 mm
- Load-bearing CLT wall 120 mm
- Service cavity with timber battens 25 mm
- Optional flax/hemp insulation in service cavity 25 mm
- Querkus oak veneer panels 12.5 mm

figure 96. Roof detail.

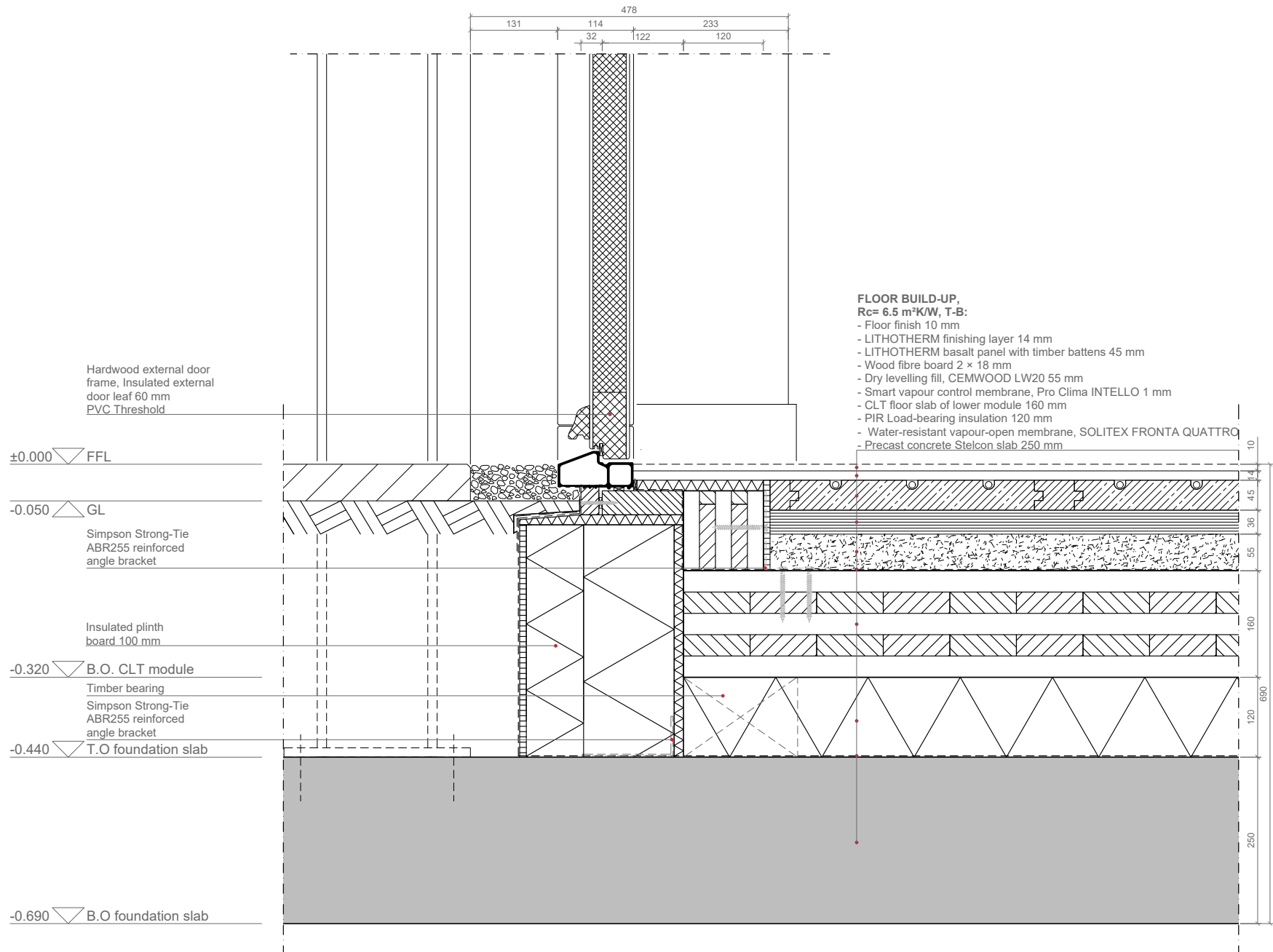


figure 97.Floor detail front door.

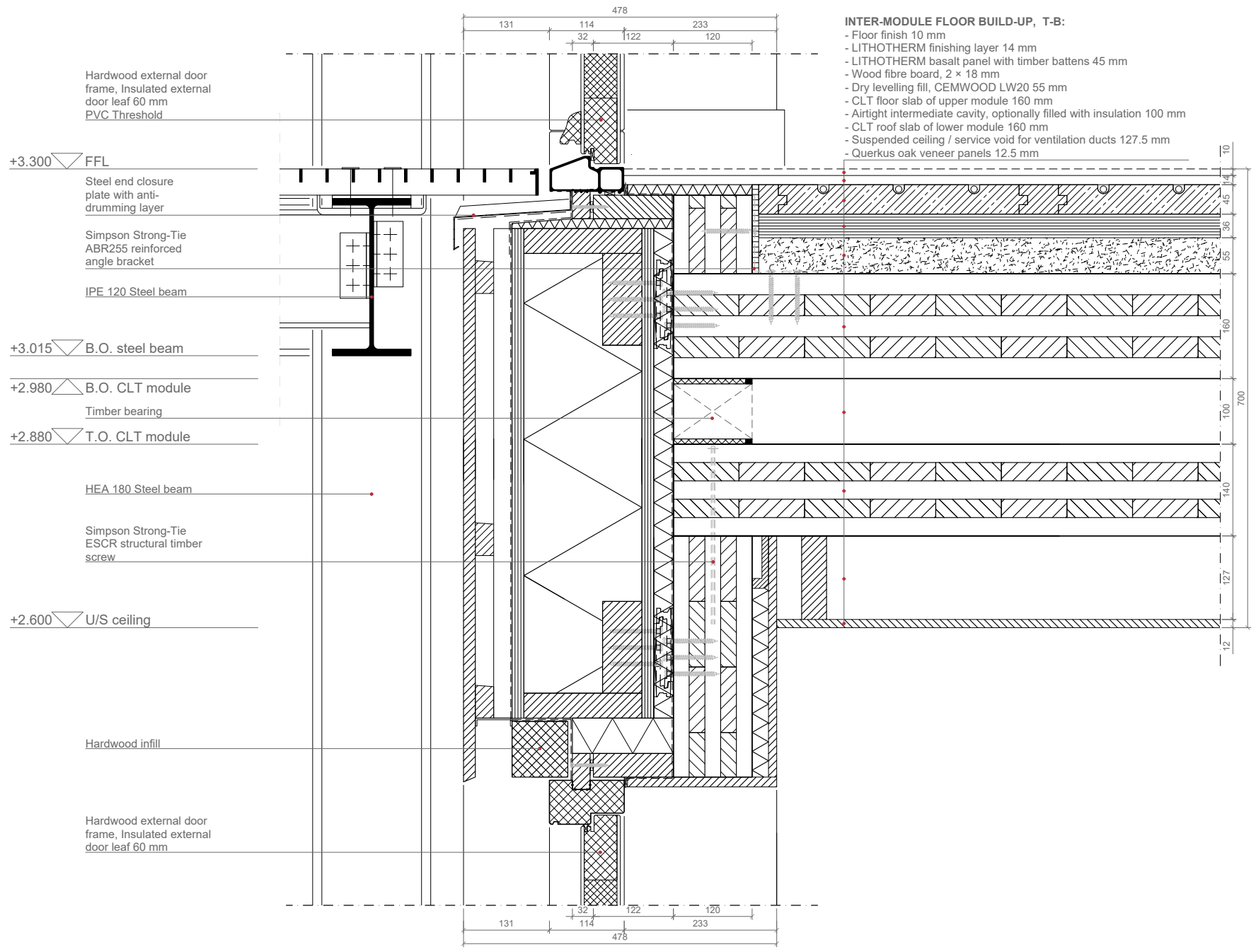


figure 98. Module-to-module detail front door.

+10.120 ▽ T.O. parapet

+10.000 ▽ T.O. HSB element

Emergency overflow

HERTALAN® Induction fastening system  
RHINOBOND® pressure distribution plate and screw

+9.480 ▽ T.O. CLT module

IPE 120 Steel beam

Simpson Strong-Tie  
ESCR structural timber screw

+9.235 ▽ B.O. steel beam

+9.200 ▽ U/S ceiling

Hardwood infill

Hardwood external door frame, Insulated external door leaf 60 mm

**ROOF BUILD-UP,  
Rc= 8.5 m²K/W, T-B:**

- Extensive green roof vegetation
- Substrate layer / stone layer 110 mm
- Drainage mat with filter fabric
- HERTALAN® EASY COVER (FR) EPDM membrane
- Tapered insulation 50-130 mm
- Thermal insulation 180 mm
- Smart vapour control membrane, Pro Clima INTELLO 1 mm
- CLT roof slab of upper module 160 mm
- Suspended ceiling / service void for ventilation ducts 127.5 mm
- Querkus oak veneer panel finish 12.5 mm

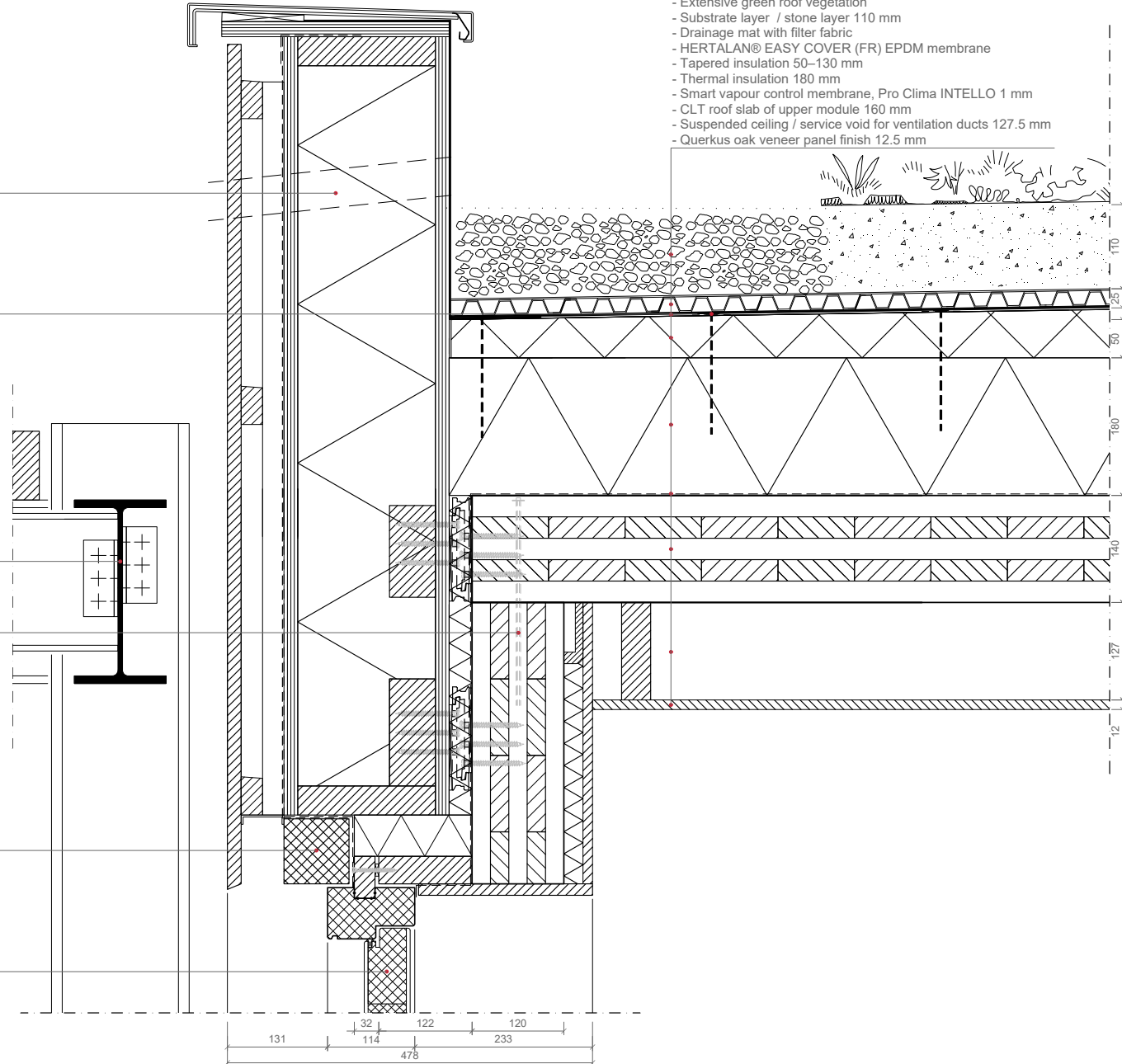


figure 99.Roof detail front door.

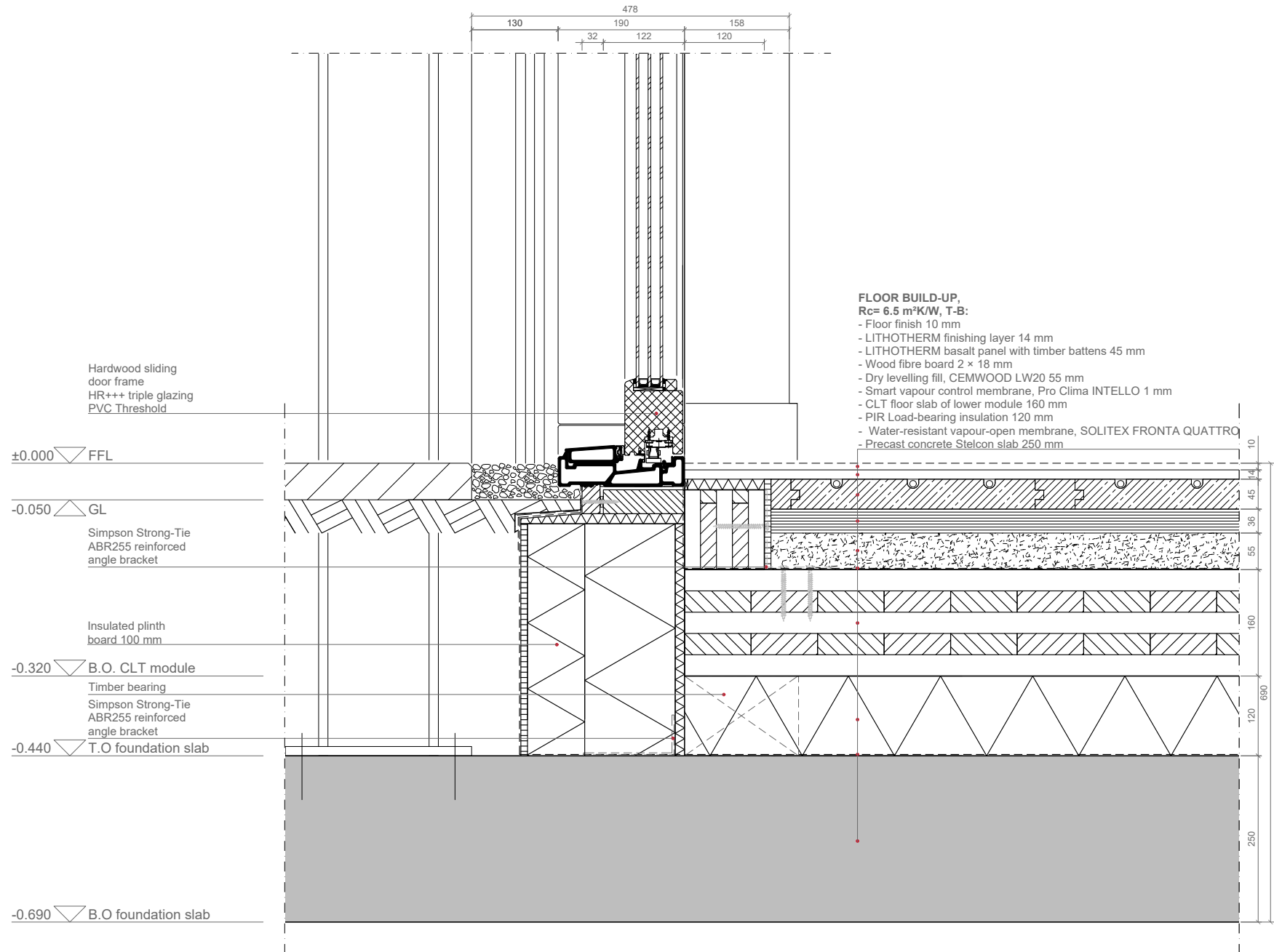


figure 100.Floor detail sliding door.

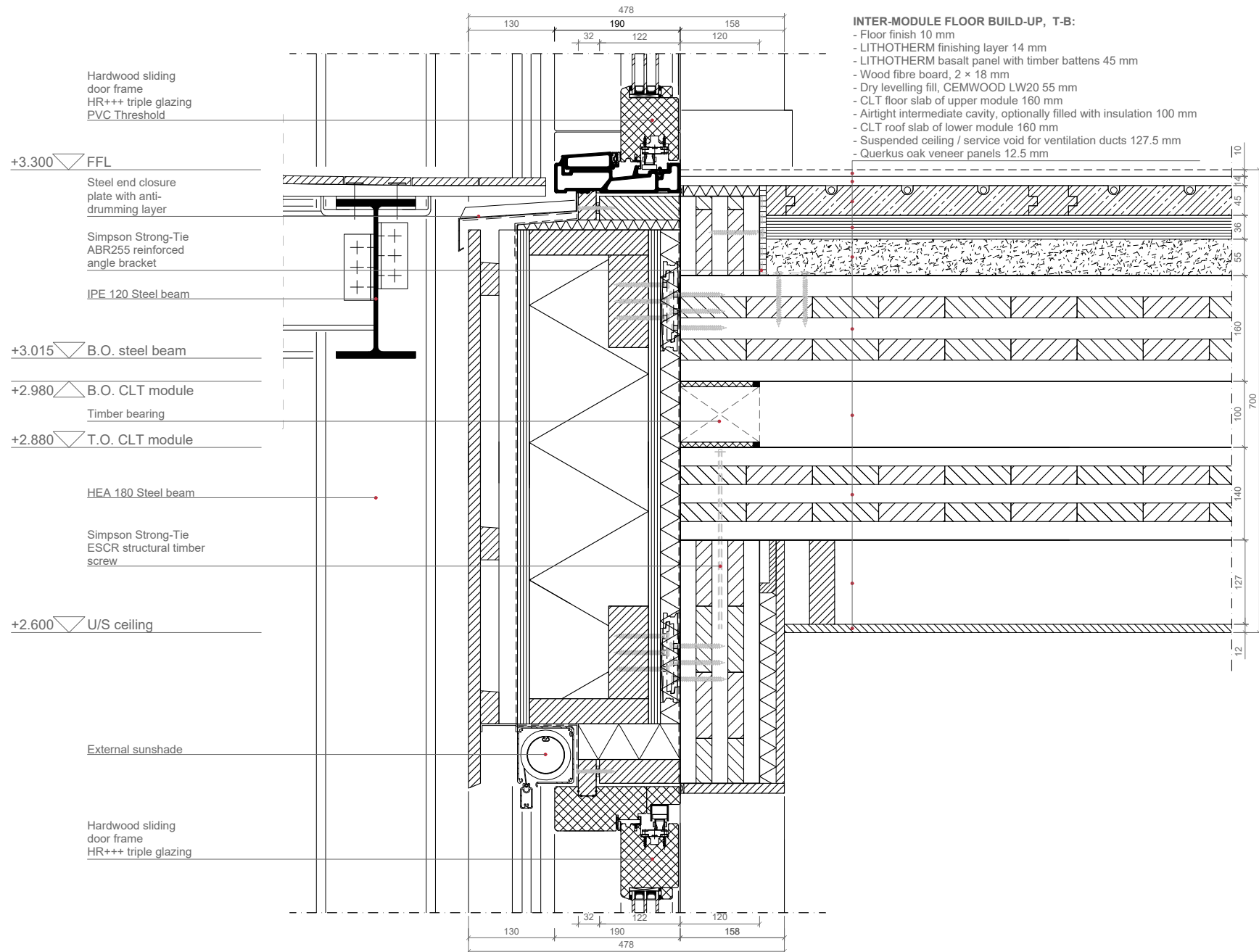


figure 101.Module-to-module detail sliding door.

+10.120 ▽ T.O. parapet

+10.000 ▽ T.O. HSB element

Emergency overflow

HERTALAN® Induction fastening system  
RHINOBOND®-pressure distribution plate and screw

+9.480 ▽ T.O. CLT module

IPE 120 Steel beam

Simpson Strong-Tie  
ESCR structural timber screw

+9.235 ▽ B.O. steel beam

+9.200 ▽ U/S ceiling

External sunshade

Hardwood sliding door frame  
HR+++ triple glazing

- ROOF BUILD-UP,  
Rc= 8.5 m²K/W, T-B:**
- Extensive green roof vegetation
  - Substrate layer / stone layer 110 mm
  - Drainage mat with filter fabric
  - HERTALAN® EASY COVER (FR) EPDM membrane
  - Tapered insulation 50-130 mm
  - Thermal insulation 180 mm
  - Smart vapour control membrane, Pro Clima INTELLO 1 mm
  - CLT roof slab of upper module 160 mm
  - Suspended ceiling / service void for ventilation ducts 127.5 mm
  - Querkus oak veneer panel finish 12.5 mm

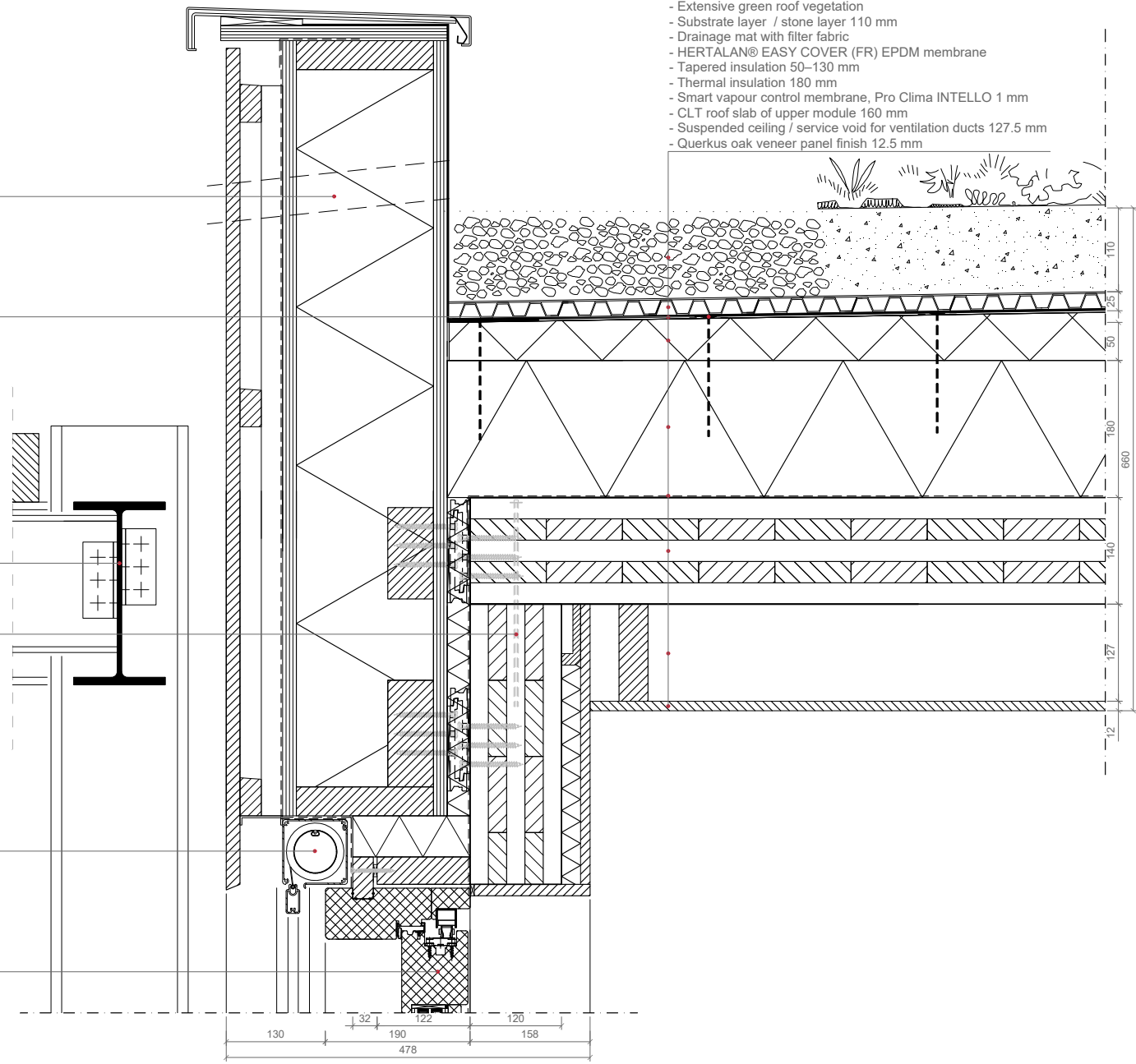


figure 102.Roof detail sliding door.

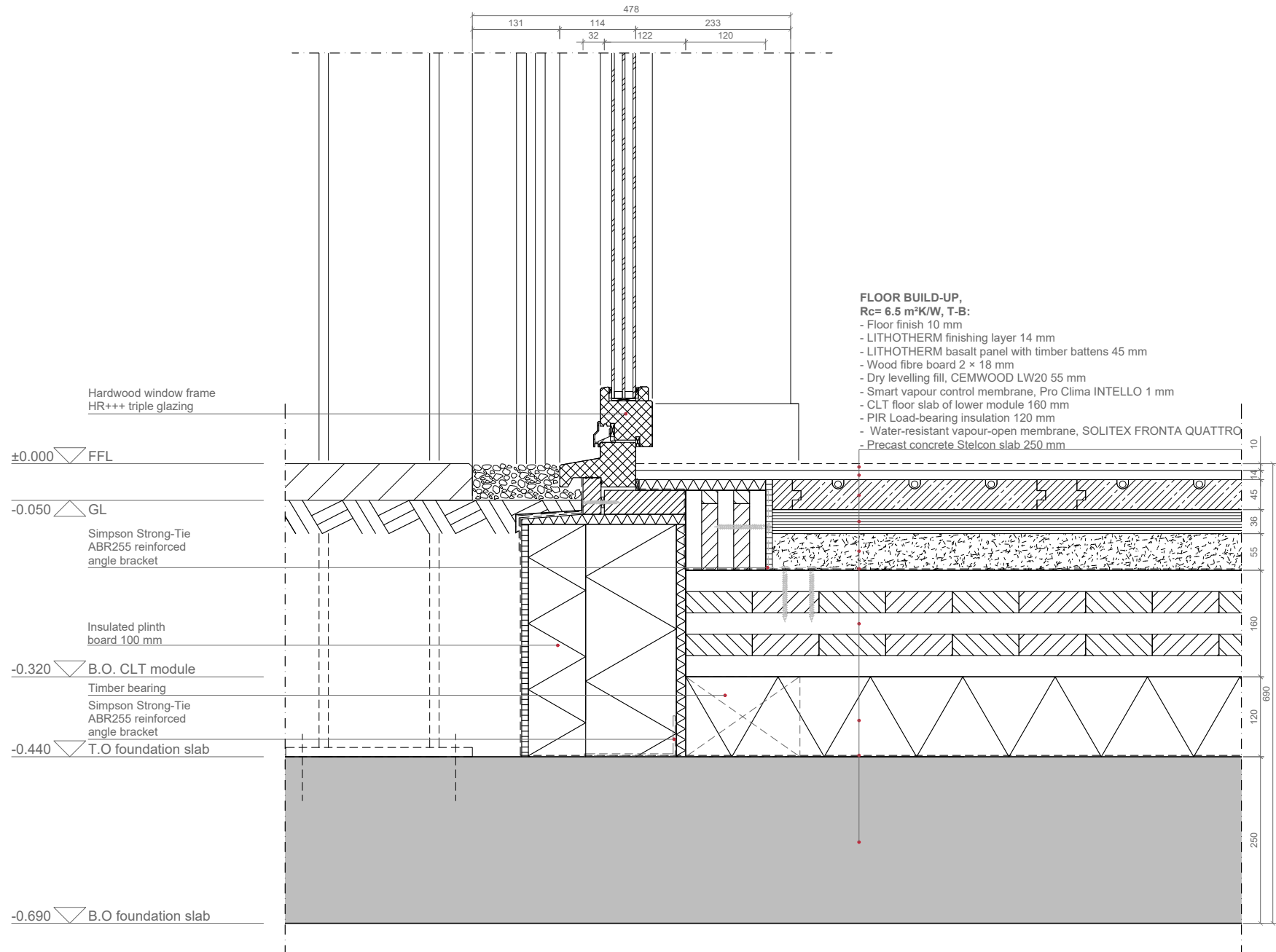


figure 103.Floor detail window.

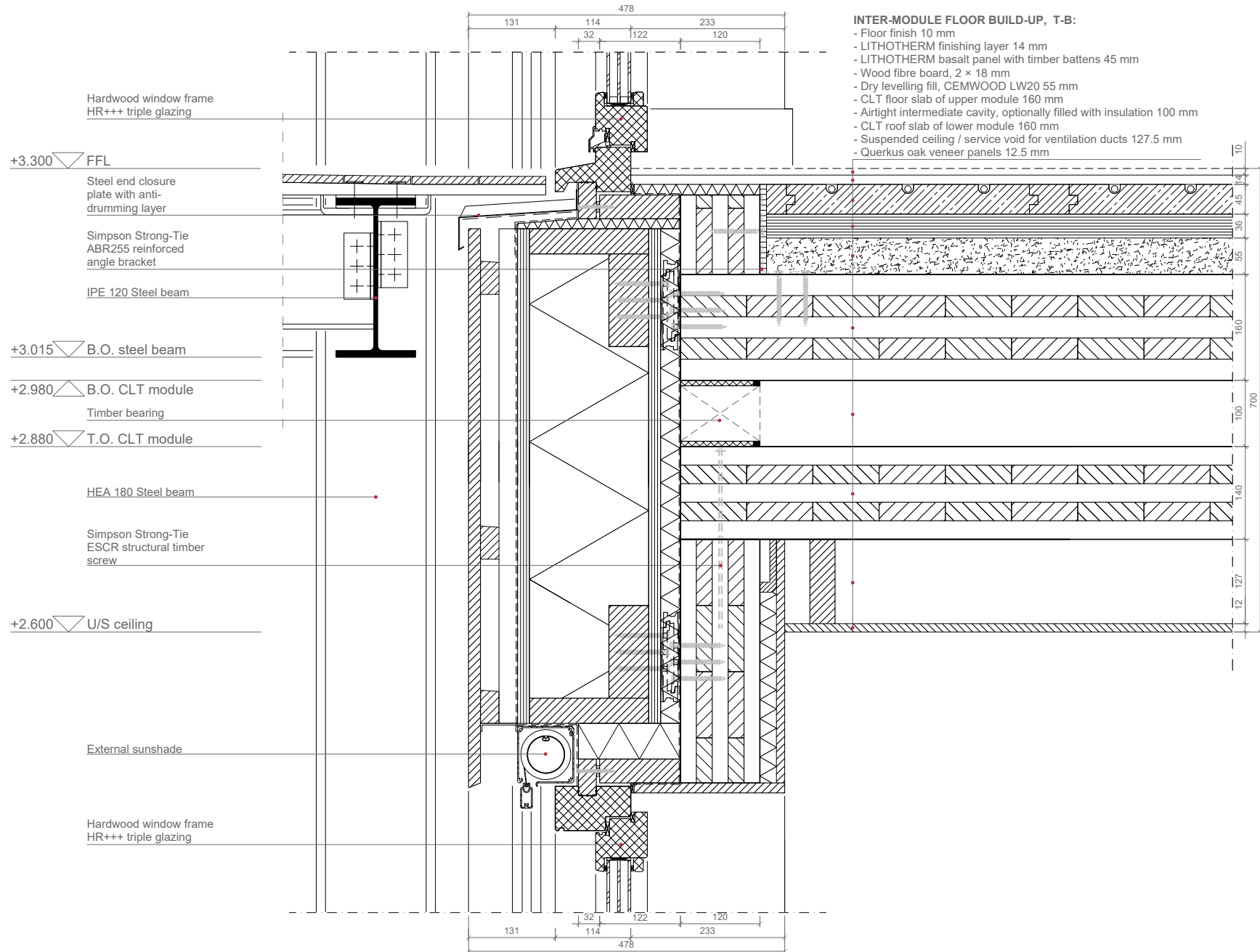


figure 104. Module-to-module detail window.

+10.120 ▽ T.O. parapet

+10.000 ▽ T.O. HSB element

Emergency overflow

HERTALAN® Induction fastening system  
RHINO BOND® pressure distribution plate and screw

+9.480 ▽ T.O. CLT module

IPE 120 Steel beam

Simpson Strong-Tie  
ESCR structural timber screw

+9.235 ▽ B.O. steel beam

+9.200 ▽ U/S ceiling

External sunshade

Hardwood window frame  
HR+++ triple glazing

**ROOF BUILD-UP,  
Rc= 8.5 m²K/W, T-B:**

- Extensive green roof vegetation
- Substrate layer / stone layer 110 mm
- Drainage mat with filter fabric
- HERTALAN® EASY COVER (FR) EPDM membrane
- Tapered insulation 50-130 mm
- Thermal insulation 180 mm
- Smart vapour control membrane, Pro Clima INTELLO 1 mm
- CLT roof slab of upper module 160 mm
- Suspended ceiling / service void for ventilation ducts 127.5 mm
- Querkus oak veneer panel finish 12.5 mm

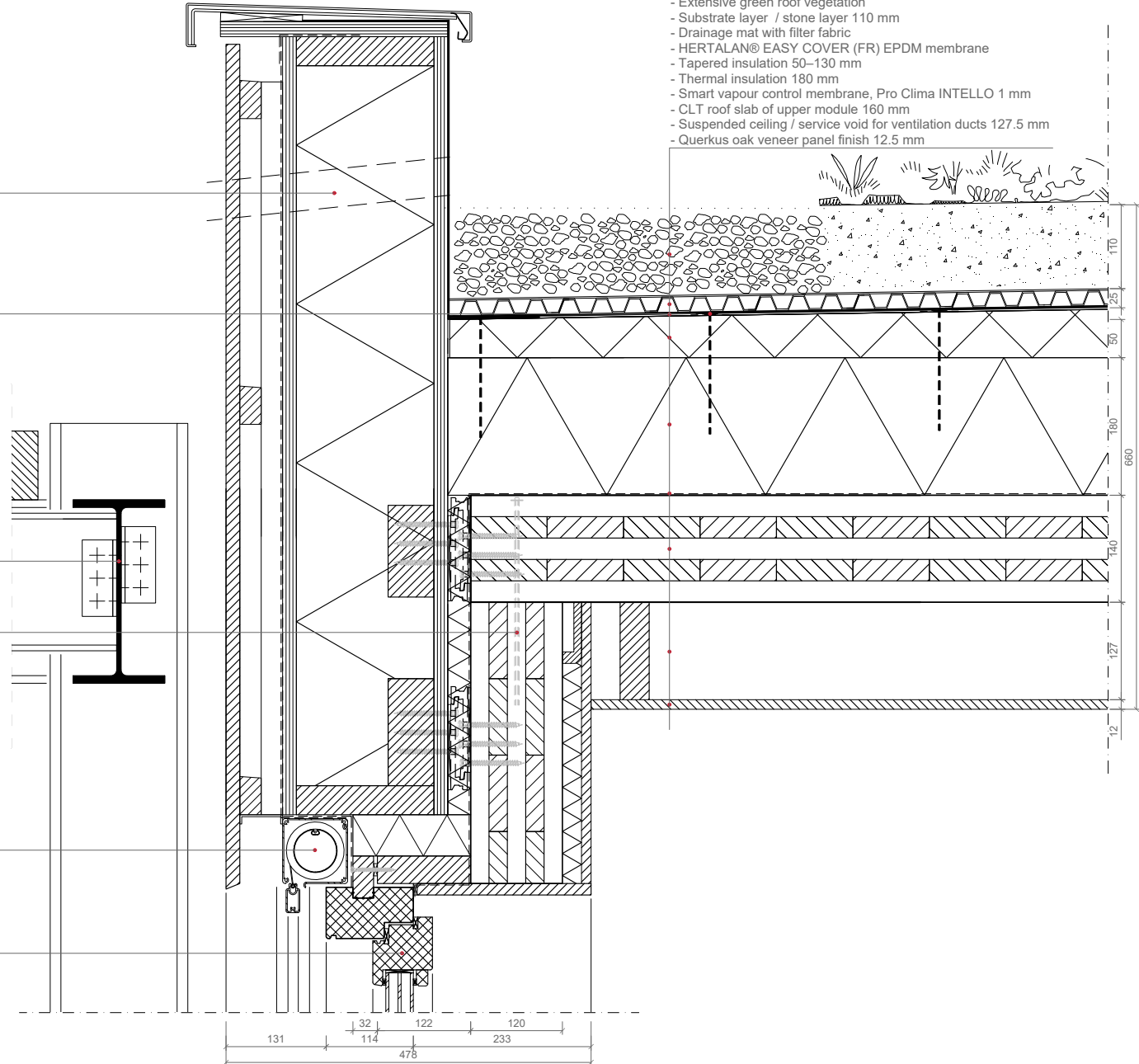
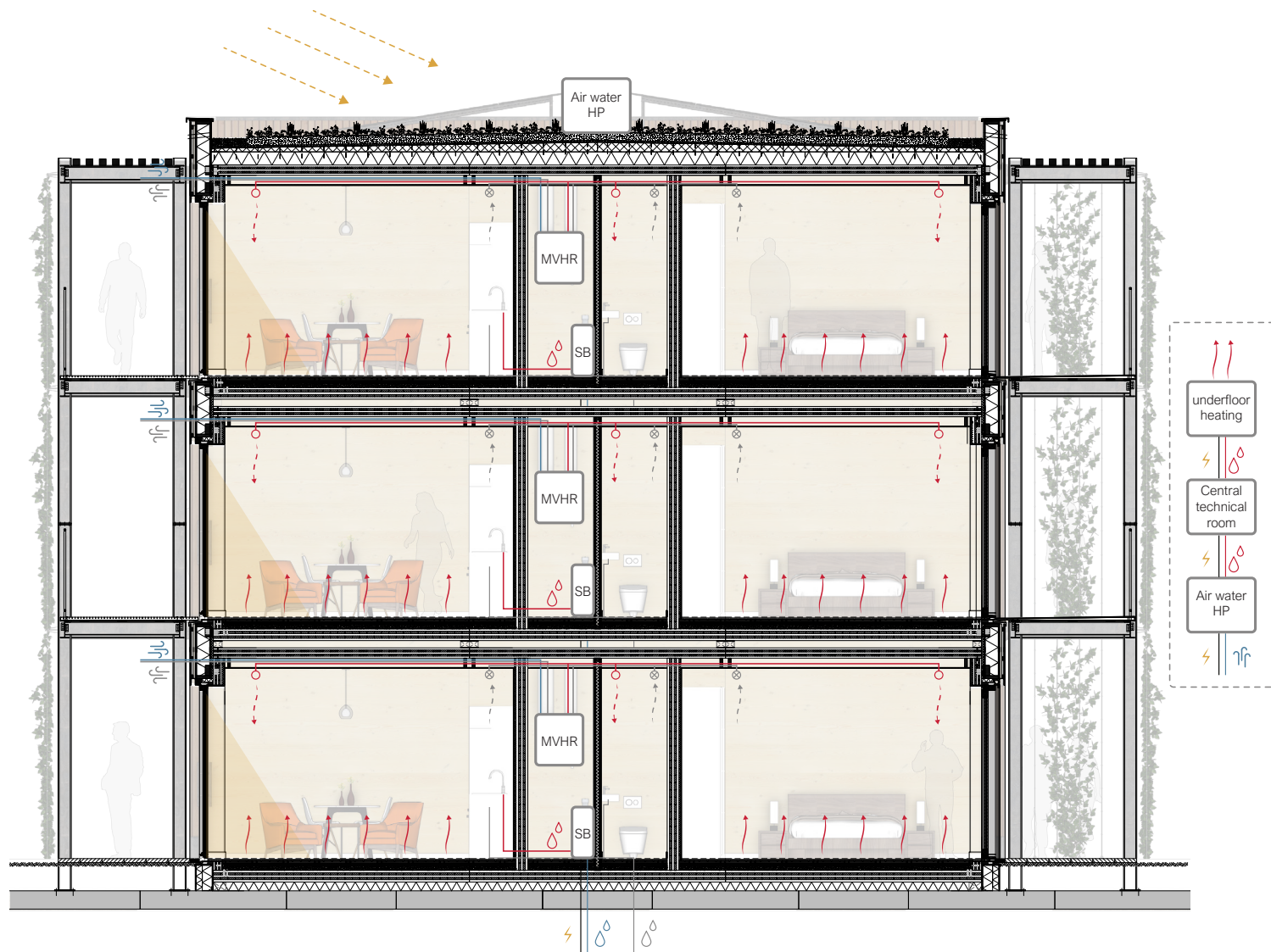


figure 105.Roof detail window.

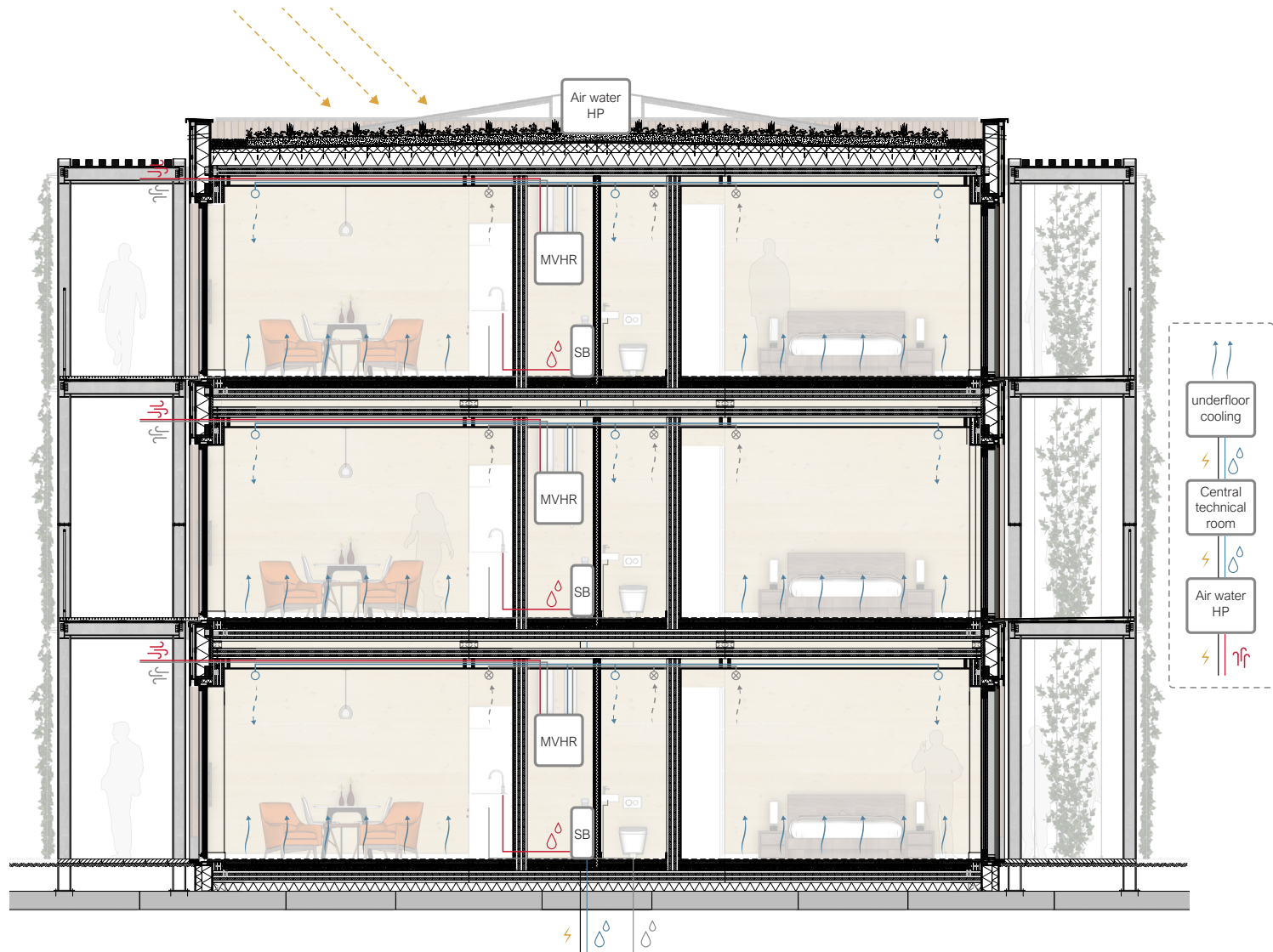
- Photovoltaic panels  
PV panels on the roof generate renewable electricity.
- Green roof  
Improves the microclimate around the solar panels and supports rainwater retention.
- Green façade  
Reduces wind exposure and supports winter thermal comfort.
- Central air-to-water heat pump (HP)  
Central air-to-water heat pump for low-temperature heating
- Type D ventilation with heat recovery (MVHR)  
Mechanical air supply and exhaust with heat recovery
- Winter solar  
Large windows allow winter sun to enter the apartment, providing passive solar gain and reducing heating demand.
- Salt boiler (SB)  
Compact salt-based thermal battery for domestic hot water storage.
- Underfloor heating  
Dry Lithotherm floor with integrated pipes for winter heating



- Service core  
The kitchen, bathroom and technical systems are concentrated within a compact service core, allowing efficient stacking and clear installation routes.
- Fire-rated shaft  
The vertical service shaft is enclosed with fire-rated construction, and all service penetrations are sealed to maintain compartmentation between apartments.
- Reversible construction  
The building is designed as a reversible system, using timber, dry floor build-ups and demountable connections to allow future adaptation or dismantling.
- Roof as technical layer  
The roof combines energy generation and building services, integrating PV panels, heat pump units and maintenance access in one technical zone.
- Low-impact foundation  
The use of stelcon slabs minimises permanent intervention in the ground and supports the temporary character of the building system.
- Dry floor system  
The dry Lithotherm screed contains the underfloor heating pipes without using a wet poured screed. This supports reversibility and reduces construction weight.

figure 106. Climate section winter.

- Photovoltaic panels  
PV panels on the roof generate renewable electricity, especially during periods of high solar radiation.
- Green roof  
Vegetation cools the roof surface, improves the microclimate around the solar panels and supports rainwater retention.
- Green façade  
Vegetation on the façade reduces heat gain, cools the building surface and supports biodiversity.
- Central air-to-water heat pump (HP)  
During summer, the heat pump can operate in reverse mode, it supplies cooled water to the floor system, allowing the apartments to be gently cooled.
- Type D ventilation with heat recovery (MVHR)  
In summer, the ventilation system can use a bypass mode. Cooler fresh air can enter the apartment without being warmed by the outgoing indoor air.
- Solar shading  
Integrated external screens reduce direct solar radiation before it reaches the façade. This limits overheating and improves indoor comfort during warm periods.
- Salt boiler (SB)  
Compact salt-based thermal battery for domestic hot water storage.
- Underfloor cooling  
Dry Litothem floor with integrated pipes summer cooling.



- Service core  
The kitchen, bathroom and technical systems are concentrated within a compact service core, allowing efficient stacking and clear installation routes.
- Fire-rated shaft  
The vertical service shaft is enclosed with fire-rated construction, and all service penetrations are sealed to maintain compartmentation between apartments.
- Reversible construction  
The building is designed as a reversible system, using timber, dry floor build-ups and demountable connections to allow future adaptation or dismantling.
- Roof as technical layer  
The roof combines energy generation and building services, integrating PV panels, heat pump units and maintenance access in one technical zone.
- Low-impact foundation  
The use of stelcon slabs minimises permanent intervention in the ground and supports the temporary character of the building system.
- Dry floor system  
The dry Litothem screed contains the underfloor heating pipes without using a wet poured screed. This supports reversibility and reduces construction weight.

figure 107.Climate section summer.

# APPOSITION

Architecture beside uncertainty.