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RE: FRAME

... REIMAGINING EXISTING STRUCTURES

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AMSTERDAM

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THINK

REACT

REDUCE

REINTRODUCE

RECYCLE

REBUILT

REUSE

REPAIR

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Content

Part 1 Introduction

Abstract	5
Problem Statement & Fascination	6
Relevance for Topping-Up & Why Timber	7
Research Question	8
Criteria for existing building	9
Location & Shortlisted Building	10-12
The Filmacademie	13
Programmatic pressure within the Filmacademie	14-15
Renovations	16

The Filmacademie - Site and History

History maps & satellite	20-21
Site Environmental Context	22-24
Building	25
Structural Grid	26-27
Scope	28
Room program	29-33
The Filmacademie	
Student Housing	

Part 2 Research

Research Approach	34-37
Analysis	38
Evaluation	39-53
Synthesis	54
Design Principles	55

Part 3 Results

Construction Type	58
Construction Hierarchy	59
Component Timeline	60-61

(Dis)Assembly	62-71
Growth strategy	72-77
Combining Research and Design	
Concept studies	79
Architectural Plans	
1:200	80-83
Urban Section	84-85
1:50 Apartment configuration	86-97
1:20 Section, Elevation, Floorplan	98-99
1:10 Details	100-111

Part 4 Visuals

Visuals	114-121
Future Extension	122-125

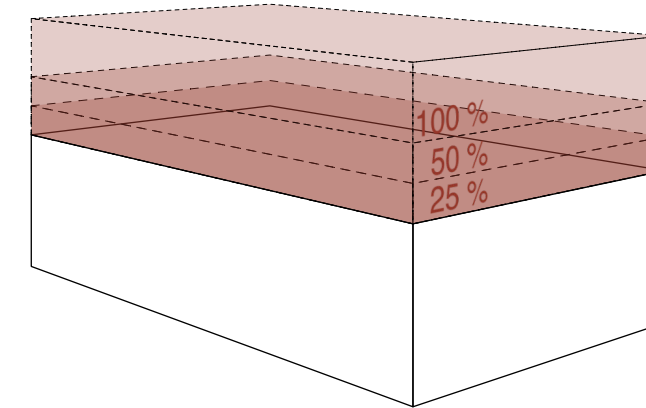
Part 5 Conclusion and Discussion

Conclusion, Implications & Recommendation	128
Reflection	129

Back Matter: Appendices

Data Management Checklist	132-133
References	134-135
Acknowledgements	136

Abstract
Problem Statement & Personal Research Fascination
Relevance for Topping Up & Why Timber
Research Question
Criteria for existing building
Location
Shortlisted Building
The Filmacademie
Programmatic pressure within the Filmacademie
Renovations
Conclusion: Site Selection



Part 1

Introduction

Urban densification has become a key strategy for cities facing spatial, environmental, and societal pressure. Rather than expanding into undeveloped land, this graduation project explores topping-up as a means of intensifying the existing urban fabric. Rooftop extensions are understood not as isolated additions, but as long-term architectural interventions that interact with existing structures, users, and future change.

The project focuses on timber construction as a lightweight and adaptable material system, particularly suited for vertical extensions on existing buildings. Its favorable strength-to-weight ratio, prefabrication potential, and compatibility with reversible construction make timber an effective material for exploring adaptable rooftop systems that respond to contemporary demands for flexibility, circularity, and sustainable urban growth.

Problem Statement

& Personal research fascination

In recent years, there has been a growing awareness of the limited nature of the resources available to us and the responsibility to use them carefully and consciously. This change goes beyond individual behaviour and social systems. It increasingly influences how we design, build and intervene in the built environment. Architecture no longer has to respond only to immediate functional needs, but must also anticipate future changes and long-term impacts.

In this context, three design approaches have become particularly relevant: Design for Longevity (DfL), Design for Disassembly (DfD) and Design for Adaptability (DfA). Together, they form key strategies within circular construction, especially in the context of timber architecture. DfL focuses on creating buildings that can stand the test of time through durable materials and robust spatial concepts. DfD, in contrast, aims to connect “products in a reversible way” and to “allow dismantling them without reducing their remaining value” (Brancart*). Both approaches contribute significantly to circularity and resource efficiency.

This research, however, places its primary focus on DfA, while drawing on principles of both longevity and disassembly. A central challenge in contemporary architectural practice is that buildings which incorporate these strategies are often designed for a single moment of dismantling, rather than for the continuous ability to change during their use phase. In most cases, DfD principles are conceptually applied across all building layers; however, while secondary elements such as façades, partitions, or finishes can

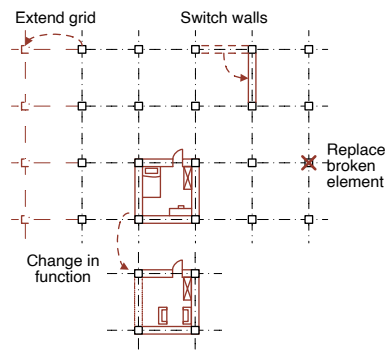
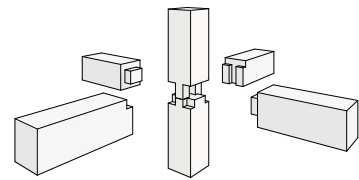
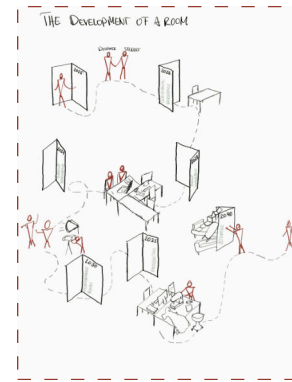
be accessed and modified with relative ease, primary structural elements remain difficult to reach and alter once construction is completed.

This limitation is closely related to accessibility and interdependence between components. As Brancart notes, adaptability requires that “components [...] would be independent from each other in such a way that one can be removed without having to remove or damage another.”. Without this, meaningful structural changes are only possible to a very limited extent.

At the same time, buildings must increasingly respond to changing uses, growing spatial requirements and evolving technical demands. Adaptability therefore goes beyond demolition and encompasses the spatial and structural ability to transform over time. Brancart defines this more explicitly by stating that “an adaptable spatial layout is designed to allow reconfigurations but also extensions or even partial dismantling of a building.”

If cities are to continue to grow at a pace comparable to that of recent decades, architectural structures must be able to cope with growth, change and adaptation over time. In response, this research shifts the focus of adaptability from secondary building layers to the primary structural level. Rather than limiting DfD to easily accessible components, the project explores how the principles of DfL, DfD and DfA can be more rigorously embedded in primary structural systems. Existing design approaches are analysed to develop adaptable strategies for secondary elements, while a new primary structural system is developed that allows components to be selectively modified, reinforced, removed or added over time.

The project does not view buildings as static end products, but as long-term architectural frameworks that can evolve without losing their structural coherence.



Relevance for Topping-Up

These issues of adaptability and long-term change are particularly relevant in dense urban contexts, where spatial growth is increasingly taking place within the existing urban structure rather than through expansion. In view of growing population pressure and limited available space, existing buildings should no longer be seen as fixed end products, but as latent spatial and structural resources.

In this context, roof structures and vertical densification, commonly referred to as topping-up, have emerged as a relevant architectural strategy. Instead of expanding into undeveloped areas, topping-up allows cities to grow within their existing footprint while maintaining urban continuity.

If we assume that our environment, social conditions and spatial requirements are changing increasingly and in ever shorter cycles, it becomes clear that existing buildings must be taken into account. Building on existing structures opens up the possibility of intervening in systems that at first glance appear static and unchangeable, and creates new scope for action in existing buildings. The intervention can also be accompanied by renovations that carry out targeted structural interventions. This allows deficits that have arisen over many years to be remedied or at least improved. Against this background, continuing to build on existing buildings appears to be a sensible approach and a precedent for the development of adaptive construction systems. These can be tested in the context of a specific building and, at the same time, have the potential to be transferred to other structural situations with appropriate adjustments.

Educational context and student housing

In this context, educational buildings combined with student housing are a particularly relevant test case as they are subject to constant change. Student numbers fluctuate, courses expand or reduce, and spatial and technical requirements evolve over time. Students, as a user group with temporary and flexible housing needs, further reinforce this dynamic.

By combining an educational context with student residences, the project locates adaptability at the structural, programmatic and usage levels. This creates conditions under which change, growth and redesign are not exceptions, but inherent features of a building's life cycle.

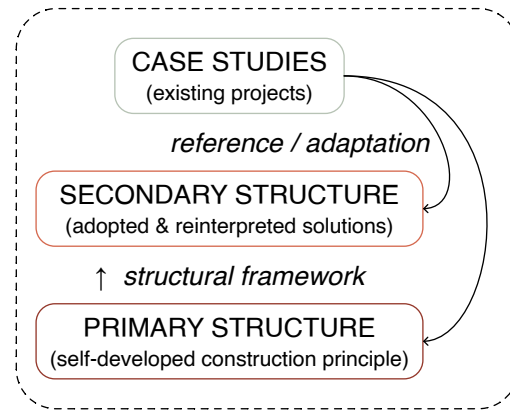
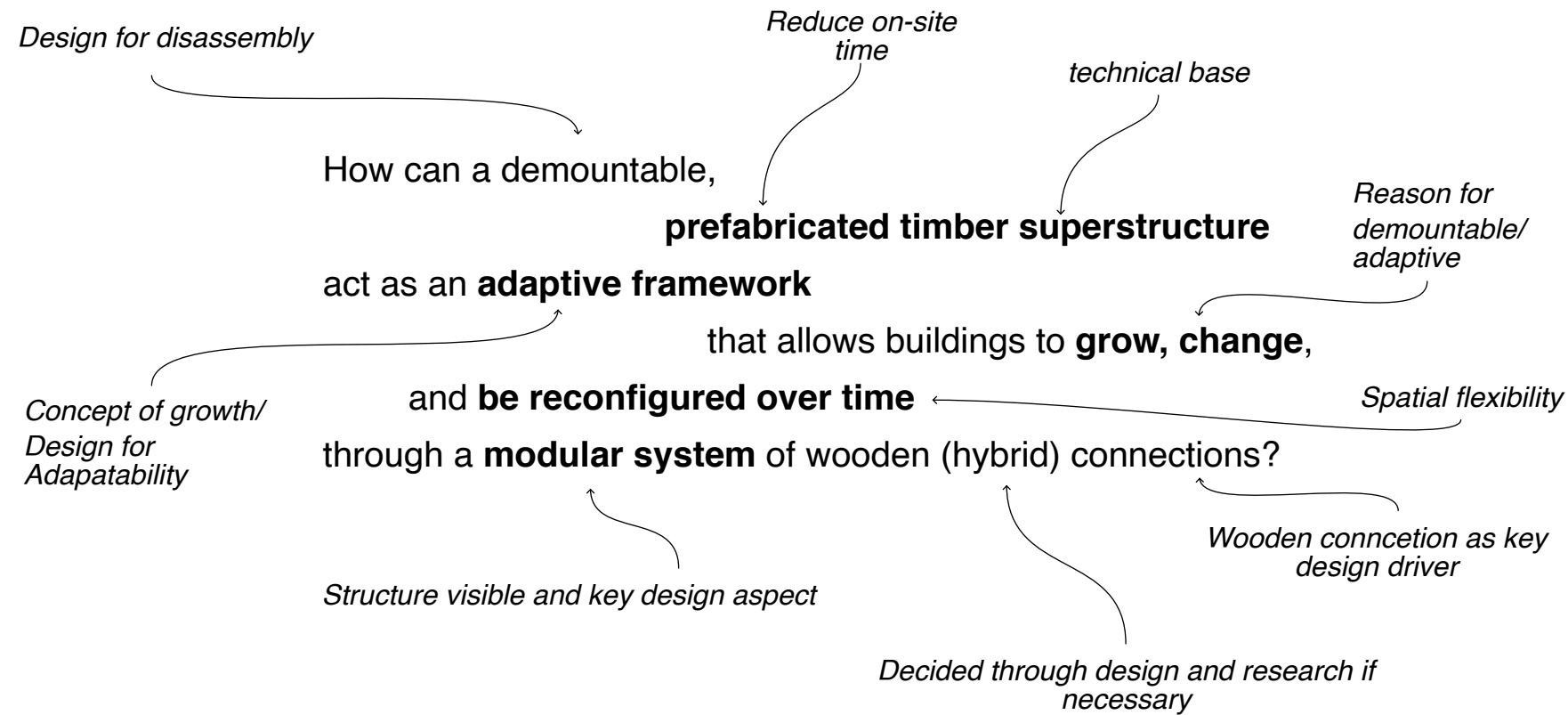
Why timber

Timber is particularly well suited for investigating adaptable and demountable construction systems in the connection with rooftop extensions. Its favourable strength-to-weight ratio makes it compatible with existing structures, especially when additional loads need to be minimised. At the same time, it is possible to prefabricate timber. This enables precise, time-efficient construction in which components can be easily adapted, replaced or reassembled over time. Beyond these structural advantages, timber supports a visible supporting structure, making the structural logic comprehensible and allowing components to be repaired, reinforced or replaced rather than concealed or permanently fixed.

Furthermore, timber is suitable for modular and hybrid connection systems. Timber components can be combined with minimal use of steel as reinforcement or connecting elements, increasing structural performance while reducing overall material, energy and CO2 consumption. In addition, wood can go through several life cycles and be reused elsewhere, making it very sustainable. Wood thus directly supports the principles of circular construction and reinforces the project's focus on long-term adaptability.

Research Question

Bringing together the increasing need for adaptable construction, the potential of Design for Disassembly, and the specific opportunities offered by timber construction and topping-up, this research is guided by the following question:



Criteria for an existing building

In order to test the proposed construction system under realistic conditions, the research requires an existing building that allows component-level adaptability to be explored beyond a small-scale or purely conceptual application. The selected building must fulfil the following criteria:

Flat roof suitable for vertical extension

The building must provide a flat roof that allows for topping-up without fundamentally altering its existing urban footprint.

Sufficient structural stability

The existing structure must be capable of supporting a lightweight timber superstructure without extensive reinforcement, enabling a realistic integration of new and existing construction.

Adequate scale

The building should be large enough to test the system at an architectural scale, allowing structural components to be inserted, replaced, or adjusted in a meaningful way rather than as a singular prototype.

Urban context under spatial pressure

The building must be situated in an urban environment where densification, change, and long-term use are relevant, ensuring that the intervention responds to real spatial demands.

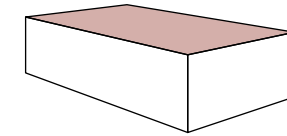
Program expected to evolve over time

The existing program should be subject to change, growth, or reconfiguration, allowing the adaptability of the proposed system to be tested in relation to future use.

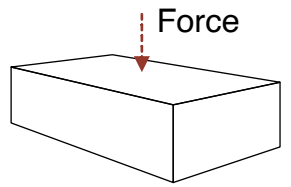
Together, these criteria ensure that the research is grounded in a realistic and transferable architectural context, allowing the proposed system to be evaluated beyond a theoretical or isolated application.

They initially guided a search focused on buildings suitable for rooftop extensions that could accommodate additional spatial demand, particularly in relation to student housing.

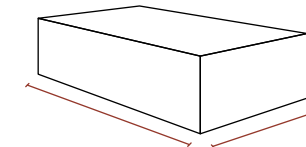
Flat roof suitable for vertical extension



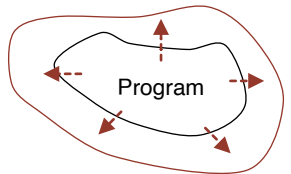
Sufficient structural stability



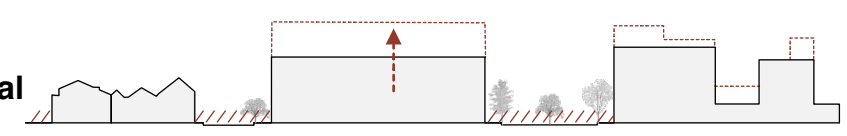
Adequate scale



Program expected to evolve over time



Urban context under spatial pressure



During site visit:

Stand alone Building for visibility

Location

The Municipality of Amsterdam conducted a study identifying buildings with potential for rooftop extensions, including a visual overview of roof types across the city. The map on the right highlights buildings with flat roofs in light red. Based on this dataset, an initial selection of potential sites was established. Buildings that met the previously defined research criteria were then shortlisted for further investigation and are indicated in deep red. Buildings located within the UNESCO-protected area (green) were excluded, as heritage restrictions would limit the feasibility of a structural intervention and compromise the transferability of the research.

The shortlisted buildings varied in scale, structural condition, program, and urban context, allowing for a broad comparison against the previously defined criteria.

Through comparative analysis and site visits, the selection was further narrowed down. During these visits, it became clear that a stand-alone building offers significant advantages for the proposed approach. A building that is spatially and structurally independent allows the intervention to remain clearly legible, avoids complex dependencies on neighbouring structures, and enables the topping-up strategy to be tested without compromising adjacent buildings. In addition, a stand-alone condition increases visibility within the urban context, allowing the intervention to be read as a clear architectural layer rather than a concealed modification.



Flat roofs in Amsterdam

Shortlisted Buildings

Following the site selection process, two buildings remained under consideration:

- the **Q-Park parking garage**
- the **Filmacademie**

At this stage, the comparison was based primarily on first impressions, visible architectural characteristics, and their immediate urban context, rather than on an in-depth programmatic analysis.

The Q-Park parking garage presents itself as a stand-alone concrete structure with large spans and a high load-bearing capacity, offering clear structural advantages for a rooftop extension. Its robust construction and infrastructural nature suggest a high tolerance for additional loads. At the same time, the building is primarily perceived as an object passed by rather than engaged with. The low floor heights would limit future spatial reconfiguration, and its location further outside the city centre reduces its relevance for programs requiring strong urban integration. In addition, the building is listed as an Order 1 structure in municipal studies, indicating that changes to its existing structure are limited, thereby reducing the potential for future architectural transformation.

In contrast, the Filmacademie appears as a prominent solitary volume within its urban context. The building is clearly legible as an institutional structure, characterised by its concrete massing and glazed façade elements. Its presence within the city, combined with its architectural expression, suggests a higher potential for visibility and engagement. Beyond its suitability for vertical exten-



Q-Park Parking garage



The Filmacademie, chosen building



Apartment complex, inside UNESCO area



DNB, recently renovated



Apartment complex, recently built



Municipality building, too big

Shortlisted Buildings

sion, the building introduced the possibility of linking student housing with an educational program. From an initial architectural reading, the Filmacademie offers a clearer relationship between building, roof, and public space, making it a more compelling candidate for testing a visible and legible toping-up intervention. Based on these first observations, the Filmacademie emerged as the more suitable test case.

Educational Context and Student Housing

University buildings in Amsterdam are dispersed across the entire city. However, when mapping the spatial distribution of educational institutions, it became evident that the Filmacademie occupies a strategic position within a dense academic network

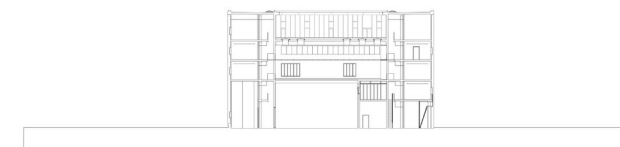
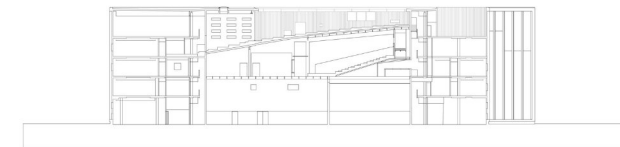
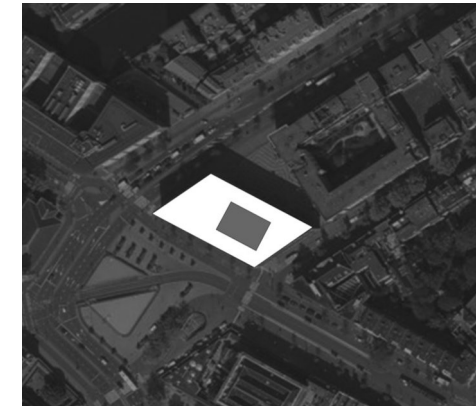
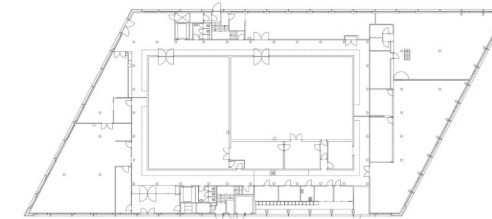
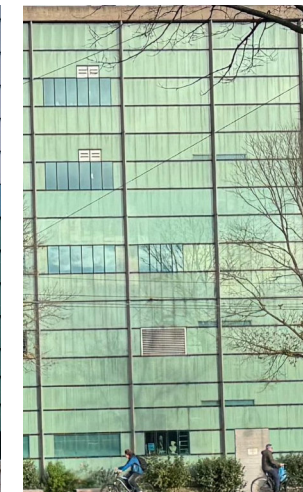
The buildings of the Amsterdam University of the Arts (AHK) are located in close proximity to one another, with most campuses approximately 6 minutes' walking distance apart and others reachable within 6–12 minutes by bicycle. The AHK consists of:

- the Conservatorium van Amsterdam,
- Academy of Theatre and Dance,
- Breitner Academy,
- Reinwardt Academy,
- Academy of Architecture,
- the Netherlands Film Academy

This proximity not only increases the demand for student housing in the surrounding area, but also strengthens the relevance of the Filmacademie as a site where educational space and living space could meaningfully interact.



The Filmacademie in Pictures



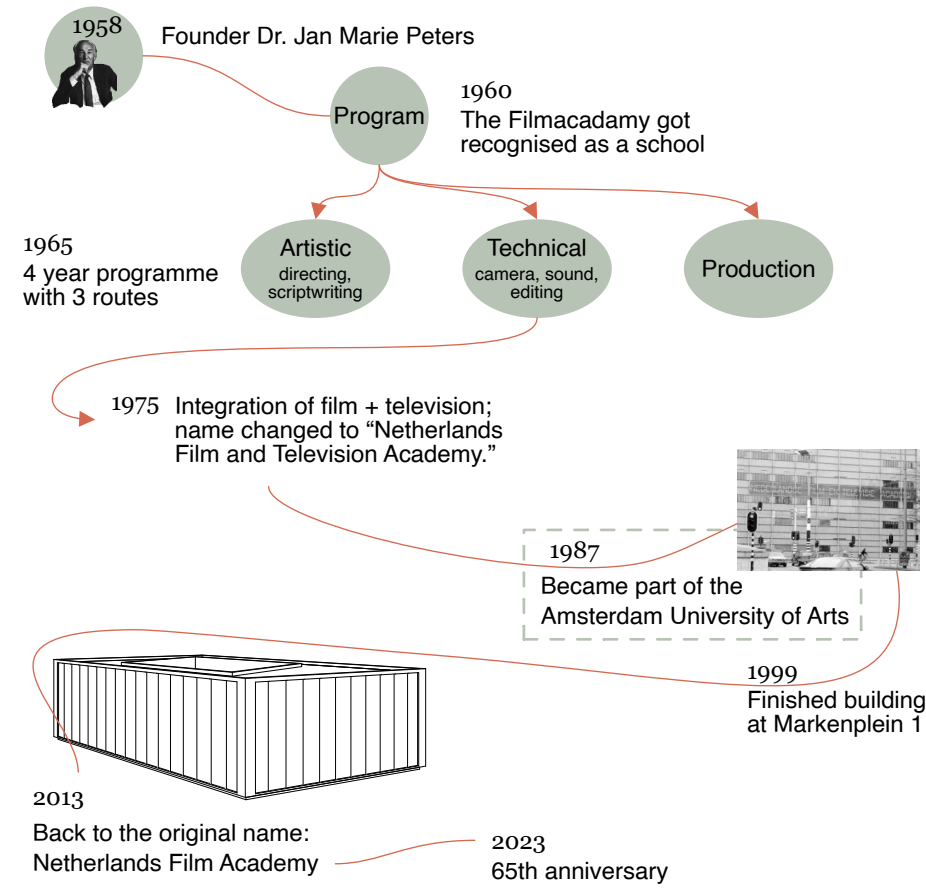
Programmatic Pressure within the Filmacademie

Today, the building accommodates a wide range of academic departments. What was originally structured around three study tracks has expanded into approximately ten different departments, each with distinct spatial and technical requirements. While these departments actively collaborate and deliberately avoid strict spatial separation in order to encourage exchange, they nevertheless compete for the same limited spatial resources.

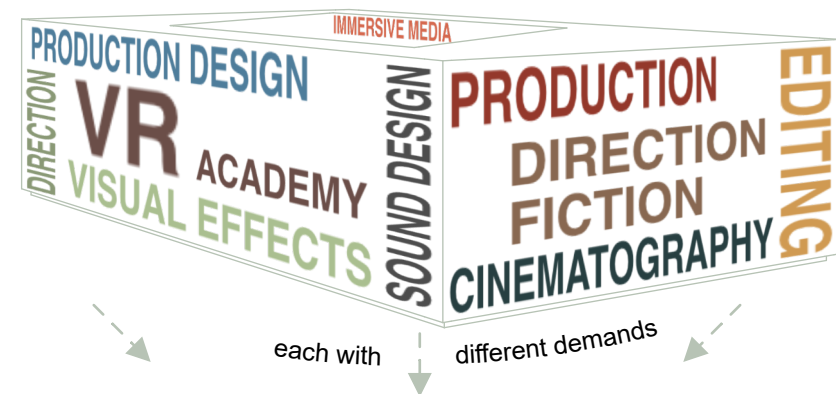
The building has effectively reached its maximum capacity. This has already led to concrete consequences: for instance, the VR Academy was forced to relocate due to insufficient space. In another case, the darkroom used for developing film and photography was removed in an attempt to repurpose the area, only for the department to later realise that the space was still needed. This has resulted in an ongoing dilemma of how to reintroduce essential facilities without available room for expansion.

Similar pressures are reflected in the everyday experience of students.

Students increasingly search for workspaces of varying sizes and degrees of privacy. There is a clear demand for both spaces for individual concentration and areas that support collective work and social interaction. However, spaces for filming are tied to specific departments and must be formally booked, while only two naturally lit workspace areas are exclusively accessible to students. Most other spaces remain inward-facing and largely disconnected from the outside.



Today



Opinions by Students and Teachers

- Dark, enclosed, "prison-like" feeling
- Severe lack of daylight
- Confusing, fragmented circulation, User get lost easily
- Unequal space distribution between departments
- Students commute time is very long
- On-site or nearby student housing improves accessibility
- Campus feeling is missing

Missing & Desired Space Types

- More studios and small screening rooms
- Need for flexible, bookable (teaching) spaces
- Small group workspaces (2-4 people)
- Retreat/decompression spaces
- Individual focus rooms

Renovations

The recent renovation phases were intended to improve the building for student use and have led to tangible improvements, particularly through the introduction of additional workspaces and the use of exposed timber elements, which softened the previously dominant concrete character. These interventions contributed to a more pleasant atmosphere in parts of the building.

However, many students still describe the renovated spaces as lacking sufficient daylight and spatial generosity. The focus of the renovations remained largely on interior upgrades rather than on addressing the building's structural limitations. Similarly, the renovation of the canteen aimed to introduce a stronger connection to nature, but resulted in reduced seating capacity, revealing the challenges of improving spatial quality within an already saturated structure.

Overall, while the renovations improved specific conditions, they did not fundamentally resolve the issue of limited capacity and adaptability. The building remains constrained in its ability to respond to growing and changing spatial demands, pointing towards the need for an architectural strategy that enables expansion and transformation without disrupting the existing system.

2023

by Agnes Otten Interieurarchitectuur
Renovation of the old, reverberant, and uninspiring canteen at the Netherlands Film Academy.
Room size: **140 m²**, height: **4.5 m**.
Keywords: **nature, silence, balance.**

before



after

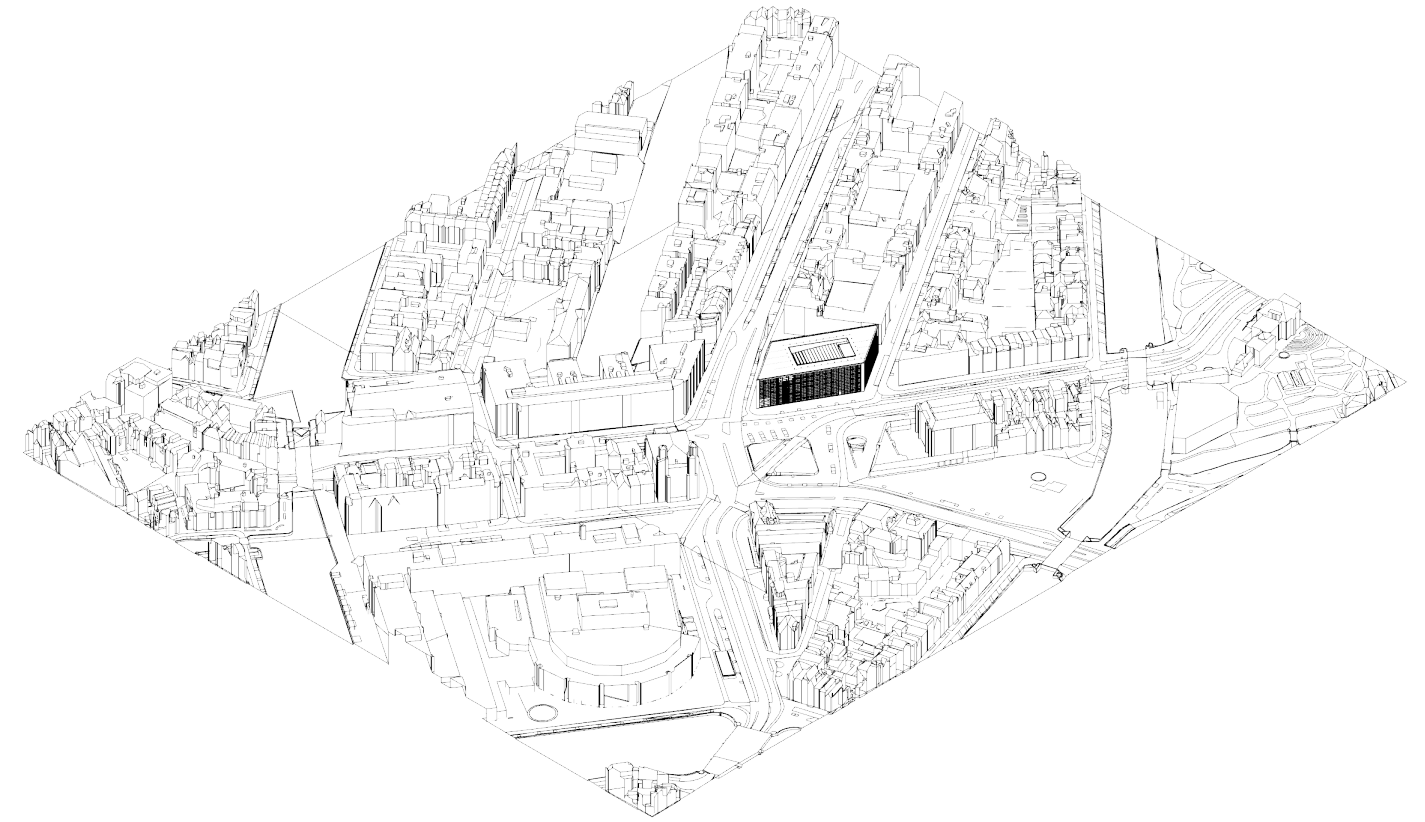


2014-2017

by better space, better people
using corridor structure and voids unlocking 200 m² of functional space within the academy



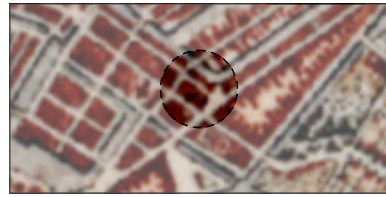
- History maps
- History satellite
- Site Environmental context
- Building
- Scope
- Room program
 - The Filmacademie
 - Student Housing



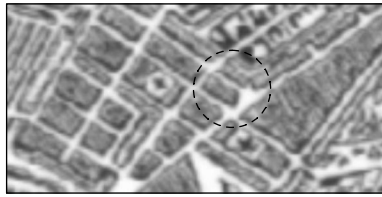
The Filmacademie

History and Site Analysis

History maps



1836-1850
Earliest map of Amsterdams context



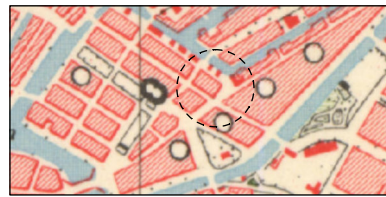
1850-1894
Building block sketch



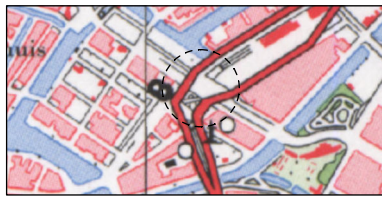
1894-1929
Colourful map with water and greenery context



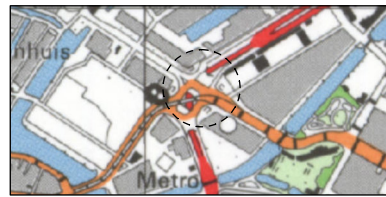
1929-1949
New parks in the surrounding



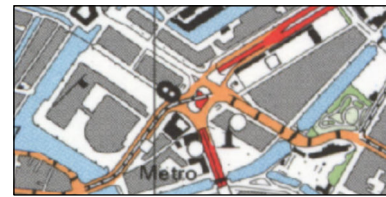
1949-1969
Change of Park structures
Circles might be where bombs hit the infrastructure



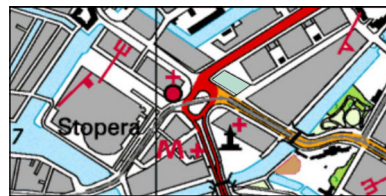
1969-1981
Traffic change, Canal is closed off
Demolition of existing structures



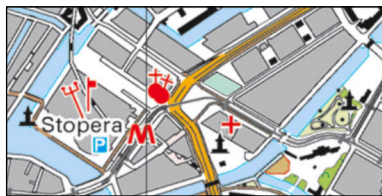
1981-1988
Roundabout created with Tram
Demolition of existing structure



1988-1999
Opera is built
Streets broadened and Metro added



1999-2011
Filmacademie is built and other buildings behind it



2011-2015
Round about is erased and only one big street is created



2015-2024
New buildings are created above

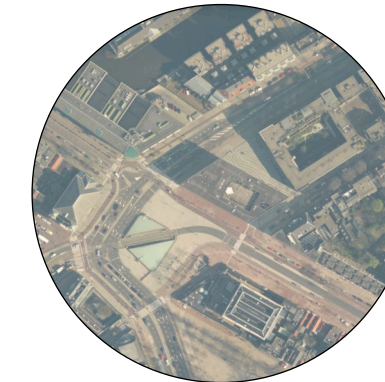
History satellite



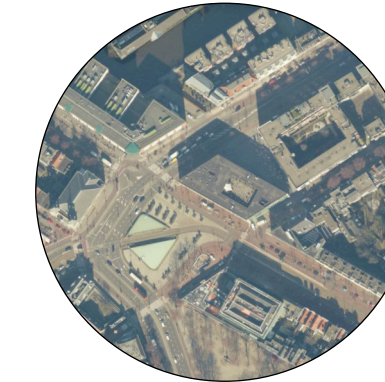
2006-2009
Roundabout in front of the building



2009
Traffic change, parking possibility on square



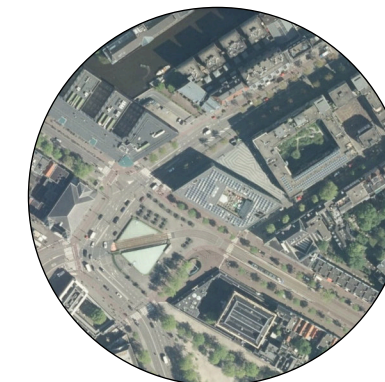
2010
Square and traffic in front change
Rooftop sunsail is added



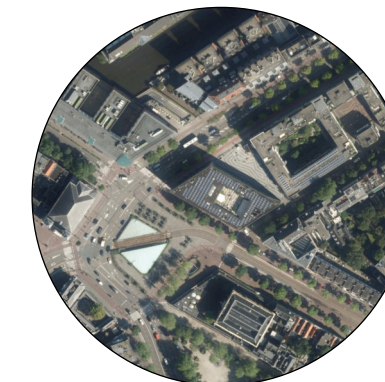
2011-2016
Benches and Trees are added to the square



2016-2018
Parking possibility on square
New Trees in the streets



2018-2024
Technical equipment is added as a steel box to the rooftop terrace
PV panels are added



2024
Today's situation

Site Environmental Context

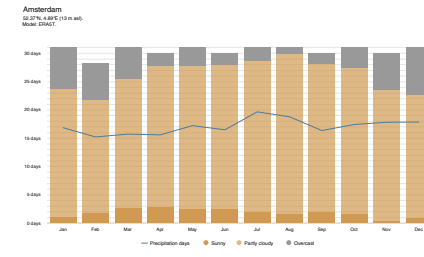
When looking at the Environment that the Filmacademie is situated it some aspects are important to consider.

The wind direction is predominantly from the southwest, resulting in consistent wind exposure at roof level. This requires careful design of roof edges, parapets, and outdoor spaces to ensure wind comfort for the rooftop extension.

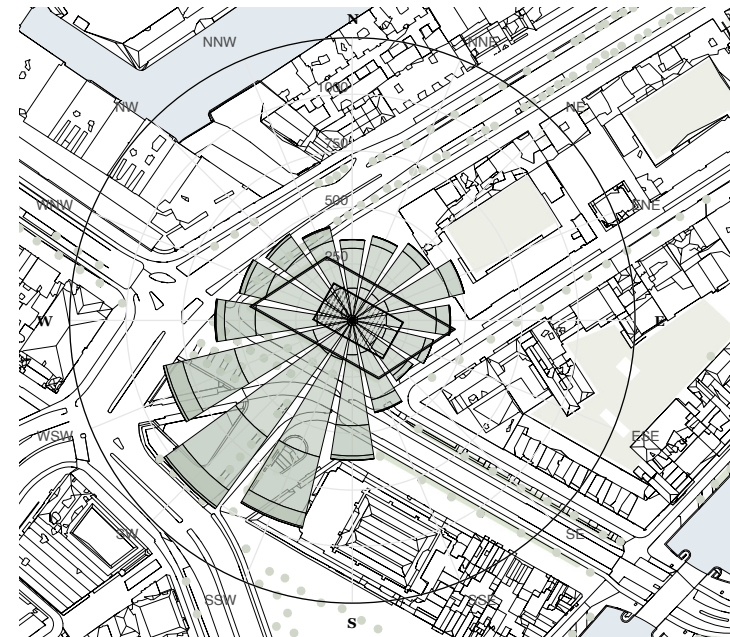
Solar exposure is very strong, as the site is largely unobstructed by surrounding buildings. The existing roof is already fully equipped with photovoltaic panels, confirming the high solar potential of the location. For the rooftop extension, the key challenge

is therefore not a lack of sunlight, but managing exposure and ensuring that additional volume does not cause excessive overshadowing of adjacent buildings, particularly residential blocks to the rear.

The green context includes a high density of street trees, predominantly Ulmus species, supporting microclimatic cooling. The adjacent public square is being actively greened, including olive trees, while the rear entrance area currently lacks greenery.

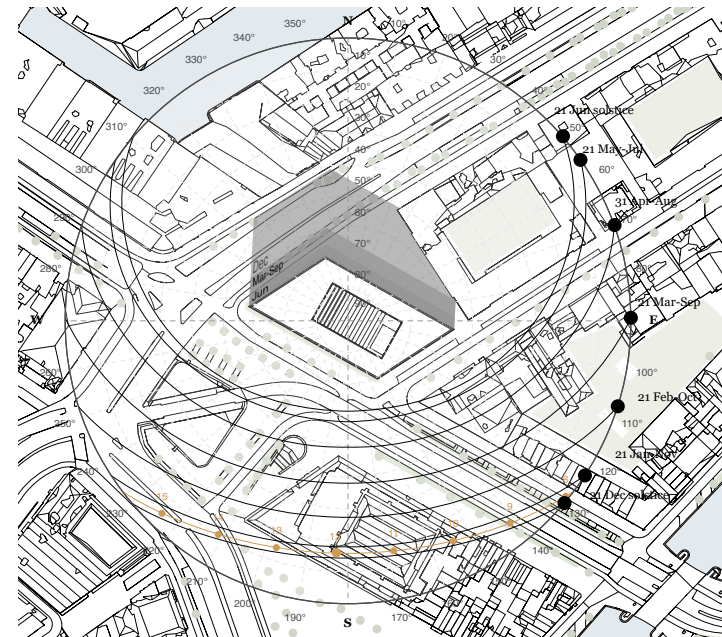


Sun days over the Year

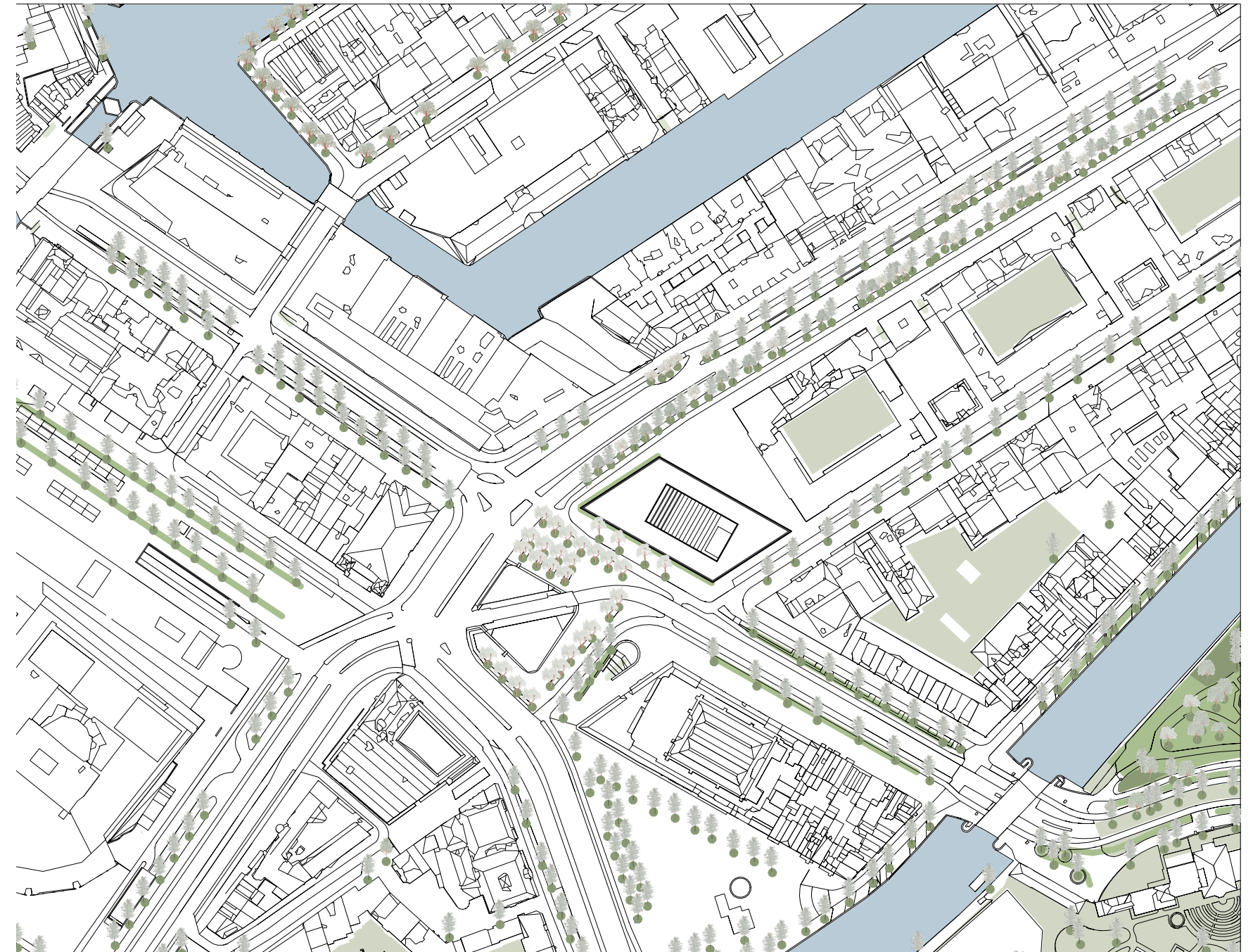


Wind analysis

- < 2 km/h
- 2 - 5 km/h
- 5 - 10 km/h
- 10 - 20 km/h
- 20 - 30 km/h
- 30 - 40 km/h
- 40 - 50 km/h
- > 50 km/h



Sun analysis



Greenery map

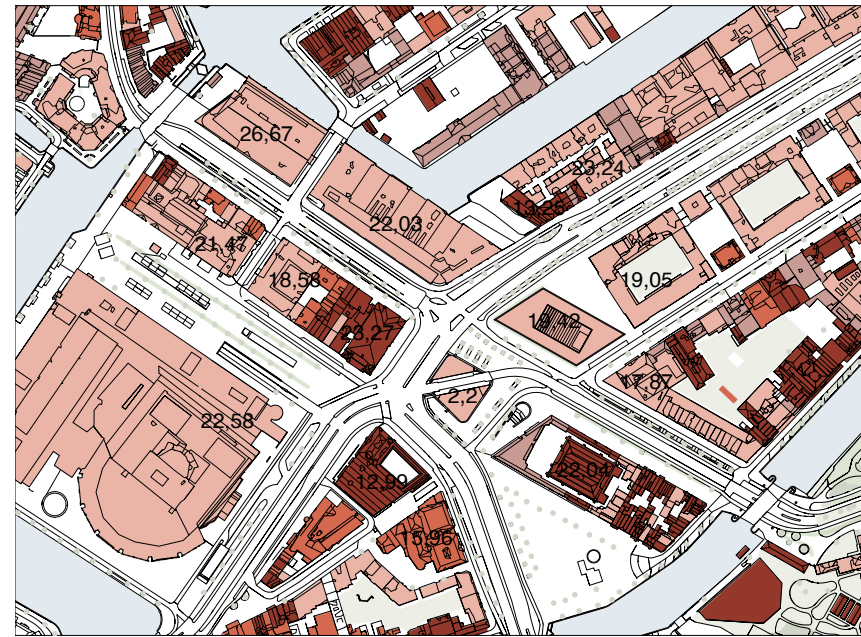
Different types of trees (1900-2020), mainly Ulmus species

Site Environmental Context

The surrounding roovescape is mixed, with an approximately even distribution of flat and pitched roofs and building heights ranging from 12 to 23 m. At 19.42 m, the existing building is already among the taller structures in the area, making further vertical extension visually sensitive.

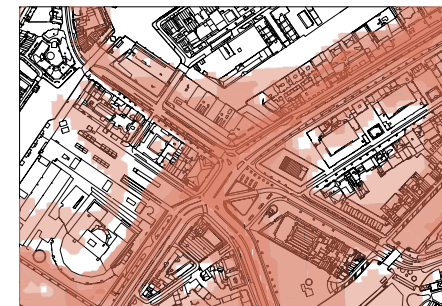
Noise levels are elevated during daytime due to traffic, while night-time conditions remain moderate. Transportation access is excellent, with metro, tram, and bus connections, strong cycling infrastructure, walkability, and nearby parking.

Pitched roof
Flat roof

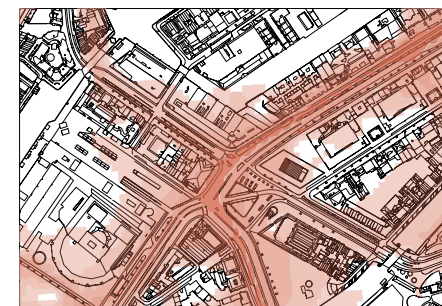


Roof map

https://efaidnbmnnnibpcajpcqlclefindmkaj/https://openresearch.amsterdam/image/2025/3/25/241101_optopppen_rapport_def_hq_4.pdf
<https://apps.webmapper.nl/gebouwen/#15.43/52.369543/4.904733/>



55-60 dB
60-65 dB
65-70 dB
70-75 dB
> 75 dB



50-55 dB
55-60 dB
60-65 dB
65-70 dB
> 70 dB

Noise during day (up) and night (lower)

Building

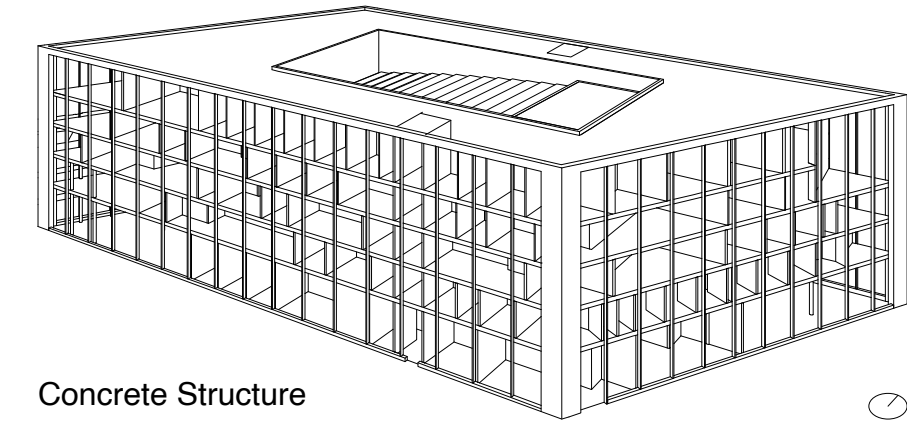
The building is a reinforced concrete structure completed in 1999. Its overall geometry is defined by an irregular grid, as the façade grid and the internal structural grid do not align.

The façade is framed by concrete corner walls on both sides, each 1.8 m wide and extending 19.42 m in height. Together with a plinth and a 75 cm deep concrete band, these elements form a rigid outer frame into which the façade is set. The façade grid is consistent on the north and south elevations, as well as on the east and west elevations.

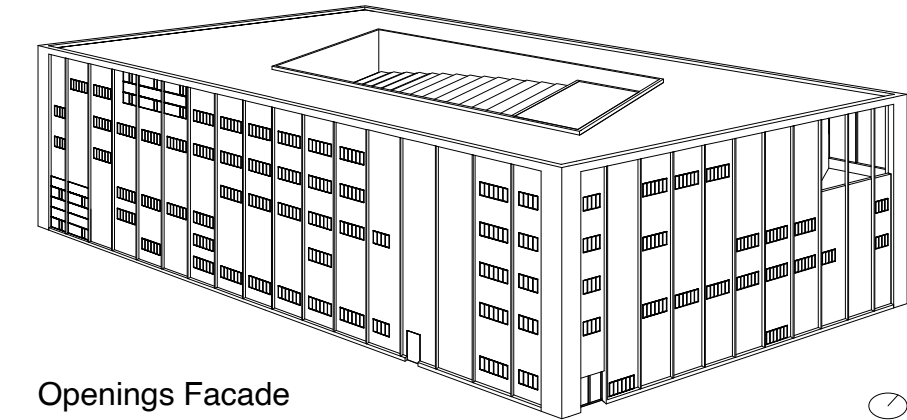
In the north–south direction, the grid consists of 4.5 m bays at the corners, a 3.6 m intermediate bay, and a 4.5 m bay at the opposite corner. In the east–west direction, the grid measures 4.335 m at the corners and 3.36 m for the remaining bays.

Internally, the structural grid is highly irregular. Horizontally (east–west), spans vary between 4.15 m and 6.85 m, except in the circulation zones and studio areas, where a constant grid of 3.885 m is maintained. Vertically (north–south), only the outer grid line measures 5.035 m; all other bays follow a regular dimension of 3.925 m.

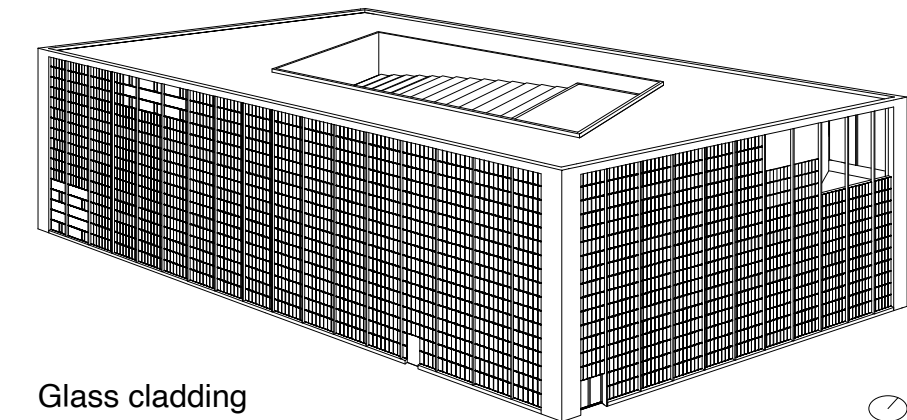
Façade openings are positioned irregularly according to functional requirements but remain aligned with the glass cladding grid. Each façade bay is composed of eight glass panels, reduced to six panels at the corners due to the widened corner walls. Panel are 40 cm wide to 1 m high. The glazing is framed with black aluminium profiles at the top and bottom and is fixed to a 30 cm thick concrete wall.



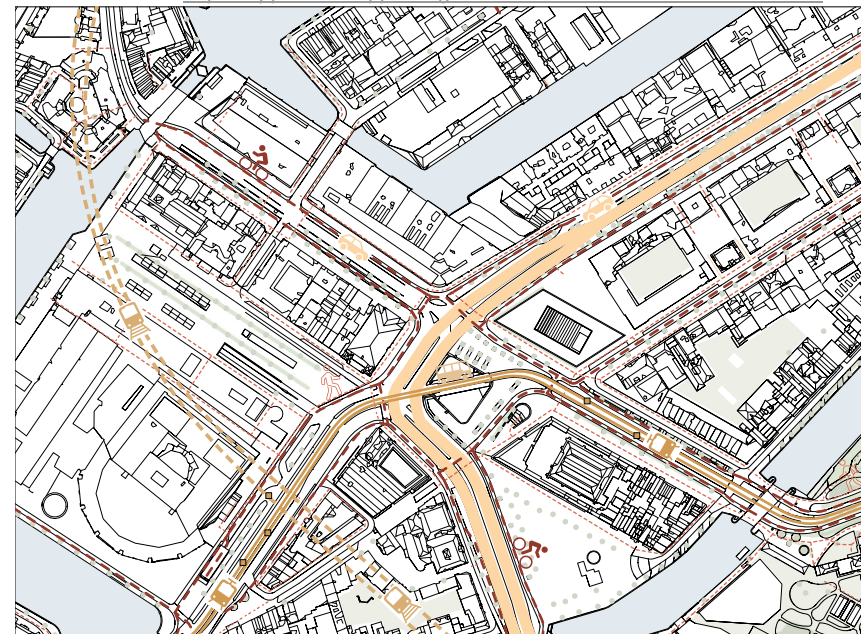
Concrete Structure



Openings Facade

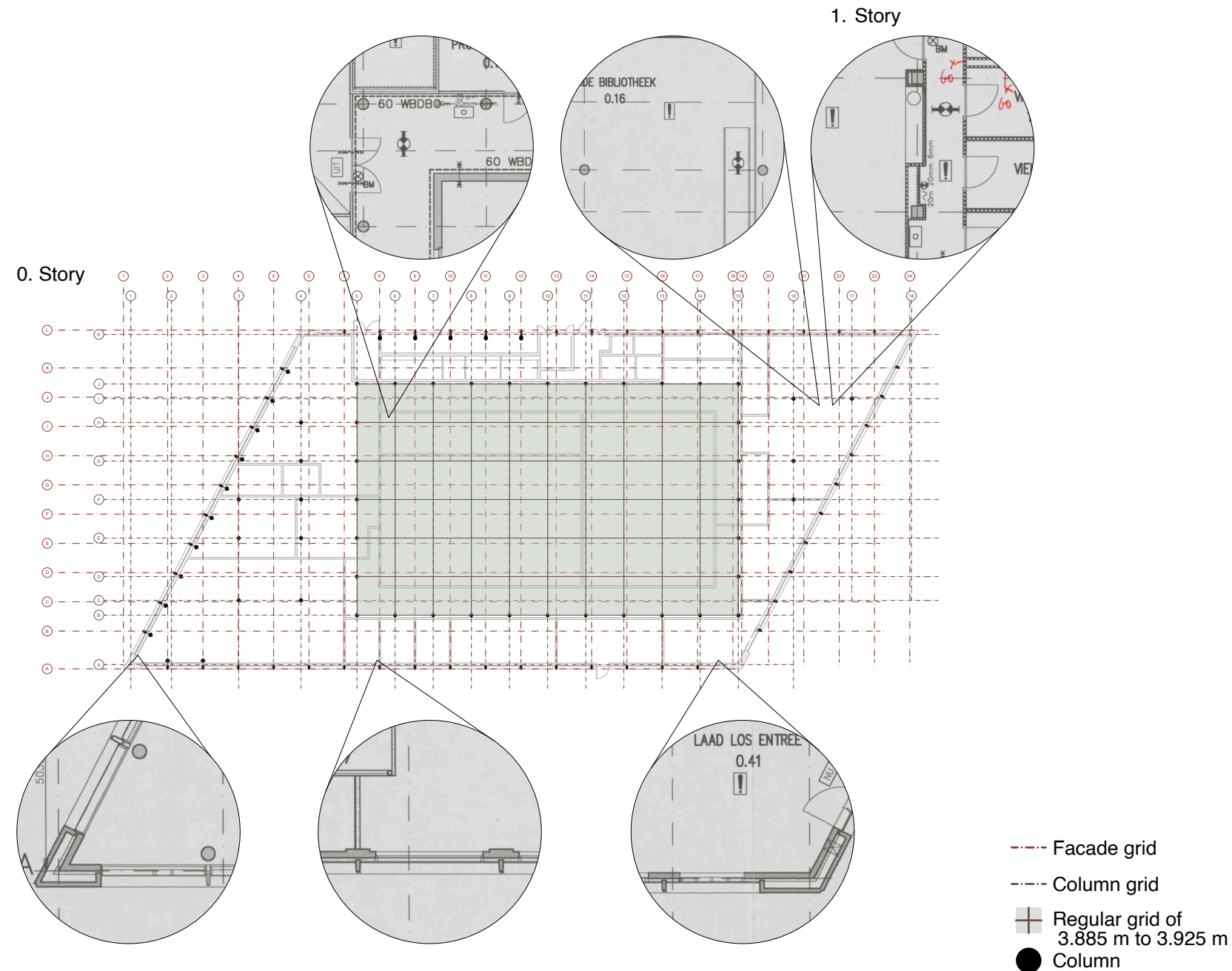


Glass cladding

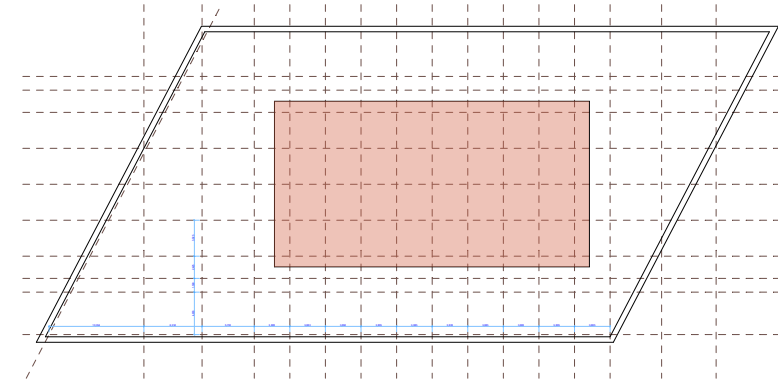


Mobility map

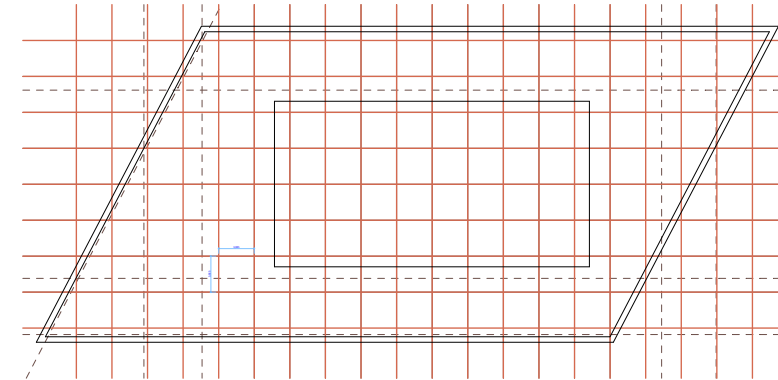
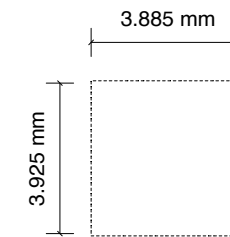
Structural Grid Exploration



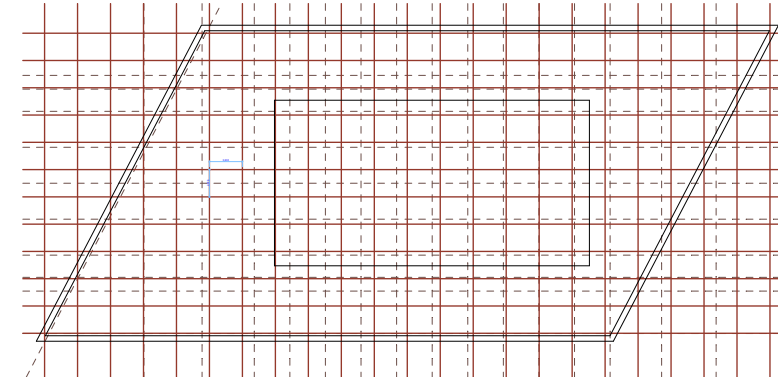
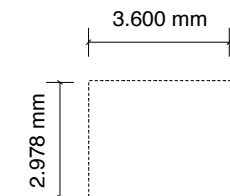
Planned grid by Koen van Velsen



Column grid



Facade grid

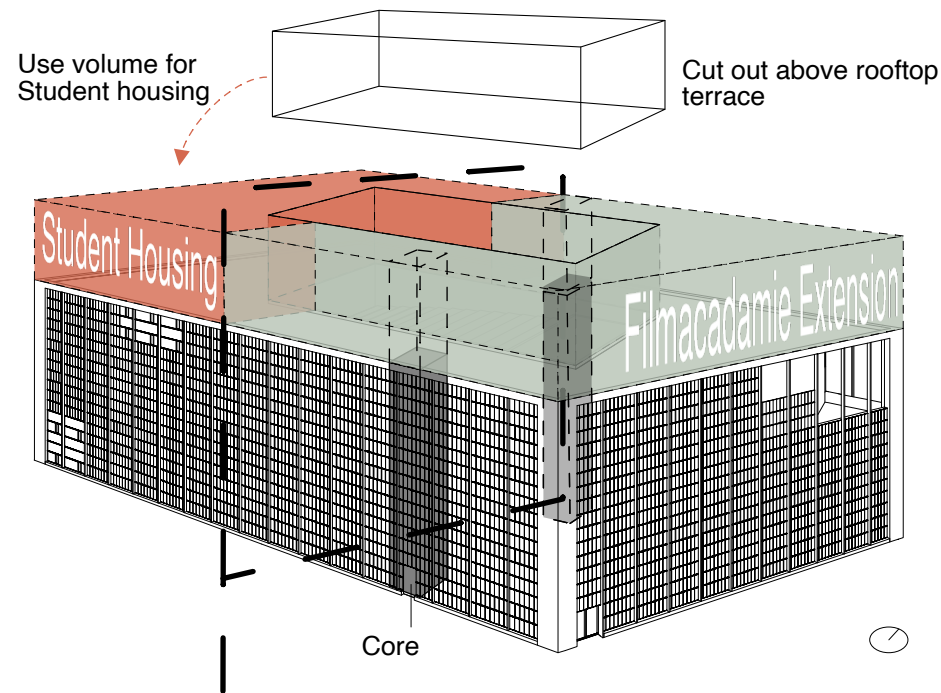
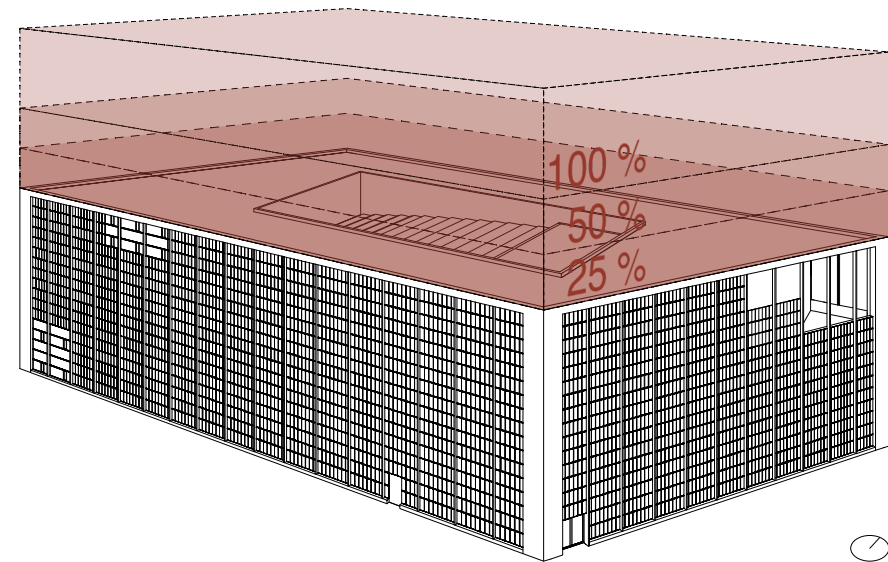


Scope

When comparing different rooftop extension strategies in relation to this specific building, a 25% intervention would appear too minimal to meaningfully activate the potential of the structure, while a 100% intervention would be overly dominant and oppressive in relation to both the existing building and its urban surroundings. A 50% rooftop extension (~7.000 m²) therefore represents a more balanced approach at this stage of the project.

An analysis of the existing circulation reveals that the primary vertical cores are located on the eastern side of the building. This condition enables the rooftop extension to be conceptually divided into two parts. On the eastern side, the existing cores can be extended upwards, providing direct and efficient access to a new expansion of the Filmacademie. In contrast, the western rooftop area, being slightly larger, can accommodate student housing, allowing this programme to remain more private and spatially separated from the institutional functions.

As residential use requires a distinct access, a separate entrance for the student housing can be introduced at the triangular square on the north-western side of the building. The existing rooftop terrace is currently an important spatial element and is therefore intended to be retained. The proposal aims to connect it carefully to the new rooftop volumes rather than replace it. The unused roof area above the existing terrace is incorporated into the student housing programme, increasing the available residential space without compromising the terrace itself.



Abstract representation for locating the functions

Filmacademie

Preliminary Room program

The Filmacademie requires a clear distinction between fixed and adaptable spaces. While the study programmes remain relatively stable, spatial needs change frequently, especially for individual work, group work, and teaching formats.

Fixed spaces are defined by technical, acoustic, and regulatory requirements. These include circulation cores, toilets, technical rooms, cleaning and storage rooms, and service shafts. Studios are also fixed elements due to their high acoustic and technical demands, which cannot be easily achieved with flexible partitions. In addition, a multipurpose room is proposed as a fixed space, responding to students' need for a large shared environment where collective work and exchange across departments can take place. Another cinema space is also considered part of the fixed programme, although its final size and configuration remain open.

Flexible spaces are designed to adapt to changing needs over shorter timeframes. Seminar and meeting rooms, as well as individual working spaces, are therefore flexible and can accommodate different group sizes and teaching formats. Exhibition and display areas are integrated into circulation zones but could also be its own space, to make student work visible and accessible. A lounge area, potentially combined with a bar, supports informal interaction and can be activated during exhibitions or events. The rooftop terrace is likewise treated as a flexible space, allowing for social, informal, and educational use.

Building Level Room Program	Fixed/Flexible
Circulation Core	Fixed
Toilets	Fixed
Technical rooms	Fixed
Janitor Room/Cleaning room	Fixed
Storage	Fixed
Service shafts	Fixed
Per unit	
Multipurpose room	Fixed
Seminar/ Meeting rooms	Flexible
Individual Working	Flexible
Studio rent out	Fixed
Exhibition/Display are (Cinema)	Flexible
Lounge/ Bar/ Leisure Time	Flexible
Roof top terrace outside	Flexible

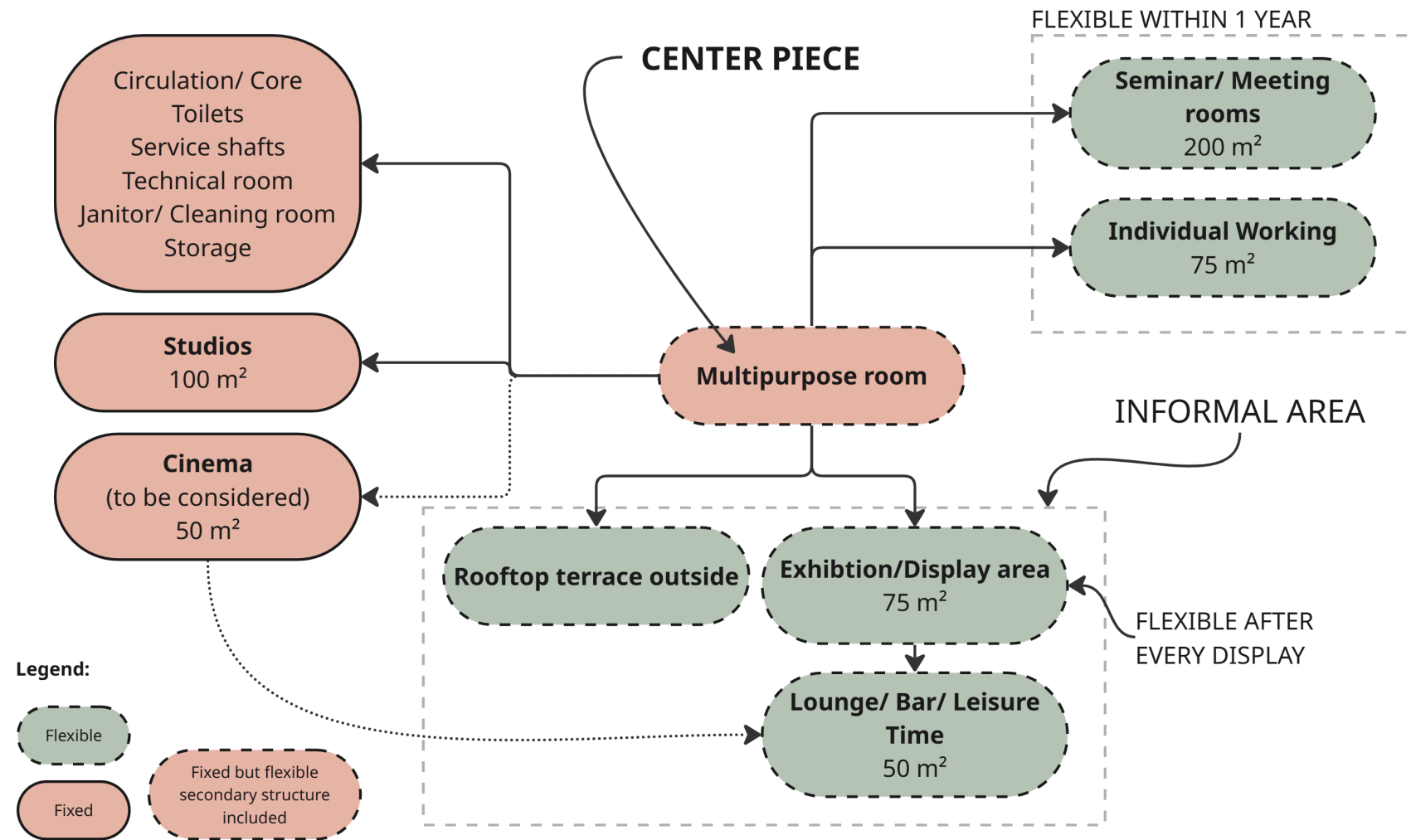
Fixed	700 m ²
Circulation Core	... m ²
Toilets	... m ²
Technical rooms	... m ²
Janitor-/ Cleaning room	... m ²
Storage	... m ²
Service shafts	... m ²
Multipurpose room	300 m ²
Studios	100 m ²
Cinema	50 m ²
Flexible 400 m²	
Seminar/ Meeting room max 10 P *5	75 m ²
Seminar/ Meeting room max 30 P *5	125 m ²
Individual Working * 15	75 m ²
Exhibition/Display are	75 m ²
Lounge/ Bar / Leisure Time	50 m ²
Roof top terrace outside	... m ²

In total approximatley

1100-1300 m²

Preliminary Concept Room program

THE FILMACADEMIE



Total:
~ 1100-1300

Student Housing

Preliminary Room program

At this stage of the project, a total of 40 apartments are proposed, consisting of 20 two-bedroom units and 20 three-bedroom units. Together, these apartments occupy approximately 3,360 m² of net residential area. Including circulation spaces outside the individual units, the total required area amounts to roughly 4,000 m².

The core idea behind the student housing concept is to clearly distinguish between fixed and adaptable elements. Kitchens and sanitary spaces are fixed within each apartment, while the remaining internal layout is deliberately left flexible. This allows residents to adapt the secondary layout according to their needs, enabling each new group of tenants to reconfigure the interior arrangement over time.

In contrast, circulation spaces outside the apartments, as well as entrance doors, remain fixed elements of the design, as required by fire safety regulations and building standards. The concept of growth and adaptability therefore takes place primarily within the apartments themselves. In the long term (over a period of 25 to 50 years) the system also allows for potential expansion or reconfiguration should there be an increased demand for student housing or residential use more generally.

Apartment 2 Bedrooms	75 m²
Kitchen	10 m ²
Toilet	5 m ²
Guest Toilet	3 m ²
Dining & Livingroom	20 m ²
Bedroom 1	12 m ²
Bedroom 2	12 m ²
Storage	5 m ²
Circulation	8 m ²
Apartment 3 Bedrooms	93 m²
Kitchen	12 m ²
Toilet	7 m ²
Guest Toilet	3 m ²
Dining & Livingroom	20 m ²
Bedroom 1	12 m ²
Bedroom 2	12 m ²
Bedroom 3	12 m ²
Storage	5 m ²
Circulation	10 m ²

40 Apartments in total: 3.360 m²
+ Circulation= 4.000 m²

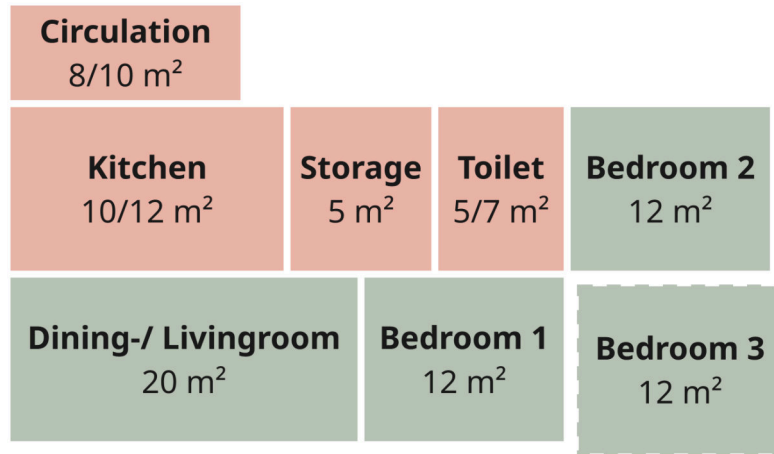
75*20= 1500m², 93*20= 1860 m²

Building Level Room Program	Fixed/Flexible
Circulation Core	Fixed
Toilets	Fixed
Technical rooms	Fixed
Janitor Room/Cleaning room	Fixed
Storage	Fixed
Service shafts	Fixed
Per unit	
Toilet	Fixed
2-3 Bedrooms	Flexible
Kitchen	Fixed
Livingroom	Flexible

Preliminary Concept Room program

STUDENT HOUSING

2-3 Bedroom apartments



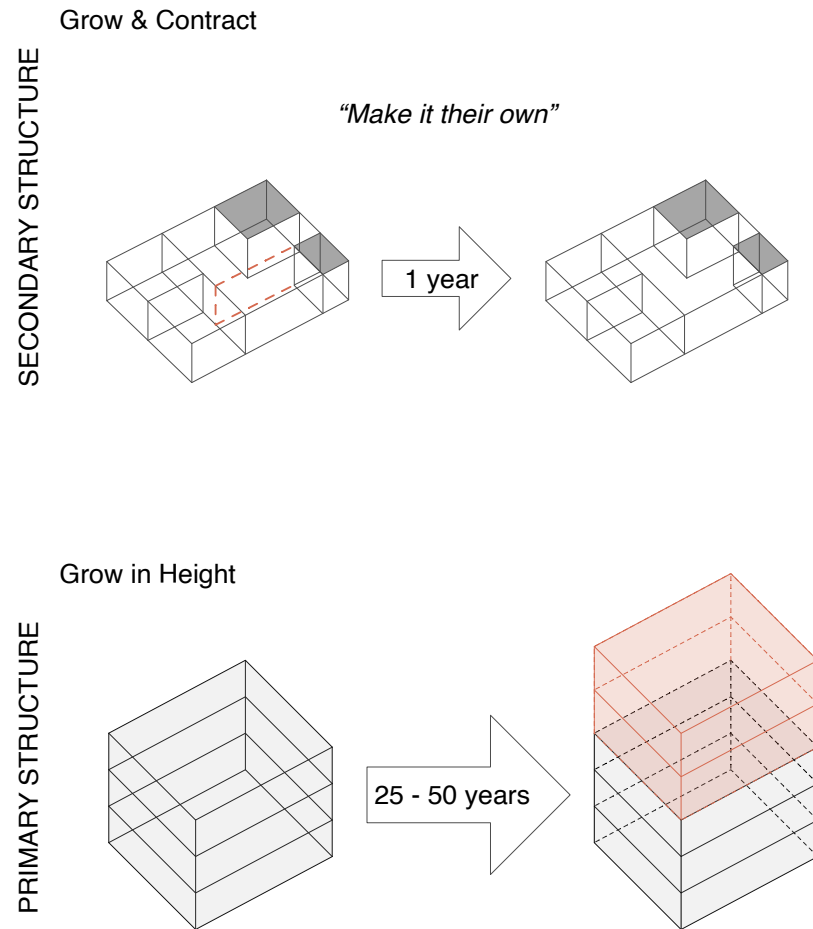
Fixed **Flexible**

75*20= 1500m², 93*20= 1860 m²

40 Apartments in total: 3.360 m²

+ Circulation

~ 4.000 m²



Preliminary structural flexibility timeline

Research Approach/ Planning

Construction

Analysis

Evaluation of Case Studies

Synthesis

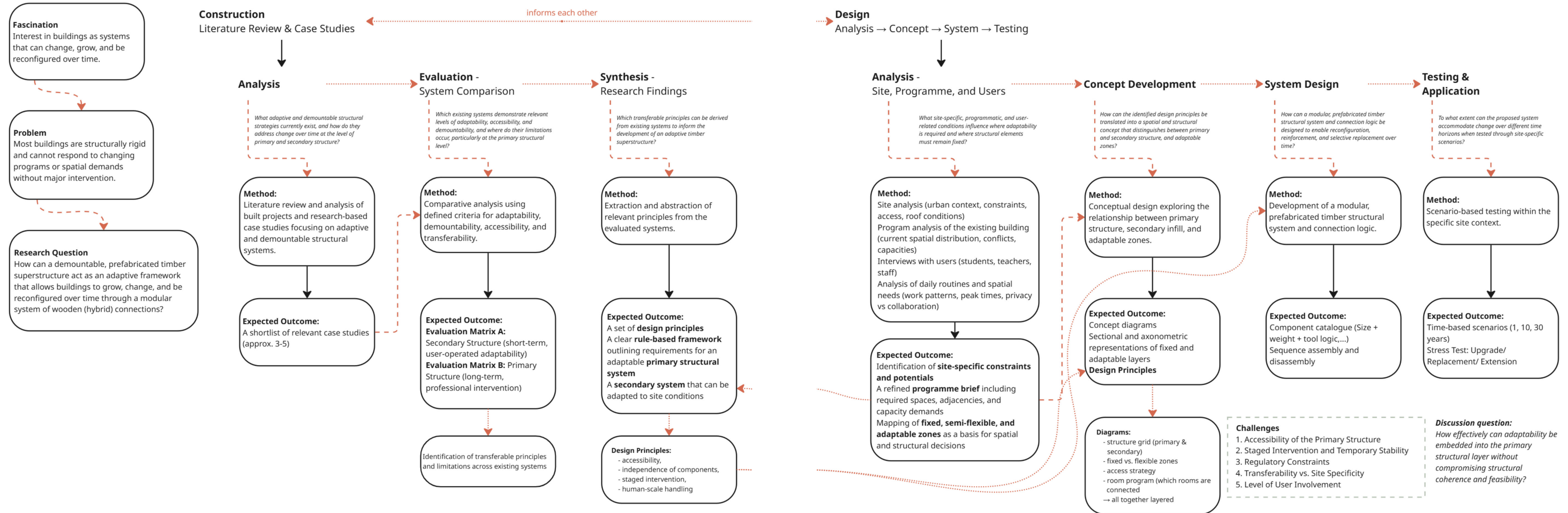
Design Principles A2

Part 2

Research

Research Approach

Research by Design



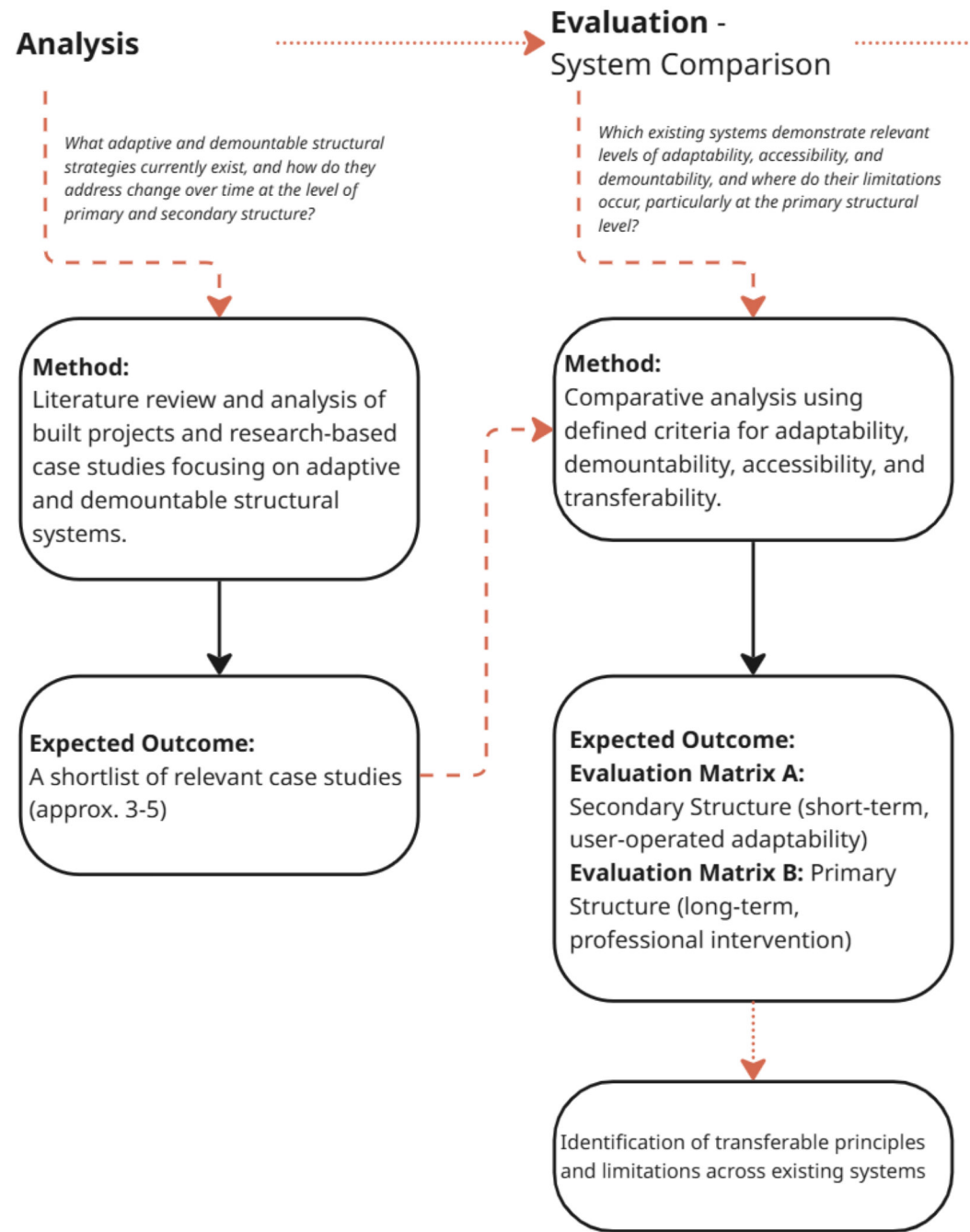
Analysis

During the analysis phase, a wider range of projects, construction systems, and theoretical approaches to adaptability were reviewed. This included concepts such as Open Building, particularly the distinction between support and infill, as developed by N. John Habraken, and later discussed by Stephen Kendall and Jonathan Teicher in Residential Open Building. These sources provided a broader theoretical background, but were not used as the main evaluation references.

For the design evaluation, four references were selected as the most relevant:

- Collegium Academicum, Heidelberg, Germany
- T3 Bayside, Toronto, Canada
- Timber-hybrid / convertible timber structure paper by TU Kaiserslautern
- Hans Drexler — Open Architecture: Nachhaltiger Holzbau mit System

These references were chosen because they address different aspects of adaptability: movable interior walls, removable floor systems, reversible timber connections, and adaptable timber construction systems. In parallel, additional sources on repair, replacement, open building principles, and traditional timber connections were reviewed to understand how building components can be changed, removed, or reconnected over time.



Evaluation

The evaluation is structured around two time horizons and two structural layers:

Secondary Structure (short-term adaptability, ~1 year): user-operated, frequent change, low risk tolerance for damage.

Primary Structure (long-term adaptability, ~25–50 years): professional intervention, rare change, high relevance of access, safety, and structural continuity.

Each layer is assessed through a parameter matrix. Parameters are translated into a simple rating scale and combined into a final “system suitability” judgement.

Rating scale (for both matrices):

- 0 = not compatible*
 - 1 = limited
 - 2 = good
 - 3 = excellent
- *if a criterion is 0, the system is not eligible*

Secondary Structure minimum rule:

A system must score at least 2 in durability, handling, and in simplicity otherwise it’s not a viable “user-changeable” layer.

Primary Structure minimum rule:

A system must score at least 2 in accessibility, structural continuity and upgrade, otherwise an “adaptable primary structure” is not credible.

Matrix A: Secondary Structure Intervention	
Goal:	Allow reconfiguration without damage, using components that can be handled by residents.
Reusability/ Durability of connection	Can it be assembled/disassembled repeatedly without material degradation? (avoid stripping, crushing, loosening)
Handling/ Weight + Size	Elements manageable by two people. Include a clear rule: e.g. max 25–30 kg per element, max length based on circulation?
Simplicity/ Intuitive assembly	Low tool dependency, low error risk, clear “right/wrong” assembly.
Tolerance + Adjustability	Can it handle imperfect conditions (existing building tolerances) and still fit?
Safety during handling	Pinch points, falling risk, stability during partial assembly, safe temporary states.
Acoustic / Comfort performance*	Does the wall/floor/partition meet minimum acoustic expectations, or does flexibility destroy comfort?
Material circularity	Separated layers, clear disassembly sequence, replaceable wear parts.
Accessibility of critical elements	Can elements be easily reached?

Connecting both: System Evaluation Logic

Step 1: Rate it as a Secondary System (user-changeable)

Step 2: Rate it as a Primary System (long-term adaptable)

Outcome categories:

Type 1: adaptable secondary + adaptable primary (ideal)

Type 2: adaptable secondary + rigid primary (common)

Type 3: rigid secondary + adaptable primary (rare, but possible)

Type 4: rigid secondary + rigid primary (not aligned with the thesis)

Evaluation

The existing systems are not expected to fully align with the Matrix B as this will be developed and explored through the design proposal of this project. Matrix B is therefore intended to identify differences between established systems and to provide a reference framework for assessing the proposed structural system at a later stage. In addition, the matrix functions as a design guide, ensuring that the developed system consistently responds to the defined criteria and long-term adaptability requirements.

Matrix B: Primary Structure Intervention	
Goal:	Allow deep change in the building over decades without massive demolition.
Accessibility of critical elements/ Selective replaceability	Can beams/columns/slabs/connection zones be reached without destroying multiple layers? Can individual components be removed/replaced without collapsing the logic of the entire system?
Structural continuity/robustness during interventions	Does the system allow safe temporary states (propping strategy, redundancy, staged replacement)?
Upgrade/reinforcement capacity	Can the primary system be strengthened later (add-on elements, hybrid reinforcement, plug-in stiffeners)?
Compatibility with fixed zones	Can it handle imperfect conditions (existing building tolerances) and still fit?
Standardisation + availability over time	Avoid exotic components that will be unavailable in 25–50 years; prefer standard profiles, repeatable connectors.
Inspection + maintenance	Can connections be inspected and detect decay/damage over time (legibility, visibility, access panels)?
Fire / building regulations integration	Does adaptability conflict with fire strategy, compartmentation, escape routes, and approvals?

Collegium Academicum

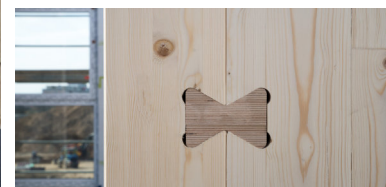
Heidelberg, Germany
Completed 2021
designed by DGJ Architektur

The project serves as a student housing complex combined with shared educational and communal spaces. The building accommodates 176 students and includes collective facilities (learning spaces, auditorium). From the outset, the project was conceived as housing by students for students, with the intention of creating an environment that supports both living and learning.

The primary load-bearing structure is realised as a timber skeleton system. Structural elements are connected using wooden dowels, resulting in a largely reversible load-bearing system.

The secondary structure consists of (non-)load-bearing interior walls that can be easily modified by the residents themselves. These partition walls are connected using the X-Fix connector system, allowing them to be assembled, removed, or repositioned without damaging the primary structure. This enables students to adapt apartment layouts over time in response to changing needs.

Through this combination of a reversible primary structure and a flexible secondary system, the Collegium Academicum demonstrates how participatory housing, timber construction, and Design for Disassembly principles can be integrated into a coherent architectural framework.



Structural System

Continuous Beams — Beam-on-Column Grid (no hierarchy)

Short Description

Two orthogonal beams of equal dimension meet on top of the column. One beam is continuous, the other connects into it. The node behaves like a beam-beam intersection on a column. The Ceiling is positioned between the beams.

Advantages

Load-bearing junction requires minimal connectors (beams are laid on top)

Simple geometry for facade and fitting-out

Cantilevers possible in both beam directions

Equal structural role in both directions

Disadvantages

No structural hierarchy → less optimised load distribution

Node becomes complex due to intersecting beams

Different structural depths and detailing can occur at junctions

Higher coordination effort at beam intersections

Primary Structural System

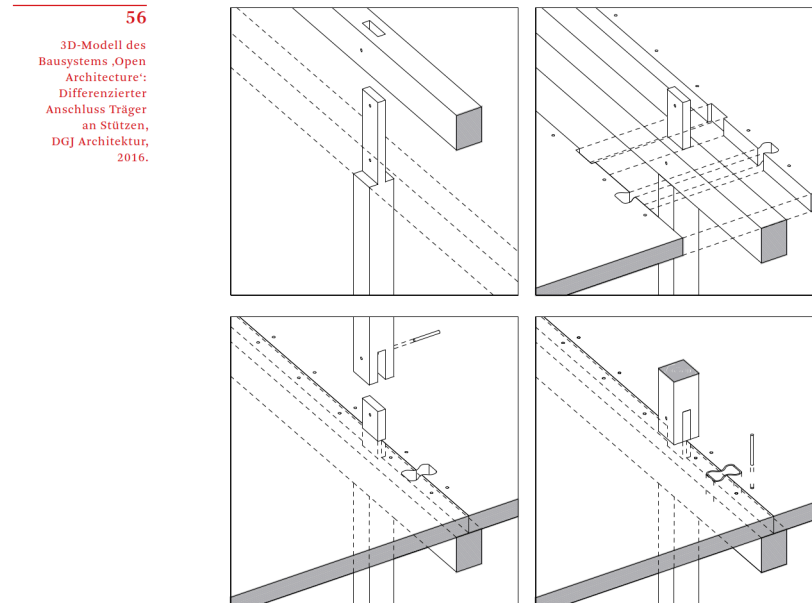
Beam-column frame (non-hierarchical, two-way system)

Load Transfer

Beams in both directions → columns

Secondary Structural System

CLT Walls connected with an x-fix connector to the columns



Visual by Drexler, 2021

Matrix A: Secondary Structure Intervention

Goal	Rating	Reasoning
Reusability/ Durability of connection	3	Partitions are designed for repeated relocation. X-fix allows easy assembly/ disassembly and repeated use.
Handling/ Weight + Size	2	Elements can be produced and moved by residents with simple means. No precise data on weight or size.
Simplicity/ Intuitive assembly	3	Self-build system, simple connectors, no power tools required.
Tolerance + Adjustability	2	System allows repeated reconfiguration. No explicit tolerance data.
Safety during handling	2	Designed for user participation and low tool dependency. No detailed safety evidence.
Acoustic / Comfort performance	2	Rubber seals and tested airtightness. Performance across all configurations unclear.
Material circularity	3	Timber system, removable elements, metal-free connectors, reversible joints.
Accessibility of critical elements	2	Secondary components are directly accessible and modifiable.

Result Matrix A

Average: ~2.4

Minimum rule: fulfilled

→ Strong, credible user-changeable secondary system

Designed for short-term reconfiguration and long-term conversion

Uses X-fix wood-wood connectors (double dovetail, self-tightening, metal-free, hammer assembly, reversible)

1. Short profile of the system:

Timber hybrid building

Primary structure: skeleton frame + stabilizing walls + cores

Secondary layer: relocatable partitions, self-build

Matrix B: Primary Structure Intervention		
Goal	Rating	Reasoning
Accessibility of critical elements/ Selective replaceability	2	Structural zones are separated. Some walls are non-loadbearing. X-fix allows disassembly of timber joints.
Structural continuity/ robustness during interventions	2	Clear system: cores + stabilizing walls + frame. Independent sections. No detailed intervention scenarios.
Upgrade/ reinforcement capacity	1	No clear strategy for strengthening or future load upgrades.
Compatibility with fixed zones	3	Strong zoning: fixed cores + flexible areas around them.
Standardisation + availability over time	2	Repetitive grid, prefabrication, CNC production, standardized connectors.
Inspection + maintenance	1	No clear information on accessibility of structural joints in use.
Fire / building regulations integration	3	Fire strategy strongly integrated (concrete access, non-combustible zones).

Result Matrix B

Average: ~2.0

Minimum rule: fulfilled

→ Partly adaptable, but not fully validated as adaptable primary structure

- structural replacement strategies
- long-term upgrading
- maintenance access

Key takeaway

Strong adaptability is concentrated in the secondary layer (partitions, layouts, user control)

Primary structure is organized and flexible in layout logic, but lacks evidence for:

Convertible wood hybrid for differentiated expansion stages

The paper “*Wandelbarer Holzhybrid für differenzierte Ausbaustufen*” investigates how multi-storey buildings can be designed to remain adaptable over time while reducing material consumption and environmental impact. The central aim of the research is to demonstrate that a robust timber-based primary structure can support multiple successive uses, such as parking, working, and living, without requiring fundamental structural modifications. This approach challenges conventional building practices that assume a single, fixed program over a building’s lifetime.

The building system is conceived as a multi-storey timber skeleton constructed from engineered beech wood, organised in a regular structural grid that allows large spans and flexible floor layouts. Load-bearing interior walls are avoided, enabling future spatial re-configuration. Lateral stability and fire-safety requirements are addressed through a separate reinforced-concrete circulation core, which structurally supports the timber frame.

A key focus of the paper is the development of reversible and demountable connections between building components. These connections avoid gluing or permanent bonding. Instead of traditional wood screws, which can be difficult to remove after decades and may damage the wood upon re-entry, the project utilizes metric screws in combination with screw-in sleeves (Einschraubmuffen). Because the threads are metric, the screws can be tightened and loosened multiple times without losing load-bearing capacity.

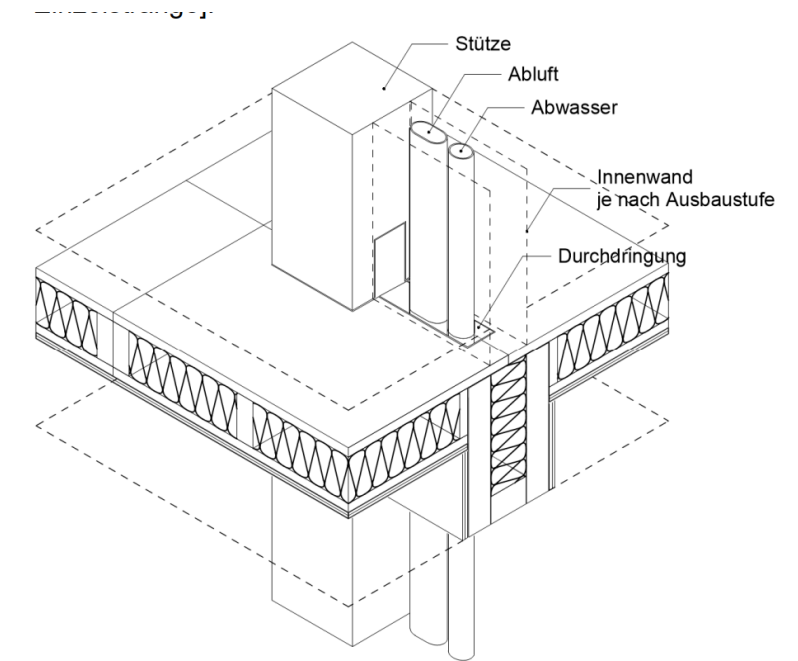
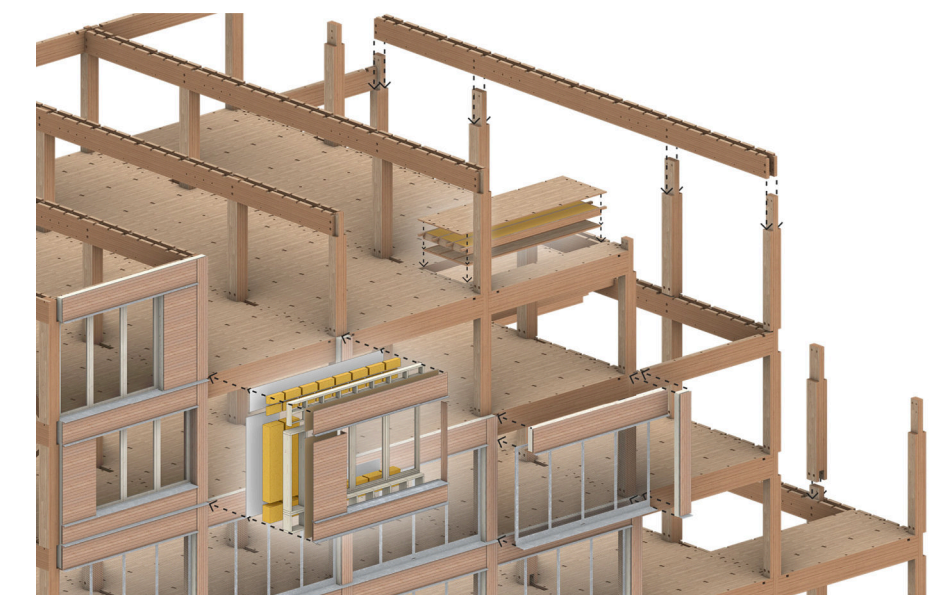


Abb. II.1.1-78: Einzelstrang und Deckendurchführung



Visual by Technische Universität Kaiserslautern–Landau, 2022

Structural System

Continuous Columns — primary beams in pairs and box slabs

Short Description

Main beams run in one direction only and are designed as paired beams. They sit on the column via a notch and are fixed around a central connector. No secondary beams exist; the slab spans in the perpendicular direction and stabilises the system.

Advantages

- Reduction of beam elements (no secondary beams)
- Clear one-directional load path
- Cantilevers possible in beam direction
- Structural system is legible and reduced

Disadvantages

- Junction between main beam and column more complicated
- Complex geometry for façade and fitting-out
- Strong dependency on slab performance for stability
- Limited redundancy due to one-way system

Primary Structural System

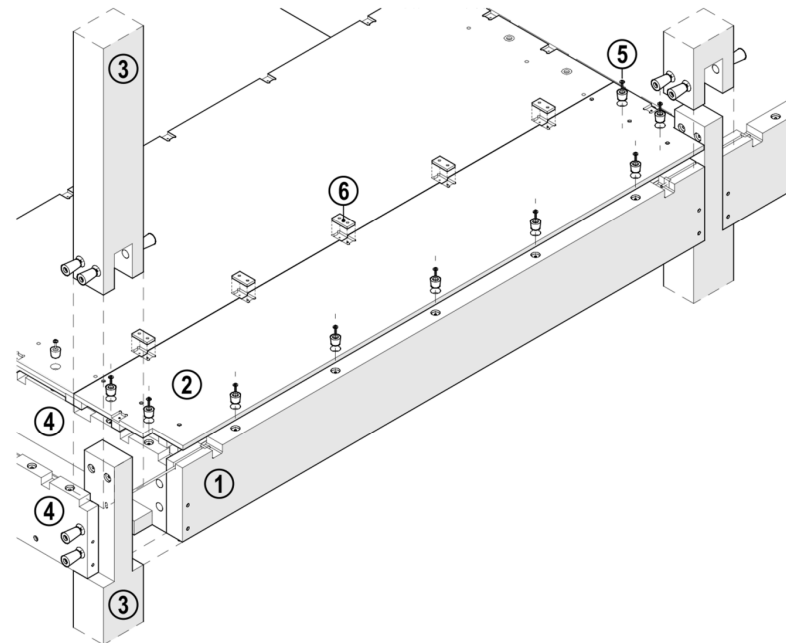
Continuous column system with one-way main beams + structural slab

Load Transfer

Slab (plate action) → main beams → columns

Secondary Structural System

Interior fit out on column non load bearing



Visual by Technische Universität Kaiserslautern–Landau, 2022

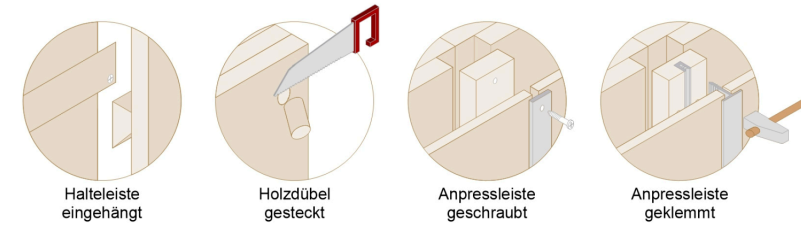


Abb. II.1.1-84: Lösbare Verbindungen

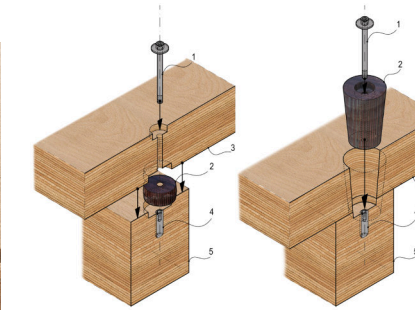


Abb. II.1.1-102: Prinzipskizze einer Zwei-Komponentenverbindung mit KP-Schraubdübel (links) und KP-Konusdübel (rechts). 1: metrische Schraube, 2: KP-Schraubdübel (links) bzw. KP-Konusdübel (rechts), 3/5: verbundene Holzkomponenten, 4: Einschraubmutter, z.B. RAMPA-Muffe). Foto: T-Tab



Abb. II.1.1-90: Modell mit Fassadenausschnitt, Foto: Bernhard Friese, Pforzheim

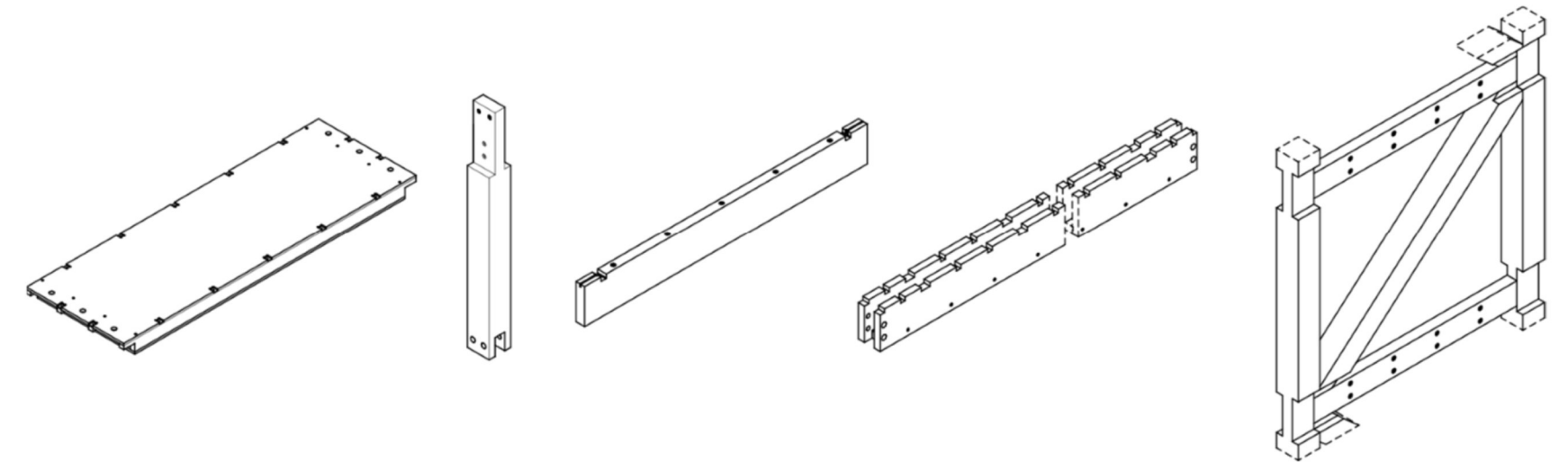


Abb. II.1.1-101: Übersicht standardisierter Bauelemente: Deckenelement, Stütze, Randriegel, Zangenträger, Aussteifungsverband

Visual by Technische Universität Kaiserslautern–Landau, 2022

Matrix A: Secondary Structure Intervention		
Goal	Rating	Reasoning
Reusability/ Durability of connection	3	Explicitly designed for disassembly and reuse across all levels.
Handling/ Weight + Size	2	Modular and standardized, but no explicit data on handling.
Simplicity/ Intuitive assembly	2	Focus on reversible connections and modular construction intended to be reconfigured through professionals.
Tolerance + Adjustability	2	Layered system allows adaptation and replacement.
Safety during handling	1	No information available.
Acoustic / Comfort performance	1	Only estimated, not validated.
Material circularity	3	Strong focus on circular construction and reuse.
Accessibility of critical elements	2	Interior elements are replaceable and accessible.

Result Matrix A

Average: ~2.0-2.1

Minimum rule: fulfilled

→ Adaptable secondary system but not user-changeable

1. Short profile of the system:

Timber hybrid building

Primary structure: standardized timber frame system (grid-based)

Secondary system: modular interior elements with replaceable layers

Designed for disassembly, reuse, and multiple use scenarios

Reversible connections enabling non-destructive assembly and disassembly

Hierarchical system: component → element → building system

Matrix B: Primary Structure Intervention		
Goal	Rating	Reasoning
Accessibility of critical elements/ Selective replaceability	3	Reversible connections and non-destructive disassembly explicitly targeted.
Structural continuity/ robustness during interventions	3	Clear frame system with standardized grid and elements.
Upgrade/ reinforcement capacity	1	No explicit upgrading or strengthening strategy described.
Compatibility with fixed zones	2	Supports different use scenarios within one structure.
Standardisation + availability over time	3	Strong standardization of structural system and elements.
Inspection + maintenance	3	Accessible, reversible connections enable inspection and replacement.
Fire / building regulations integration	3	Fire safety concept developed and validated.

Result Matrix B

Average: ~2.6

Minimum rule: not fulfilled (Upgrade 1)

→ Strong reversible primary system, but no upgrading strategy

Key takeaway

Strong adaptability is concentrated in the secondary system (modular interior elements, layered construction, replaceable components)

Primary structure is standardized and designed for reversibility, disassembly,

and accessibility, but lacks evidence for:

- structural upgrading strategies

T3 Bayside



Toronto, Canada
Completed 2024
Designed by 3XN

The 42-metre-tall building is currently the tallest timber office building in North America and sets a new benchmark for sustainable office construction. With a total floor area of approximately 23,000 m², the project reflects the ambition to integrate working, social life, and public space within a dense urban environment.

The building is organised around a public plaza that acts as an urban gateway, linking the neighbourhood to the waterfront promen-

ade. Retail and café spaces activate the ground floor, while a series of stepped interior spaces extends the public realm into the building, gradually transitioning from public to private use. The upper floors accommodate flexible, open-plan office spaces with double-height zones that allow adaptation to changing tenant needs.

The exposed timber structure defines both the architectural expression and the interior atmosphere. Assembled with mechanical connections, the building is designed for disassembly and reuse, supporting a circular approach to construction.



Structural System

Continuous Columns — primary and secondary beams at same Level with hierarchy

Short Description

Primary and secondary beams of different sizes are connected to the column and to each other at the same level. The system is hierarchical, with one dominant beam direction and smaller secondary beams transferring loads into it. Mechanical/ dry connections in specific zones, CLT slabs with concrete topping (acoustic layer), Structural stability via concrete core (lateral system).

Advantages

- Uniform loading of primary beams through alternating secondary beams
- Simple geometry for facade and fitting-out
- Clear hierarchical load distribution
- Structurally efficient due to differentiated beam sizes

Disadvantages

- Cantilevers not possible
- More complicated junctions between beam-column and beam-beam
- Increased connection complexity due to same-level configuration
- Strong directional dependency of the system

Primary Structural System

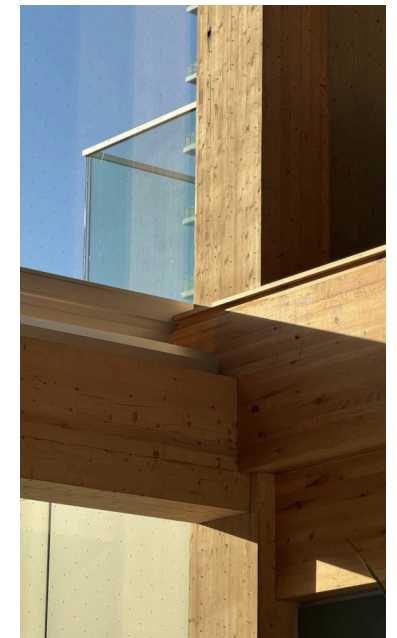
Hierarchical beam-column frame (primary + secondary beams at same level)

Load Transfer

Secondary beams → primary beams → columns

Secondary Structural System

Slabs are connected to beams and supposedly flexible to change



Double height ceiling without slab, photos by Clara Soltész

Matrix A: Secondary Structure Intervention		
Goal	Rating	Reasoning
Reusability/ Durability of connection	2	Slab zones are designed to be removed and reconfigured, but not repeatedly or easily.
Handling/ Weight + Size	1	Large-span CLT slabs with concrete topping → heavy, difficult to handle.
Simplicity/ Intuitive assembly	1	Interventions require structural modification (removal of slab + topping + beams).
Tolerance + Adjustability	2	System allows predefined spatial changes (double-height), but not fine-grained adaptability.
Safety during handling	1	No evidence; interventions imply construction-level processes.
Acoustic / Comfort performance	2	Acoustic performance addressed via topping layer.
Material circularity	2	Timber is reusable, but composite slab reduces full circularity.
Accessibility of critical elements	2	Dry connections exist locally, but overall system is not easily accessible for change.

Result Matrix A

Average: ~1.6-1.7

Minimum rule: not fulfilled

→ Secondary system is strategically adaptable, but not practically user-changeable

1. Short profile of the system:

Mass timber office building (hybrid system)

Primary structure: timber frame + concrete core

Secondary system: open floor plates

with predefined removable slab zones

Designed for flexibility under uncertain future tenancy

Flexibility focused on double-height transformations and open layouts

Matrix B: Primary Structure Intervention		
Goal	Rating	Reasoning
Accessibility of critical elements/ Selective replaceability	2	Reversible connections and non-destructive disassembly explicitly targeted. Mechanical connections support disassembly in principle, but large-scale replacement is complex.
Structural continuity/ robustness during interventions	3	Clear, consistent structural grid and load path.
Upgrade/ reinforcement capacity	1	No explicit upgrading or strengthening strategy.
Compatibility with fixed zones	2	Open floor plates enabled, but strongly dependent on concrete core.
Standardisation + availability over time	3	Prefabricated timber system with rational spans.
Inspection + maintenance	2	Exposed timber allows inspection, but hybrid system limits full accessibility.
Fire / building regulations integration	3	Well resolved through hybrid strategy and code adaptation.

Result Matrix B

Average: ~2.3

Minimum rule: not fulfilled (Upgrade 1)

→ Primary system is robust and partially reversible, but not fully adaptable

Key takeaway

Adaptability is implemented mainly as a design strategy at building scale (open floor plates, predefined slab removals), rather than as an easily operable system

Primary structure is standardise and partly reversible, but limited by:

composite slab system (timber + concrete topping)

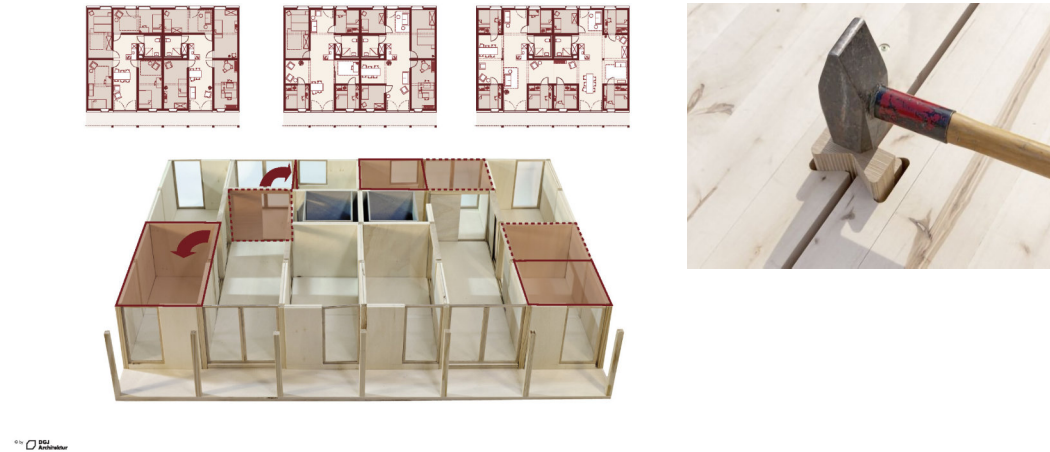
dependence on a concrete core for stability

lack of structural upgrading strategies

Synthesis

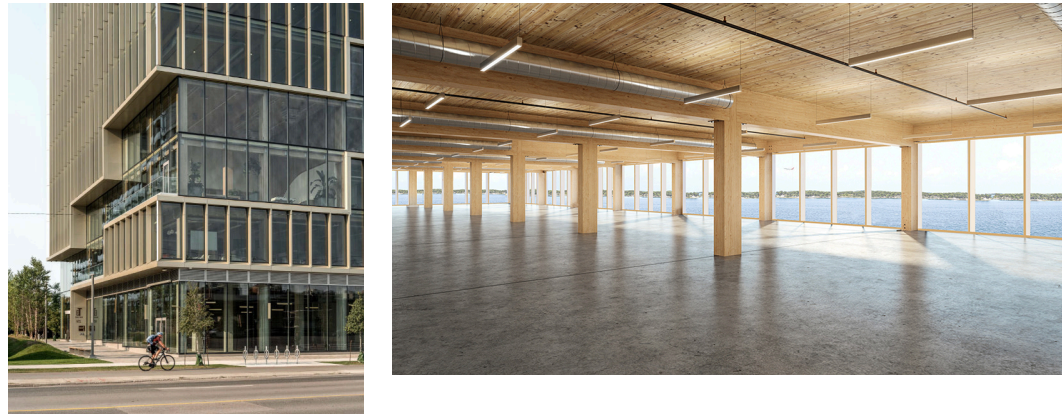
Collegium Academicum

The X-Fix connector was mainly relevant for the movable interior wall system of the reference project, rather than for the primary load-bearing structure. Its main contribution was the spatial logic behind the system: residents were able to adapt the layout of their apartments by shifting internal walls. This principle of adaptable apartment layouts was taken as a conceptual reference. However, the specific X-Fix connector detail was not directly transferred, as a different wall system was developed for the design.



T3 Bayside

The adaptable floor system of T3 Bayside introduced an interesting approach to spatial flexibility, as removable floor elements can create double-height spaces. However, the system was not directly suitable for the design intention. The elements are large, approximately six metres, and the system relies heavily on concrete. This made the approach less convincing in terms of dismantling, handling, and future reconfiguration. Due to the material intensity and sustainability concerns, a lighter floor system was considered more appropriate.



Convertible wood hybrid for differentiated expansion stages

The structural system of the reference project was adopted more directly. Its load-bearing logic and cone dowel connection were particularly relevant, as they were developed for a multi-storey timber structure and focus on reversible connections. The system was not copied one-to-one, but adapted and extended with additional components to respond to the specific site, structural requirements, and chosen architectural system. The cone dowel and related connection principles were especially suitable because they allow timber elements to be connected reversibly while remaining appropriate for a taller structure of approximately seven to eight storeys.



Abb. II.1.1-90: Modell mit Fassadenausschnitt, Foto: Bernhard Friese, Pforzheim

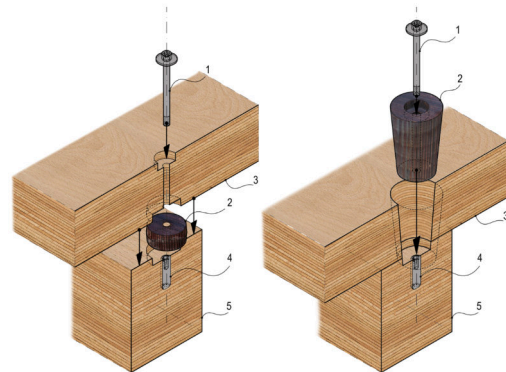


Abb. II.1.1-102: Prinzipskizze einer Zwei-Komponenten-Verbindung mit KP-Scheibendübel (links) und KP-Konusdübel (rechts). (1): metrische Schraube, 2: KP-Scheibendübel (links) bzw. KP-Konusdübel (rechts), 3/5: verbundene Holzkomponenten, 4: Einschraubmutter, z.B. RAMPA-Muffe), Foto: t-lab

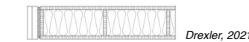
Design Principles A2

Prefabricated timber slab system (Lignatur LFE 40)

Layered construction for structure, acoustics, and fire performance
Exposed timber soffit with integrated acoustic profiling
Modular ribbed system enabling lightweight spans

L-shaped steel angle (100x50x10 mm)

Slab support fixed to primary beam with screw connection
Beam pre-fitted with steel sleeve for threaded bolt



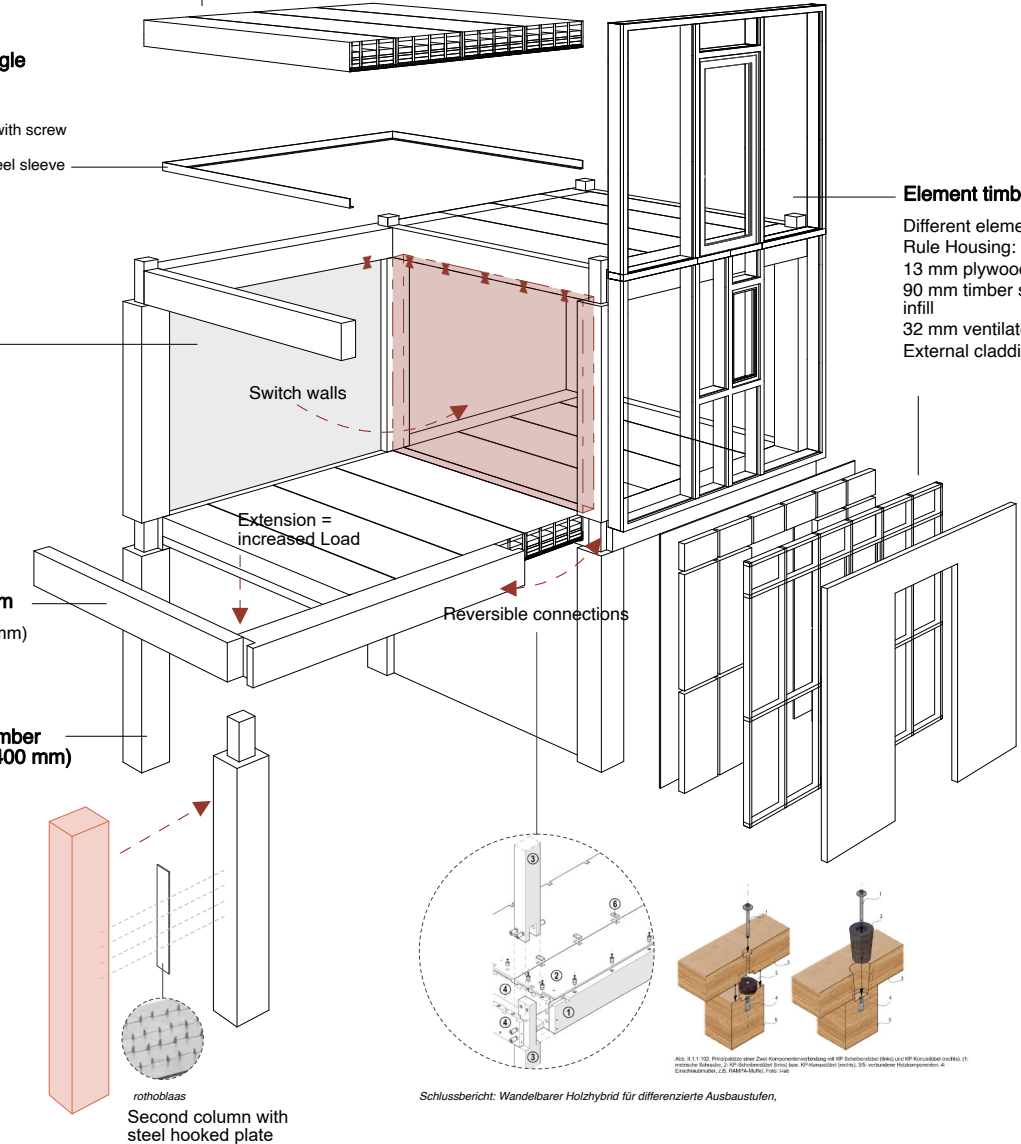
Timber stud partition wall (3525 x 200 x 2600 mm)

Closed stud system filled with mineral wool insulation to improve acoustic performance
Lightweight, modular construction
Easy installation and replacement of insulation panels

Co-planar beam system

with primary (400 x 400 mm) and secondary beams (400 x 200 mm)

Load bearing Timber Column (400 x 400 mm)



Element timber facade

Different element combinations
Rule Housing: One Panel must always be closed
13 mm plywood interior finish
90 mm timber stud framing with hemp insulation infill
32 mm ventilated cavity
External cladding facade

rothoblaas
Second column with steel hooked plate

Schlussbericht: Wandelbarer Holzhybrid für differenzierte Ausbaustufen.

Construction Type
Building - Component Hierarchy
Growth Strategy
(Dis)Assembly
Design Results

Part 3

Design through Research

Construction Type

In Open Architecture, Drexler compares different timber construction types, including skeleton, hybrid, and solid timber systems. The comparison evaluates aspects such as timber quantity, flexibility, usability, fire safety, acoustic performance, and building physics. **This evaluation was used to assess which structural principle would best support an adaptable and resource-conscious building strategy.**

Based on this comparison, a hybrid timber structure was selected. The skeleton structure from the *“Wandelbarer Holzhybrid”* report was used as a starting point, as it offers a clear and reversible primary load-bearing system. However, fixed wall elements were added to improve structural performance and spatial organisation. Through this adaptation, the system shifts from a pure skeleton structure towards a hybrid construction, combining the flexibility of a frame system with the stability of selected fixed walls.

Which construction type is the most efficient in using wood?

Global structural system	Timber volume per residential unit (m³)	Timber volume per living area (m³/m² LFA)	Comparison
Skeleton structure with solid timber floors	24,25	0,288	100% (Baseline value)
Hybrid structure: skeleton with solid timber floors and partially solid timber walls	28,23	0,33	114%
Solid timber construction	31,9	0,38	124%

Translated table by Drexler, p. 158

1. Timber Frame (Skeleton Construction)

Advantages

- High flexibility (easy to adapt layouts, walls, and functions)
- Material-efficient → lower cost
- Lightweight structure
- Supports reversible and modular systems

Disadvantages

- Poor acoustic performance (sound transmission via structure)
- Requires additional beams for load transfer
- Complex structural detailing (load concentration in columns)
- Needs extra measures for lateral stability (e.g. shear walls)

2. Hybrid Construction (Frame + Mass Timber Walls)

Advantages

- Balanced system: combines flexibility + structural performance
- Improved lateral stability (CLT walls provide stiffening)
- Better acoustic performance than pure frame
- Reduced structural complexity compared to pure frame

Disadvantages

- Partial loss of flexibility (fixed structural walls)
- More material use than pure frame
- Interface complexity (connections between systems)
- Some redundancy in load-bearing elements

3. Mass Timber Construction (Solid / CLT-based)

Advantages

- High structural efficiency (loads distributed through walls)
- Excellent stiffness and stability
- Good acoustic performance (due to mass)
- Simpler load paths (no need for separate beams/columns)

Disadvantages

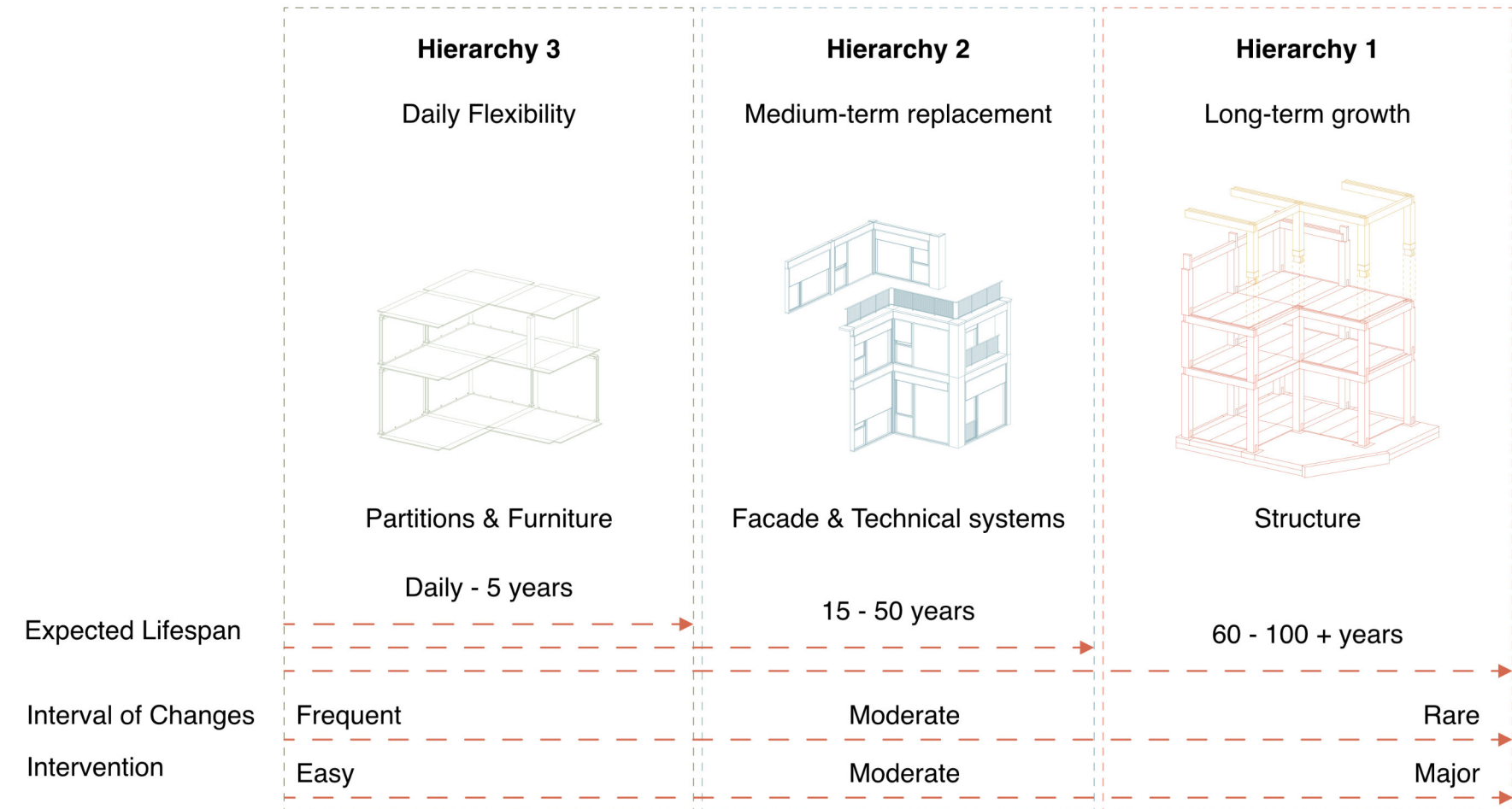
- Low adaptability (difficult to modify later)
- High material consumption → higher cost
- Less reversible / harder to disassemble
- Overdimensioning / redundancy possible




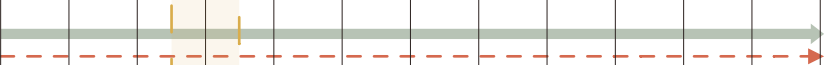



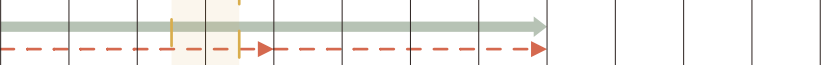

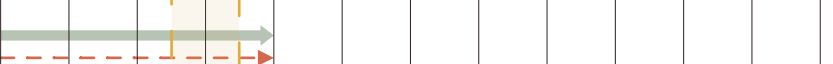



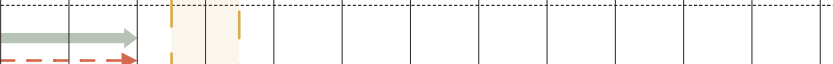

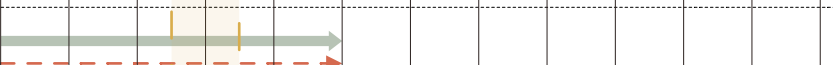

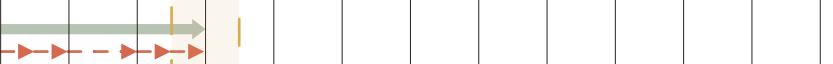



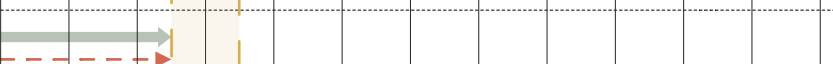
Conclusion

Most flexible & cheapest: Timber frame
 Best balance: Hybrid
 Most rigid & material-intensive: Mass timber

Summary of Drexler's Points on different Construction types

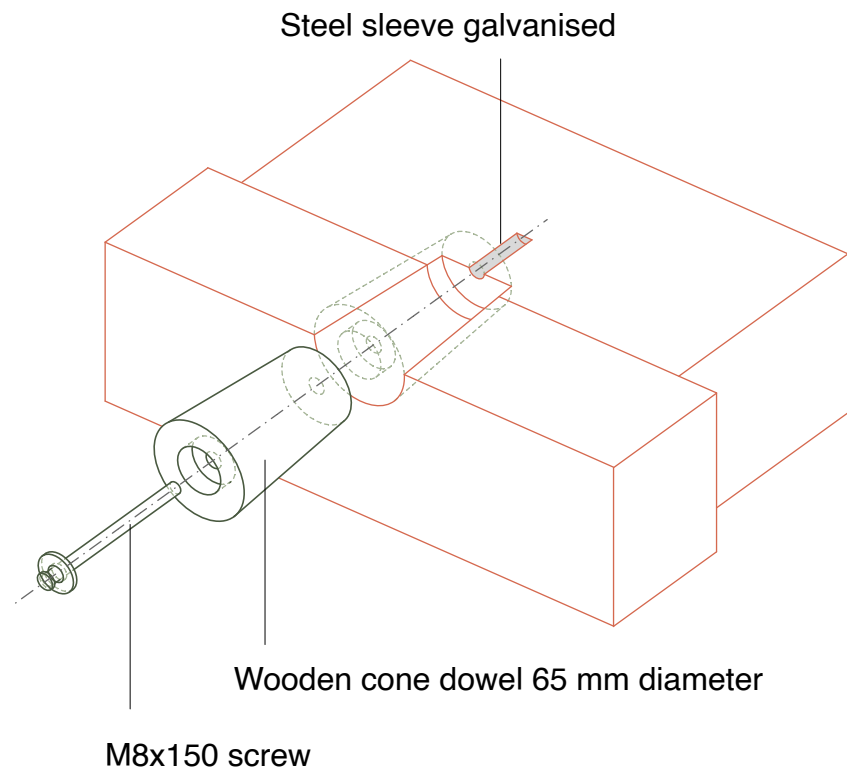
Hierarchy of Adaptability & Construction



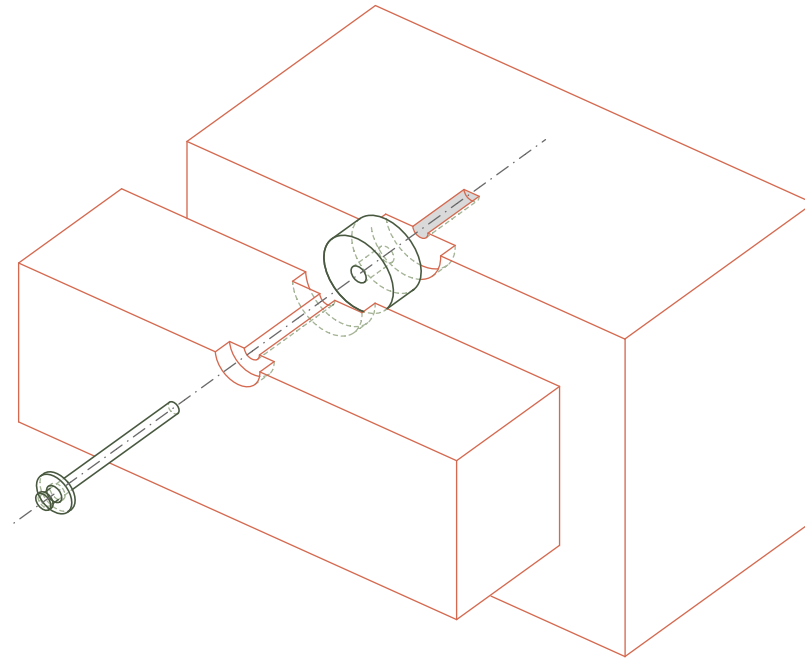
Hierarchy	Component Material	Maintenance Strategy	Repair Strategy	Replacement Strategy	Expected Lifespan (Years)	Adaptability score (1-5)	Strategic Intervention Window
1 Structural Framework Fixed	 Foundation: Concrete C30/37	Structural inspection only	Local concrete patching if needed,	Permanent; only through demolition		2	1 Static Difficult to replace part of primary structure 2 Repairable Local repair possible 3 Replaceable Component can be exchanged 4 Reconfigurable Spatial/ aesthetic layout can change 5 Expandable Supports future extension Notes Lifespan values are estimated and depend on material quality, maintenance, usage and
	 Columns & Beams: Baubuche LVL GL75, Spruce LVL GL 32, Spruce LVL GL 24	Regular dry inspection for moisture	Local timber reinforcing	Difficult, Interior fit out, Slab removal necessary,.		2,3,5	
	 Slabs & Core Walls: Spruce LVL GL 24, Hemp	Occasionally inspection for moisture	Localised panel strengthening	Interior fit out necessary to remove beforehand. Otherwise able to be removed		5	
2 Shell (Internal & external) Partially Flexible	 Facade Cladding: Larch	None required (natural silvering)	Individual board swap	Full facade skin renewal after lifespan		4	35-50 years Major renewal necessary Building adaptation 60+ years Structural inspection & Timber repairs if needed
	 Insulation & Fire Barrier: Hemp & Stone wool	Protected inside cavity; none	Only accessible during cladding replacement	Together with facade cladding		4	
	 Windows & Doors: Glass	regular cleaning & hardware oiling	Seal/hardware swap; individual pane replacement	Frame and glass assembly swap		4	
	 Sunshade: Pre-constrained polyester fabric	Annual wash with water and mild soap	Local cable/motor fixes	Fabric re-skinning at end of life		4	
	 Railing: Metal Mesh	Occasional cleaning	Local tension or tightening	Unbolt and swap elements		4	
3 Interior fit-out Flexible	 Interior Partition Walls: Spruce LVL GL32 & Hemp	None	Patching surface layers	Easy dismantling due to dry, non-bearing connection.		4	
	 Underfloor Heating & Electrical: Gutjahr IndorTec System, Tunel	System flushing; zero floor maintenance	Open flooring replace easily	Complete detaching from floor slab possible		3	
	 Flooring Surface: Oak Design Flooring	Damp-mop only; no sanding/oiling needed	Local plank swap via click/loose-lay system	Quick lift-and-replace process		3	

Reversible Main Connection

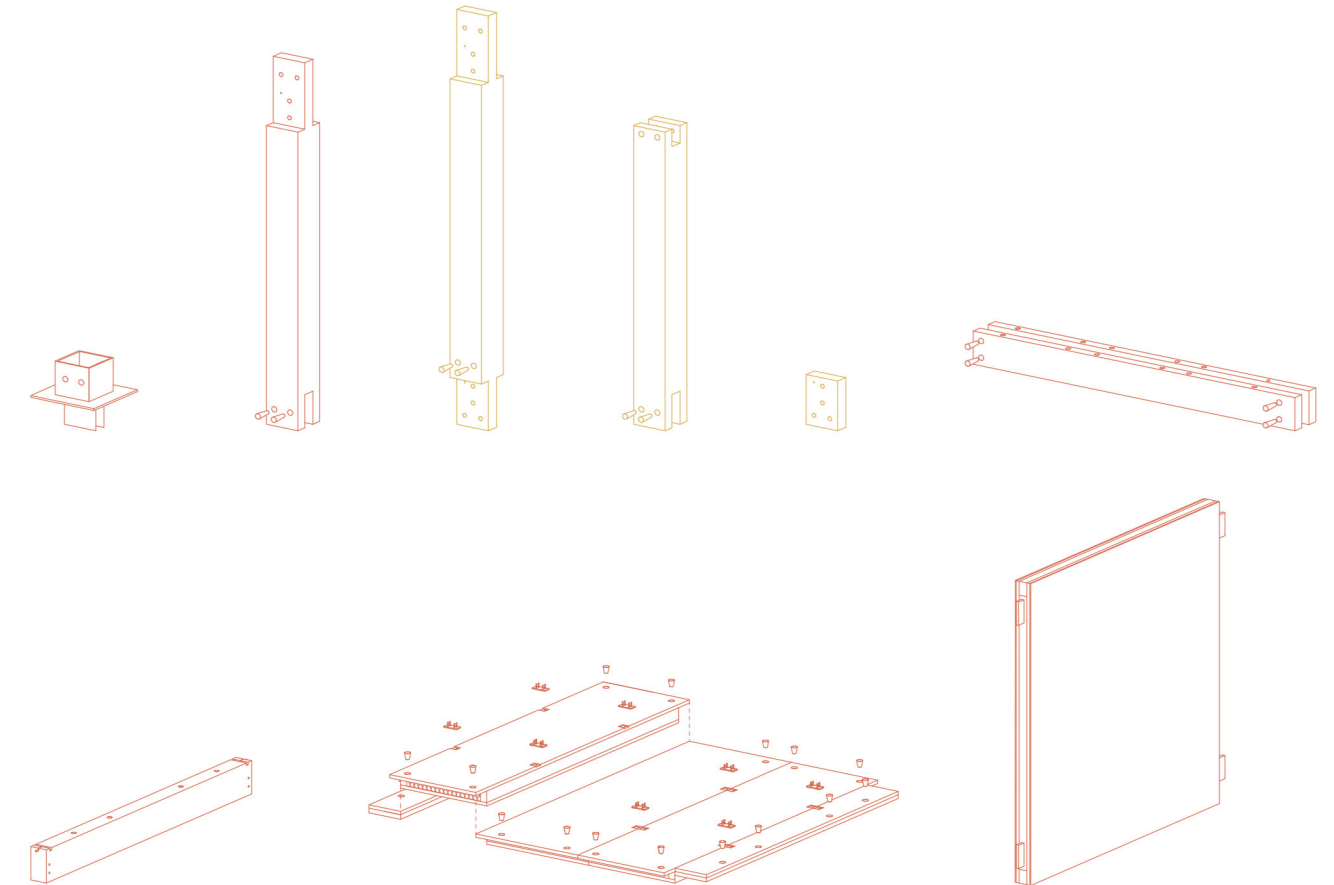
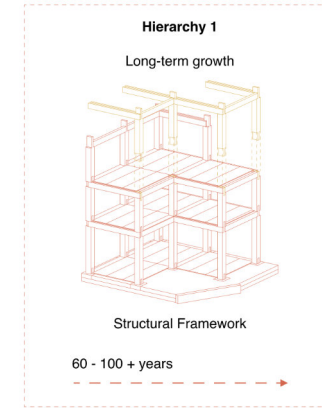
Visible Wooden Dowel connection



Hidden Wooden Dowel connection

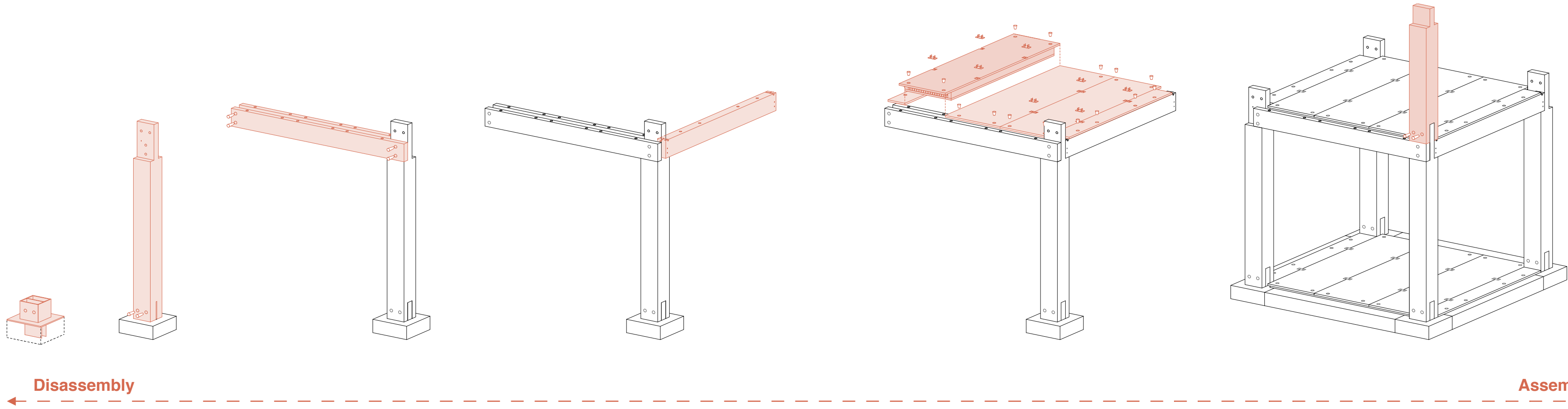


Hierarchy 1 - Structural Framework



Structural components

(Dis)assembly - Hierarchy 1



← Disassembly

Assembly →

Components

Steel foot in reinforced concrete

Timber Column 400x400 mm

Timber Beam in pairs 125x400mm

Timber Edge Beam 200x400mm

3 Timber Slabs 1295x3925x280 mm
With Hemp insulation 200 mm
Beam cover Timber plate 40 mm

Timber Columns connection to each other

Connection

Connected to existing Building

Connected to Foundation with 2 Cone dowels

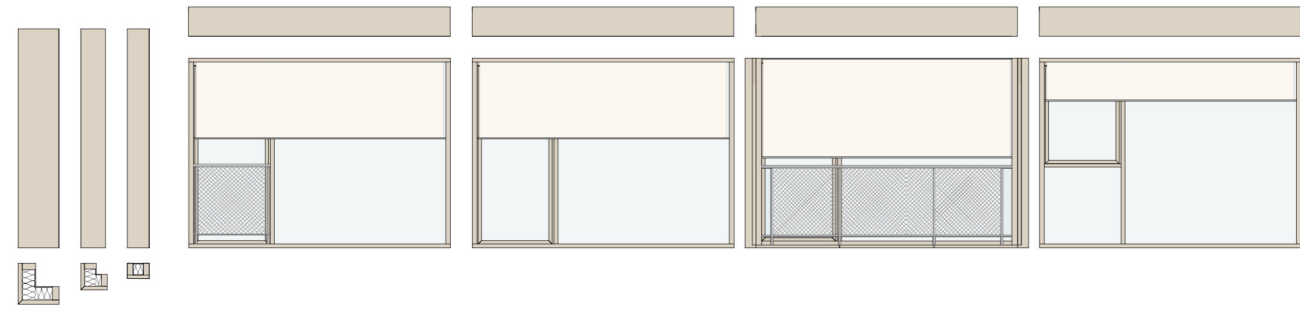
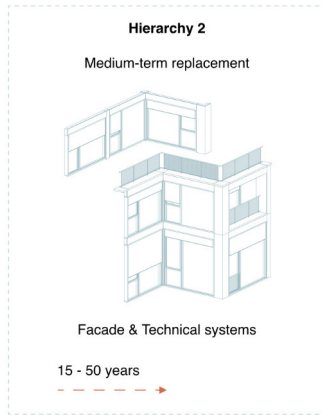
Connected to Column with 2 Cone dowels on either side

Connected to the Beam with 2 Screws and 1 screw in the Column

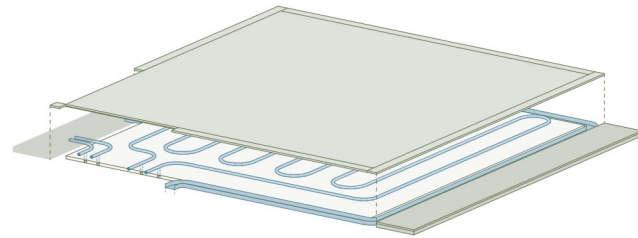
Connected to Beams with 2 Cone dowels on either side and wooden plate connectors to connect the slabs together

Connected to Column with 2 Cone dowels

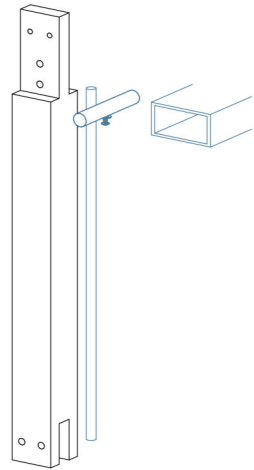
Hierarchy 2 - Facade & Technical Installations



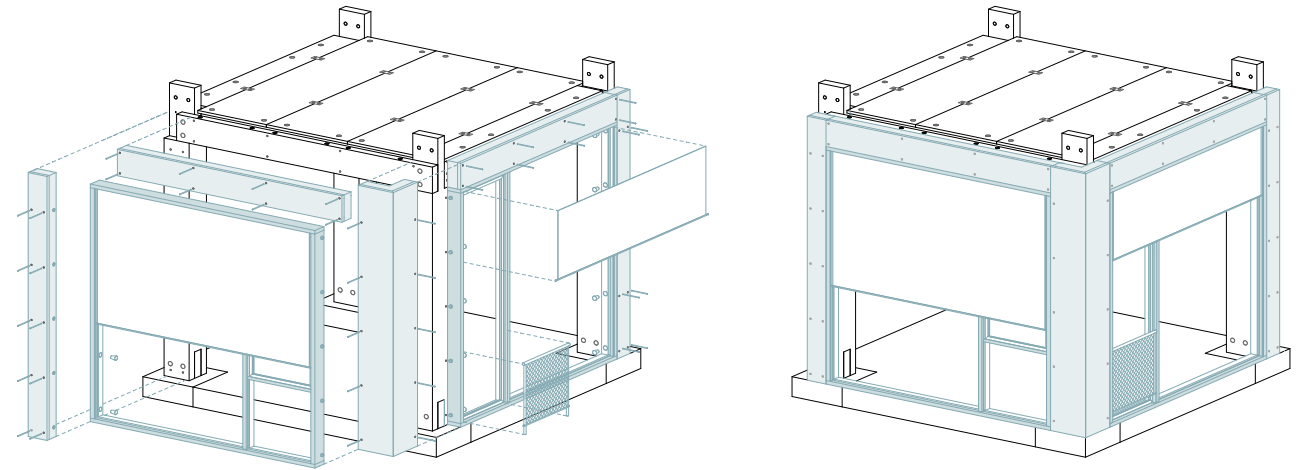
Facade Modules



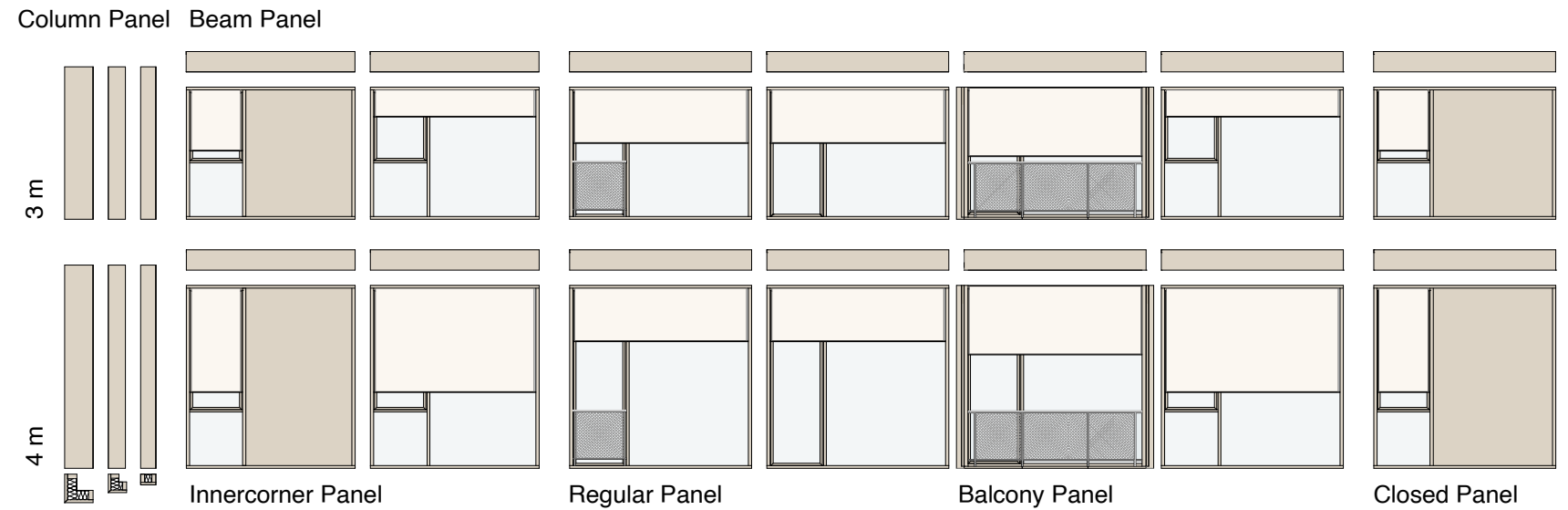
Technical Installations



(Dis)assembly - Hierarchy 2

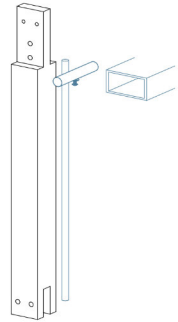
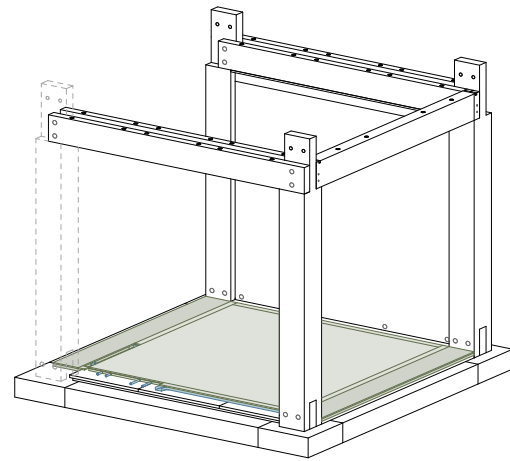
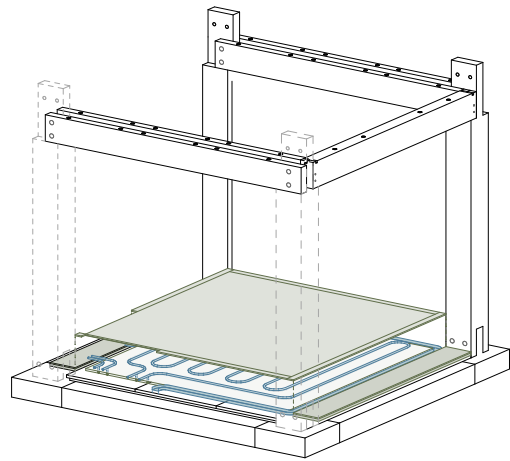


(Dis)assembly of different facade panels with
Outside: Hidden Wooden Dowel connection, Inside Visible Wooden Dowel



Facade Modules are always a combination of one Column Panel + Beam Panel + Facade Panel

(Dis)assembly - Hierarchy 2 + 3



Underfloor Heating and Cooling System by IndorTec®

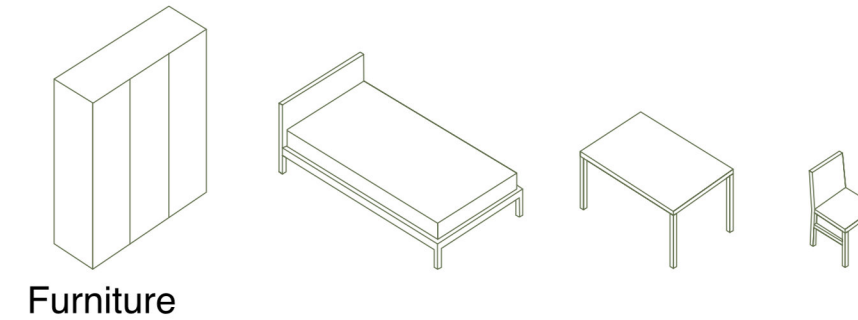
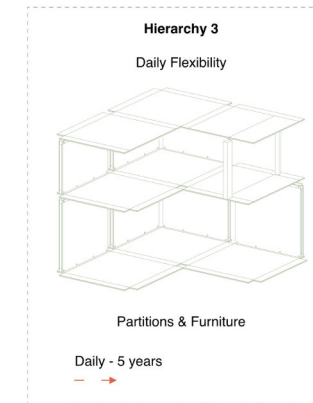
Floor Construction (43 mm):

- Design Oak Flooring
- IndorTec® THERM-E TD / TM / TW
- IndorTec® THERM-E BF floor sensor EU, 230 V
- IndorTec THERM-E heating cable
- IndorTec THERM-E carrier mat

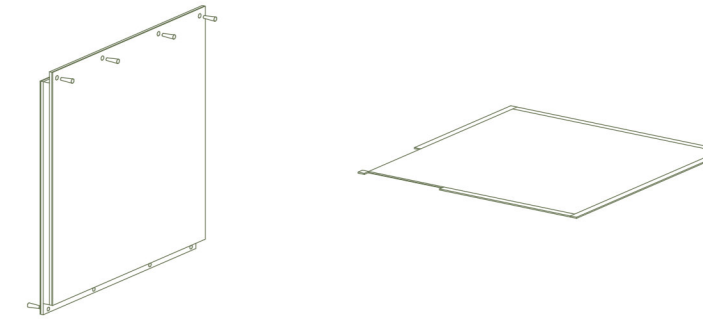
The floor system is glued to the structural slab. If replacement becomes necessary at a later stage, the upper timber plate of the slab can be removed and replaced without dismantling the entire structural floor system.

There are cable ducts for sockets along the outer edges of the floor. Everything is accessible and can be opened from the floor, allowing for an open-plan layout.

Hierarchy 2 - Partitions & Furniture

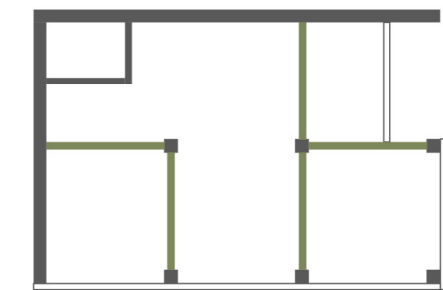
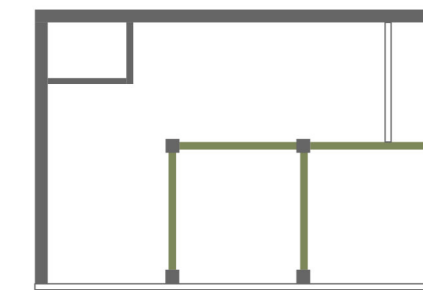


Furniture



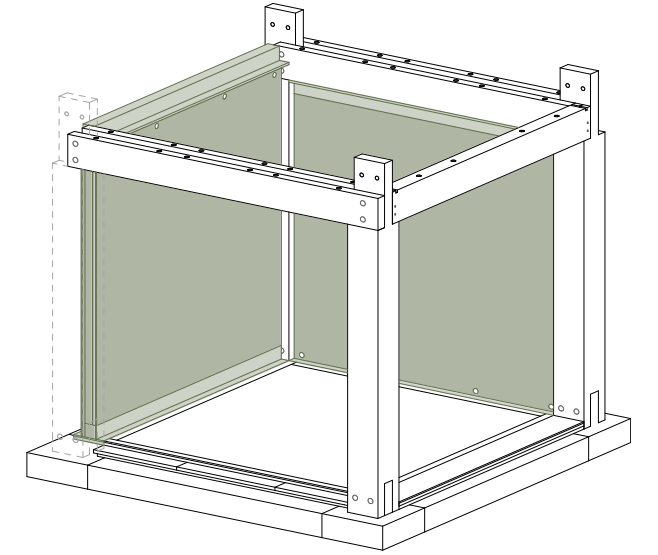
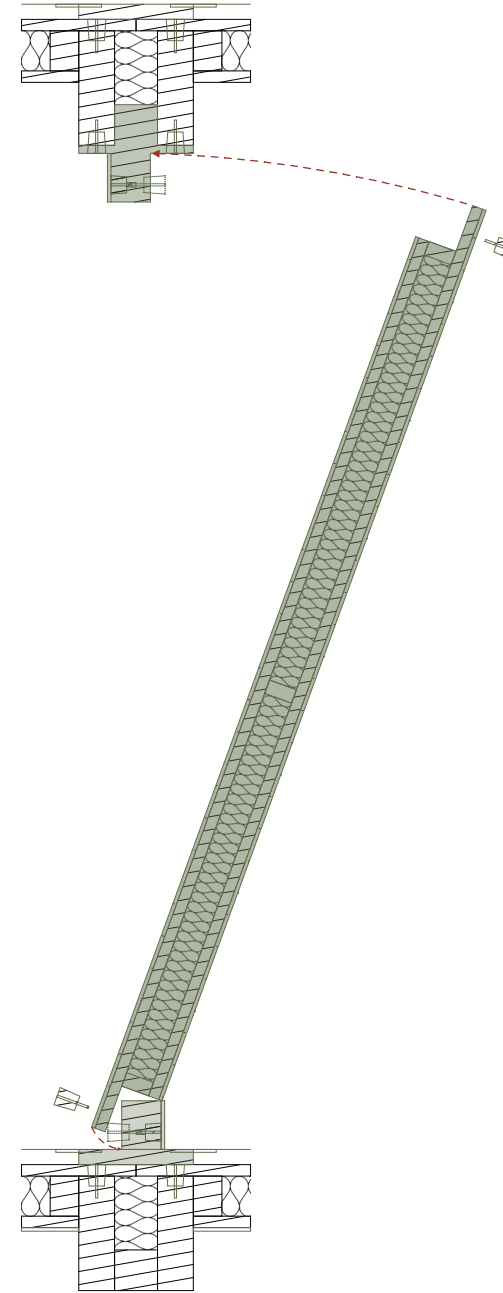
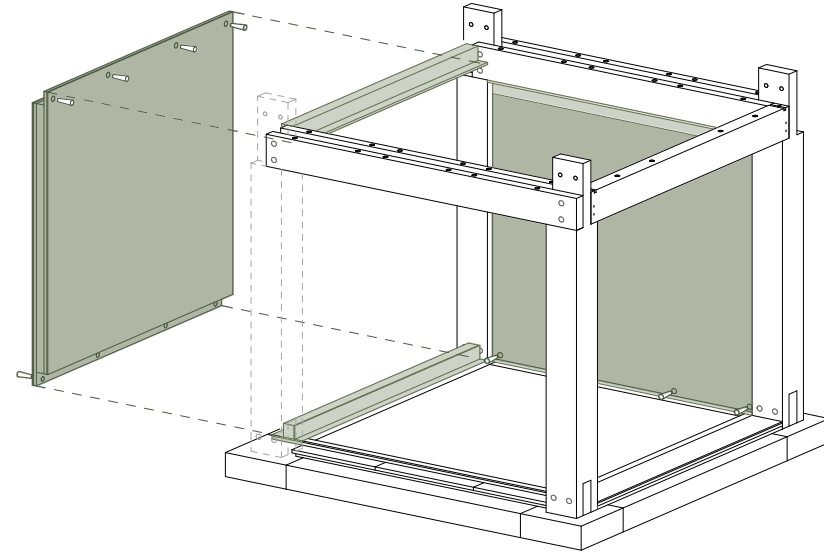
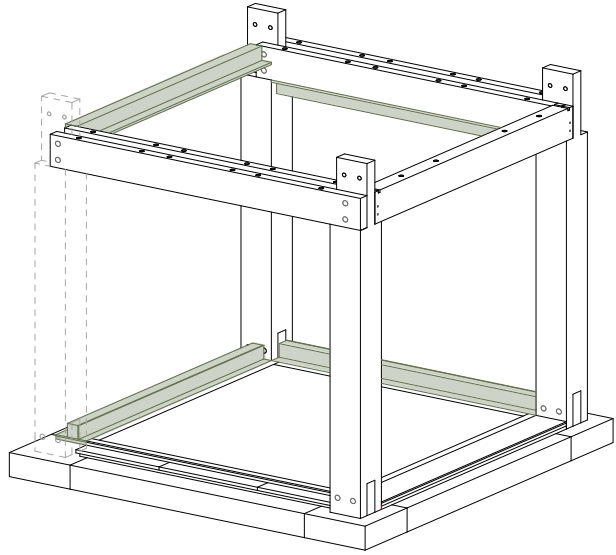
Wall

Flooring



Different Layout

(Dis)assembly - Hierarchy 3



Wall Construction (205 mm):

- Clayplaster board 12,5 mm
- Baubuche plate 40 mm
- Hemp insulation 100 mm
- Baubuche plate 40 mm
- Clayplaster board 12,5 mm

The Wall is connected via wooden dowels into to two attachments at the bottom and at the top. It is angled into it.

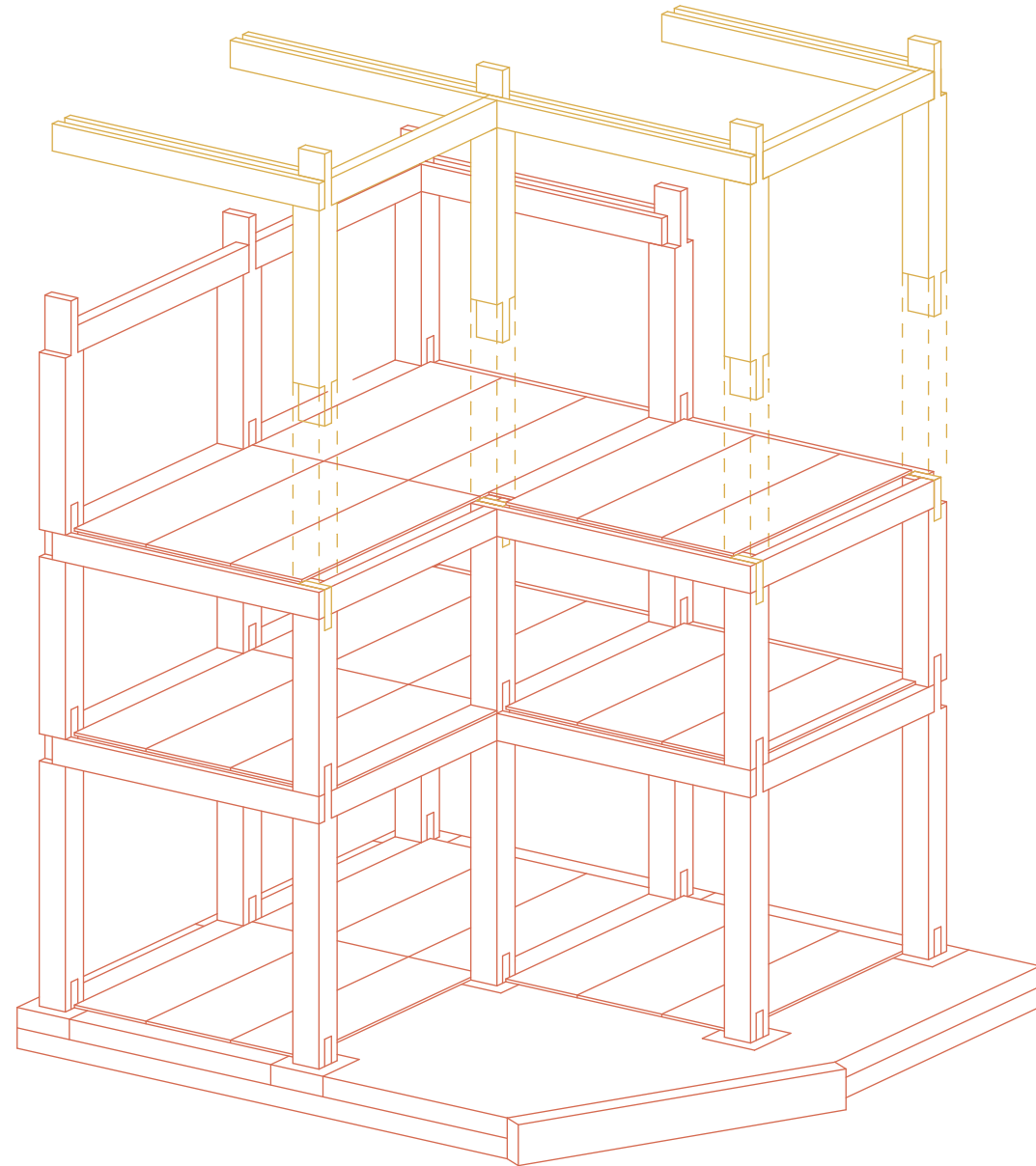
Growth Strategy

The structural strategy is developed from the idea that the building should be able to receive a future vertical extension of up to four additional storeys. This means that the primary timber structure has to be designed not only for the current building, but also for a possible future load case.

Two main aspects had to be considered: the additional weight of the extension and the fire safety performance of the timber structure. Since timber loses section during fire, a simplified radial charring rate of 0.7 mm per min was used to estimate the remaining column capacity after a 90-minute fire scenario.

Four strategies were therefore compared: adding: another column to the existing, Fire Safety Cladding, Sprinkler Strategy, and considering material density & weight. They were evaluated in terms of structural performance, architectural expression, reversibility, material use, and user impact during later interventions.

The aim was to keep the structure as adaptable as possible while reducing unnecessary overdimensioning and avoiding damage to the primary structure. A key criterion was that future extensions should not require major interventions inside the existing apartments. The following pages summarise the findings and explains why Option 3 and Option 4 were selected.



Possible later extension on top of the designed Construction

Option 1 - Column to Column

Structural Component

+ Direct vertical load transfer. Existing column grid can be reused.

– Requires many screws/connectors, approx. every 100 mm. Strong penetration of the existing timber column. Metal hook plates could transfer friction, but mainly in one direction, so additional fixing is still required. High risk of damaging the existing column and reducing its reuse potential.

Aesthetic / Architectural Component

+ Clear and readable structural logic.

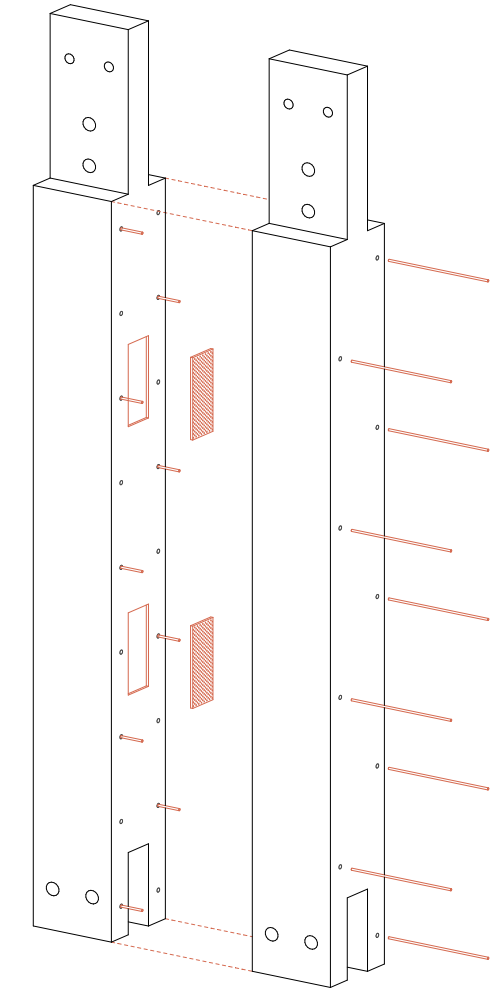
– Dense fixings create a heavy technical appearance. The original timber expression is damaged.

Later Intervention / User Impact

– Requires access to every column. Fixed walls, flexible partitions, finishes, and interior fit-out would be affected. Major intervention inside apartments. Future disassembly is possible, but leaves heavily penetrated timber.

Overall Assessment

This option has a clear structural logic, but it is too invasive. It damages the existing timber, affects the interior, and requires major disruption for users.



Column connected with Steel hooked plate and screws

Option 2 - Fire Safety Cladding

Structural Component

+ Existing column remains largely in place. Improves fire resistance by adding protected or sacrificial depth.

– Timber cladding still requires many screws/fixings. Fixings penetrate the existing column. The cladding must be carefully detailed against separation, buckling, or failure. Mainly improves fire safety, not structural adaptability.

Aesthetic / Architectural Component

+ Can keep a coherent timber expression. Could also be done with clay boards, gypsum fibre boards, or other protective fire layers.

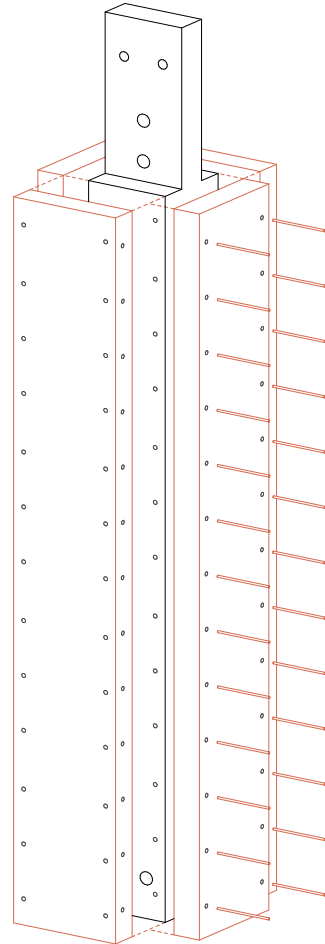
– Increases column dimensions and reduces spatial clarity. The column becomes visually heavier.

Later Intervention / User Impact

– Still requires access to every existing column. Interior walls, apartment layouts, finishes, and usable space are affected. Construction work would disturb occupied apartments.

Overall Assessment

This option solves part of the fire safety problem, but it still requires intervention inside the existing building as well as overdimensioning.



Column clad with Timber posts 100x500 mm, other cladding would be with less screws and thinner material

Option 3 - Sprinkler

Structural Component

+ Column keeps its 90-minute fire dimension based on radial charring.

+ Sprinkler prepares the column for future extension, when its capacity is more fully used. With that the infrastructure is already integrated before the future extension occurs.

– Partly redundant in the current phase.
– Depends on maintenance, inspection, and reliable technical operation.

Aesthetic/Architectural Component

+ Timber remains visible.

+ No later fire-protection cladding around every column.

+ The structural expression stays clean and readable.

– Sprinkler pipes and technical elements need careful visual integration.

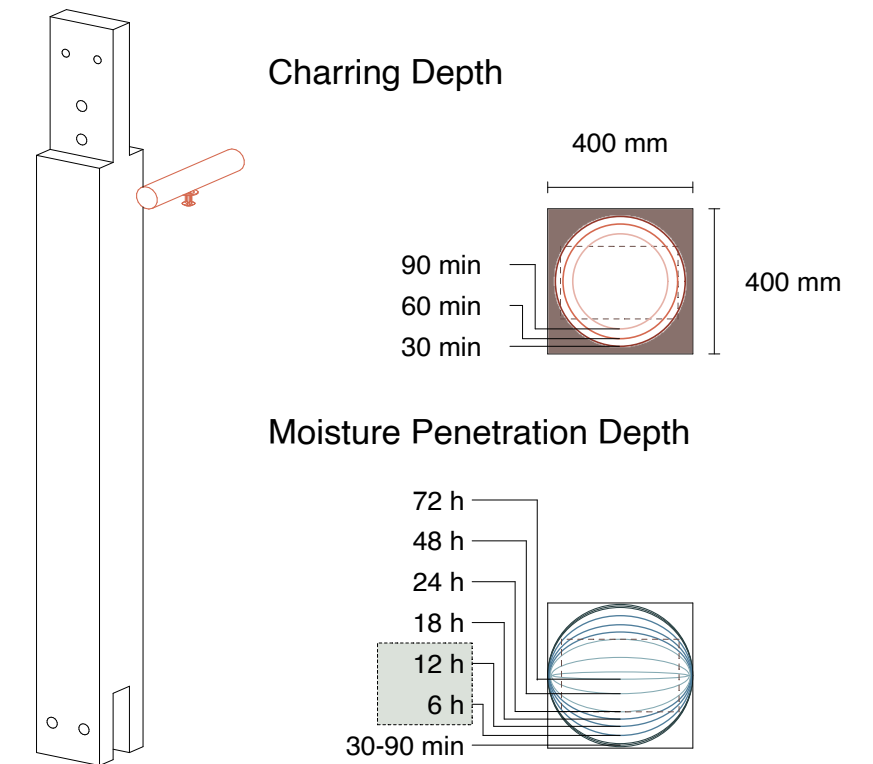
Later Intervention / User Impact

+ Rather integrate the sprinkler system from the beginning than to retrofit later as it would require opening floors, ceilings, walls, and service zones again.

+ Existing infrastructure reduces later intervention in occupied apartments.

– Water exposure after activation must be managed.

– Zoning, monitoring, fast drying, and inspection are necessary.



Comparison: Loss of structural integrity (Baubuche LVL GL75) due to Fire or Water exposure

Overall Assessment

The strategy accepts planned redundancy in the current phase: the column is already dimensioned for 90 minutes, and the sprinkler adds another protection layer. This early integration avoids disruptive retrofitting later. In a future extension scenario, the column carries more load, so fire-related section loss becomes more critical. Water exposure is more manageable than fire damage, as fast drying can often restore timber moisture levels and avoid immediate column replacement. Inspection after activation is still necessary.

Option 4 - Material density & weight

Structural Component

+ Uses stronger and denser timber only where structurally needed. BauBuche GL75 can carry higher loads in the lower storeys. Spruce GL32 and GL24 reduce weight in the upper storeys. This reduces total added load and makes further vertical growth more feasible. Creates a hierarchy: strong below, light above.

— Different timber grades and densities require coordinated connection detailing. Transitions between BauBuche and spruce must be checked for load transfer, deformation, fire resistance, and moisture behaviour.

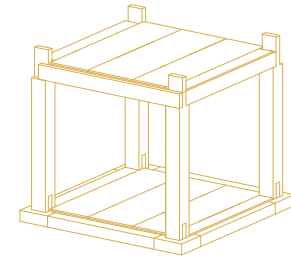
Aesthetic / Architectural Component

+ The structure can remain visually calm and consistent. The material hierarchy can express the logic of growth: heavier and stronger below, lighter above.

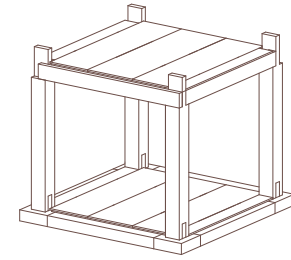
Later Intervention / User Impact

+ Mainly affects the new extension rather than the existing apartments. Reduces the load transferred to the existing building. Supports future vertical extension without excessive strengthening below.

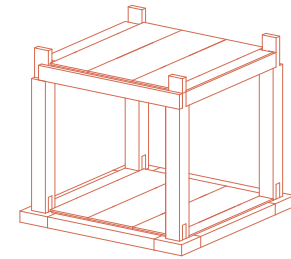
– Future adaptations require clear documentation so the material hierarchy is understood.



$$5,36\text{m}^3 \times 380\text{kg/m}^3 = 2036,8\text{kg}$$



$$5,36\text{m}^3 \times 440\text{kg/m}^3 = 2.358,4\text{kg}$$



$$5,36\text{m}^3 \times 730\text{kg/m}^3 = 3.912,8\text{kg}$$

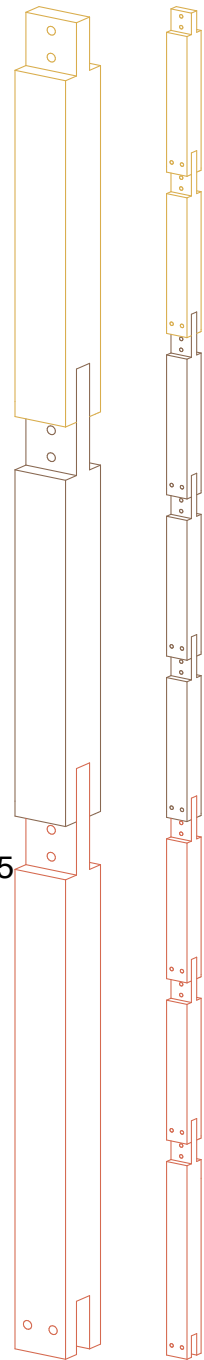
Overall Assessment

This option is structurally and conceptually strong because it uses material where it is needed most. Heavy, strong timber is placed below; lighter timber is placed above. This reduces load and supports future growth. The main challenge is the complexity of connections, documentation, and material-specific fire and moisture behaviour.

Spruce LVL GL24
385 kg/m³
47% lighter

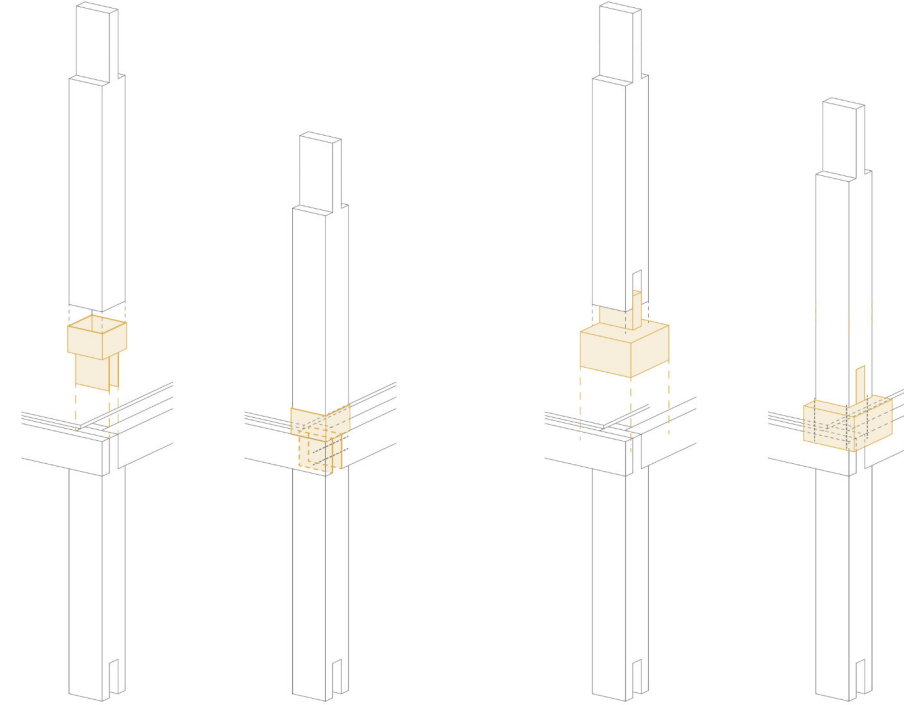
Spruce LVL GL32
440 kg/m³
40% lighter

Baubuche LVL GL75
730 kg/m³
100%



Order of Wood species in Stories

Connection between Columns



Steel foot

inserted in existing structure fixed with the same cone dowel on the side of the beam.

+ Connection is stable

– Wood has to be cut away for insertion

Wooden foot

placed on existing structure fixed with wooden cone dowel from above into beam and column underneath.

– Very massive, connection not necessarily fixed

– Drilling into existing structure is not the best solution for Dissassembly and Longevity

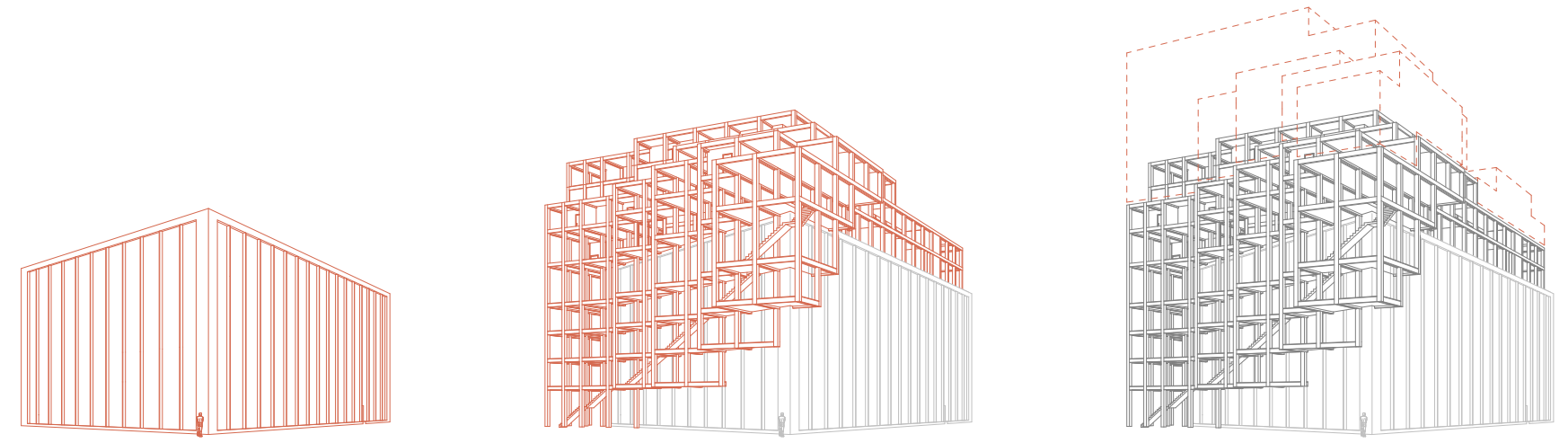
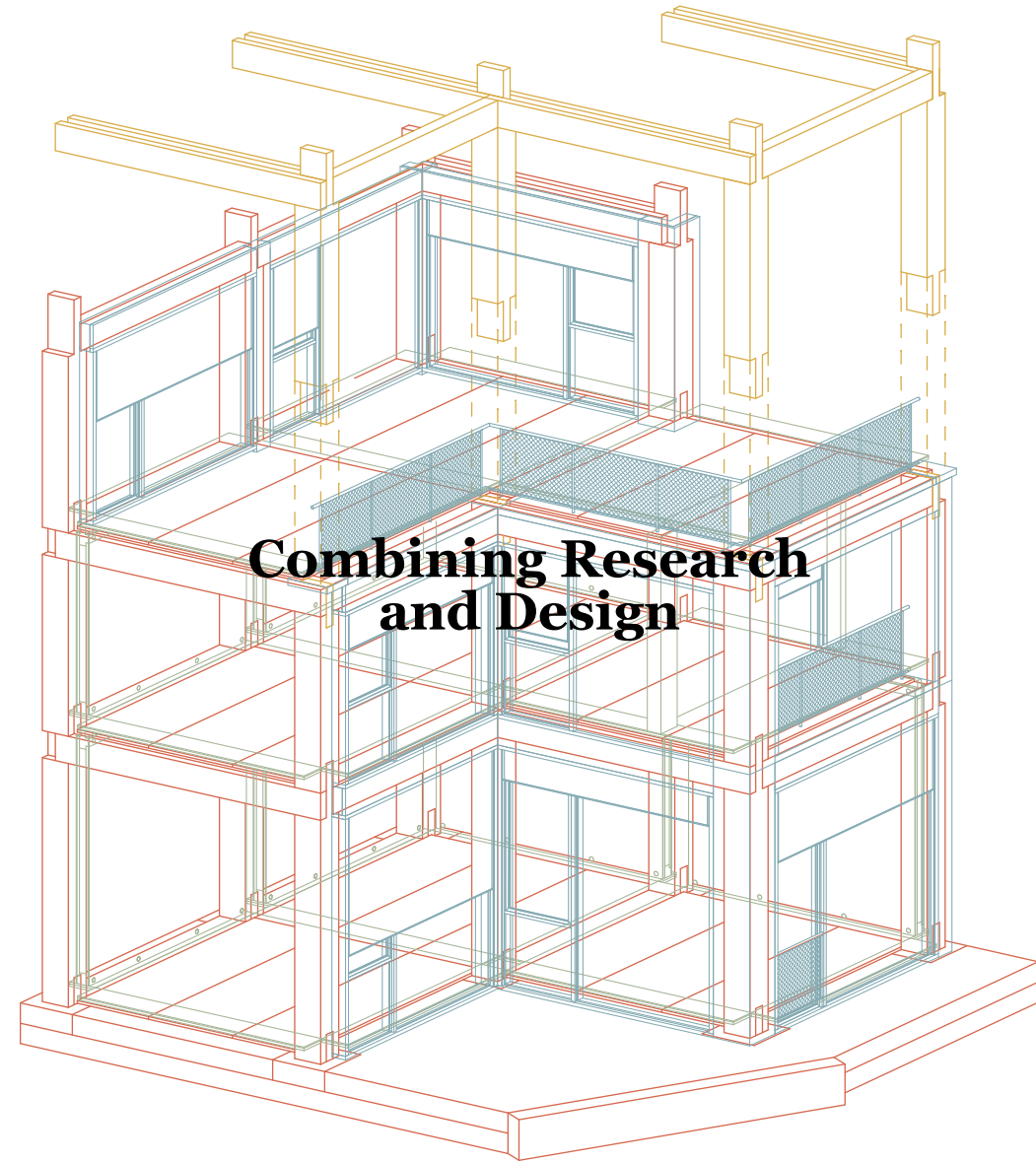
Wooden adapter*

Previous installed wooden adapter for End column. The adapter can be taken out to accommodate a new column. The connection from the top of the original column is reversed and is connected with the Wooden cone dowels.

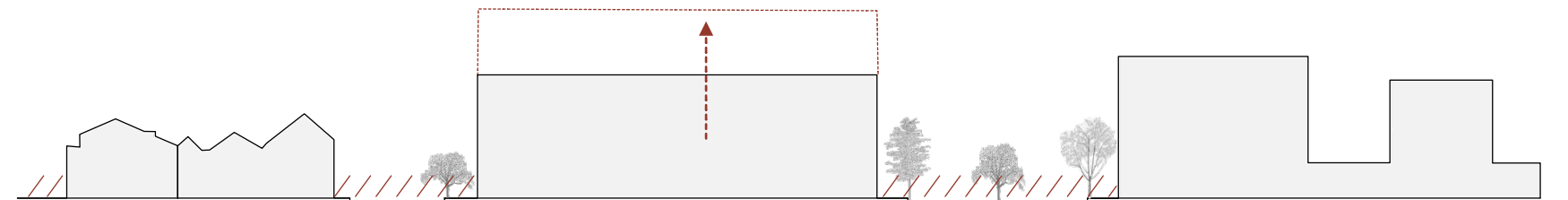
+ Same wood to wood connection

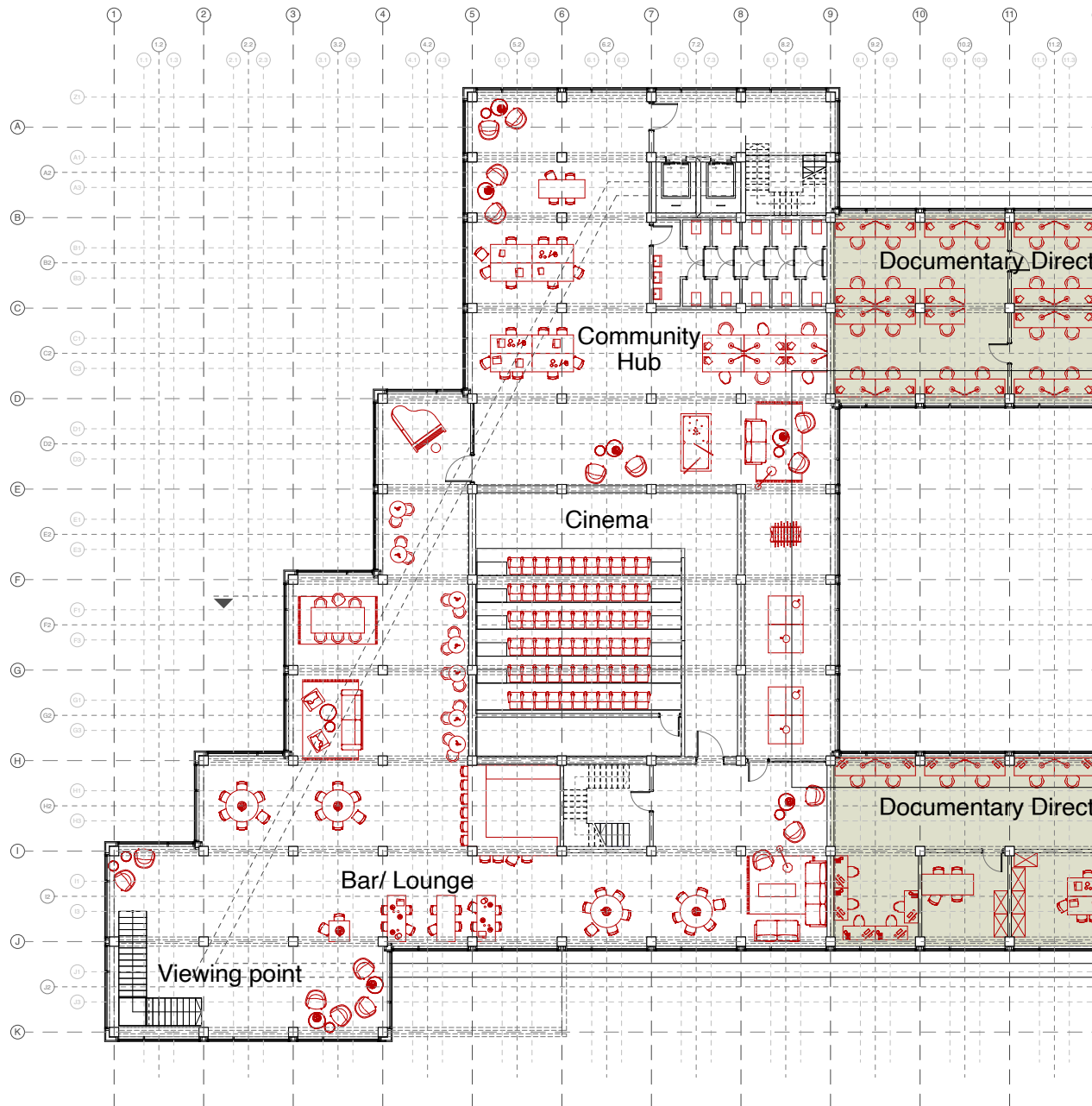
–/+ Accessibility has to be accomplished

Evolving Building

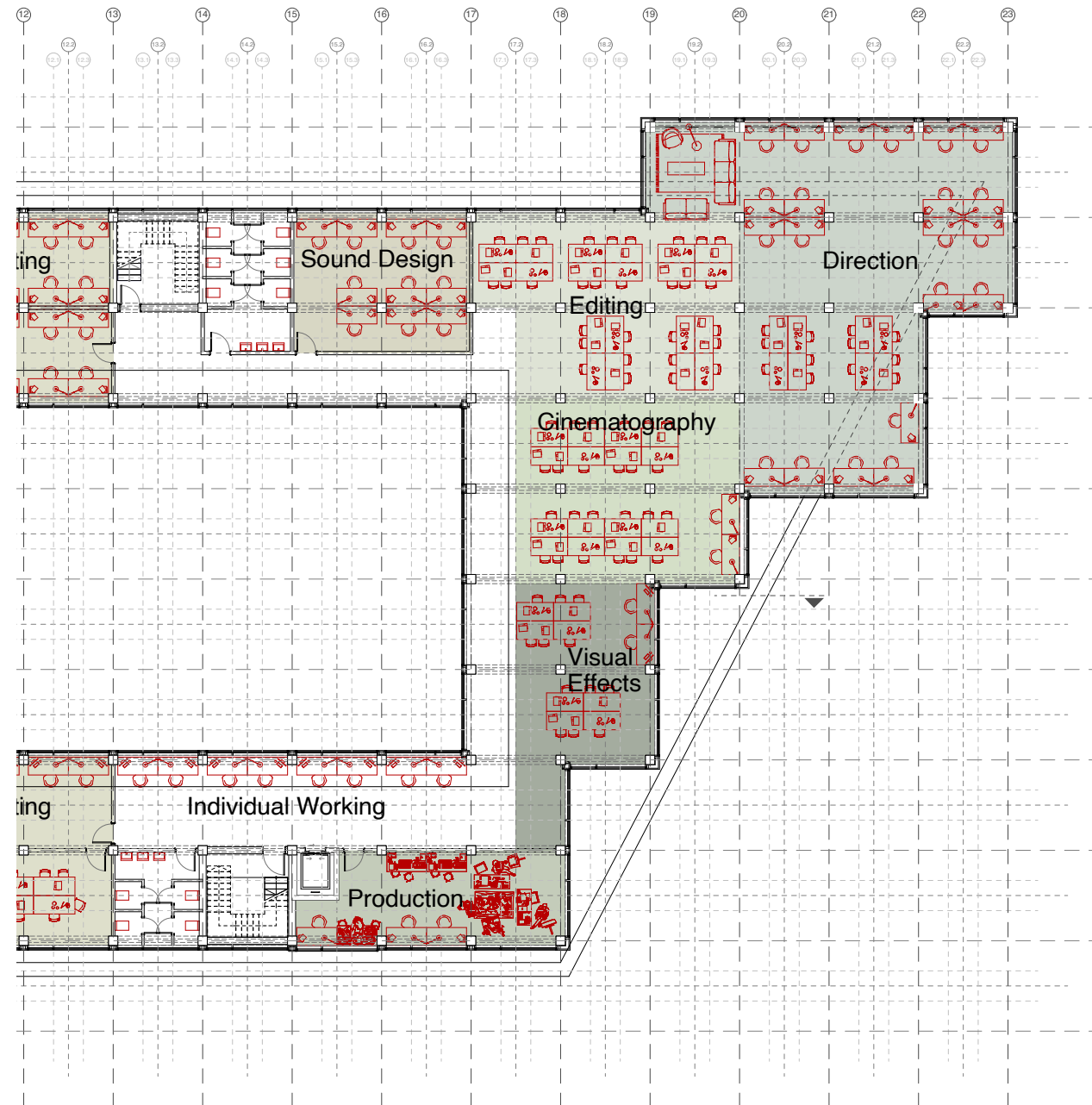


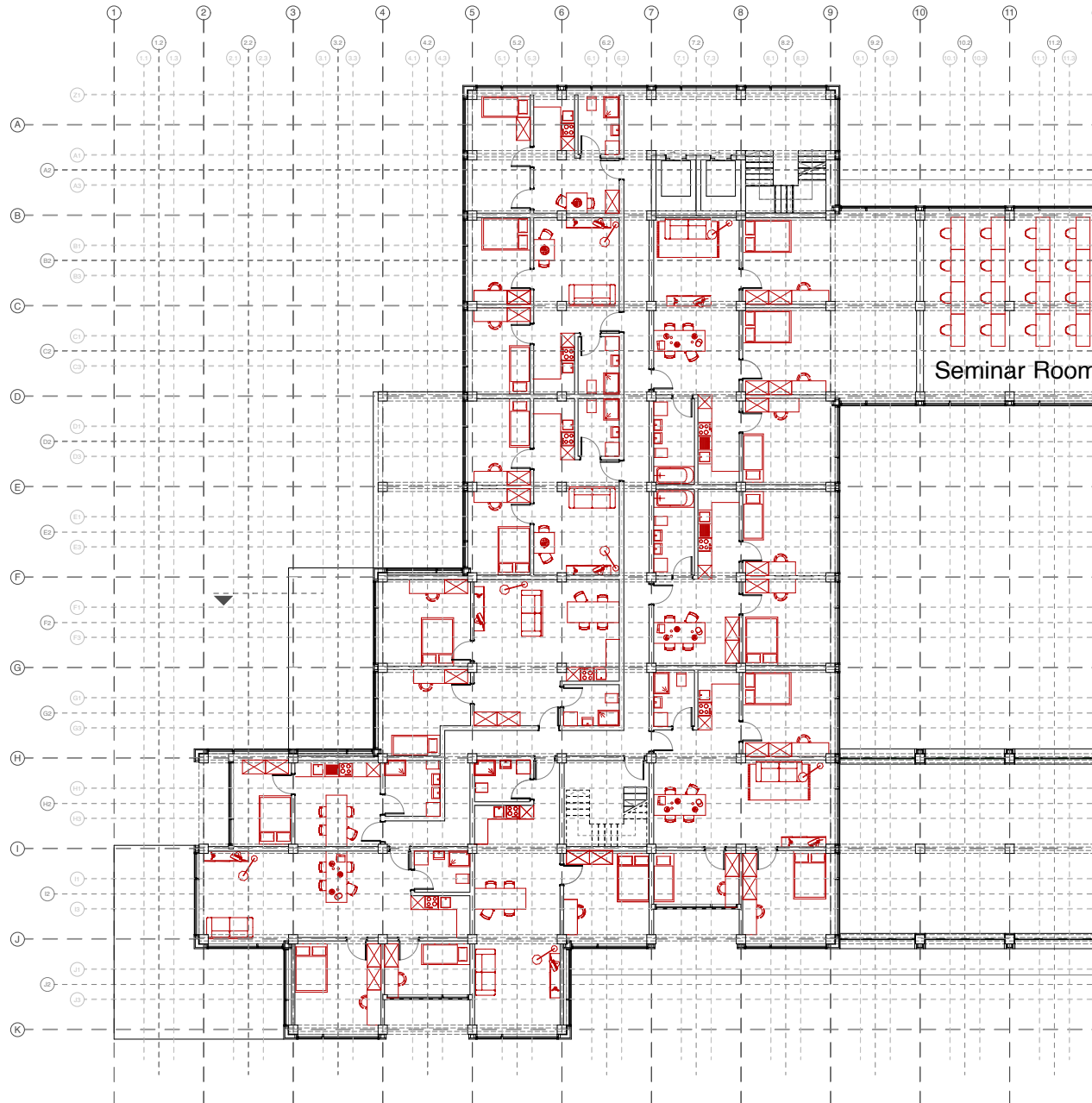
Existing → Extension → Future Extension



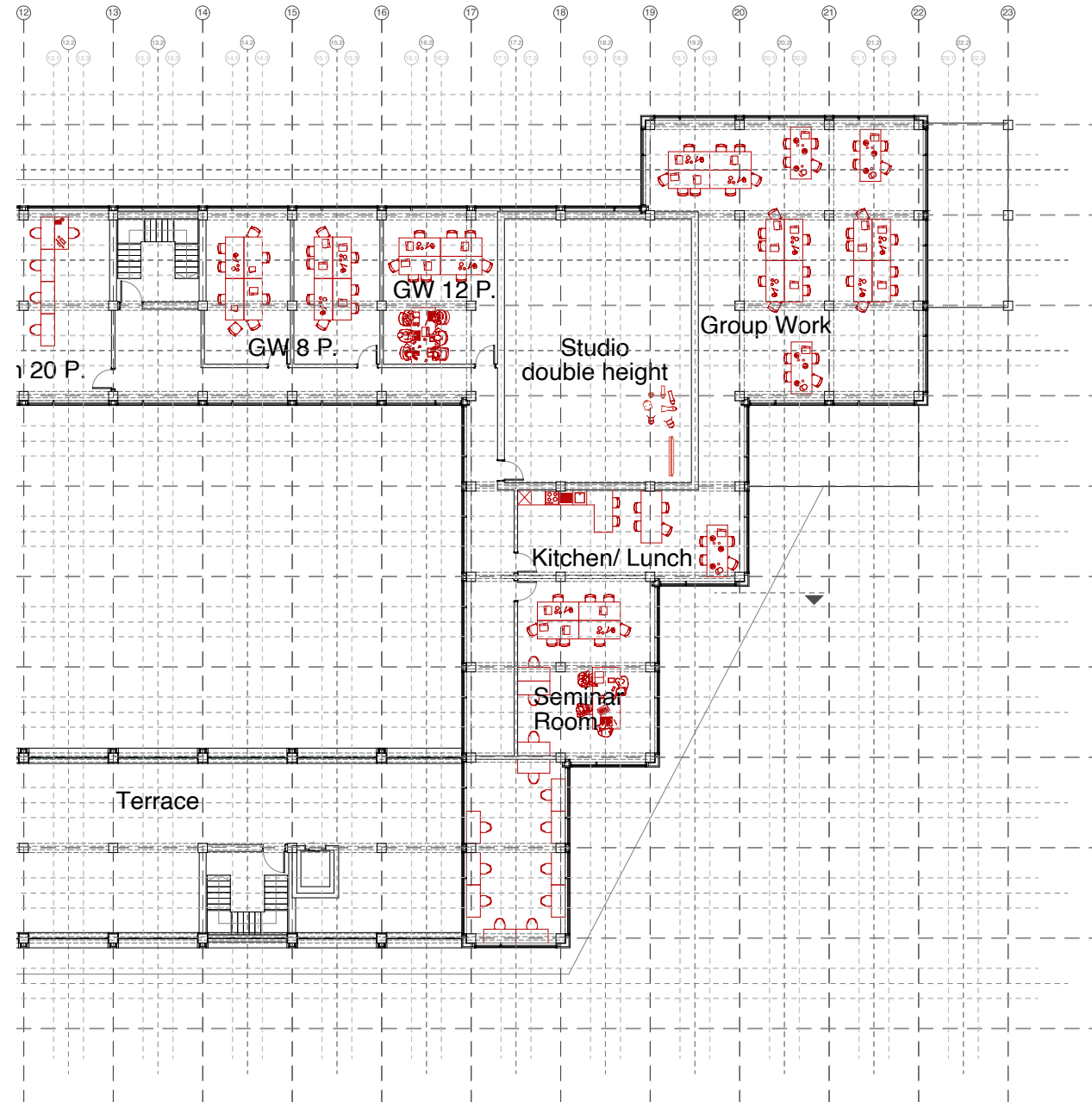


Groundfloor





1. Floor





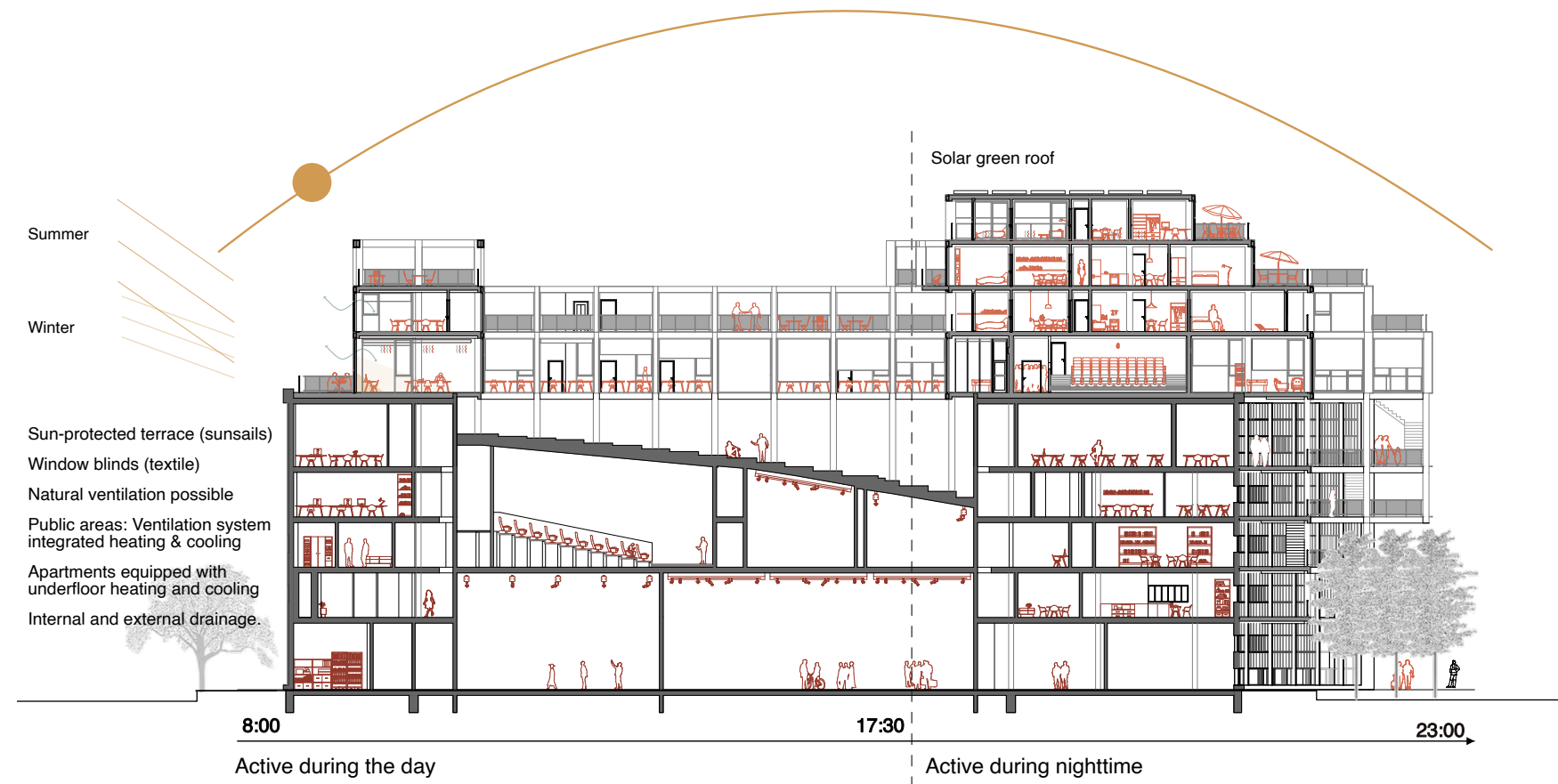
Urban Section South side



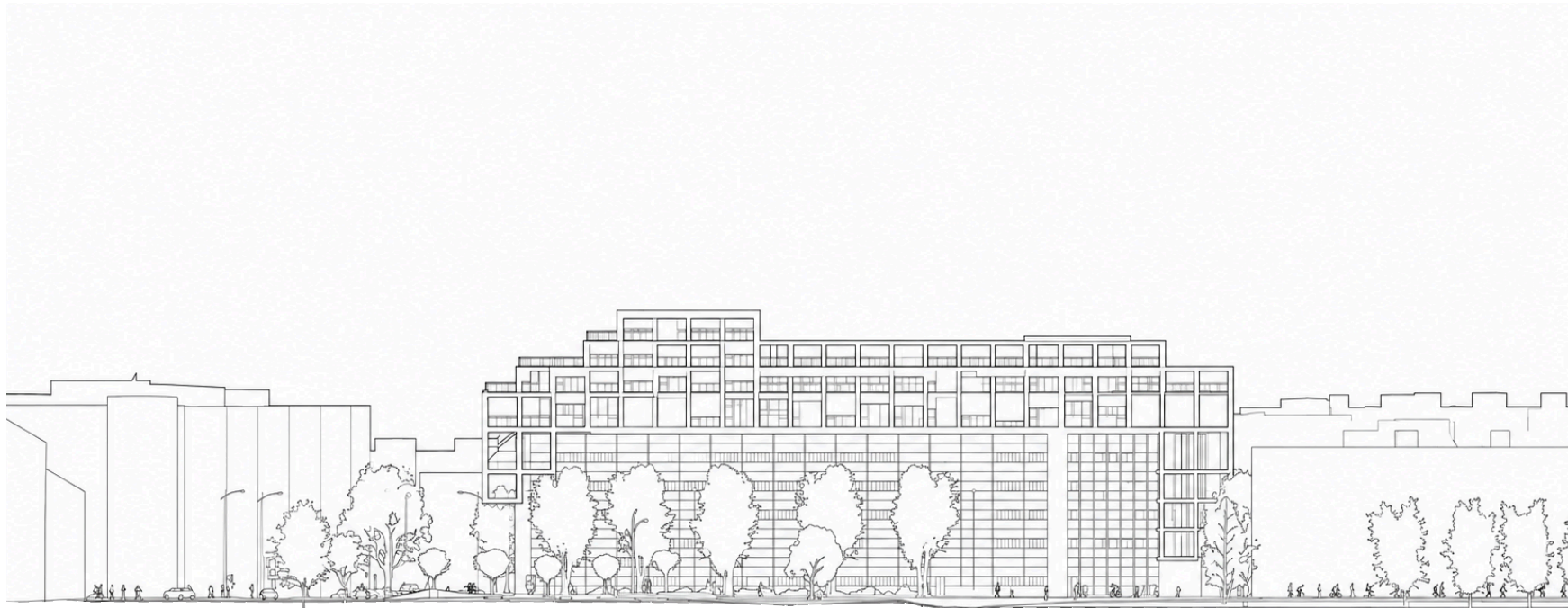
Urban Section West side



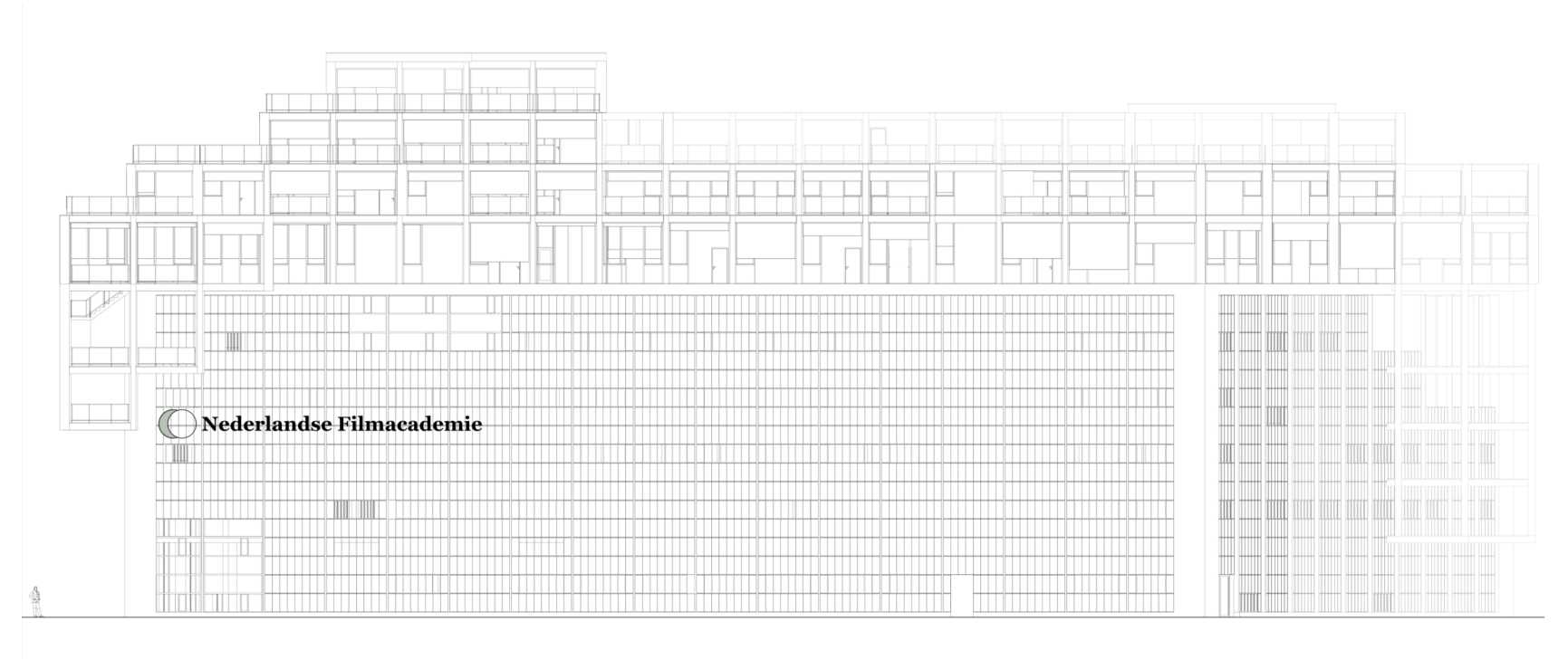
Spatial Organisation



Occupation



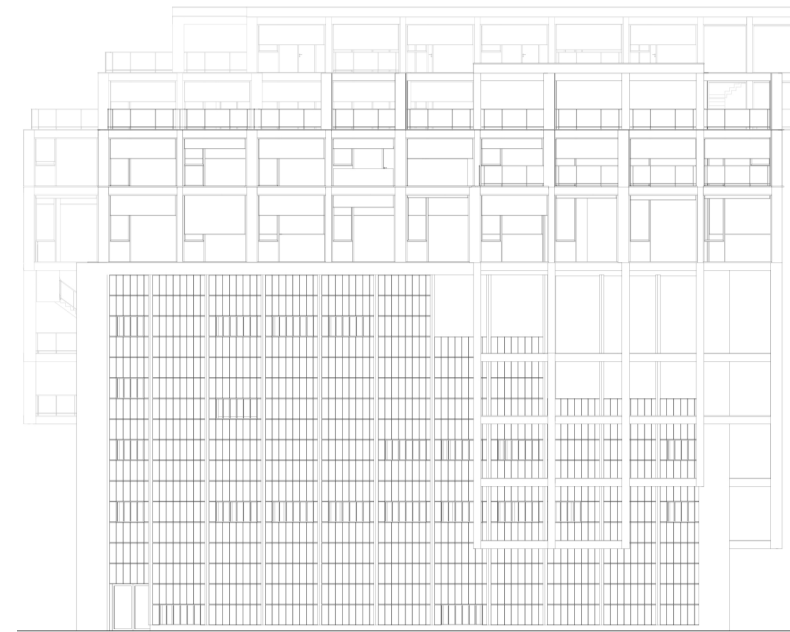
Elevation South side with context



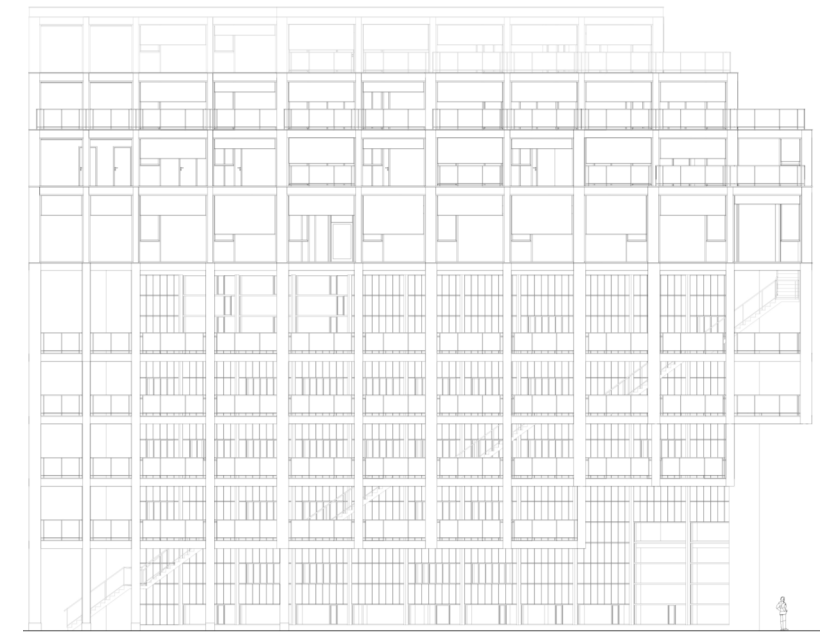
Elevation South side



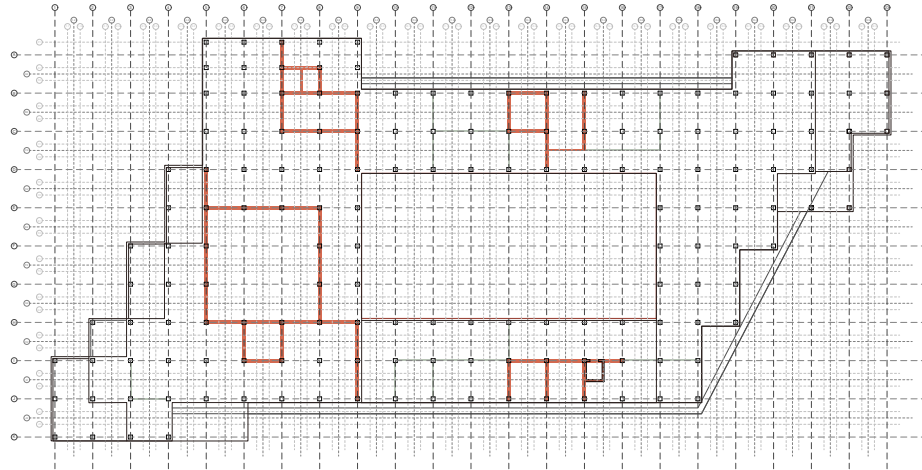
Elevation West side with context



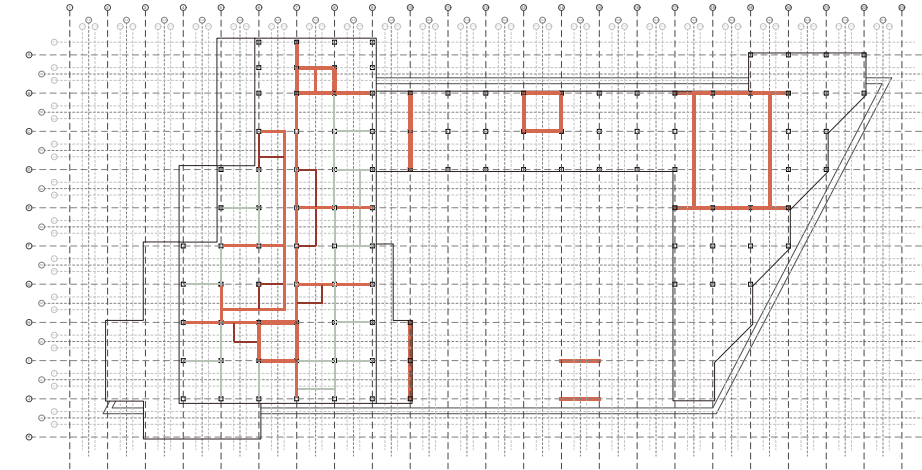
Elevation East side



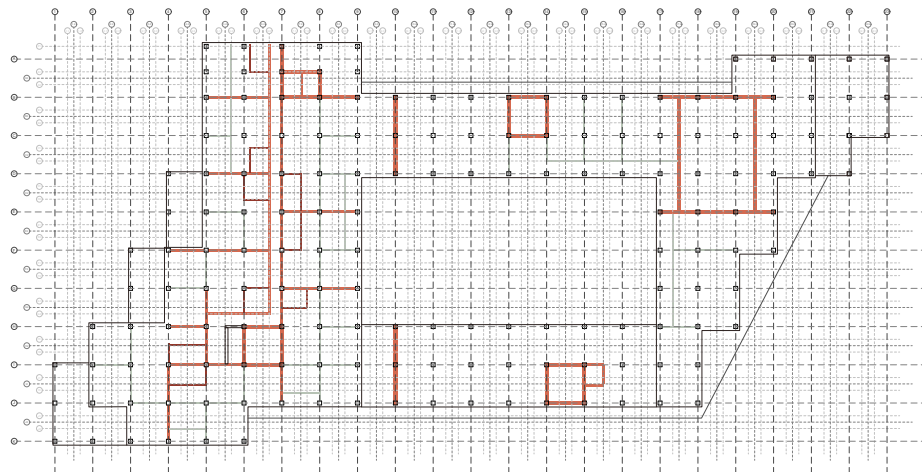
Elevation West side



Groundfloor

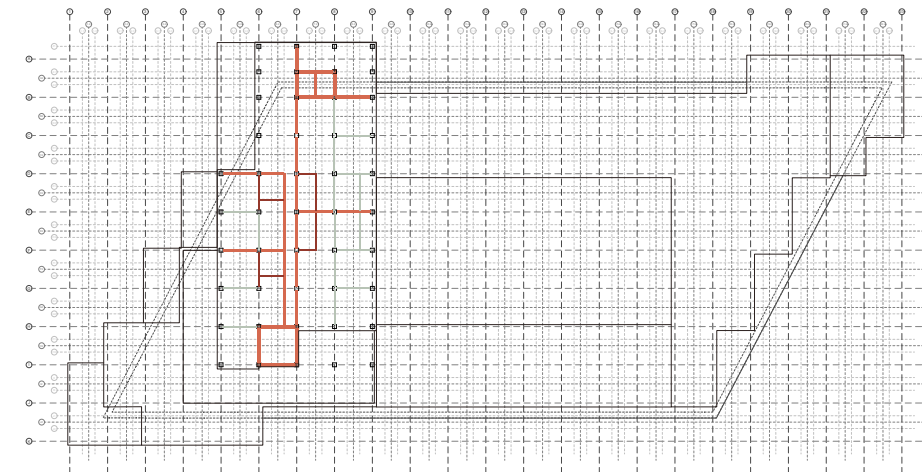


2. Groundfloor



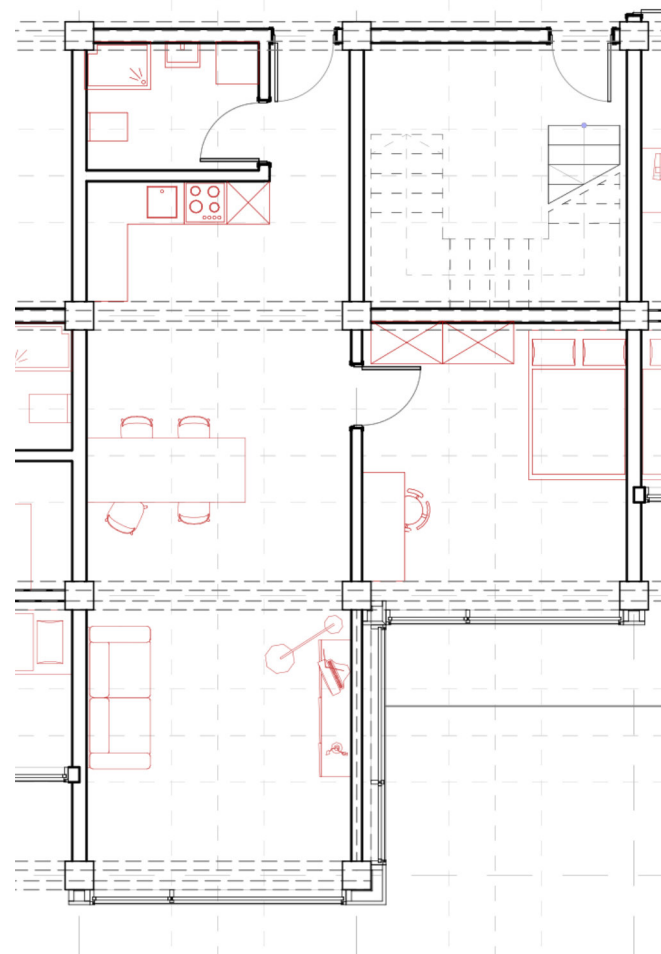
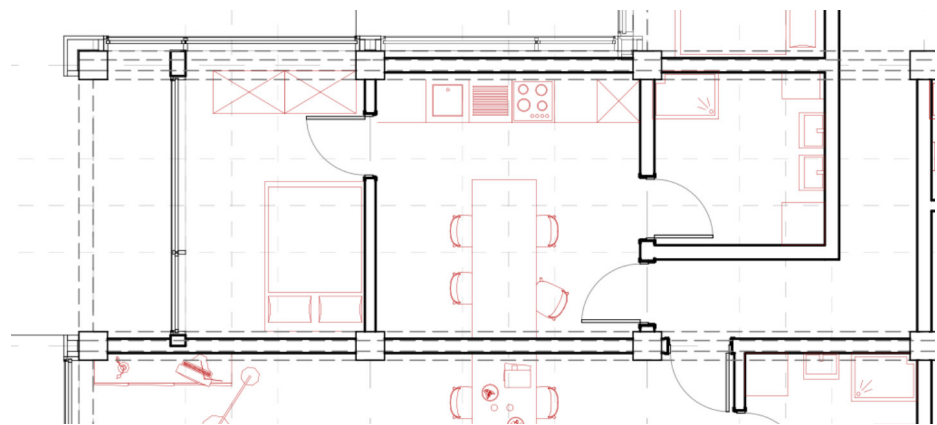
1. Floor

█ Fixed Load Bearing Wall
█ Flexible Interior Wall

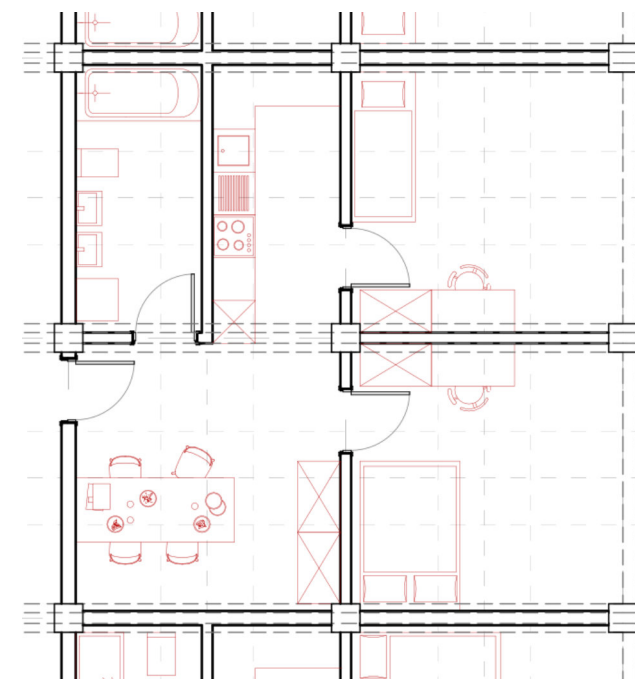
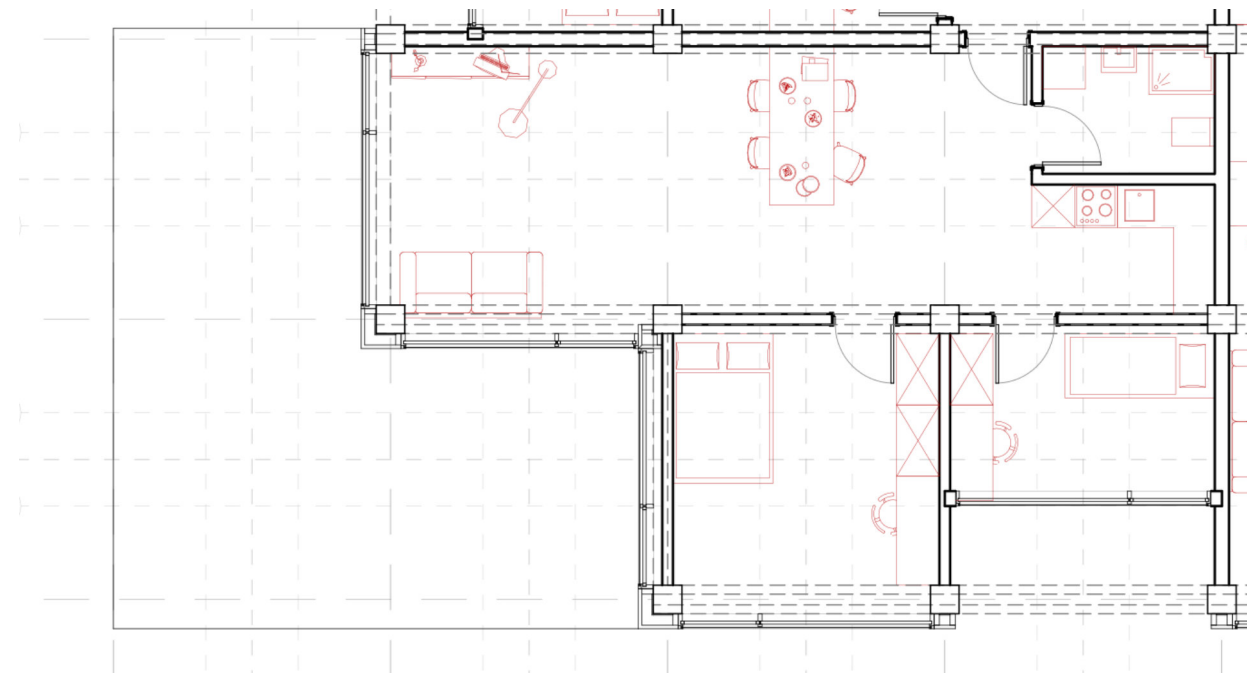


3. Floor

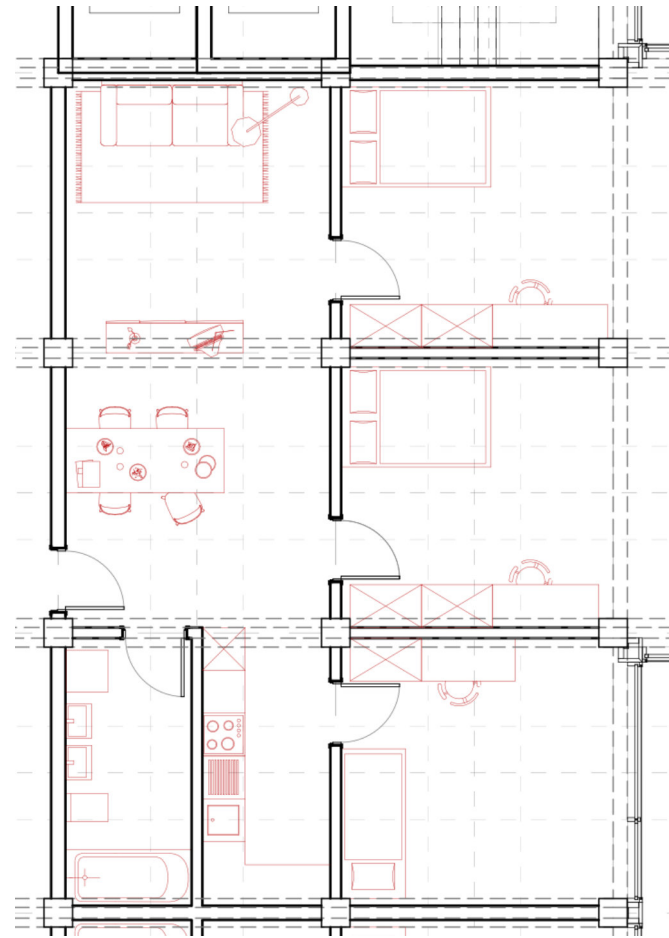
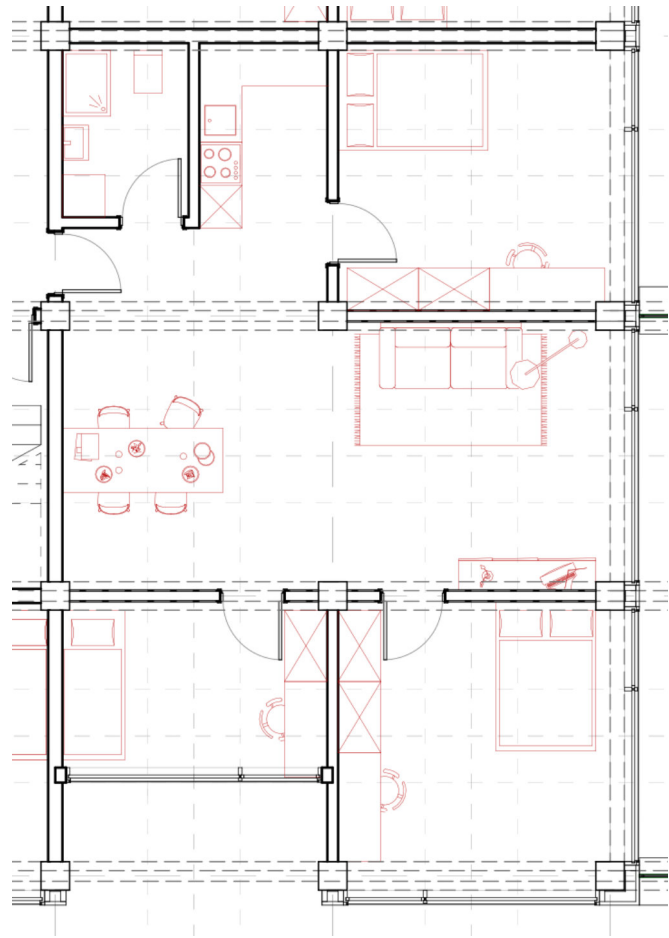
█ Fixed Load Bearing Wall
█ Flexible Interior Wall



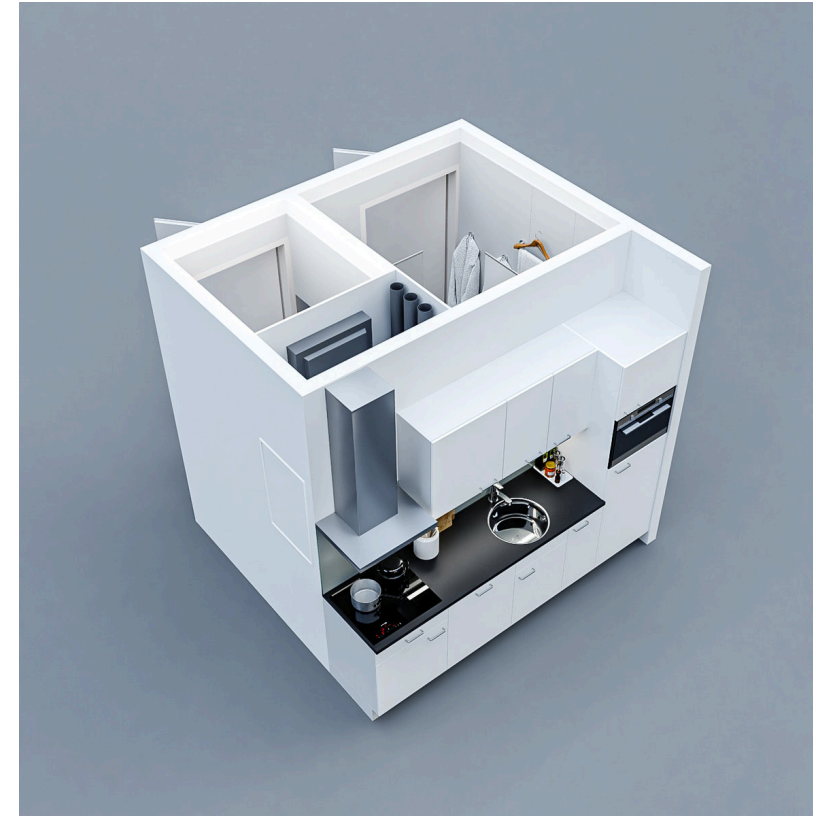
1 Bedroom Apartment 2 different layouts



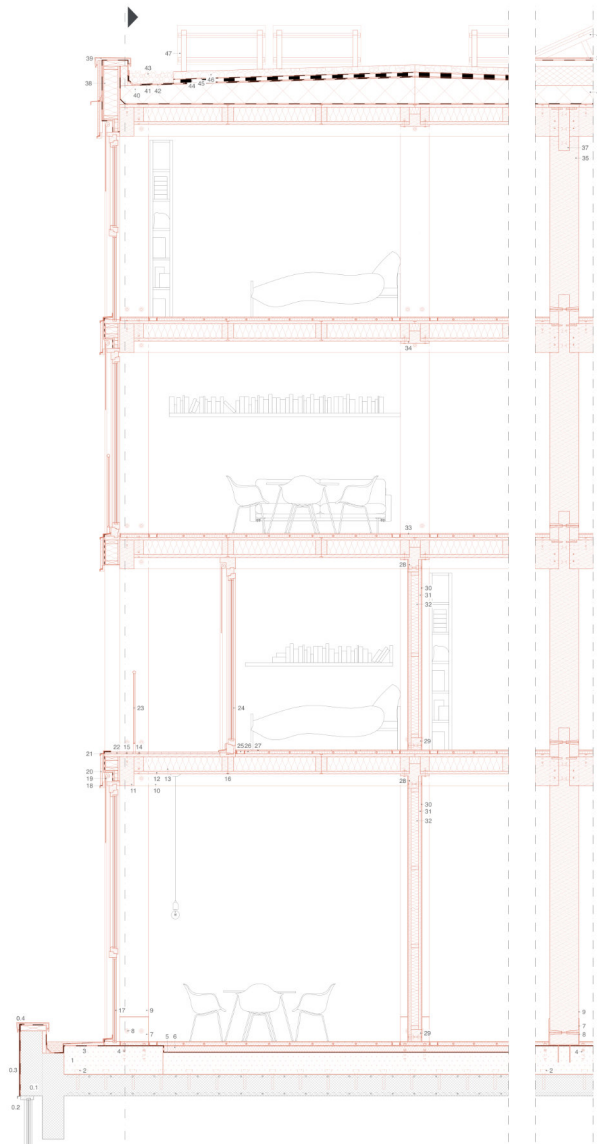
2 Bedroom Apartment 2 different layouts



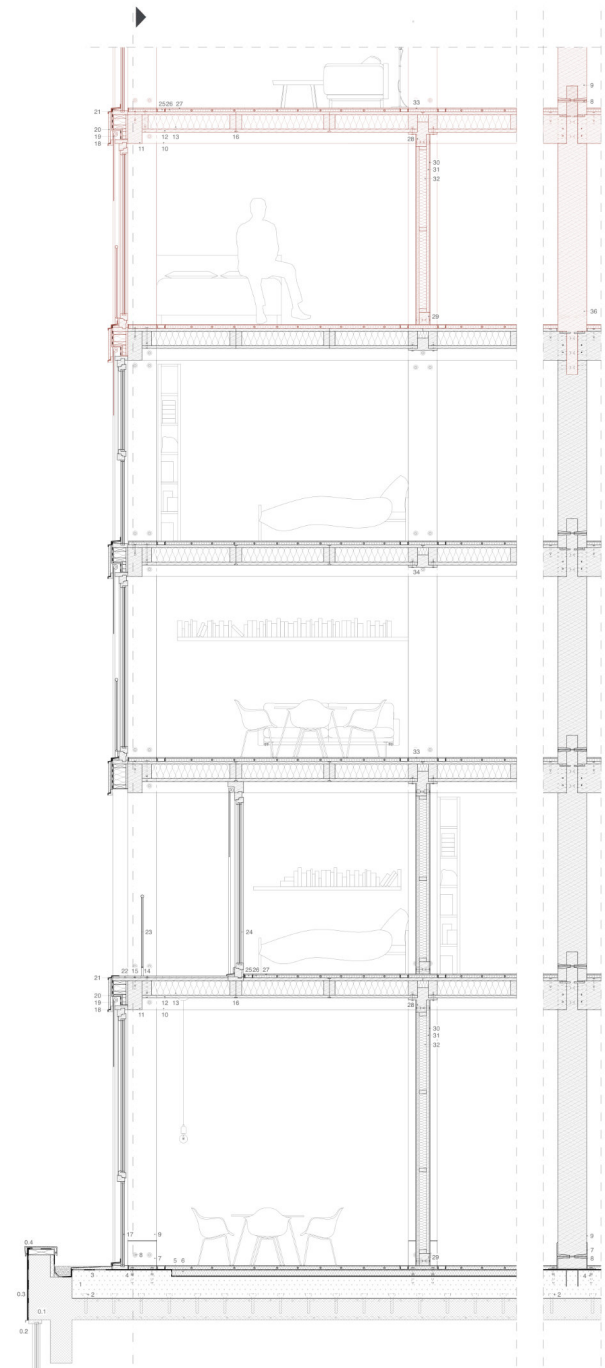
3 Bedroom Apartment 2 different layouts



Bathroom and Kitchen Unit by Sanifab, placed into the Grid on top of each other, Visual by Sanifab

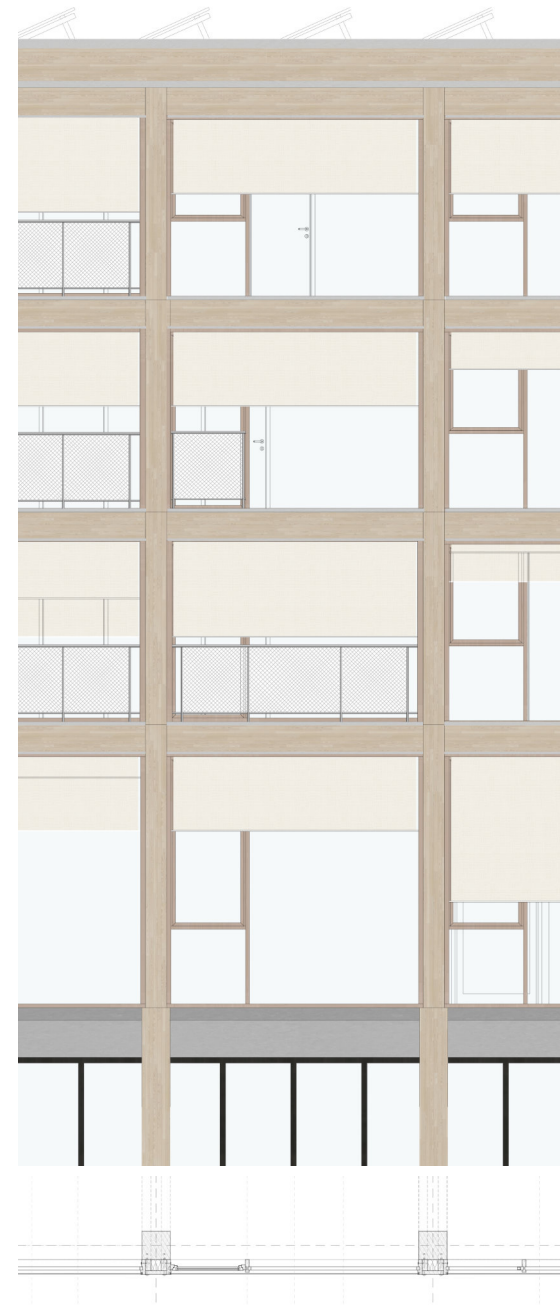


New Rooftop Extension

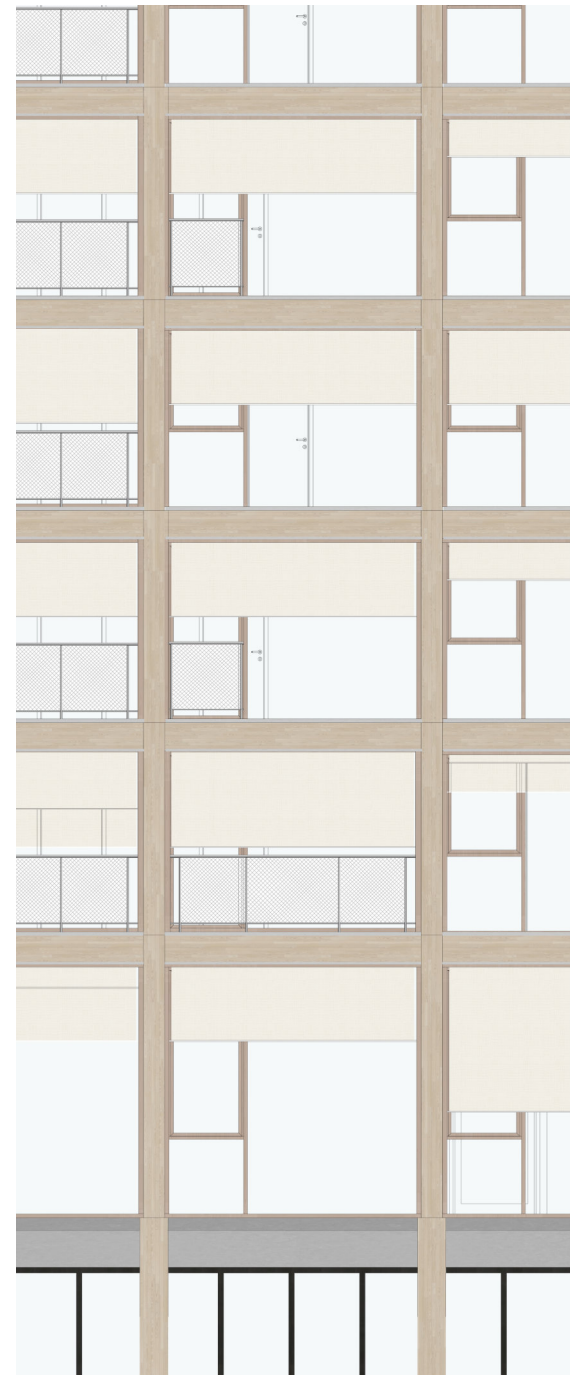


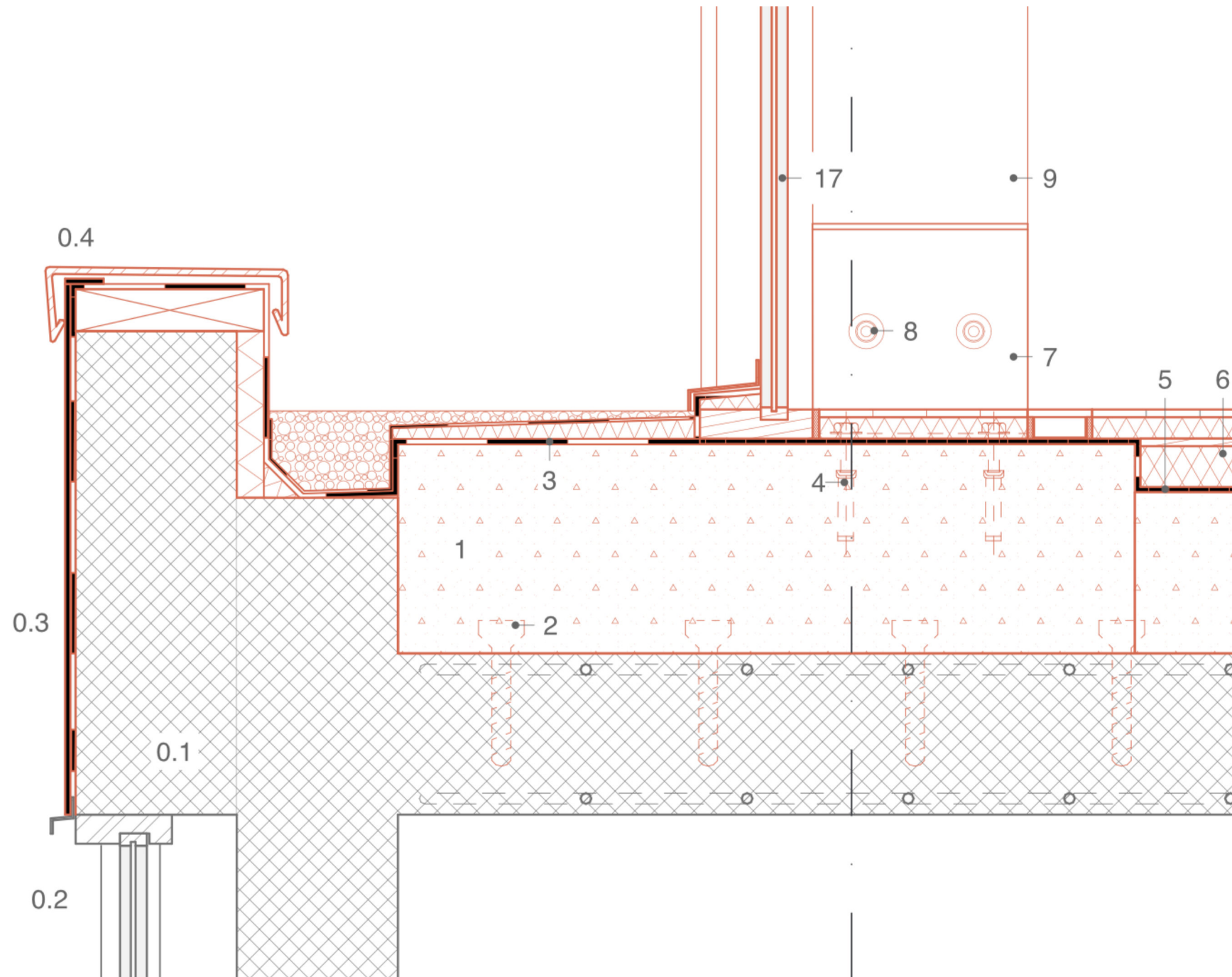
Future Extension

SECTION THROUGH EXISTING BUILDING AND NEW ROOFTOP EXTENSION



Elevation and Floorplan





Connection to Existing Building, 1:10

Existing Structure:

- 0.1 Reinforced concrete slab, 300 mm
- 0.2 Curtain wall with aluminium profiles
- 0.3 Aluminium cladding
- 0.4 Attica metal sheet

Rooftop extension

Foundation:

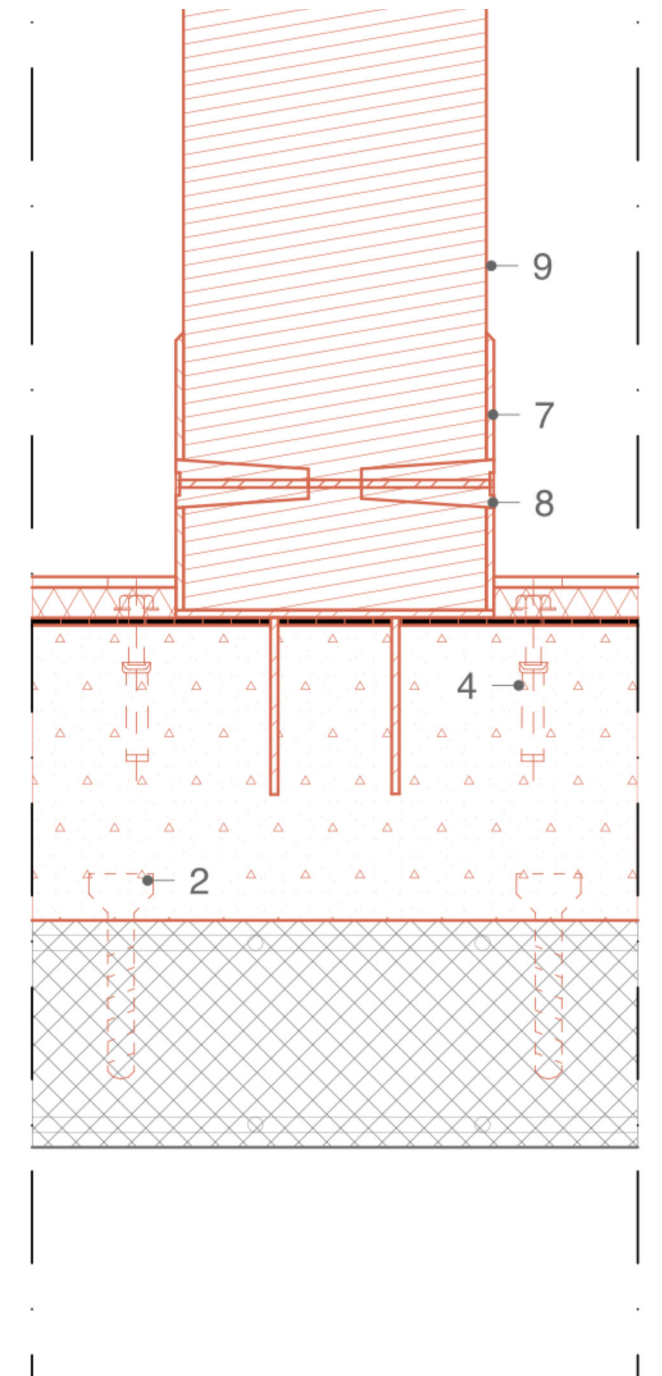
- 1. Reinforced concrete, 390 mm
- 2. Hilti steel anchor
- 3. Bituminous waterproofing membrane
- 4. M12 x 150 mm threaded screw
- 5. Rigid insulation board, 80 mm
- 6. OSB board, 40 mm

Structural Framework:

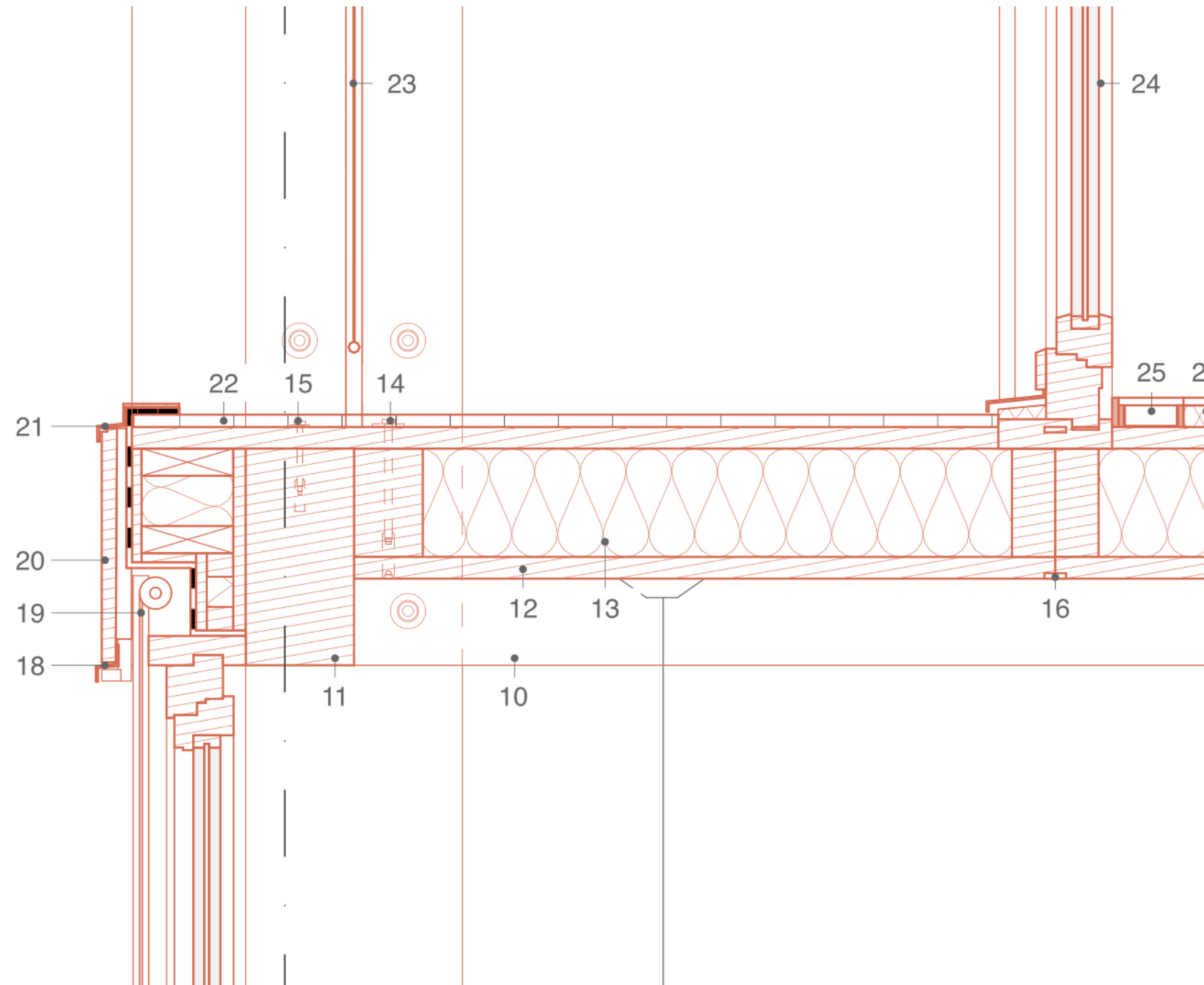
- 7. Steel foot 10 mm
- 8. Wooden Cone dowel, Ø65 mm
- 9. Column, 400 x 400 mm, Baubuche LVL GL75

Facade:

- 17. Window facade panel



Connection to Existing Building, 1:10



Ceiling Detail Balcony, 1:10

Rooftop extension

Structural Framework:

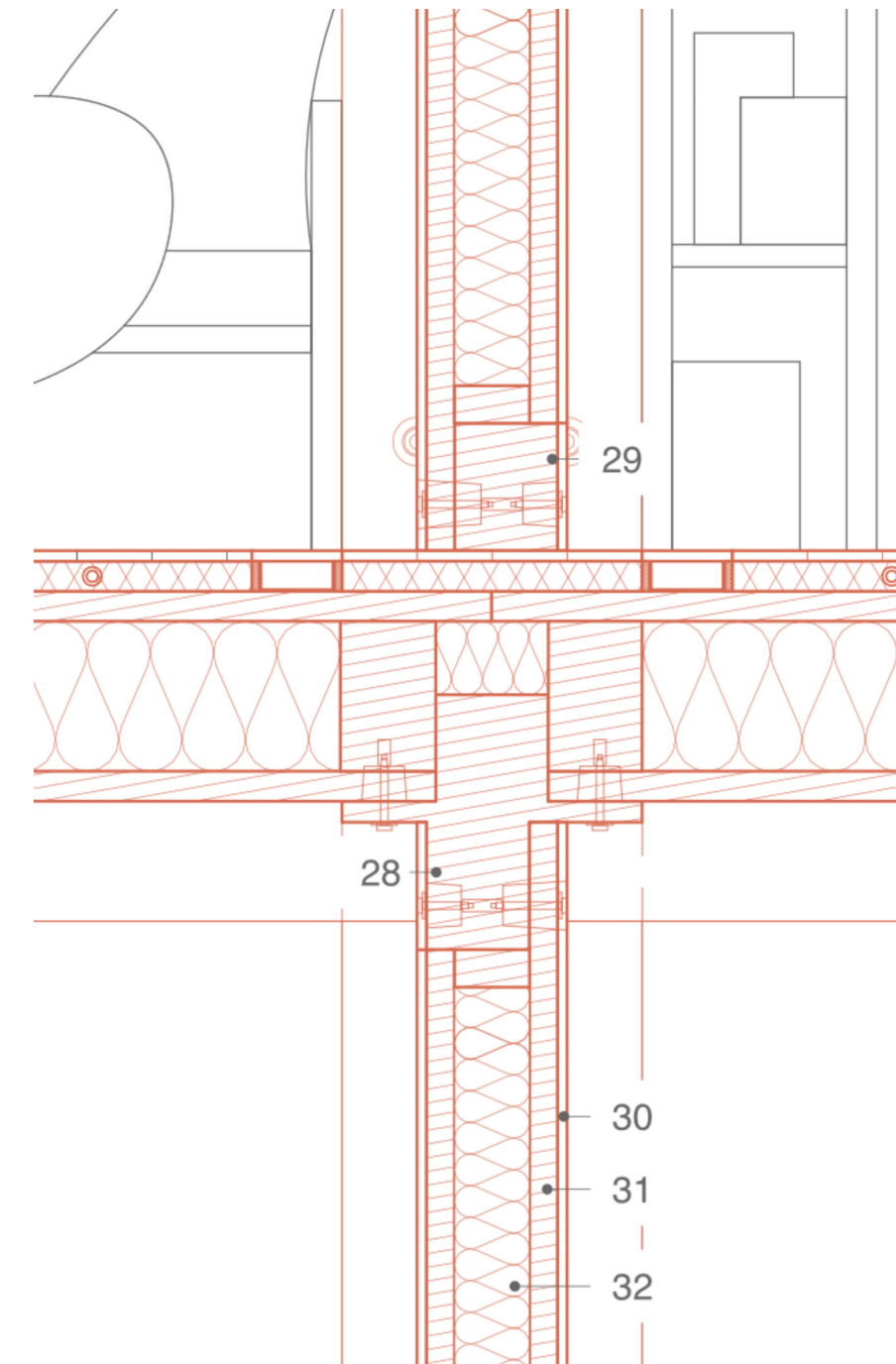
- 10. Beam, 125 x 400 mm, Baubuche LVL GL75
- 11. Edge beam, 200 x 400 mm, Baubuche LVL GL75
- 12. Baubuche LVL floor plate, 40 mm
- 13. Hemp insulation, 200 mm
- 14. M8 x 280 mm hexagon screw, transfer force
- 15. M8 x 150 mm screw
- 16. Wooden plate connector

Facade:

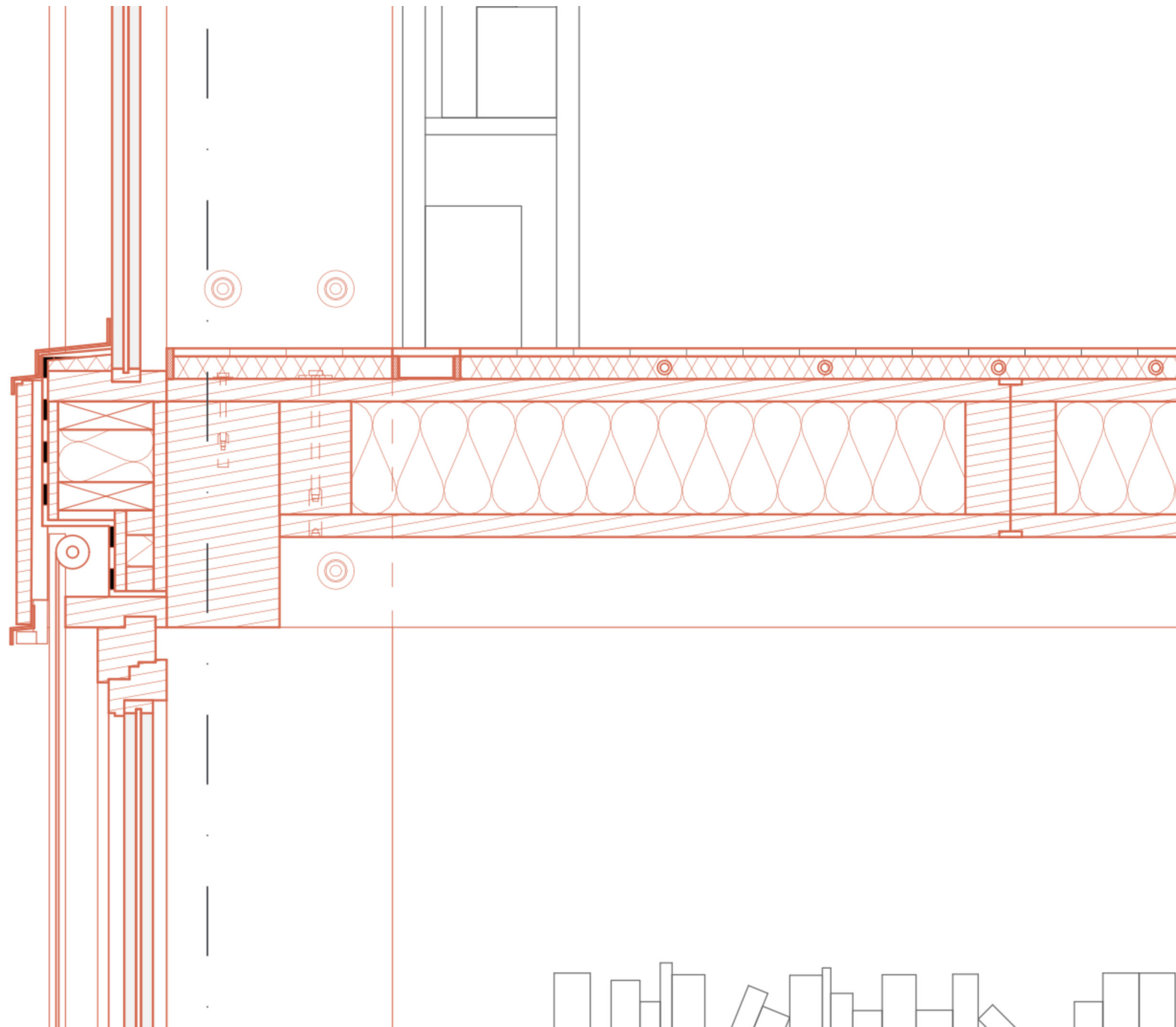
- 17. Window facade panel
- 18. Drip edge sheet
- 19. Movable textile sunshade panel
- 20. Larch cladding beam panel, 400 mm, 20 mm
- 21. Protective metal sheet for fire/ weather protection
- 22. Larch wooden planks
- 23. Lightweight steel mesh railing
- 24. Facade door panel

Flooring/ Technical Installation:

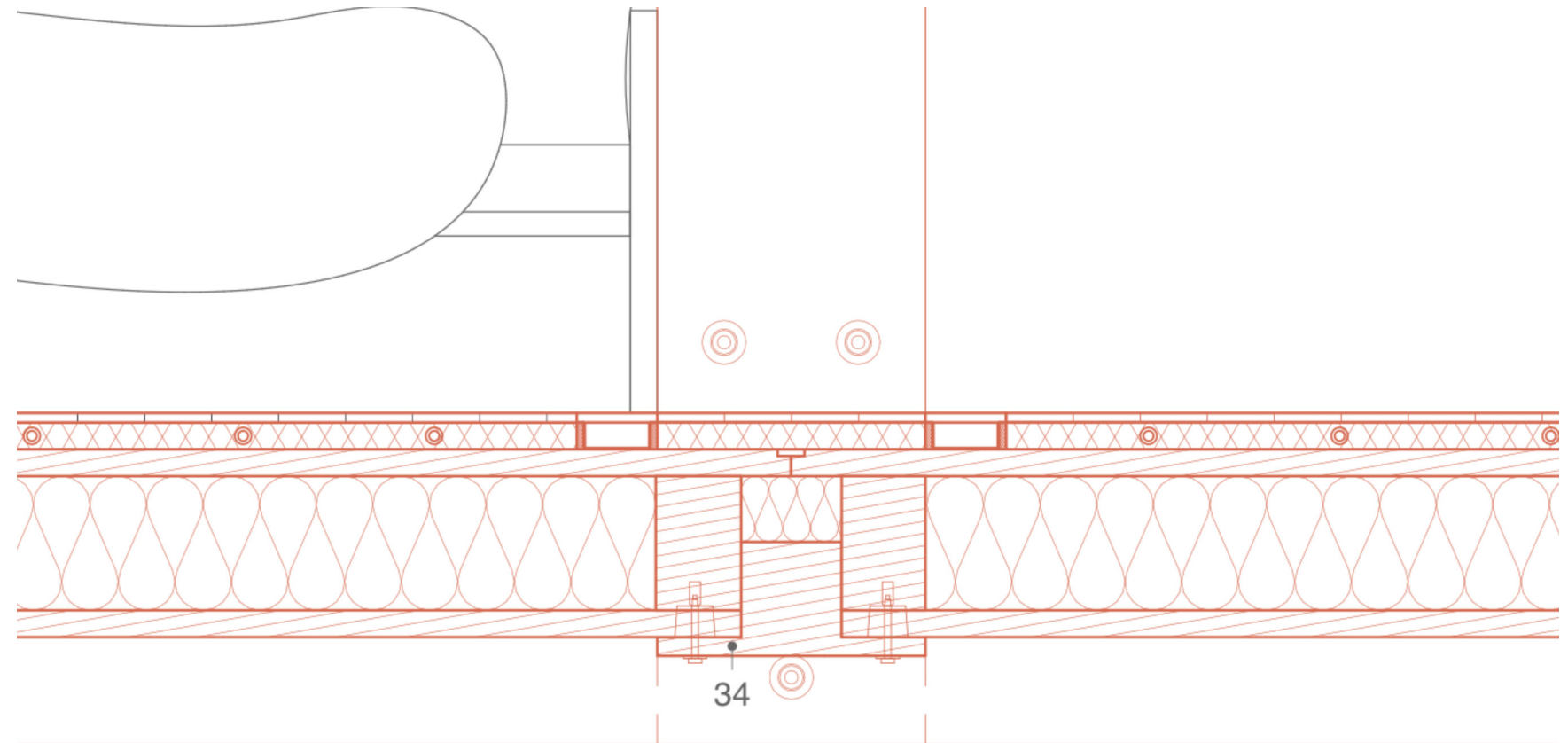
- 25. Cable duct/ tunnel
- 26. IndorTec floor system
- 27. Design Oak flooring
- 28. Wall attachment to ceiling
- 29. Wall attachment to floor
- 30. Clay plaster board, 12.5 mm
- 31. OSB board, 22 mm
- 32. Hemp insulation, 100 mm



Ceiling Detail with Wall, 1:10



Ceiling Detail, 1:10

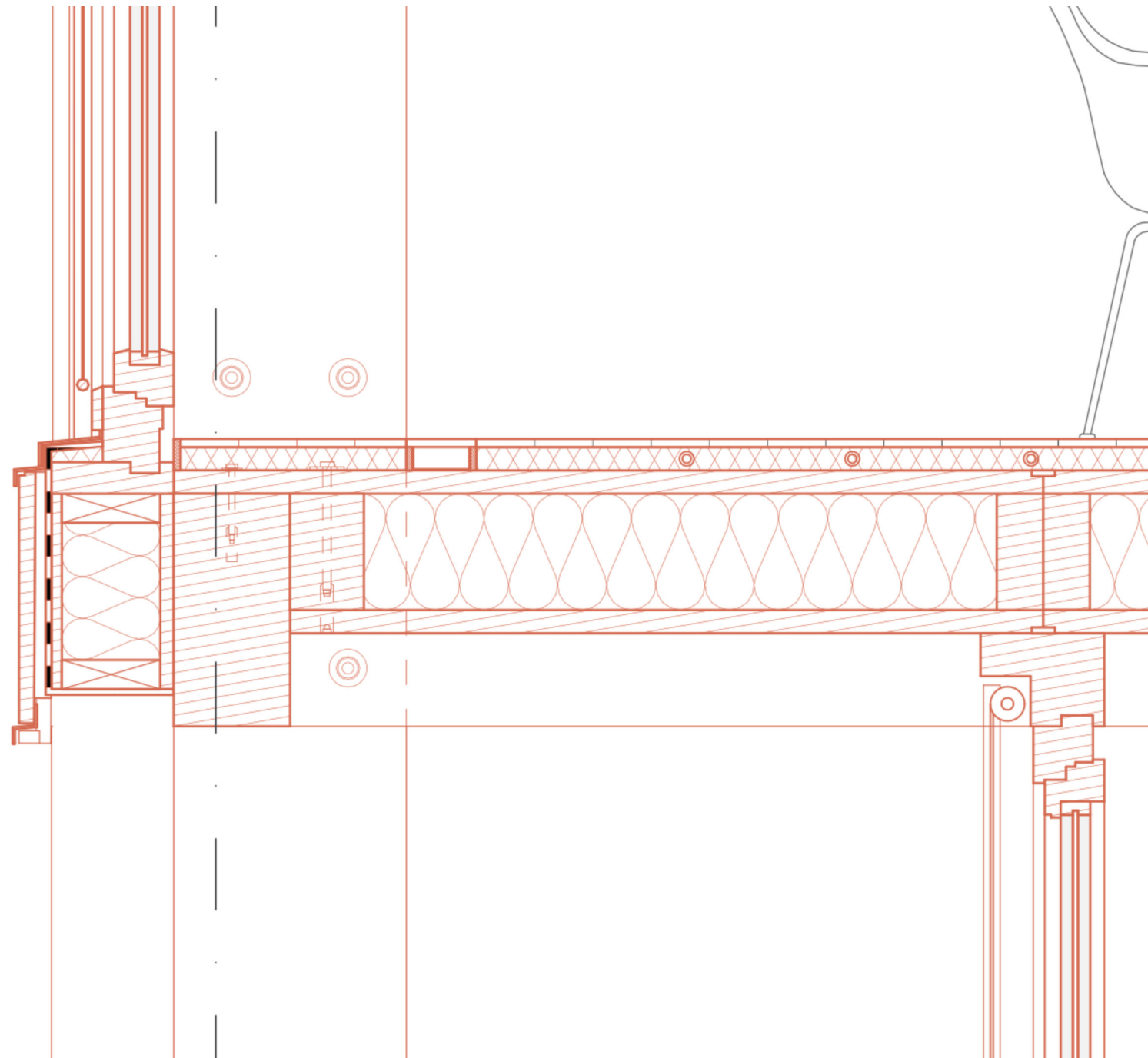


Rooftop extension

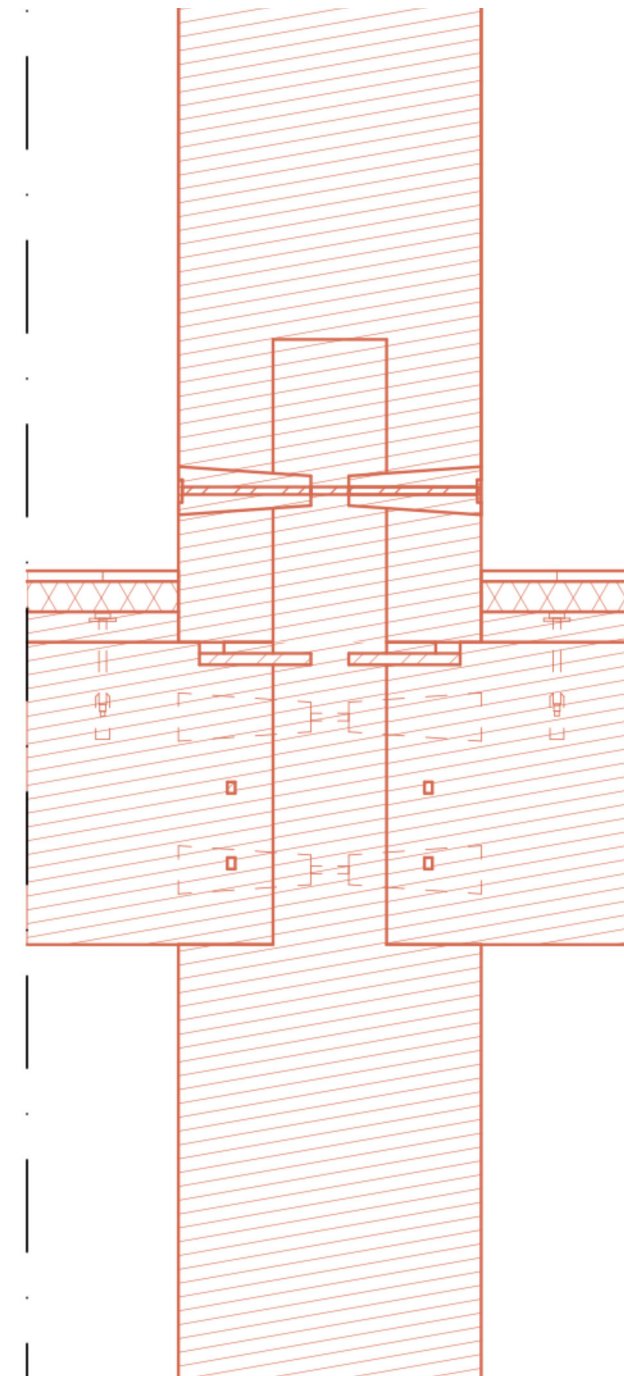
Flooring/ Technical Installation:
34. Ceiling panel without wall



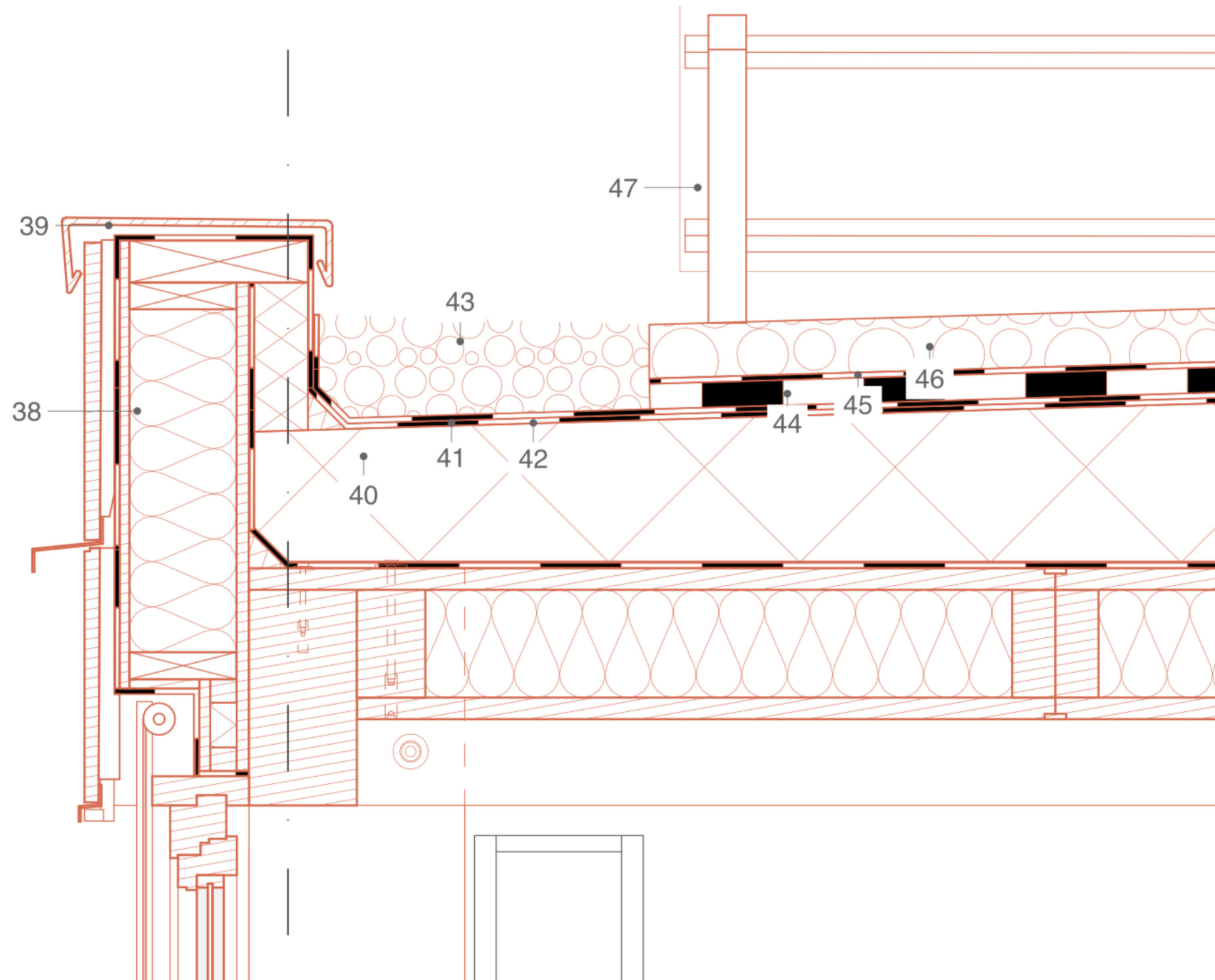
Ceiling Detail without Wall, 1:10



Ceiling Detail Balcony, 1:10



Column and Beam Connection, 1:10



Attica Detail: Edge with extensive greenery and PV panels, 1:10

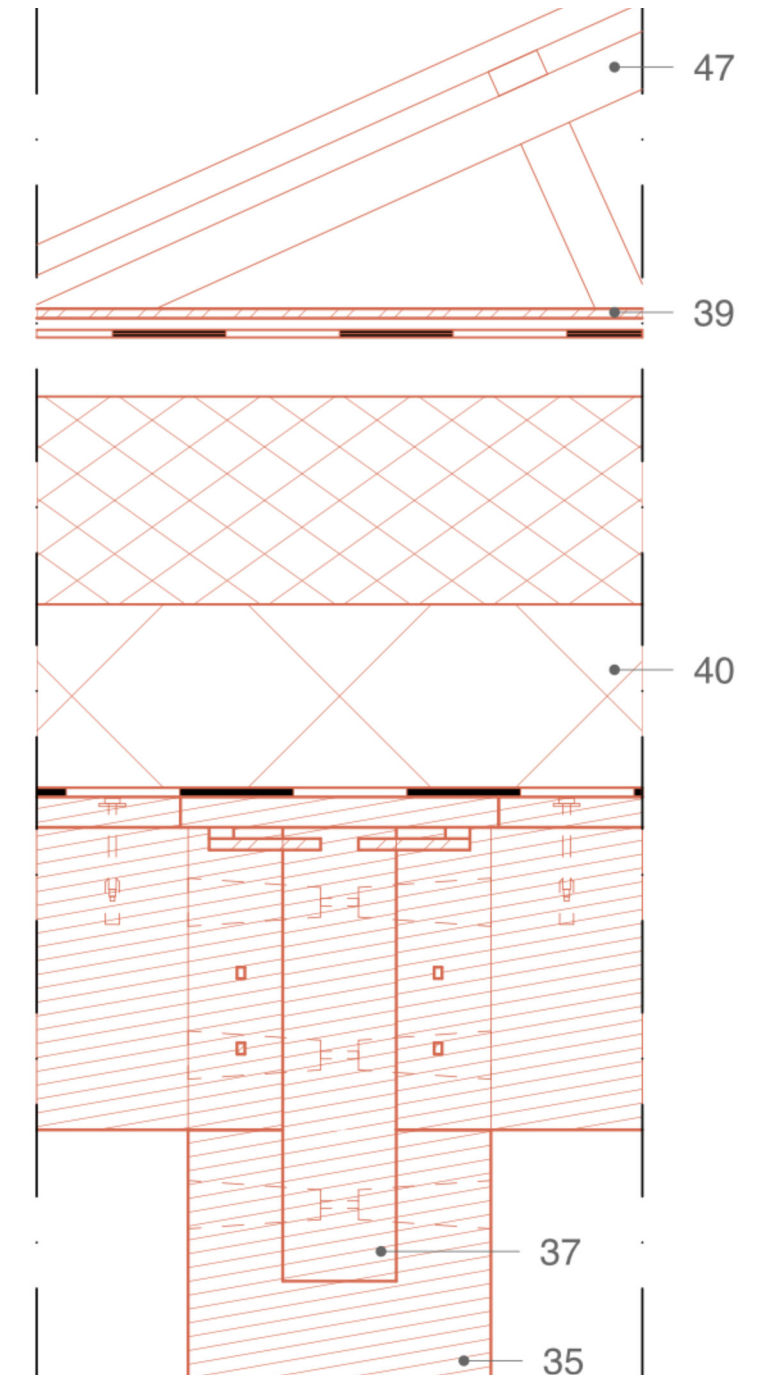
Rooftop extension

Future Extension:

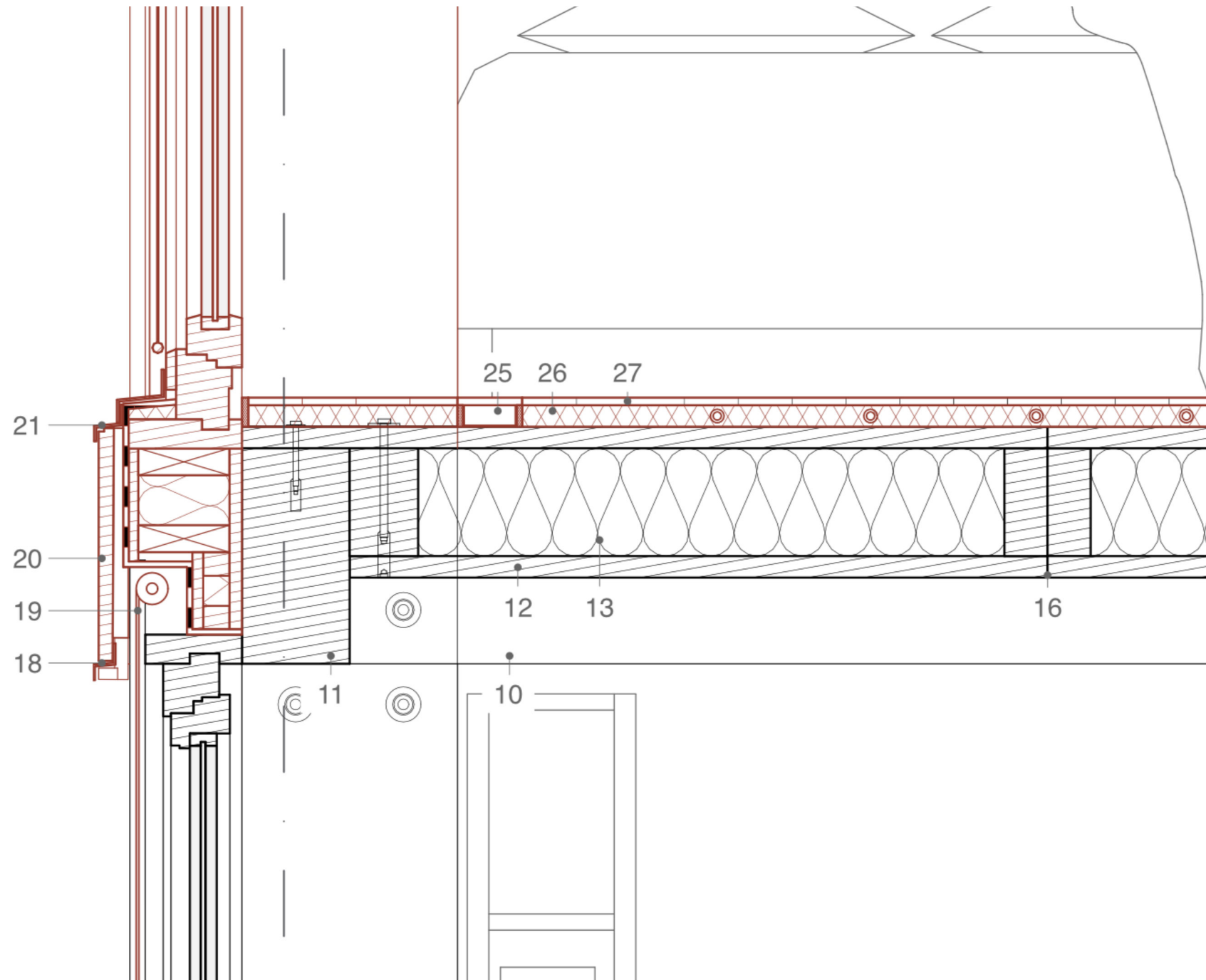
- 35. Base Column, 400 x 400 mm, Spruce LVL GL34
- 36. Extension Column, 400 x 400 mm, Spruce LVL GL34
- 37. Wooden adapter, 150 x 400 x 600 mm, Spruce LVL GL34

Roof:

- 38. Hemp insulation, 200 mm
- 39. Attica sheet metal
- 40. Sloped insulation, 2% gradient
- 41. Waterproof membrane
- 42. Protective fleece below gravel/ above waterproofing layer
- 43. Gravel layer
- 44. Drainage insulation for extensive green roof system
- 45. Protective fleece
- 46. Extensive green roof substrate
- 47. PV panels



Attica Detail: Column to extensive solar - green roof, 1:10



New Extension on top of Rooftop Extension, 1:10

Rooftop extension

Structural Framework:

- 10. Beam, 125 x 400 mm, Baubuche LVL GL75
- 11. Edge beam, 200 x 400 mm, Baubuche LVL GL75
- 12. Baubuche LVL floor plate, 40 mm
- 13. Hemp insulation, 200 mm
- 16. Wooden plate connector

Facade:

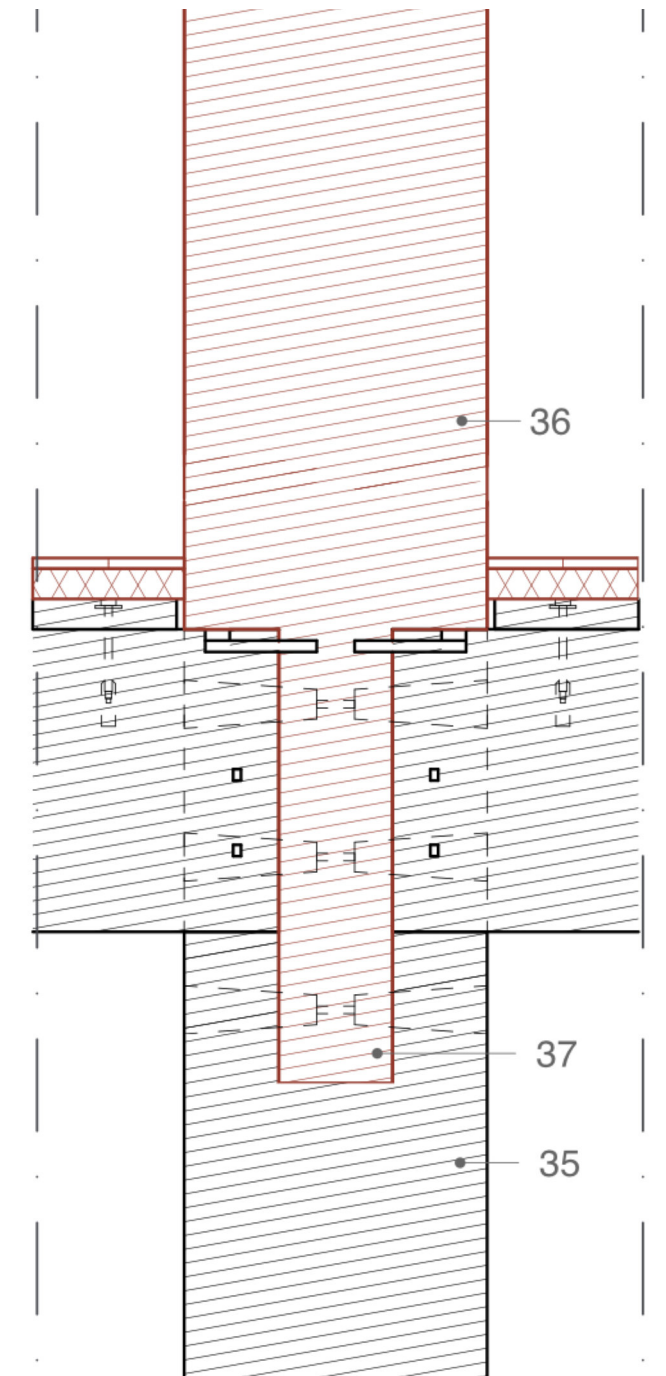
- 18. Drip edge sheet
- 19. Movable textile sunshade panel
- 20. Larch cladding beam panel, 400 mm high, 20 mm thick
- 21. Protective metal sheet for fire and weather protection

Flooring/ Technical Installation:

- 25. Cable duct/ tunnel
- 26. IndorTec floor system
- 27. Design Oak flooring

Future Extension:

- 35. Base Column, 400 x 400 mm, Spruce LVL GL34
- 36. Extension Column, 400 x 400 mm, Spruce LVL GL34
- 37. Wooden adapter, 150 x 400 x 600 mm, Spruce LVL GL34



Column connection to existing column, 1:10

Part 4

Visuals



New Extension walking towards the West side of the Filmacademie



New Extension, View from above



Rooftop Terrace



Facade, Rooftop terrace



Public terrace



Cafe, Bar, Viewing point



Co-Working space for all departments, Filmacademie



Student dorm

Future Top - Ups



122 *Generated with Gemini AI, with base rendering*





124 *Generated with Gemini AI, with base rendering*

Future Top - Ups

Prompt

Create a four story timber structure on top of the existing Timber Building. Use the same structural grid as the previous one and experiment with setbacks.

Do not change the camera angle, the surrounding environment, people, trees, cars or buildings. Only add a new structure on top of the old one.

Keep the same season early summer, 12:00 pm in Amsterdam, Netherlands with a cloudy sky.

Conclusion

Implications and recommendations

Reflection

Part 5

Conclusion/ Discussion

Conclusion

The project investigates how an existing rigid building can be transformed into an adaptive architectural framework that is able to grow, change and be reconfigured over time. Rather than treating the existing structure as a fixed and final condition, the design proposes a system that allows continuous transformation and extension in response to future spatial, social and technical needs. Through the combination of a permanent structural framework and adaptable secondary systems, the project explores how architecture can remain flexible beyond its initial construction phase.

The final design demonstrates that adaptability can become an integrated architectural strategy rather than an afterthought. Instead of relying on demolition and replacement, the proposal uses extension and transformation as tools for long-term development. At the same time, the intervention improves existing shortcomings of the original building while introducing new possibilities for occupation, circulation and spatial organisation. The project therefore connects architectural, structural and environmental ambitions within one coherent system.

Overall, the design suggests that buildings should no longer be understood as static objects designed for a single moment in time, but rather as evolving frameworks that are capable of responding to changing users, technologies and urban conditions throughout their life-cycle.

Implications and Recommendations

The project suggests that architecture should move beyond static final solutions and instead be understood as a system capable of adapting over time. In response to environmental pressures, changing needs and evolving urban conditions, adaptability becomes a central architectural principle rather than only a technical feature. Adaptability should not only be considered as a technical feature, but as a fundamental architectural principle integrated from the beginning of the design process.

One key implication is that long-term transformation can offer an alternative to demolition and replacement. By clearly separating permanent structural elements from adaptable secondary systems, existing buildings can be extended and modified with less material waste, fewer interventions and reduced disruption.

A similar approach could be applied to climate installations, which are often hidden within buildings or permanently fixed to architectural components. Future research could therefore examine how these systems can be designed as more accessible, reversible and maintainable elements. This would strengthen the relationship between environmental performance and long-term architectural flexibility.

Reflection

The design process was strongly exploratory and iterative, requiring continuous testing and reconsideration of spatial, structural and technical decisions. One of the main limitations of the project was the subjective nature of the evaluation process. Although matrices and comparative criteria were developed in order to make decisions more transparent and systematic, the selection, weighting and interpretation of these criteria ultimately remained influenced by my own architectural perspective and priorities. This reflects a broader challenge within design research, where qualitative aspects such as adaptability, spatial quality and flexibility cannot be measured entirely objectively.

Another major challenge was the limited availability of relevant case studies. Because adaptive rooftop extensions and long-term transformable structural systems are still relatively uncommon, only a small number of comparable precedents could be identified. As a result, the project relied less on direct comparison and more on speculative and design-driven exploration. In addition, many assumptions about future uses and transformations remain hypothetical, since the long-term performance of adaptive systems cannot be fully verified within the time frame of an academic project.

A further challenge was balancing flexibility with technical constraints such as structure, fire safety, circulation, facade systems and environmental performance.

A further important aspect of the process was the choice of the existing building itself. The selected case met the criteria of the research, but its irregular structural grid and

parallelogram-shaped geometry made the design process significantly more complex. The existing structure did not offer a simple, regular framework onto which an adaptive extension could easily be applied. Instead, many design decisions had to respond to geometric irregularities, structural constraints and spatial misalignment's.

However, this difficulty also became productive for the project. By testing the adaptive system on a challenging existing building, the proposal demonstrates that the concept is not limited to ideal or generic conditions. The irregularity of the case study allowed the design to prove its relevance in a more complex and realistic context. In that sense, the chosen building was both a limitation and an opportunity: it complicated the process, but also strengthened the argument that adaptive transformation can work even under difficult existing conditions.

Appendices
References
Acknowledgements

Back matter

Data Management Checklist

VI. DATA MANAGEMENT CHECKLIST

Instruction

This checklist is relevant for all graduation projects of the Master AUBS. The form is intended to highlight common aspects of graduation projects that require particular attention with regard to planning the research and data management. Relevant information and supplementary sources regarding each question are provided below each question.

With this checklist, the faculty wants to avoid that students unexpectedly find themselves in complex and stressful situations, in which ethical or privacy matters and/or other laws and regulations become an issue. In projects involving humans, certain types of data processing increase the risks to the human participants: planning such projects requires additional evaluations and advice from university staff before ethical approval can be received and the project can begin. In the case of a graduation project, obtaining additional advice or permits may delay the project with an extra education period or semester. To avoid this, it is recommended that students set up a graduation project with a low level of risk. Therefore, all students have to check their risk, by completing this checklist before their A1.

The first section of the checklist (A) should be completed by all students, together with their supervisor, during the planning of the graduation project, before the A1. It does not need to be submitted to anyone for review or approval. Please consider questions 1 to 3 carefully in relation to the intended graduation project, and answer with 'yes' or 'no'.

The second section of the checklist (B) should only be completed if the graduation project involves working with data from human participants. In that case, the student and their supervisor must apply for and receive ethical approval from the [Human Research Ethics Committee](#) (HREC) before the project can begin (see the paragraph 'Explanation and follow-up' after the questions). The student can submit the application to the HREC, but the supervisor is responsible for making sure that the project is compliant with relevant privacy regulations and ethical policies.

Section A. General considerations	yes	no
1. Is the graduation project conducted as part of an internship (at a company), or as part of a research project at TU Delft? If a student's graduation project is conducted at a company or as part of a research project at the university, questions of data ownership and intellectual property rights need to be addressed in a written graduation or internship agreement before the project begins. Student and supervisor should consult the Intellectual Property Rights of Students webpage . Additional information can also be found in the Extended Personal Research Data Workflow . If applicable, complete the Confidentiality Agreement .		X
2. Does the project involve conducting (part of) the research outside the Netherlands? Students who intend to travel abroad (even to other EU countries) for study, exchange, research, internship, or graduation project purposes need to follow the Travel Safety Protocol . This includes attending a mandatory Travel Safety Training Session: see the Disclaimer .		X
3. Will the research involve processing data from humans, such as running a survey, conducting interviews or workshops, collecting data through social media or internet forums, or re-using existing datasets about humans provided by a third party? (If 'yes', see follow-up questions 4 to 13 in Checklist B.) Students who work with data from human participants must complete the next section and apply for and receive ethical approval from the Human Research Ethics Committee (HREC) before conducting the research.		X

Section B. Extended risk factors (only if question 3 has been answered with 'yes'.)	yes	no
4. Will the project involve participants who may be considered vulnerable, such as the elderly, refugees or asylum seekers, ethnic minorities, patients, or people with disabilities? Participants who may suffer very adverse consequences (for instance, due to discrimination) if their personal data became publicly available can be considered vulnerable.		X
5. Will the project involve participants who cannot themselves give informed consent for taking part in the project, but for whom consent must be obtained from a legal guardian? Participants who cannot give informed consent can include, for instance, children or participants with intellectual disabilities, mental disorders, or dementia. Such participants are also considered vulnerable in the context of the General Data Protection Regulation (GDPR).		
6. Will the project involve processing any of the special categories of personal data below? - Race - Ethnicity - Criminal offence data - Political opinion - Union membership - Religious or philosophical beliefs - Sex life and/or sexual orientation - Health data (including measurements such as heart rate) - Biometric or genetic data (including fingerprints, iris scanning, facial recognition) The General Data Protection Regulation (GDPR) defines a stricter rules for processing special categories of personal data . If it is necessary to process these data in a project, it is important to provide additional safeguards.		X
7. Will the project involve processing personal data that could be considered sensitive, such as the ones listed below? - Information about a person's income, debts, or other payments - Information about a person's (un-)employment status - Information about a person's performance at school or work - Information about relationship problems or (gambling) addiction - Information about poverty, domestic violence, or youth welfare/social work involvement Some types of personal data are considered sensitive , because they can have a high impact on the privacy of the data subject if other persons gain access to these data. Sensitive personal data should only be processed if necessary: in such cases, additional safeguards need to be put in place.		X
8. Will the project involve processing video-recordings, or photographs of participants? TU Delft considers photographic and video-materials of research participants to be sensitive personal data . If such data need to be processed, additional safeguards must be put in place.		X

47

Section B. Extended risk factors (only if question 3 has been answered with 'yes'.)	yes	no
9. Will the project involve sharing or transferring personal data between multiple partners or collaborating organisations involved, such as between TU Delft and an internship company? According to privacy law, sharing personal data between organisations requires a privacy agreement to be in place: setting this up takes time, and requires support from additional university staff. Furthermore, personal data sharing can potentially expose research participants to different types of risks: these risks must be considered in the ethical application.		X
10. Will the project involve deception, or covert observation of participants? In some types of research, obtaining informed consent for processing participants' personal data is not an option: for instance, if the research involves deception, or the research is covert (conducted without participants knowing about it). In such situations, the steps to mitigate risks to participants are important, and an alternative legal basis for processing the participant's data needs to be established with the help of additional support staff.		X
11. Will the project involve working with social media data? Social media data are personal data, but since it is usually not possible to ask for informed consent for processing social media data, another legal basis for processing the participant's data needs to be established. Processing of social media data also involves legal considerations related to terms of use of data from third-party platforms: therefore, research with social media data requires expert support on privacy, ethics, and legal matters.		X
12. Will the project involve using learning algorithms or other AI to analyse, combine, or otherwise process data from participants? The use of AI in research involves many considerations in terms of data protection, ethics, security, and intellectual property: for more information, see TU Delft's Instructions for use of Generative AI .		X
13. Will the project involve participants who are based in a country or countries outside of the EU? Students affiliated with TU Delft must comply with Dutch and EU regulations of personal data processing (GDPR). Furthermore, the student and their supervisor must make sure that the research complies with local (privacy) legislations of any foreign destinations. Additional support from an external (local) expert may be required.		X

Explanation and follow-up

If you have answered 'no' to all questions 4 to 13, your project is likely to be considered low or minimal-risk: see the paragraph 'Projects with minimal or low-risk' on the next page.

If you have answered 'yes' to one or more of the questions 4 to 13, your research likely involves extended or high risks to participants, according to the [General Data Protection Regulation](#) (GDPR) and TU Delft's privacy and ethical policies: for information regarding such projects, see the paragraph 'Projects with extended or high-risk' on the next pages.

48

Projects with minimal or low-risk

If you have answered 'no' to questions 4 to 13, your project is likely to be considered low-risk. This does not mean that the project involves no risks at all, but suggests that these risks can likely be addressed by the student and supervisor in the application to the [Human Research Ethics Committee](#) (HREC) within the timeline for a graduation project and without need for additional support.

Compiling the HREC application:

An application to the HREC generally involves a Data Management Plan (DMP), a risk-identification and mitigation checklist, and informed consent materials. Master's students at ABE who intend to compile a HREC application are advised to make use of the following support documents:

- the [student guide](#)
- the [Example Data Management Plan](#) for MSc projects

The graduation supervisor is [responsible](#) for the student's project and ethical application, and must provide support for compiling the HREC application documents.

Additional support

For low-risk student graduation projects, compiling of the HREC application documents should be done by the student in consultation with the supervisor. The Faculty Data Steward can be contacted for individual questions at datasteward-BK@tudelft.nl; however, the Data Steward does not provide detailed feedback on student DMPs for low-risk HREC applications.

Additional resources

The HREC has guides available for [completing the checklist](#) and for compiling [informed consent materials](#). Additionally, the [Guide to the Extended Personal Research Data Workflow](#) has been created to help researchers and students who work with human participants comply with both GDPR principles and TU Delft's policies on Data Management and Human Research Ethics.

Timeline

Minimal or low-risk HREC applications are generally processed faster than extended or high-risk applications (see the paragraph below). Nevertheless, the initial evaluation by the HREC usually takes approximately 2 weeks, and may take longer during busy periods or holiday: see the [HREC website](#) for up-to-date information. Additionally, the application may require revisions before final approval is granted. If you do not receive an initial response about your ethical application after 4 weeks from the time of submission, you may follow up with the HREC to enquire about an update.

Projects with extended or high-risk

If you have answered 'yes' to one or more of questions 4 to 13, there are potential increased risks related to how data from human participants will be processed in your project. These risks will need to be addressed in consultation with the Data Steward and other relevant support staff before submitting the ethical application to the [Human Research Ethics Committee](#) (HREC).

Compiling the HREC application

An application to the HREC generally involves a Data Management Plan (DMP), a risk-identification and mitigation checklist, and informed consent materials. Master's students at ABE who intend to compile a HREC application are advised to make use of the following support documents:

- the [Ethical Approval & Data Management Planning Student Information](#)
- the [Example Data Management Plan](#) for MSc projects

The graduation supervisor is [responsible](#) for the student's project and ethical application, and must provide support for compiling the HREC application documents.

49

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