

# **The Circular Cornerstone.**

## **Timeless Architecture.**















Pietersberg (weg), 2018, Amstel III.



# What can we do here?

3Xn  
GXn

 TU Delft

× Gemeente  
× Amsterdam

# UP CYCLE AMSTEL

THIS BOOK CONTAINS TOOLS FOR A CIRCULAR AMSTEL-STAD







# Amstel III

Current Situation





# Amstel III

Ambitions





TOILETS THIS WAY 

BUS 9A & HARBOUR BUS 



#VON  
PLAST






# Ambitions

European, Dutch and Amsterdam’s Circular Ambitions



# Definitions

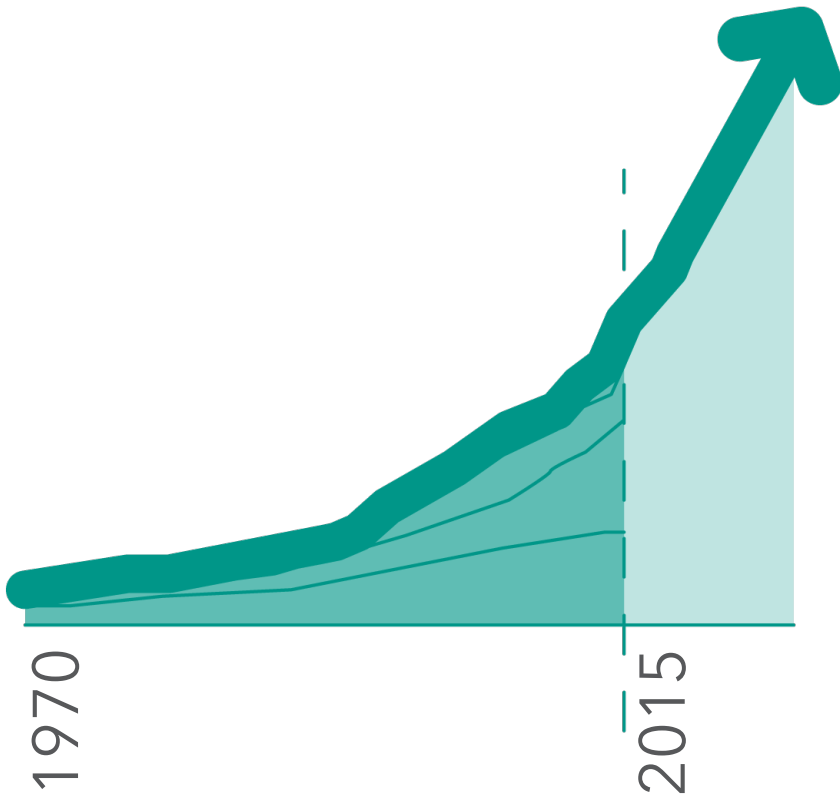
Upcycling, Re-use, Downcycling, Contaminating, Wasting.

Process	Quality	Definition
Increasing the quality and/or value through the use of the material. E.g. by growing algae out of CO <sub>2</sub> and using it to produce new materials or marking a computer chip out of old copper cladding.		UPCYCLING
Reusing materials at similar value. E.g. Taking a facade panel from a facade and mounting it onto another facade without modification.		RE-USE
Reusing materials at lower value. E.g. taking a structural concrete floor and using it as a wall in a new building or shredding jeans to use as insulation for a new house.		DOWNCYCLING (cascading)
Contaminating one element by irreversible contact with other. E.g. by glueing old bricks permanently together with cement (instead of chalk). Using composite materials that can never be taken apart again.		CONTAMINATING
Using crushed concrete rubble as foundation for new roads. Burning end-of-life products for energy production. Or as a last resort, putting waste in landfill.		WASTING (landfill / incineration)

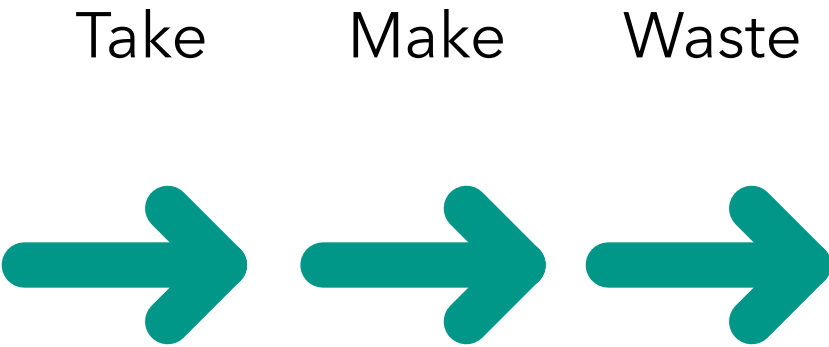


# Material Consumption

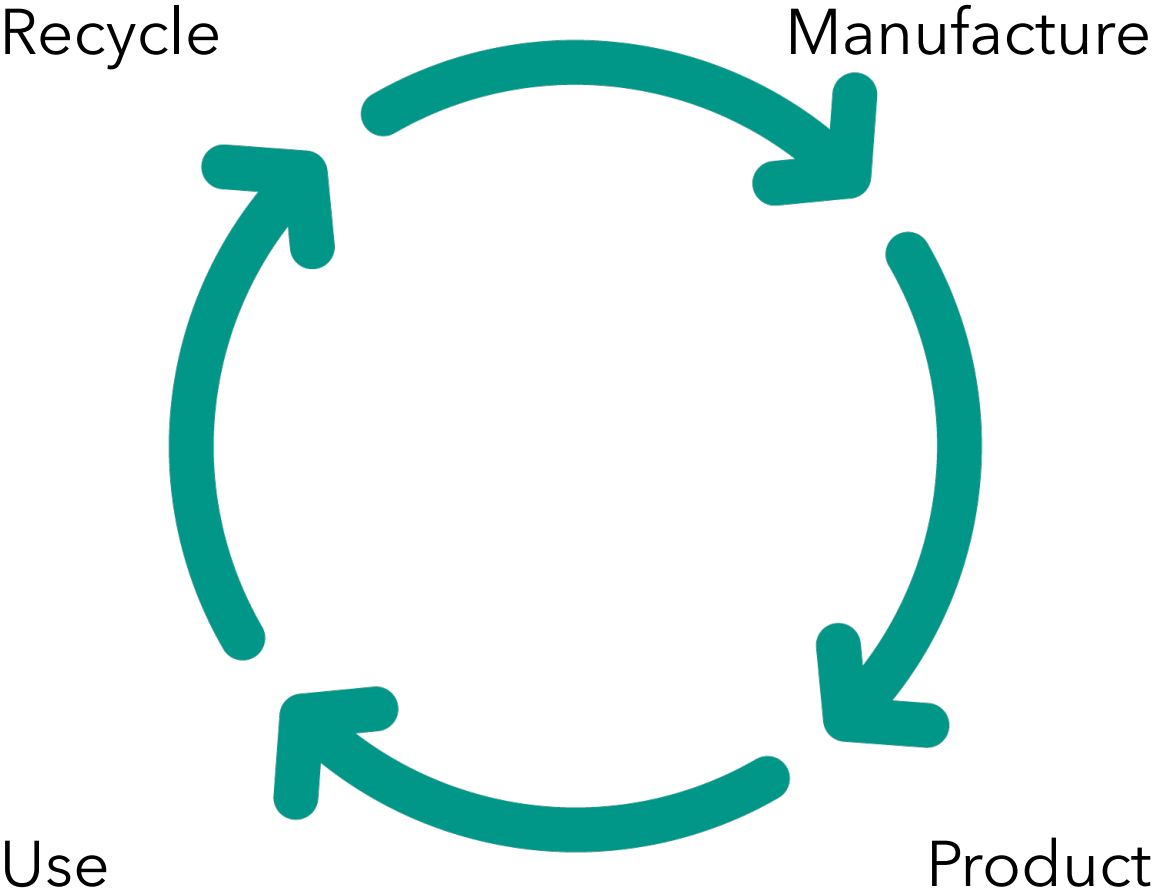
From Linear to Circular.



**Material Consumption**  
67% of current emissions are material related.  
Material use tripled from 1970 to 2015.\*



**Linear economy**  
Partial re-cycling where possible.  
Not linked with design.



**Circular economy**  
Full recycling and re-use. Starts with design.

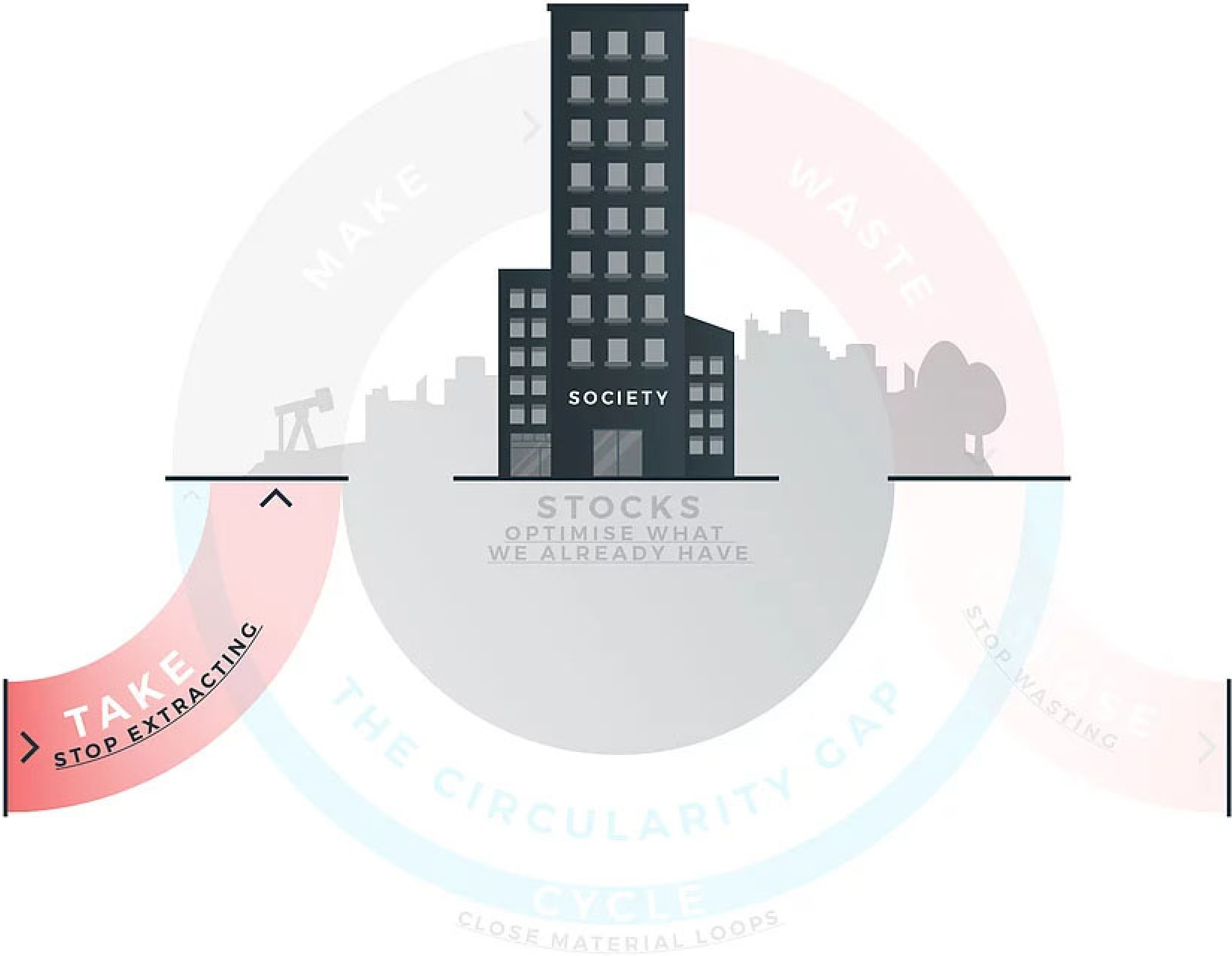
# A circular Economy

Closing the cycle



# A circular Economy

Closing the cycle



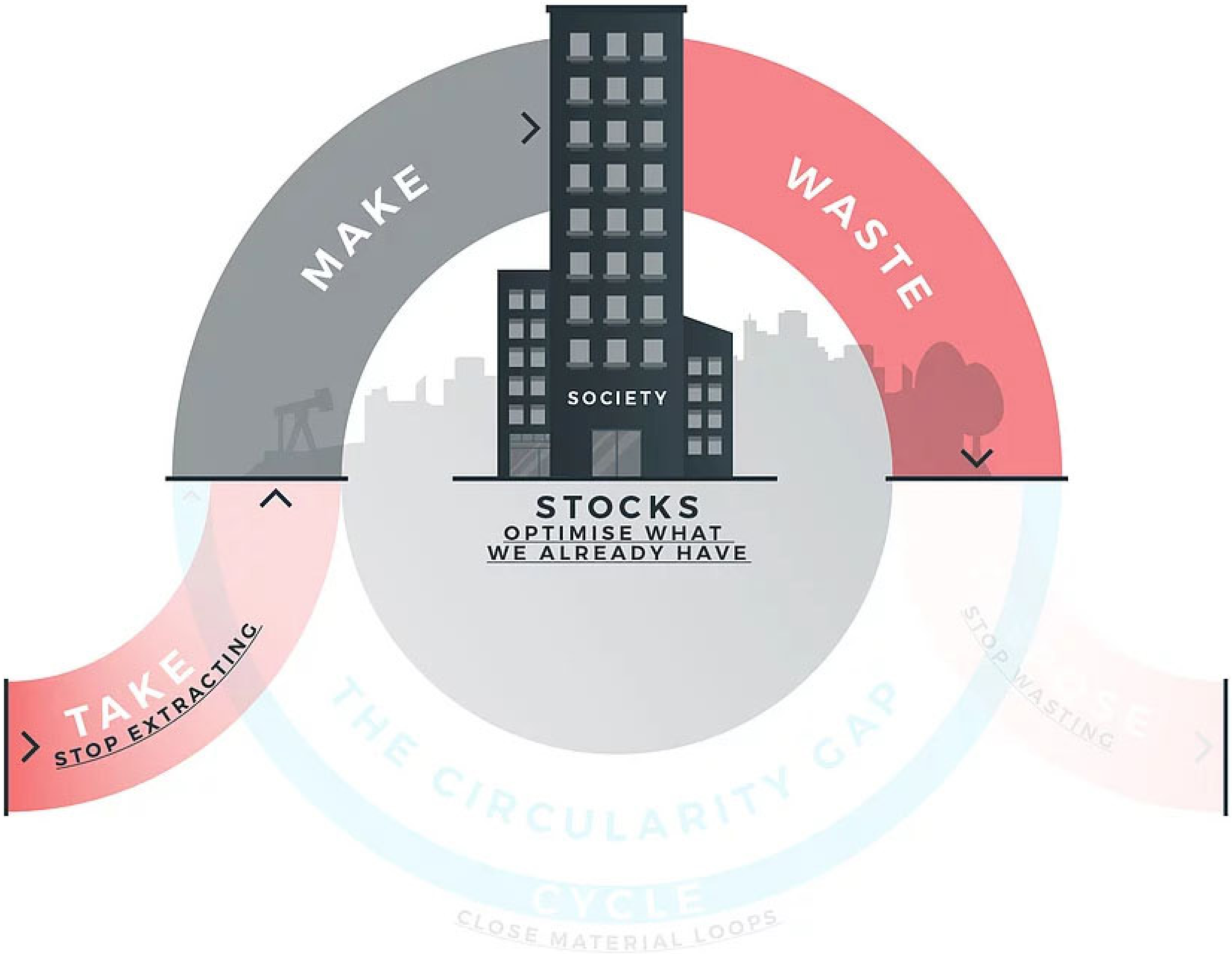
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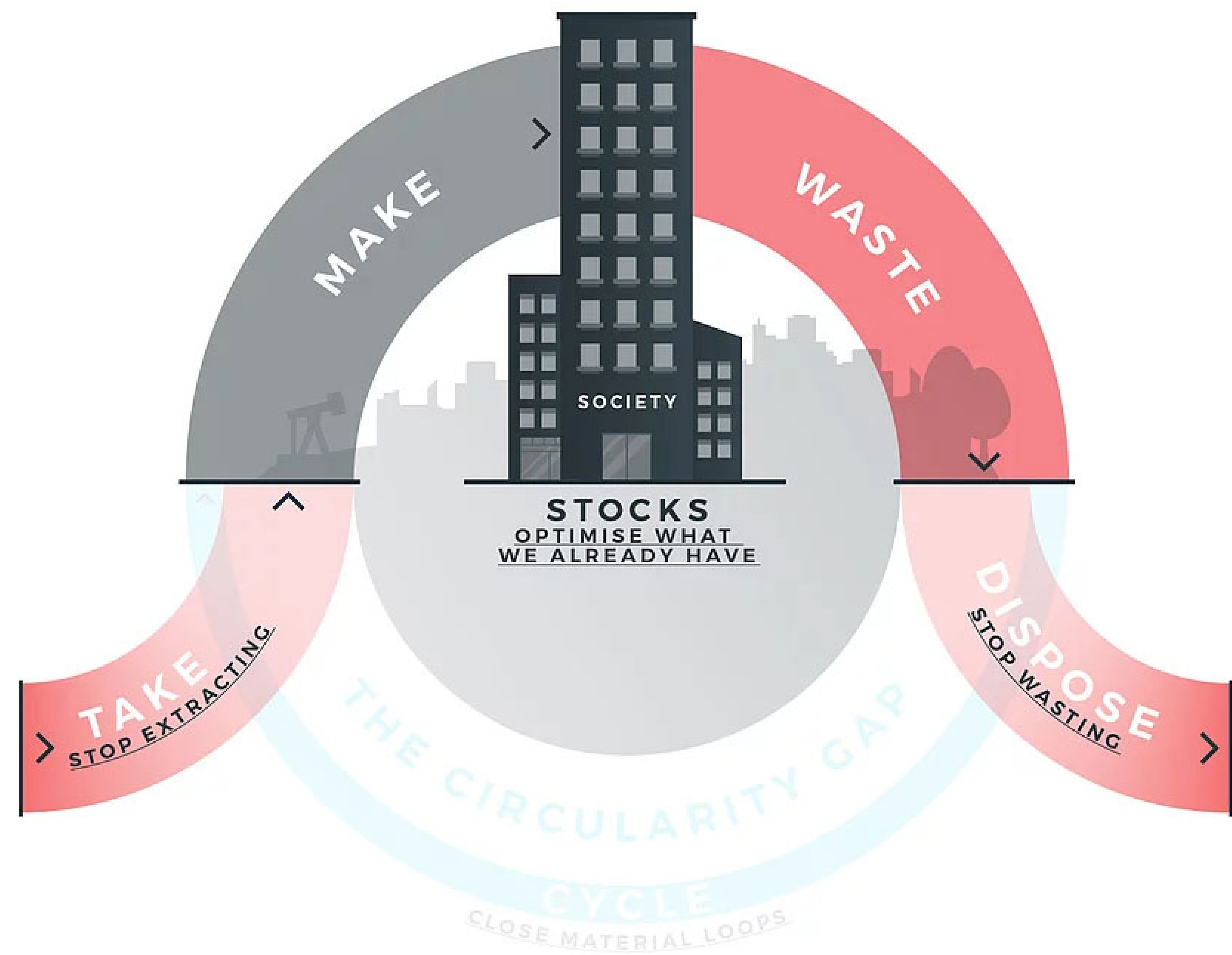
Closing the cycle





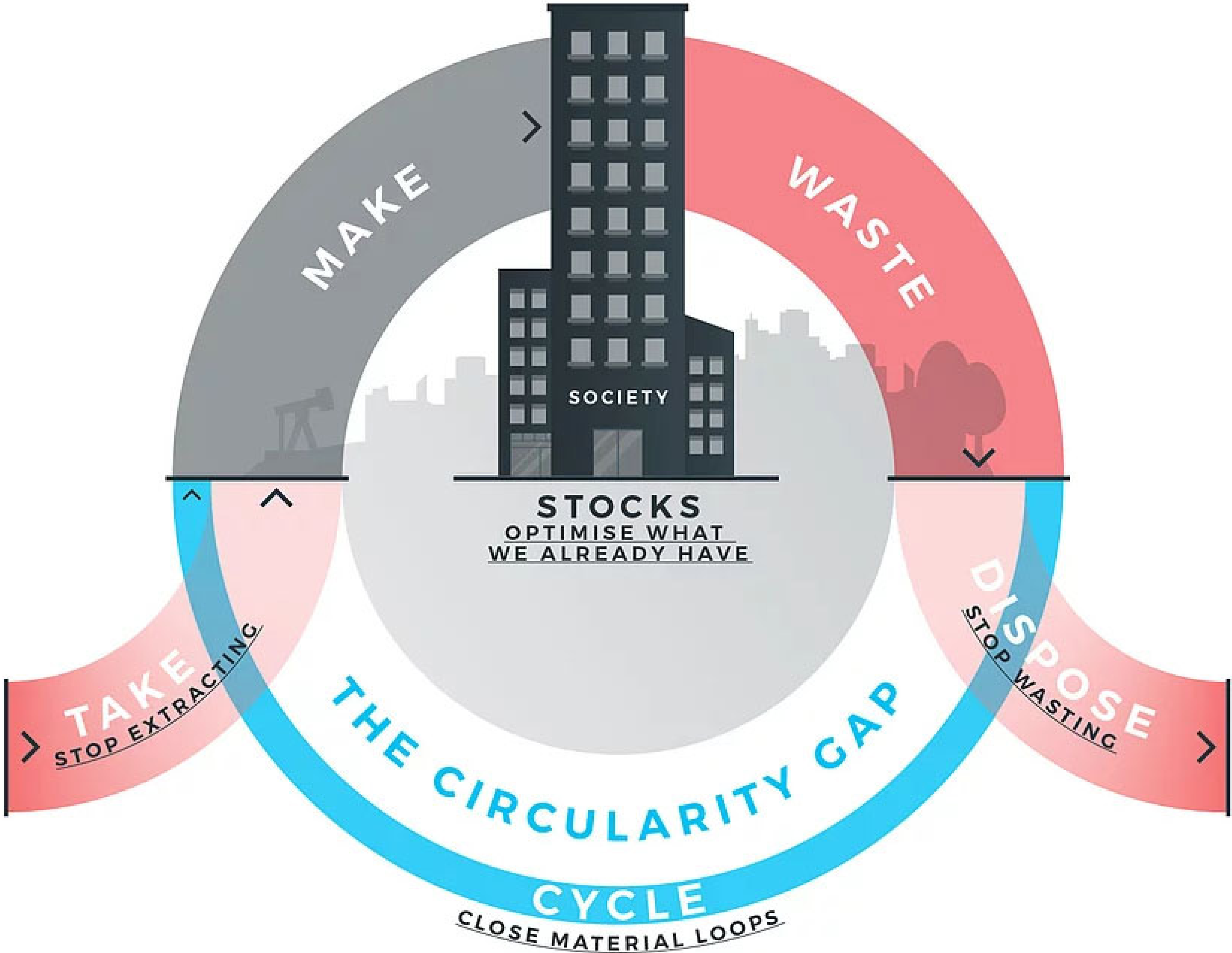
# A circular Economy

Closing the cycle



# A circular Economy

Closing the cycle



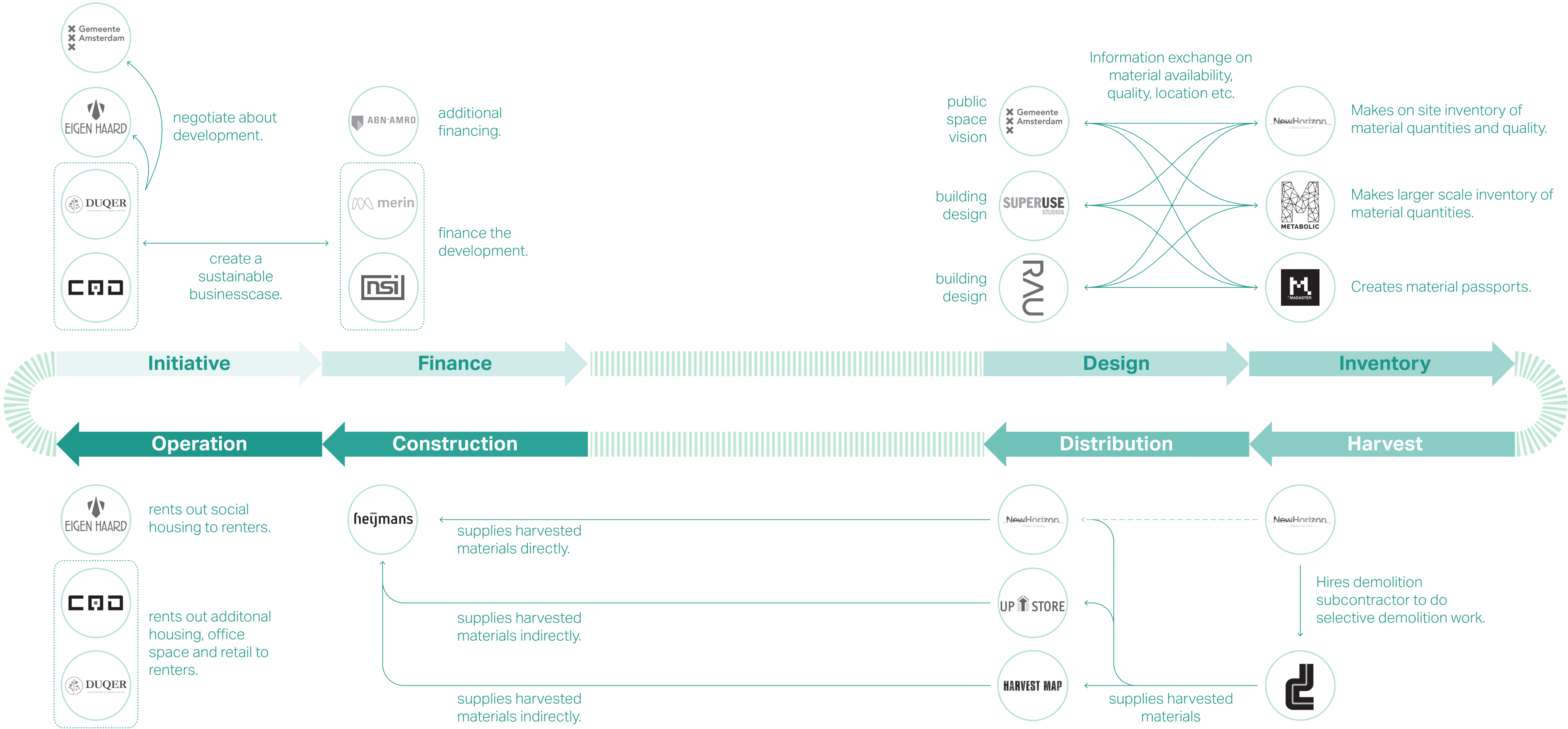
# A circular Economy

Closing the cycle



# Stakeholder Engagement

Connecting the dots





# Hullenbergweg 1-3

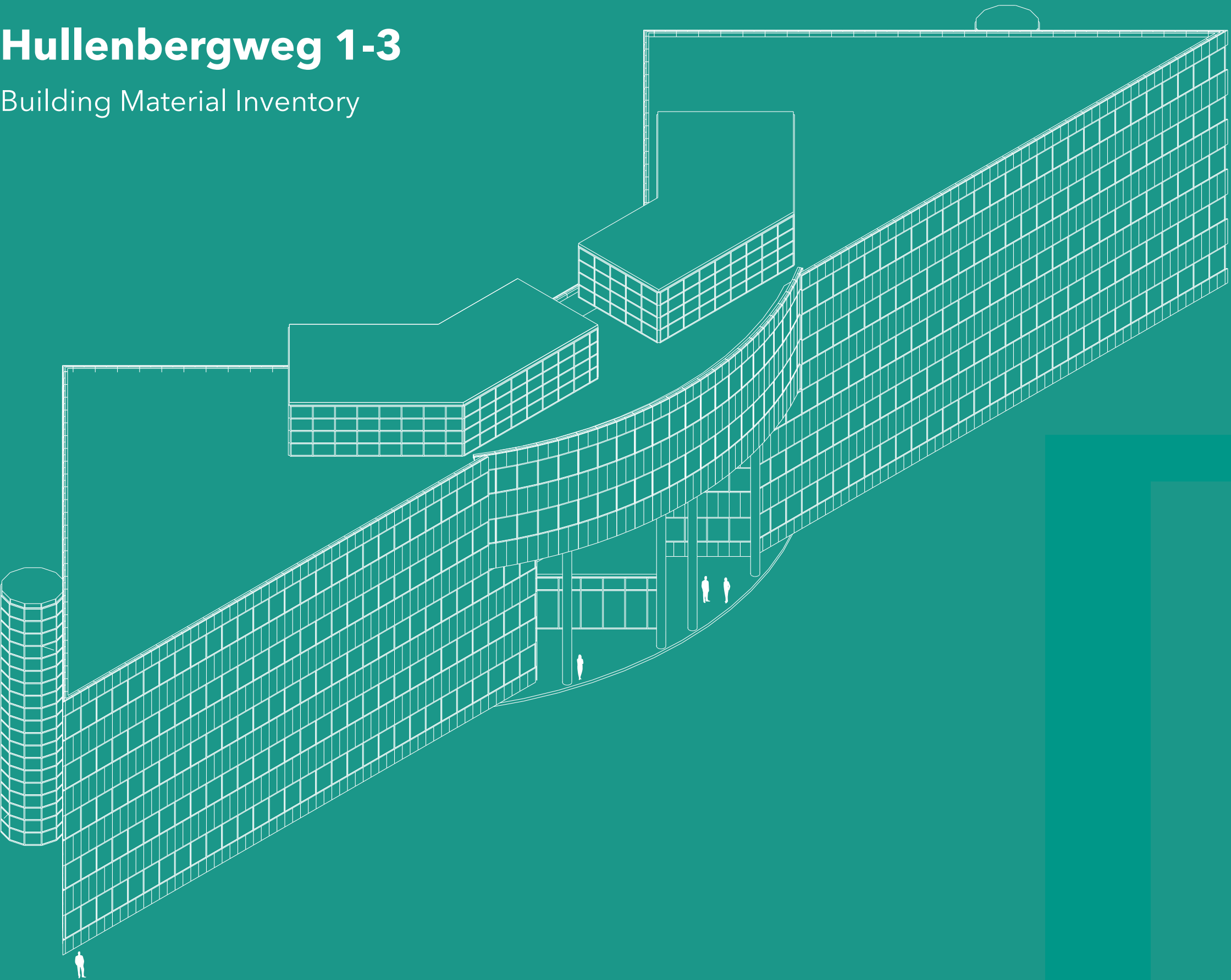
Material Glossary





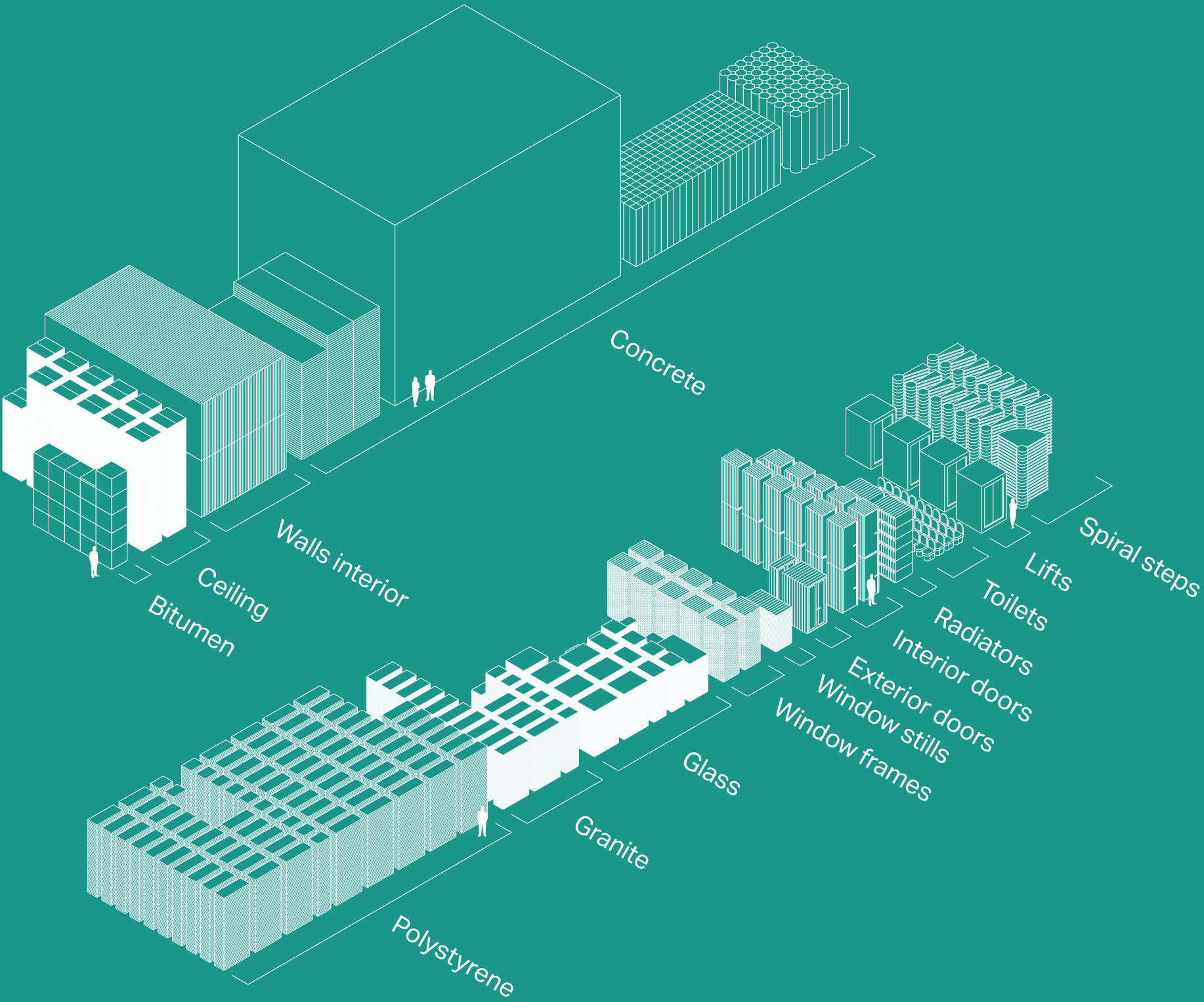
# Hullenbergweg 1-3

Building Material Inventory



## Material volume for upcycling

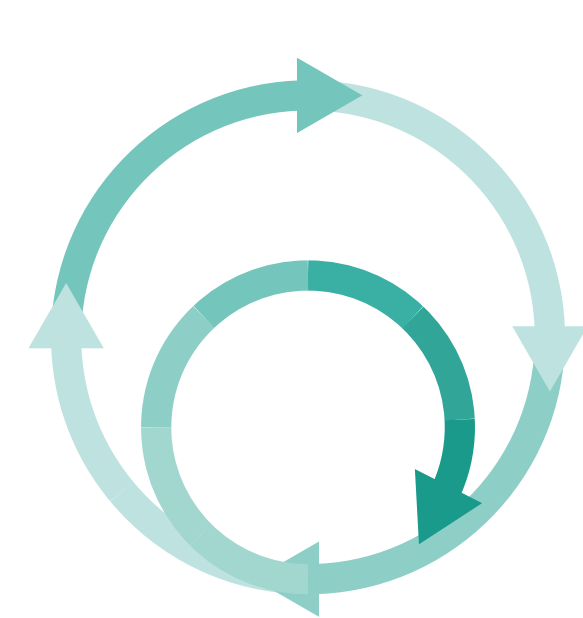
Concrete		1.750 m <sup>3</sup>	Lifts	4 pc
Granite panels	1.750 m <sup>2</sup>	52 m <sup>3</sup>	Toilets	41 pc
Polystyrene	4.100 m <sup>2</sup>	330 m <sup>3</sup>	Doors exterior	13 pc
Double glazing	2.300 m <sup>2</sup>	45 m <sup>3</sup>	Doors interior	228 pc
Bitumen	1.100 m <sup>2</sup>	21 m <sup>3</sup>	Radiators	240 pc
Ceiling	6.300 m <sup>2</sup>	125 m <sup>3</sup>	Spiral steps	288 pc
Walls interior	3.650 m <sup>2</sup>	365 m <sup>3</sup>		
Window frames	6.900 m <sup>2</sup>	50 m <sup>3</sup>		



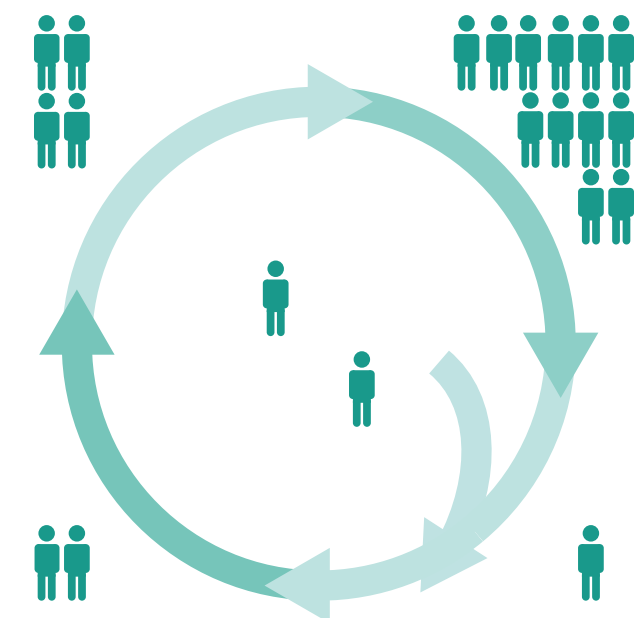
\* images are in relative scale to eachother

# Drivers

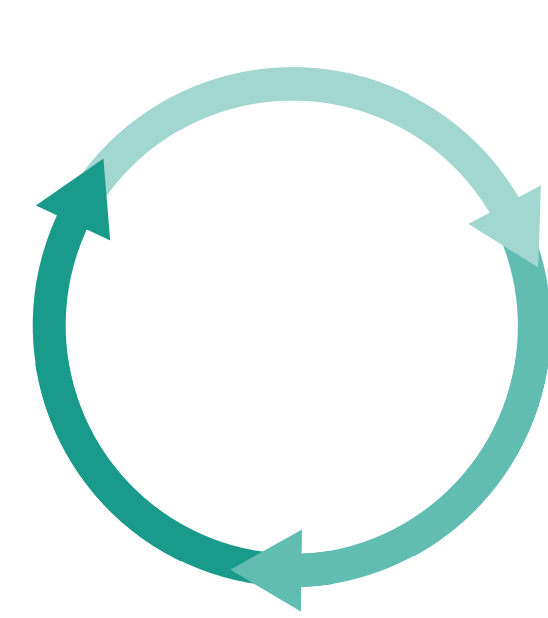
Key drivers for a circular transformation



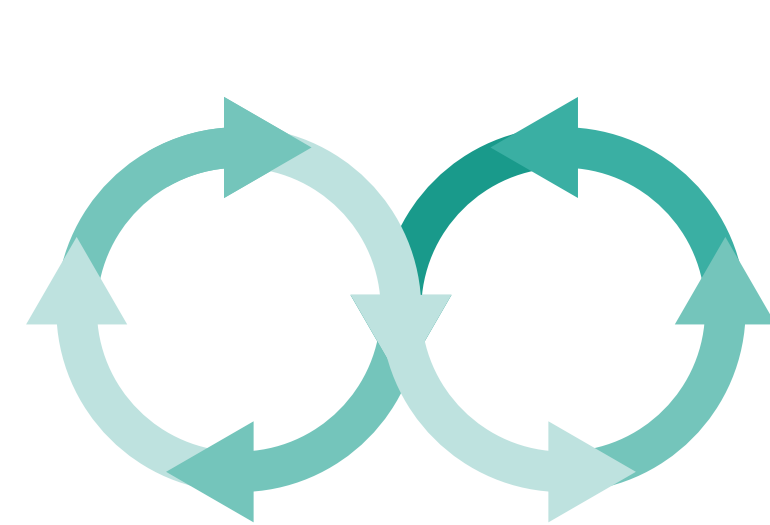
Robotic Refabrication



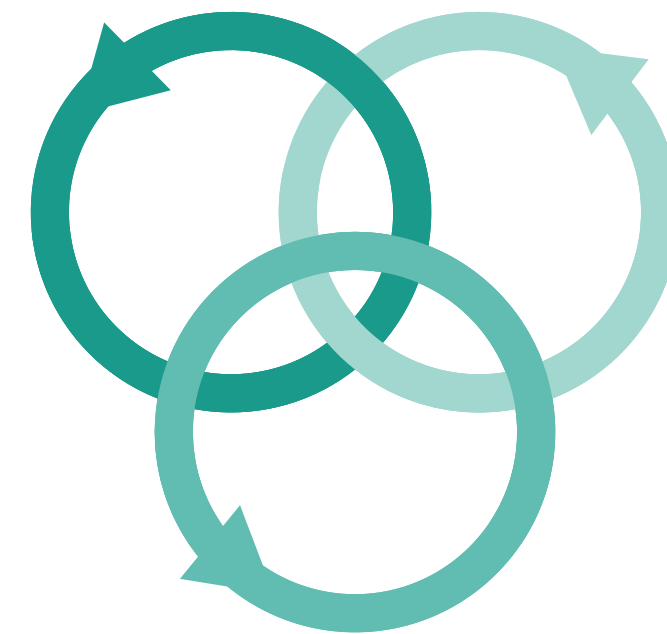
Community Engagement



Design for Disassembly



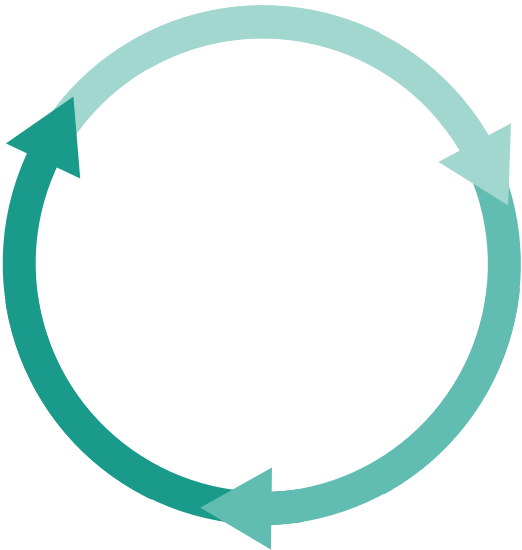
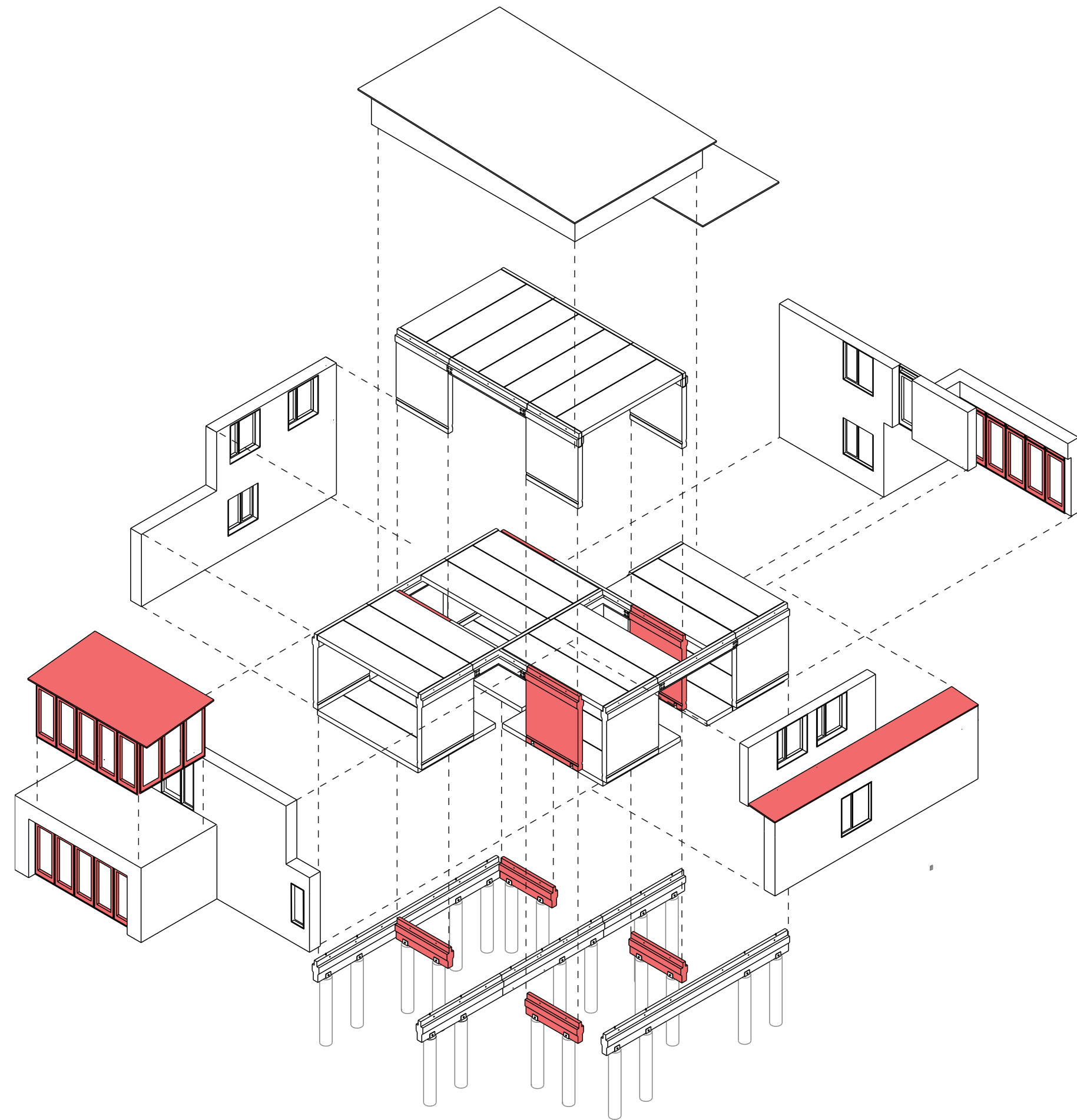
Component upcycling



Stakeholder Synergy

# Design for Disassembly

Driver overview



Design for Disassembly



# Design for Disassembly

## Case Study

Circle House project consists of 60 general housing units in Lisbjerg outside Aarhus, which is expected to be completed in 2020.

In addition to serving as housing, Circle House is a scalable demonstration project that can give the building industry new knowledge about circular construction. Circle House consists of a range of building systems that can be assembled, disassembled and reassembled into other buildings while keeping their economic and aesthetic values intact.

The objective is that 90% of the materials being used for the buildings, can be reused without losing significant value. A wide range of materials can be used in the project, the key is the approach of the principles of design for disassembly and circularity. As it is the system that is crucial, great architectural freedom is achieved for material selection in circular construction. The project will be built in the new residential area 'Lisbjerg Bakke', located in the north of Aarhus, currently undergoing a sustainable development plan. The residential typologies are a mix of 2 and 3 story terraced houses and 5-story tower blocks. The super structure of the 3 different typologies is built from the same 6 concrete elements, optimized for a quick construction, disassembly and reuse.

In order to transform the building industry to a circular building practice the entire value chain of the industry needs to be engaged. The Circle House project involves more than 30 Danish companies across the entire industry. The Circle House project aims to develop, propagate and anchor knowledge about circular construction in the industry. As an example of this the architectural development of the project was made in as a so called 'collaboration studio', a joint team consisting of four companies with sustainability as their foundation, Vandkunsten, Lendager Group and 3XN Architects with the professional facilitation and coordination by GXN Innovation.



Project Circle House  
Location Copenhagen  
Year 2018  
Owner Lejerbo  
Architects Lendager Group, Vandkunsten, 3XN architects  
Photo Helene Høyer Mikkelsen







### Upcycle Amstel

Amstel III  
re-cycle, re-use  
Waste & Up-cycle  
Design for Disassembly.



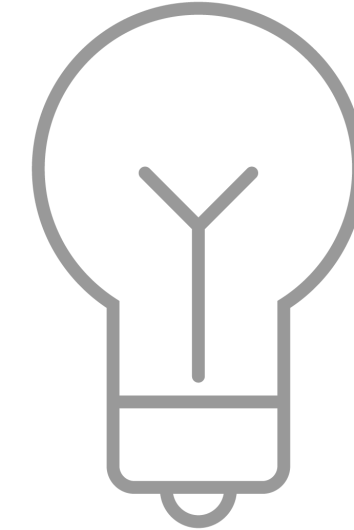
### Research

Circular Components



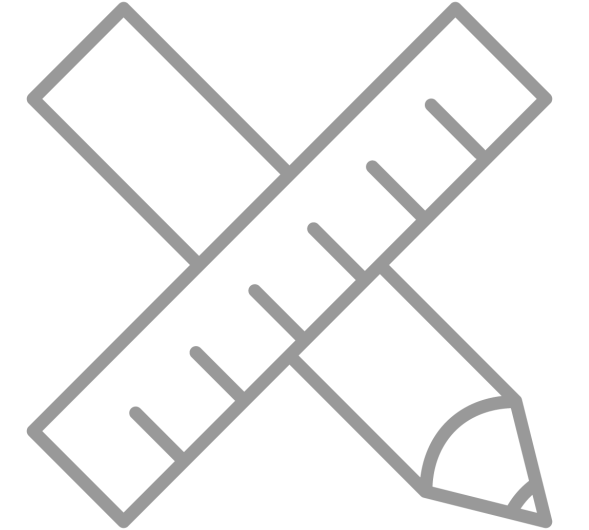
### Urban plan

Amstel III  
Main street  
Park



### Concept

Cultural Meeting spot.  
Circular Demonstrator.  
Innovation hub.



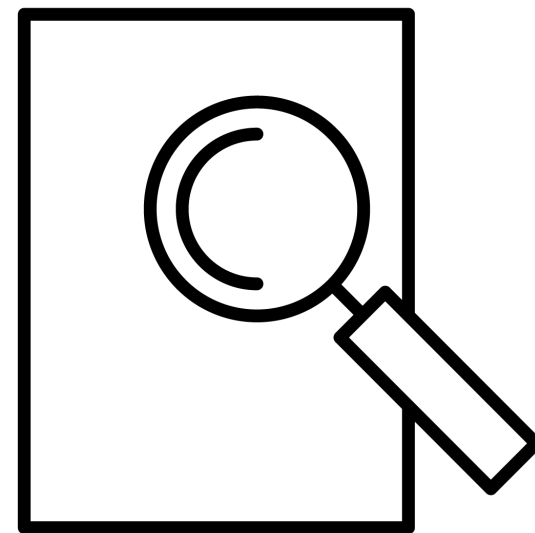
### Design

Program  
Volume study.



### Upcycle Amstel

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re-cycle, re-use  
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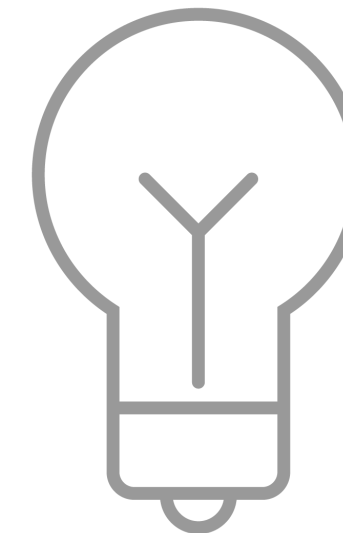
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Circular Components



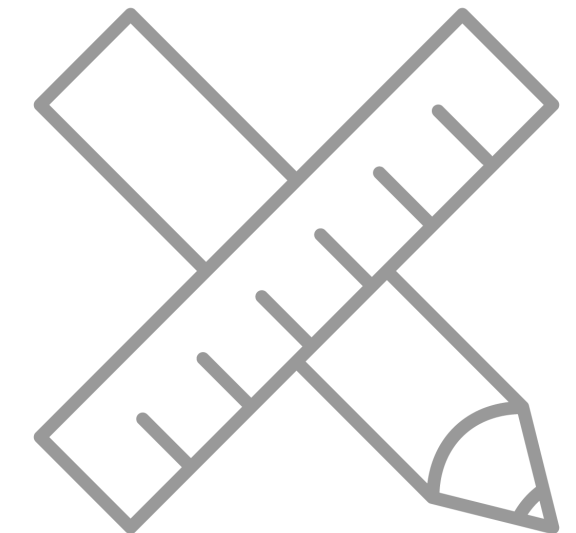
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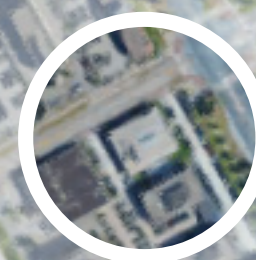
Gebiedskaart





# Amstel III

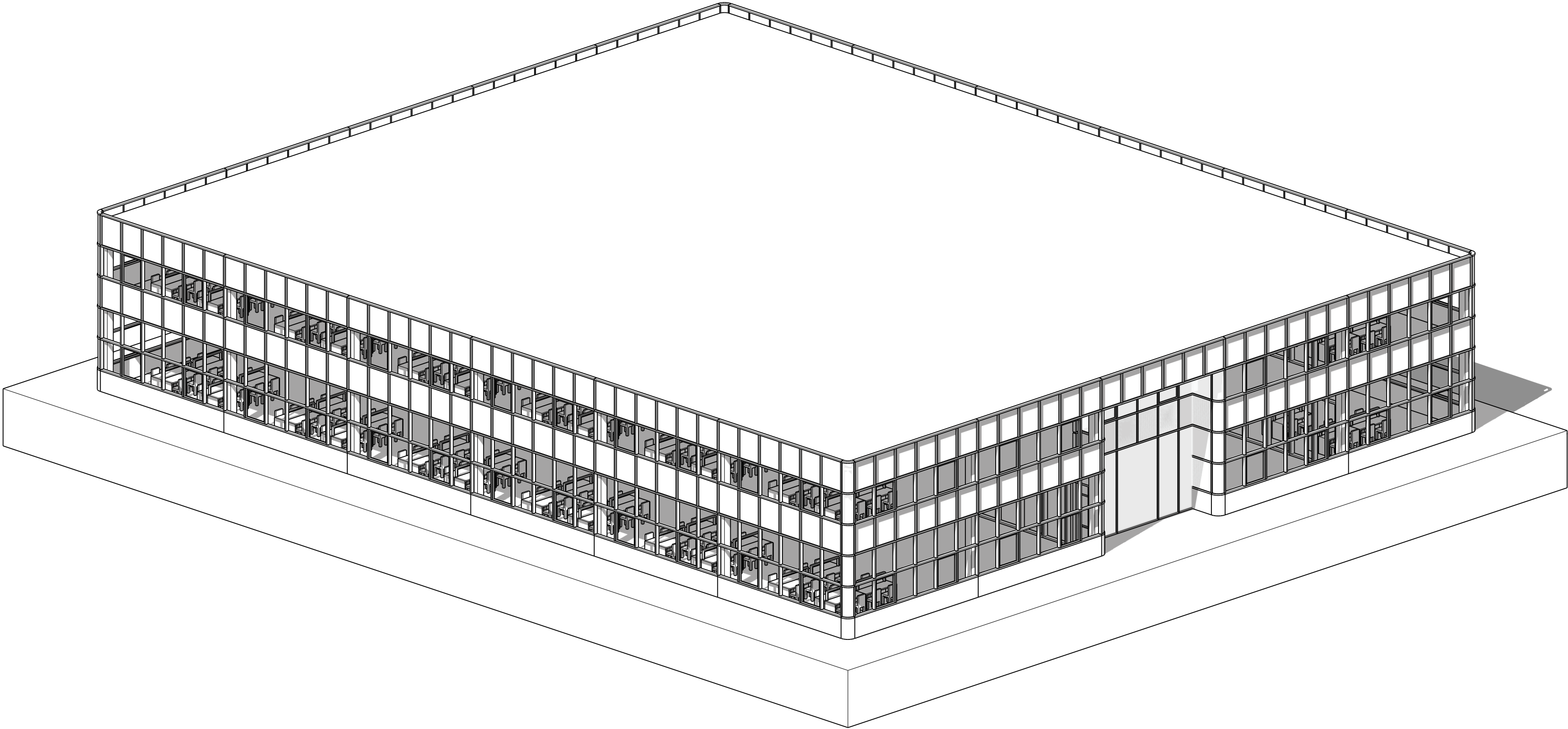
Gebiedskaart





# Hessenbergweg 8

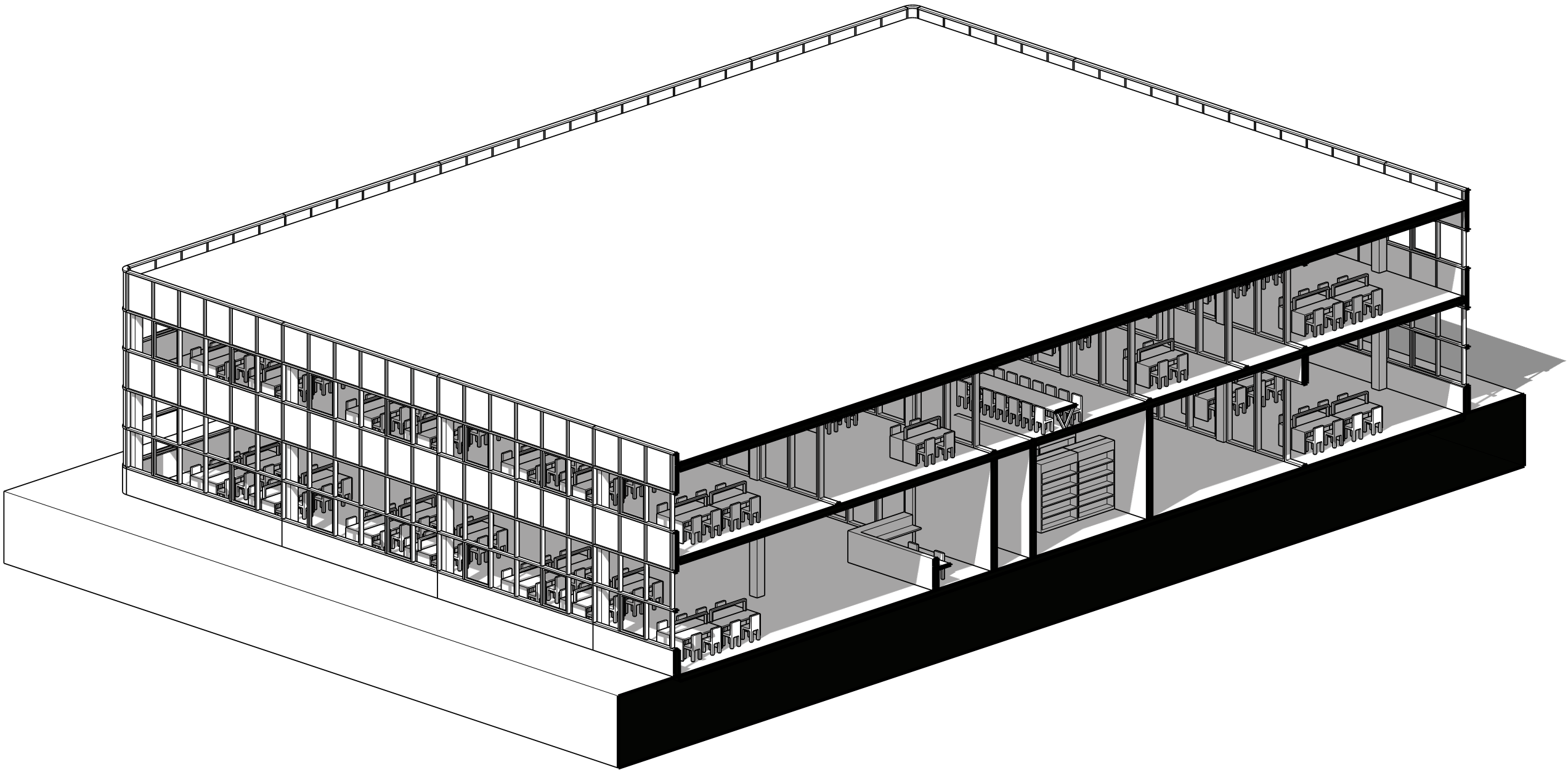
1986 building





# Hessenbergweg 8

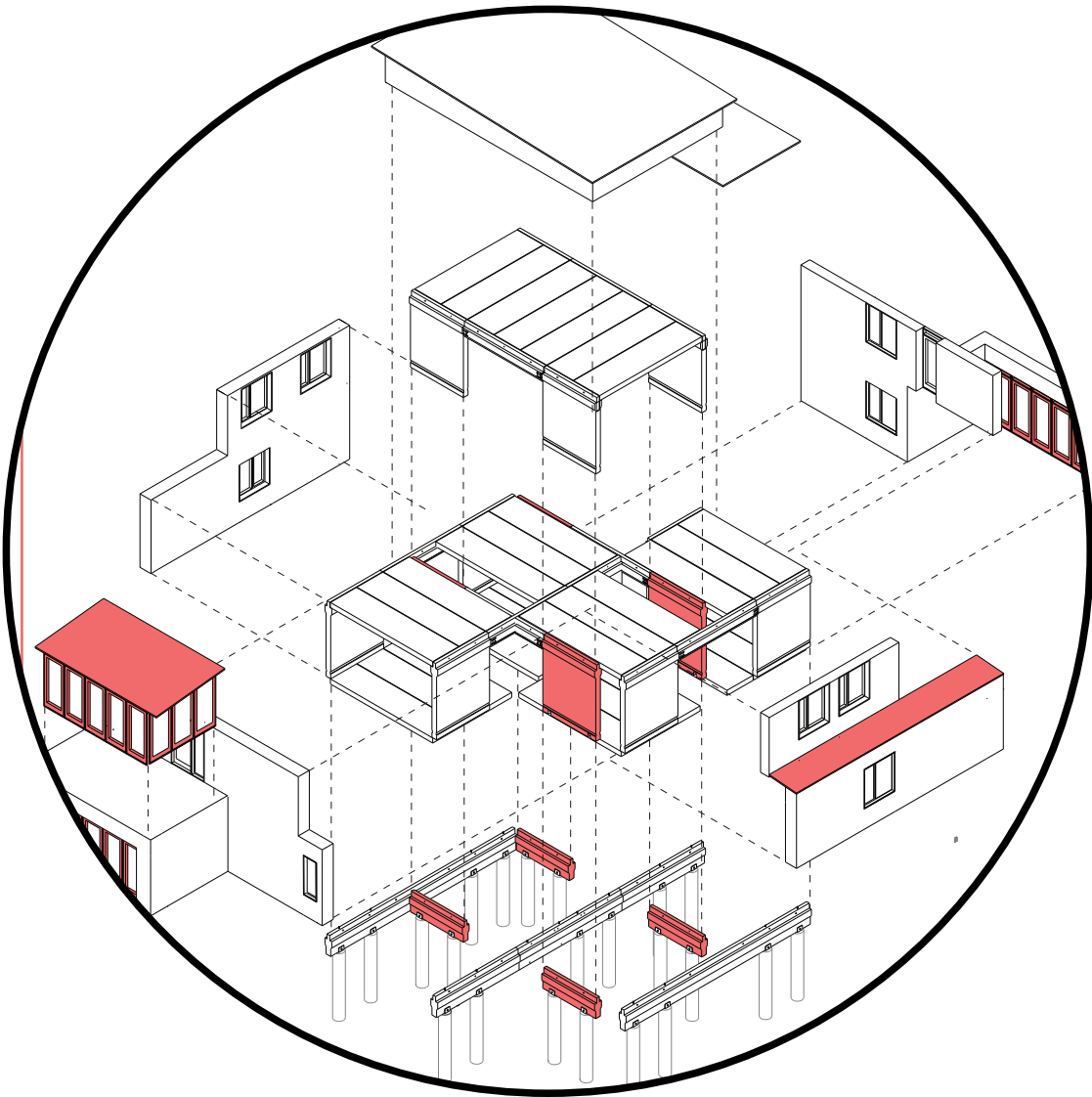
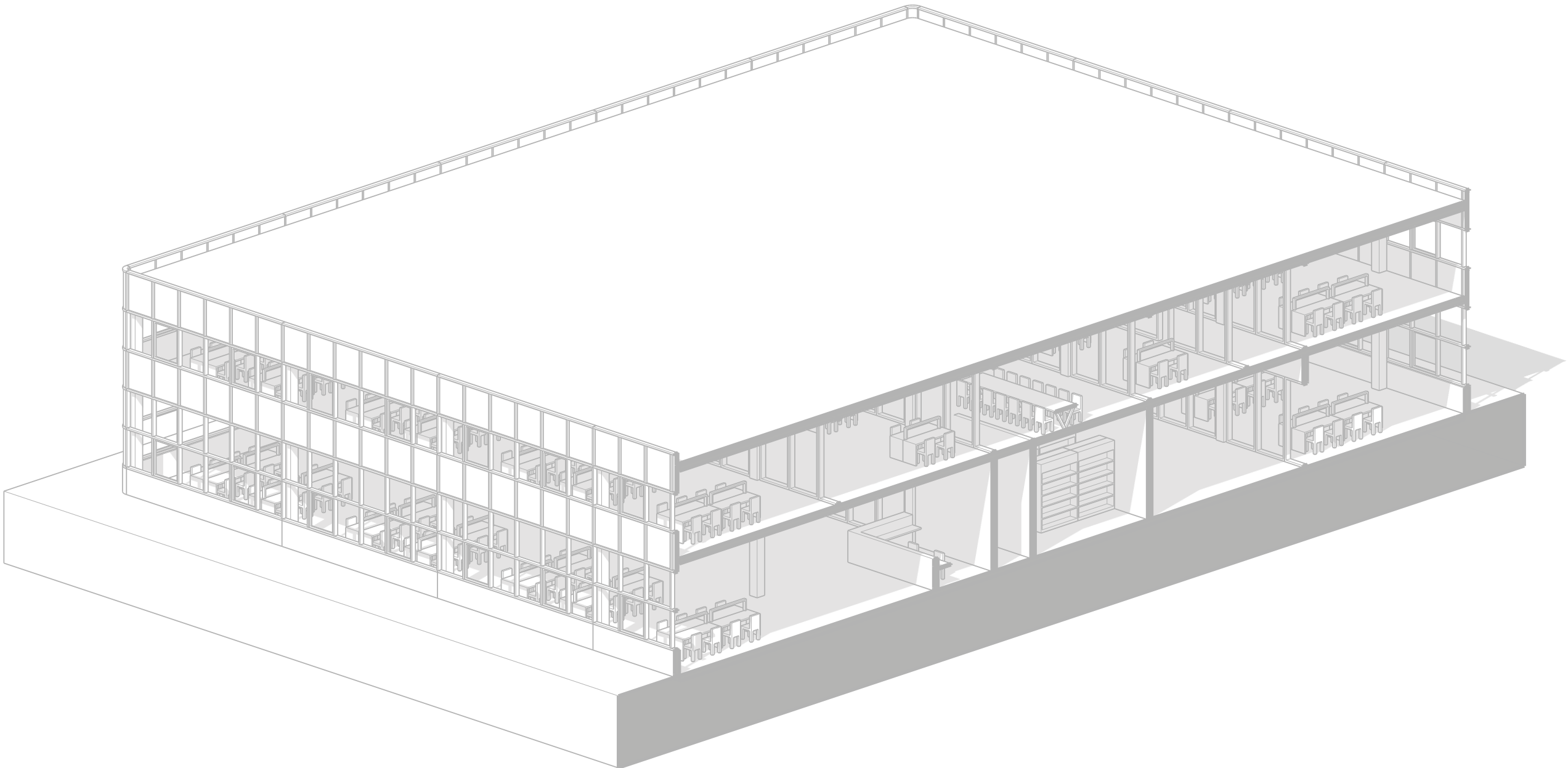
1986 building: Section





Hessenbergweg 8

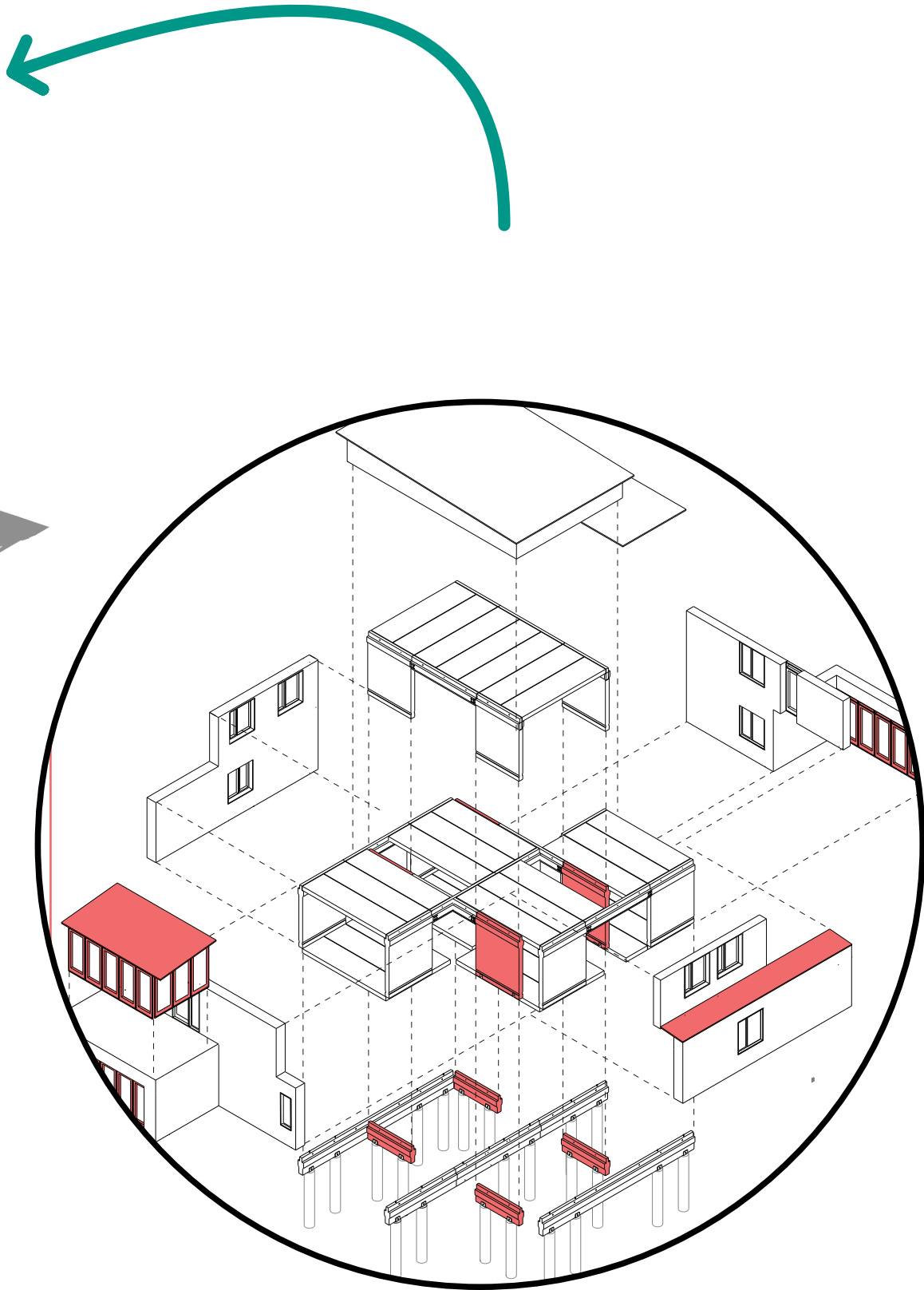
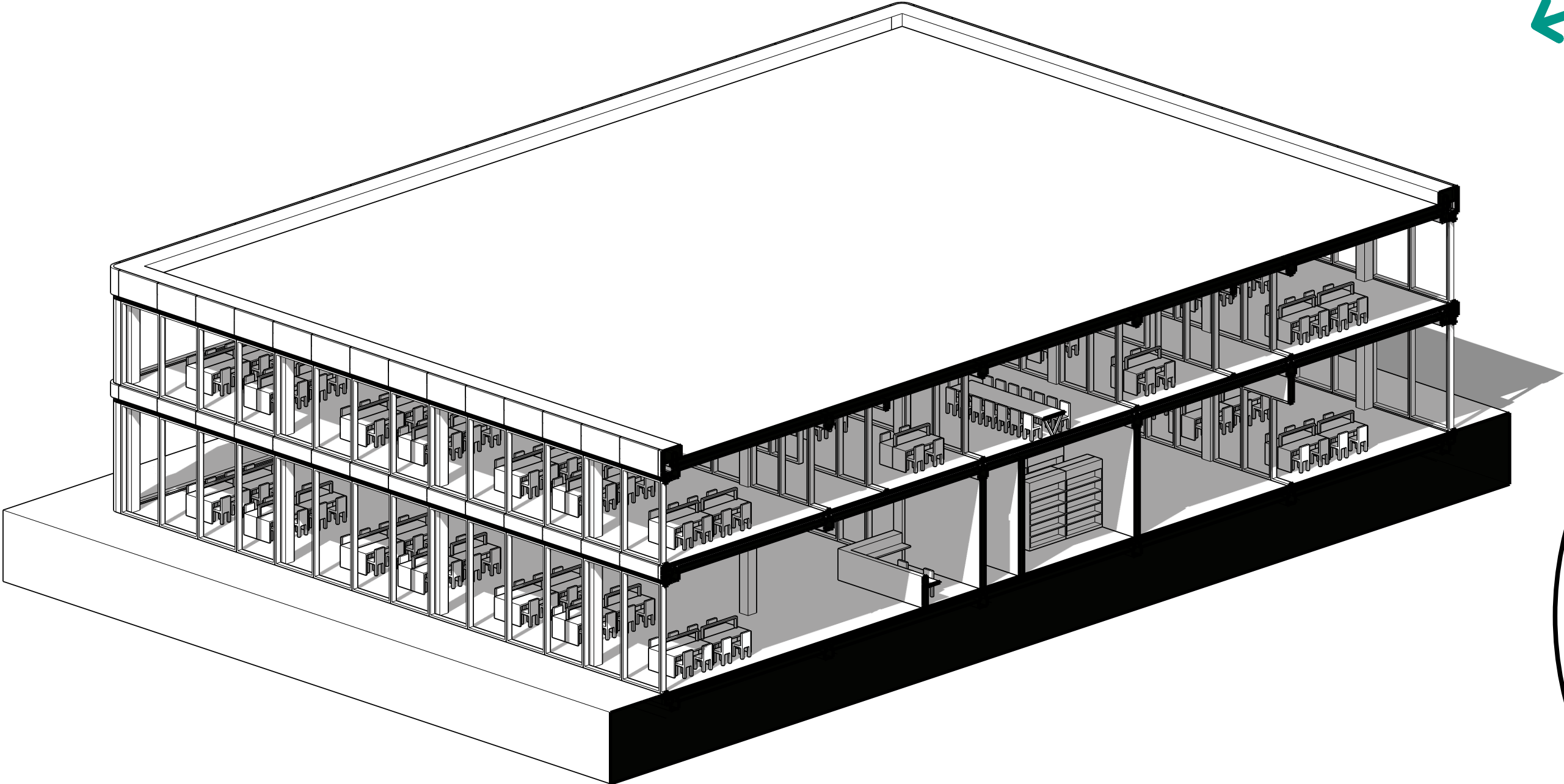
1986 building: Section





# Circle Building

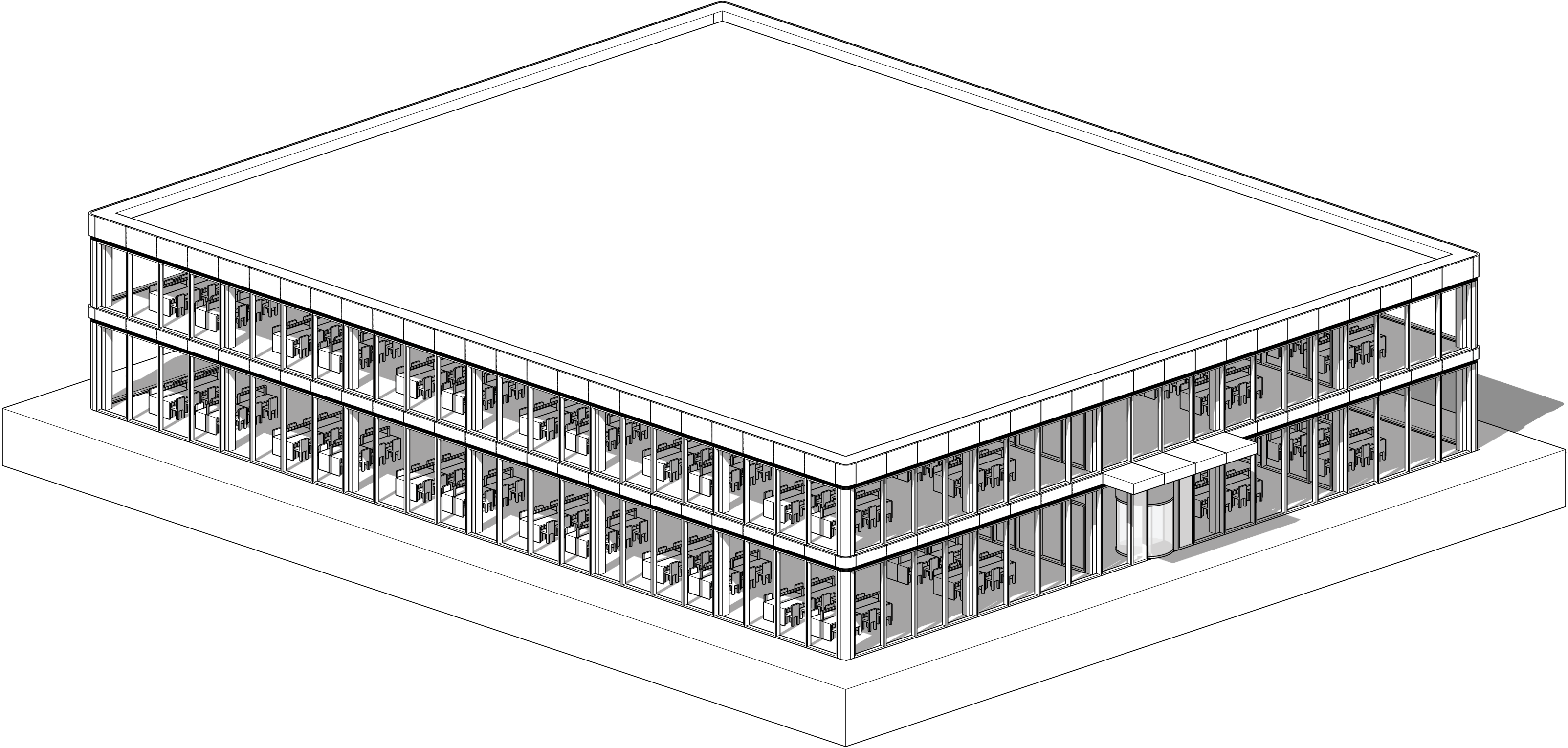
Circular construction methods that allow for Disassembly.





# Circle Building

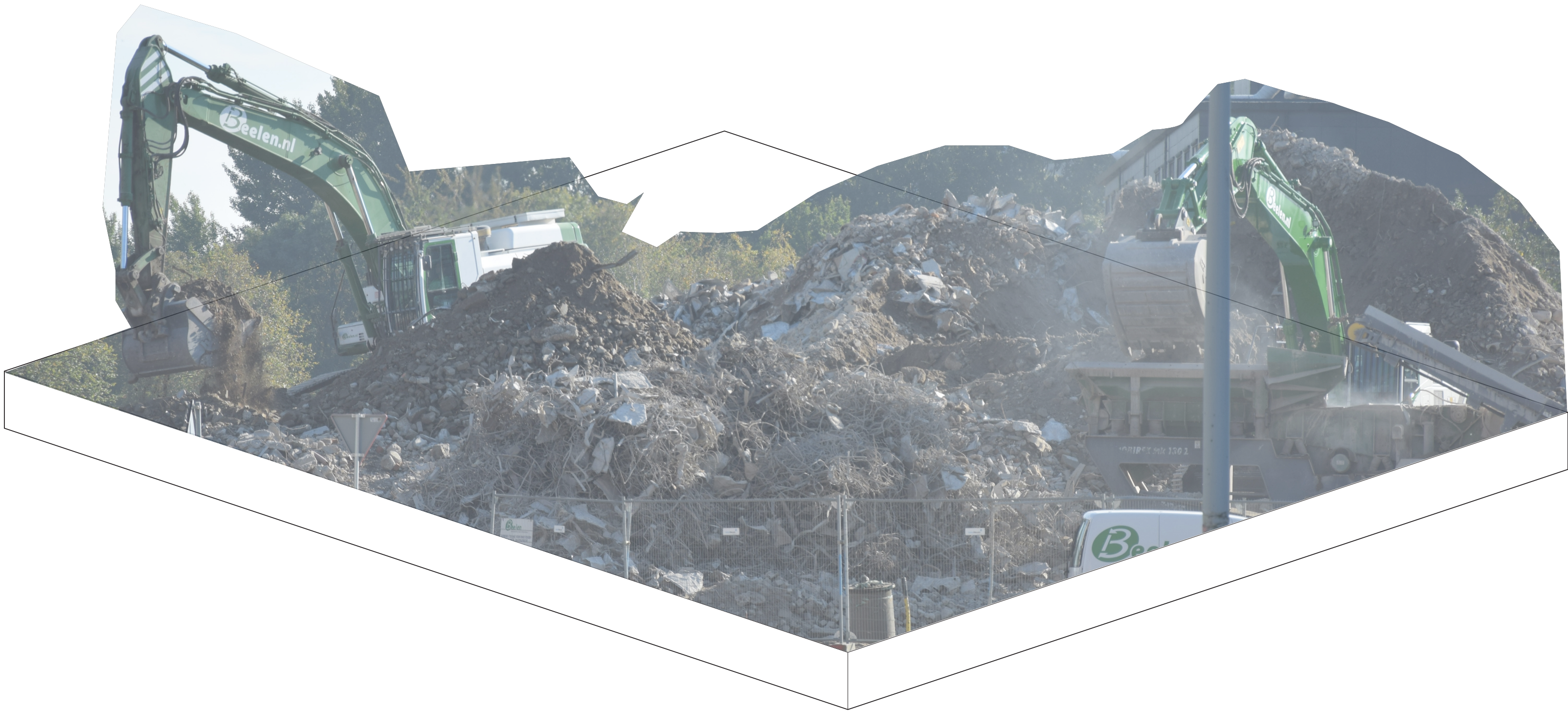
Circular construction methods that allow for Disassembly.





# The current End-of-life state of buildings.

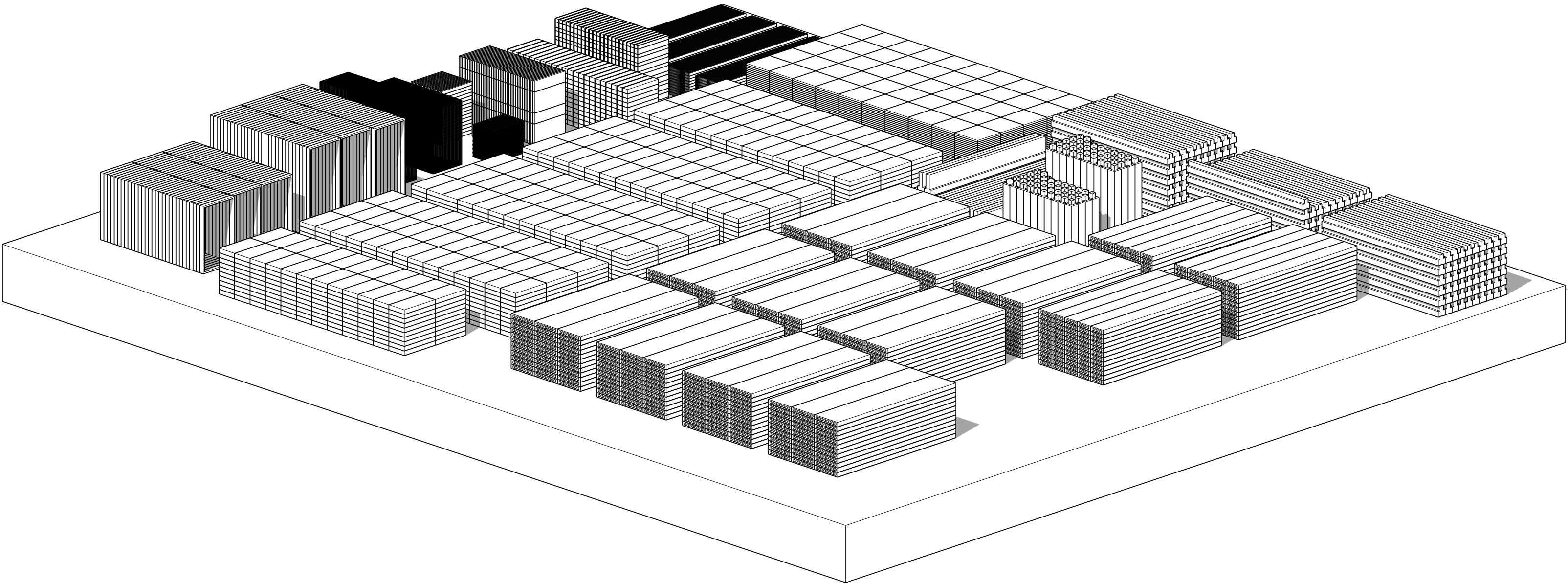
Rubble that can hardly be re-used or recycled.





# Circle Components

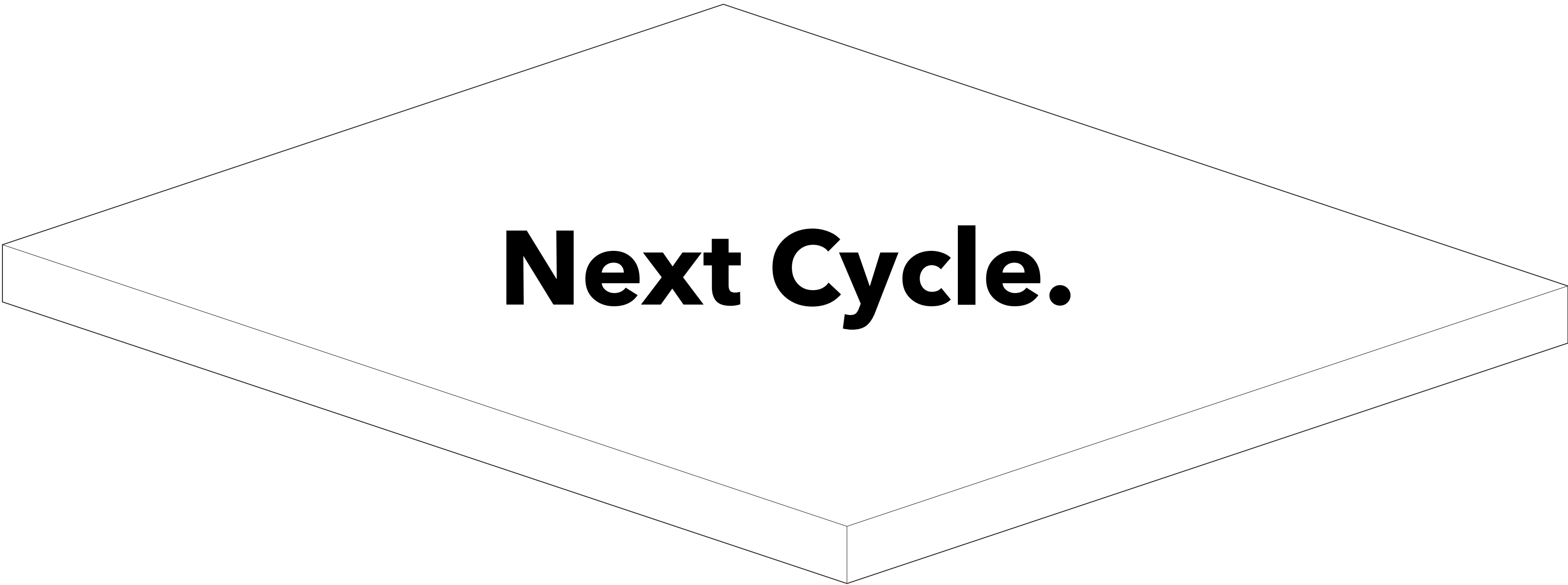
Disassembled.





# Circle Components

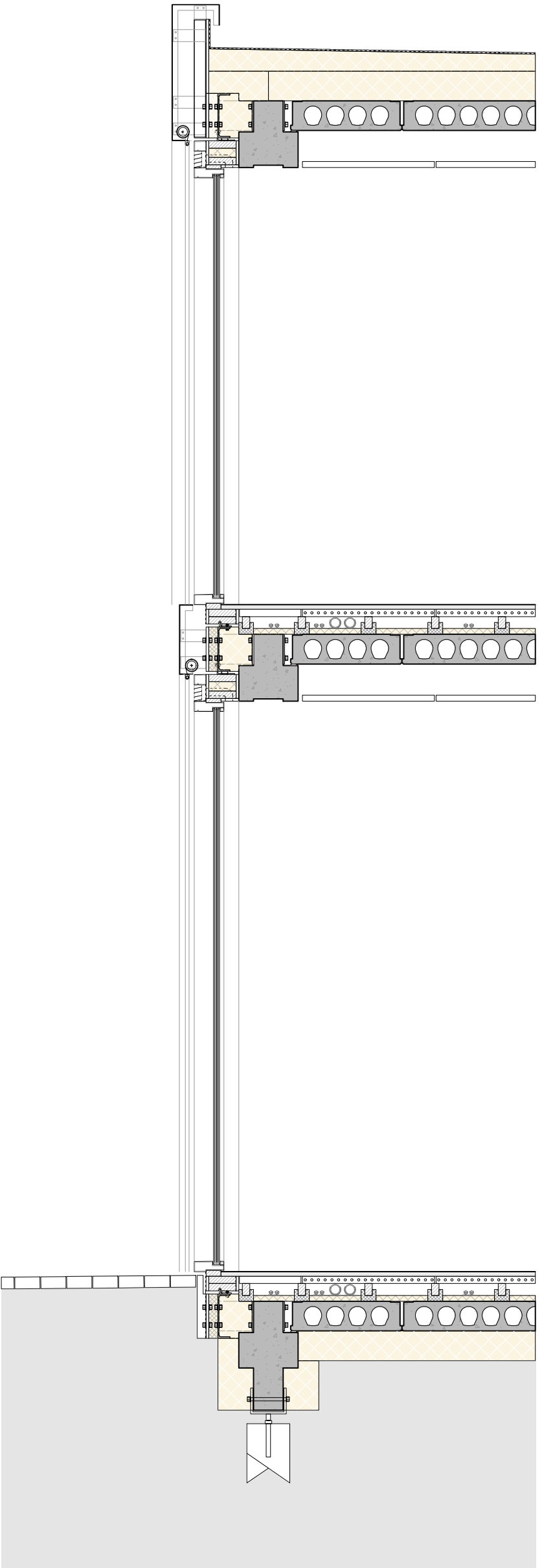
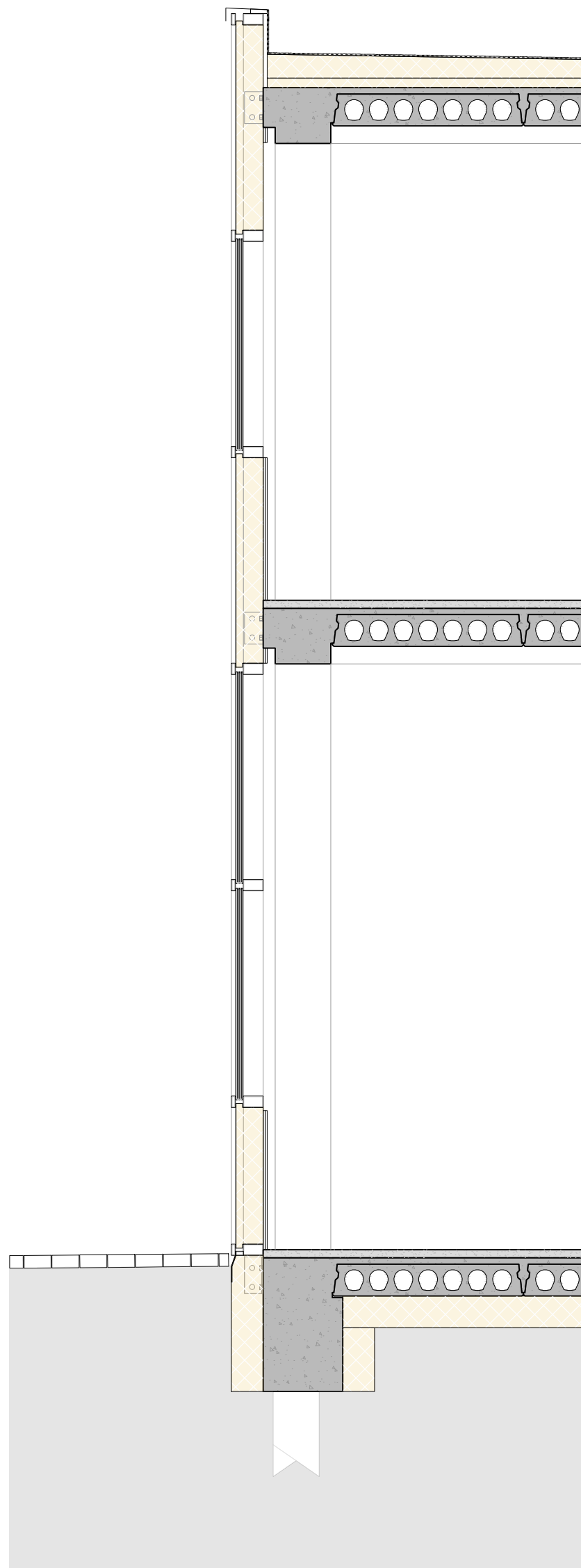
Disassembled.





# Circle Components

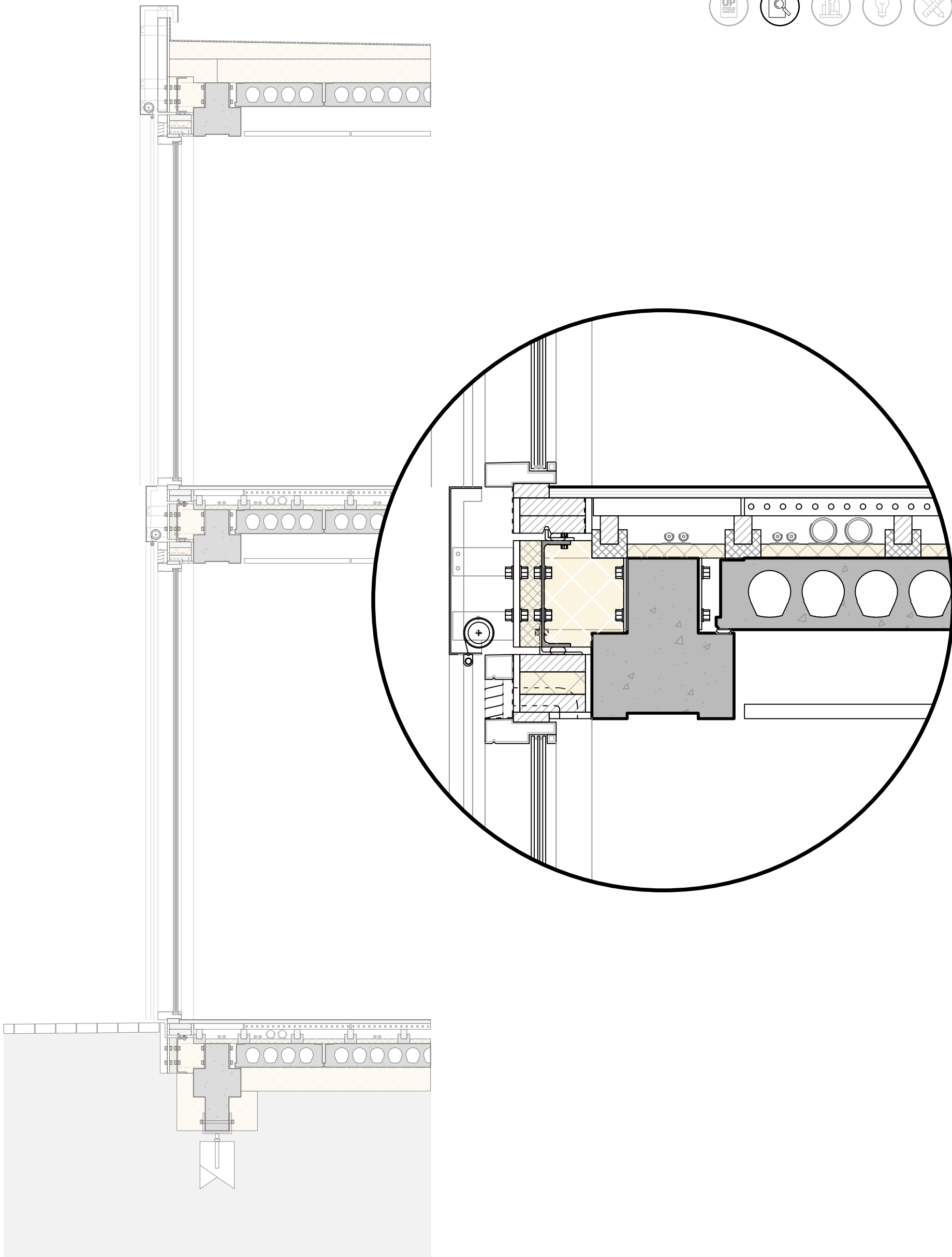
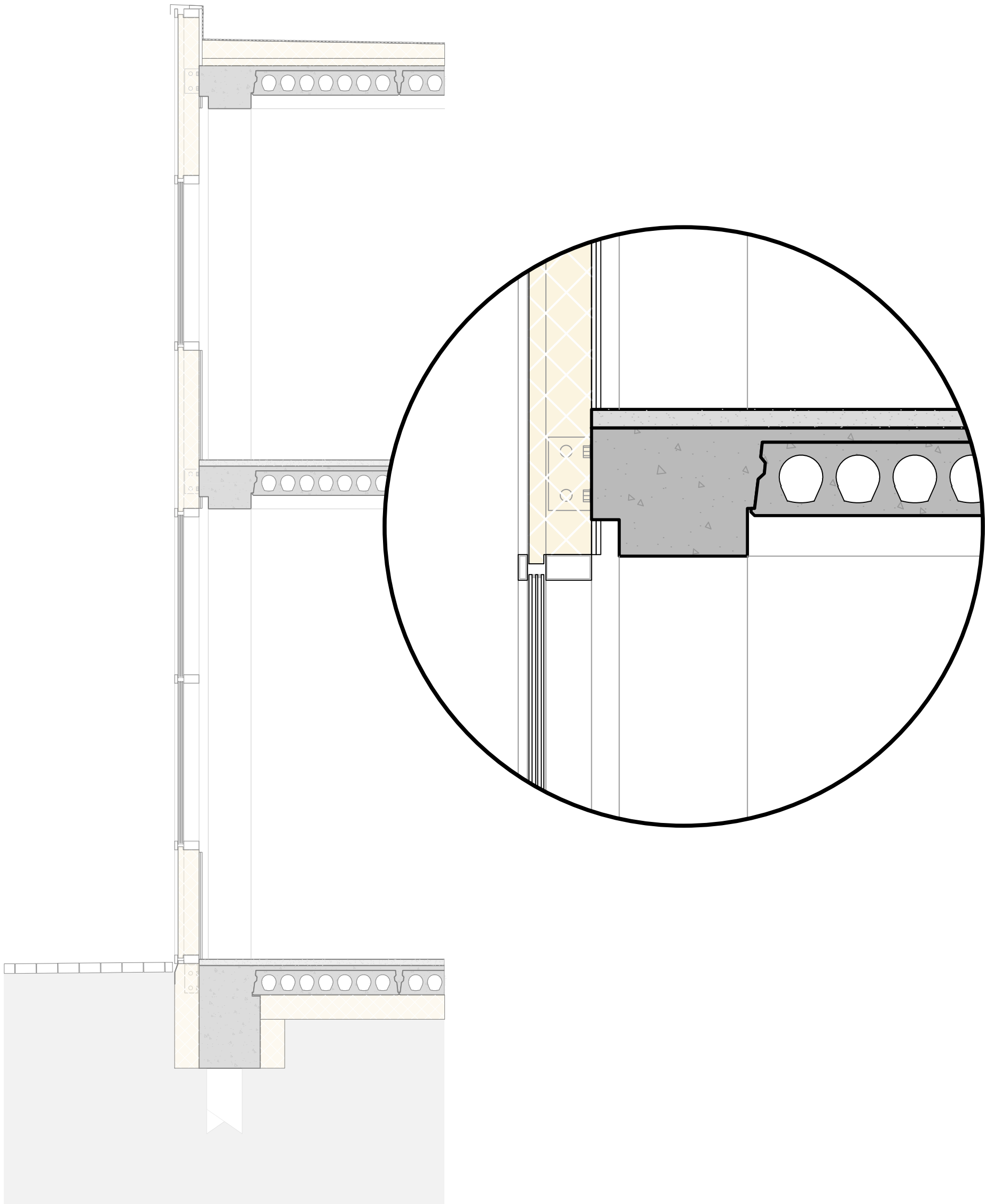
Detail Comparison.





# Circle Components

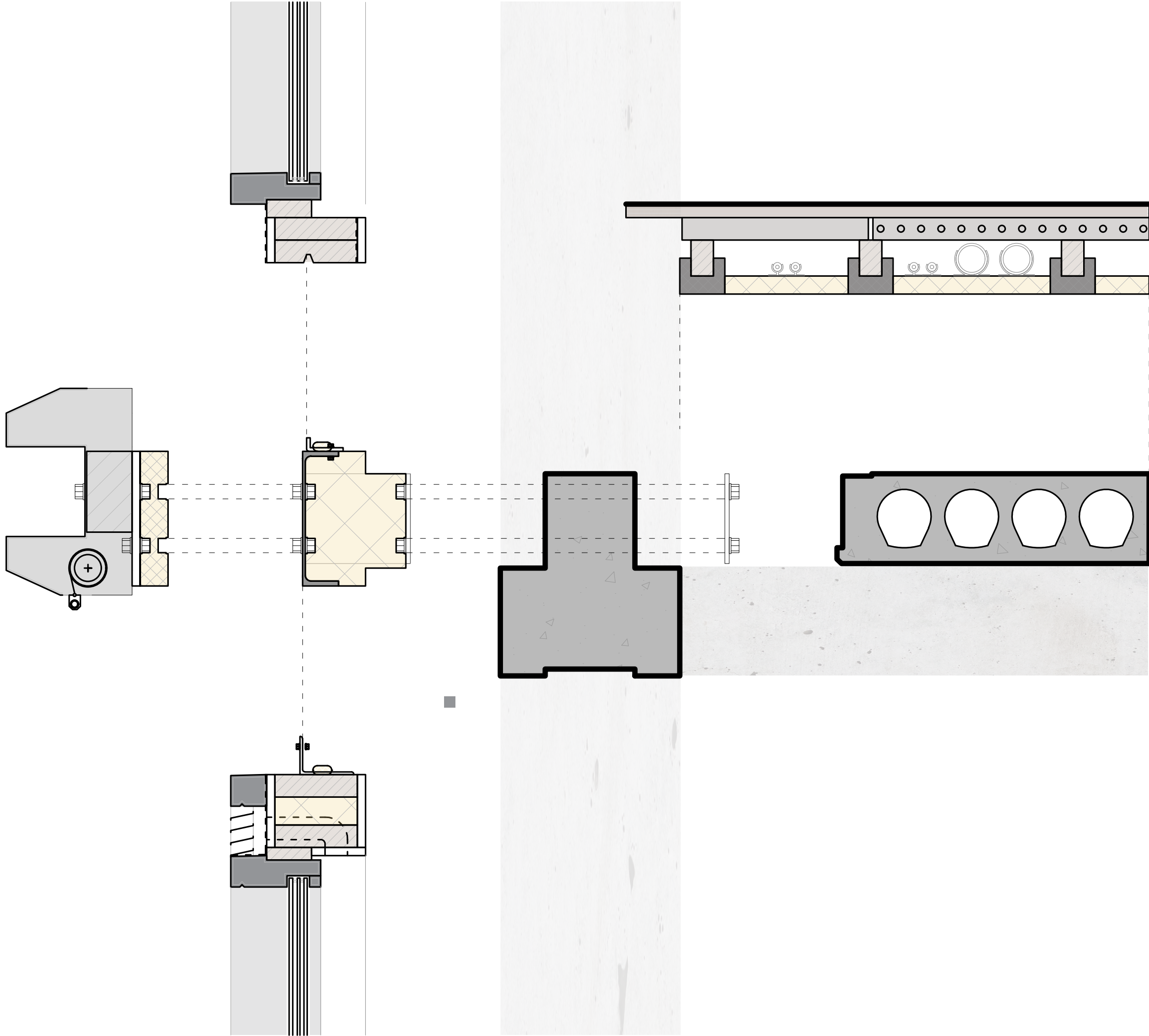
Detail Comparison.





Details.

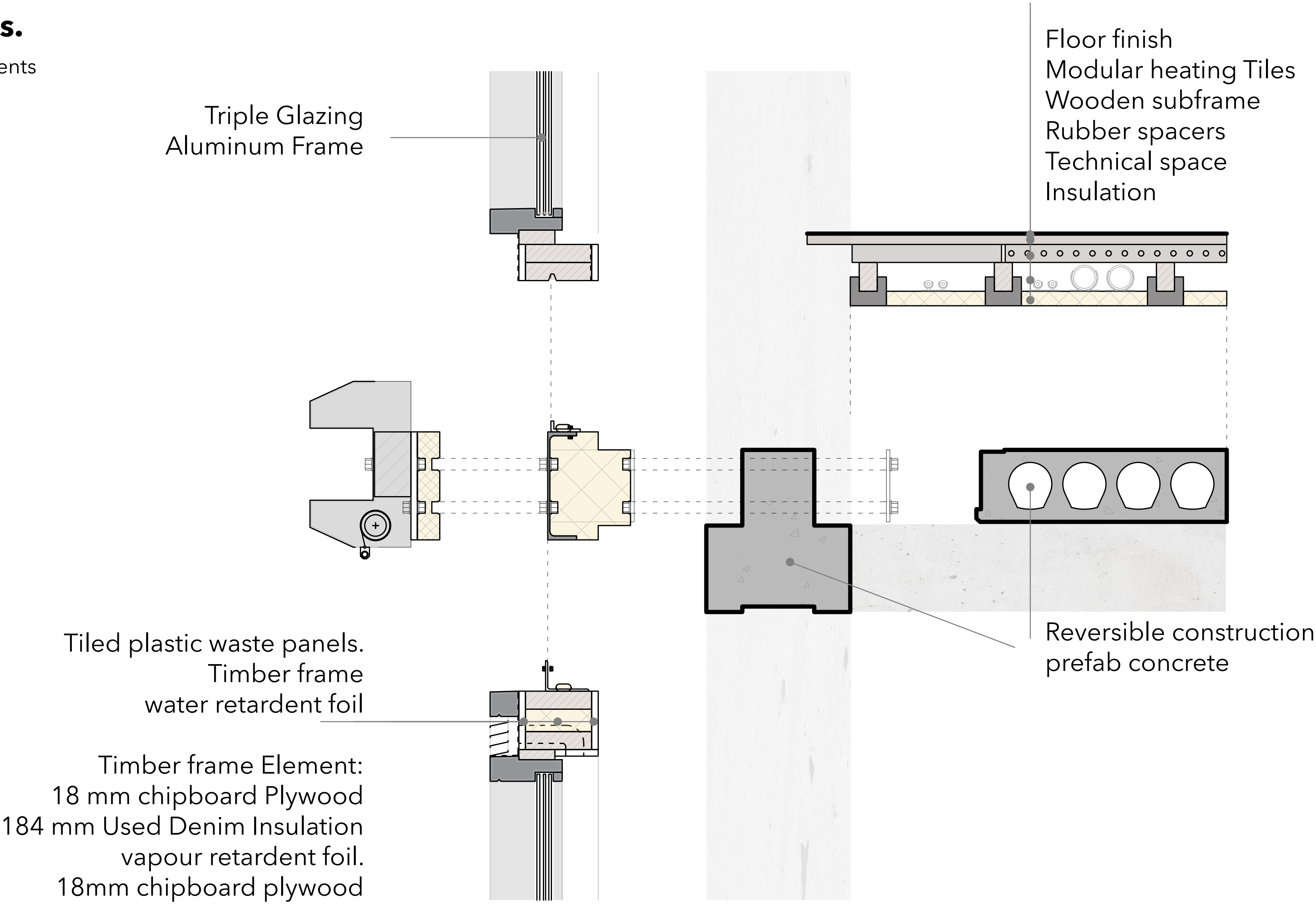
Components





Details.

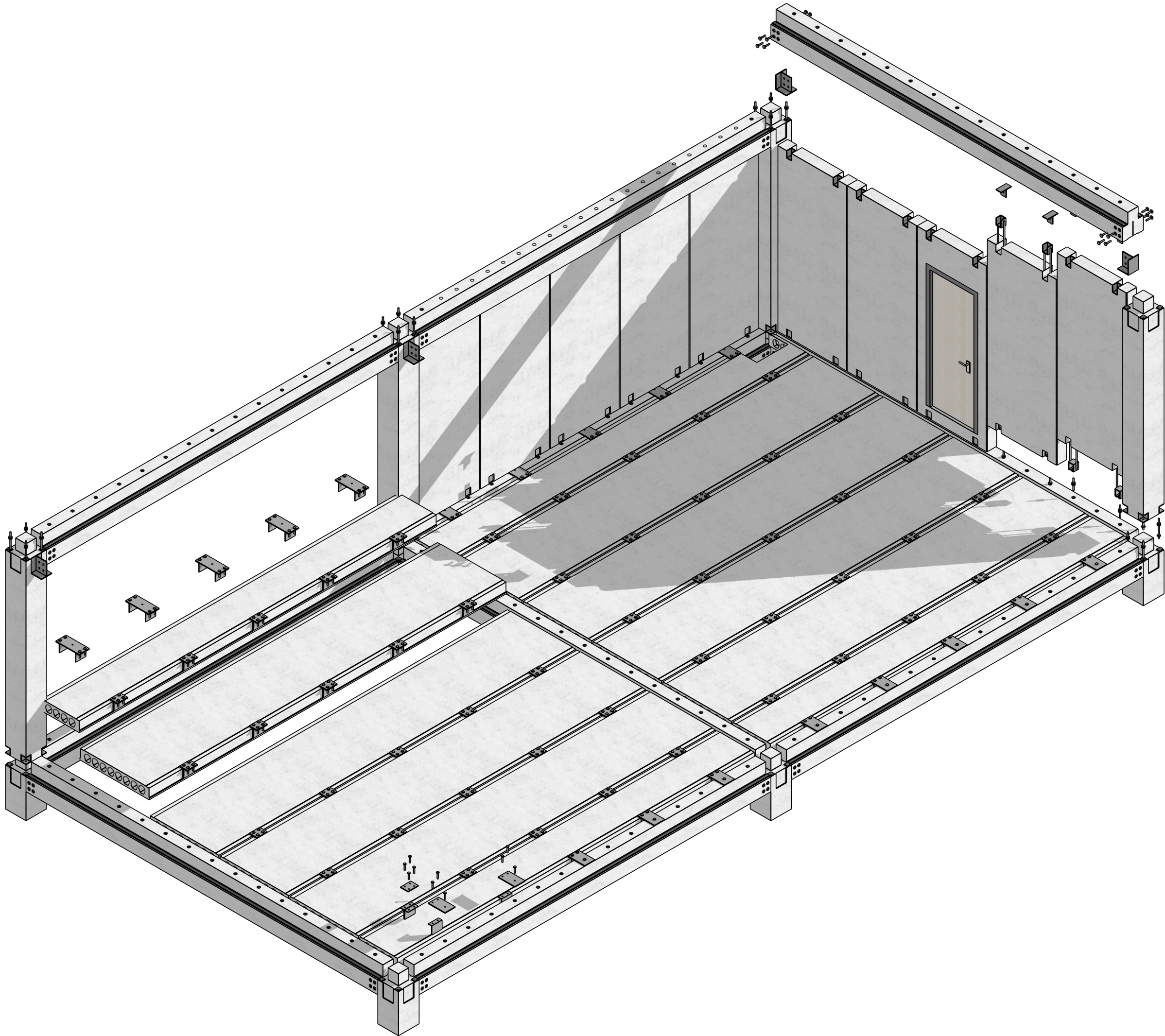
Components



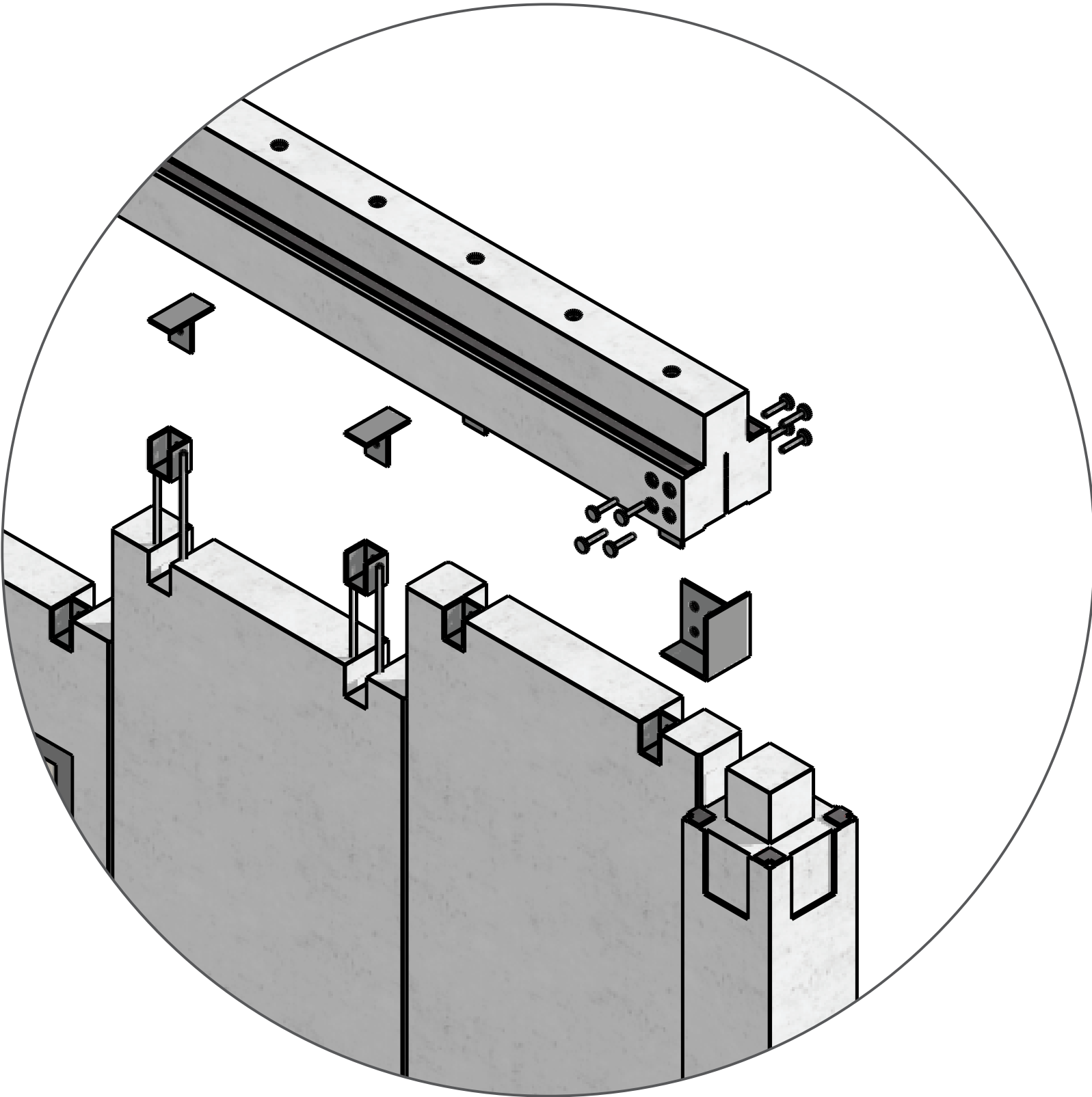
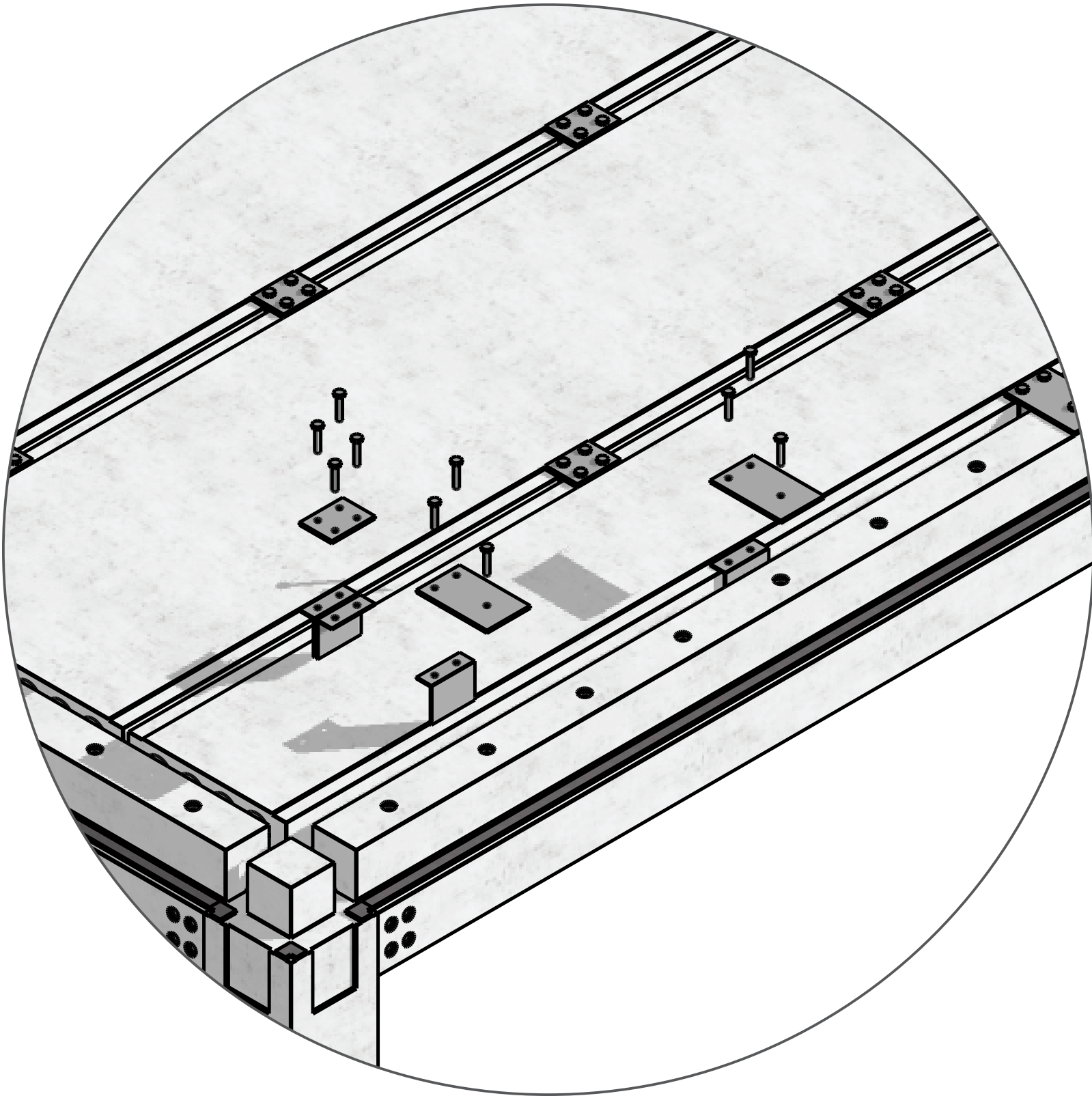


# Circle Construction

Phase 01: Adding the Loadbearing Structure



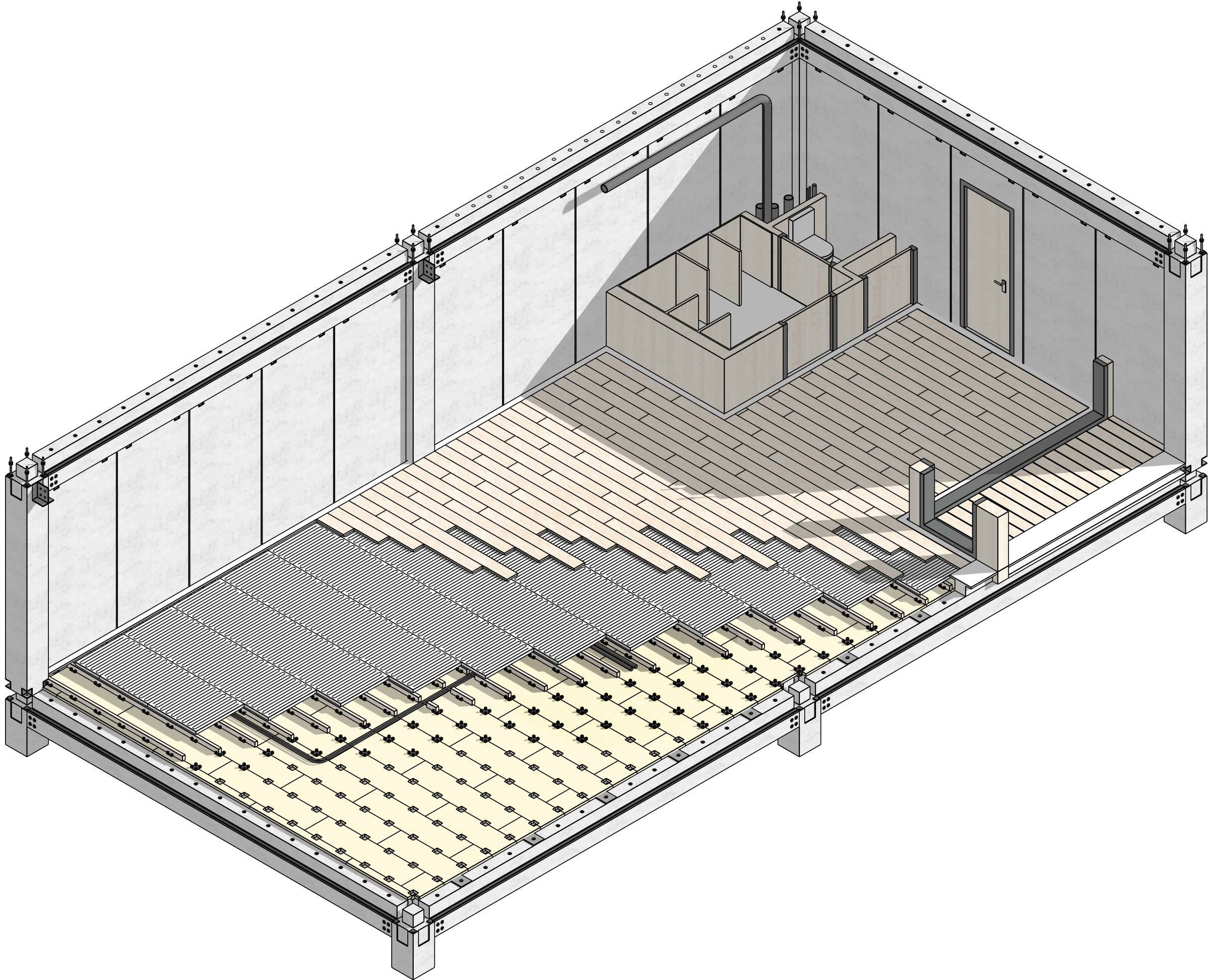




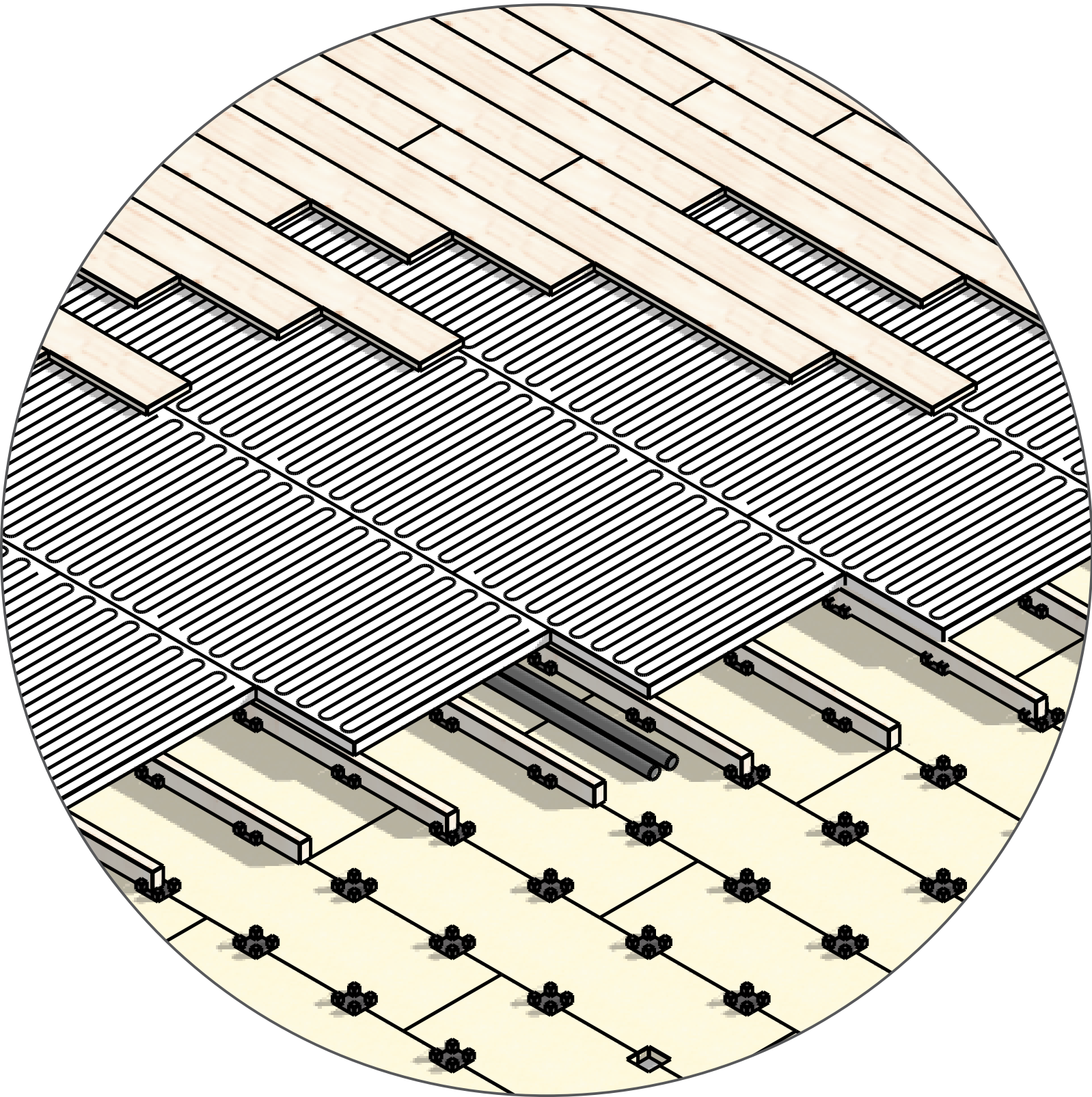


# Circle Construction

Phase 02: Adding the Floor Structure.



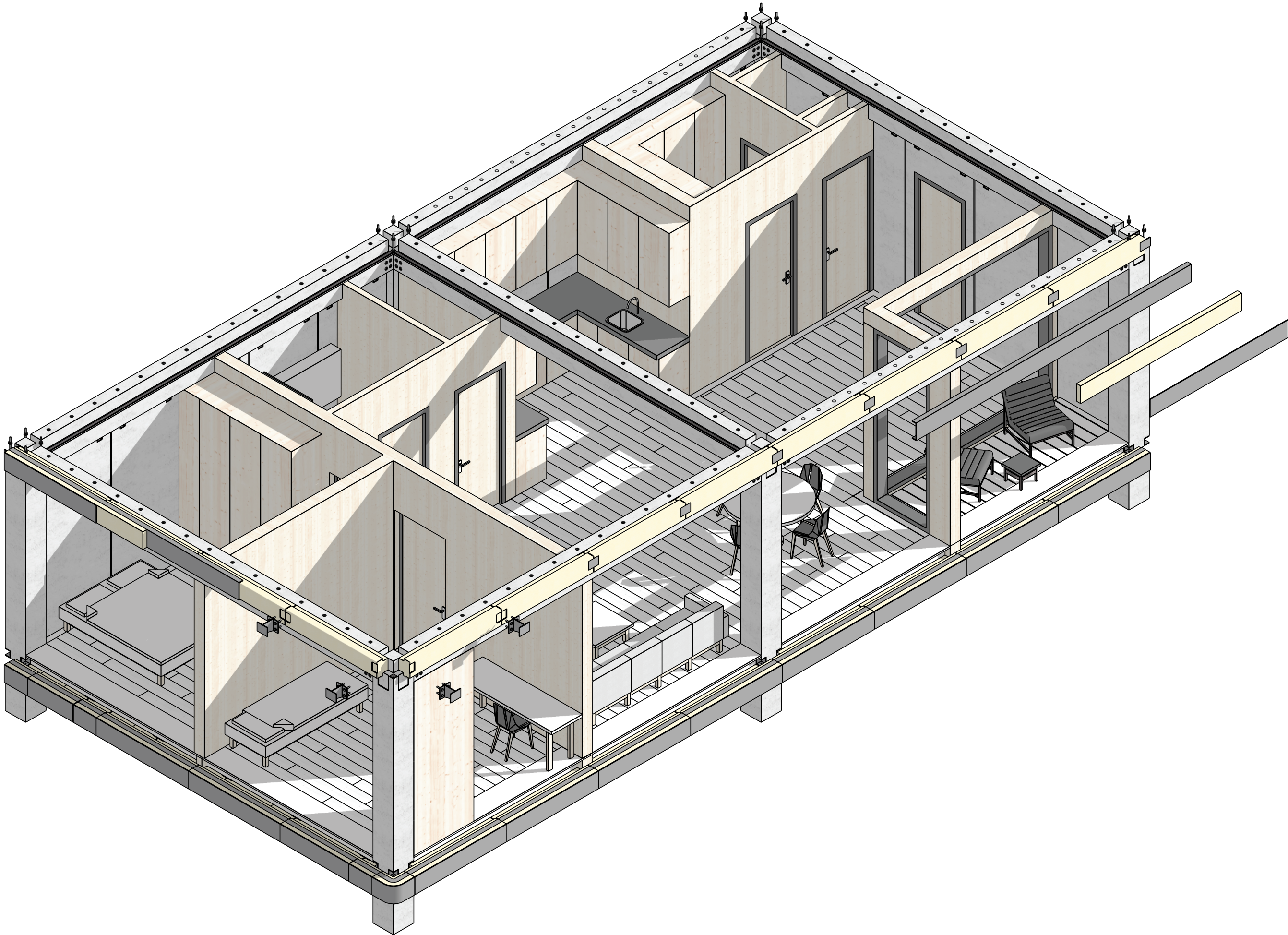






# Circle Construction

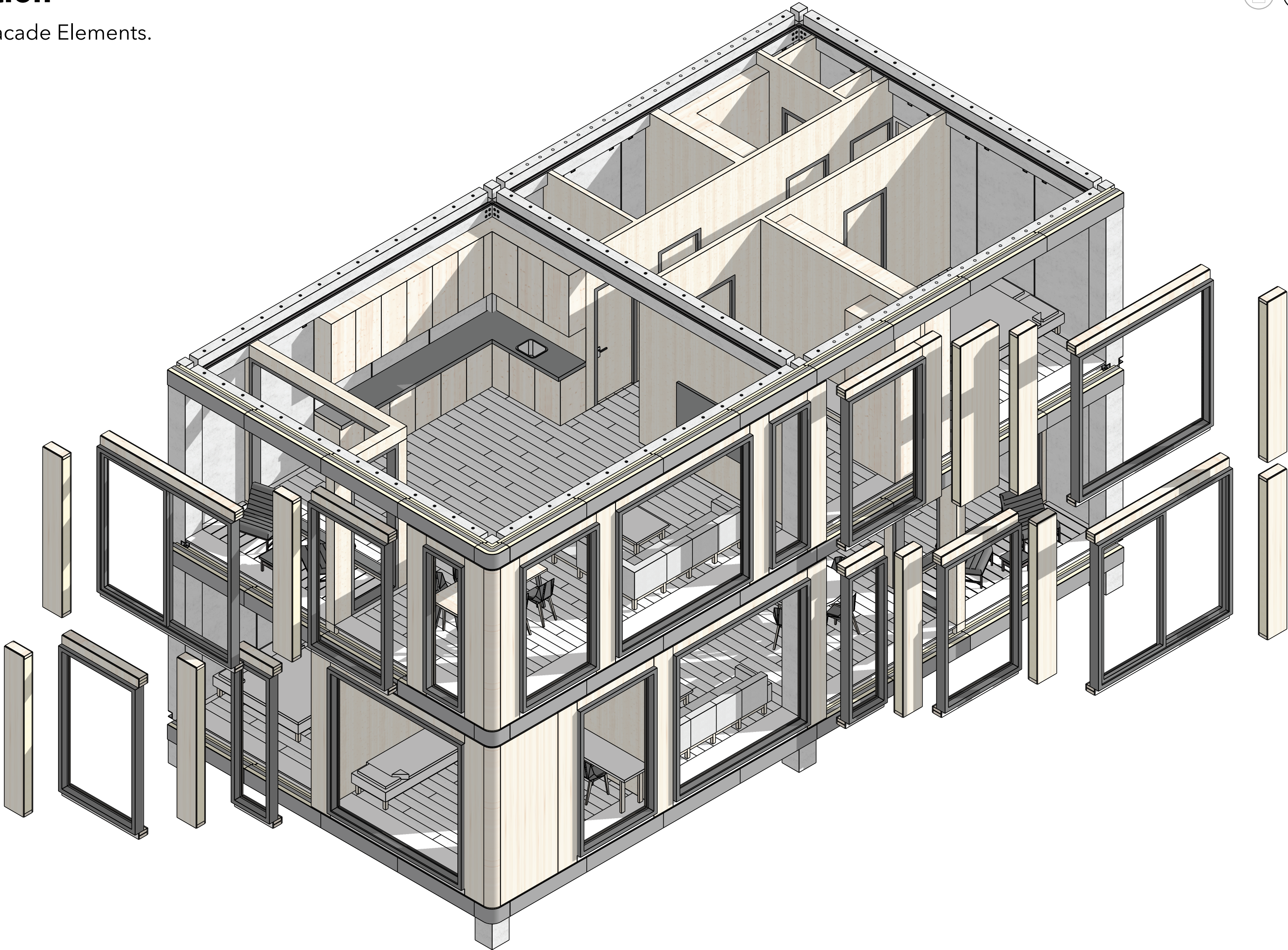
Phase 03: Adding the Interior.





# Circle Construction

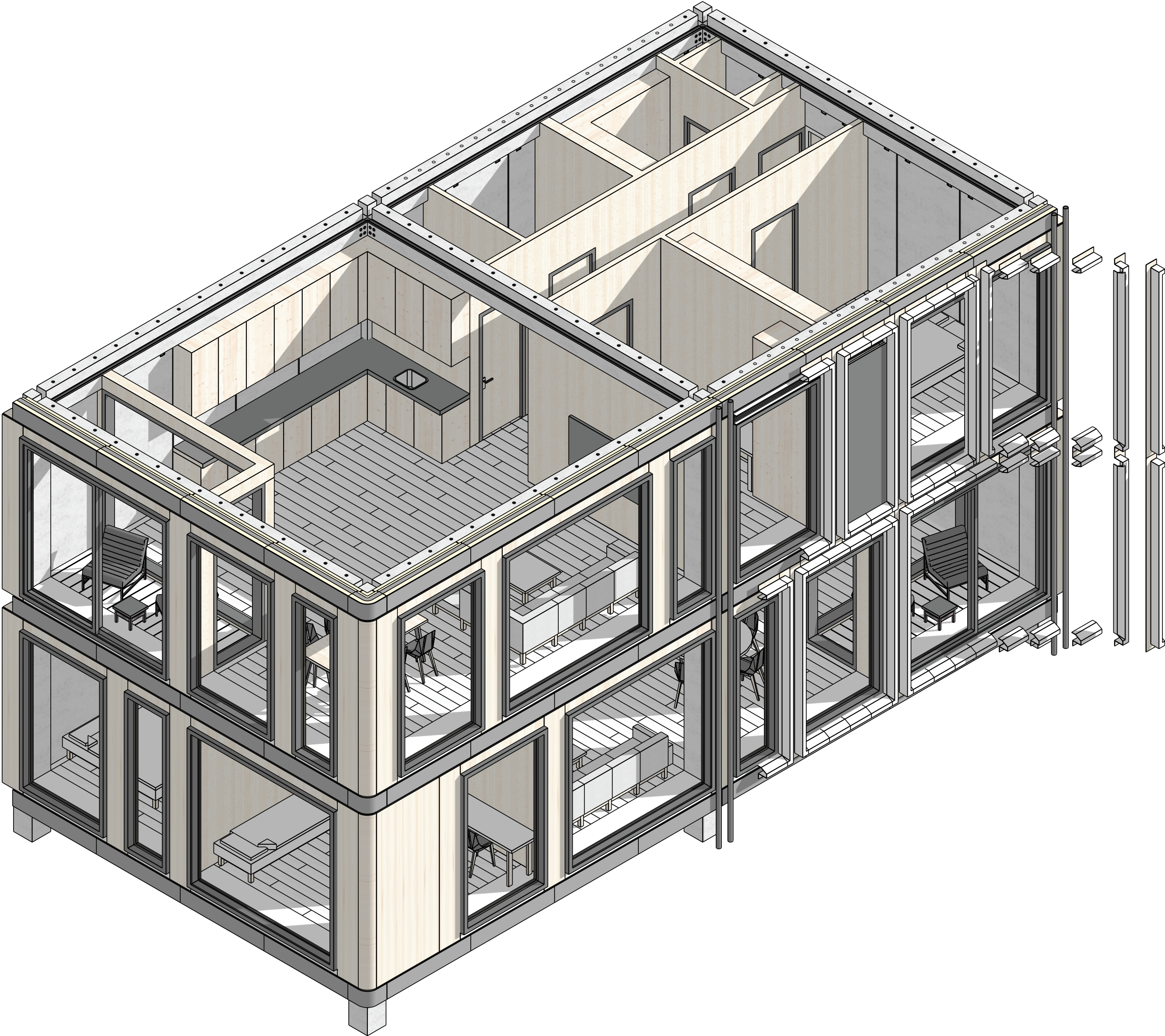
Phase 04: Adding the Facade Elements.





# Circle Construction

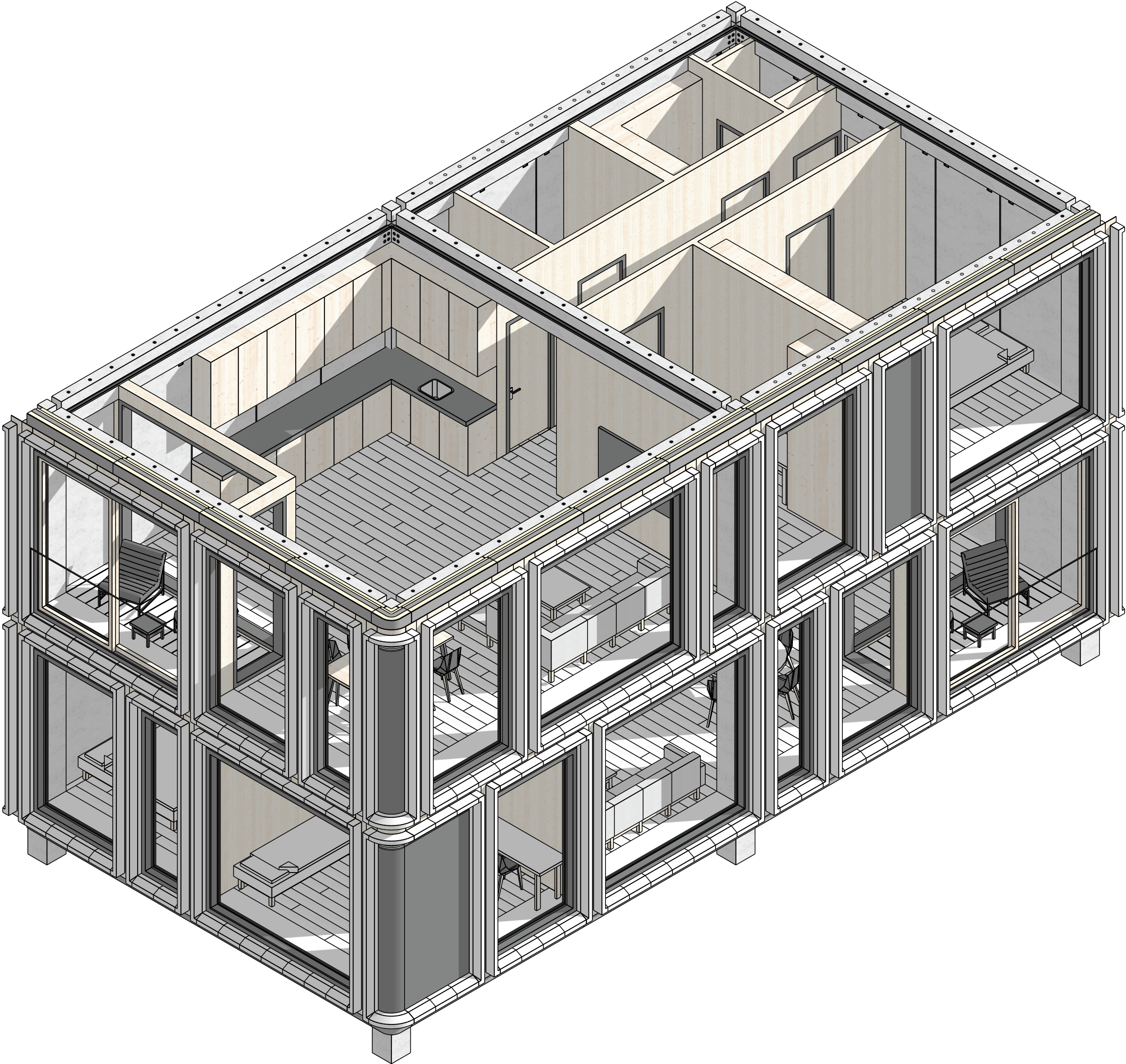
Phase 05: Adding the Final Details.





# Circle Construction

Phase 06: Finished Project



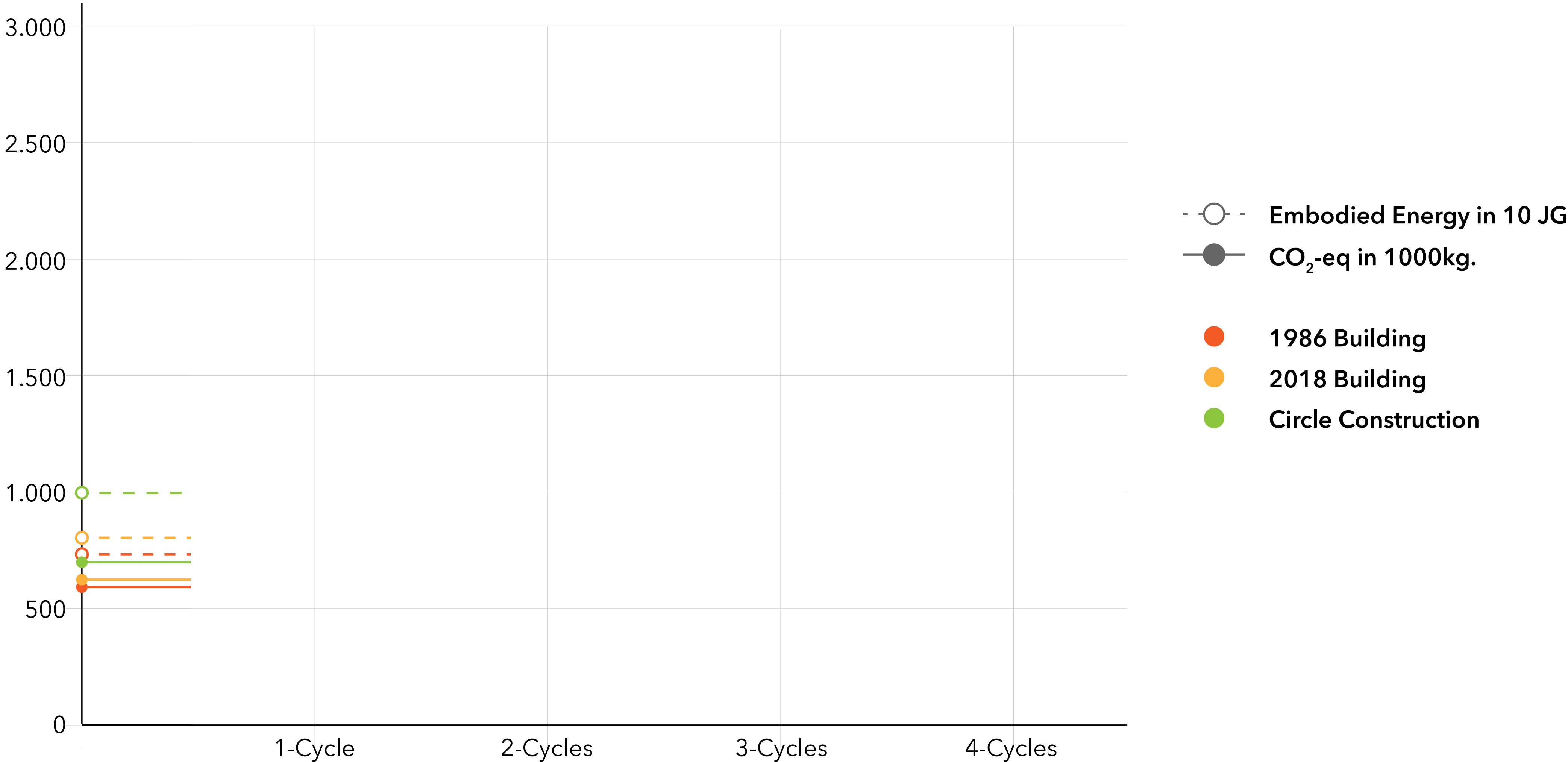


# So what does this save in numbers?



# The re-use and Recycling Potential

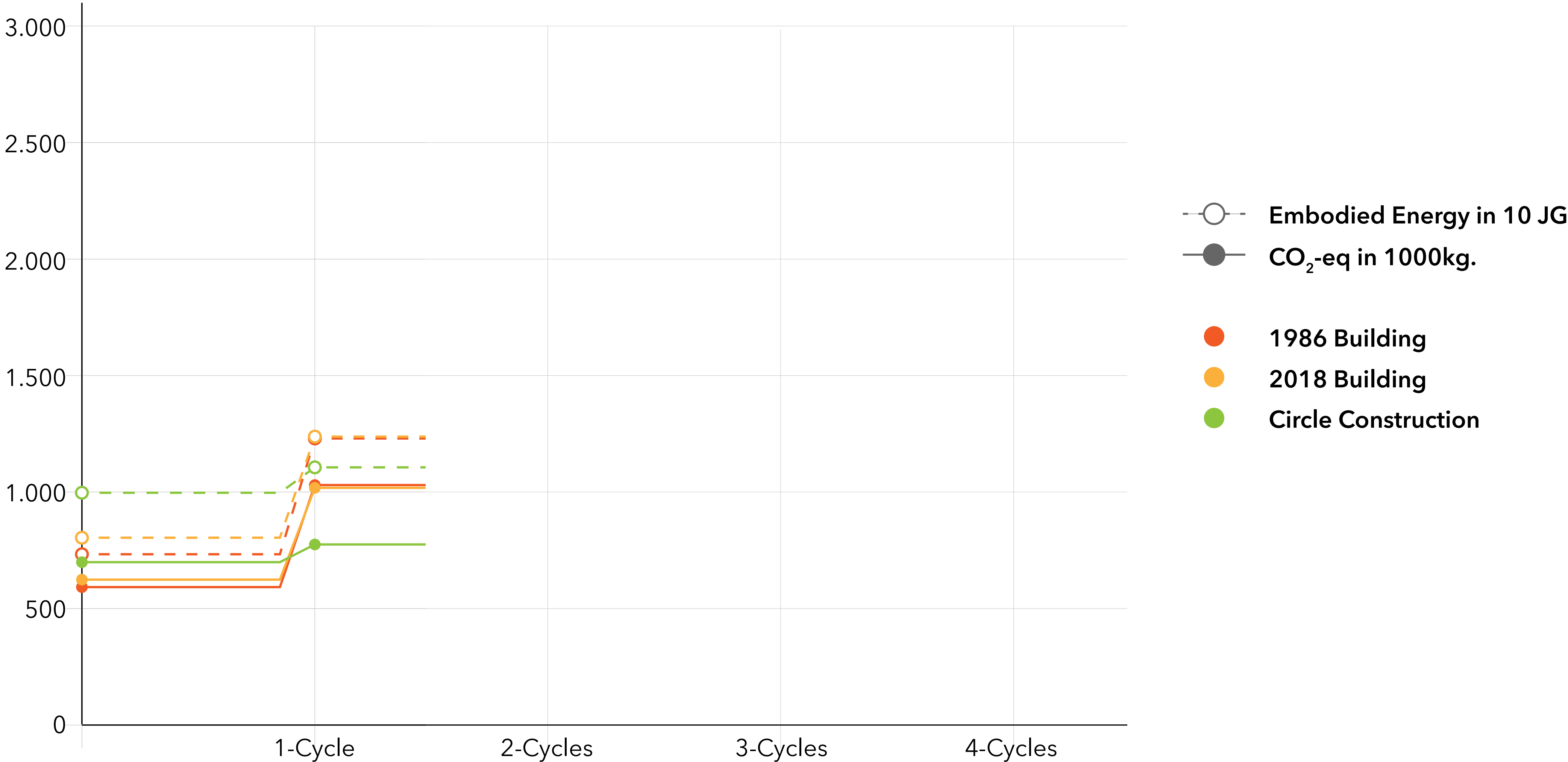
In CO<sub>2</sub> and Embodied Energy.





# The re-use and Recycling Potential

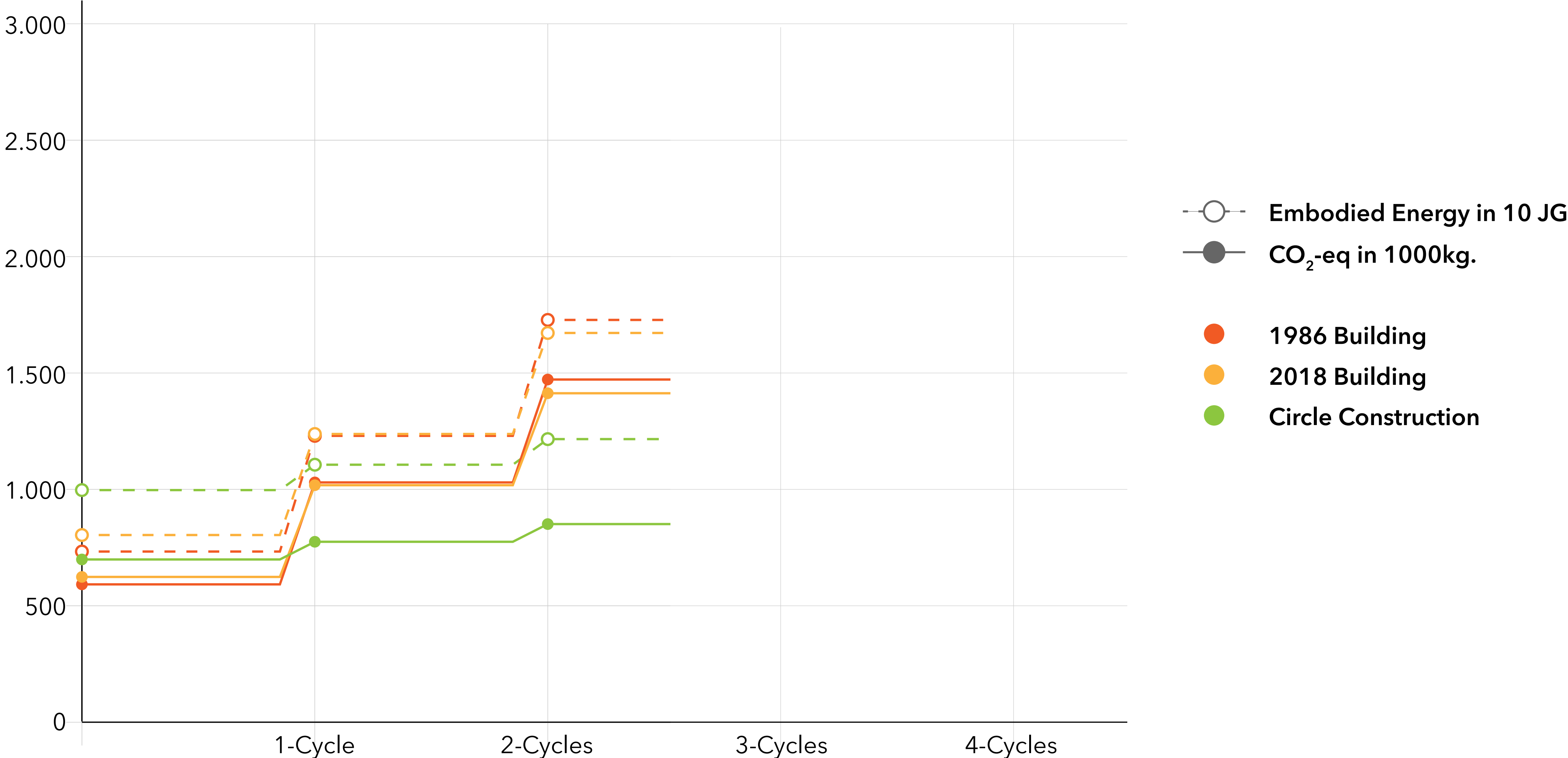
In CO<sub>2</sub> and Embodied Energy.





# The re-use and Recycling Potential

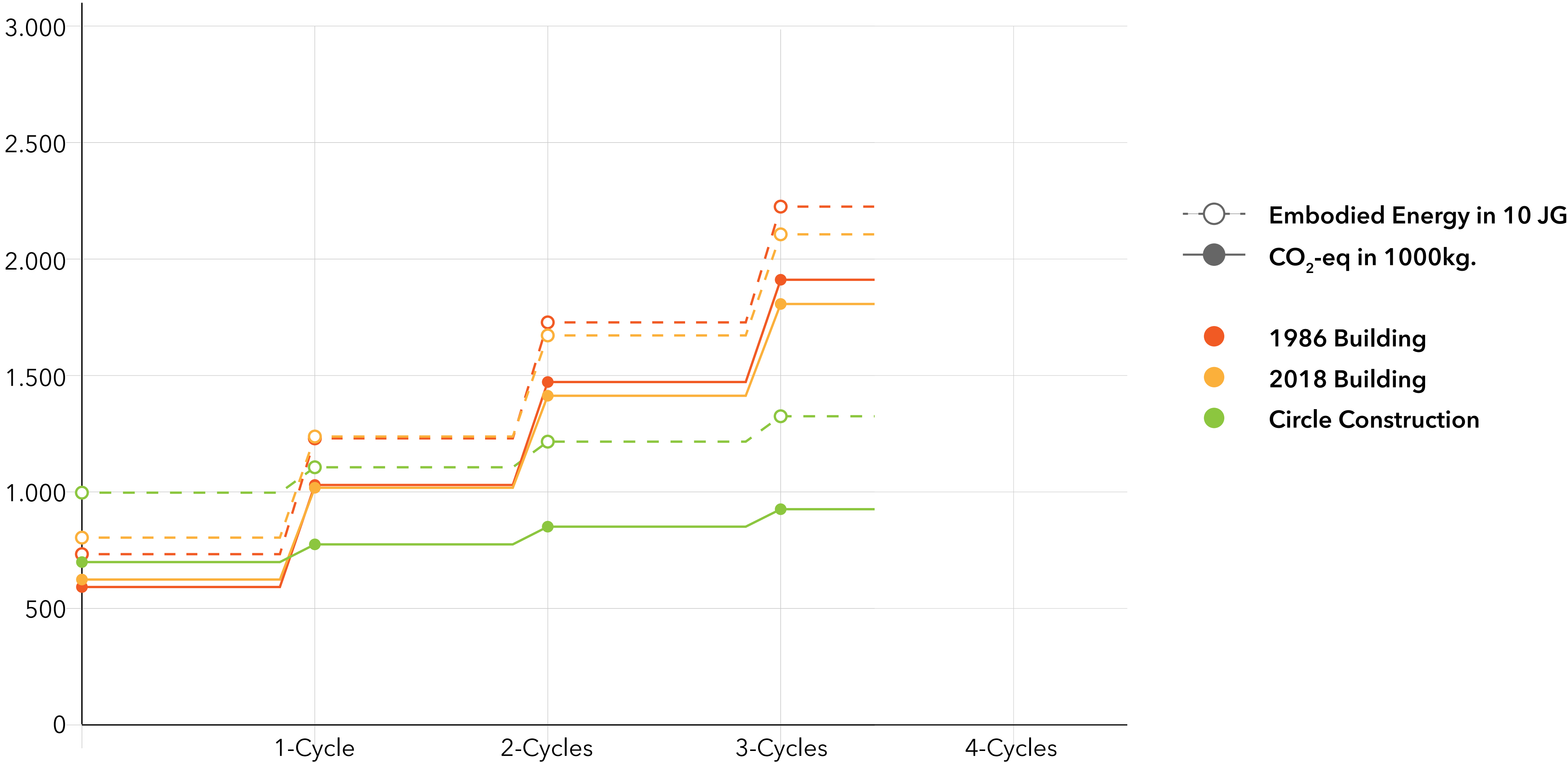
In CO<sub>2</sub> and Embodied Energy.





# The re-use and Recycling Potential

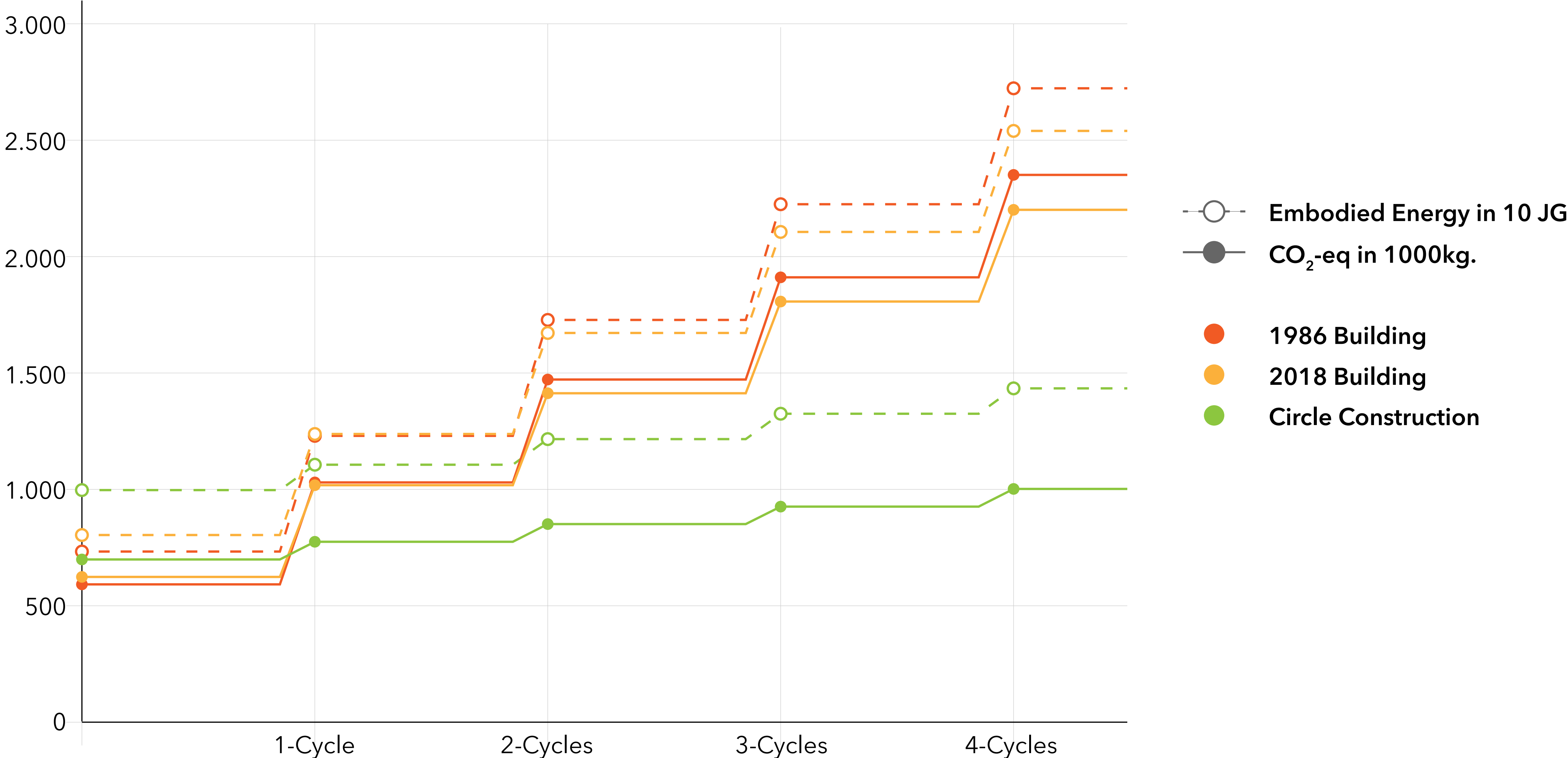
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# The re-use and Recycling Potential

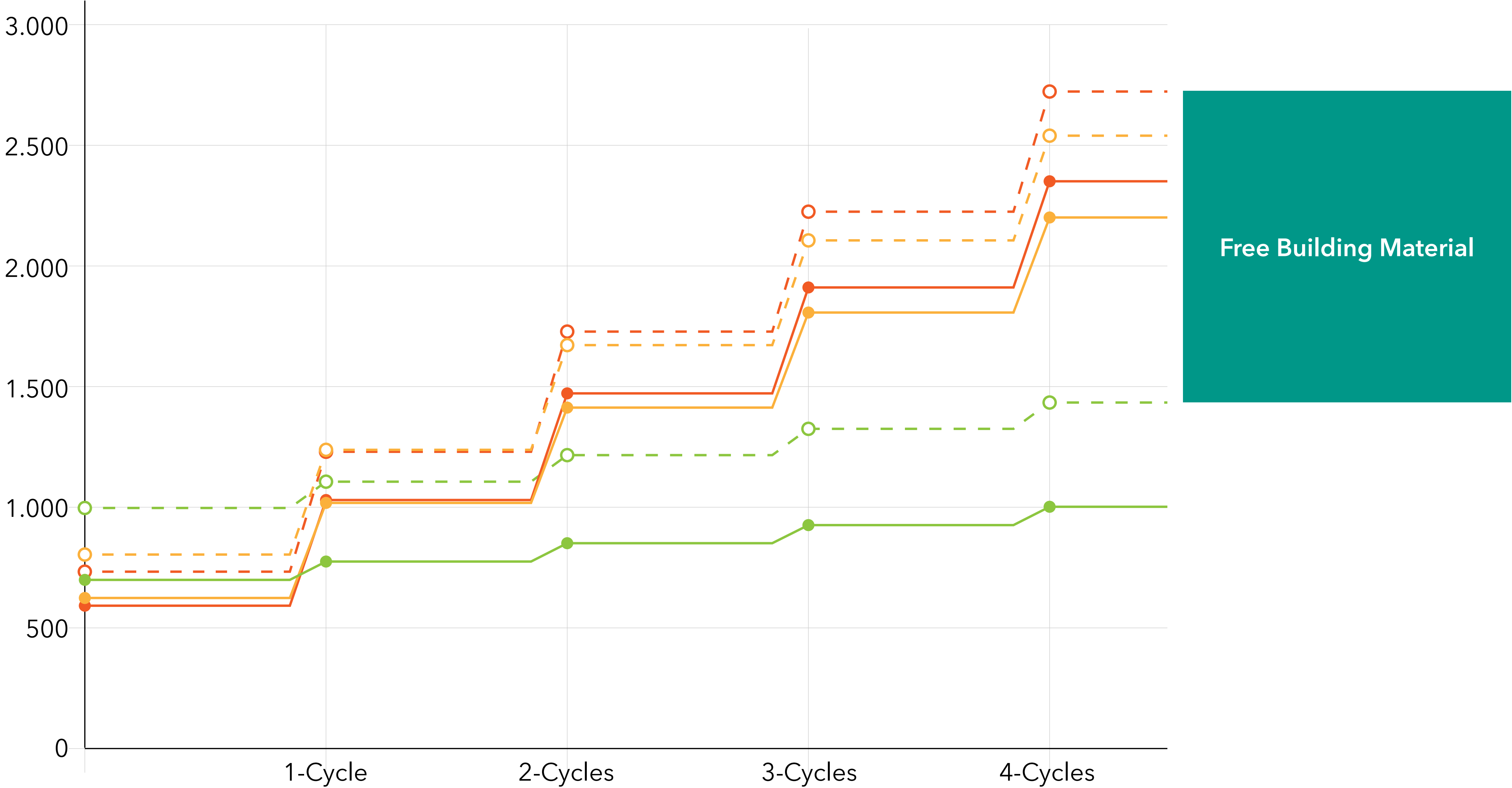
In CO<sub>2</sub> and Embodied Energy.





# The re-use and Recycling Potential

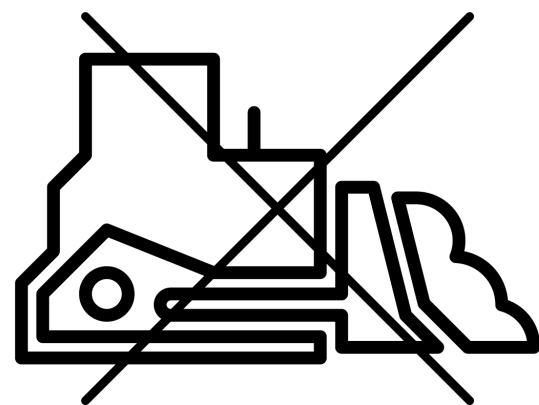
In CO<sub>2</sub> and Embodied Energy.





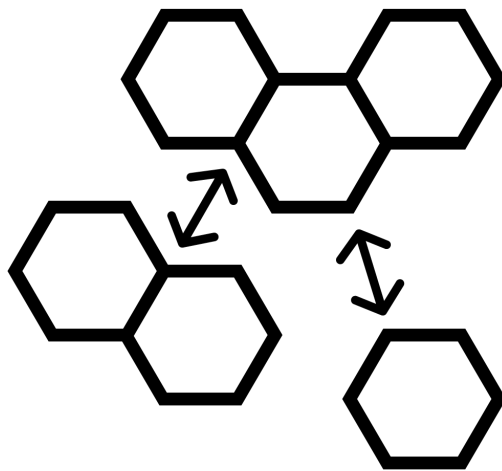
# The Circle Structure

Findings



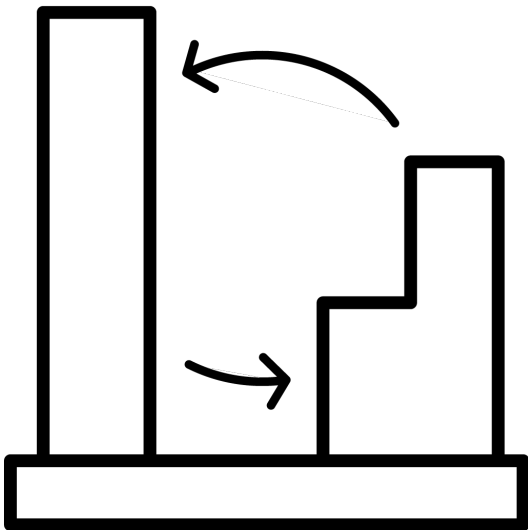
## No Single-Use Materials

Keep materials separated.  
Simplify the process to re-cycle  
and re-use building materials.  
Avoid certain materials.



## Reversible Connections

Use reversible connections.  
Communicate materials with  
passports.



## On-Site Reassembly

On site development and re-  
development.  
Take materials from case study.





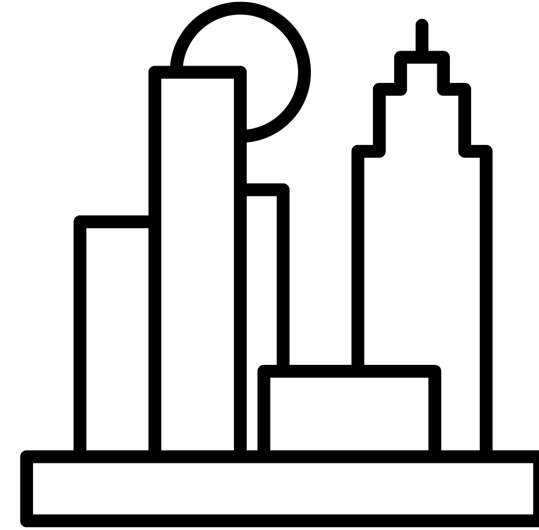
### Upcycle Amstel

Amstel III  
re-cycle, re-use  
Waste & Up-cycle  
Design for Disassembly.



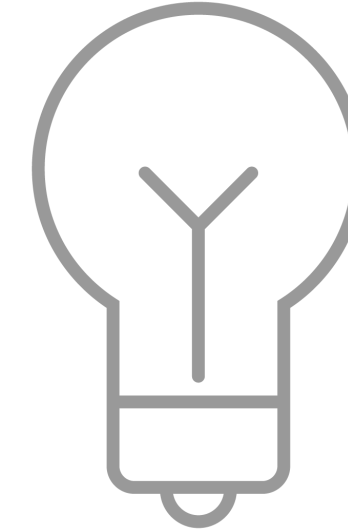
### Research

Circular Components



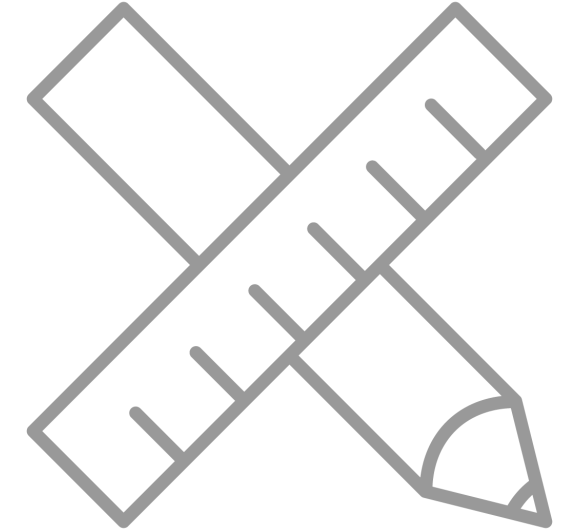
### Urban plan

Amstel III  
Main street  
Park



### Concept

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Circular Demonstrator.  
Innovation hub.



### Design

Program  
Volume study.



Site

Vision Amstel III 2030





**Site**

Vision Amstel III 2030





Site

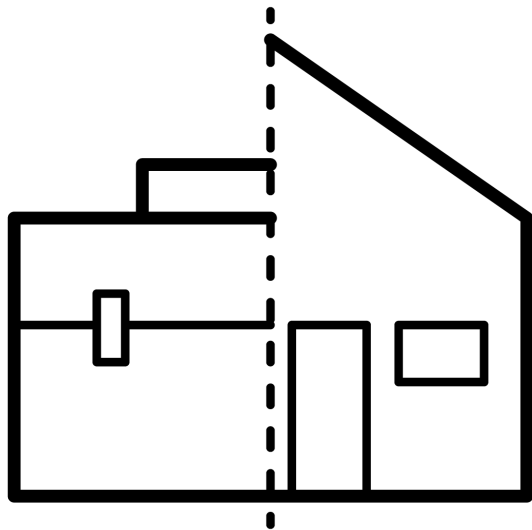
Vision Amstel III 2030



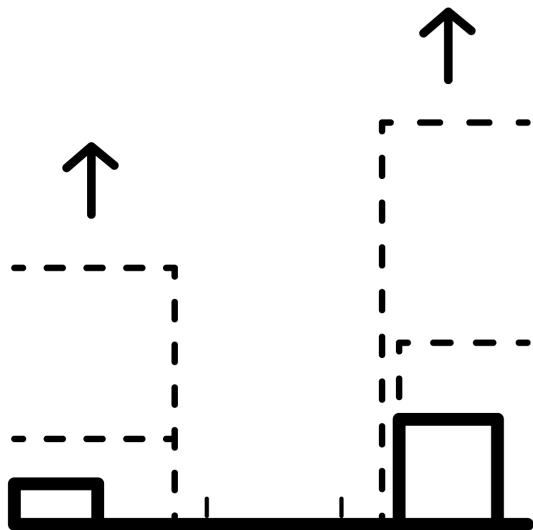


# Amstel III

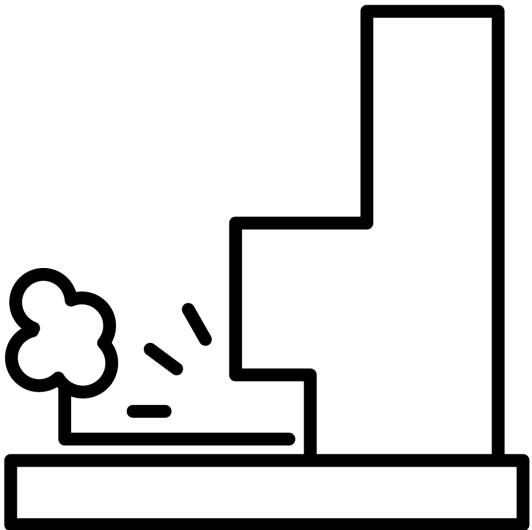
Development Goals.



**To Living and working**  
Maintain Working Environment.  
Add 25.000+ Houses.



**Transforming Area**  
New and Constantly developing  
Area.

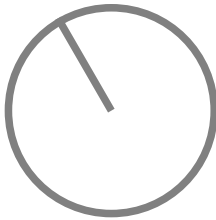
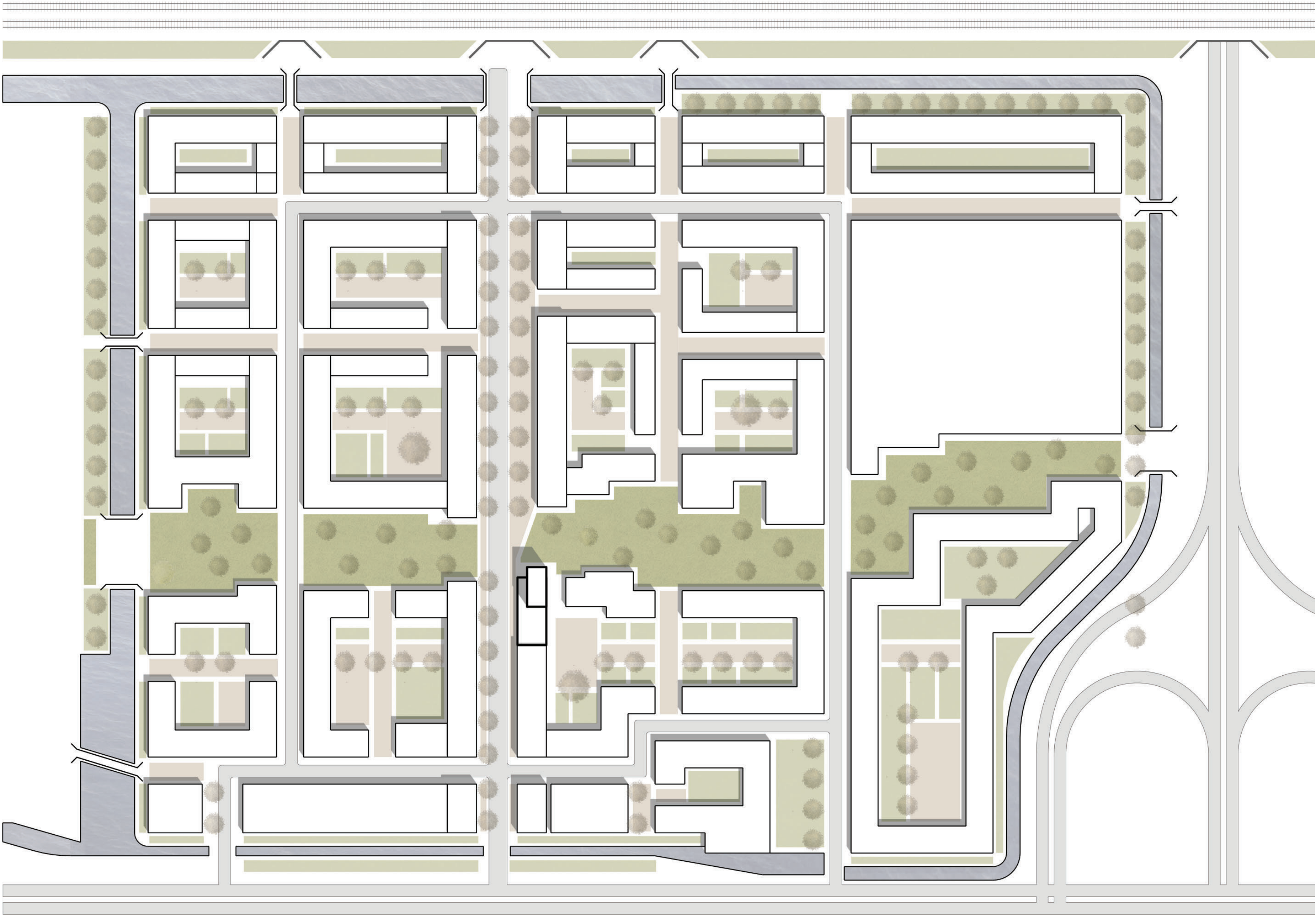


**Social points**  
Shopping.  
Bars.  
Recreational.



Site

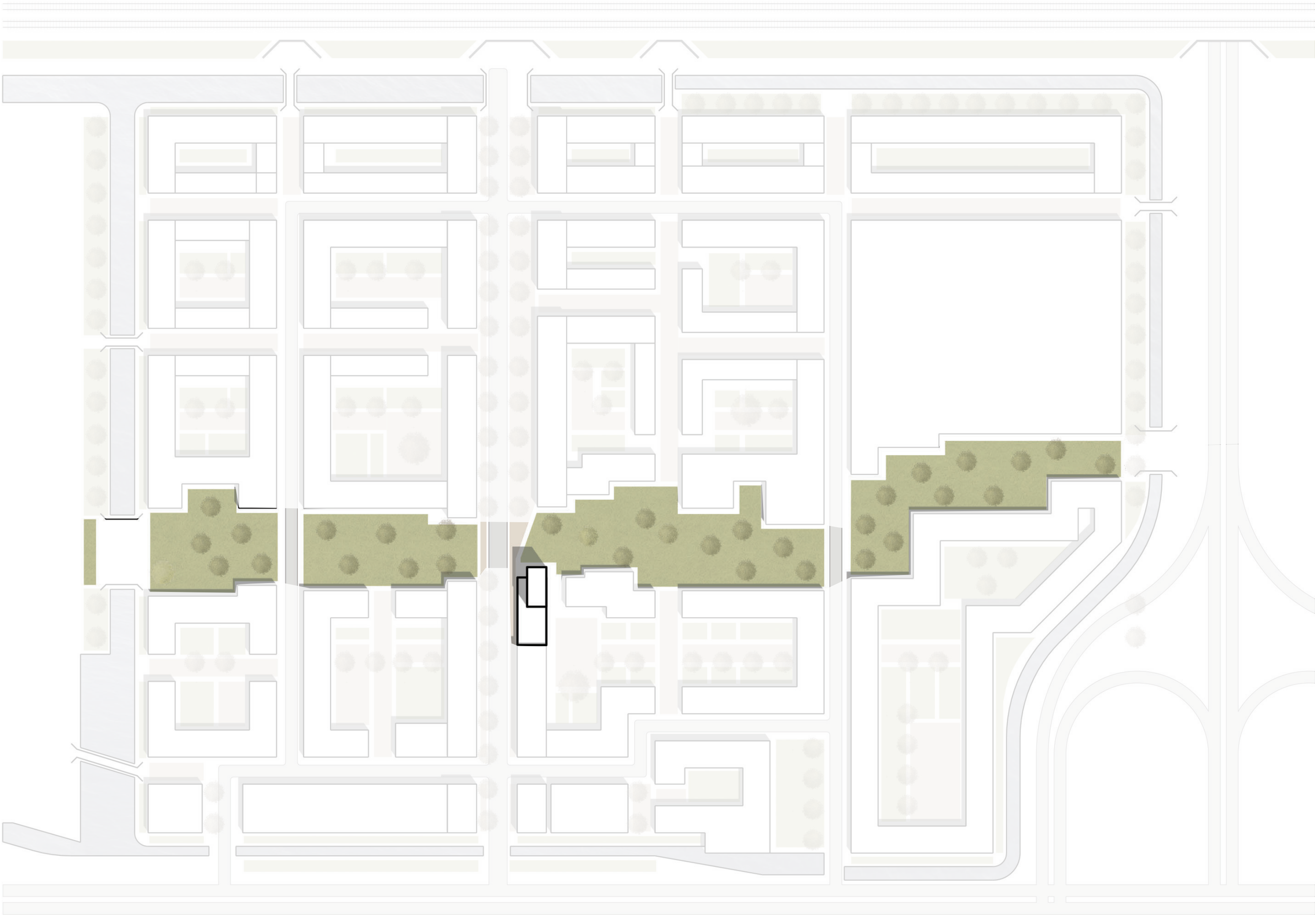
Vision Amstel III 2030





Site

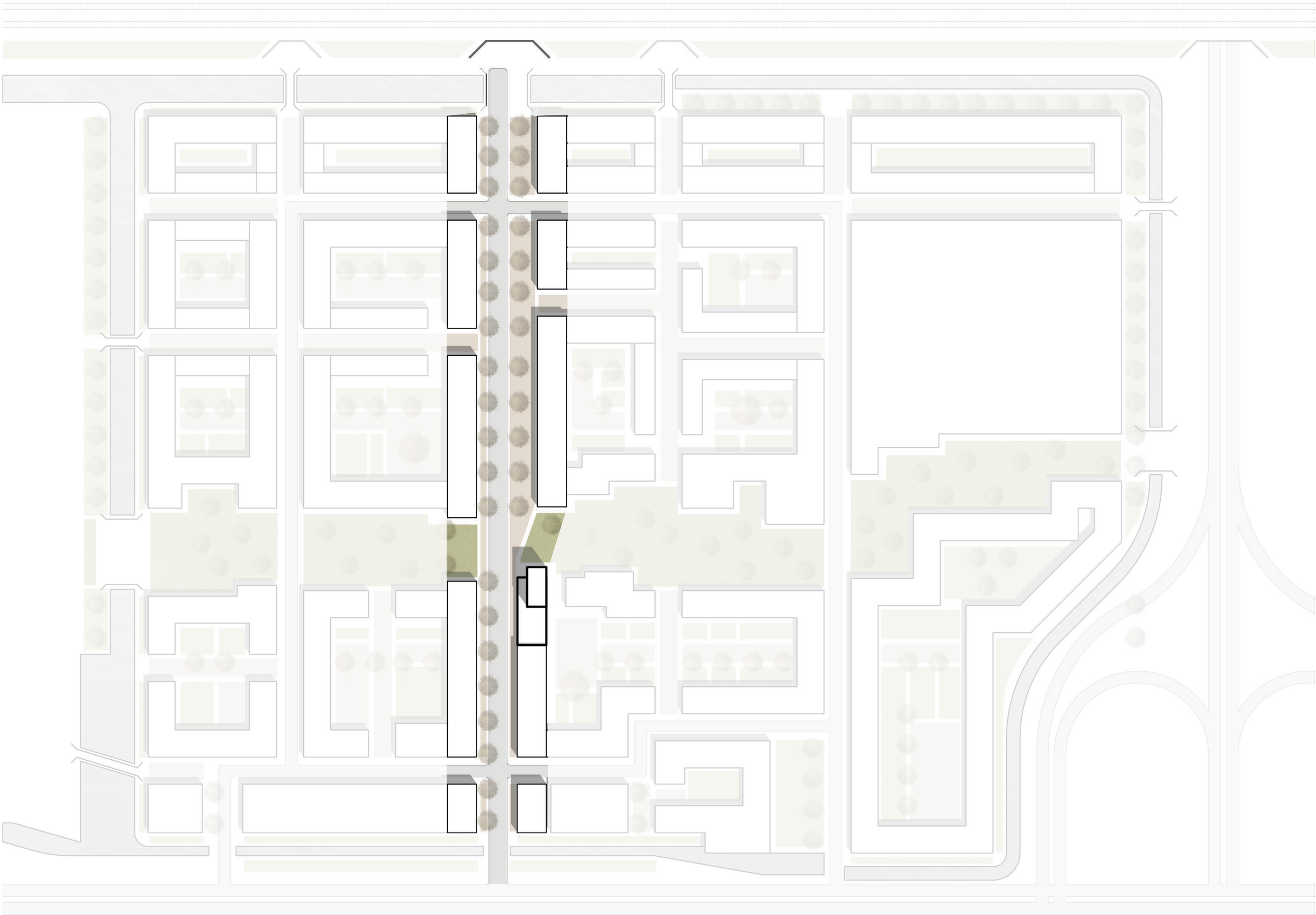
Vision Amstel III 2030





Site

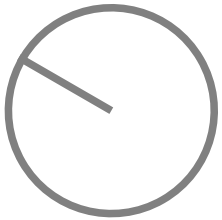
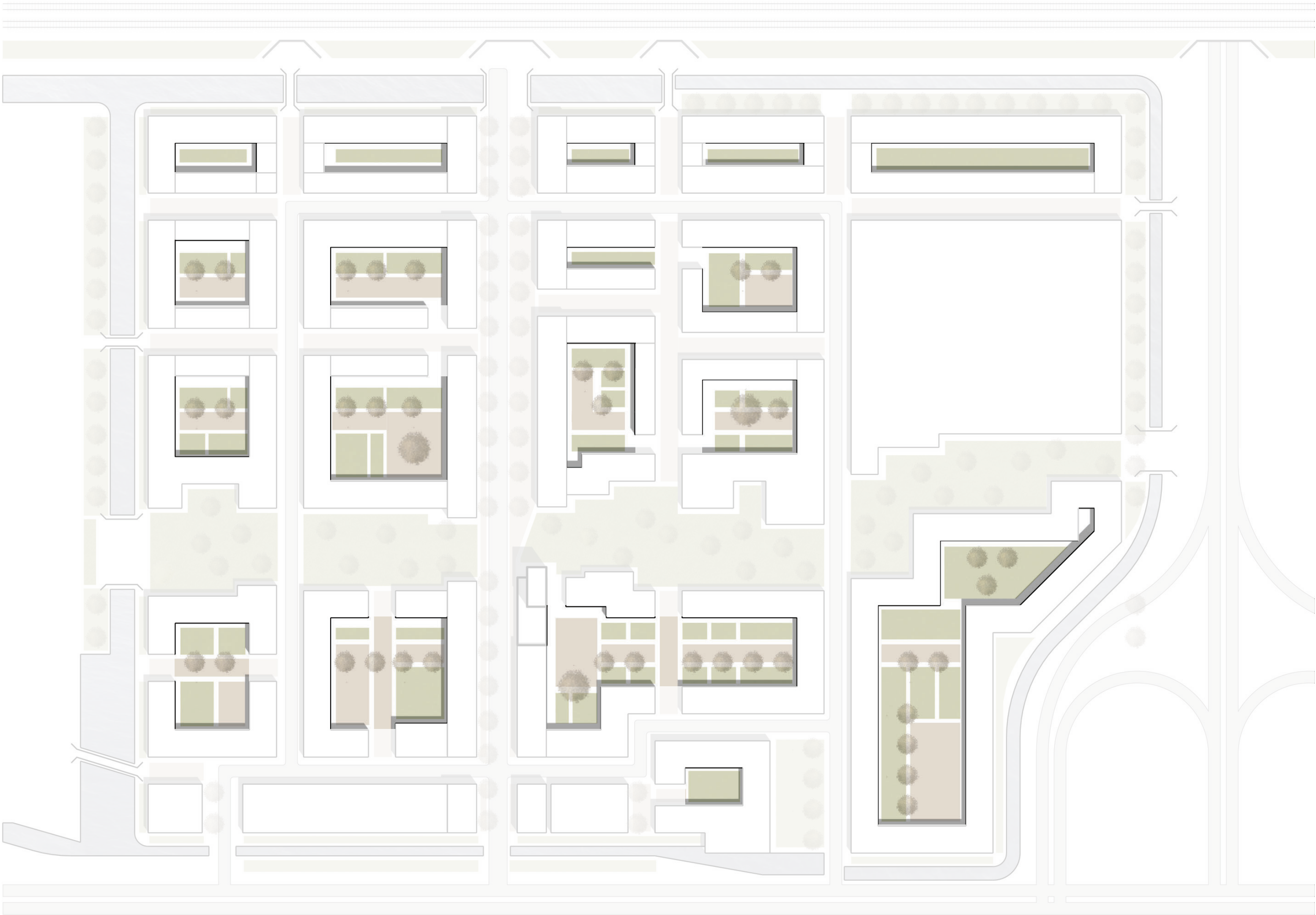
Vision Amstel III 2030





Site

Vision Amstel III 2030



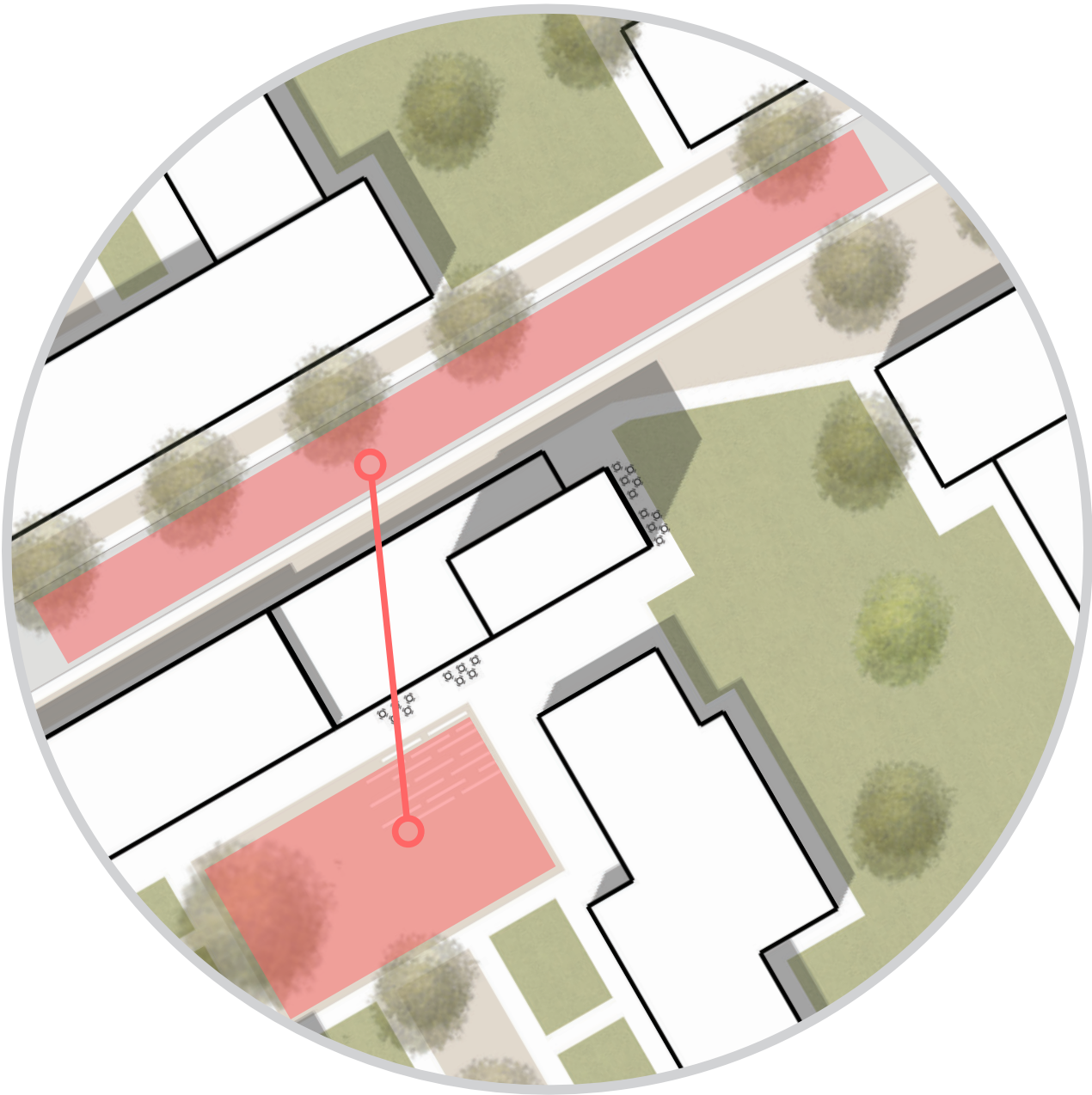


Site

Close Up.



South Facade



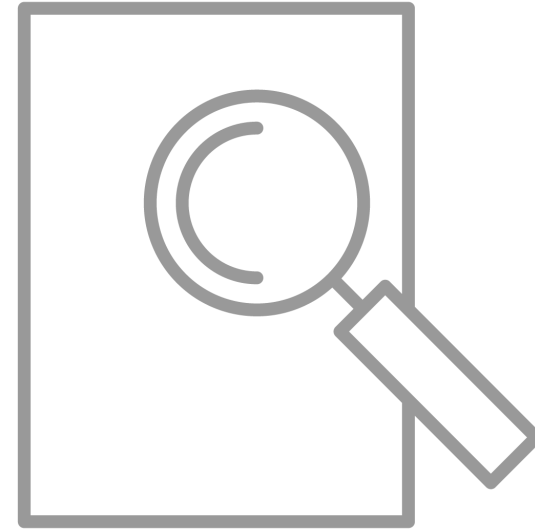
Connecting the Neighborhood to the street.





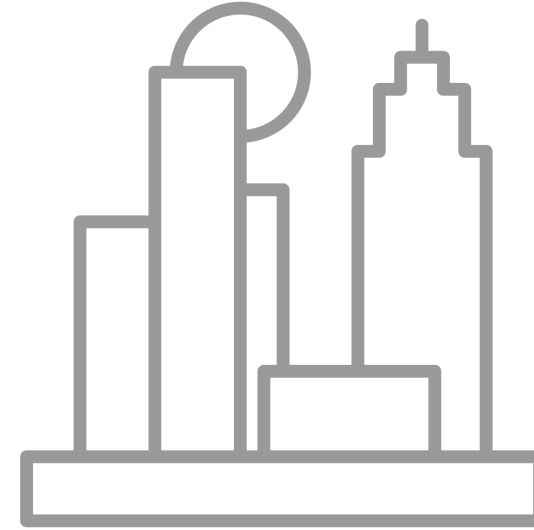
### Upcycle Amstel

Amstel III  
re-cycle, re-use  
Waste & Up-cycle  
Design for Disassembly.



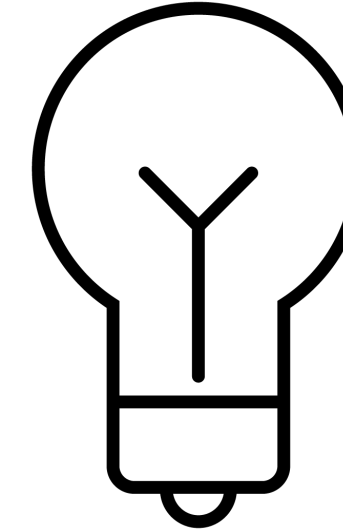
### Research

Circular Components



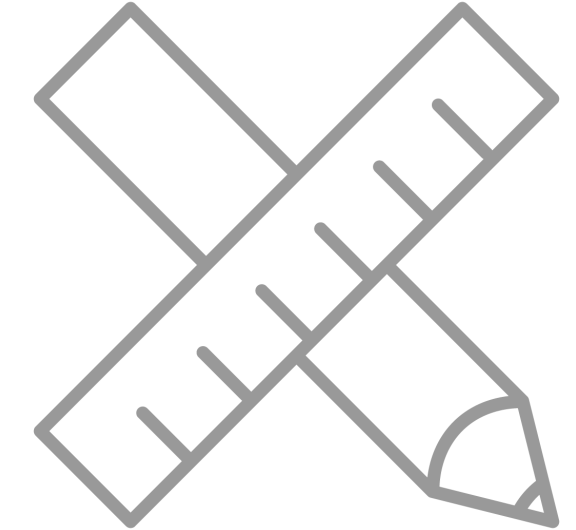
### Urban plan

Amstel III  
Main street  
Park



### Concept

Cultural Meeting spot.  
Circular Demonstrator.  
Innovation hub.



### Design

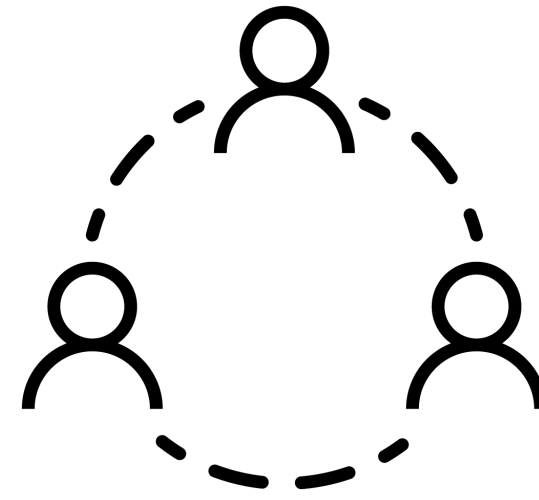
Program  
Volume study.





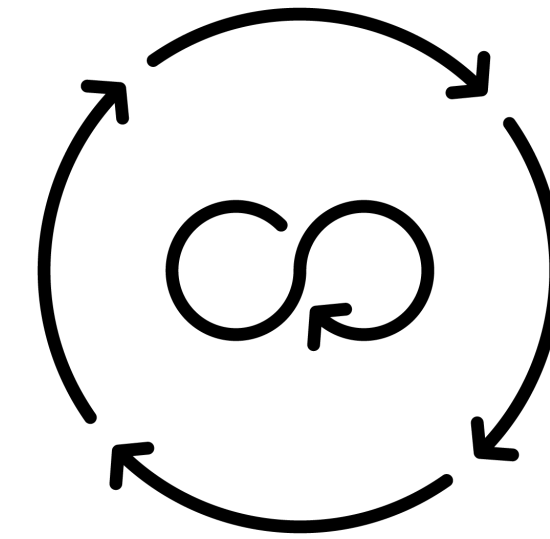
### **New Identity**

Transition to Mixed Urban City.  
Increased density  
136 --> 30.000 Inhabitants.



### **Social connexion**

Need for Social interaction.  
Spot to come together  
Knowledge Sharing.



### **Circular economy**

Material re-use.  
Design out waste.



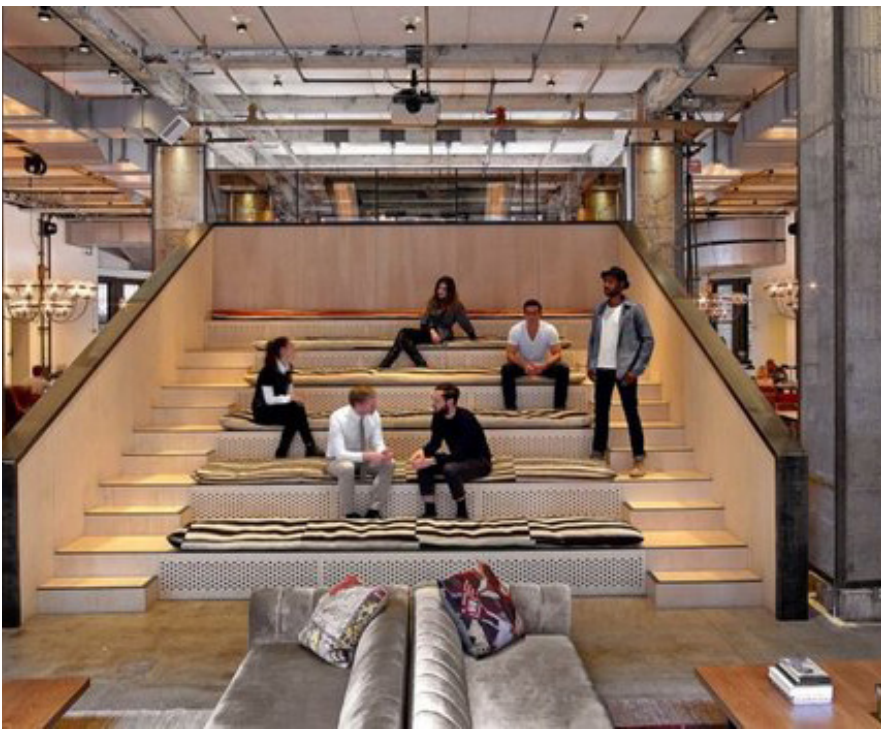
### Meet

Casually drop by hang out and start a conversation.



### Learn

Sharing of interests and knowledge  
Community driven Social workshops  
and educational opportunities.  
Develop knowledge.



### Live

Live close to this community and  
integrate it into the public space.





Meet

Casually drop by hang out  
and start a conversation.

Restaurant	180 m²
Cafe	70 m²
Flexible Expo / library	500 m²

Total800 m²

Learn

Sharing of interests and knowledge  
Community driven Social workshops  
and educational opportunities.  
Develop knowledge.

Auditorium	185 m²
Rentable Workspaces	144m²
Rentable halls	110 m² & 180 m²
Conference Room	33 m² & 70 m²
Central space	225 m²

Total800 m²

Live

Live close to this community and  
integrate it into the public space.

Entrance	30 m²	Toilets	60 m²
Bike Storage	30 m²	Storage	35 m²
			40 m²
Housing Type A	50 m²	Tech Space	100 m²
Housing Type B	100 m²	Backoffice	30 m²
		Transport	250 m²

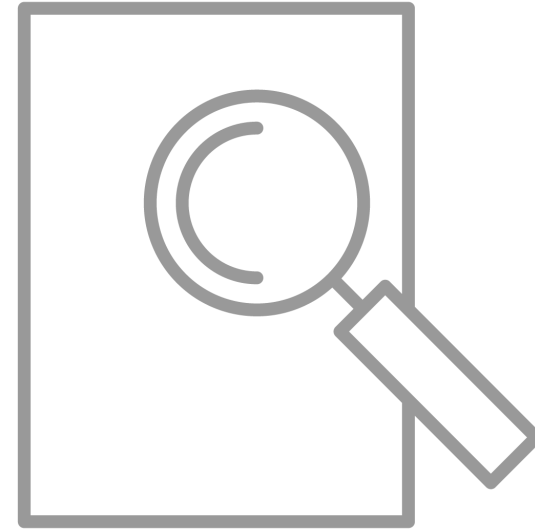
Total2000 m²  
Grand total4100 m²





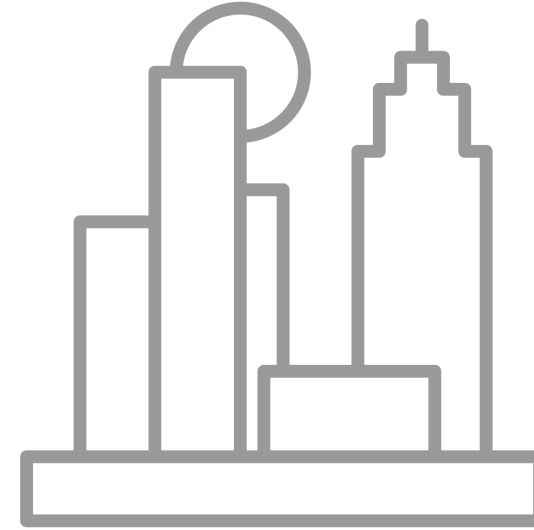
### Upcycle Amstel

Amstel III  
re-cycle, re-use  
Waste & Up-cycle  
Design for Disassembly.



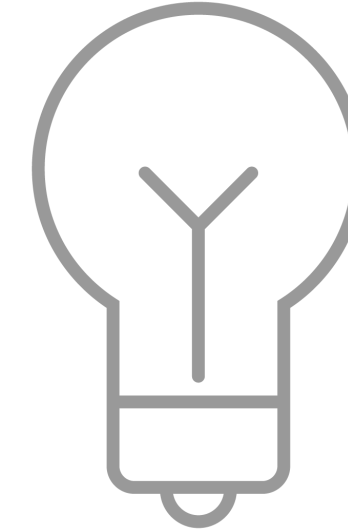
### Research

Circular Components



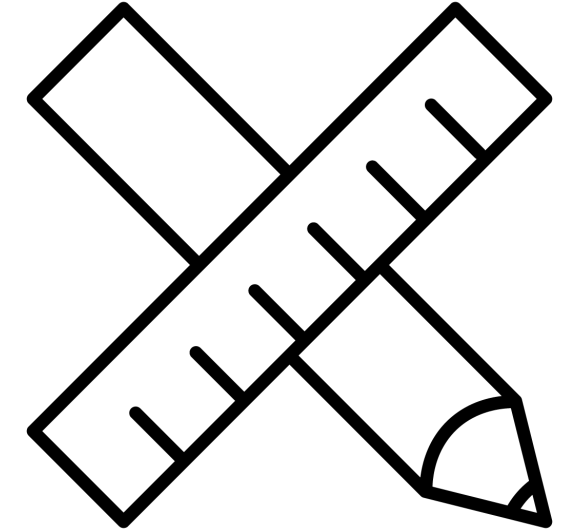
### Urban plan

Amstel III  
Main street  
Park



### Concept

Cultural Meeting spot.  
Circular Demonstrator.  
Innovation hub.



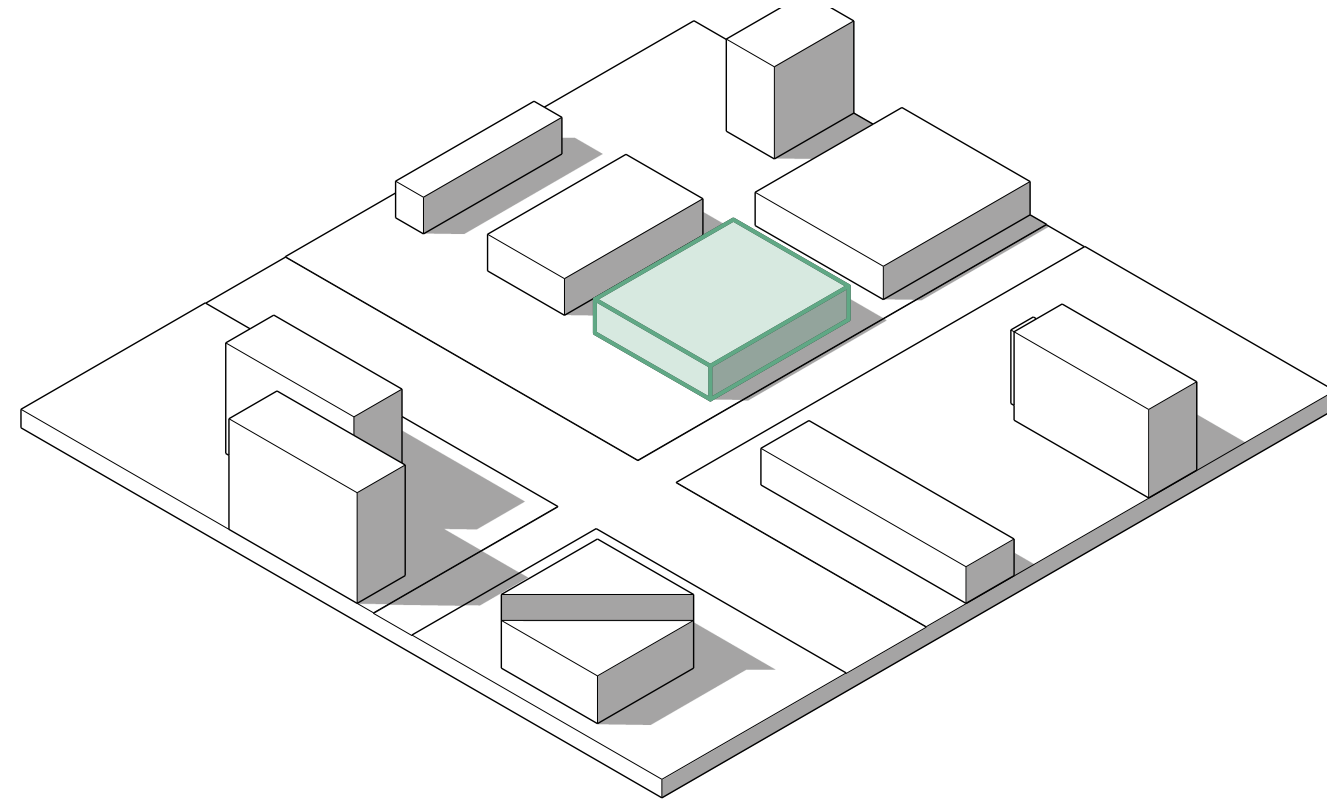
### Design

Program  
Volume study.



## The Circular Cornerstone

Form digrams.

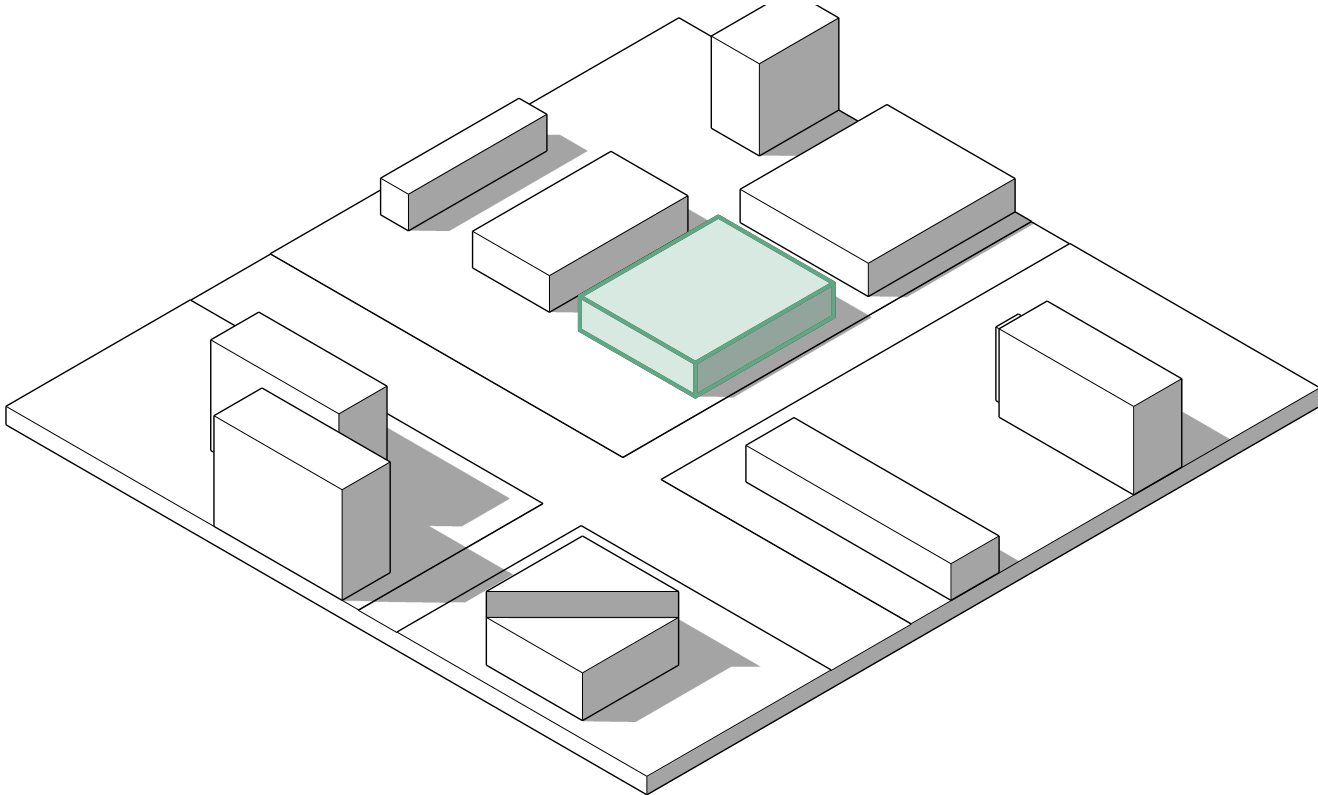


## Current Situation

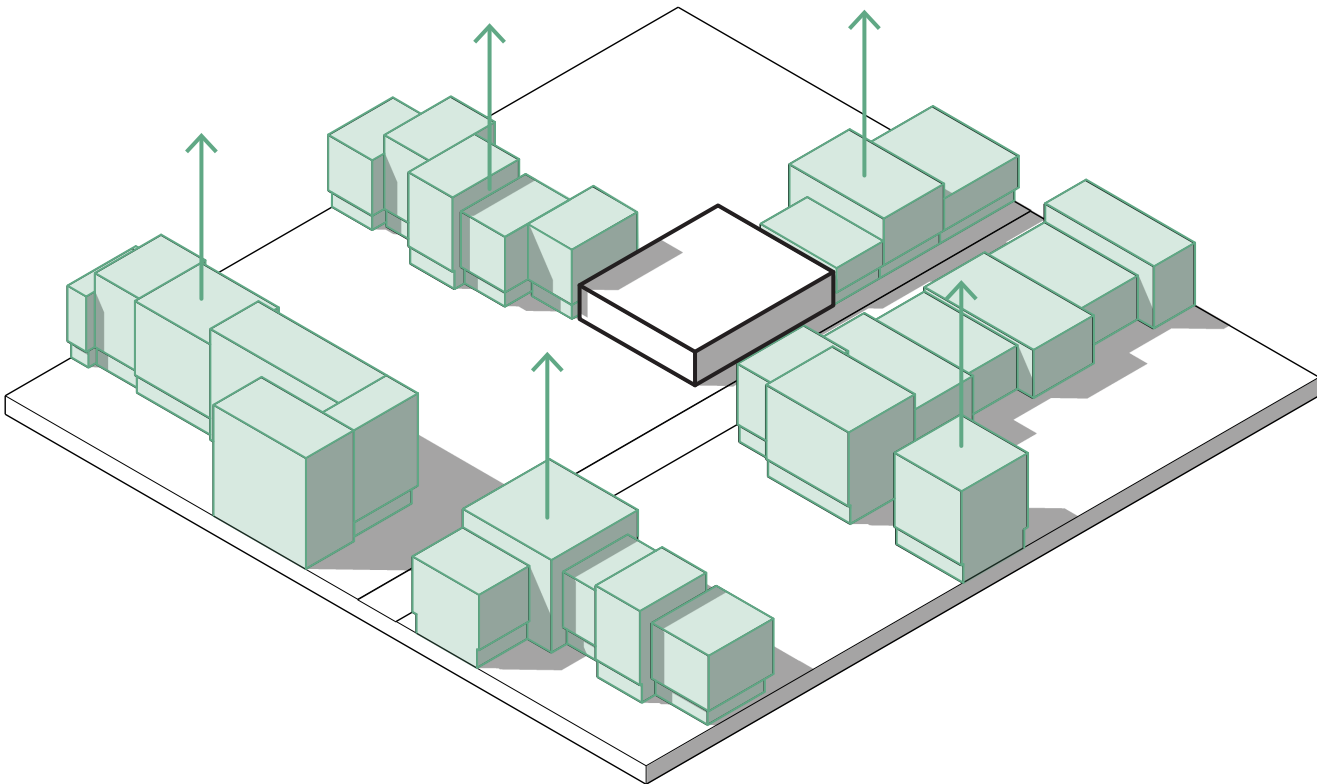


# The Circular Cornerstone

Form digrams.



Current Situation

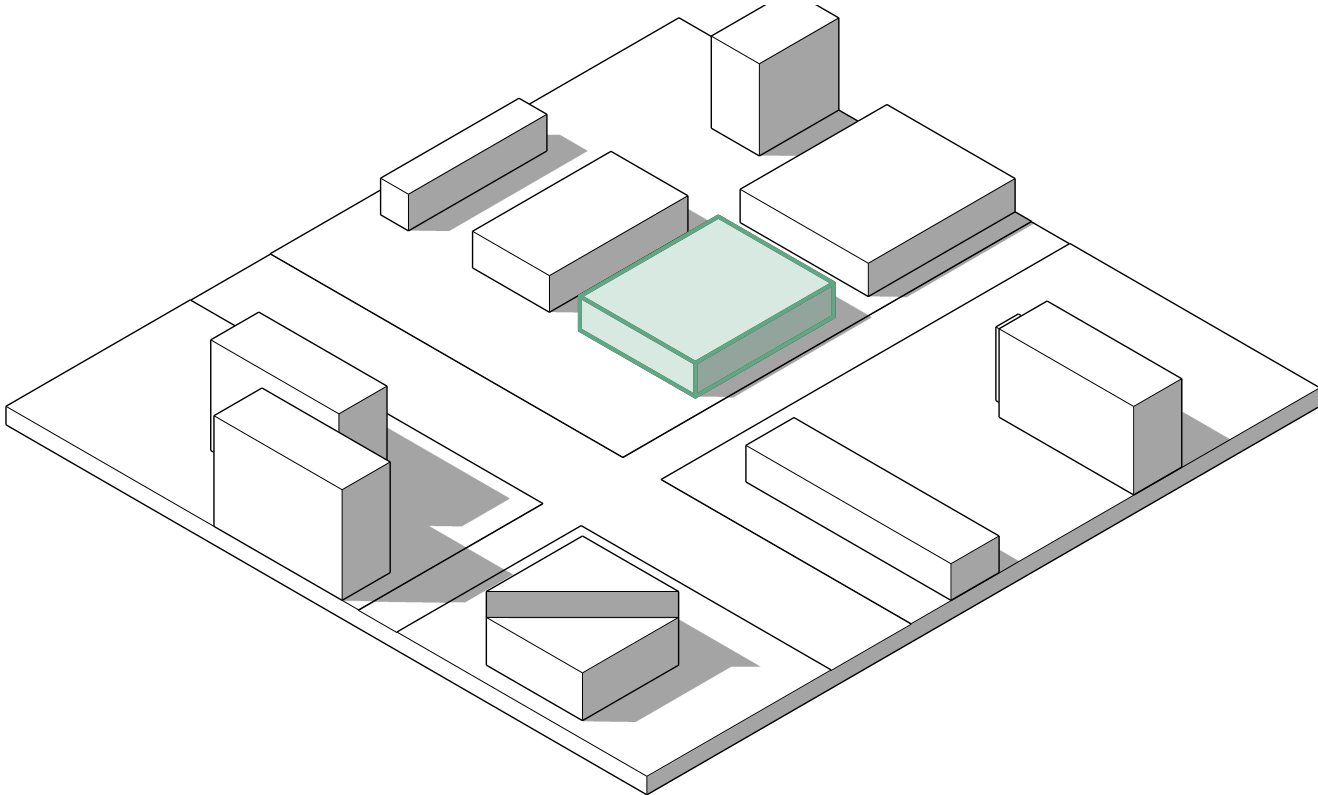


Development of the Area

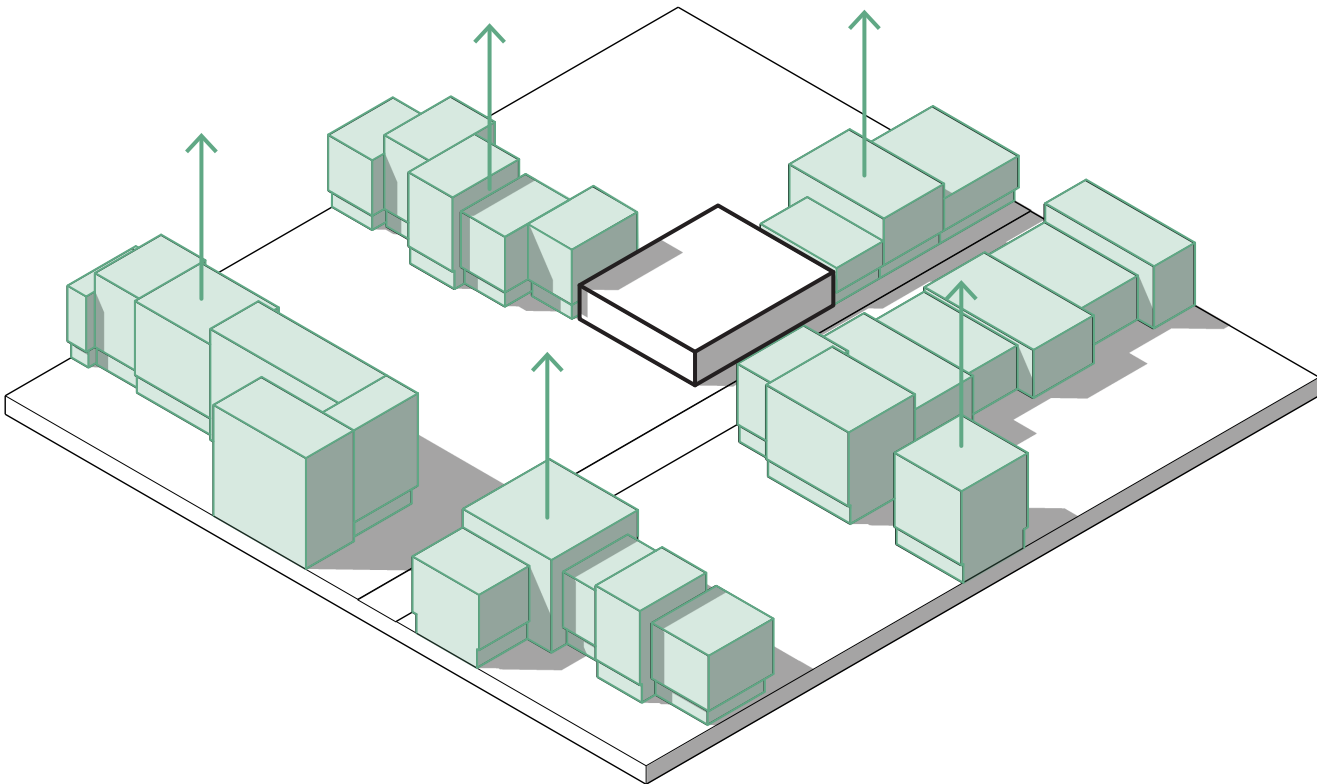


# The Circular Cornerstone

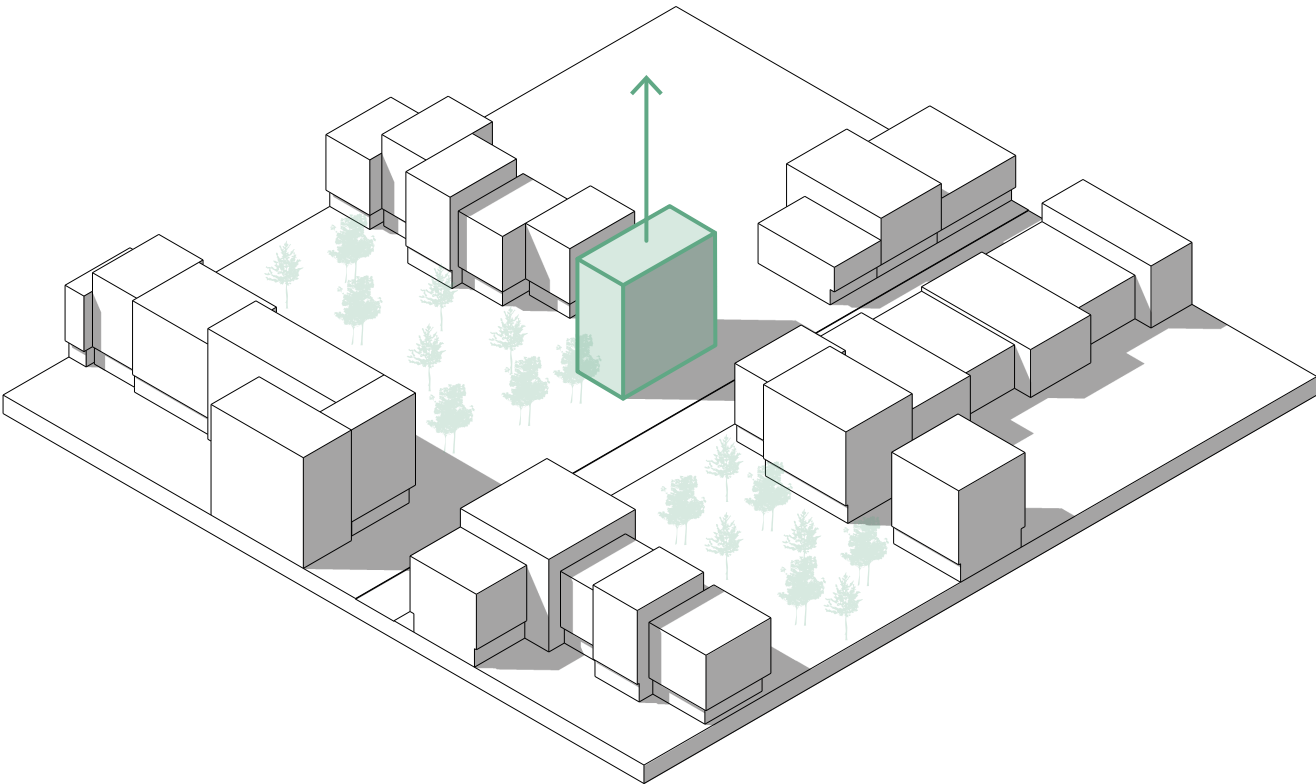
Form digrams.



Current Situation



Development of the Area

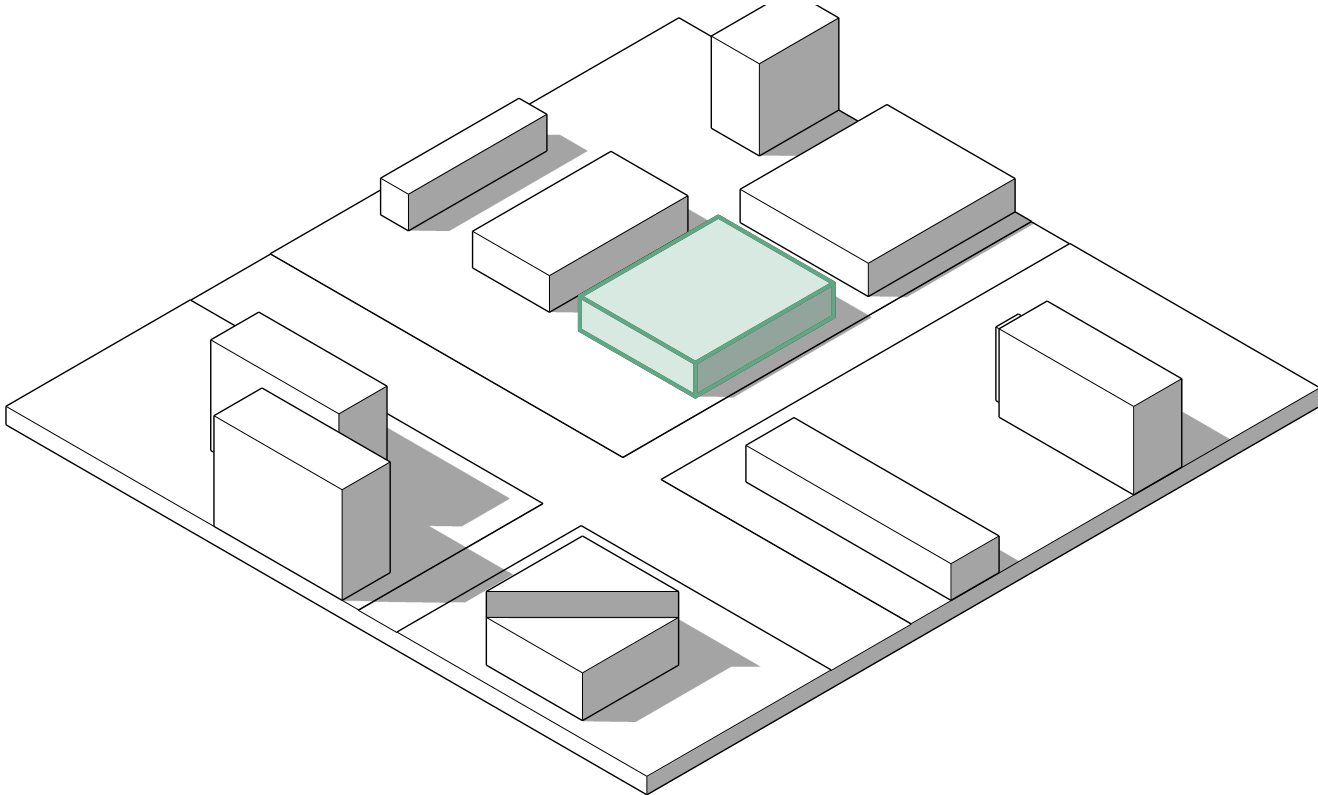


Densification of Components

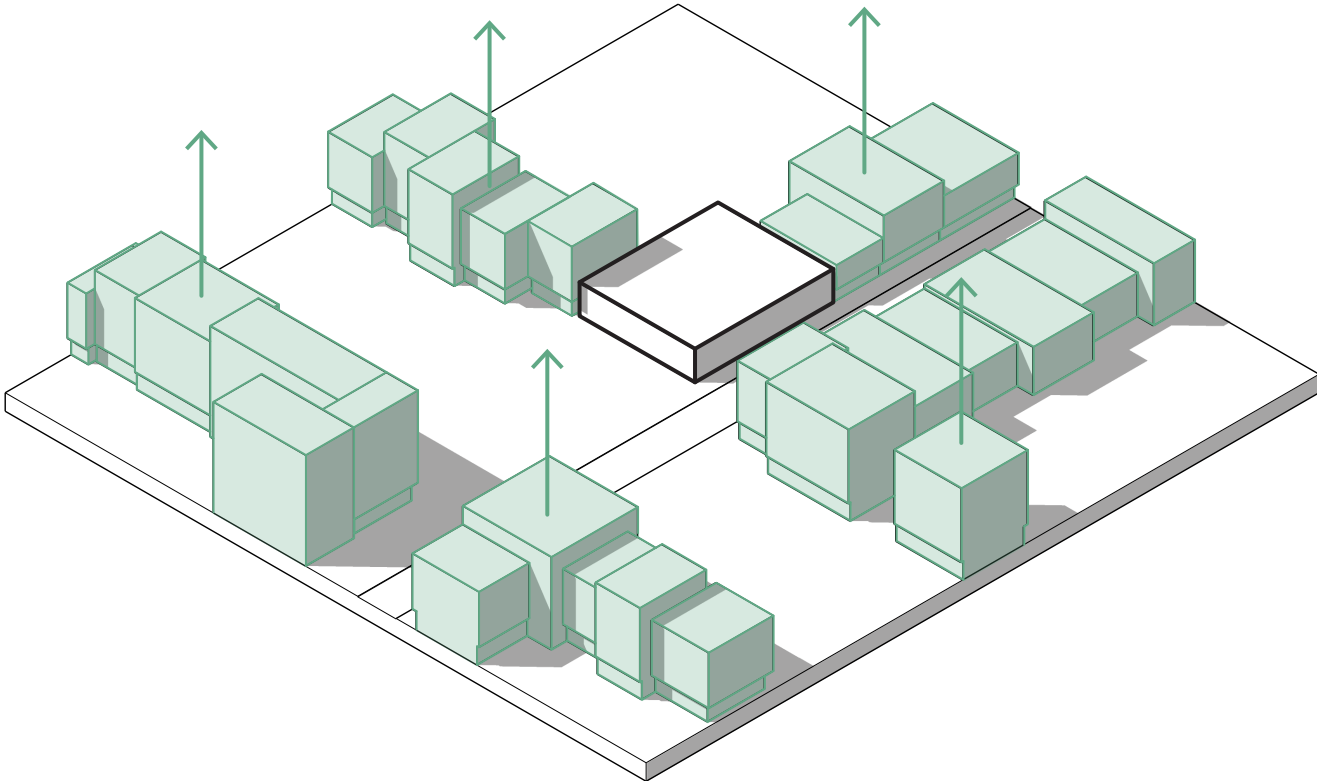


# The Circular Cornerstone

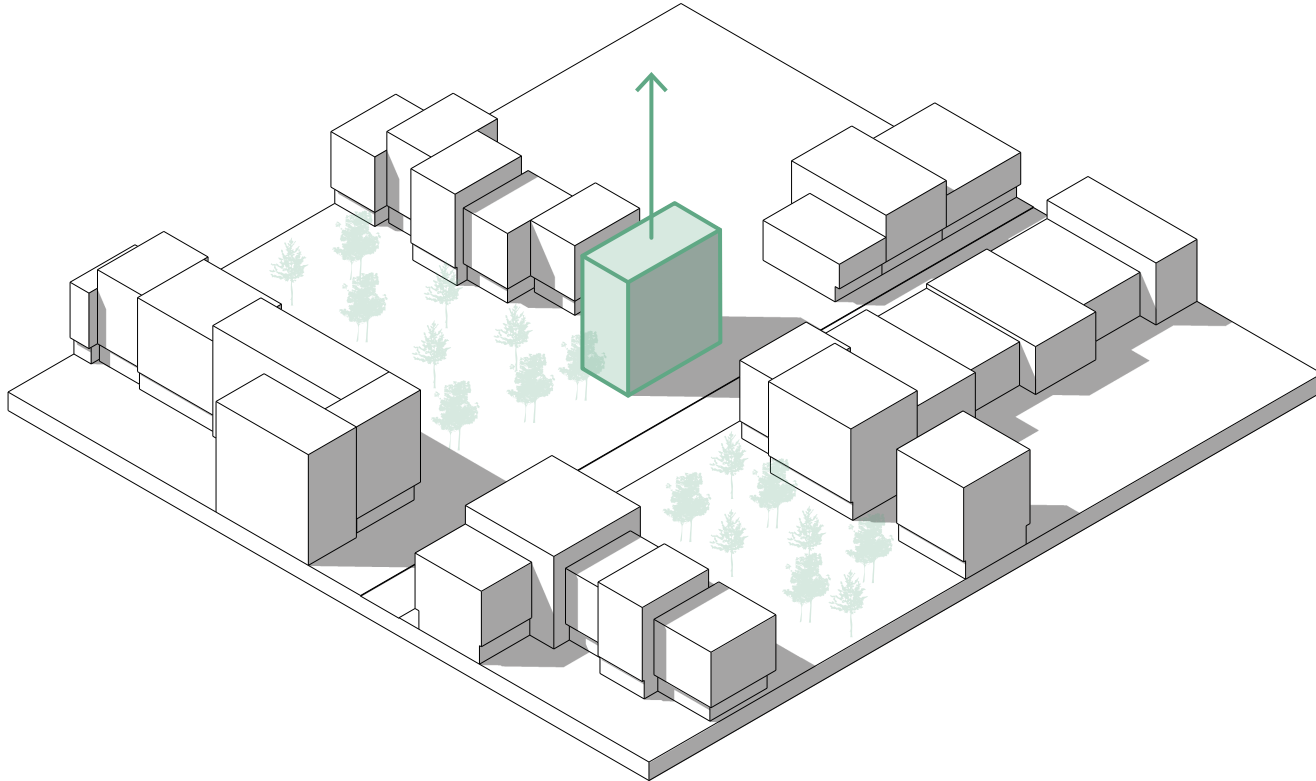
Form digrams.



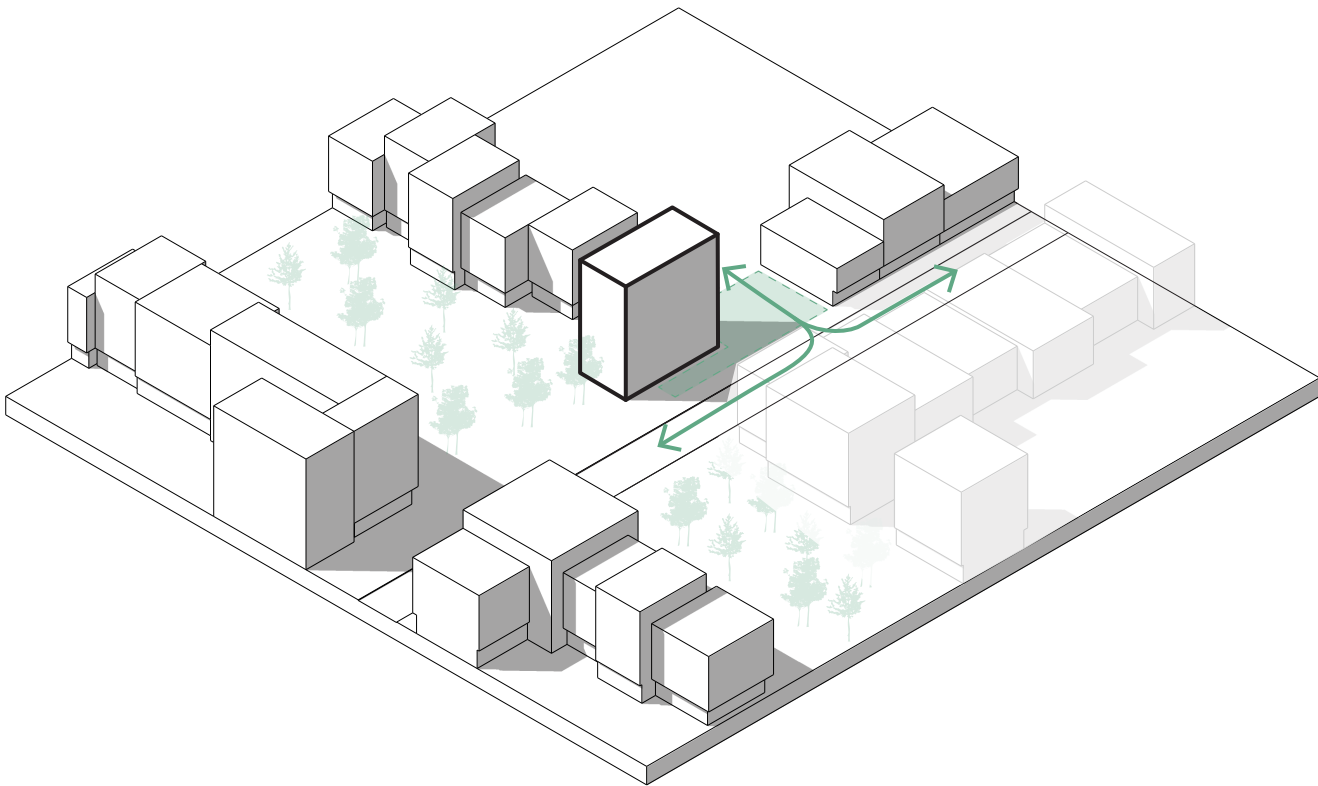
Current Situation



Development of the Area



Densification of Components

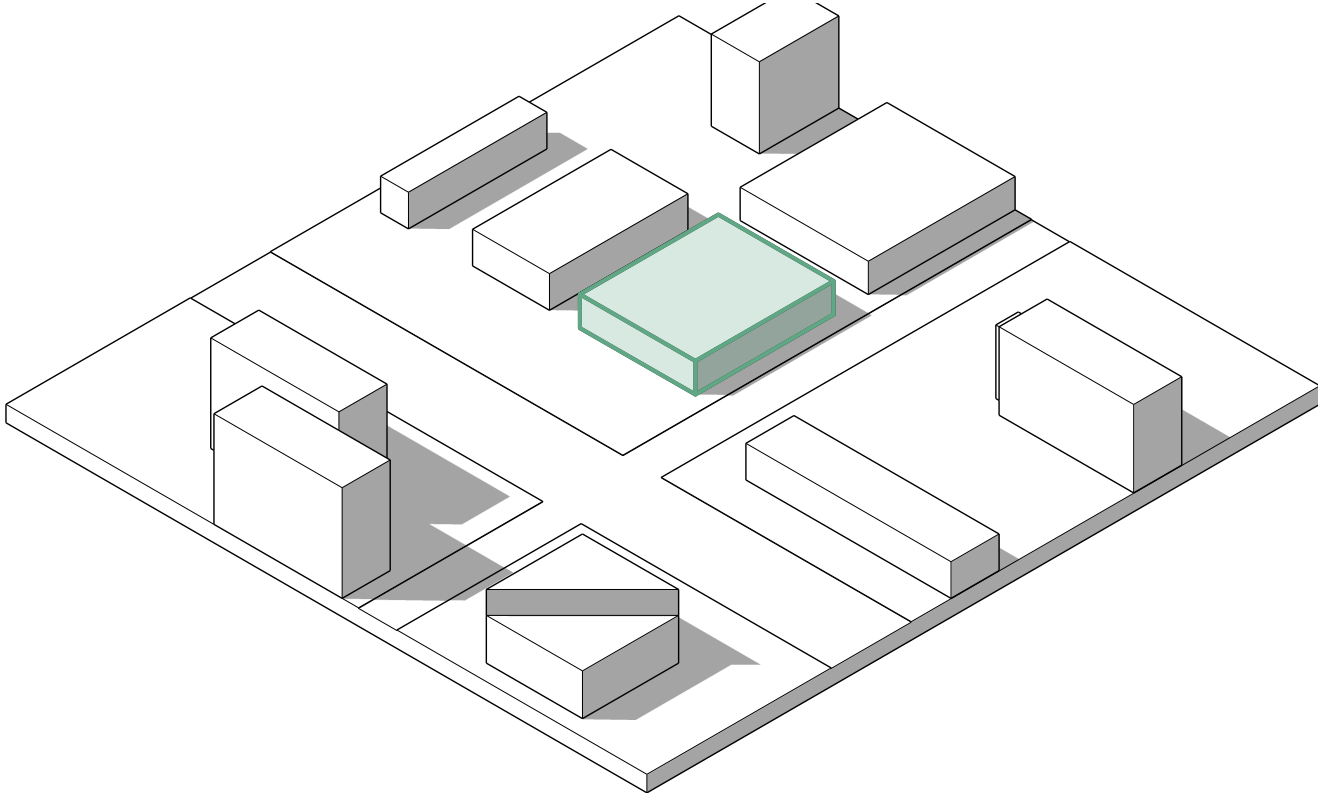


Integration of the Neighborhood

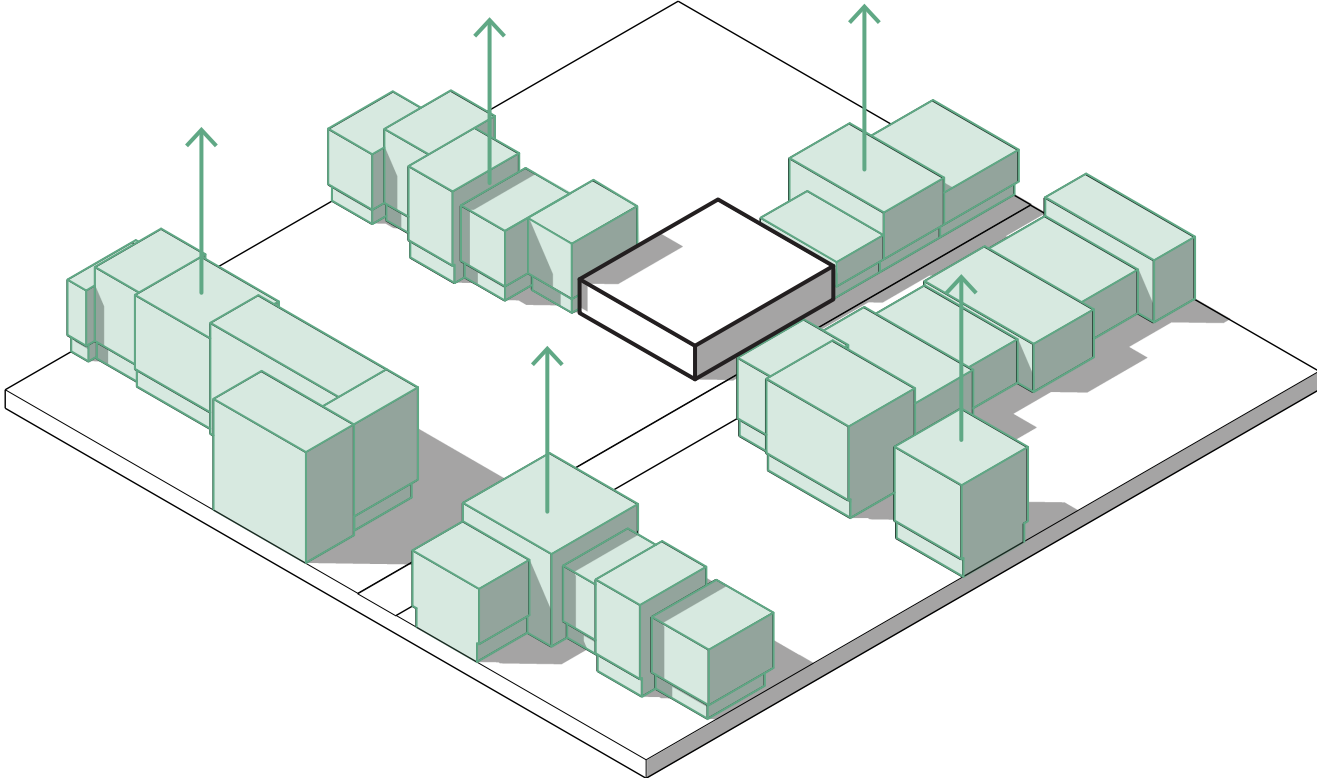


# The Circular Cornerstone

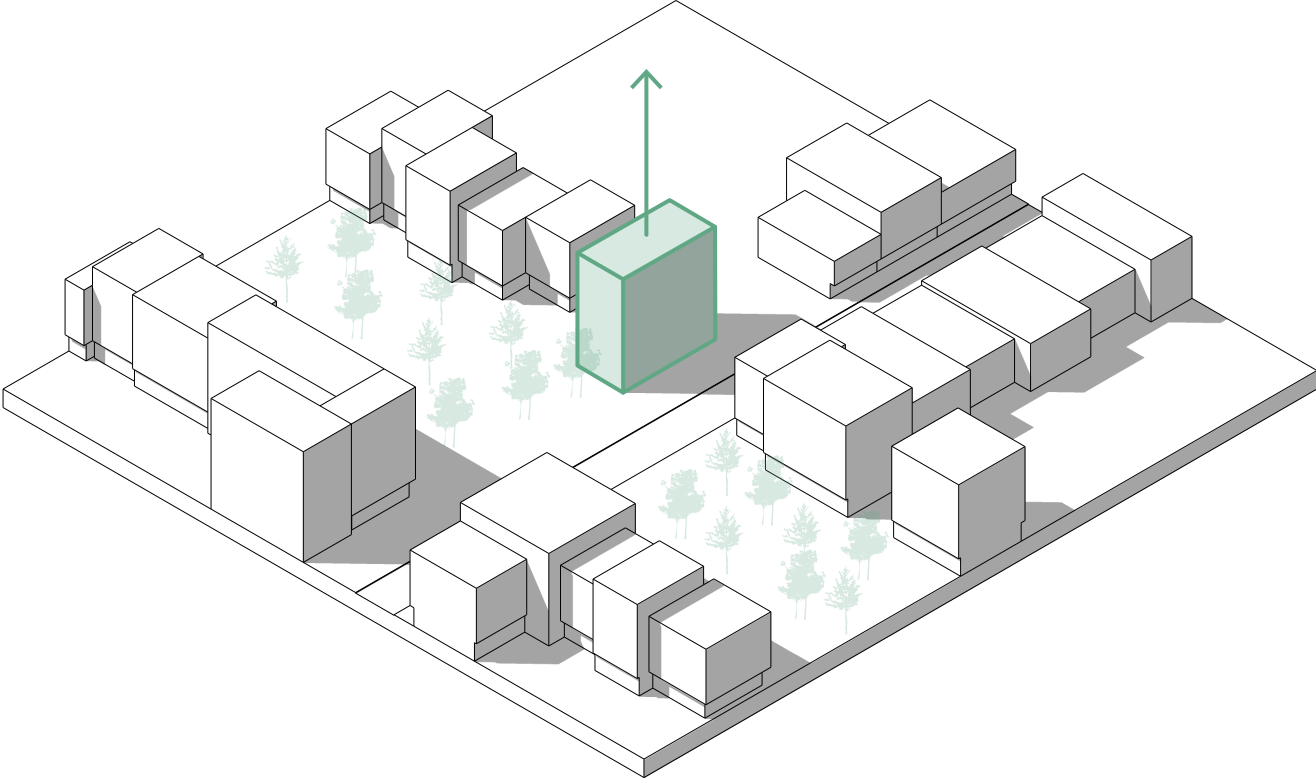
Form digrams.



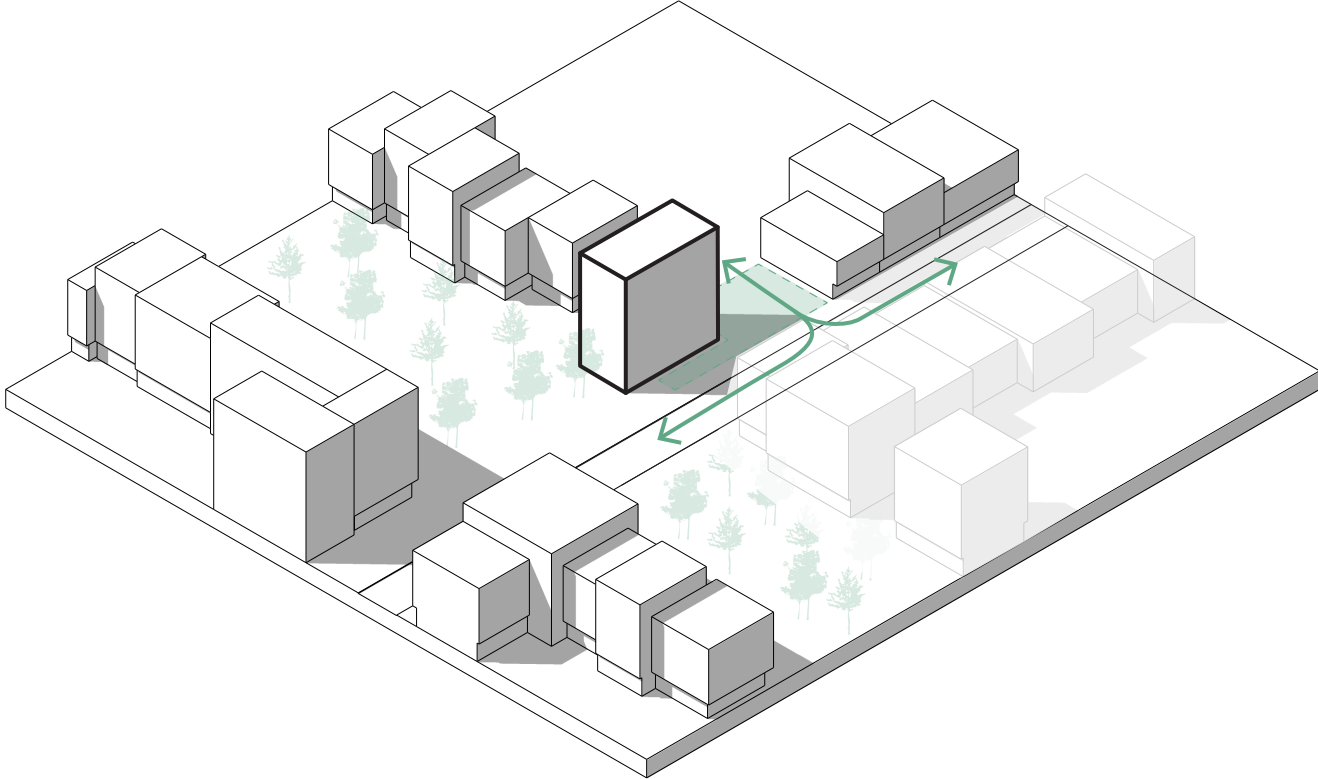
Current Situation



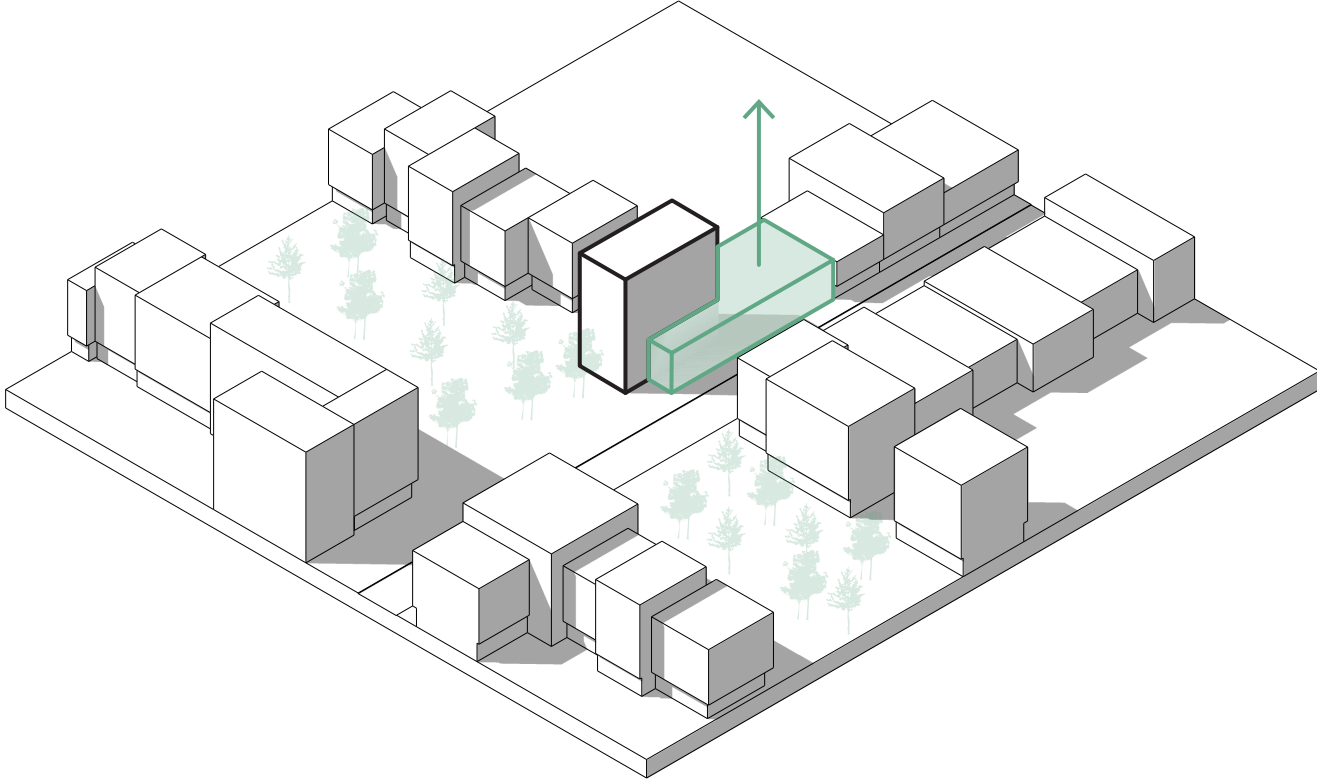
Development of the Area



Densification of Components



Integration of the Neighborhood

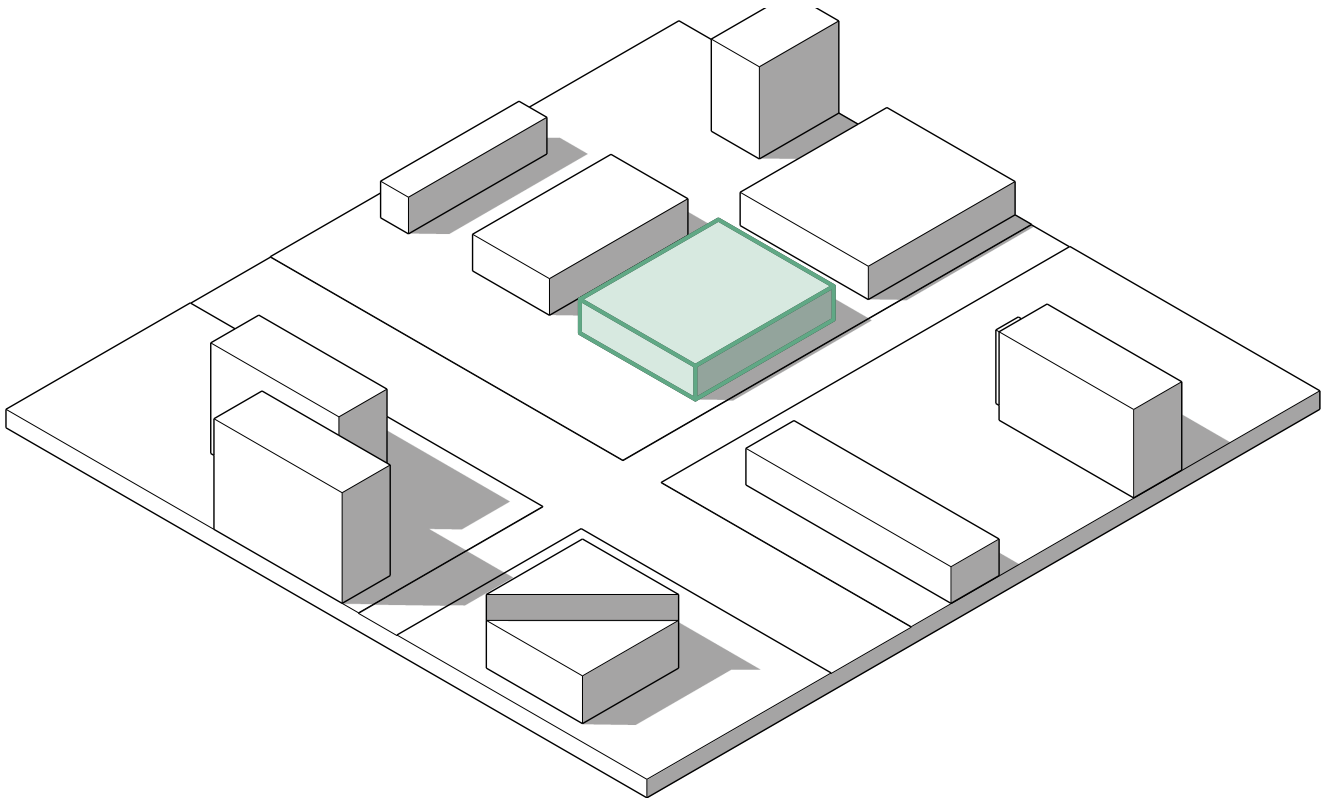


The Circular hub.

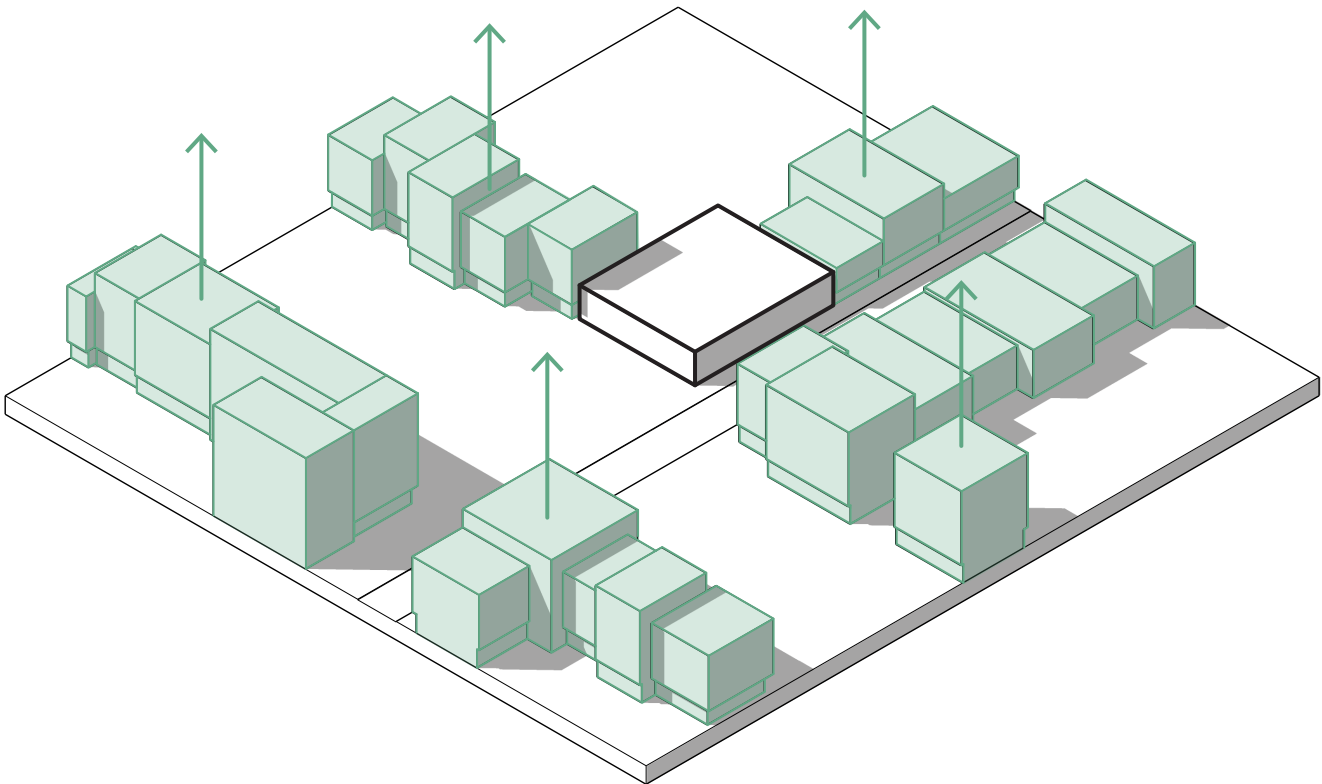


# The Circular Cornerstone

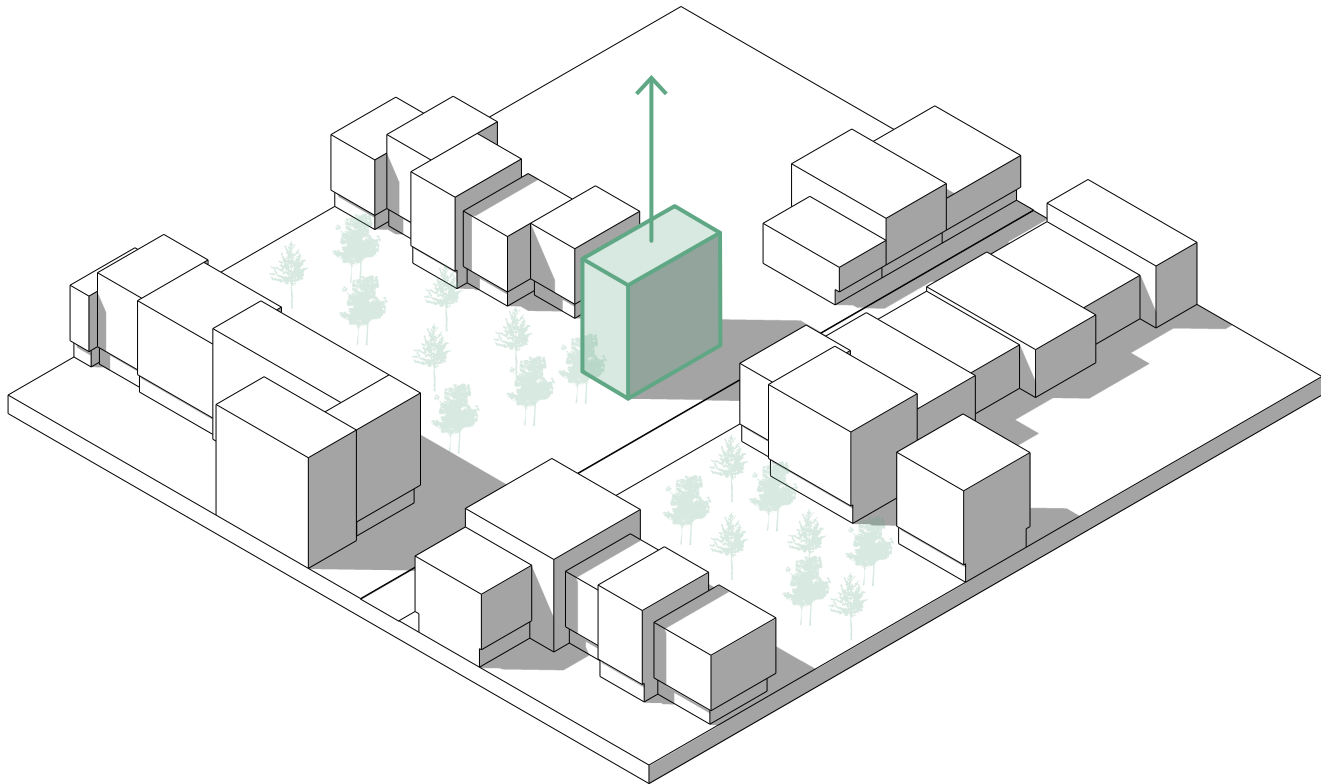
Form digrams.



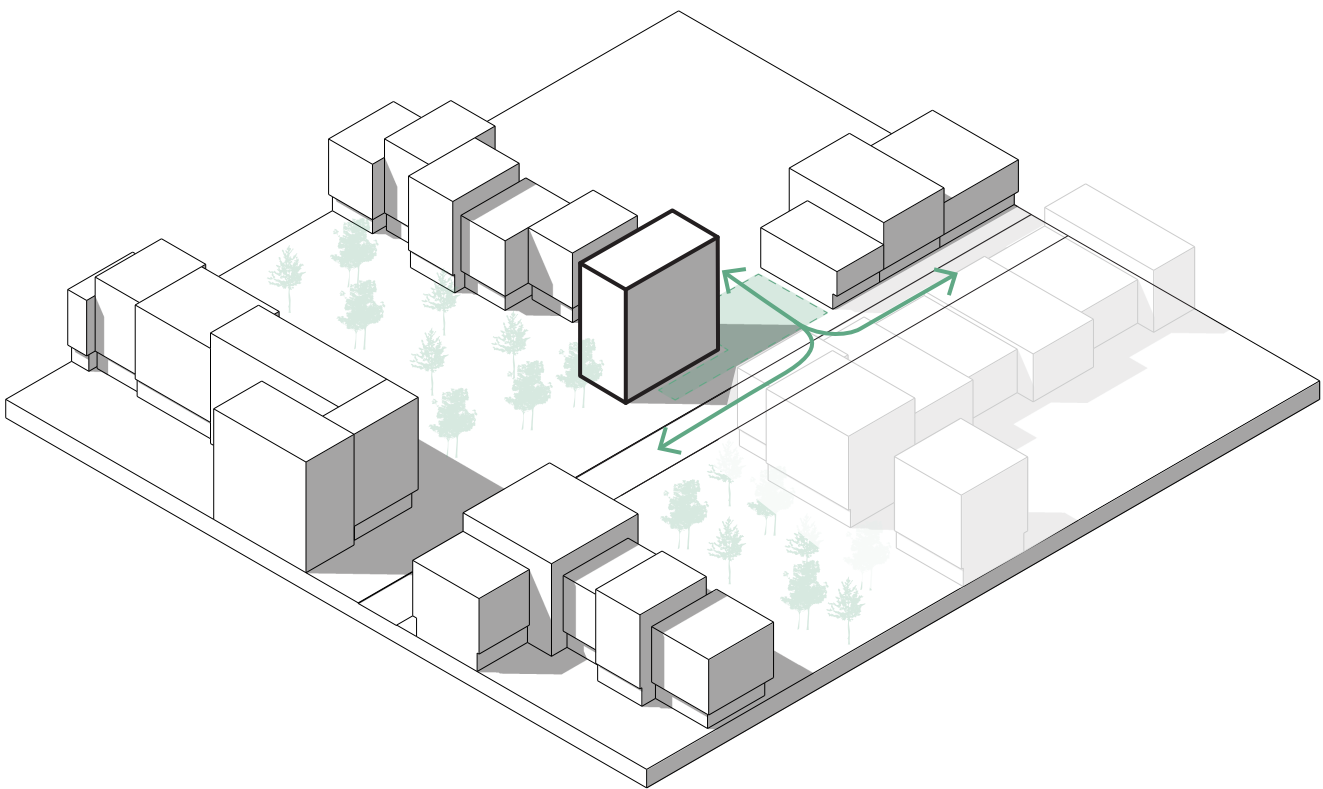
Current Situation



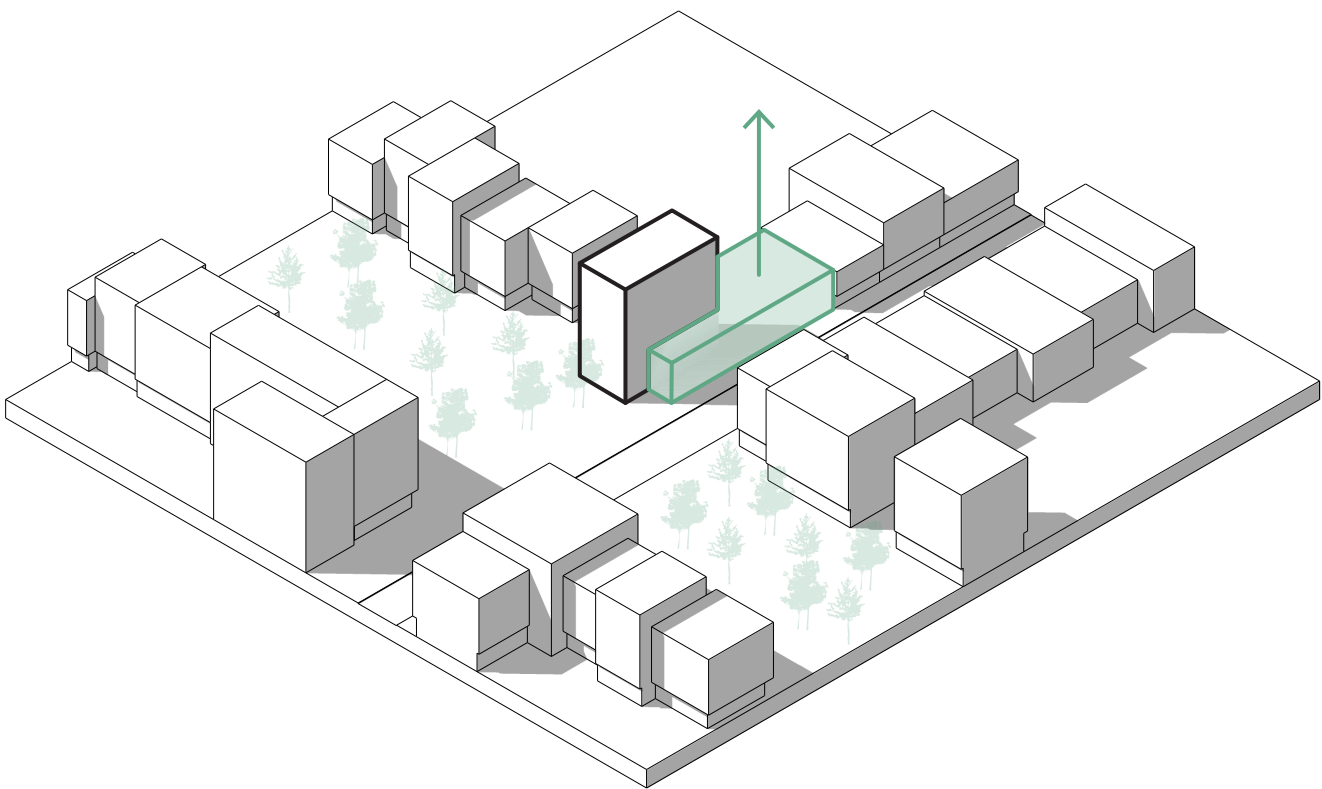
Development of the Area



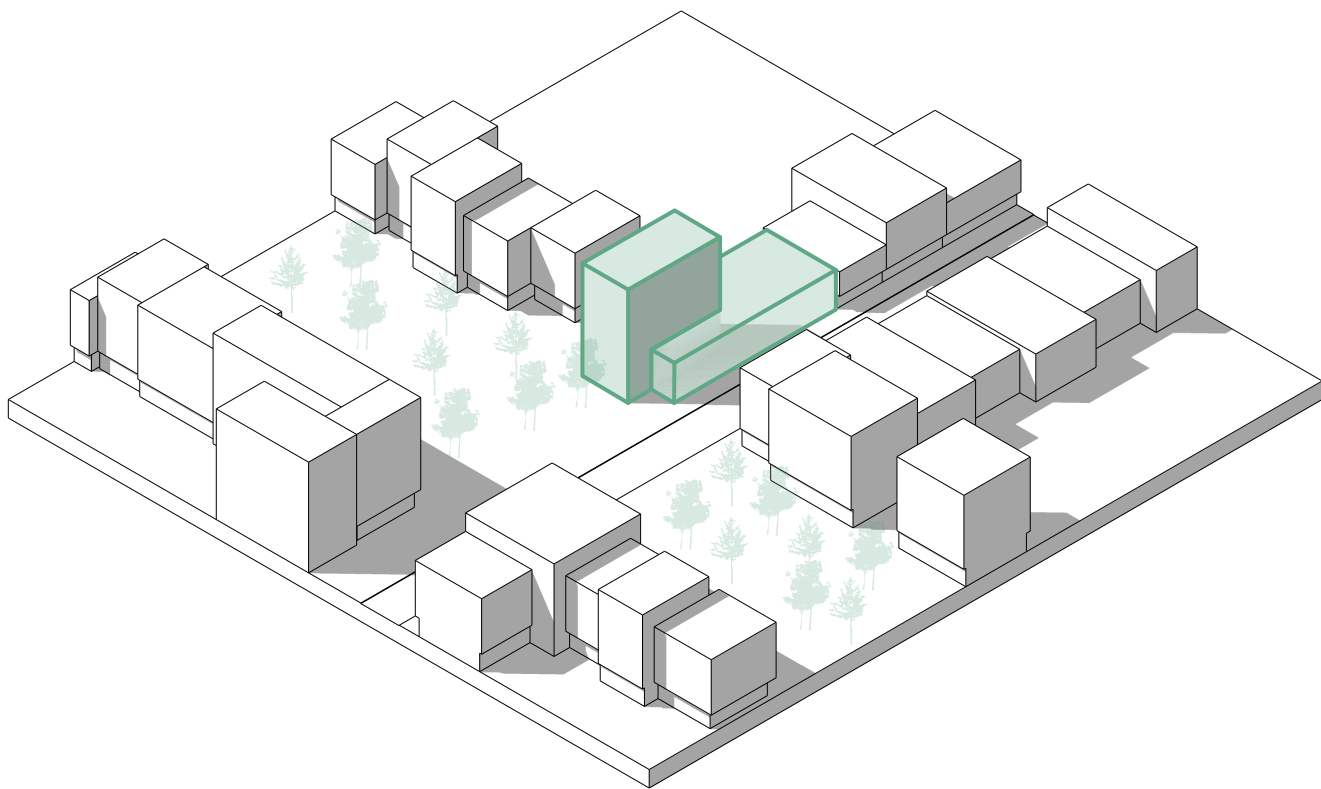
Densification of Components



Integration of the Neighborhood



The Circular hub.

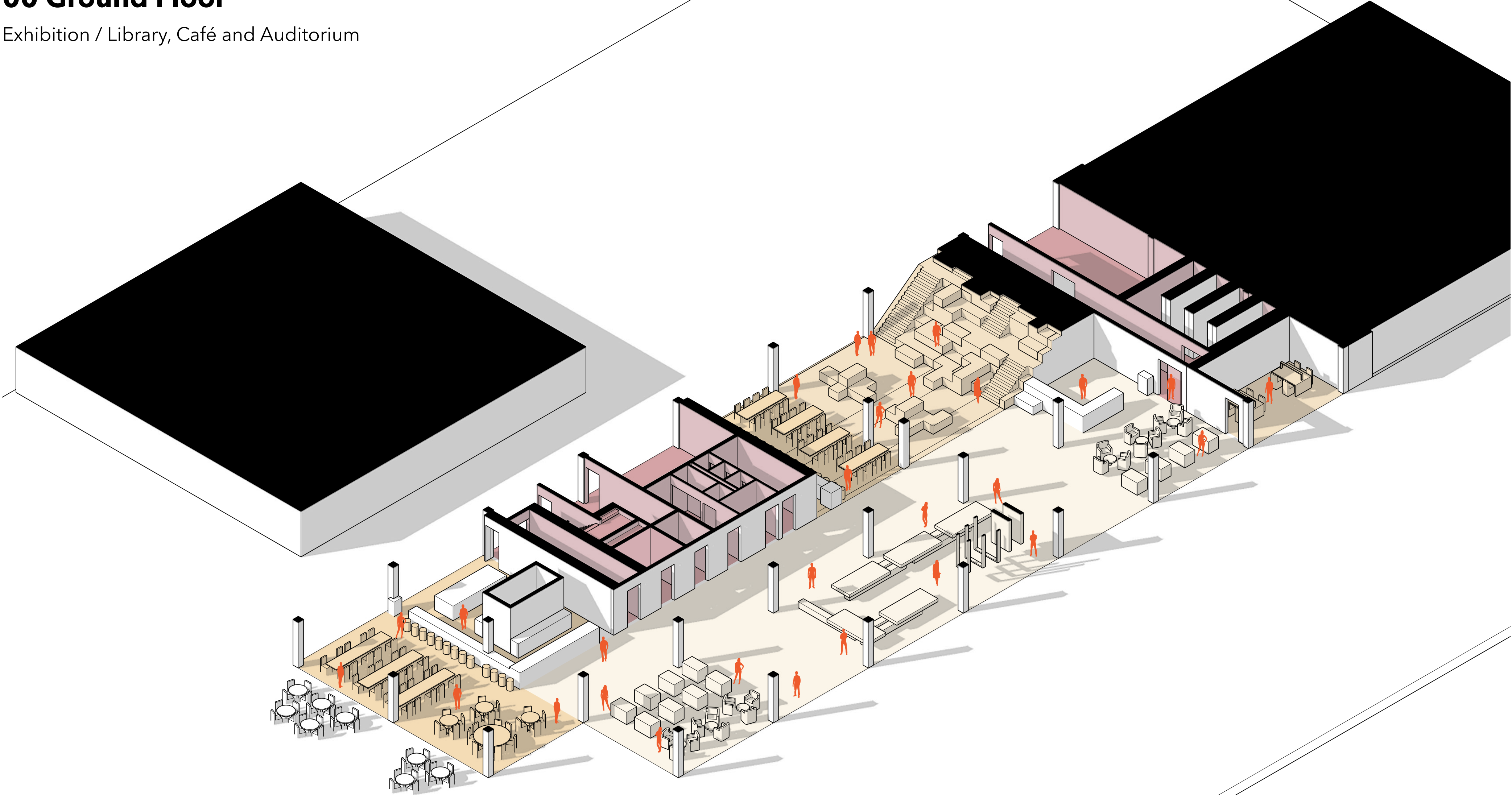


The Circular Cornerstone.



# 00 Ground Floor

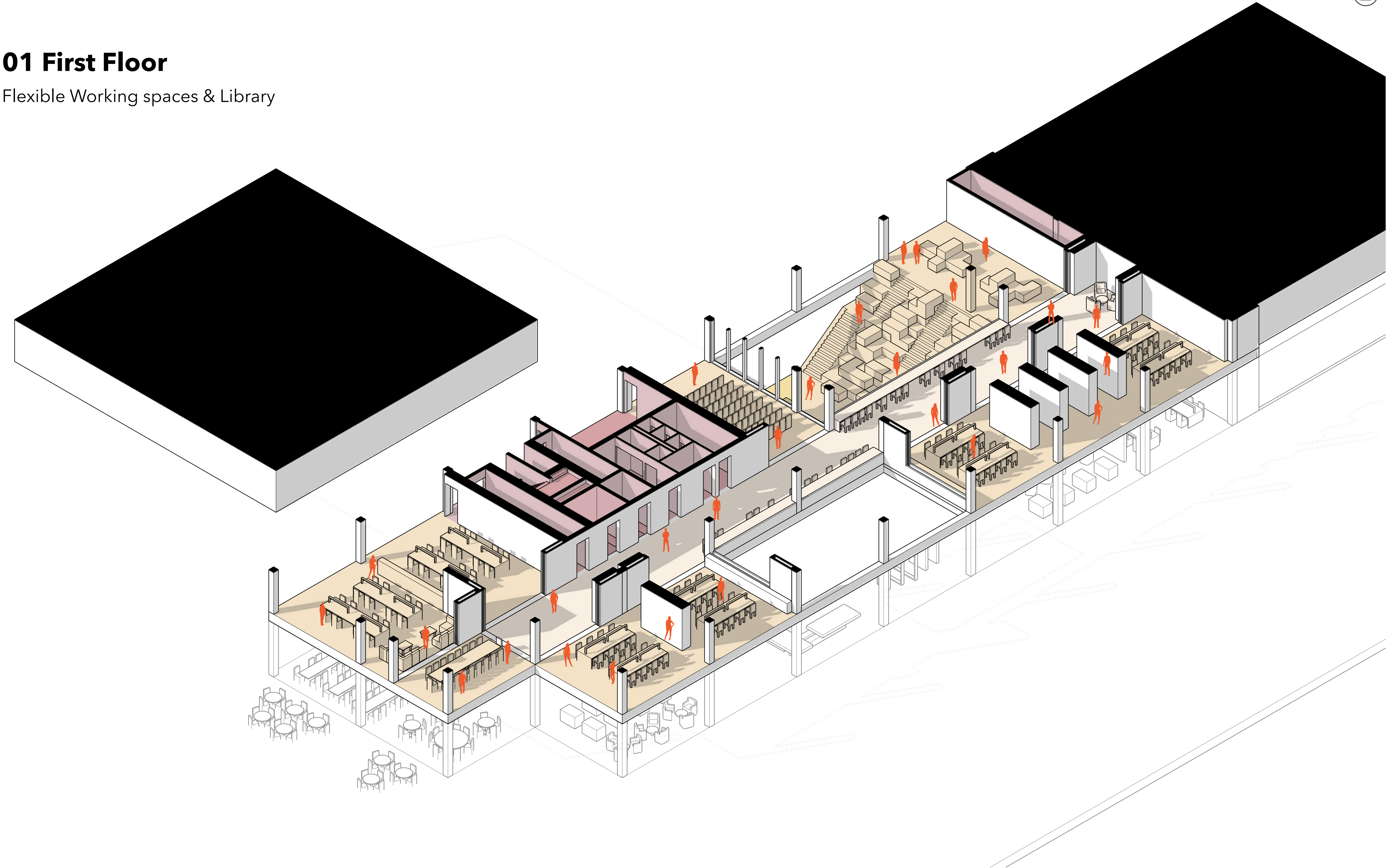
Exhibition / Library, Café and Auditorium





# 01 First Floor

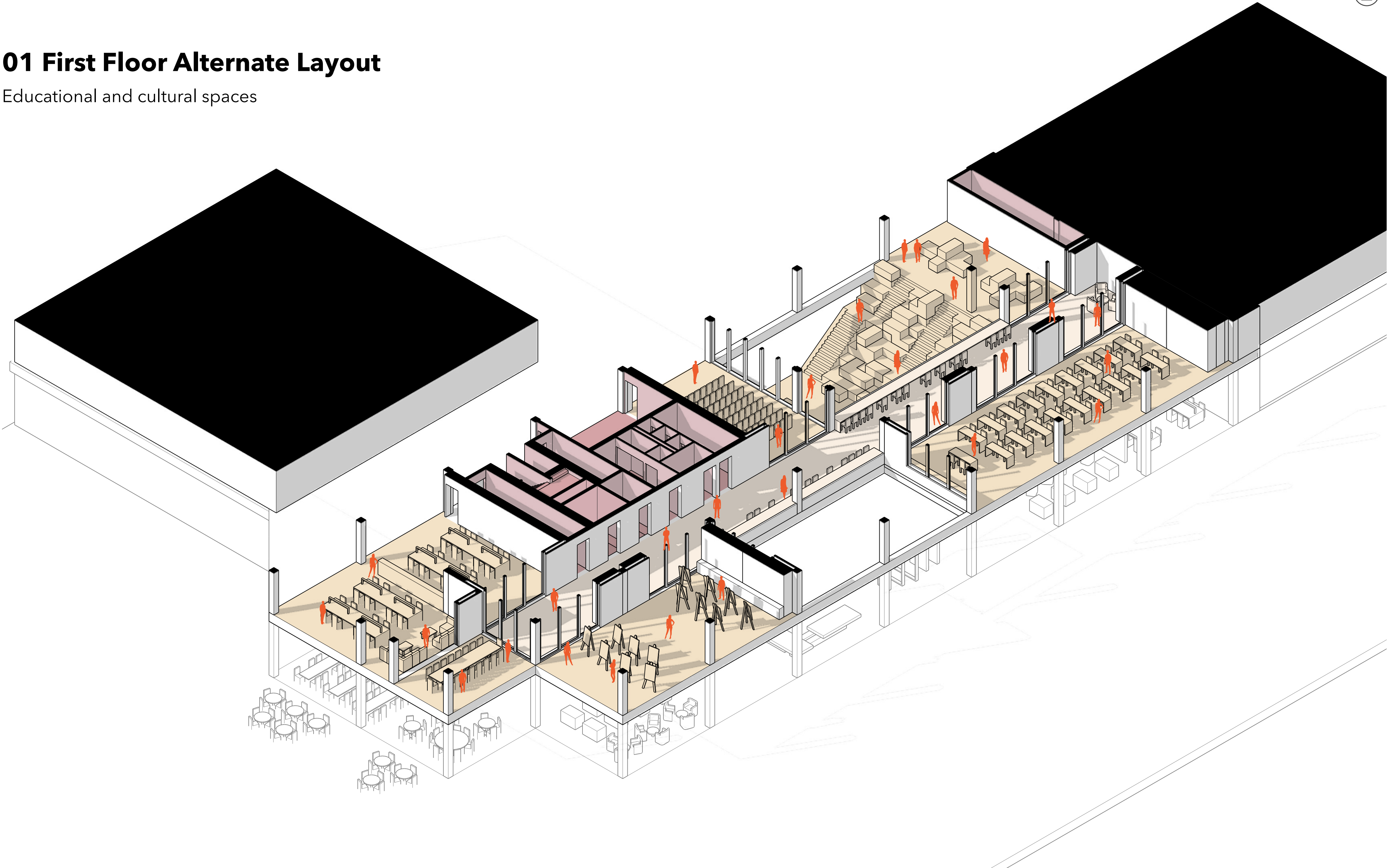
Flexible Working spaces & Library





# 01 First Floor Alternate Layout

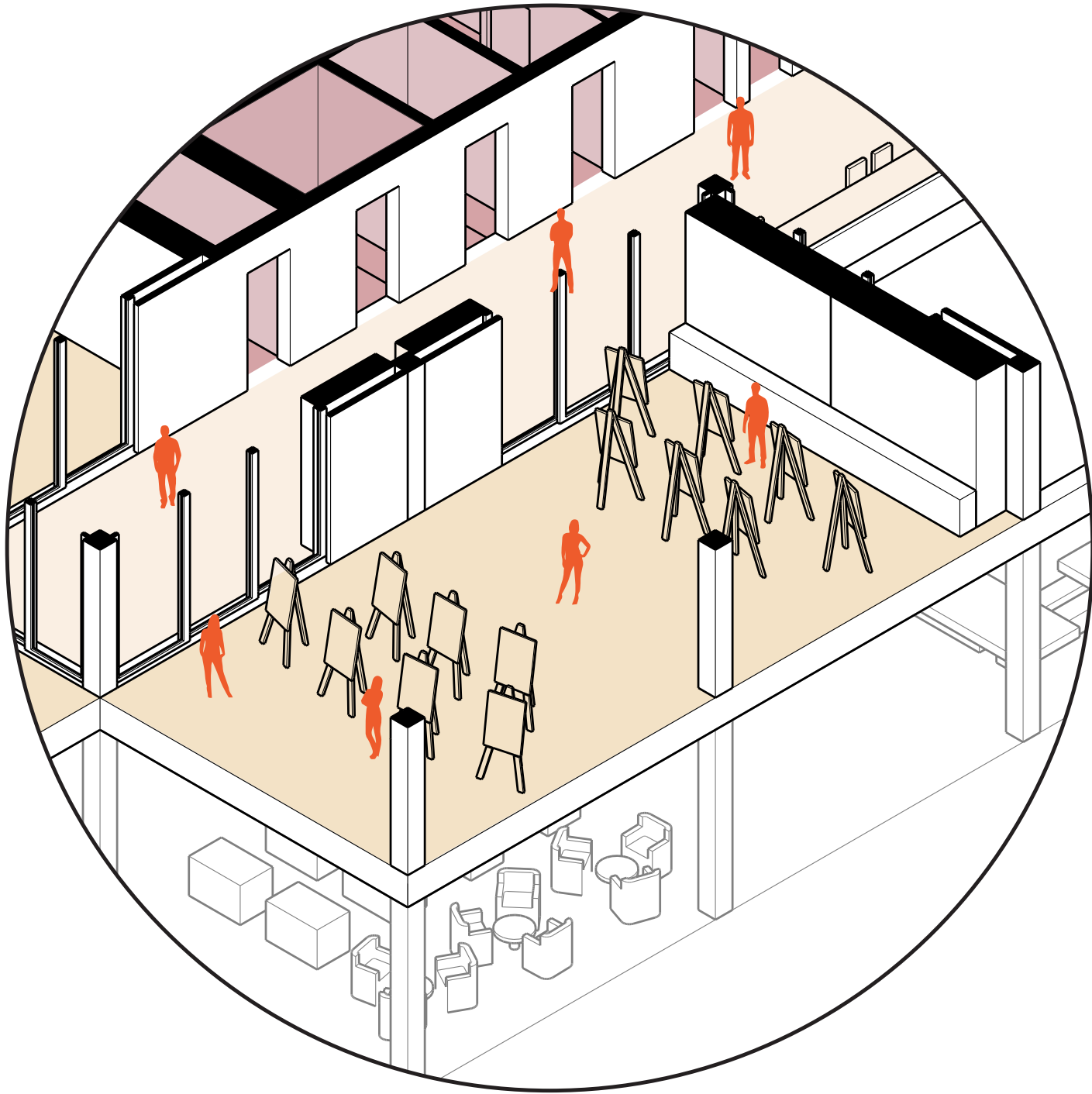
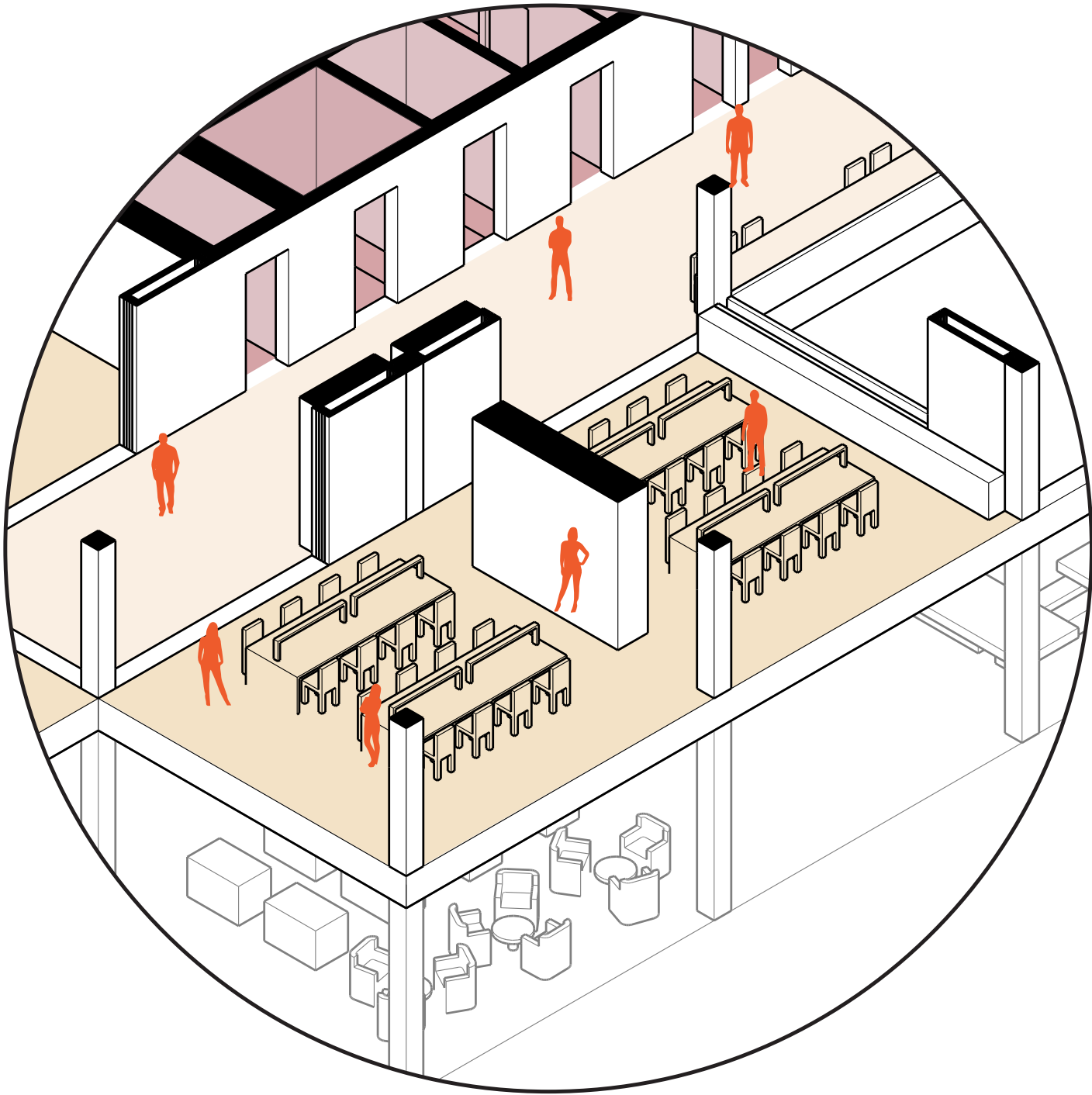
Educational and cultural spaces





# 01 First Floor Alternate Layout

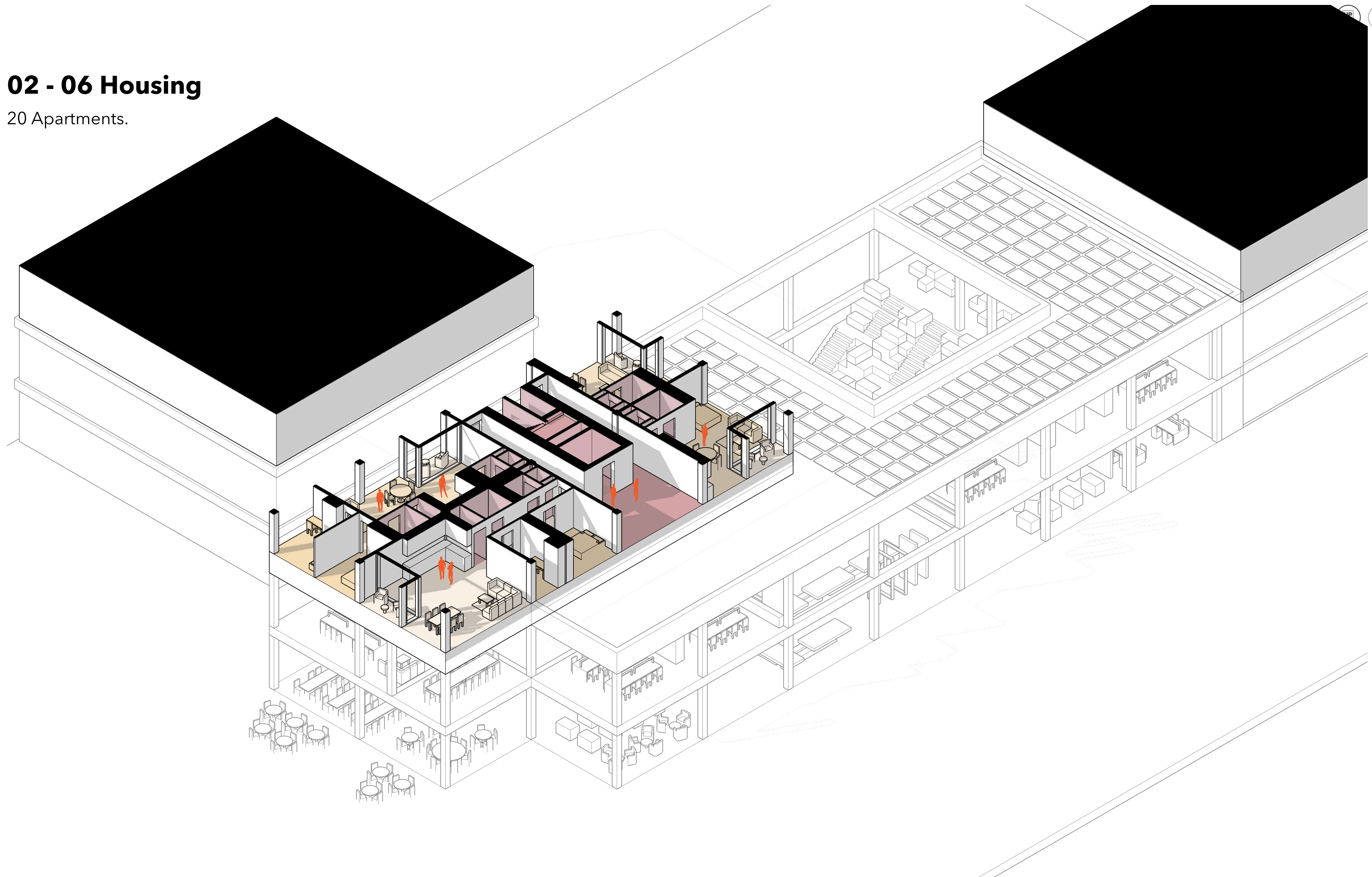
Educational and cultural spaces





## 02 - 06 Housing

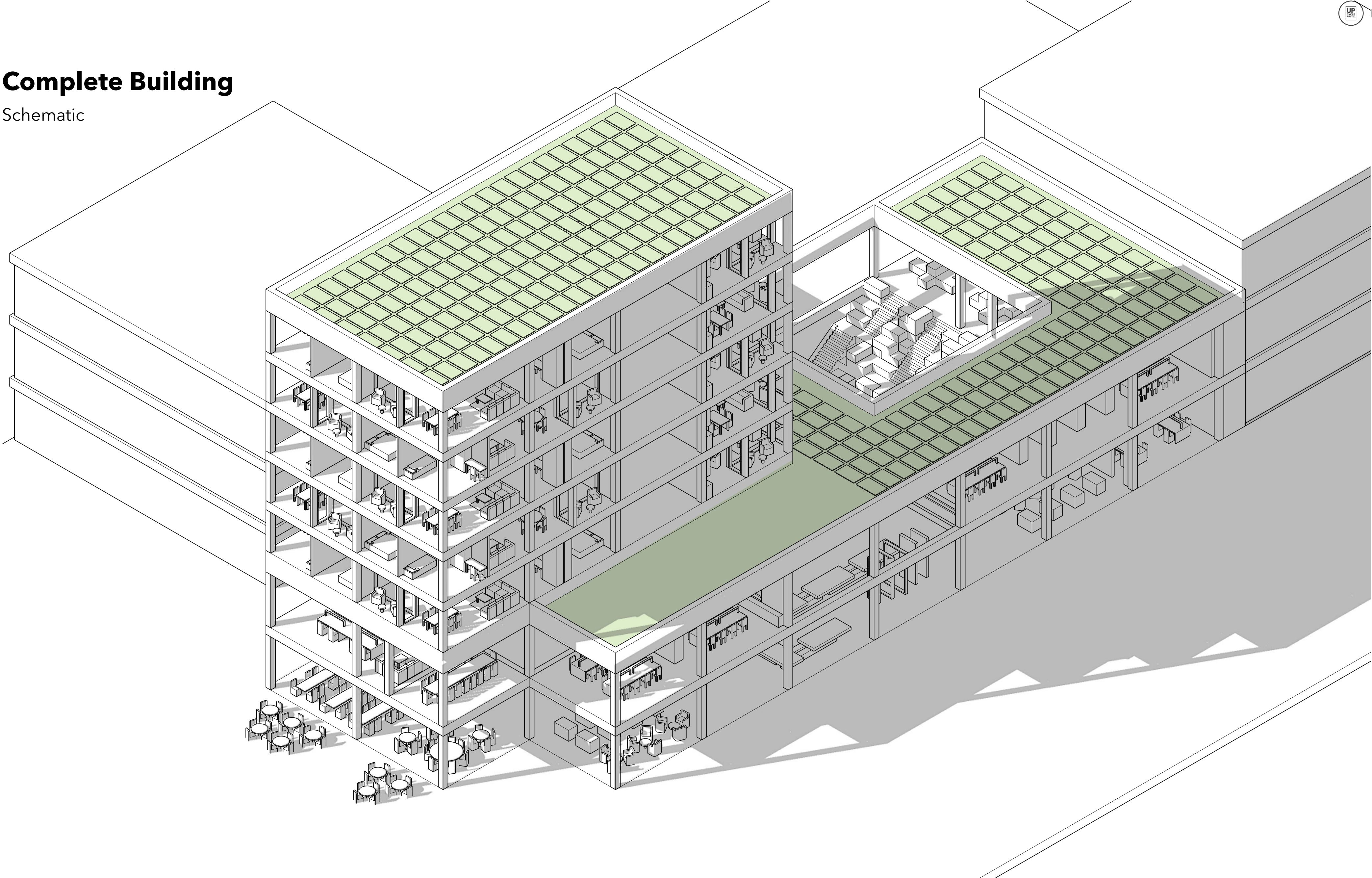
20 Apartments.





# Complete Building

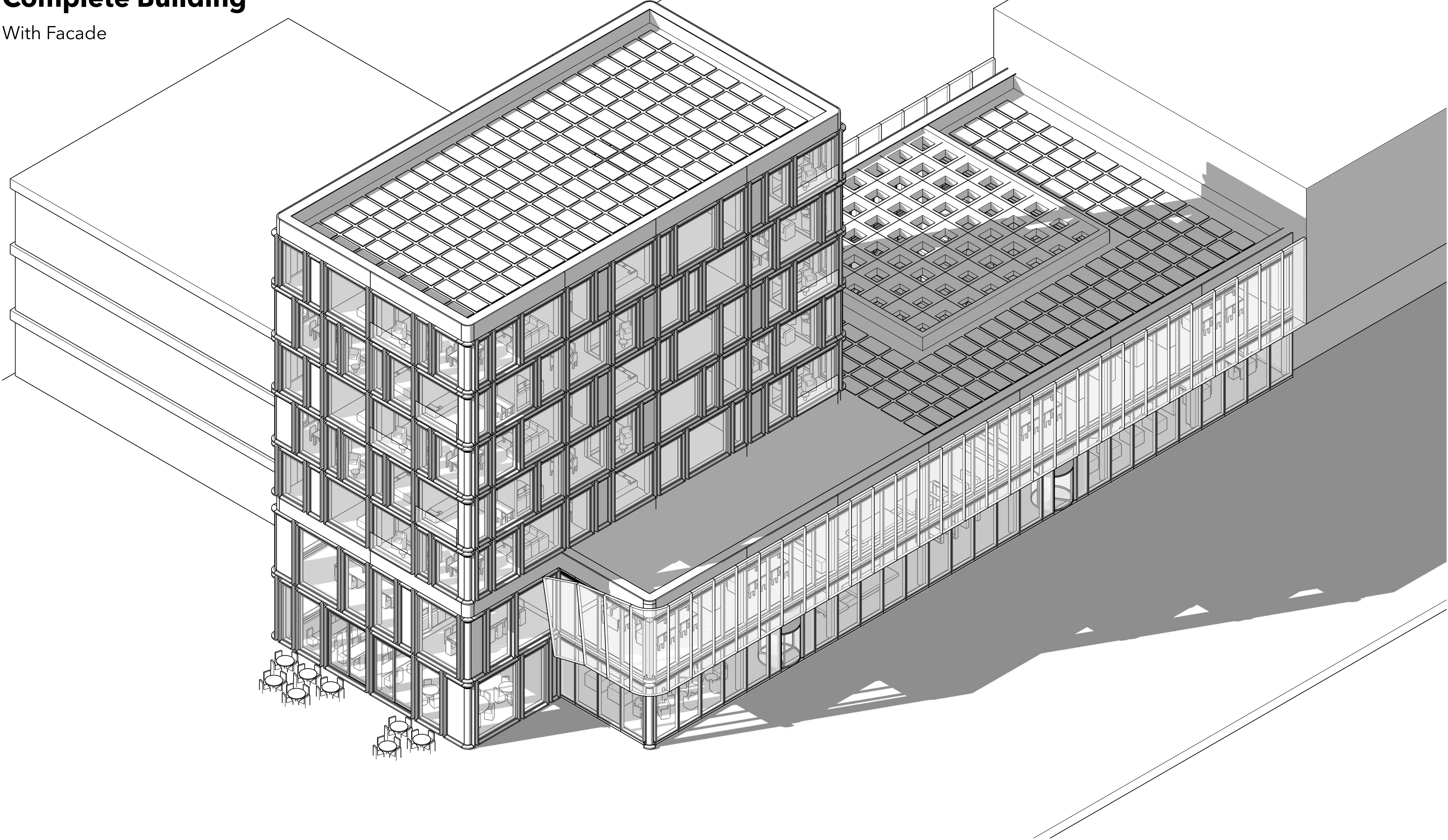
Schematic





# Complete Building

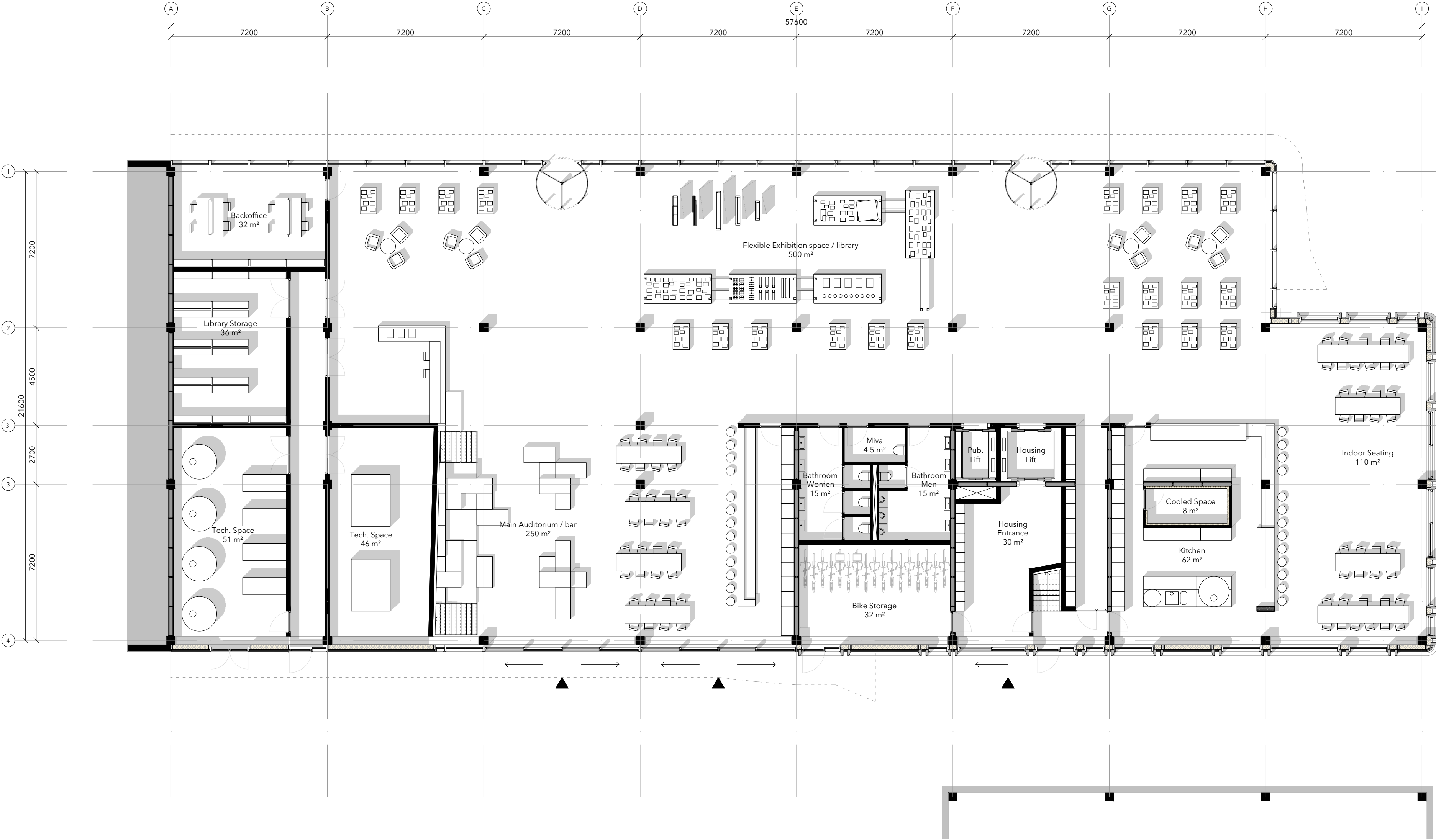
With Facade





# Floorplan

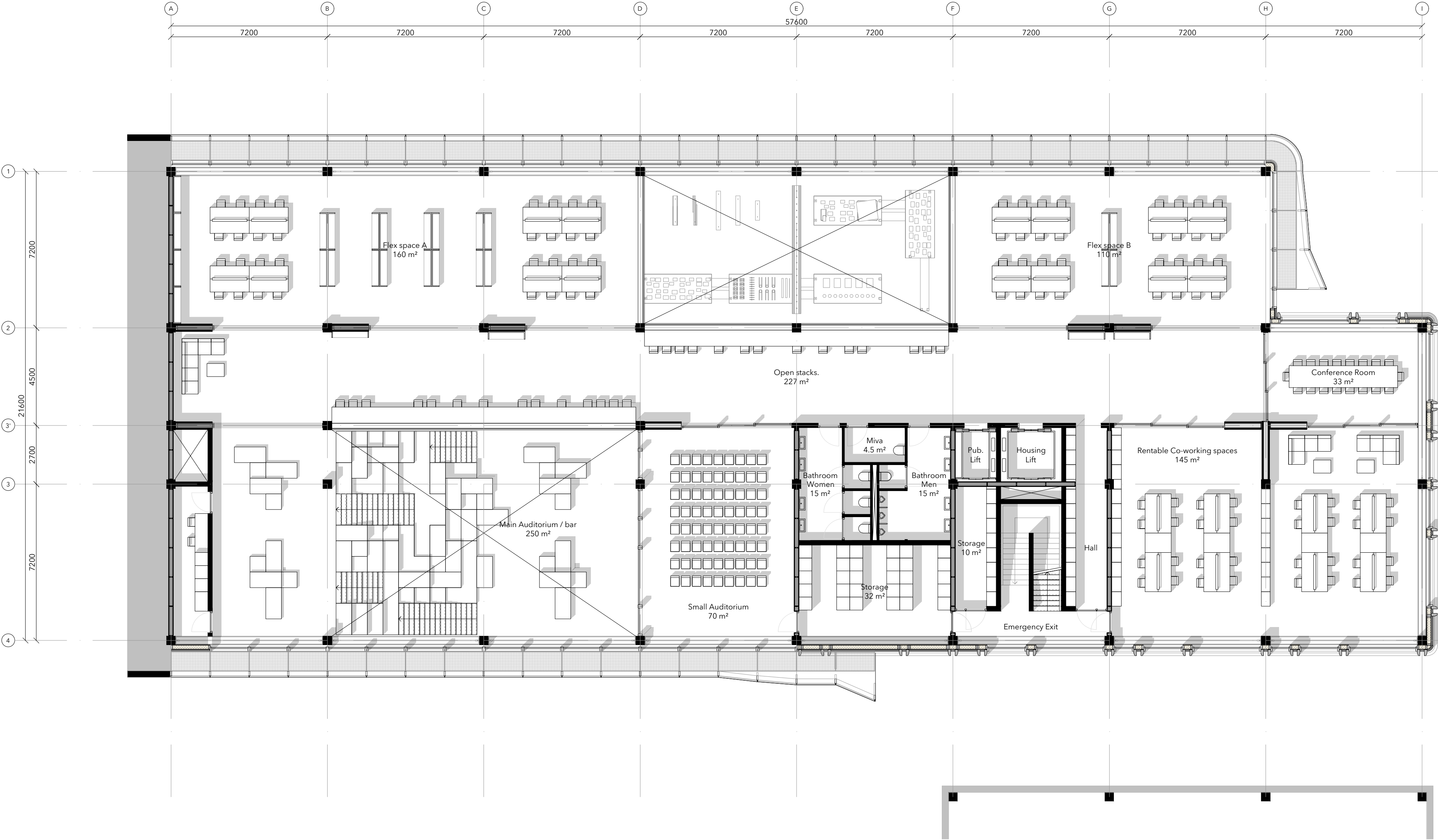
00 Ground Floor





# Floorplan

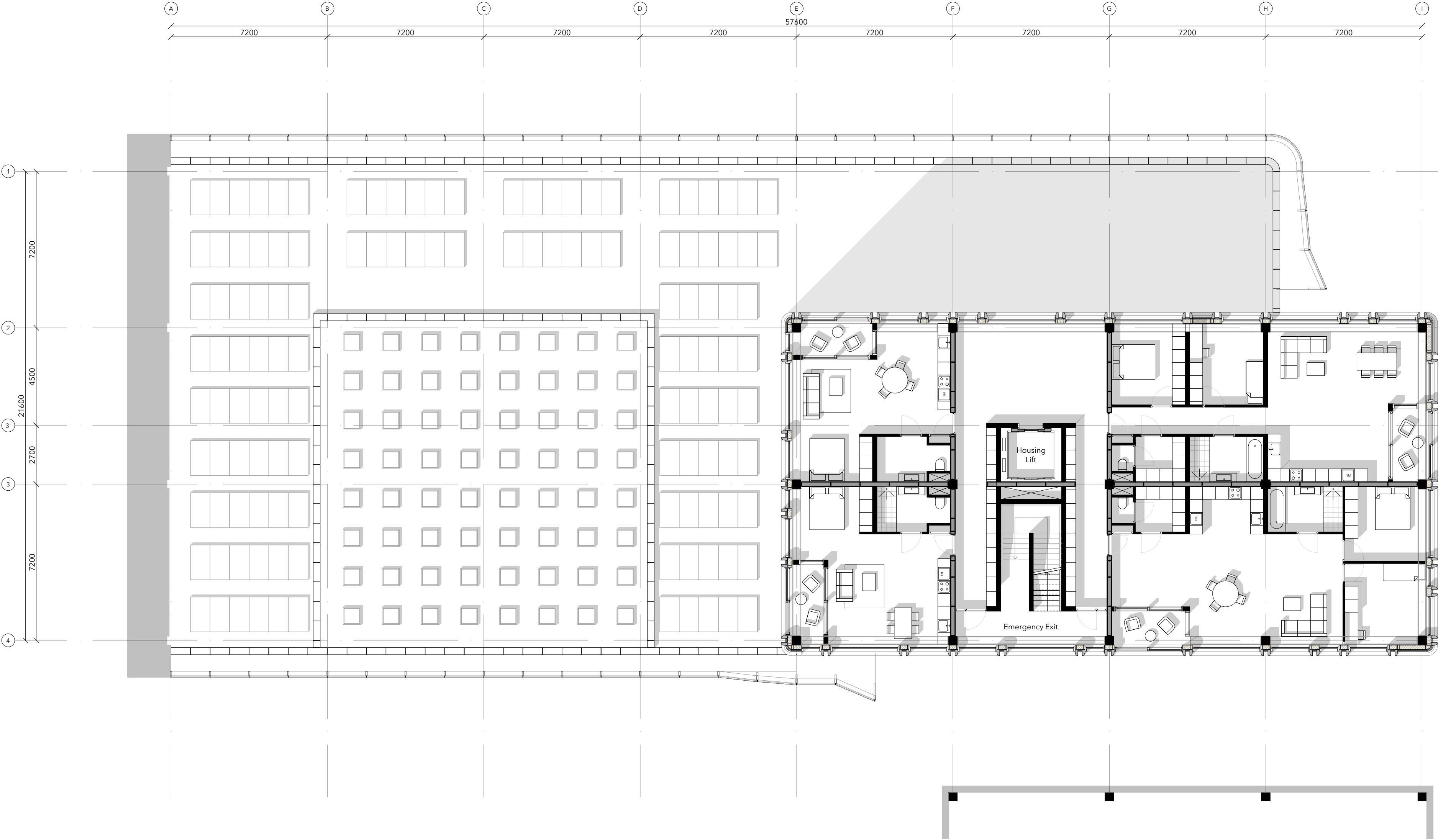
00 First Floor





# Floorplan

02 - 06 Housing



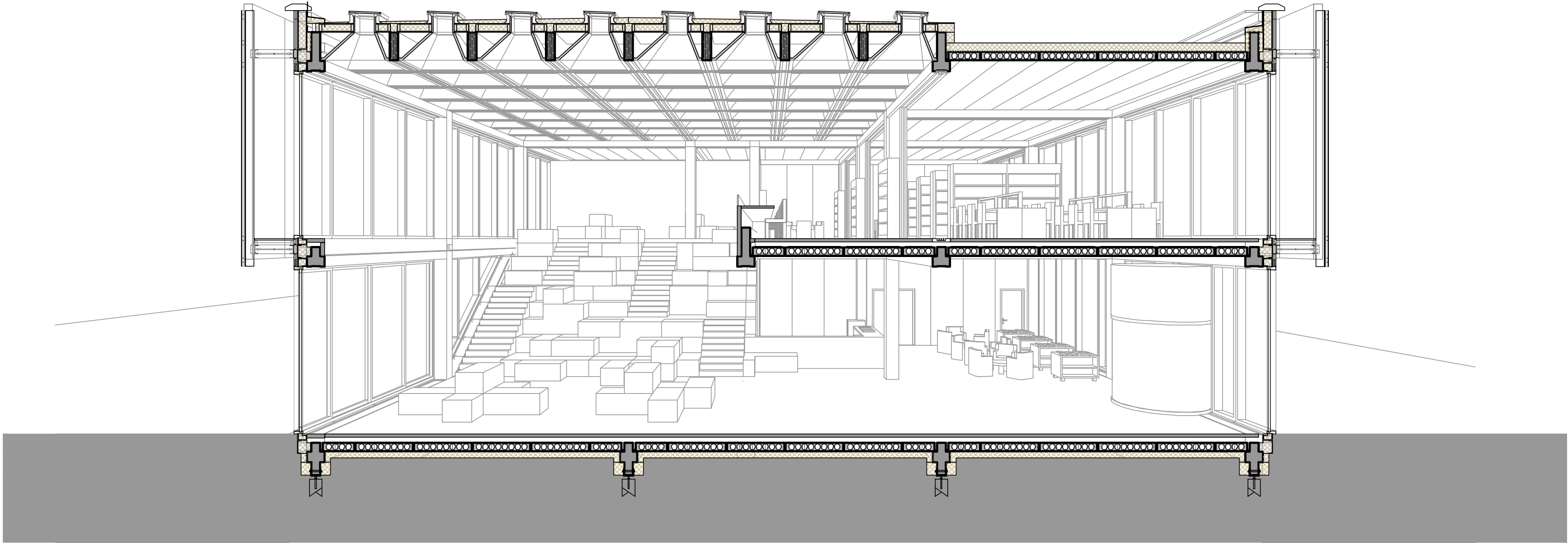






# Section

Section AA





Elevation

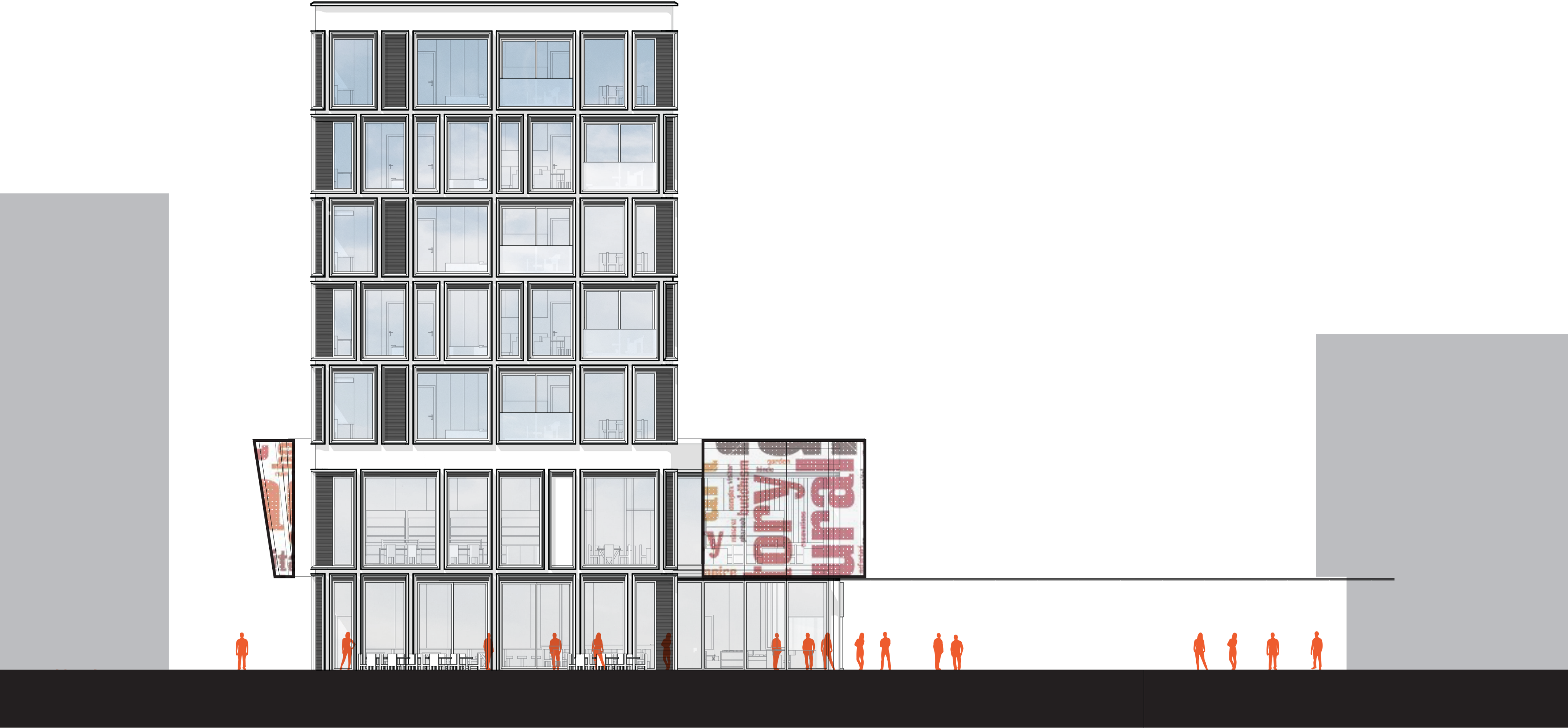
South Facade / Inner Square





# Elevation

West Facade / Parkside





# Elevation

South Facade / New Main street.



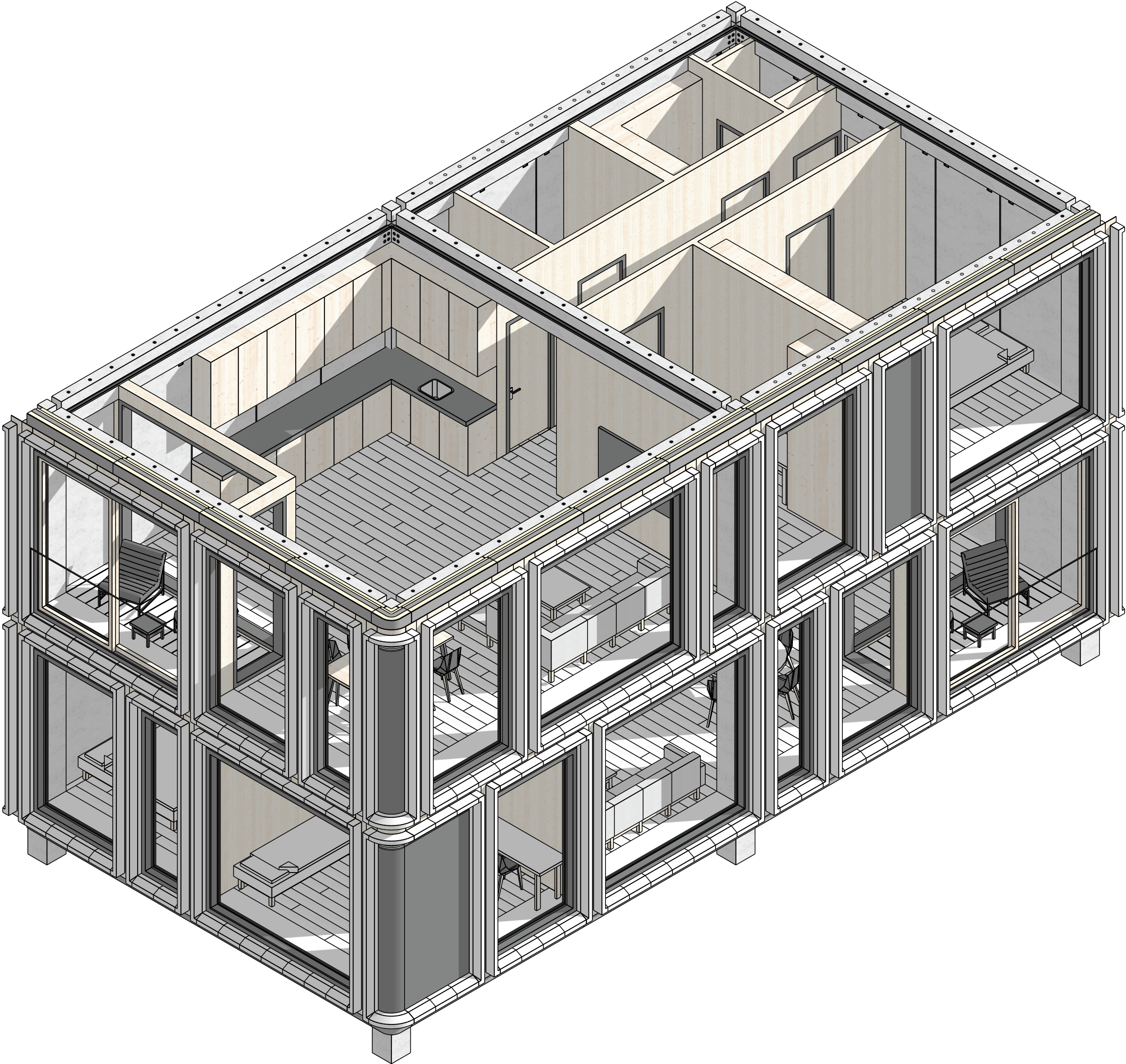


# Two Distinctive parts.



# Circle Construction

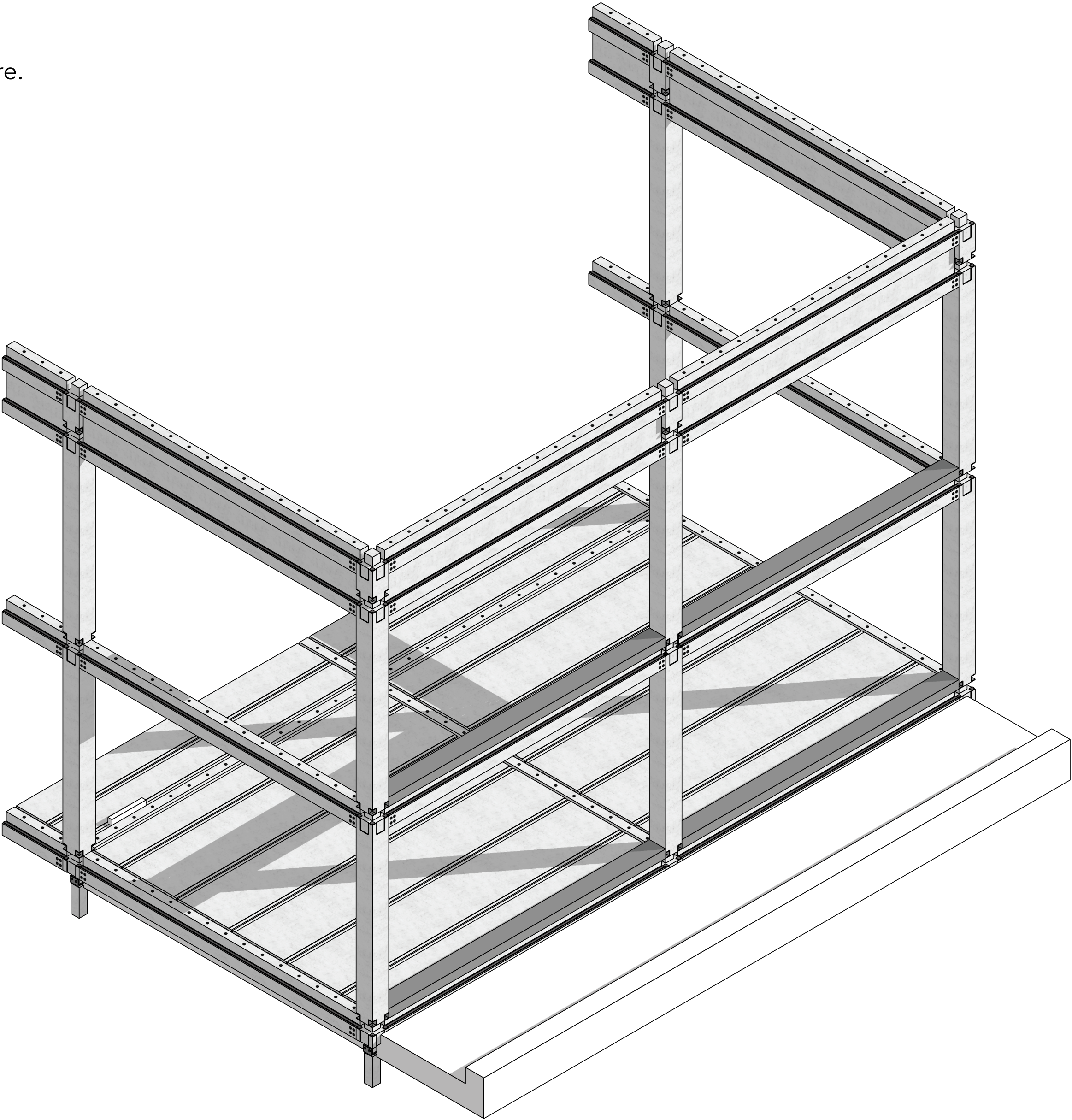
Housing Structure





# Circle Construction

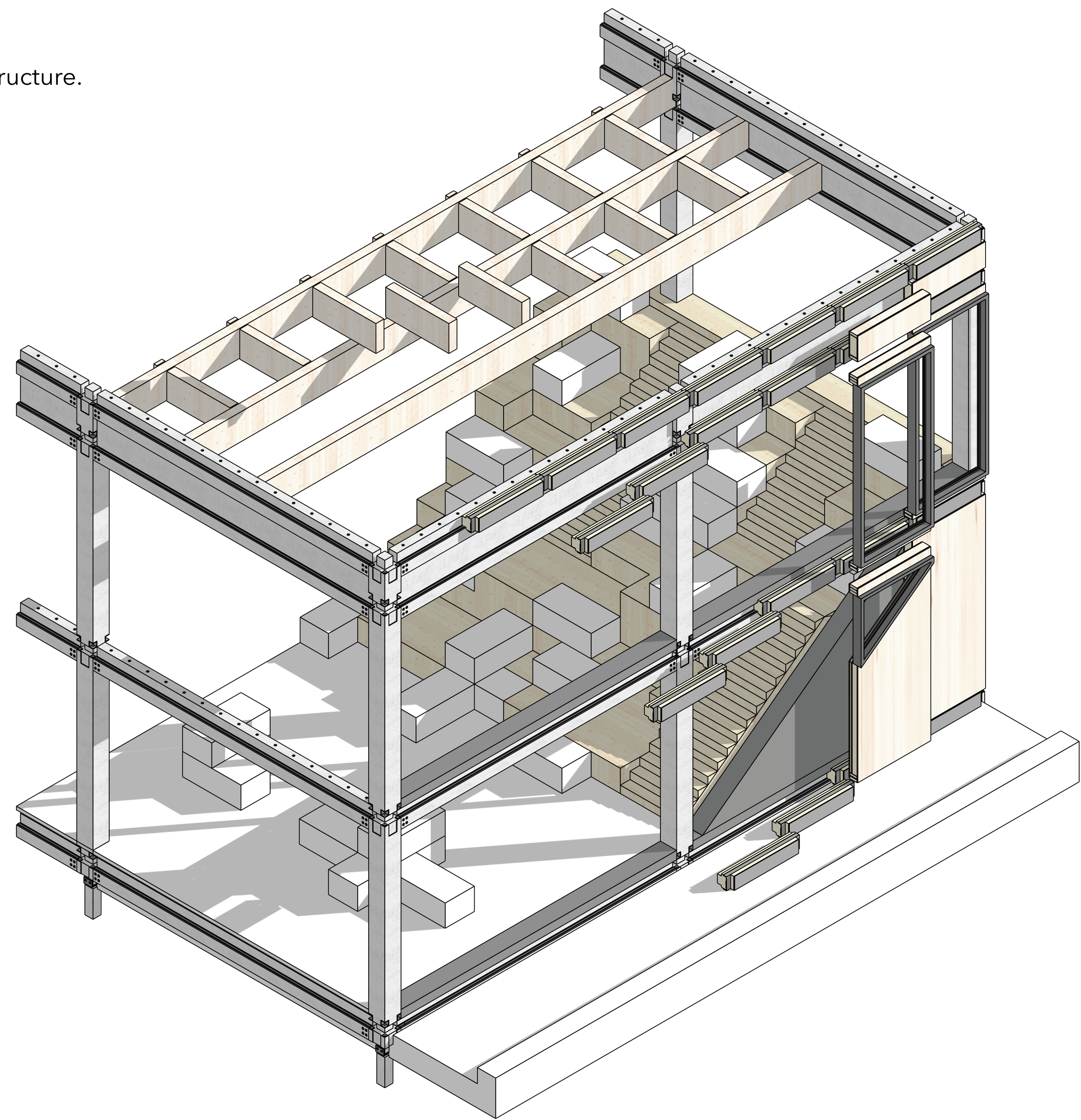
Phase 01: Adding the Loadbearing Structure.





# Circle Construction

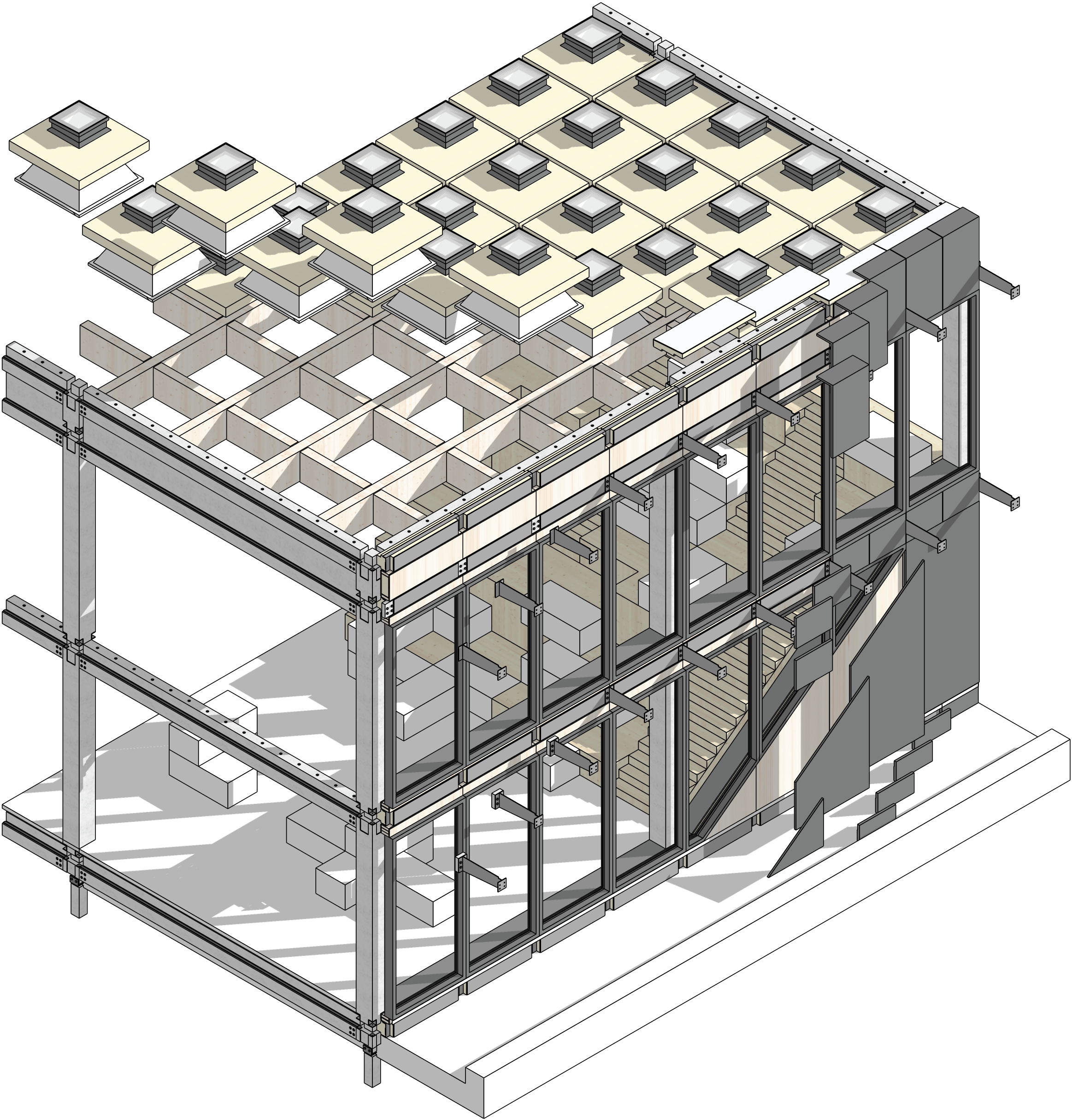
Phase 02: Adding the Roof and Facade Structure.





# Circle Construction

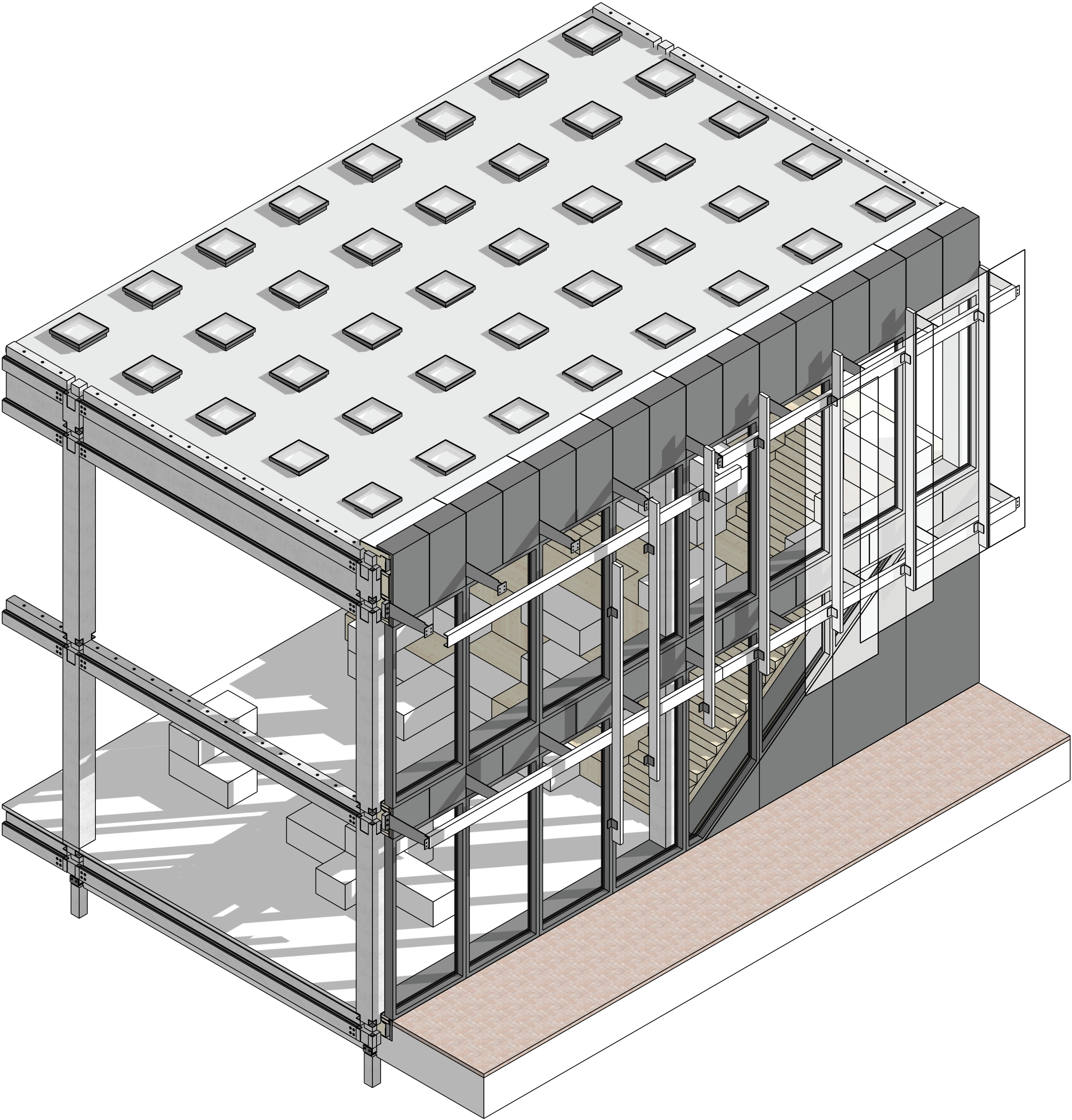
Phase 03: Adding the Facade Elements.





# Circle Construction

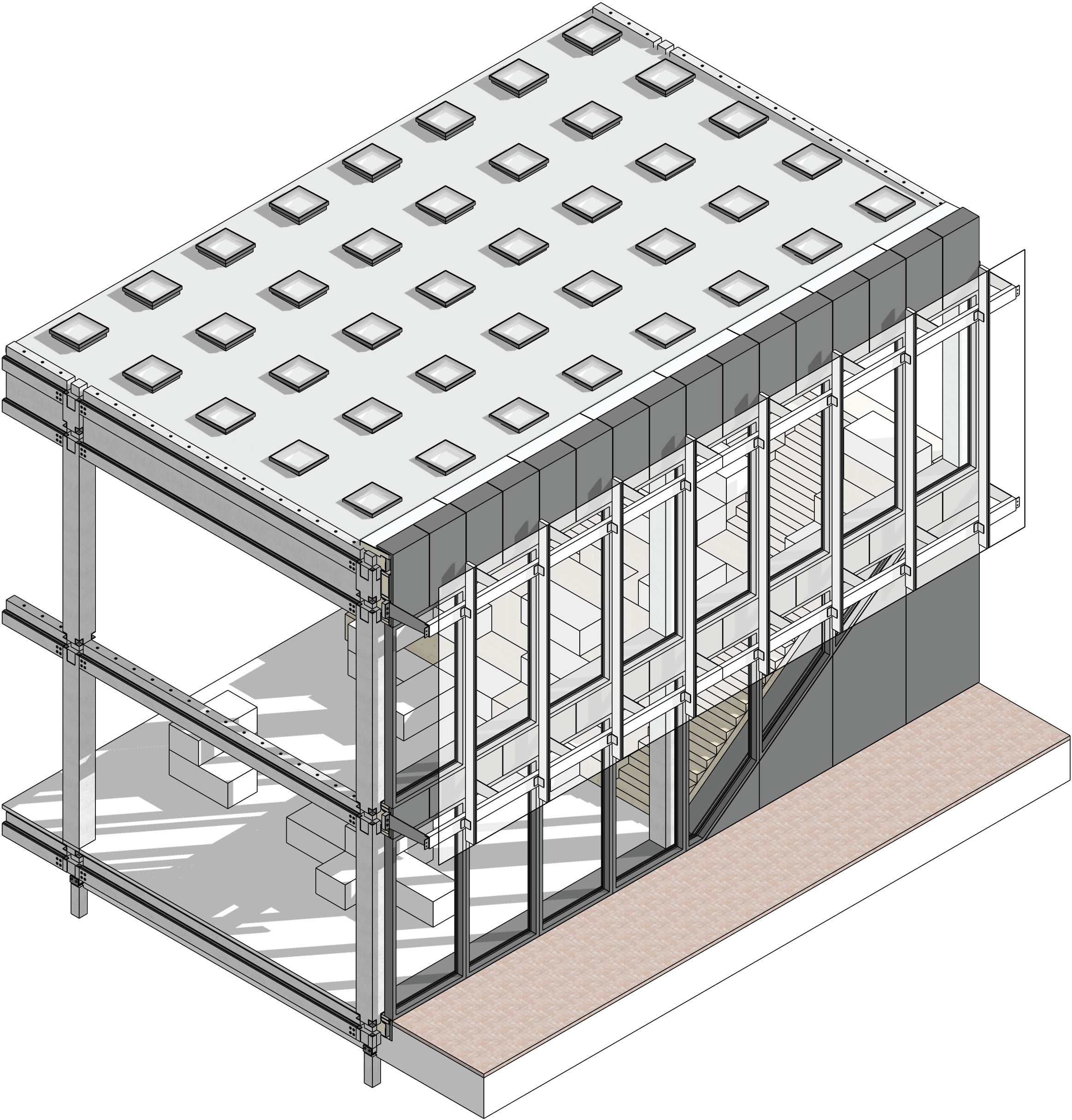
Phase 04: Adding the Second Facade Skin.





# Circle Construction

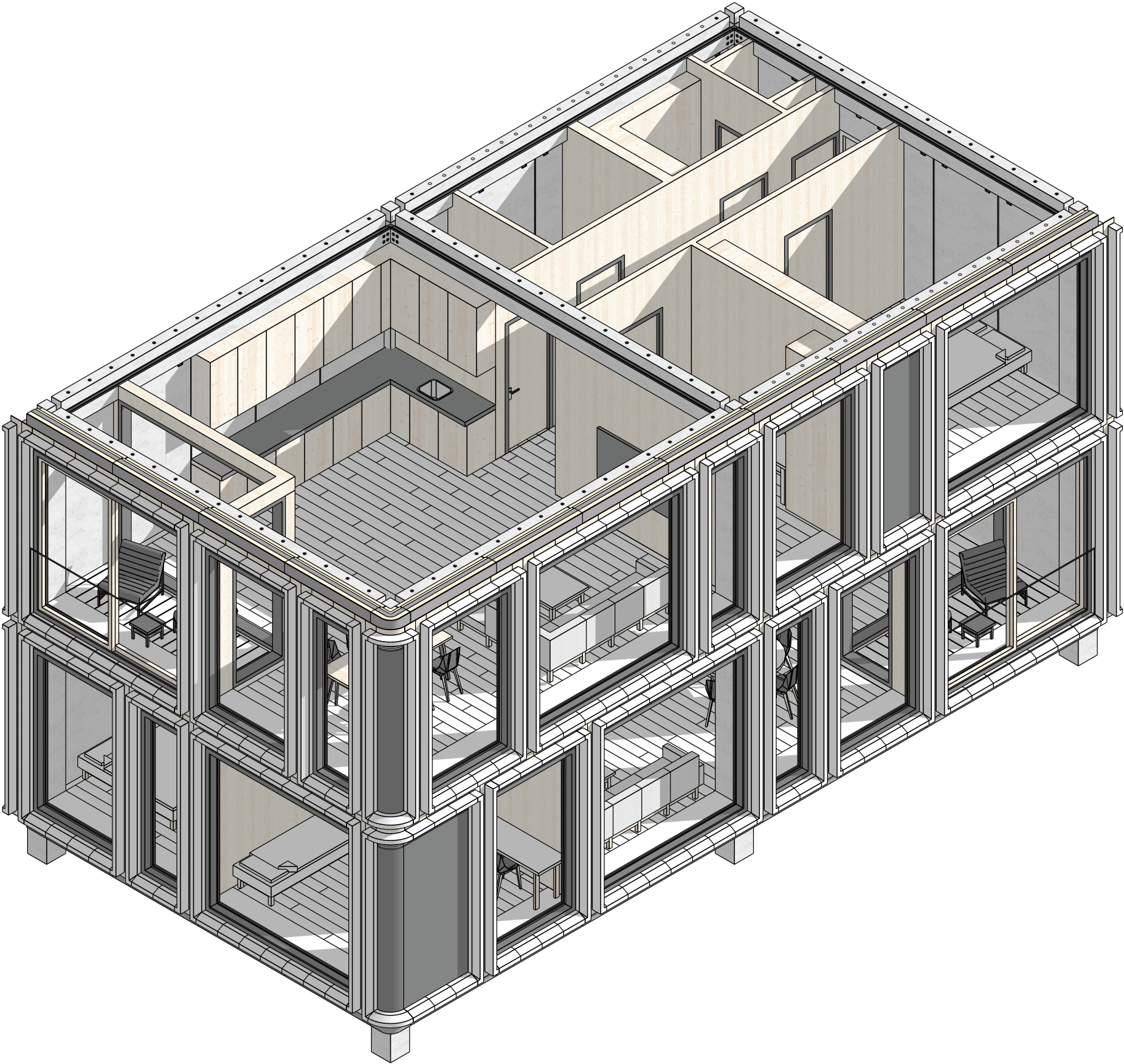
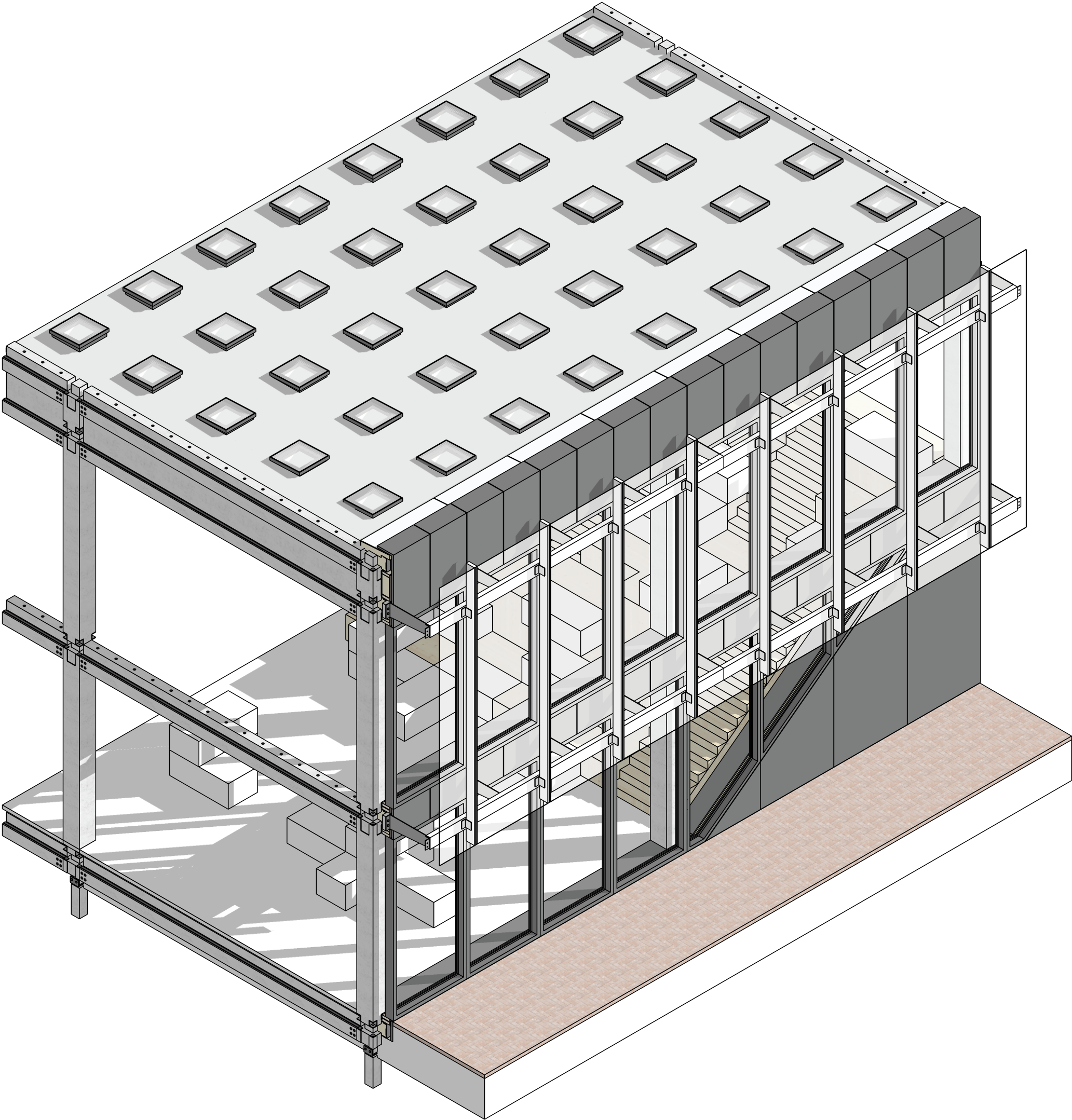
Phase 05: Finished Project





# Circle Construction

Public and Housing Functions within the same frame.



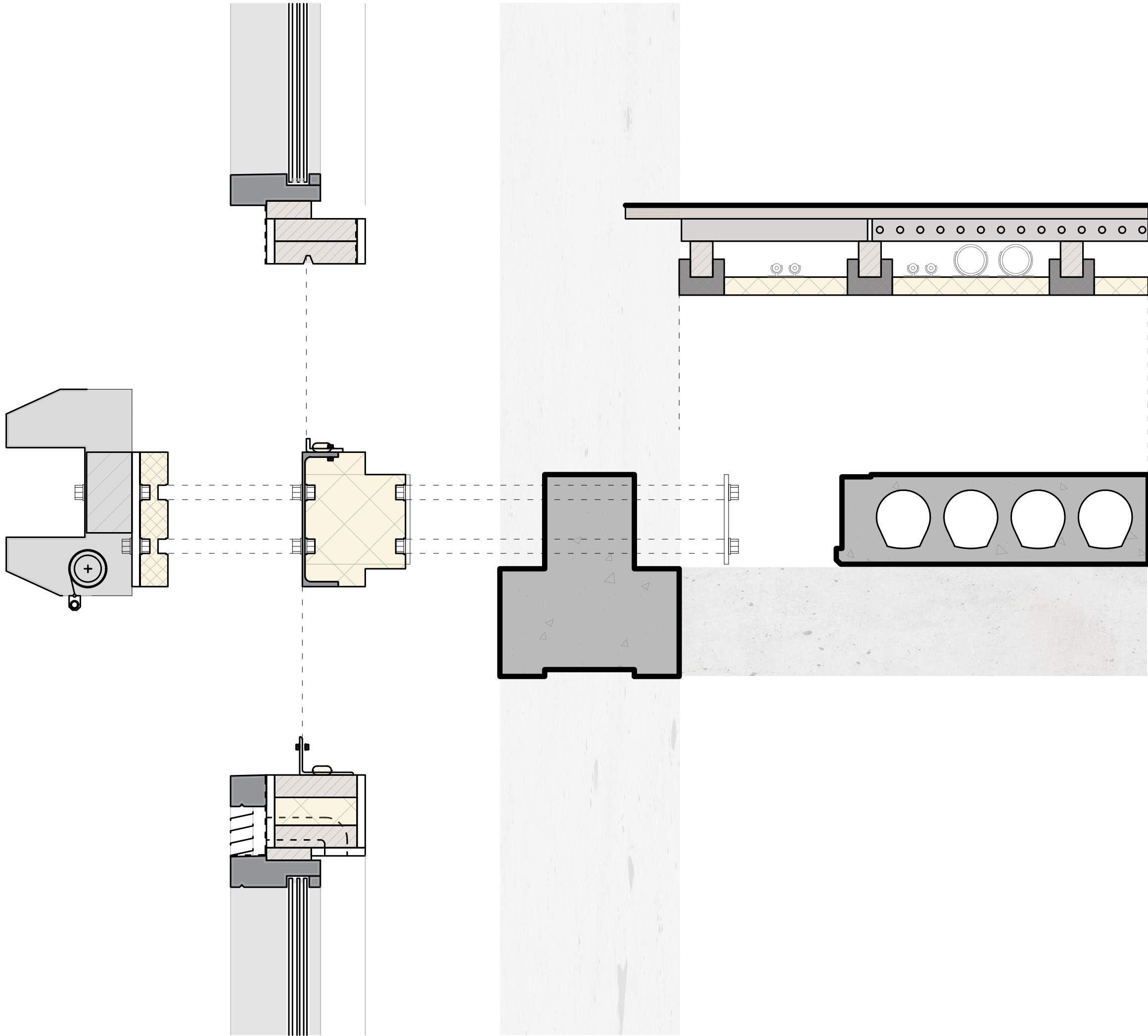


# Technical Details.



Details.

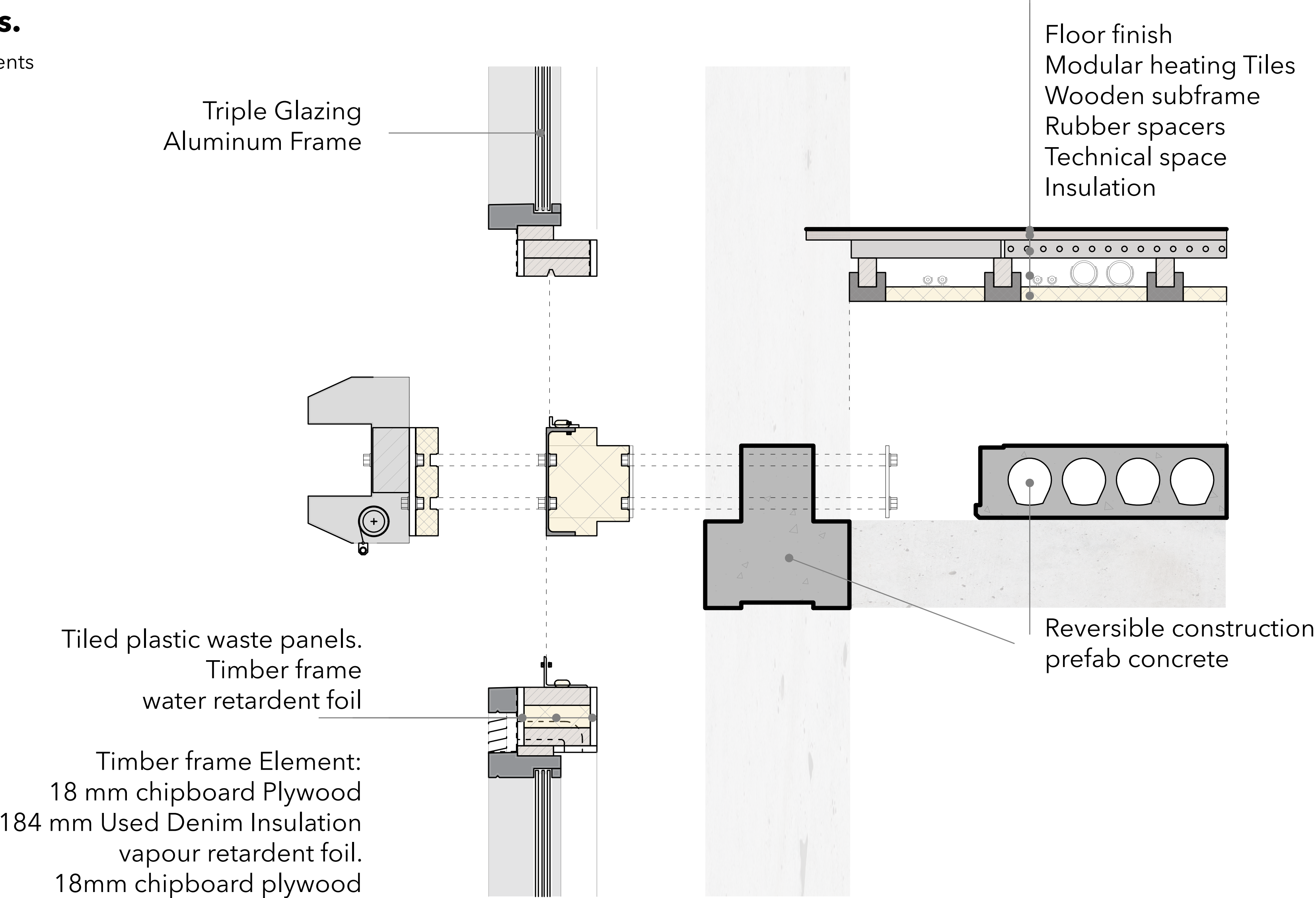
Components





Details.

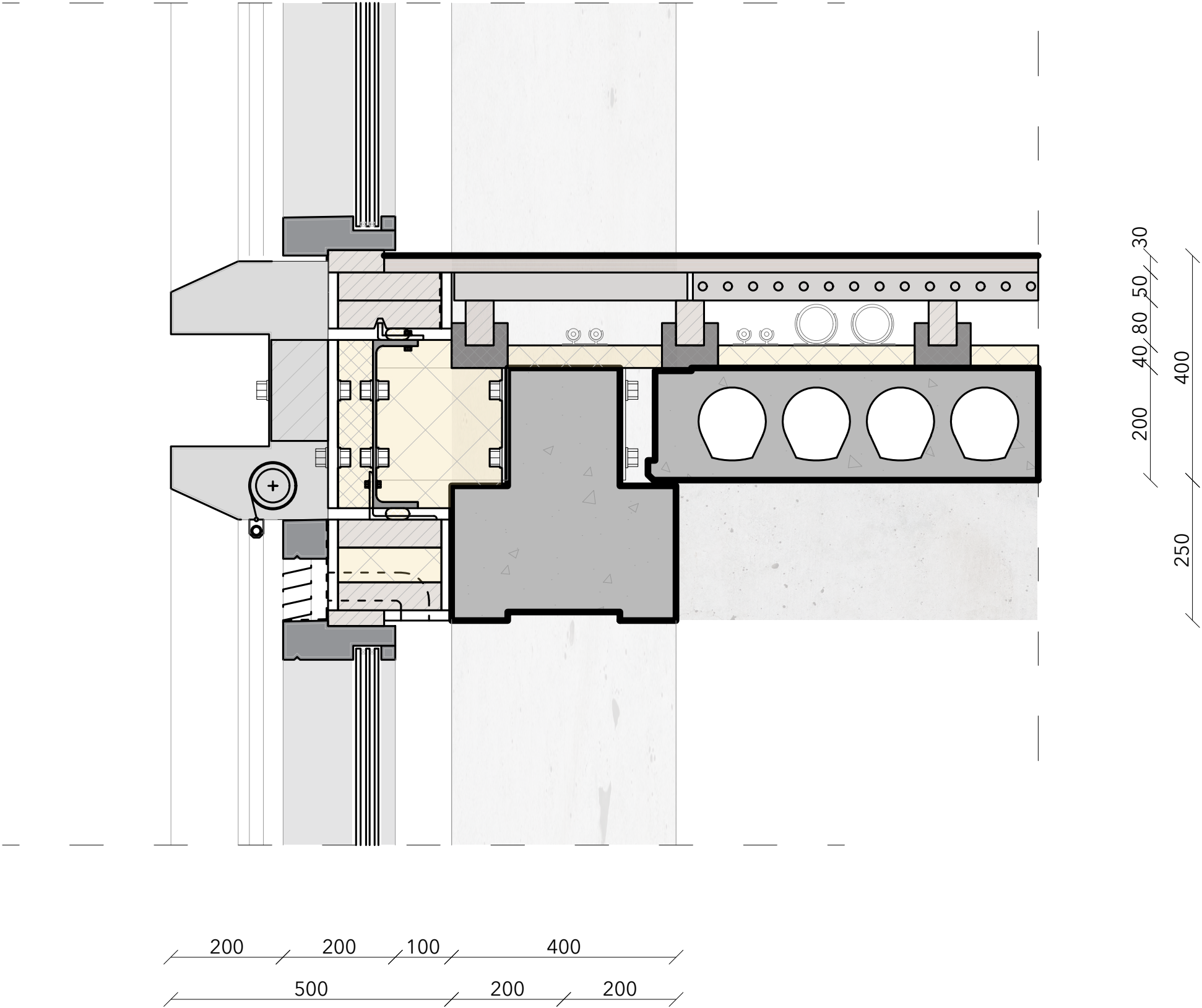
Components





Details.

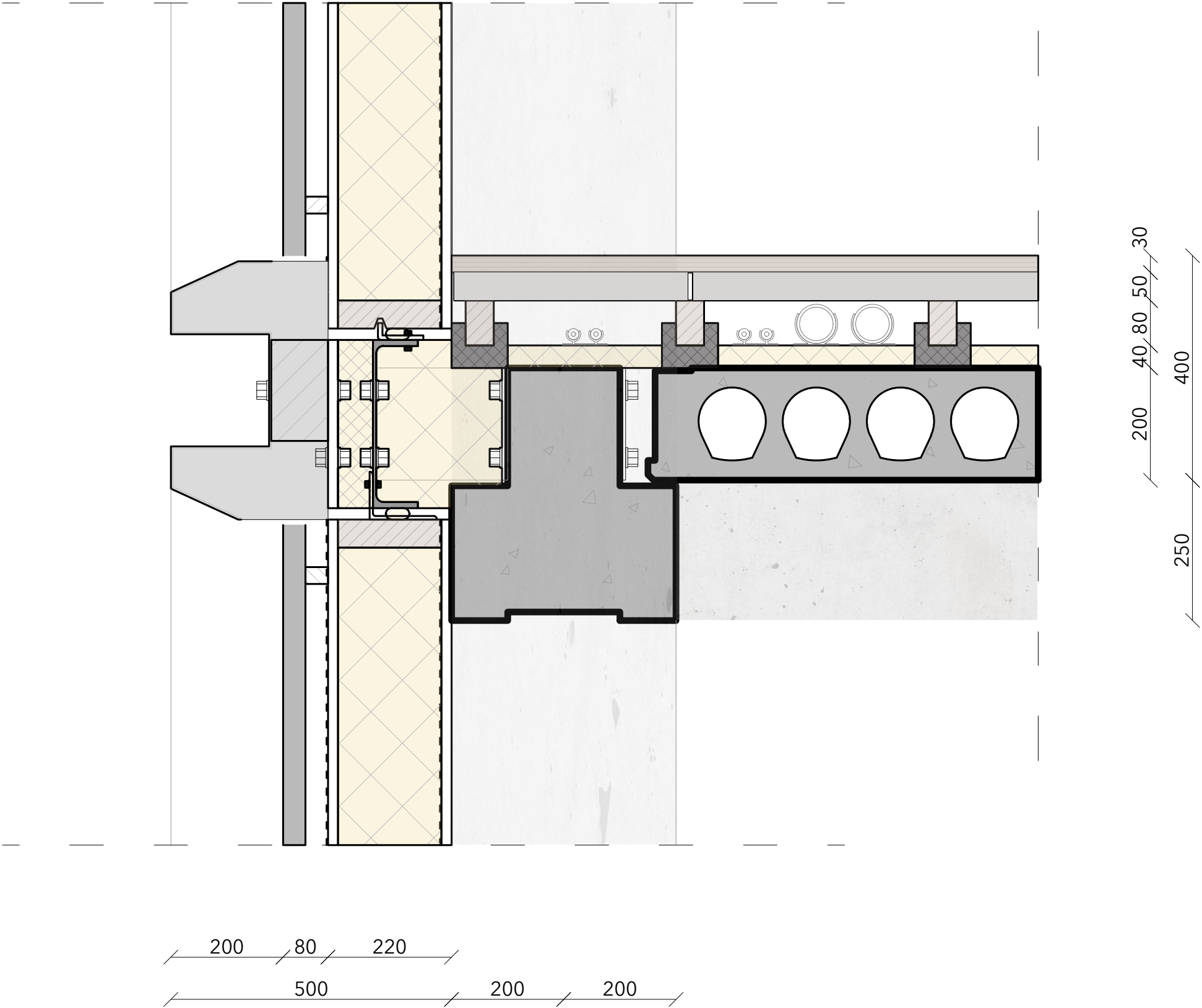
Tower Floor.





Details.

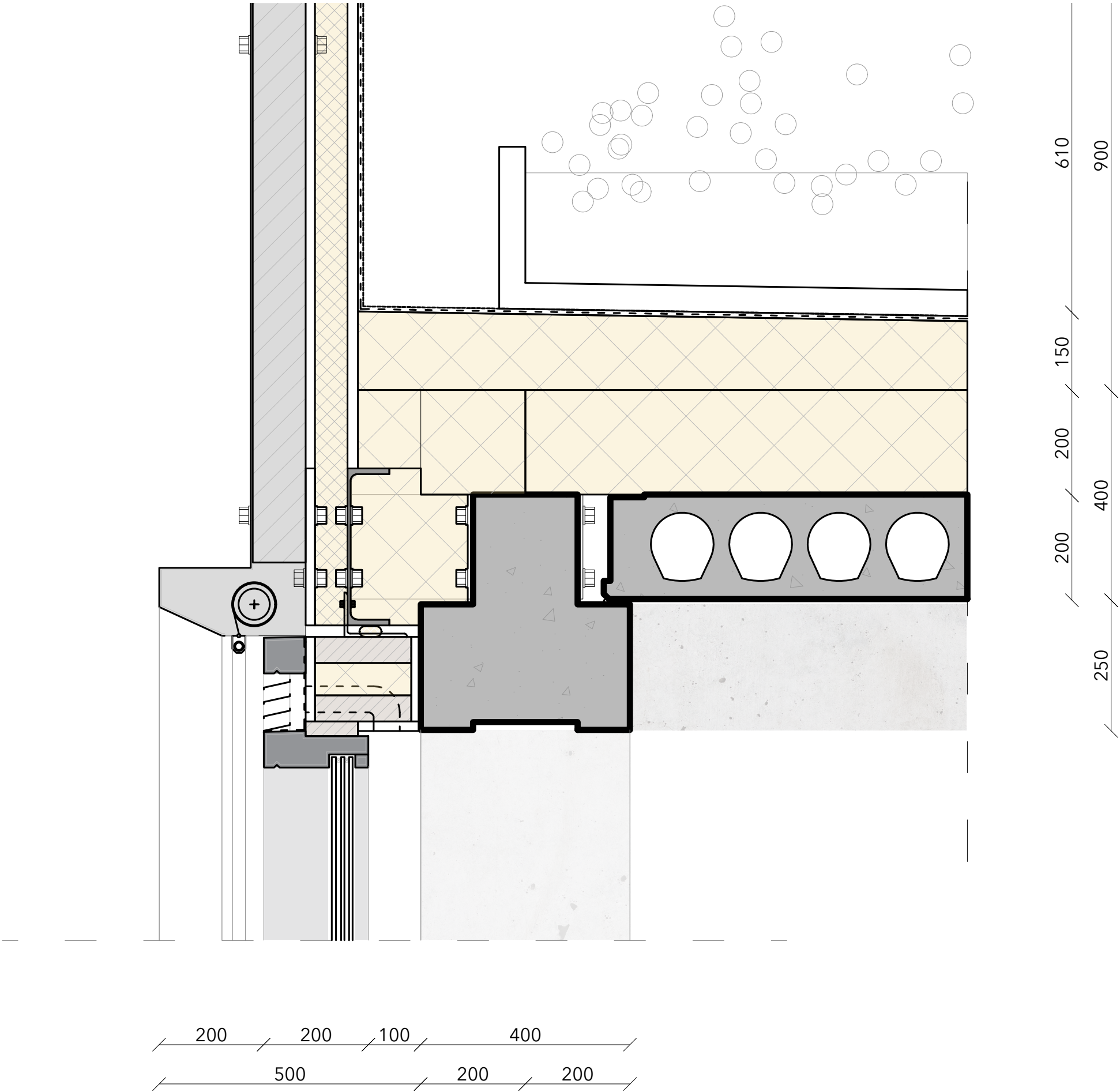
Tower Floor.





Details.

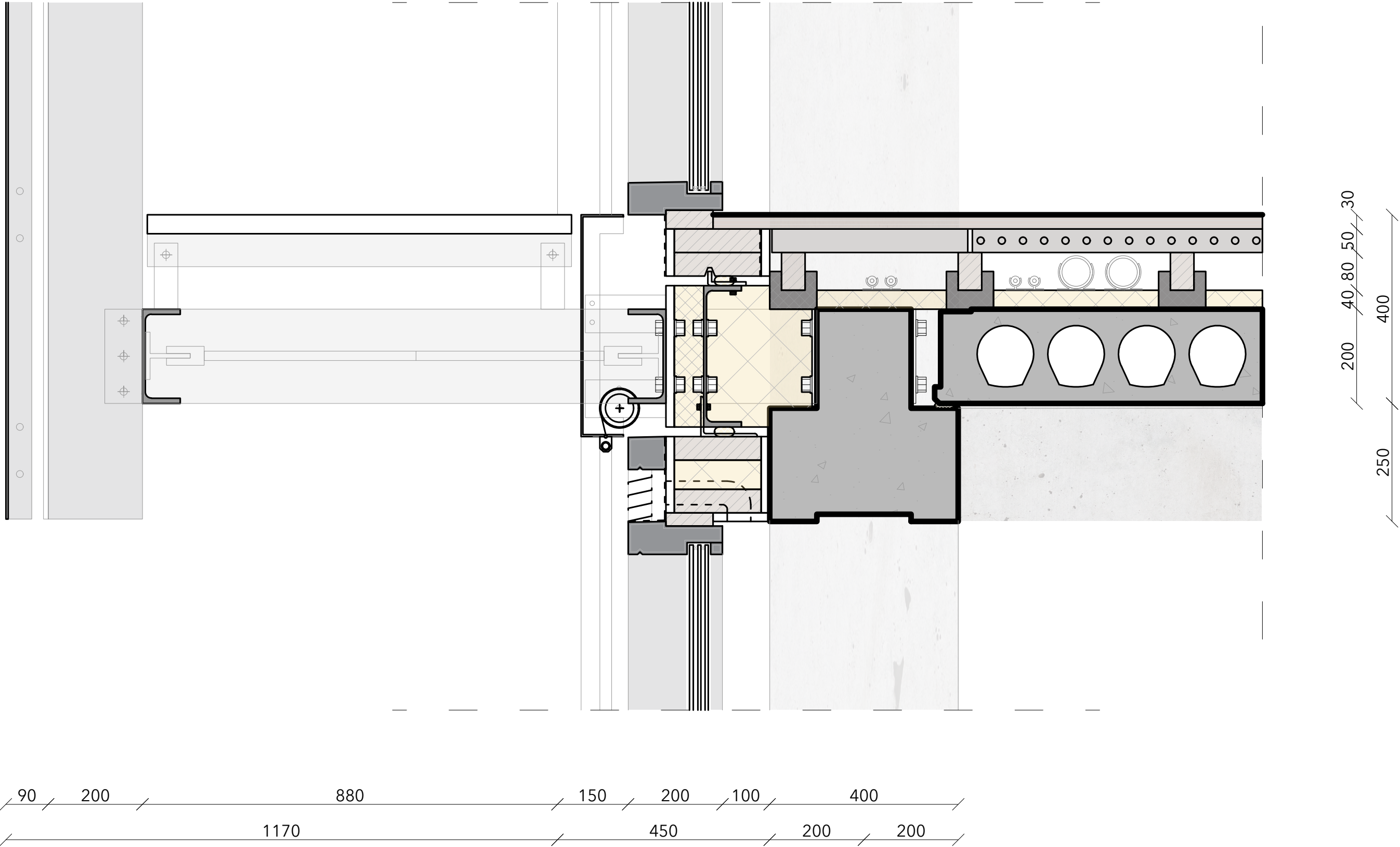
Tower Roof.





Details.

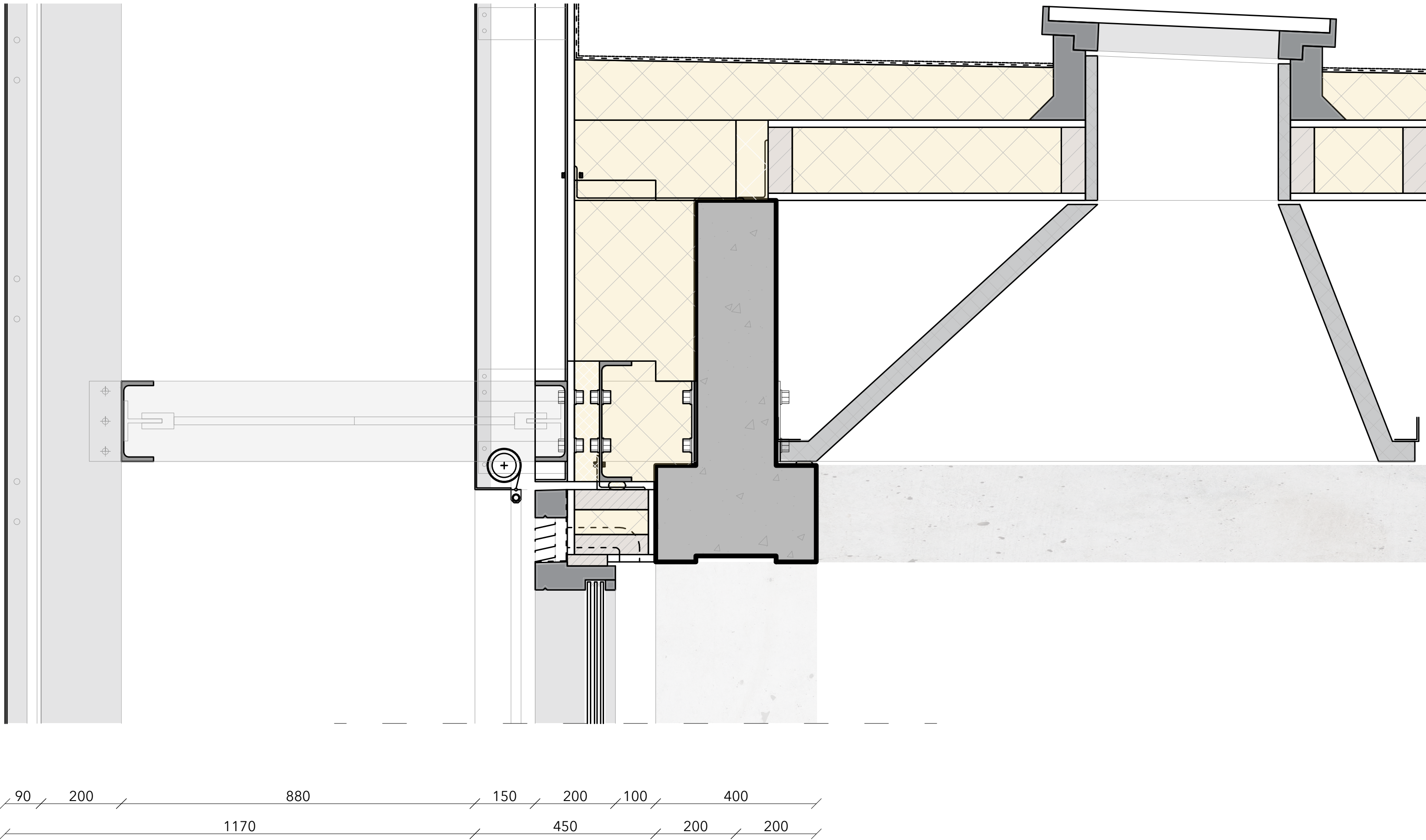
Expo floor.





Details.

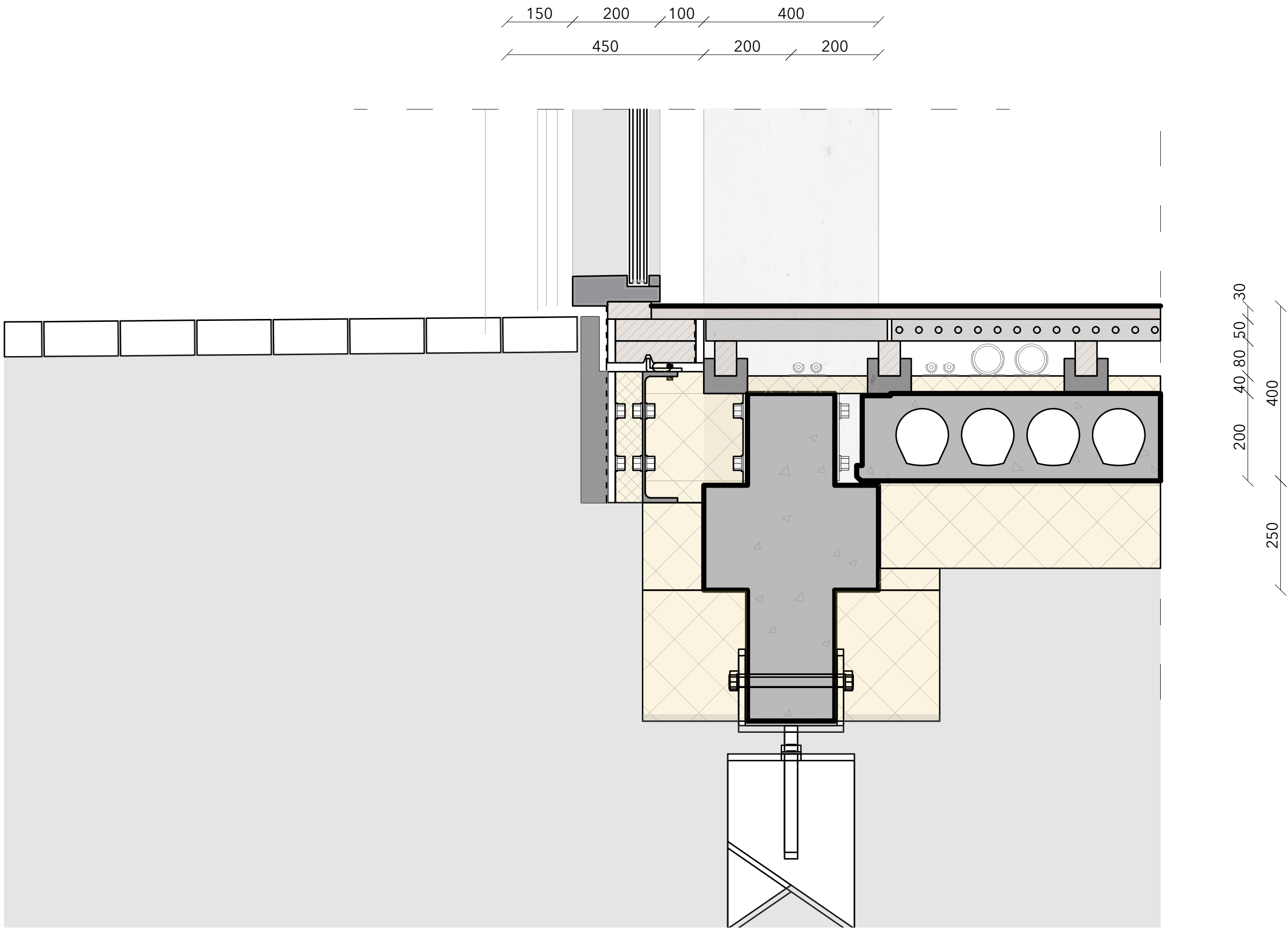
Expo roof.





Details.

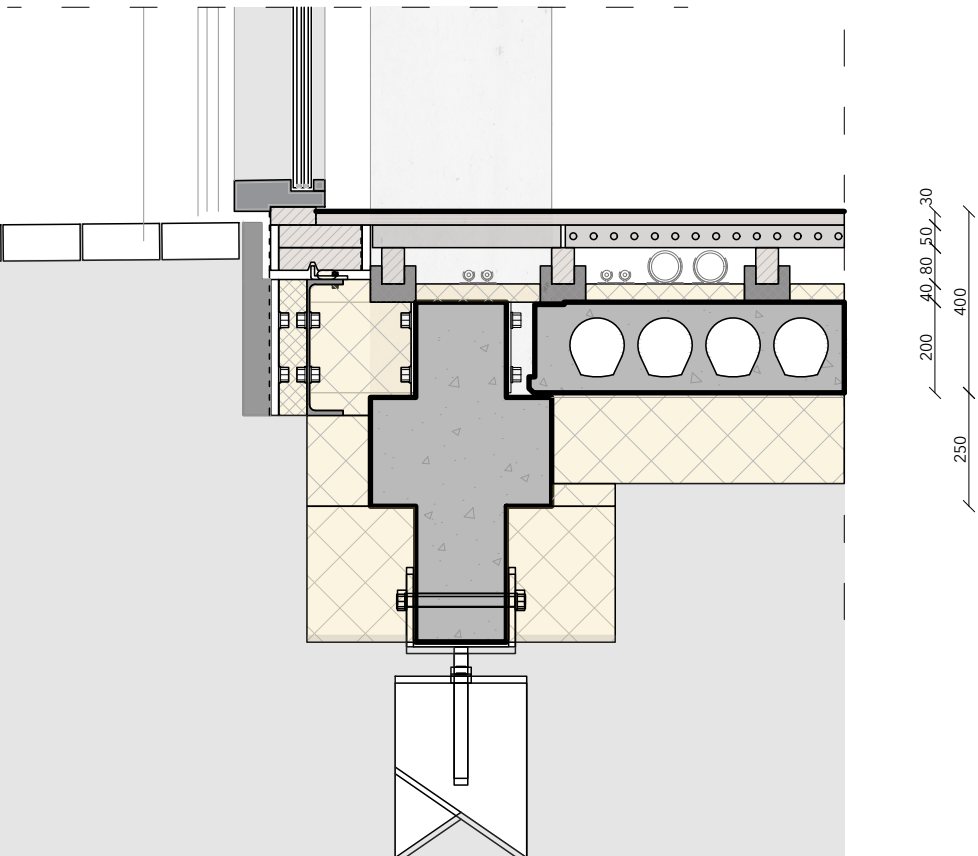
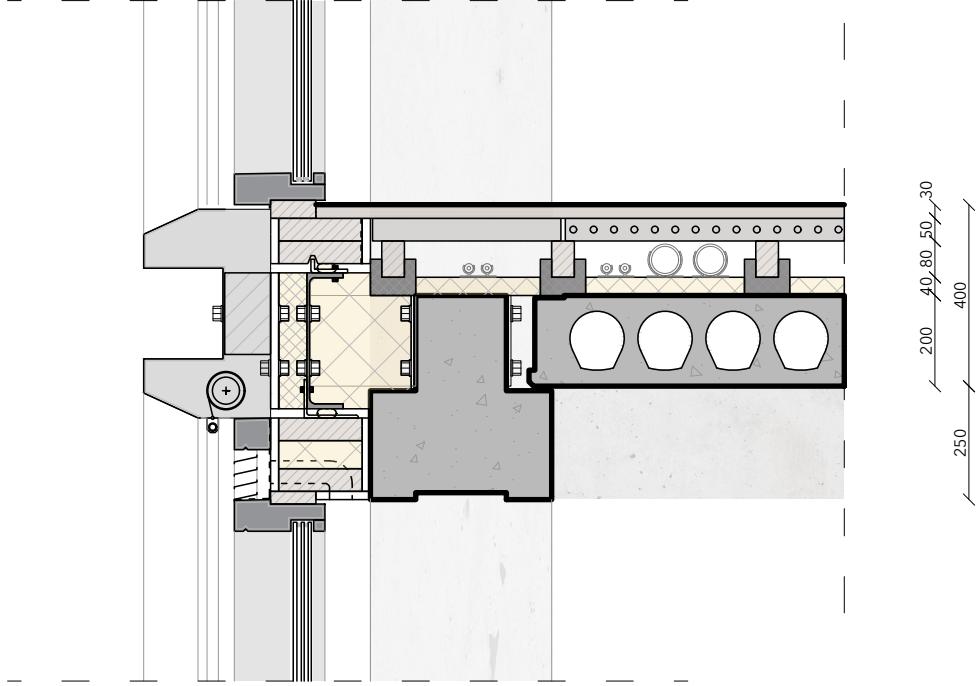
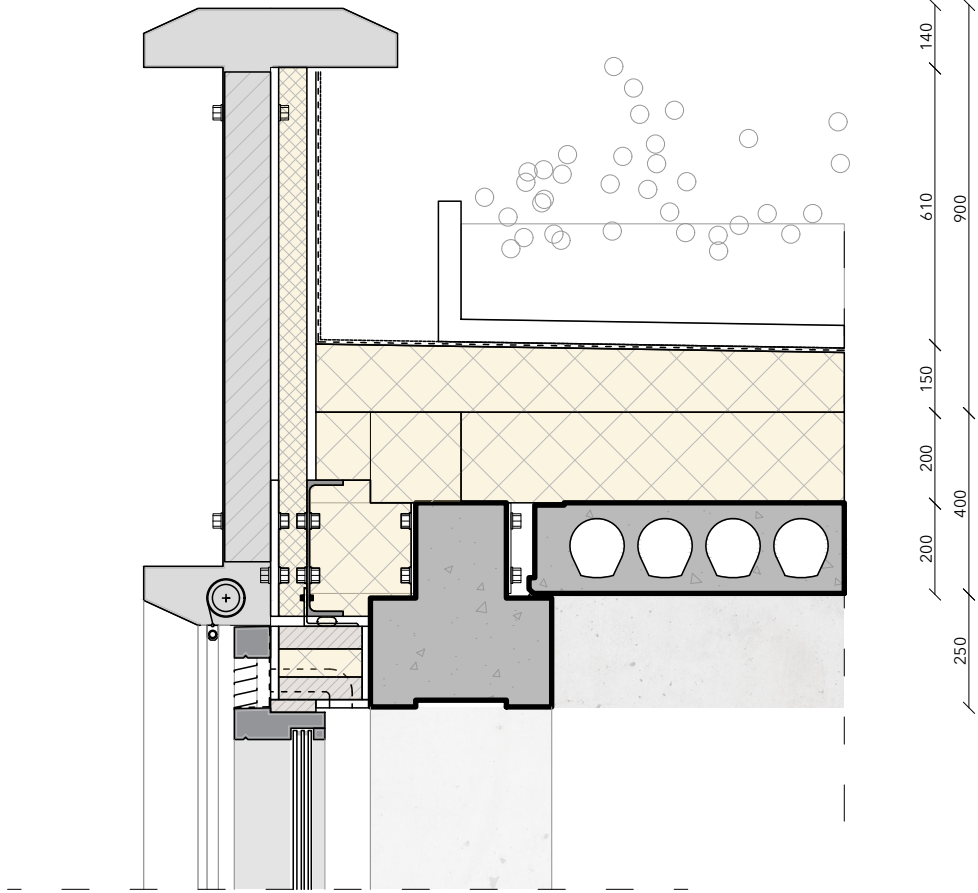
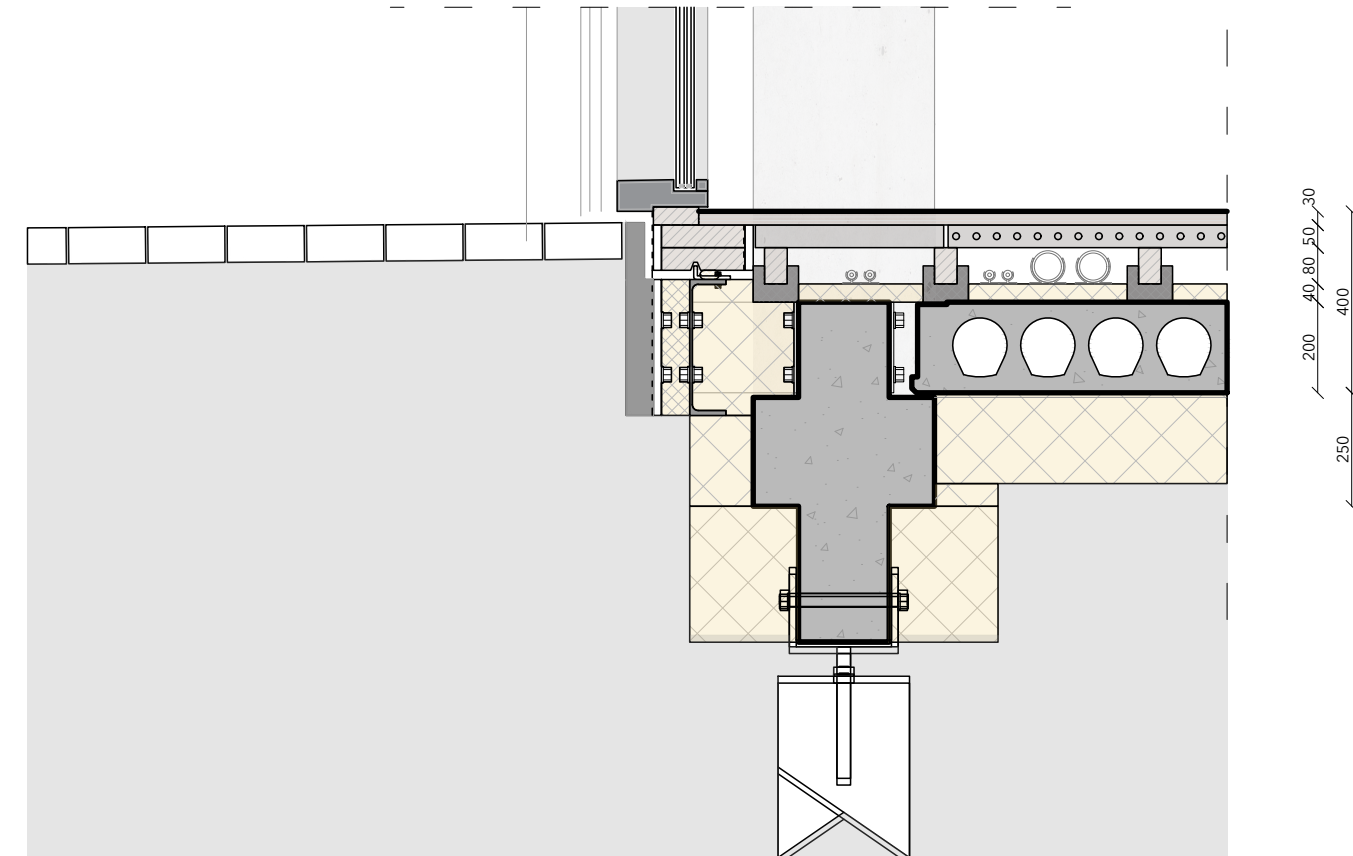
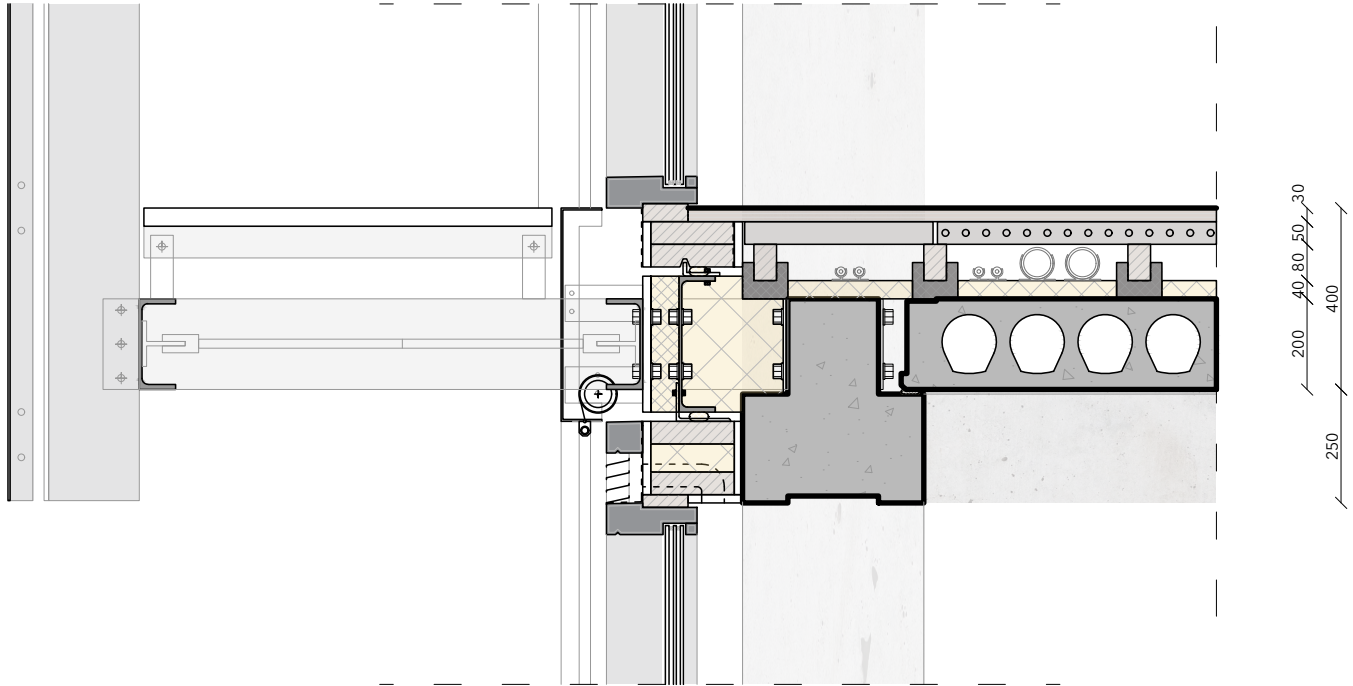
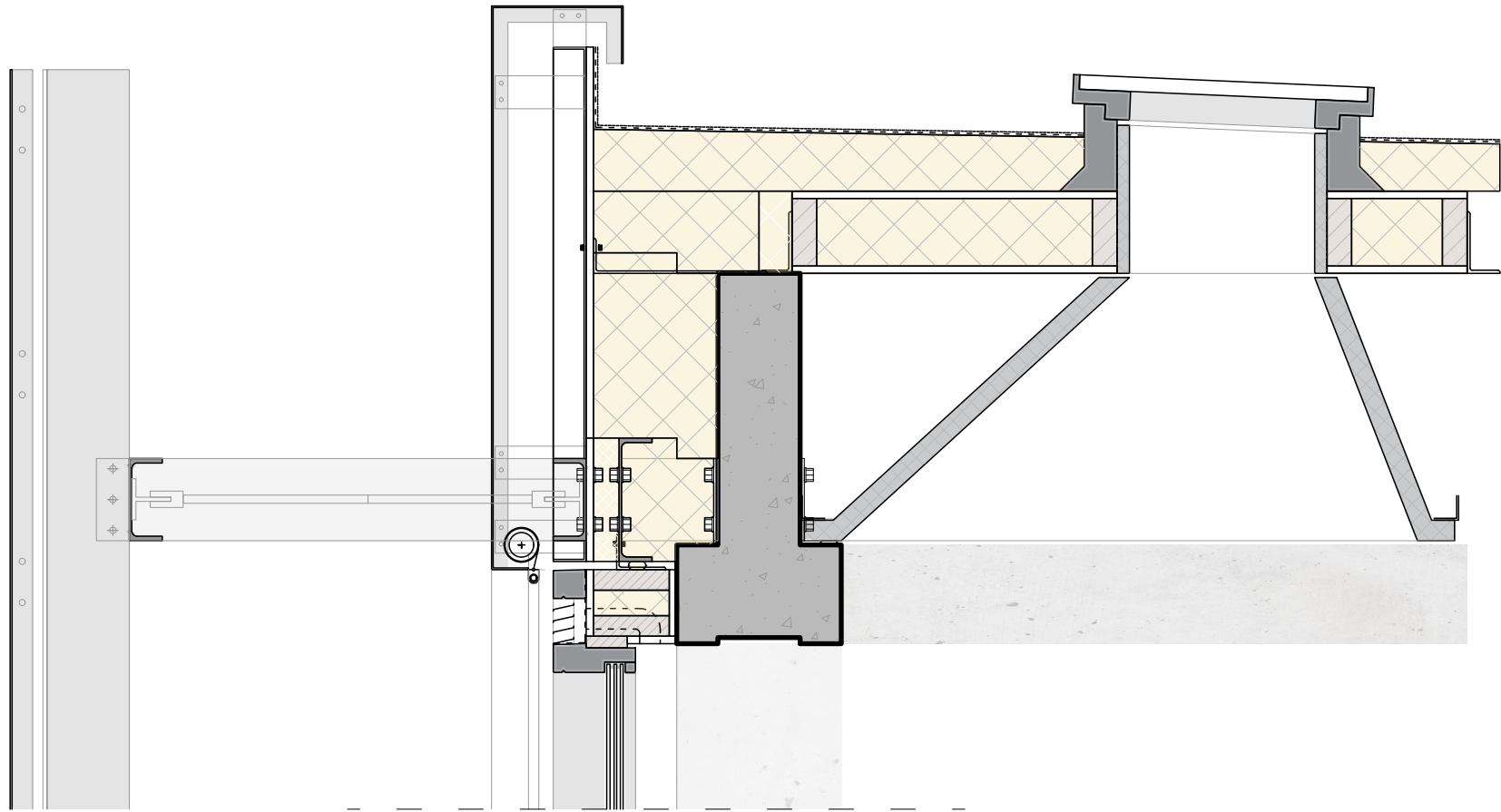
Ground floor.





Details.

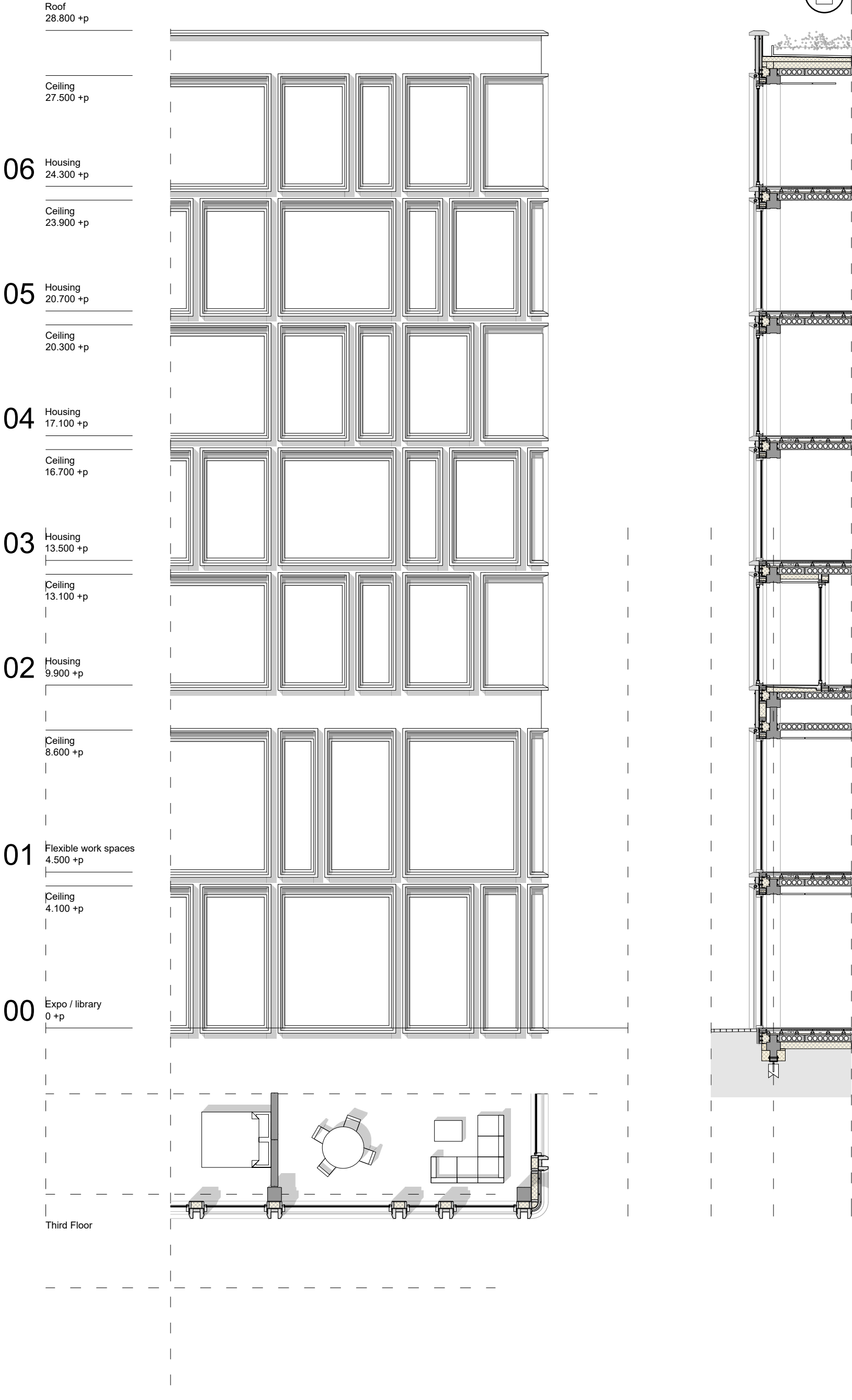
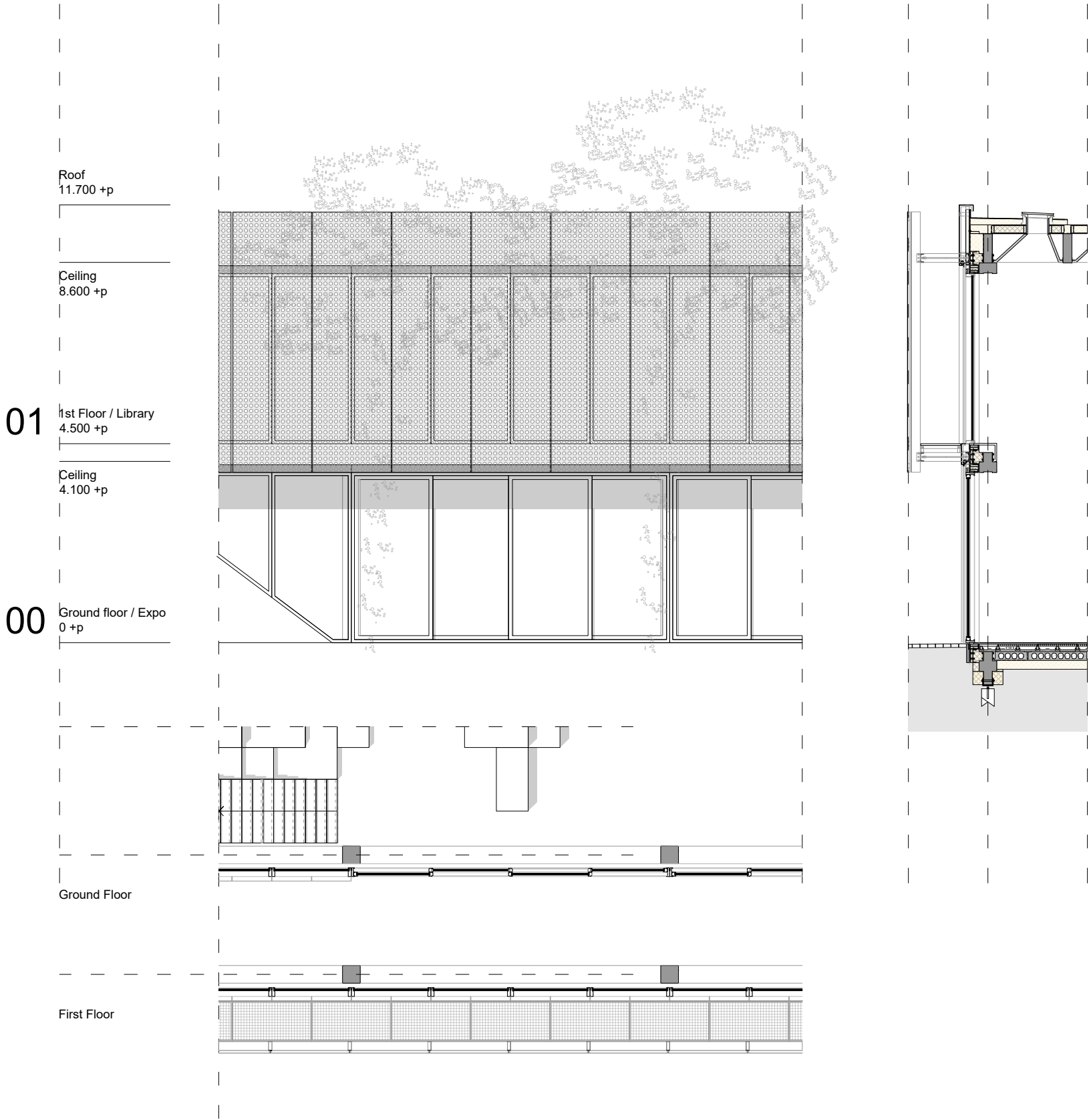
Fragment.





# Fragment

Two facades.





# Test Case: Model.























# Visualisations.



















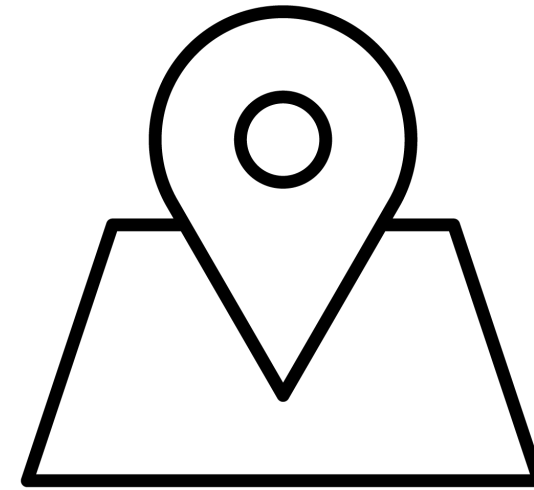
# Conclusions





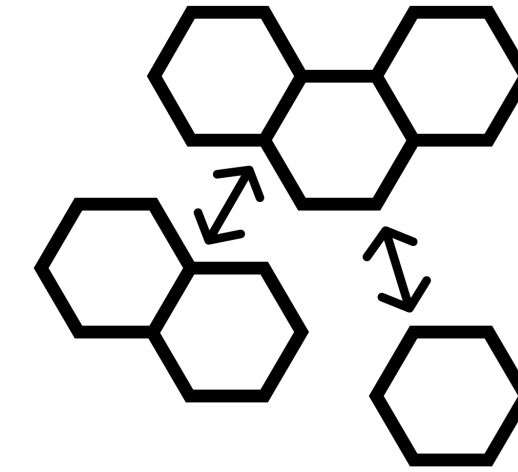
### **New Identity**

Transition to Mixed Urban City.  
Increased density  
136 --> 30.000 Inhabitants.



### **Meeting point**

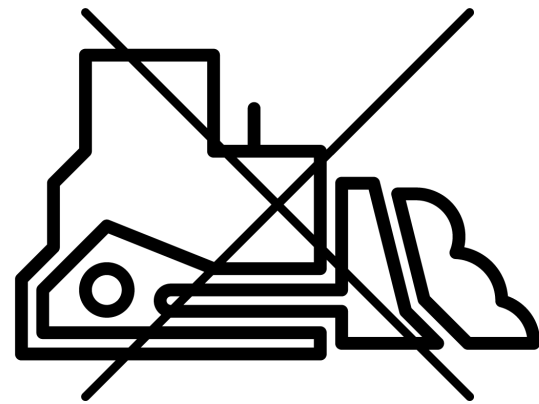
Cultural meeting point for locals.  
- Meet  
- Learn  
- Live



### **Demonstrate circularity**

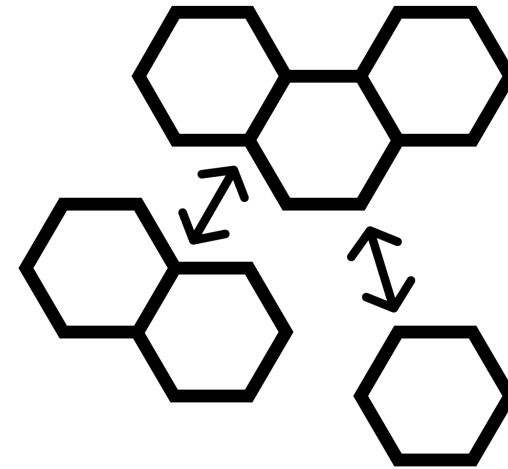
Circular Economy  
Design for disassembly.  
Re-use Components.





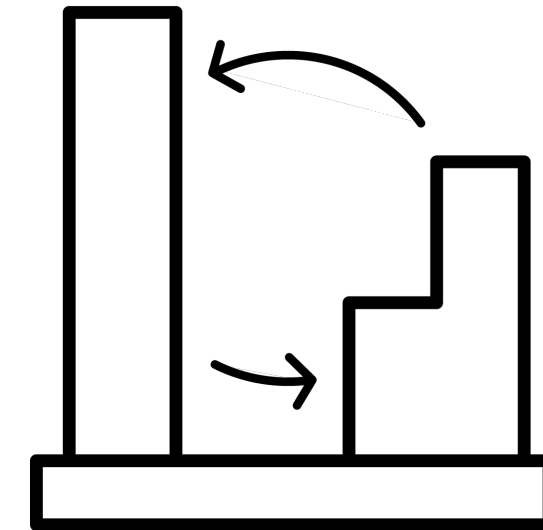
### no single-use materials

Keep materials separated.  
Simplify the process to re-cycle  
and re-use building materials.  
Avoid certain materials.



### Reversible connections

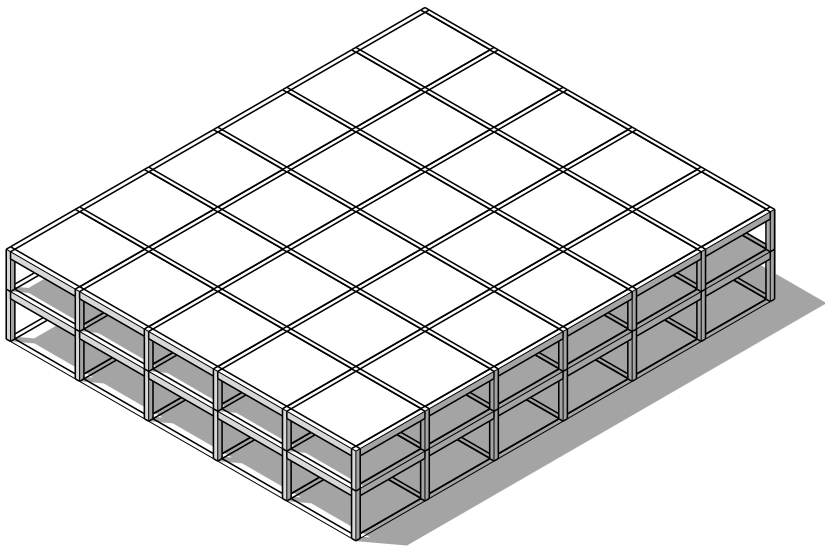
Use reversible connections.  
Communicate materials with  
passports.



### on-site reassembly

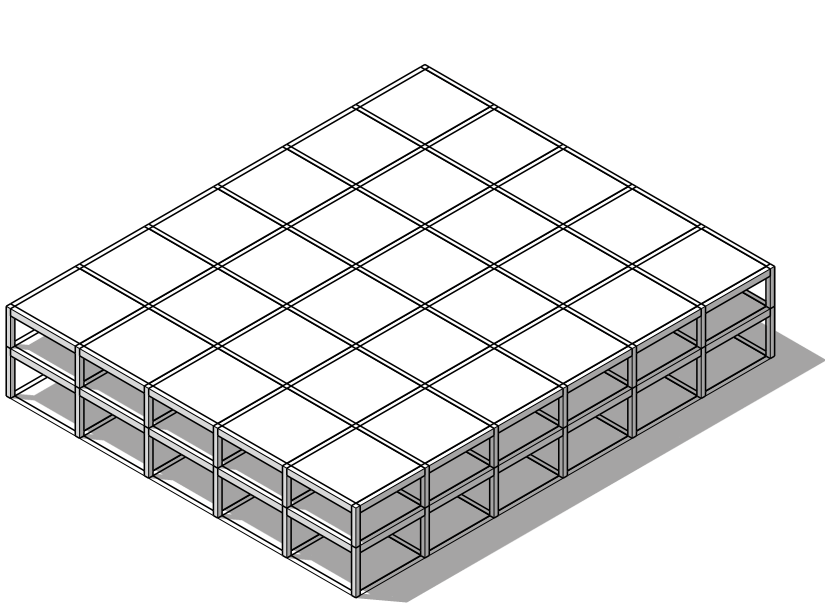
On site development and re-  
development.  
Take materials from case study.



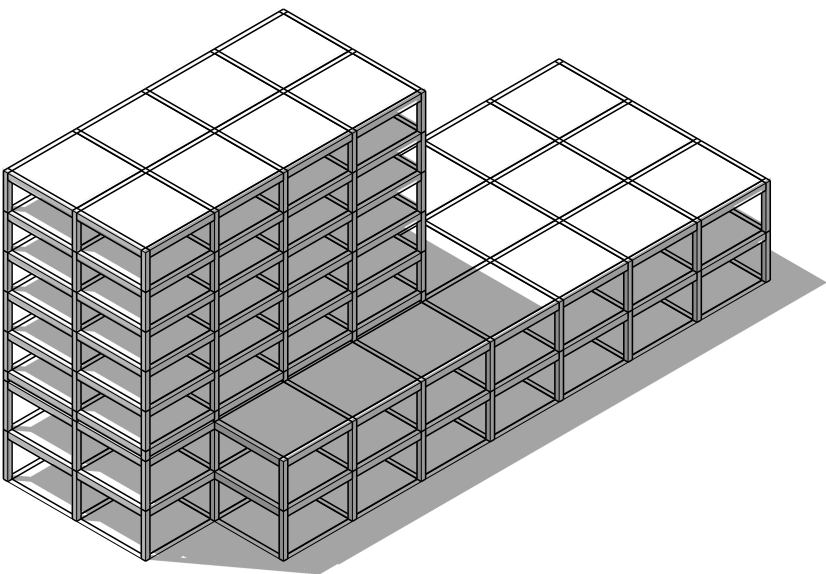


Old Situation



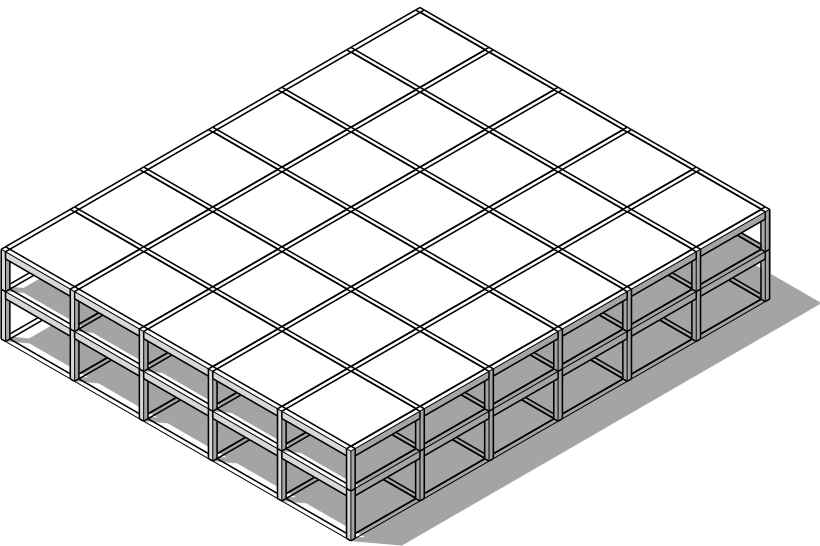


Old Situation

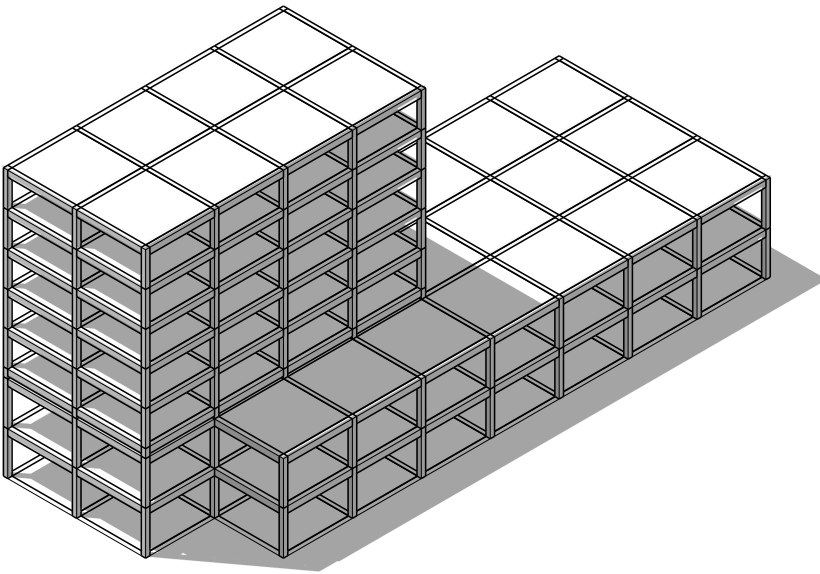


Current Project

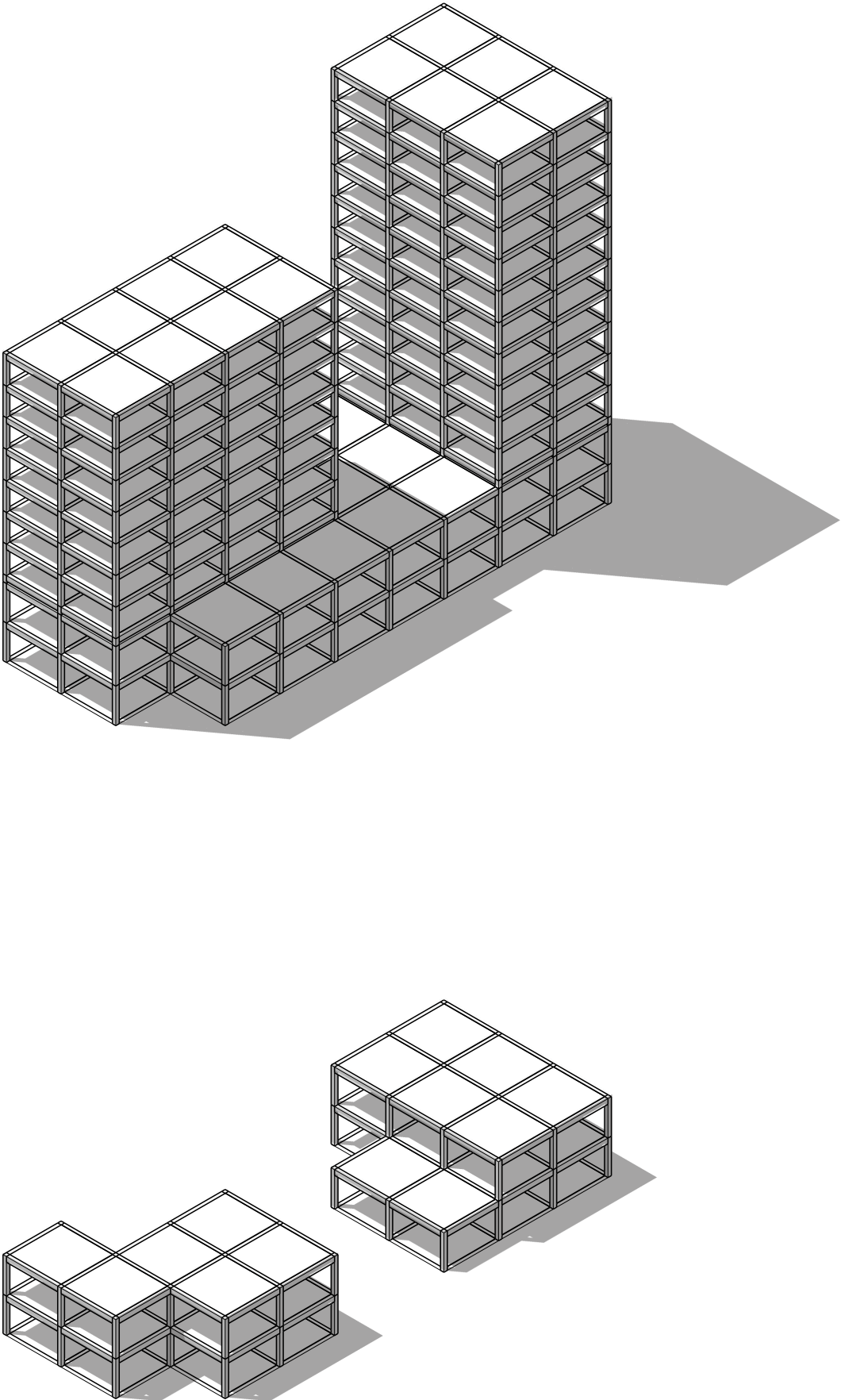




Old Situation



Current Project



Future?



# The Circular Cornerstone.















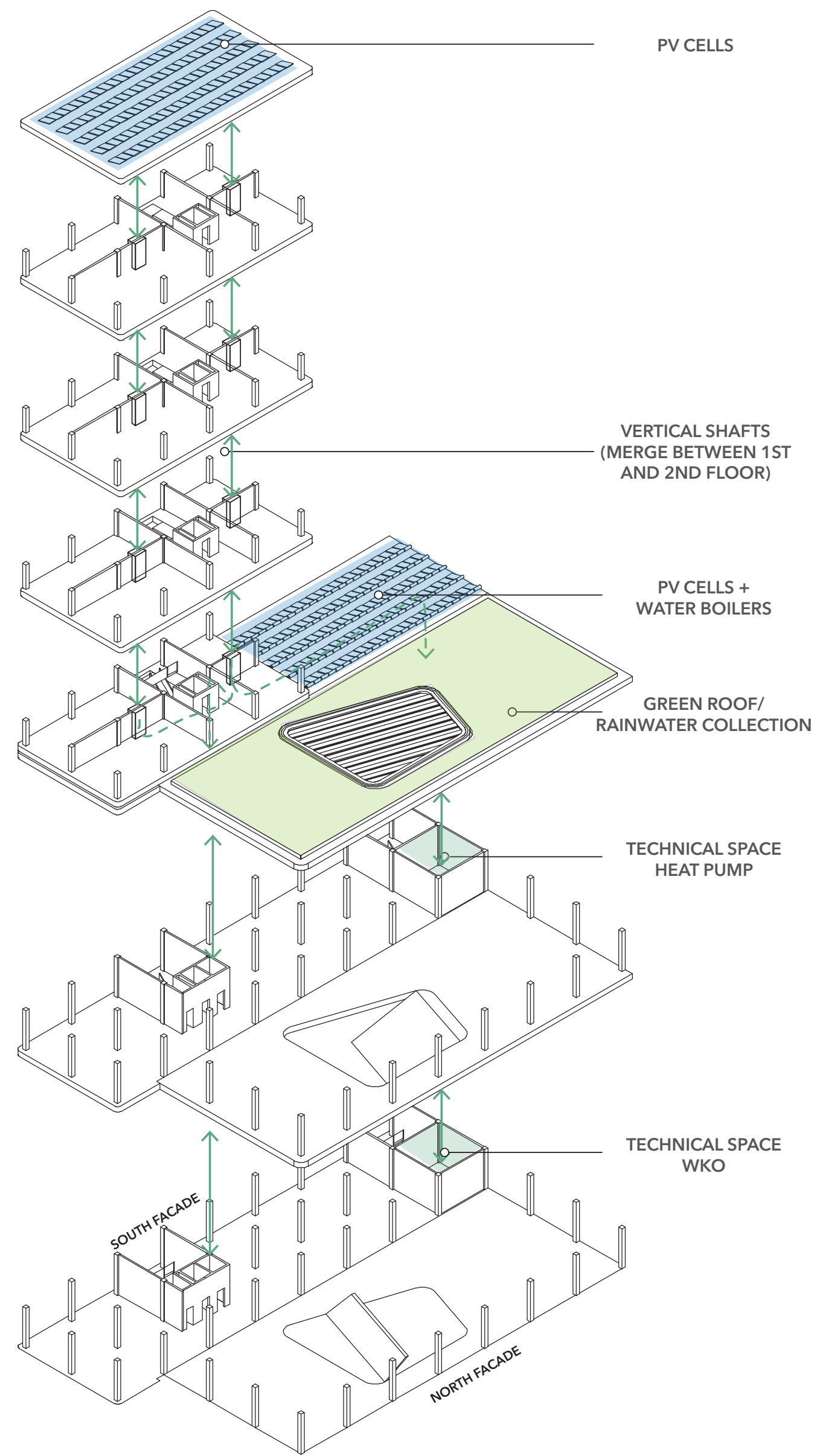












## CLIMATE DESIGN