How To Print A House:

Extension Altes Hallenbad Heidelberg

Project MA / WS 2024-2025

Professorship of Digital Fabrication
Prof. Dr. Kathrin Dörfler / Iuliia Larikova, M.A.

Chair of Building Technology and Climate Responsive Design
Prof. Thomas Auer / Dr. Sandra Persiani / David Briels, M.Sc.

Introduction

Additive Manufacturing (AM), or 3D Printing, offers a variety of technological perspectives that will influence all aspects of building construction in the future: materiality, structure, detailing, thermal envelope, building climate. Among many aspects, AM allows to completely redesign building elements, embedding new material solutions with advanced functionality.

The design task of the studio project is to design a mixed-use residential building for flexible use in a vacant lot next to the famous Altes Hallenbad in central Heidelberg, combining passive design strategies with the specific Additive Manufacturing Technology - Selective Paste Intrusion (SPI). By understanding the SPI technology features, such as resolution and granularity, mechanical properties, building physics usability, geometric freedoms, as well as process constraints, we will explore and creatively investigate its possibilities to use these properties as a design driver for designing a sustainable, and resource efficient building. These features can range from energy-efficient elements, such as optimised thermal insulation, to intelligent systems that enhance occupant comfort and sustainability.

In a first phase, students will focus on a given research topic, working in groups of three people. The aim is to allow the students to deepen one given aspect which will be of relevance in the design task. In a second phase, as the students are mixed into new groups of 3 integrating different knowledge from the previous phase, the teams are to develop design concepts integrating architectural design, climate strategies and SPI technology into one concept - by focusing on SPI-only or SPI-timber hybrid constructions. The third design phase further deepens on the development of the design principles, the construction principles of prefabricated SPI building blocks or hybrid SPI-timber elements and the overall design of the building. The design proposal should be developed that find a balance between durability, material justice, resource conservation, and flexible, spatial playability, and that take up the need for sustainability in various facets.

Project MA / WS 2024-2025 / Technical University of Munich

Teaching

Professorship of Digital Fabrication

Prof. Dr. Kathrin Dörfler, Iuliia Larikova, M.A.

Chair of Building Technology and Climate Responsive Design

Prof. Thomas Auer, Dr. Sandra Persiani, David Briels, M.Sc.

In collaboration with

SSV Architekten (Jan Volkmann)

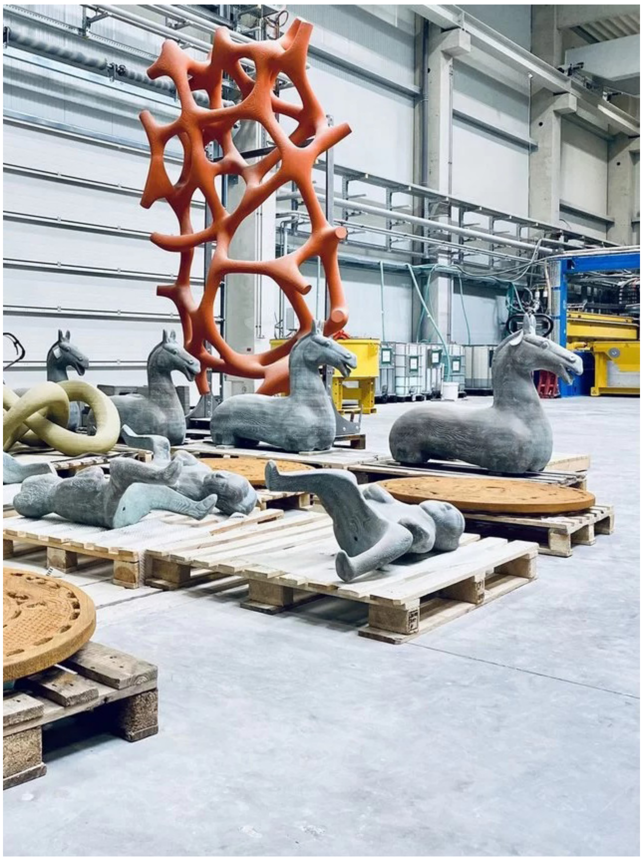
Addditive Tectonics (Bruno Knychalla)

Schedule

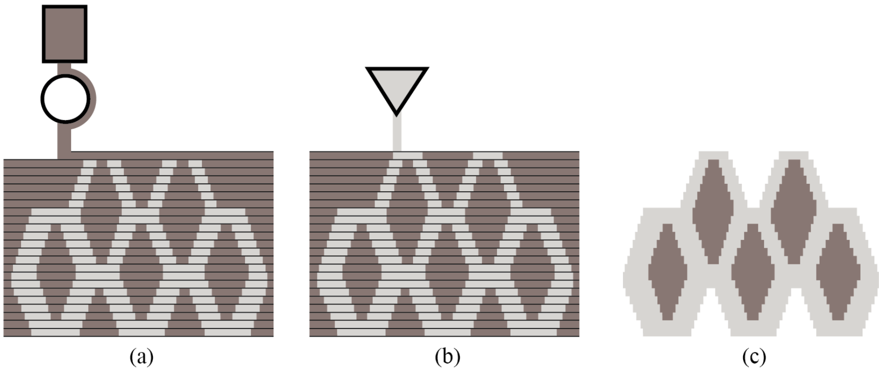
Tuesdays / 10:00 - 13:00 / Room will be announced

Date	Program	Room	Presentation
16/10	**Kick-off**	5146 / 0501	
22/10	Lectures Input		
24/10-25/10	Exursion Heidelberg + Additive Tectonics		
29/10	**Research presentation**		*Tasks 1 & 2*
05/11	Desk crit		
12/11	**1. Midterm presentation**	5146 / 0501	*Task 3*
19/11	Desk crit		
26/11	Desk crit		
03/12	Desk crit		
10/12	Desk crit		
17/12	**2. Midterm presentation**	5146 / 0501	*Task 4*
07/01	Desk crit		
14/01	Desk crit		
21/01	Desk crit		
28/01	Desk crit		
04/02	**Final presentation**	5146 / 0501	*Task 5*

Altes Hallenbad © KRAUSGRUPPE



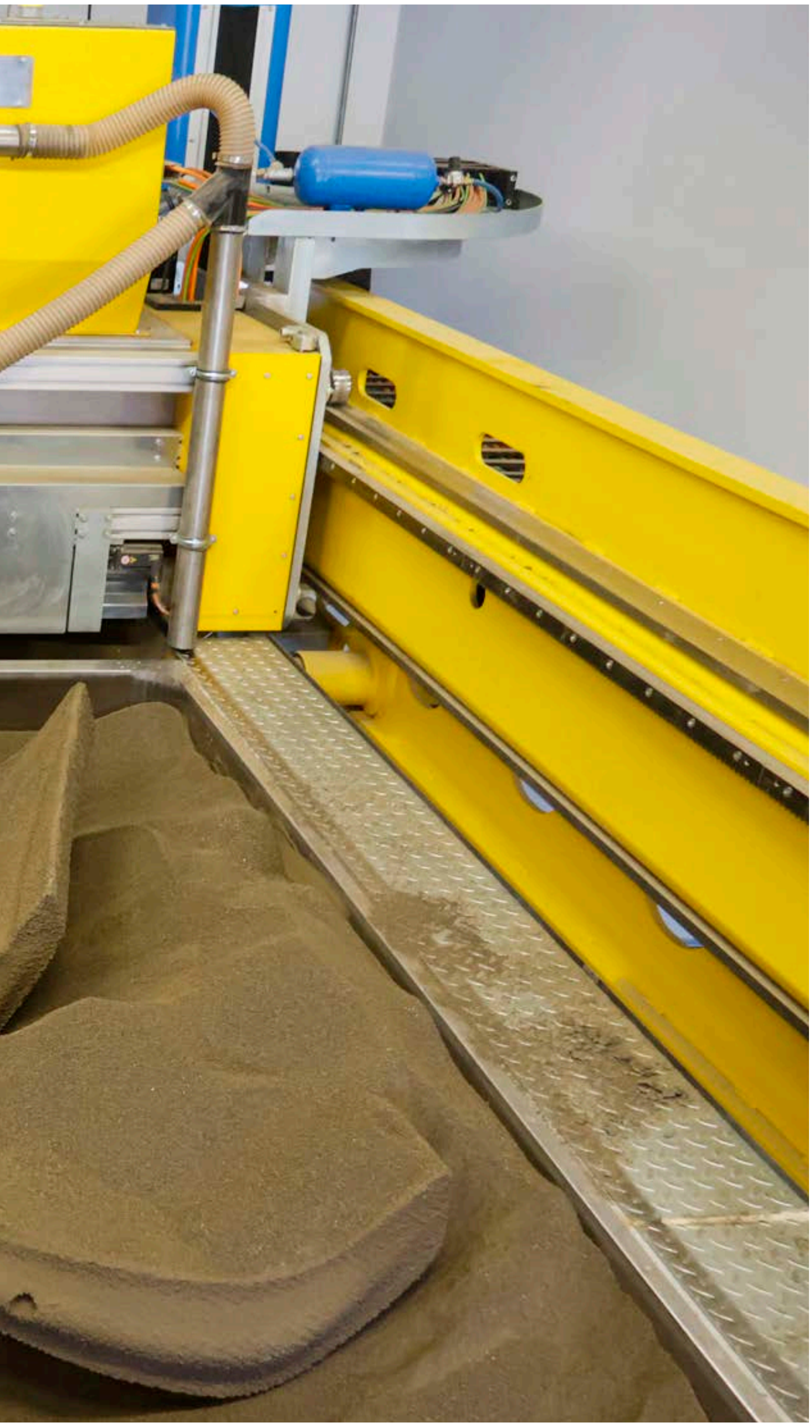
Additive Tectonics © Hochschule für Technik Stuttgart



SPI method utilised for closed-cell geometries with trapped lightweight aggregates:
a) deposition of aggregate layer; b) selective binding with a cement-paste, c) excavated component.

3D-Printing Method

The chosen 3D-printing method Selected Paste Intrusion (SPI) involves spreading loose aggregates in layers within a particle bed, which are then selectively bound using a binder, in this case, cement paste. The surrounding unbound aggregates thereby act as a support structure for the fabricated unreinforced concrete component, enabling the creation of intricate, high-resolution, free-form geometries. Following the printing process, the component is left for curing within the particle bed and can subsequently be excavated. The proposed design strategy of large-scale and lightweight components utilizes the SPI method while expanding its intended application through the use of lightweight aggregates, particle trapping, and functional grading. *Krakovská et al. 2024*



Kurt Wohlgemuth, inventor of the SPI printhead, excavating the produced segments.

Semester Structure

The semester is organized around five tasks completed in groups of three students.

Task 1 / Research / 29.10
A4 research report
Presentation
We will begin with a research task that focuses on different aspects of the research context. This includes current construction practices, the potential role of regenerative materials, as well as computational tools and digital fabrication. Each group will be assigned a specific topic, along with relevant literature to read. Use the provided literature as a foundation to delve deeper into your own investigations. Along with analizing the provided literature, each group should find and analyse at least 4 more references of their choice, such as books, papers, architectural objects, etc. You'll be asked to summarize your findings into a concise research report (one A4 page) and deliver a 10-minute presentation.

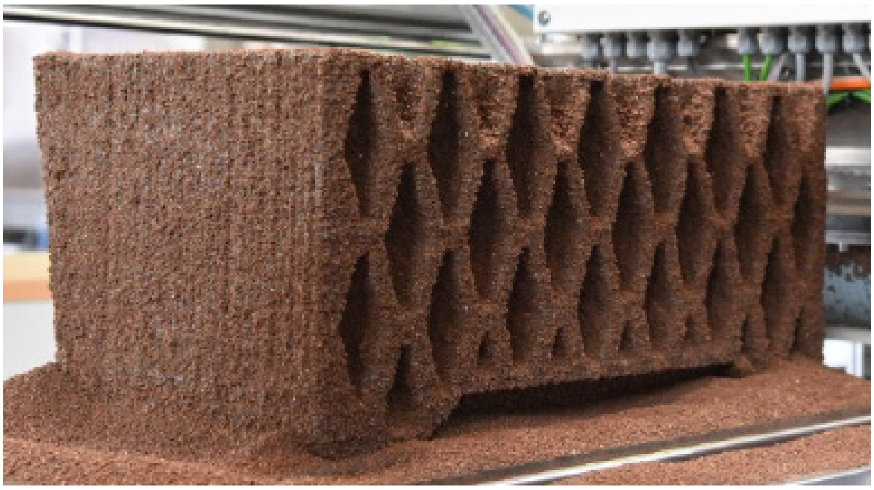
Task 2 / Model of the surroundings / 29.10
Model:1:200 model of single colour (gray, beige etc.)
All of the students of the studio should collectively produce a detailed physical model of surroundings with the removable building site part.

Task 3 / Design Idea / 12.11
Hand or digital sketches: floor plans with zones, isometries of the whole building, isometries of the building block
Climate concept:choice of the climate parameter, description of its integration in the deisgn
Model: 1:200 draft model of the building volume to insert into the model of surroundings
In the first phase of the project design, four key topics should be addressed: interpretation of program/ organization concept, building concept/urban form, climate concept, construction concept/preliminary concept of the building block produced with SPI or hybrid SPI-timber elements.

Task 4 / Construction & Concept design / 17.12
Drawings: 1:100 Floor plans and two sections, 1:20 drawing of the building block, draft isometry of the building block, schemes of the construction method
Visualizations: draft street view of the whole building, close-ups of the facades and interiors where building blocks are recognizable
Climate concept: Preliminary climate simulations
Models: 1:200 more detailed model of the whole building, 1:20 or 1:10 model of the building block
In the second phase the typology and construction concept are developed simultaneously. The focus is on the combination of the spatial program with an intelligent construction system, based on the methods of SPI.

Task 5 / Final presentation / 04.02
Drawings: 1:100 Floor plans and two sections, 1:10 drawing of the building block, detailed isometry of the building block, detailed schemes of the construction method.
Visualizations: detailed high-quality street view of the whole building, close-ups of the facades/interiors where building block is recognizible.
Climate concept: Climate simulations
Models: 1:200 detailed model of the whole building, 1:10 detailed model of the building block with the usage of the cast gypsum
The project design will be completed. The project objectives need to check the following:
architectural design, climate strategies and SPI technology into one concept - by focusing on SPI-only or SPI-timber hybrid constructions.

Playing with blocks © Ema Krakovská



Playing with blocks © Ema Krakovská

Research

The topics on this page are offered for the Task 1: Research revolving around the two main themes of Digital Fabrication and Climate Responsive Design. The literature provided is a starting point for your own research. Each group is expected to find and analyze at least four more references for each chosen topic: these could include books, papers, architectural projects, and research projects.

Digital Fabrication:

1. Building with Blocks
The Cannibal's Cookbook: Mining Myths of Cyclopean Constructions / Brandon Clifford
The Armadillo Vault: Computational design and digital fabrication of a freeform stone shell / Matthias Rippmann, Tom Van Mele, Mariana Popescu et al.

2. Digital Materiality
Digital Materiality in Architecture / Fabio Gramazio and Matthias Kohler

3. **Future of Earth Construction**
Upscaling Earth: Material, Process, Catalyst / Anna Heringer, Lindsay Blair Howe, Martin Rauch

4. **Monomateriality**
Mono-Material: Monolithic, Homogeneous and Circular Construction / Till Boettger, Ulrike Knauer
Architected Porosity: Foam 3D Printing for Lightweight and Insulating Building Elements / Patrick Bedarf

5. **Post-Carbon Built Environment**
Material Reform: Building for a Post-Carbon Future / Material Cultures, Amica Dall, Charlotte Malterre-Barthes, Jess Gough *

Climate Responsive Design:

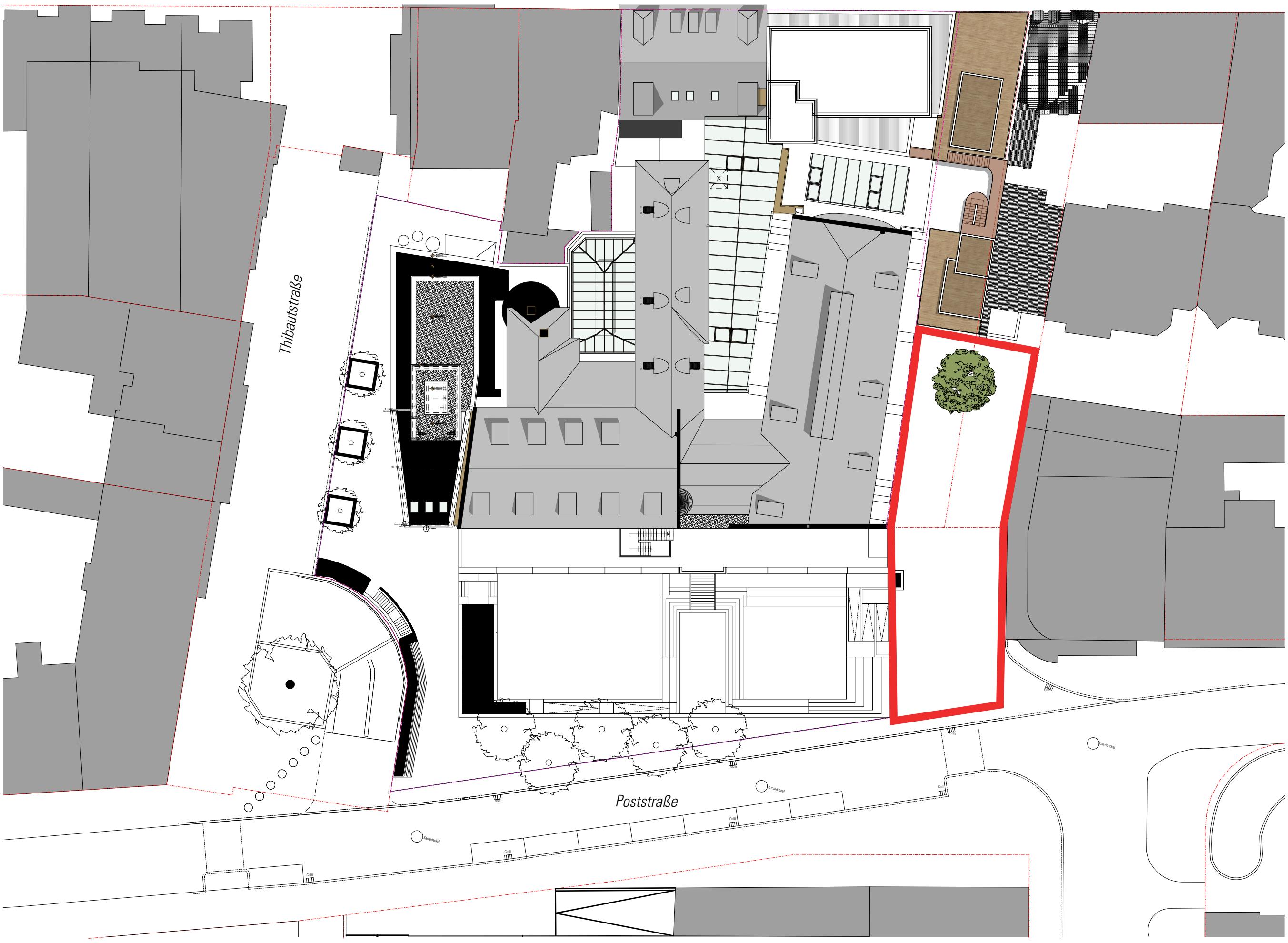
6. **Passive Design: Insulation vs Thermal mass**
Building to Suit the Climate: A Handbook - Hardcover / Liedl, Petra; Hausladen, Gerhard; Saldanha, Michael

7. **Passive Design: Solar Design**

8. **Passive Design: using water and vegetation**

9. **Einfach Bauen: technological simplicity vs high-tech**
Einfach Bauen: https://www.einfach-bauen.net/

Building Site



Development Plan

Aerial View

Building Site

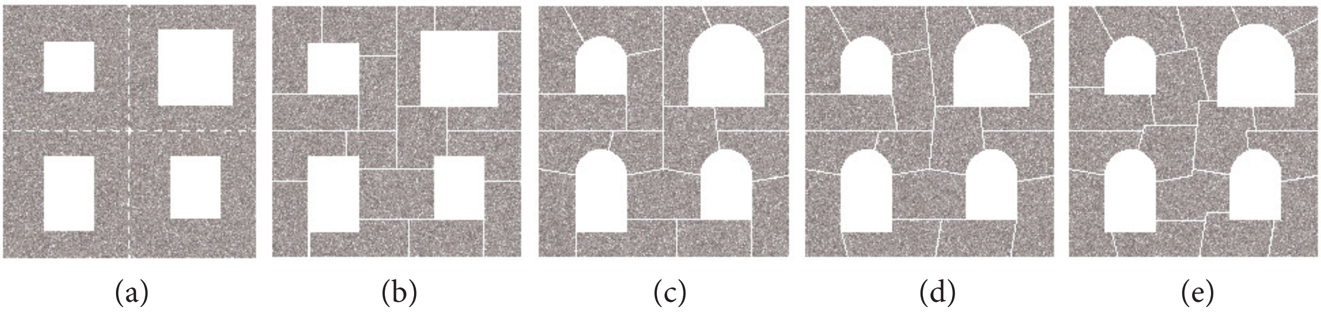
Area of Altes Hallenbad:

Altes Hallenbad (Old Indoor Swimming Pool) in Bergheim, which has been listed under monument protection since 1967, was built between 1903 and 1906 by Franz Sahles Kuhn for its client Alois Voth. After a long period of vacancy, the building complex was extensively renovated and redesigned with additional extensions between 2009 and 2012. As part of this, the “Bergheim 41” hotel was built in a new building on Bergheimer Strasse, right next to the historic main entrance to the Altes Hallenbad.

Vacant lot:

The lot of approximately 260 m² allocated for the project is closed on three sides, with the Altes Hallenbad on the west side, a refurbished hotel on the north side, and a residential building on the eastern side. The southern side is free and is the only access to the plot, facing an open space. At the moment, this plot of land is covered by a big tree and further vegetation, and delimited by a low brick wall.
The open square facing the plot on its southern side, of approximately 210m², serves at the moment as a sort of extension to the Hallenbad’s square. This “unplanned” square acts as a filter space between the first area and the street with cars and is also part of the design task.

Street view



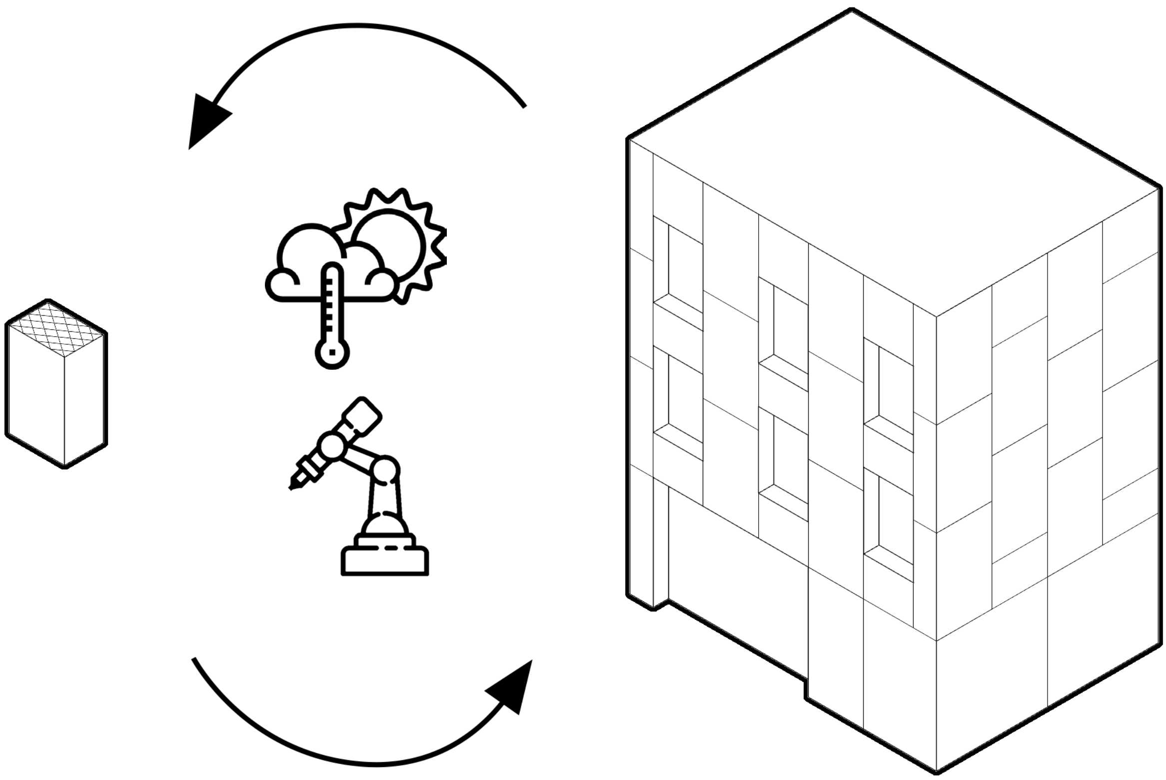
Conceptual scheme of the lightweight SPI design principles: a) initial building design outline, b) segmentation according to the SPI printer size, c) compression-dominant shape adjustment, d) accommodation of the assembly sequence, e) topological interlocking. ©Krakovská et al. 2024

Design Task

The studio project “How to Print a House: Extension Altes Hallenbad Heidelberg” aims to explore two key areas.

First, we will investigate architectural form and structure suitable for the 3D Printing method of Selective Paste Intrusion (SPI), offering new perspectives on the construction of massive buildings. 3D printing technology expands the possibilities of monomaterial constructions by enabling large geometric and material customisation. This approach allows for integrating multiple functions—such as structural integrity and thermal performance—into single building components, enhancing material efficiency and offering greater design freedom. Specifically, we will explore the notion of designing with volumetric components within SPI and investigate their potential to store and release thermal energy or act as long-term CO_2 sinks. This exploration opens up additional opportunities, such as integrating energy storage capabilities into the building’s mass, thereby giving it a multifunctional role.

Second, we will examine the typologies of mixed-use and residential buildings, focusing on designs that can adapt to changing needs over the coming decades while intelligently interacting with the underlying construction system.



Design from simple building block scale to house scale, taking into consideration parameters such as climate and construction and constantly working on both scales.

Altes Hallenbad South Facade ©SSV Architekten

Design Program

Site
260 m²

Ground Floor
100-150 m²
Cafe including storage/sanitary Rooms
Shop

Upper Floors
200-300 m²
Appartements
Community Space

Submission Documents
Master Plan *M 1:1000*
Site Plan *M 1:500*
Plans *M 1:100*
Sections *M 1:100*
Elevations *M 1:100*
Facade Section *M 1:20*
Building Block Details *M 1:5-1:50*
Schemes/Diagram Construction Process
Sketches/Schemes Design Concept
Climate Simulations
Urban Model *M 1:500*
Building Model *M 1:200*
Model of Construction Concept *M 1:20-1:50*
Visualization Exterior min. 2 images
Visualization Interior min. 1 image

Design Projects

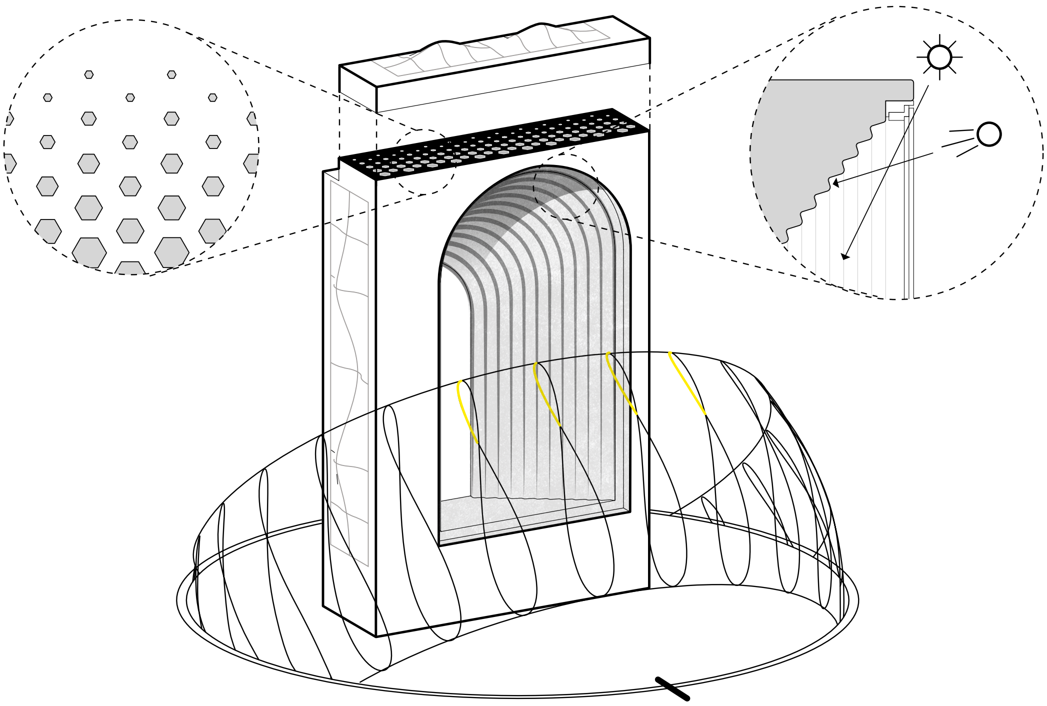
*Sol*ARCH

Bruno Heringer, Louisa Knopf, Jesper Druckrey

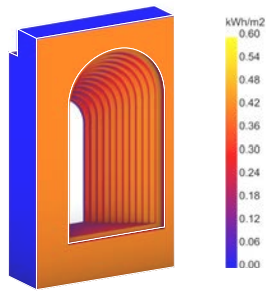
Located in Heidelberg, SolArch fuses a massive arch construction with the latest SPI technology in response to its surroundings. The climate design strategy features a facade that absorbs heat in winter and delays heat in summer by optimizing sun direction and thermal storage, ensuring an energy-efficient and thermally comfortable building further devoloping the principle of the Trombe Wall. These load-bearing arches transmit loads through compression forces and are also arranged to form a structural grid that allows for a flexible layout and the assembly of standardized components. Moreover, the building opens up to Altes Hallenbad Plaza, creating an inviting public space at the front and in the courtyard.

Outdoor Perspective

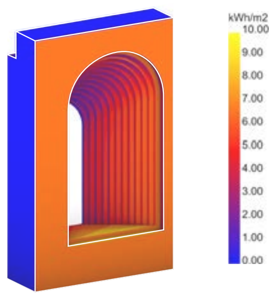
Climate Concept



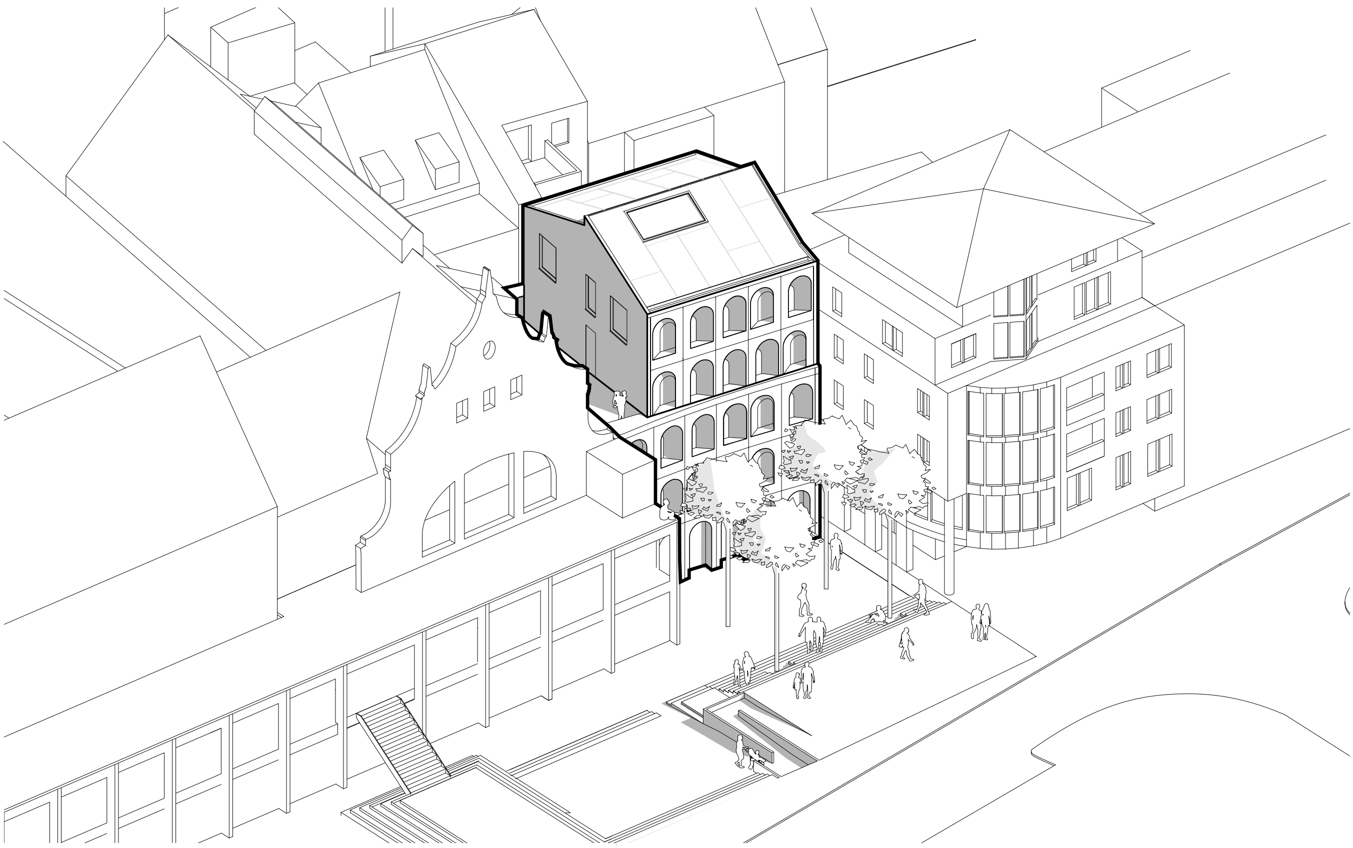
Block detail (Pictogram)



Sunradiation Winter

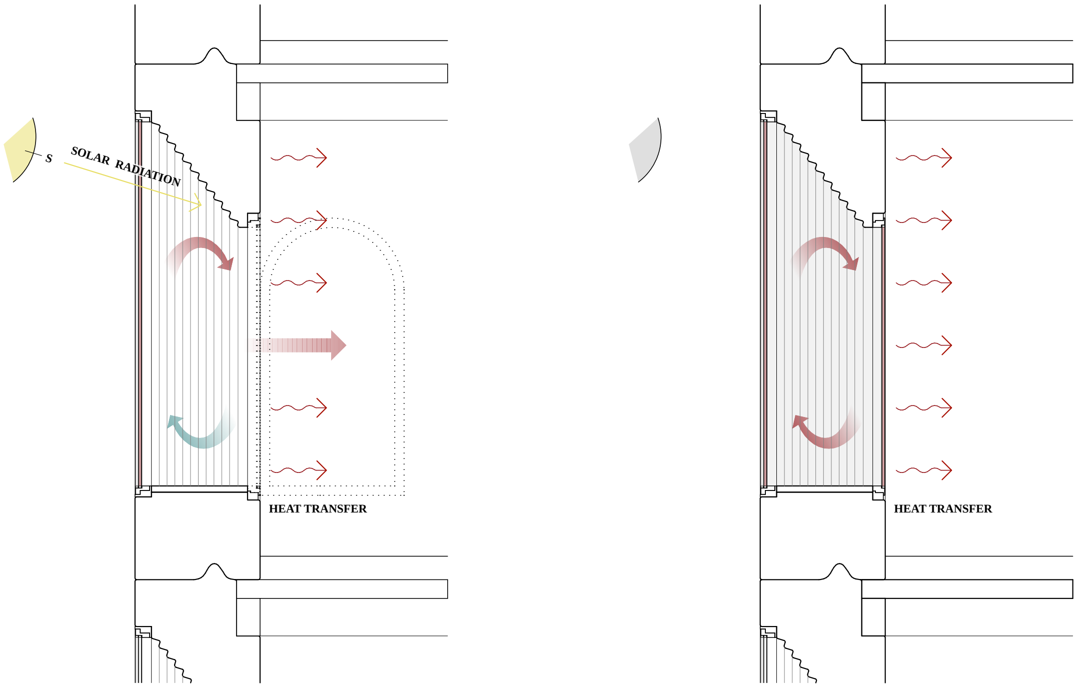


Sunradiation Summer

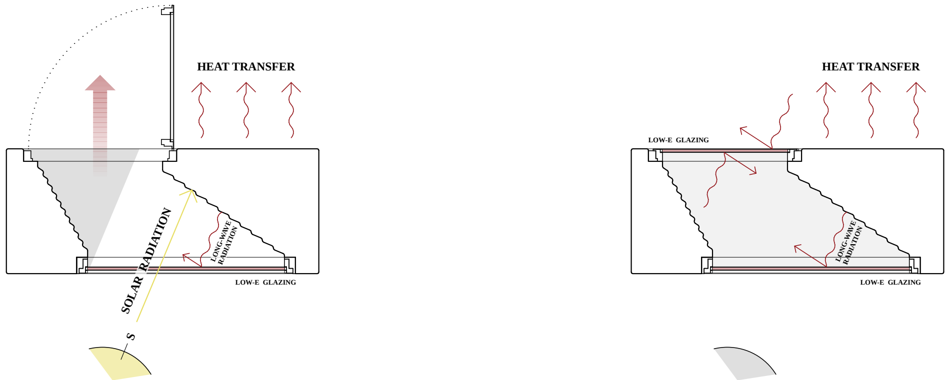


Site Plan

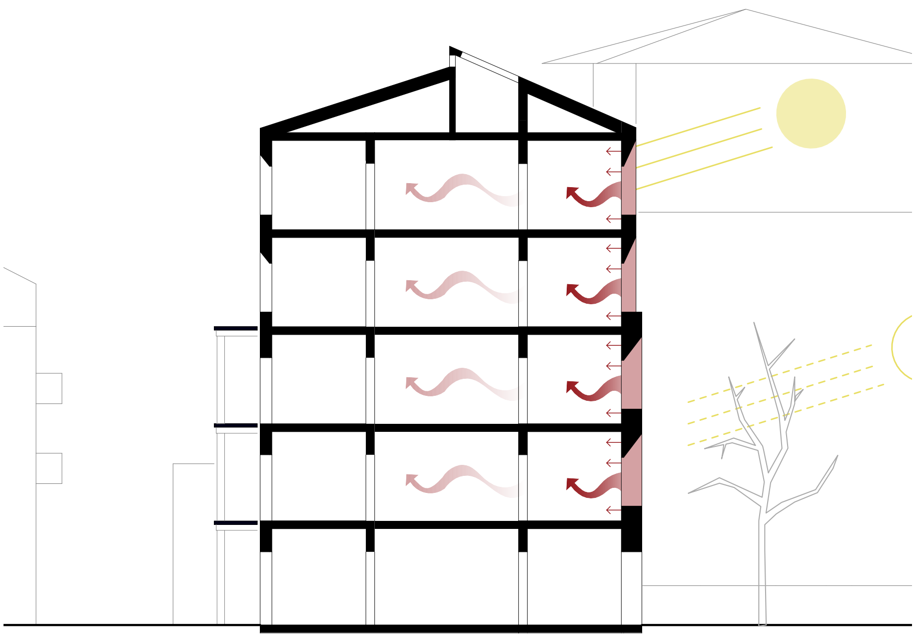
Climate Concept: Winter



Vertical Cut

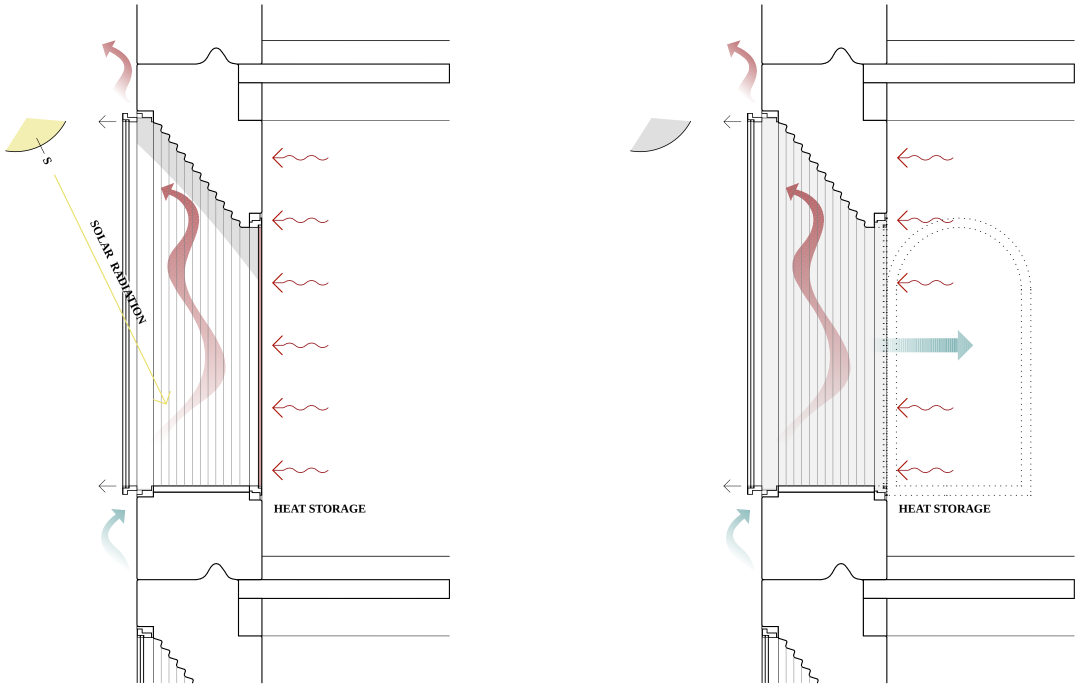


Horizontal Cut

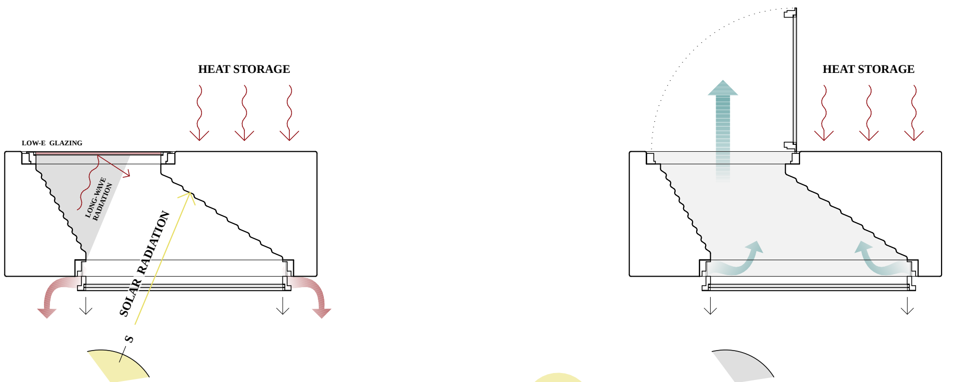


Ventilation (Section)

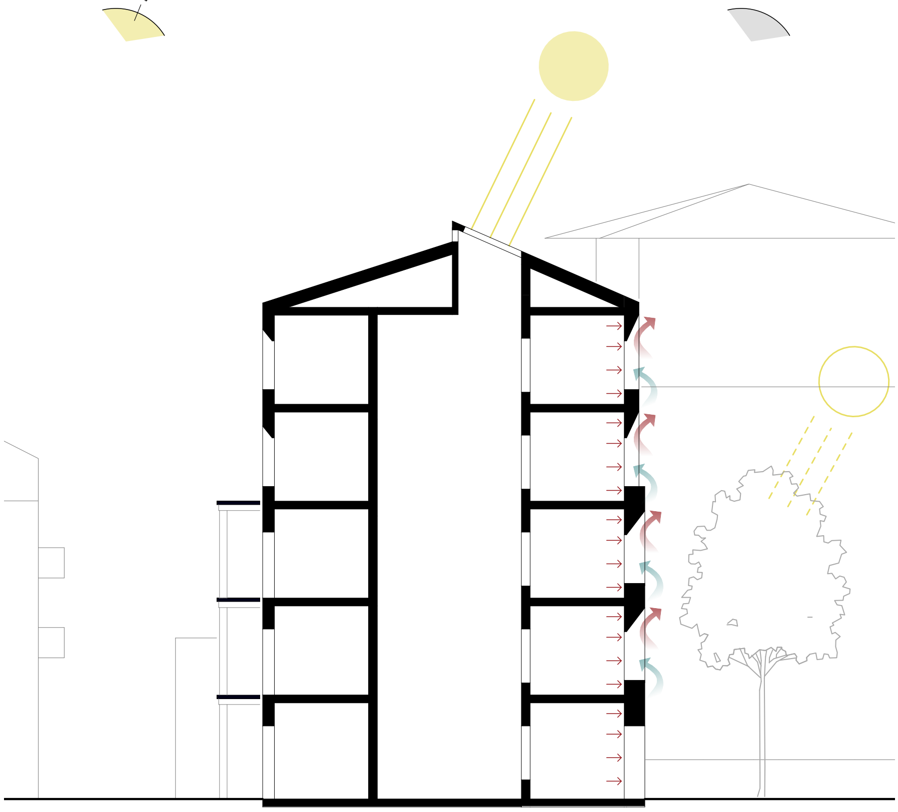
Climate Concept: Summer



Vertical Cut

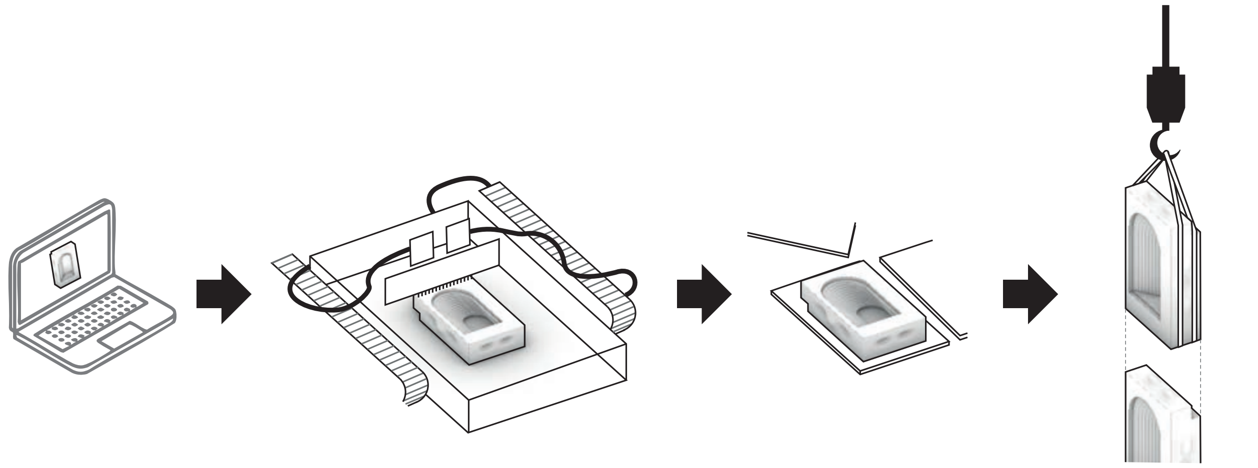


Horizontal Cut

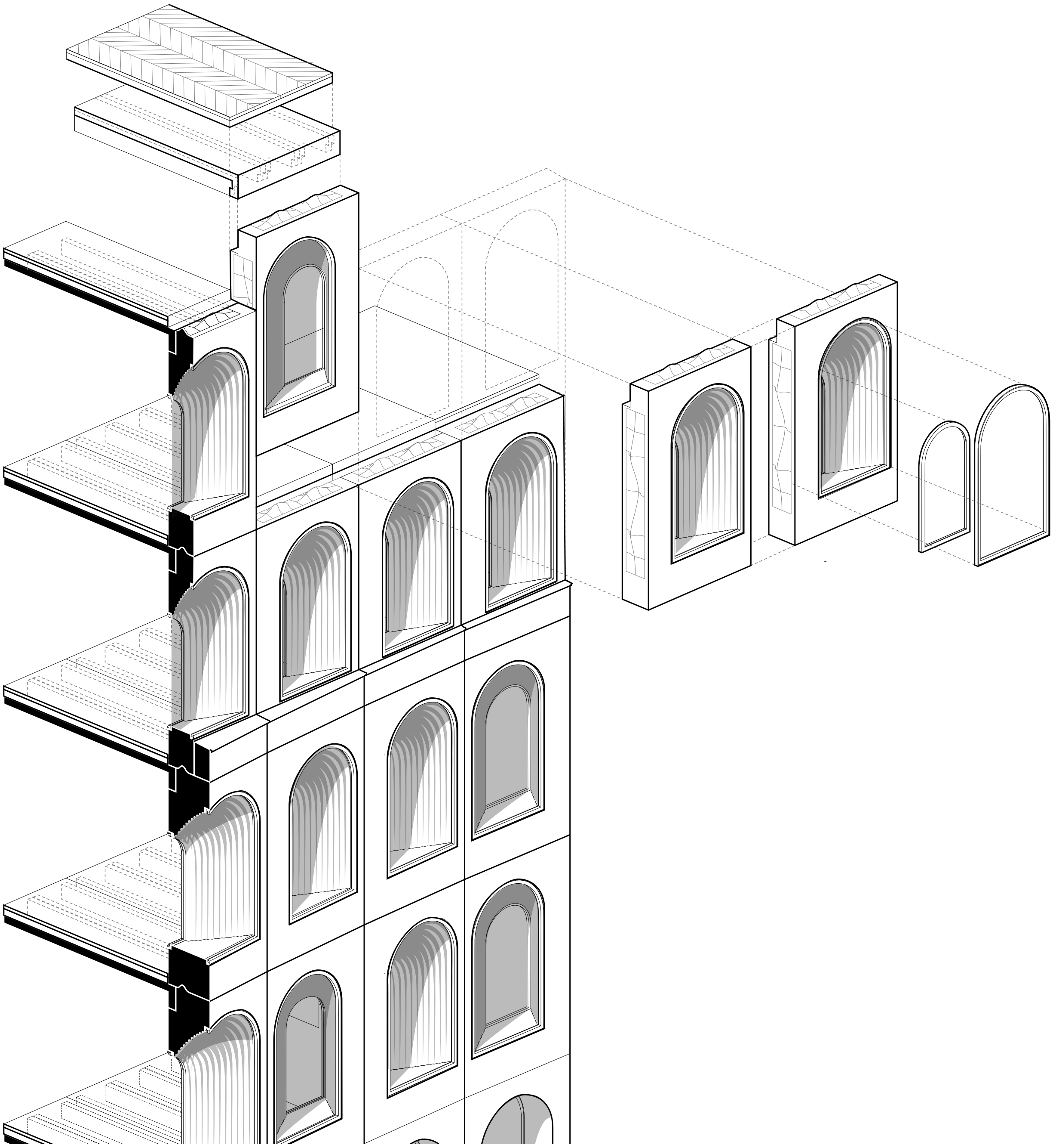


Ventilation (Section)

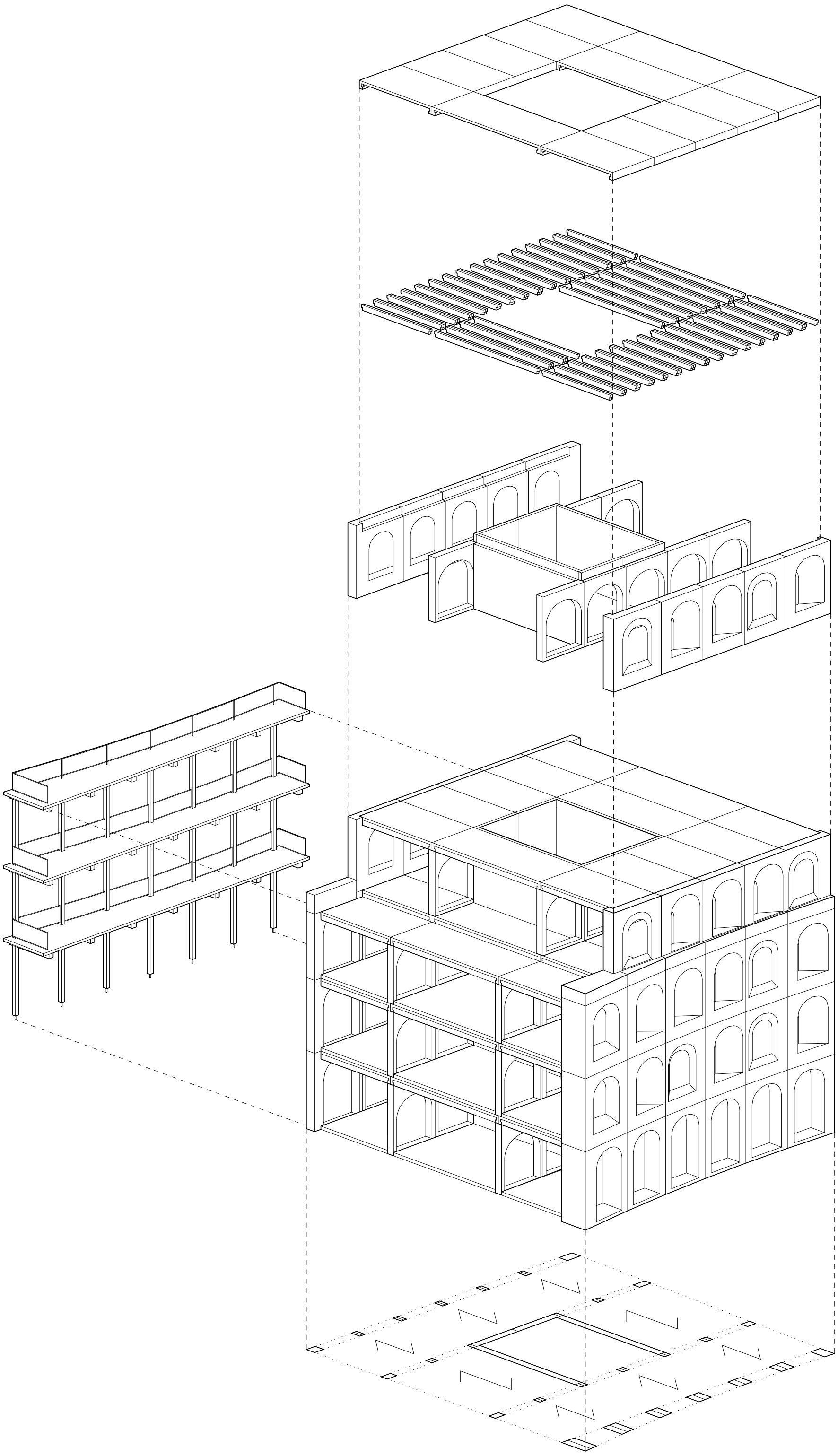
Fabrication Concept



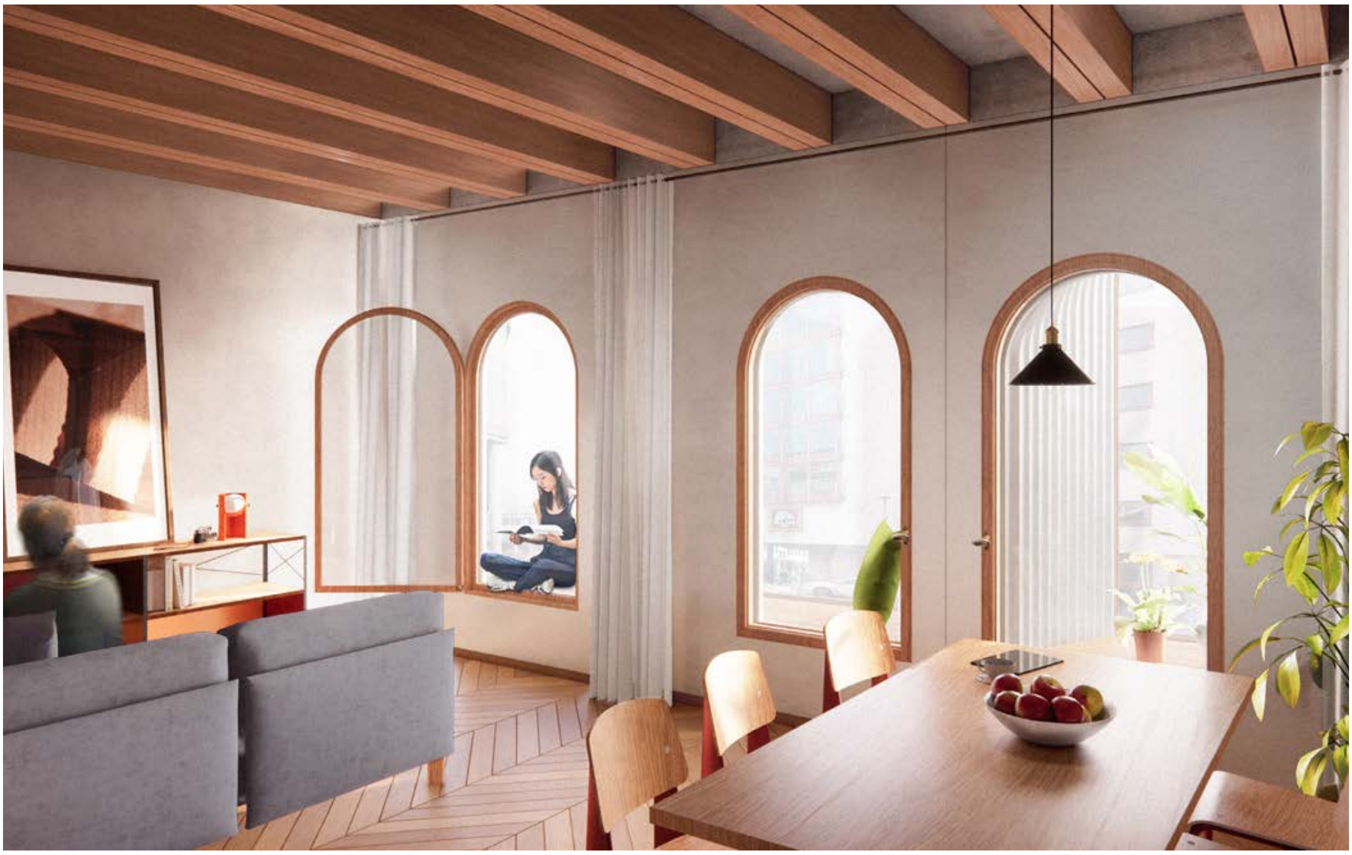
Fabrication Process



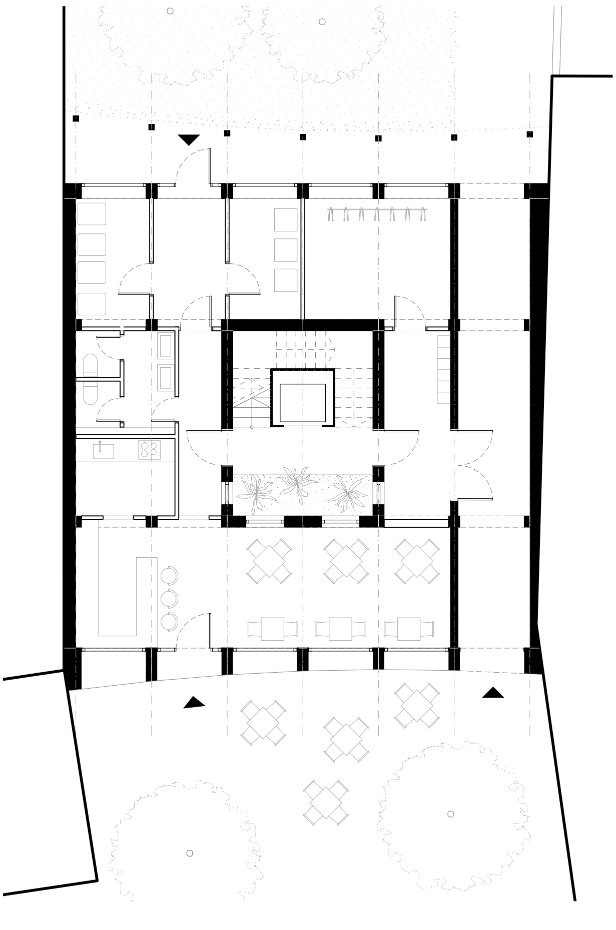
Façade Assembly



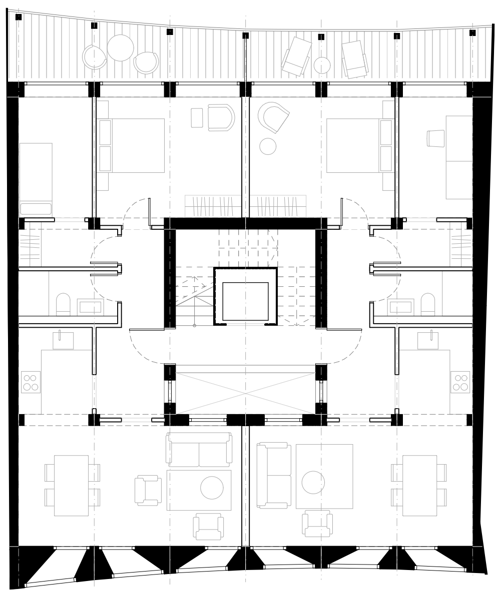
Construction Isometry (Layers)



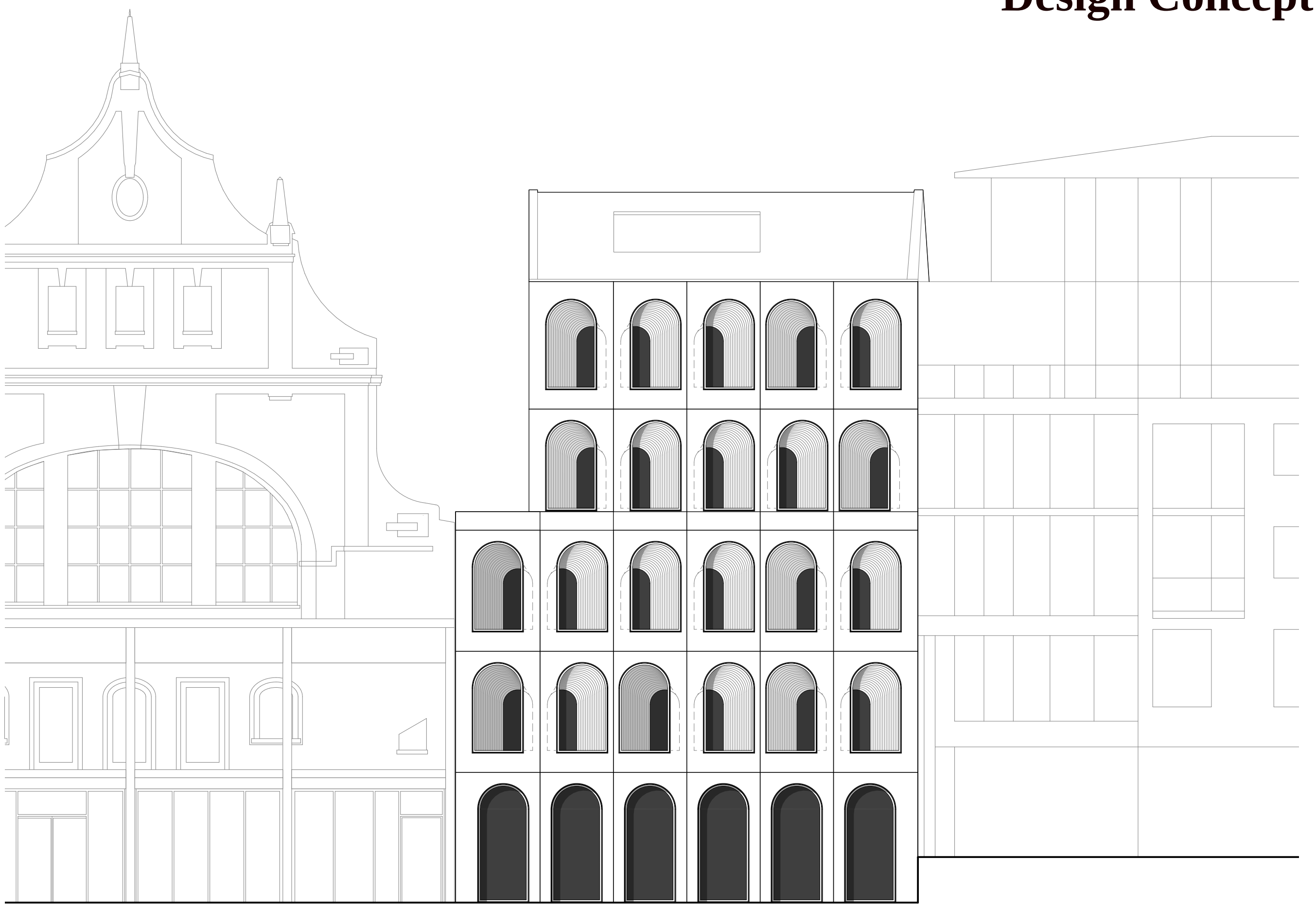
Indoor Rendering (Living)



Groundfloor



1. Floor



Elevation

Section (Perspective)

Model



1:200 Model (with Surrounding)



1:5 Model (Façade and Construction)

HeidelBrick

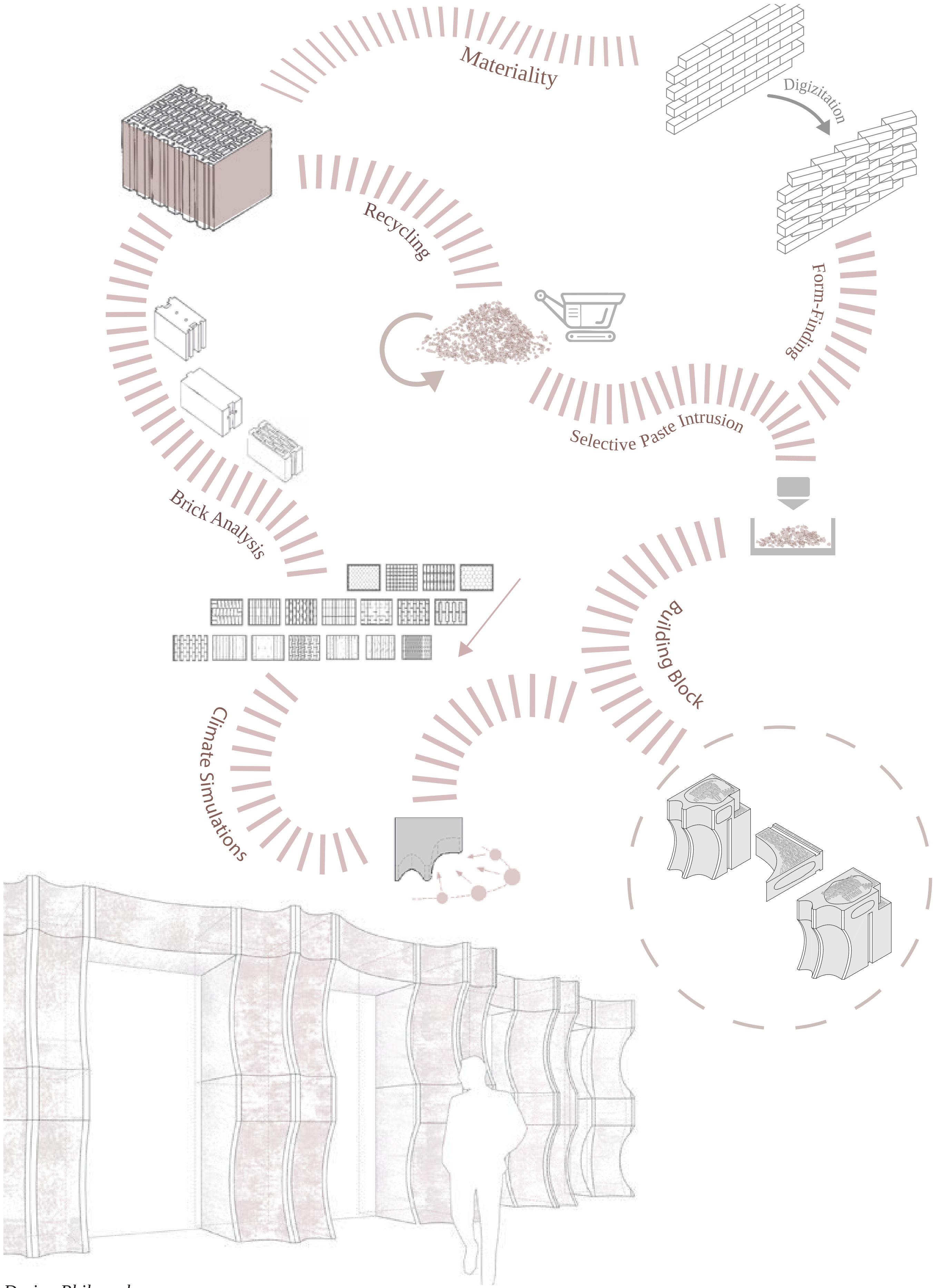
Buket Göksen, Karolin Savitri Klein, Pim Okhuizen

Materiality in the age of digitization is undergoing a paradigm shift for architects and designers. Human-machine interaction, which already plays a vital role in industrial sectors, is steadily reshaping the field of architecture. Digital Fabrication demonstrates how innovative technologies can harness material properties to enhance the overall performance of buildings and their construction processes. Thereby, the building material retains its conventional appearance. But what if architects re-imagined industrially produced products, reshaping building components using cutting-edge 3D-printing innovations, such as Selective Paste Intrusion and Selective Cement Activation?

HeidelBrick explores this design methodology, rethinking conventional building products to create a brick-like component. This approach integrates innovative elements into historical contexts while optimizing physical performance. By doing so, the project demonstrates how material innovation can contribute to addressing the challenges of climate change.

Situational Building Render

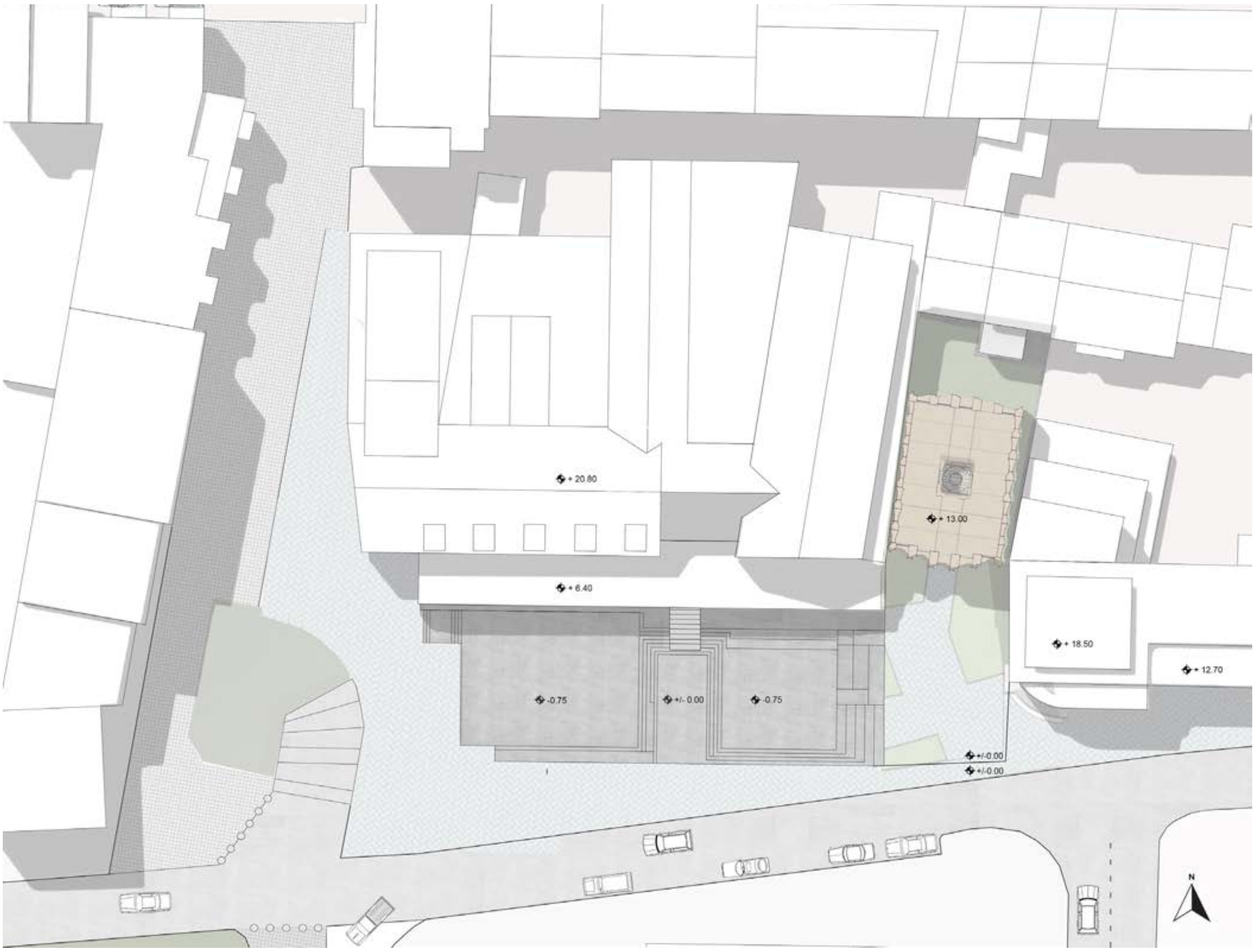
Design Concept



Design Philosophy

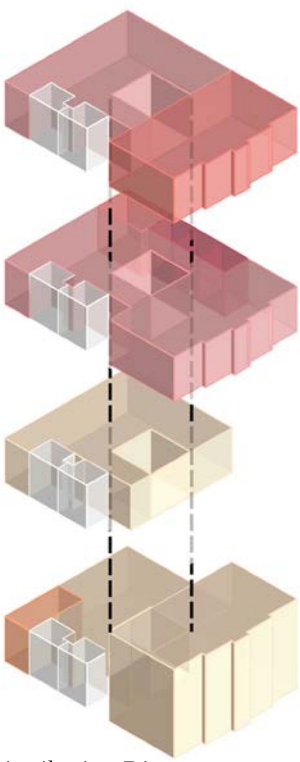
HeidelBrick

Design Concept



Site Context Plan

1:750 0 15



Amenities

Office

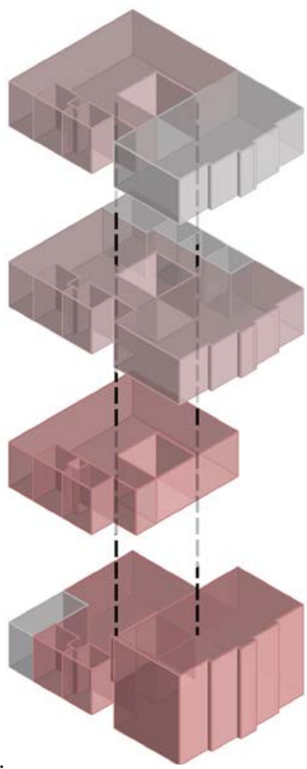
Function Space

Meeting Space

Cafe Seating

Kitchen

Distribution Diagrams

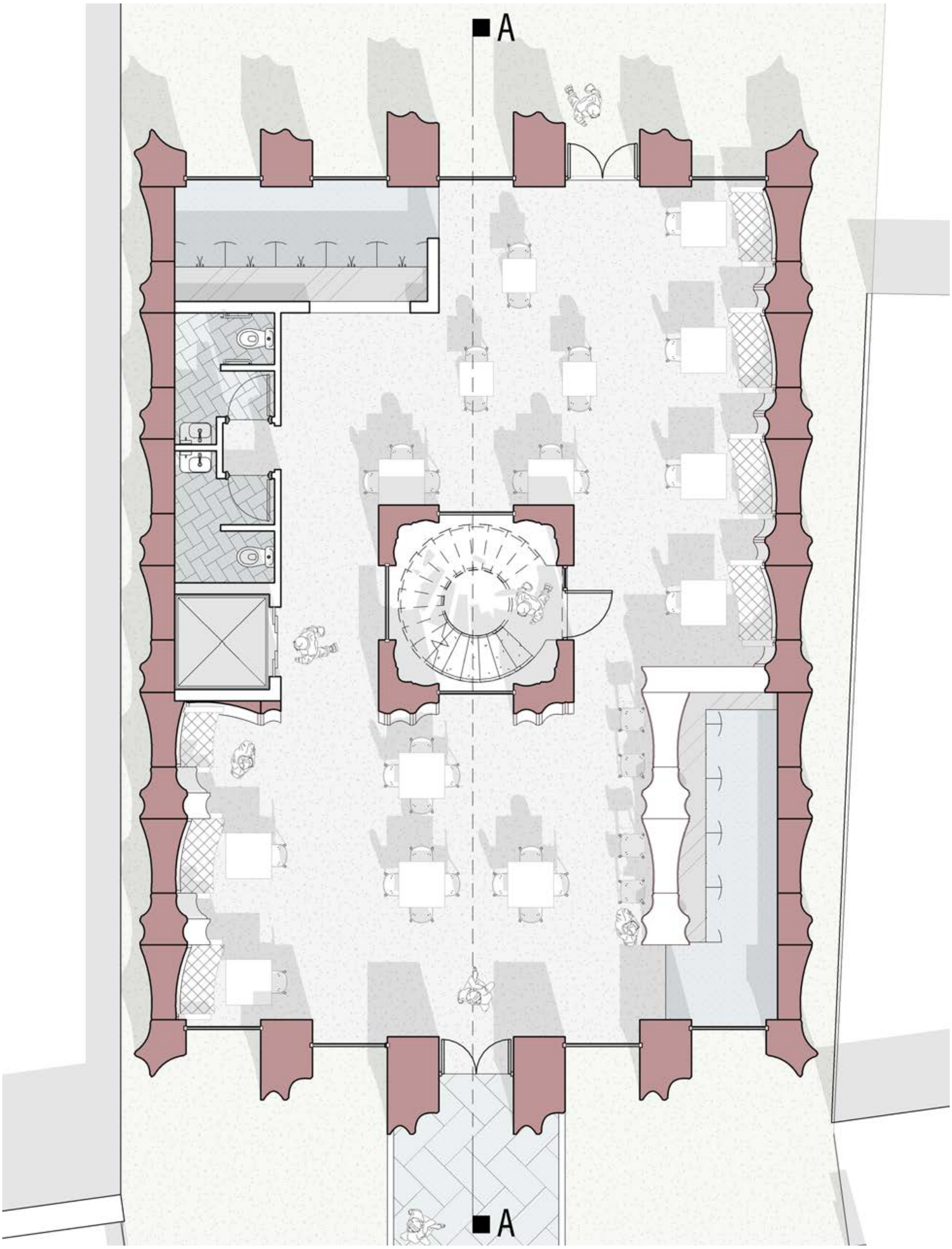


Private

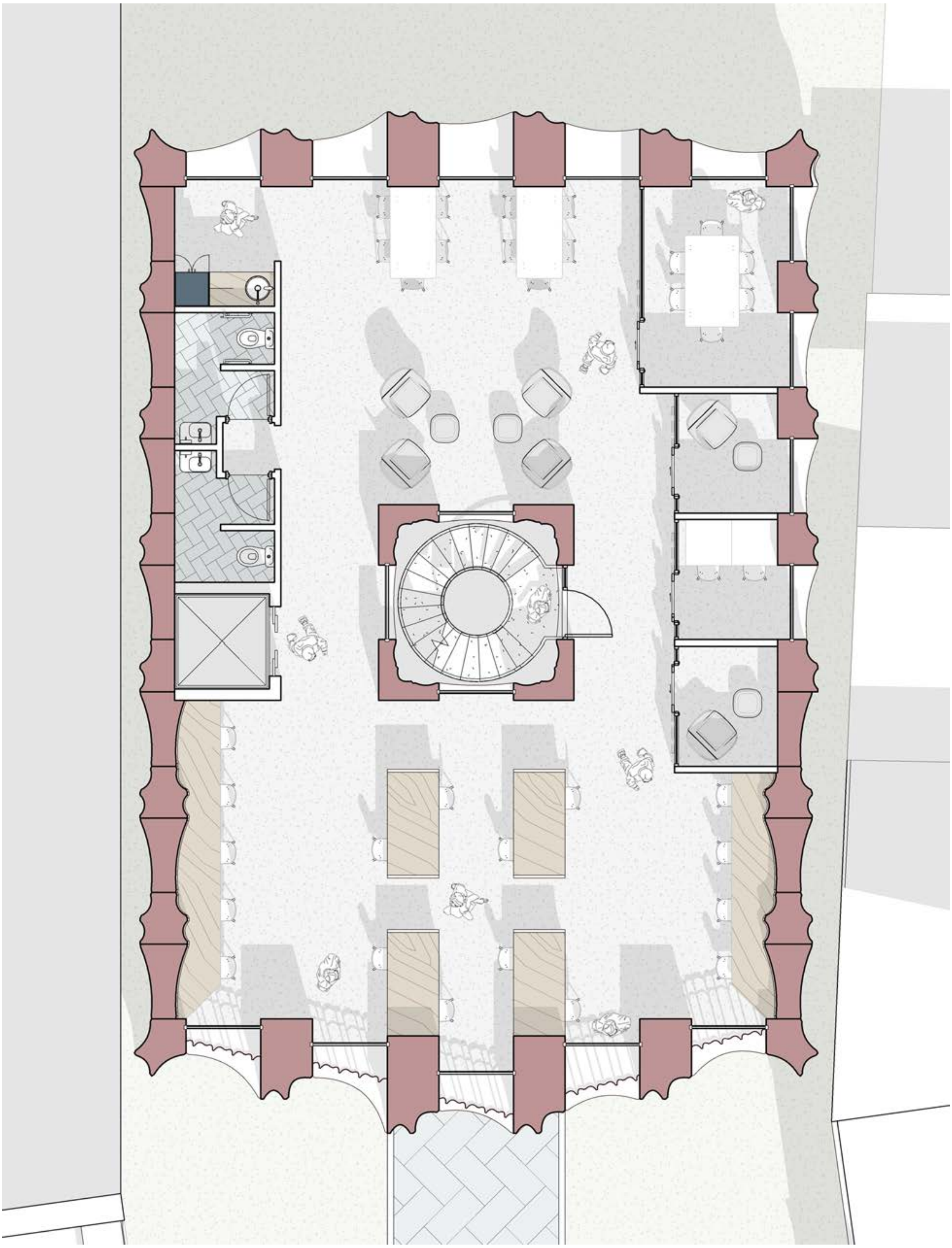
Semi - Public

Public

Function Diagram



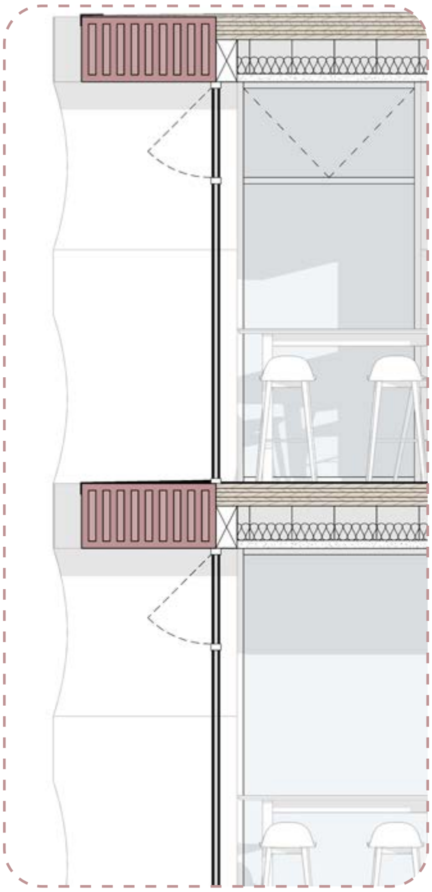
Ground Floor Plan



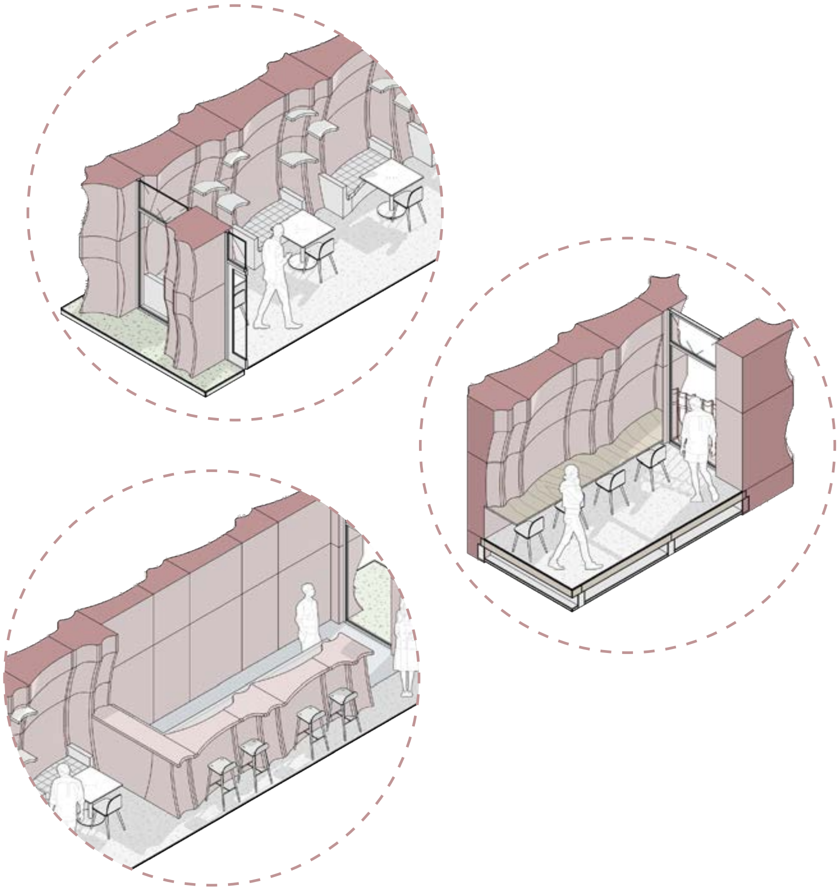
First Floor Plan

1:100 0 2

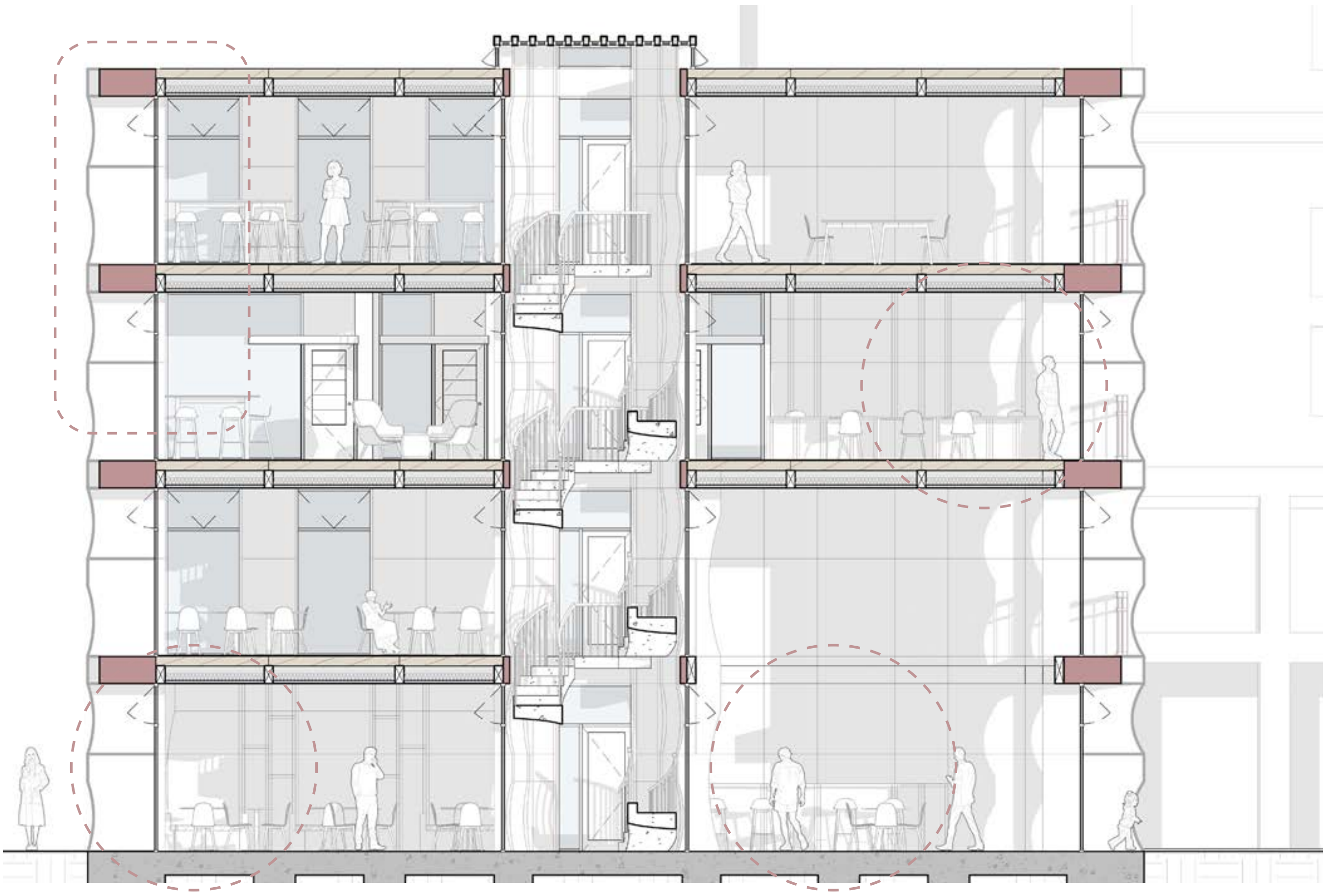
Design Concept



Detailed Section 1:50 0 1

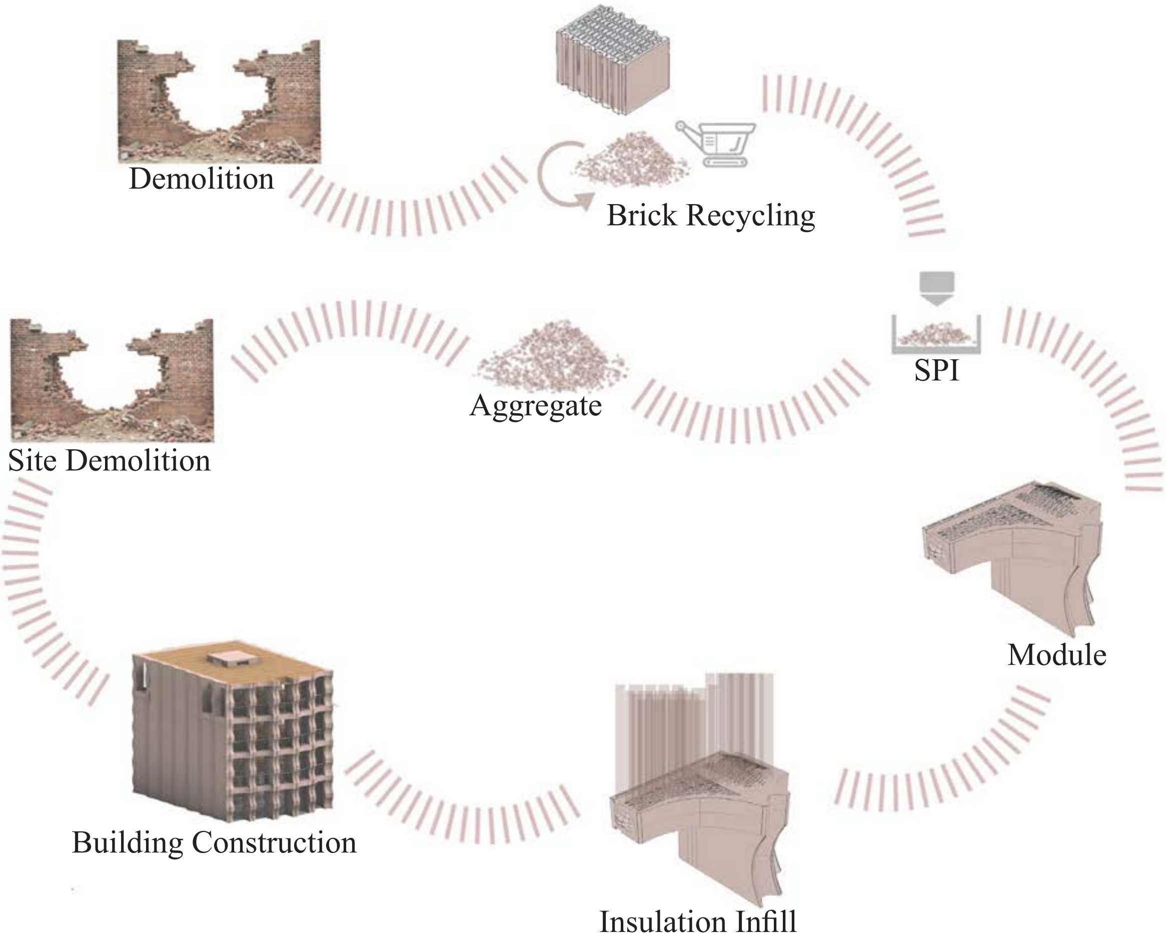


Furniture 3Ds 1:125 0 2.5

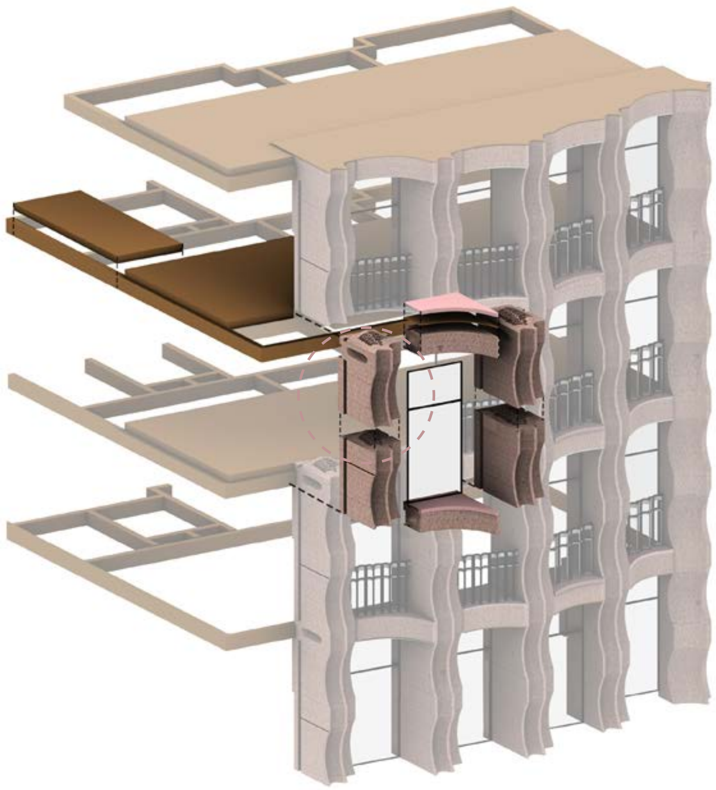


Section A-A 1:125 0 2.5

HeidelBrick



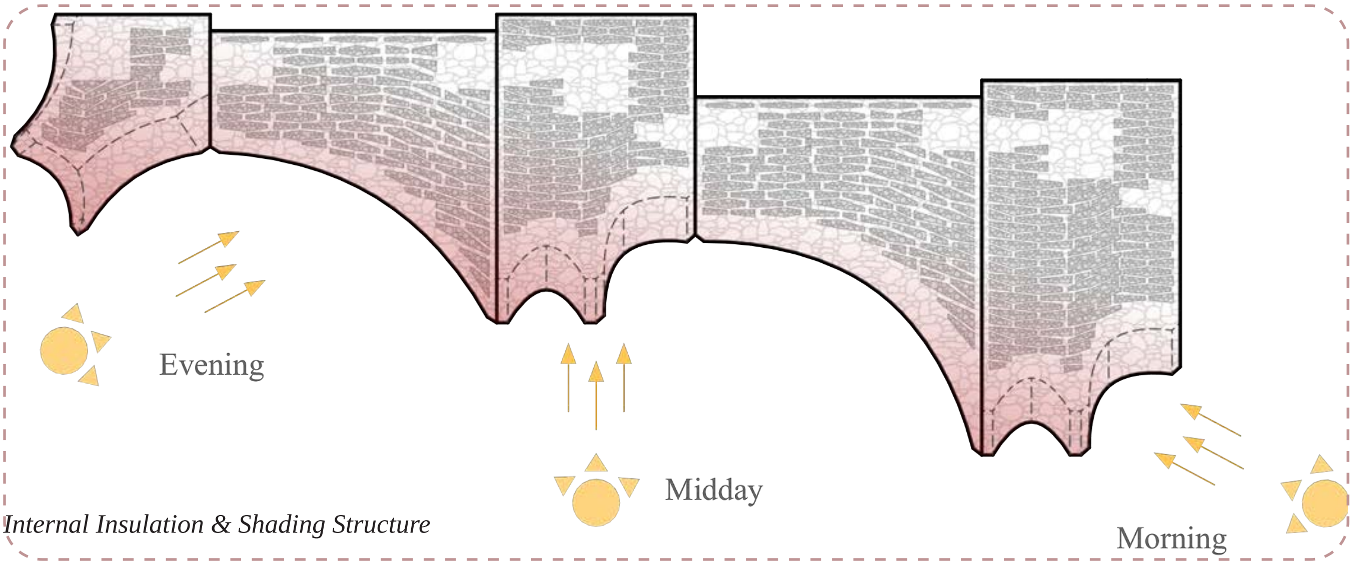
Building Fabrication Life-cycle



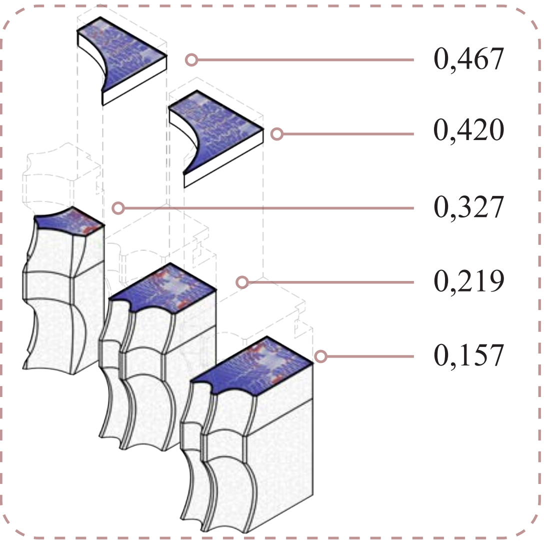
Exploded Structural Isometric

Detailed Structural Isometric

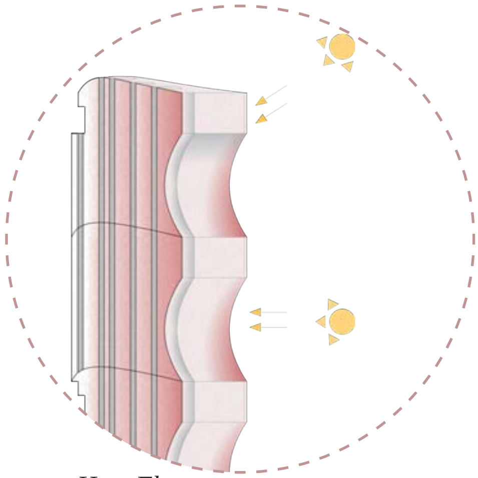
Climate Concept



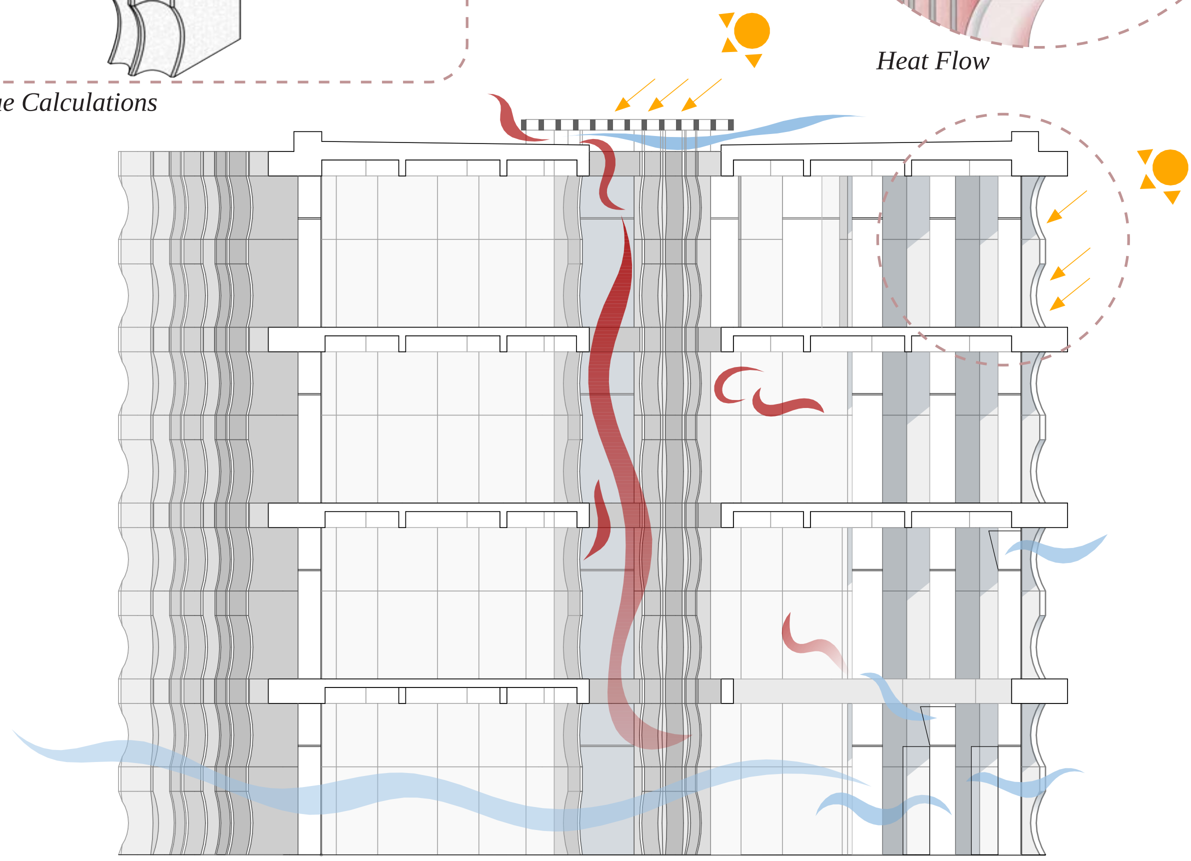
Internal Insulation & Shading Structure



U-Value Calculations



Heat Flow



Climate Integration Section

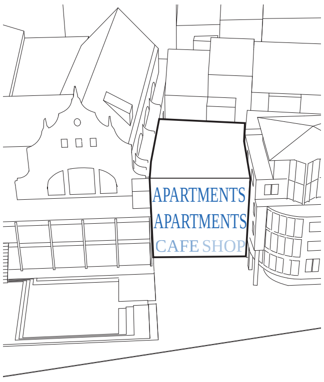
Pipe Your House

Marie Fiedler Amlien, Anton Dakowski, Luca Alexander Jans

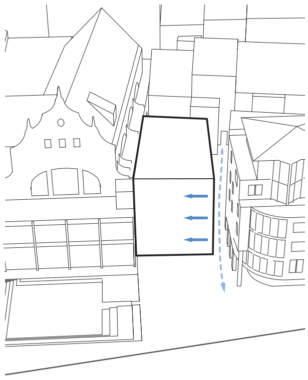
‘Pipe Your House’ investigates how we can integrate all the features of the modern “layered” wall into a monomaterial wall. The solution is to incorporate air channels into the walls, which contributes to insulation and drive natural ventilation through the building structure. The passive ventilation system uses the chimney effect to heat rooms in winter and cool them in summer. Cold outside air is preheated in the ground and then by the thermal mass in the walls before entering the interior. The helix structure of the channels also creates a heat exchange between the outlet and inlet air channels. The architectural concept is based on visibly symbolizing the air channels on the façade, with the outer channels creating the vertical décor of the columns. ‘Pipe Your House’ combines aesthetics and efficiency for sustainable architecture.

Visualization of South facade

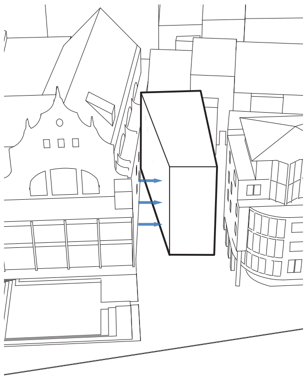
Design Concept



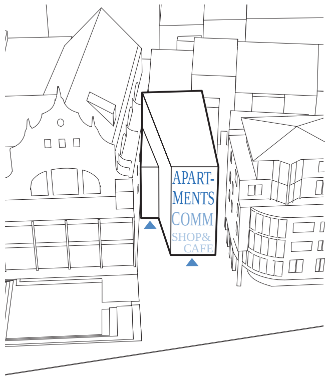
Maximum Shape



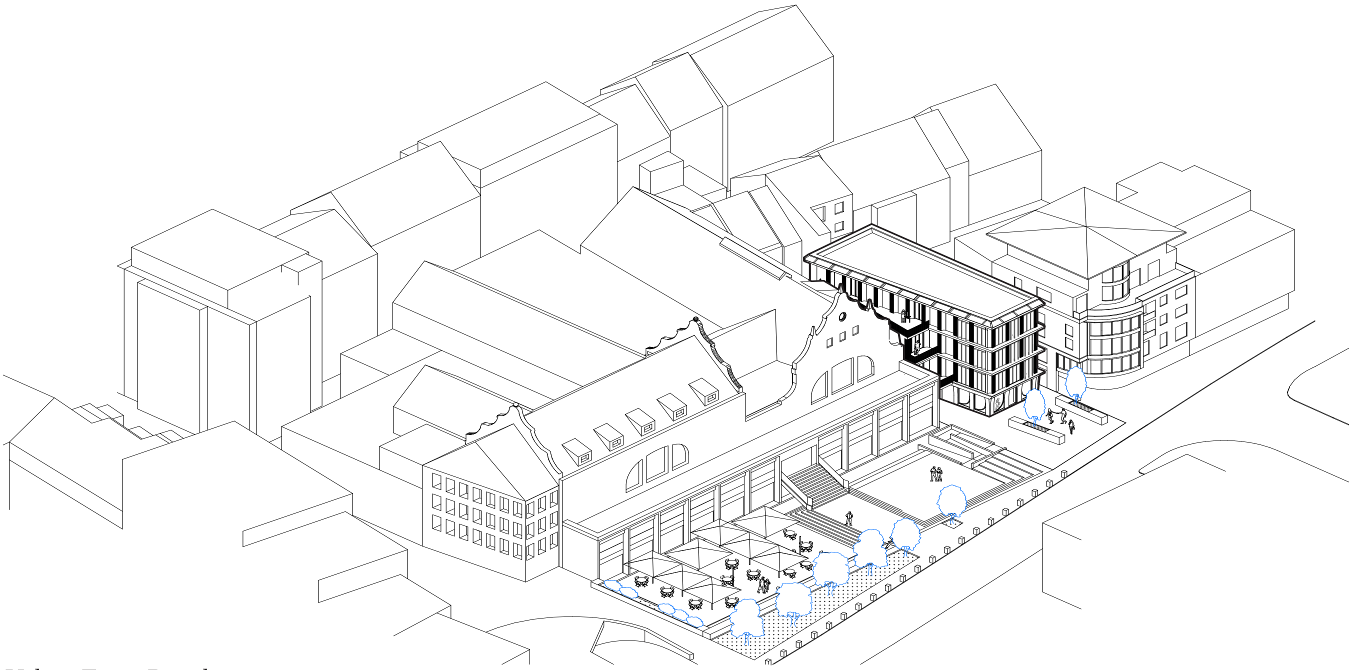
Separation



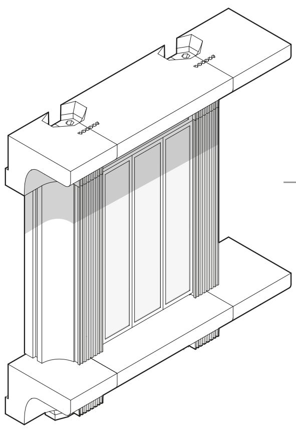
Seperation

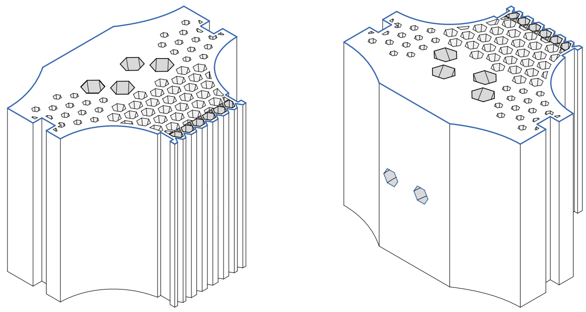


Development



Urban Form Development

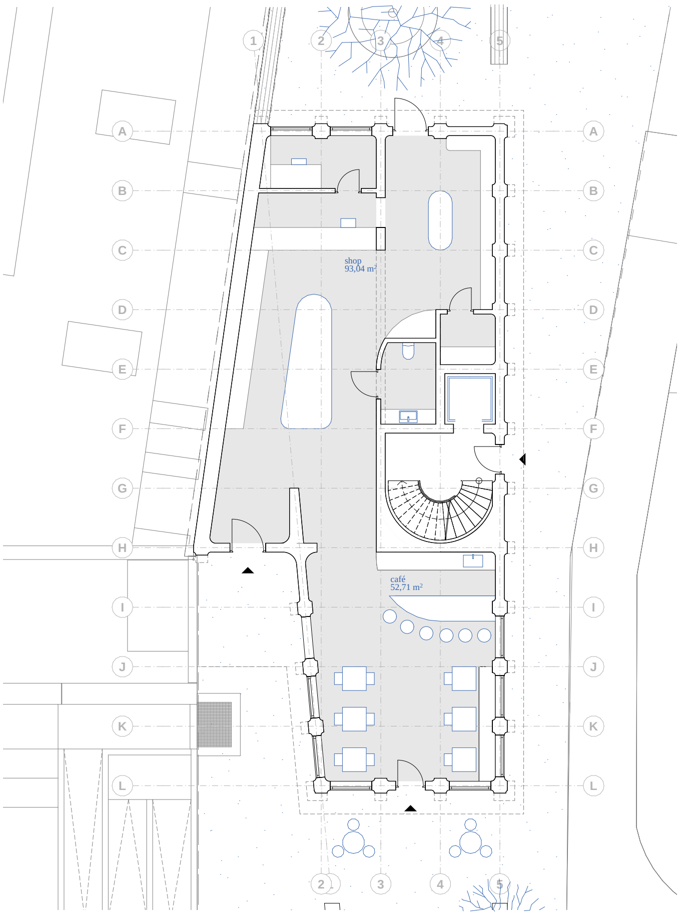


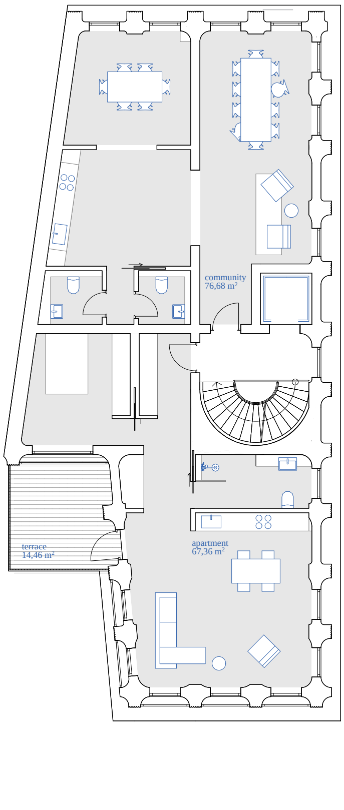


Isometrie of the Block

Detail of the Block Structure

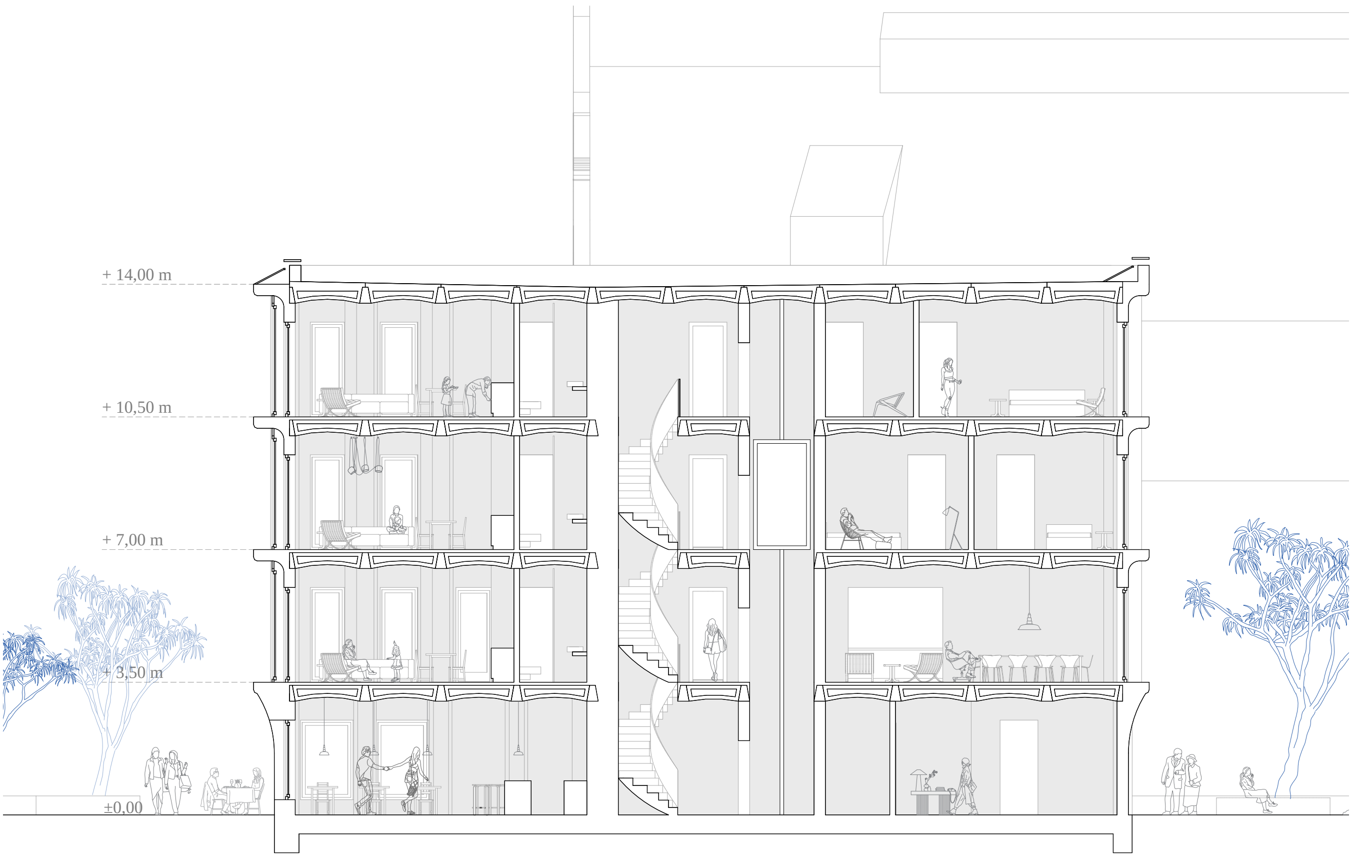
Pipe Your House





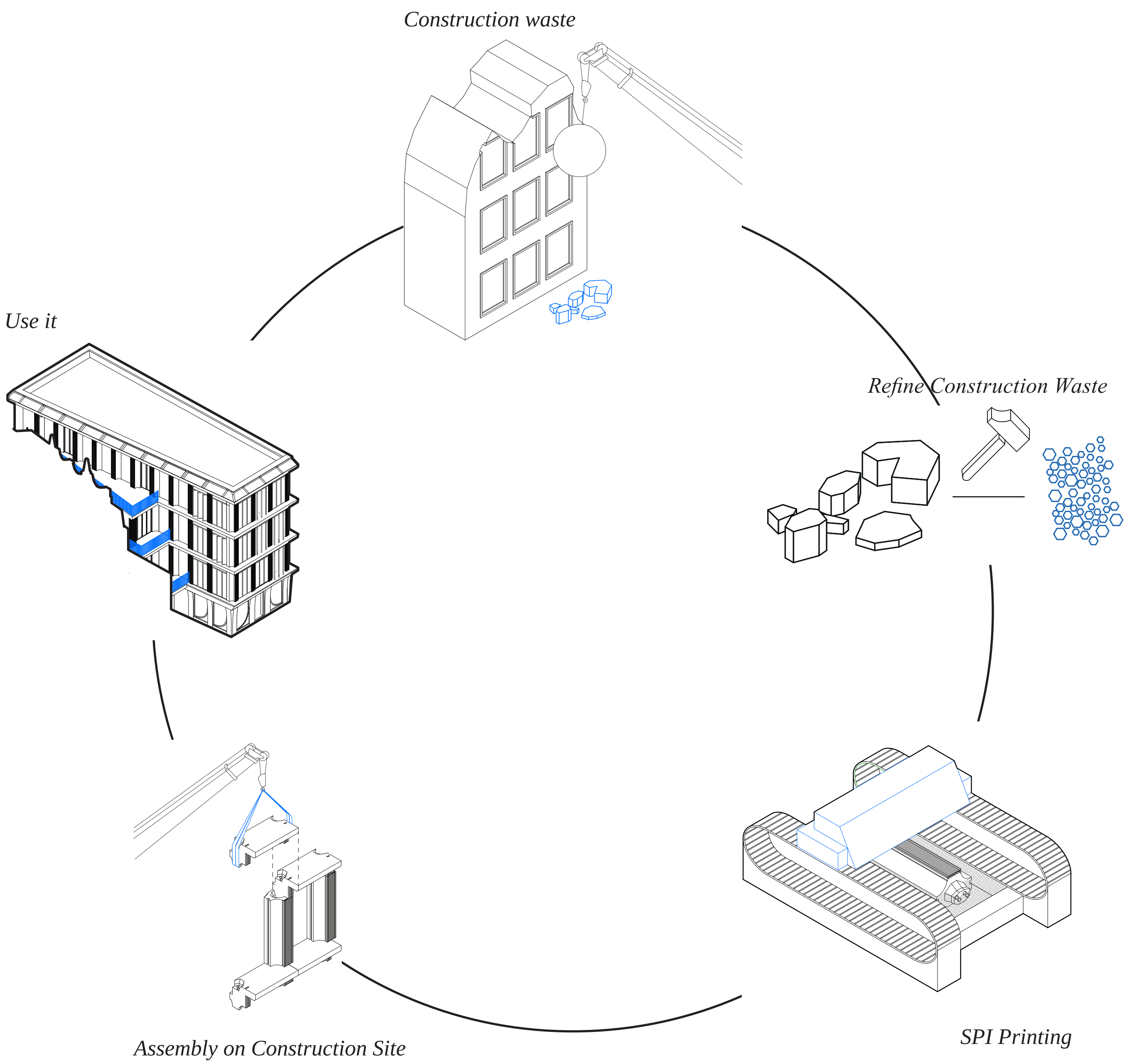
Ground Floor 1:250

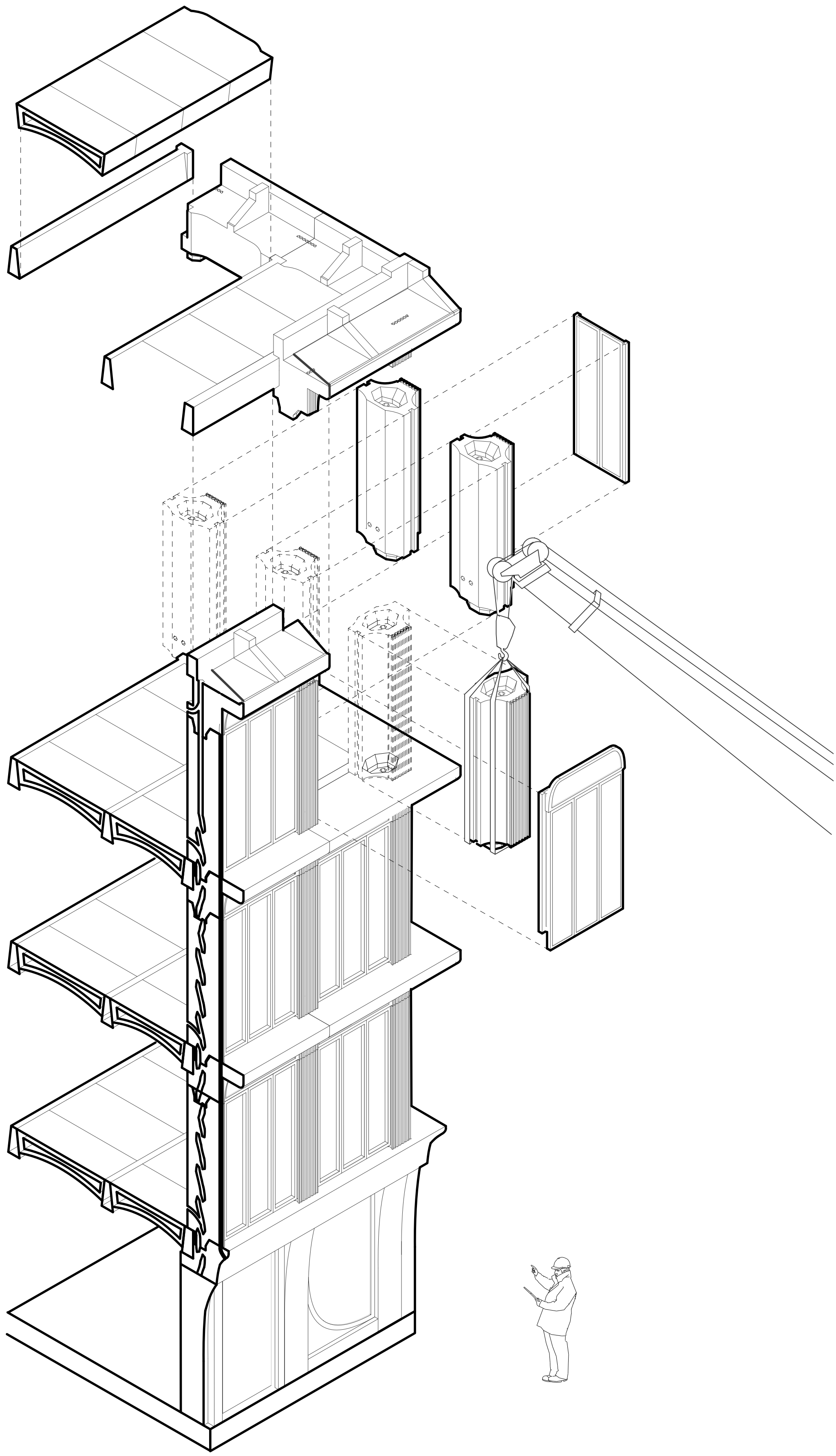
Second Floor 1:250



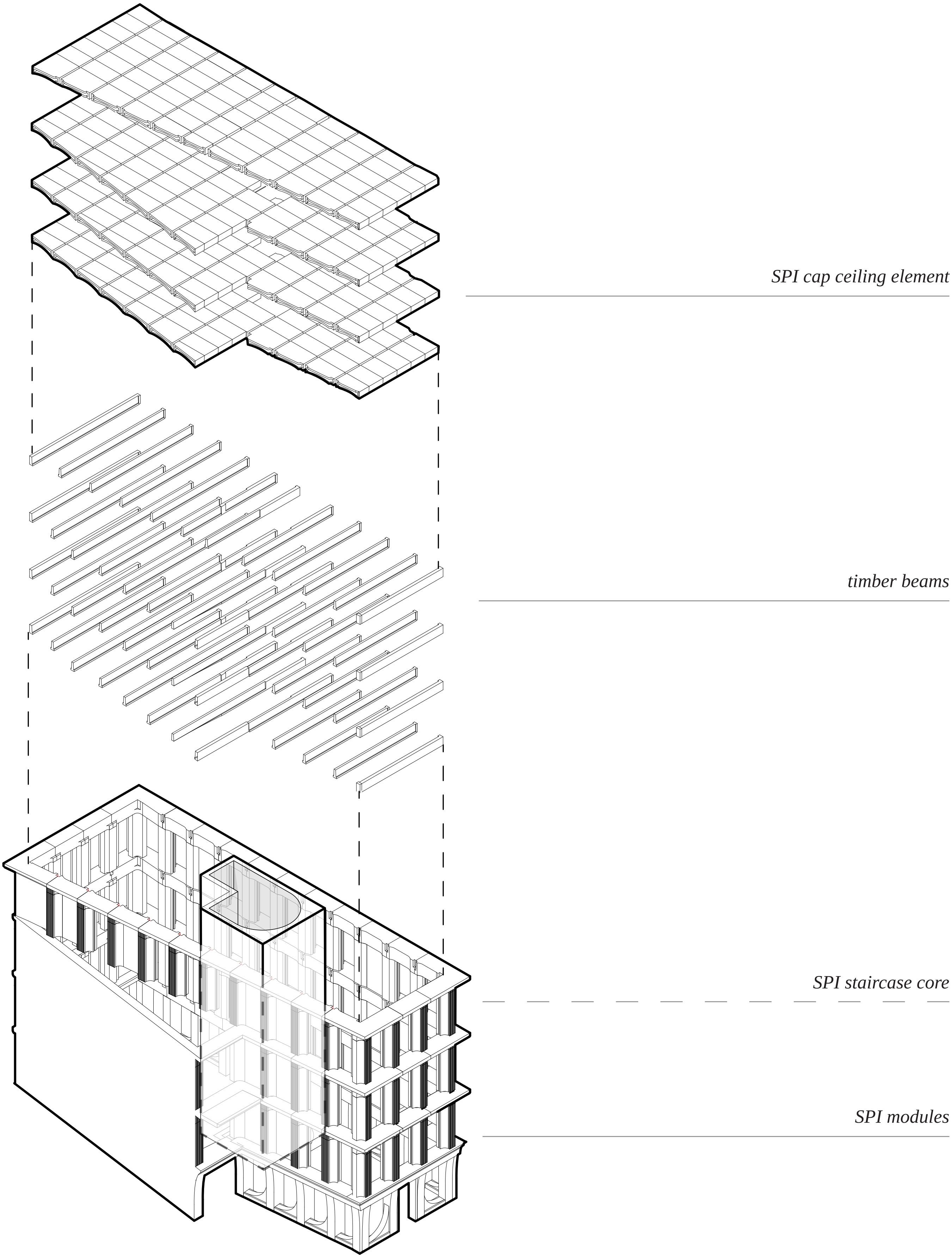
Section looking West 1:250

Fabrication Concept



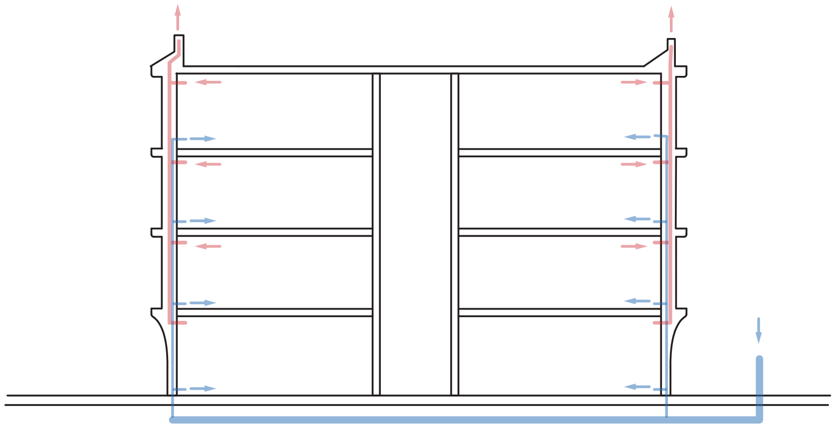


Construction on Site

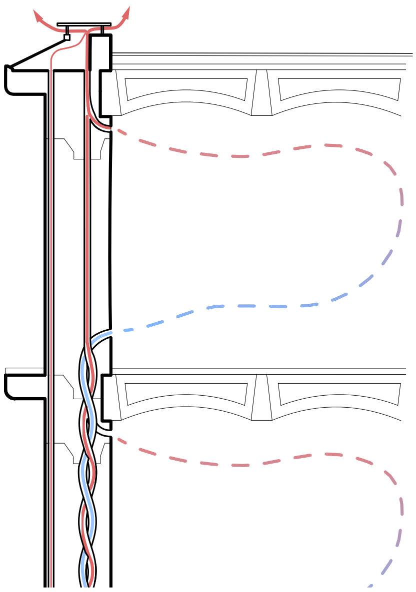


Construction Elements

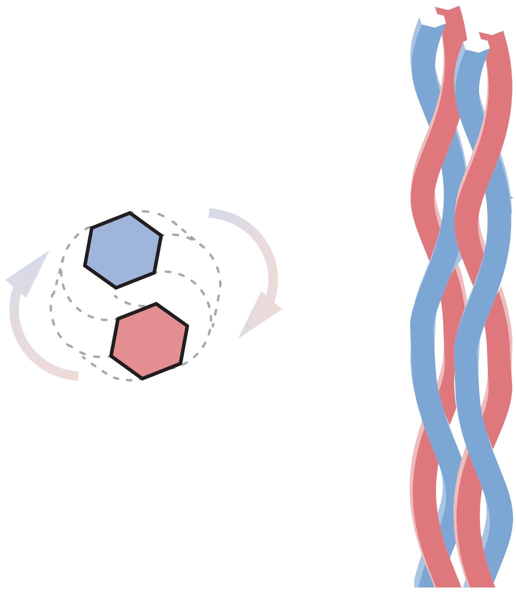
Pipe Your House



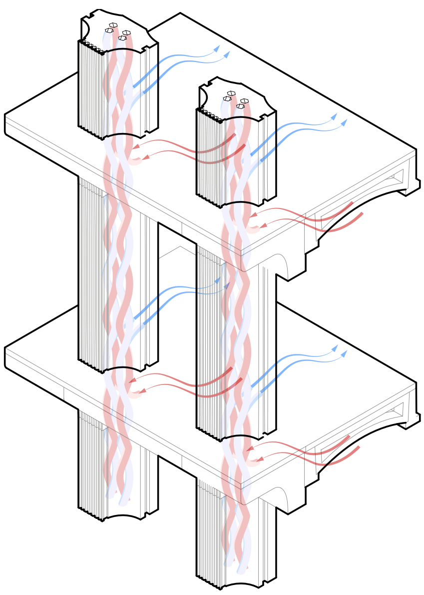
Internal Air channels with Air Supply from the Backyard



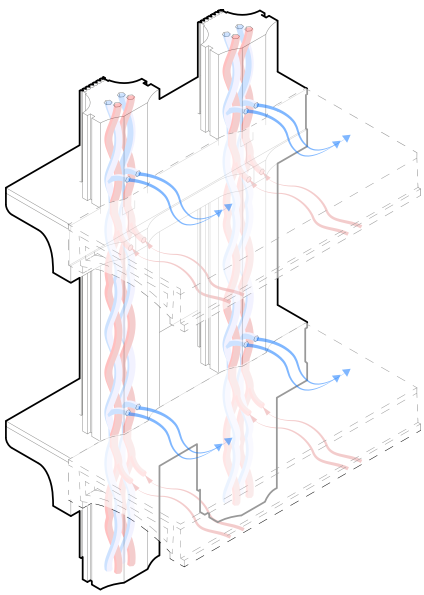
Ventilation



Channel Strucutre



Ventilation Isometry



Ventilation Isometry

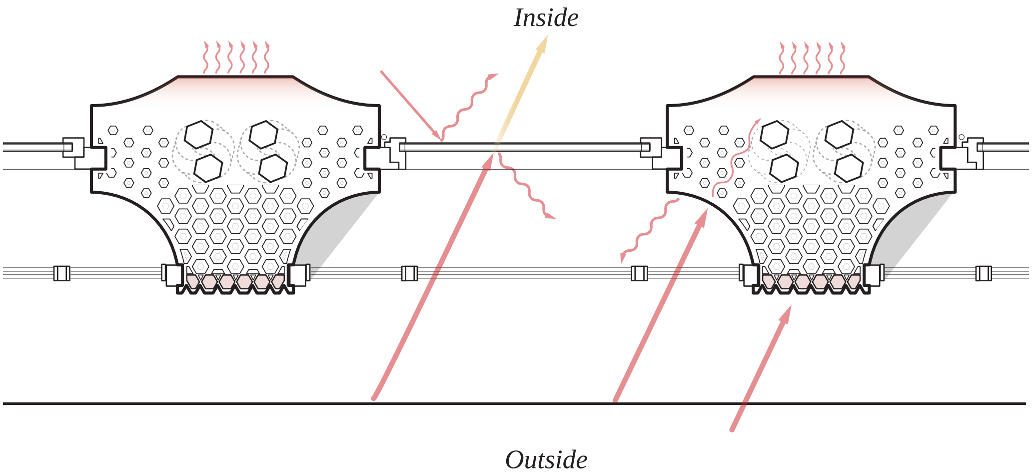
Climate Concept

Energy Concept: Winter

the outer glass has high g-value and allows most solar energy to pass. the inner window reflects the heat.

radiant heat reach the winged surface and heats up the thermal mass.

Radiation

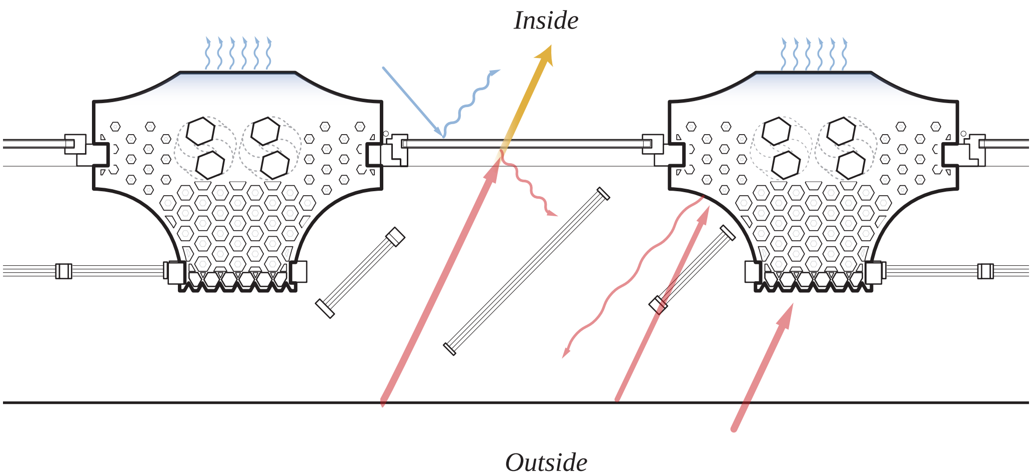


Energy Concept: Summer

most summer heat is refleced outside from the inner low-e glass.

less radiation reach the winged surface because of the higher sun-angle.

Radiation



Pipe Your House

Model

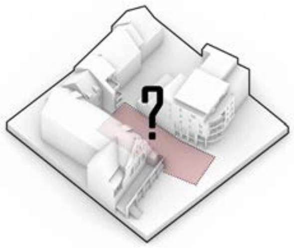
Vault House

Yiran Li, Erin Wai In Wong, Sebastián Canovas Quintana

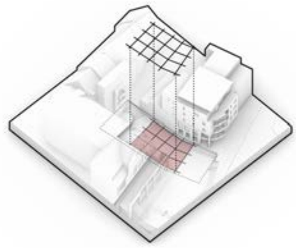
We would like to envision a modern library space due to the large number of students in Heidelberg, which embodies a fusion of learning, relaxation, and community. Apart from the design strategy, we have also focused on climatic sustainability. Our design features the a structurally optimized slab system, which reduces material and at the same time increases its surface area and its view factor to improve its performance as a thermal radiator and convector. The transparent facade of the building emphasizes the lightness of the system and allows the slabs to be seen from the square reminding of the coffered vaults of the historic Altes Hallenbad while showing exciting possibilities for the future of digital fabrication in the construction industry.

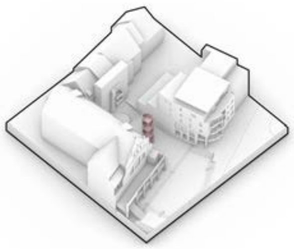
Night Scene from the Main Square

Design Concept


Site


Access

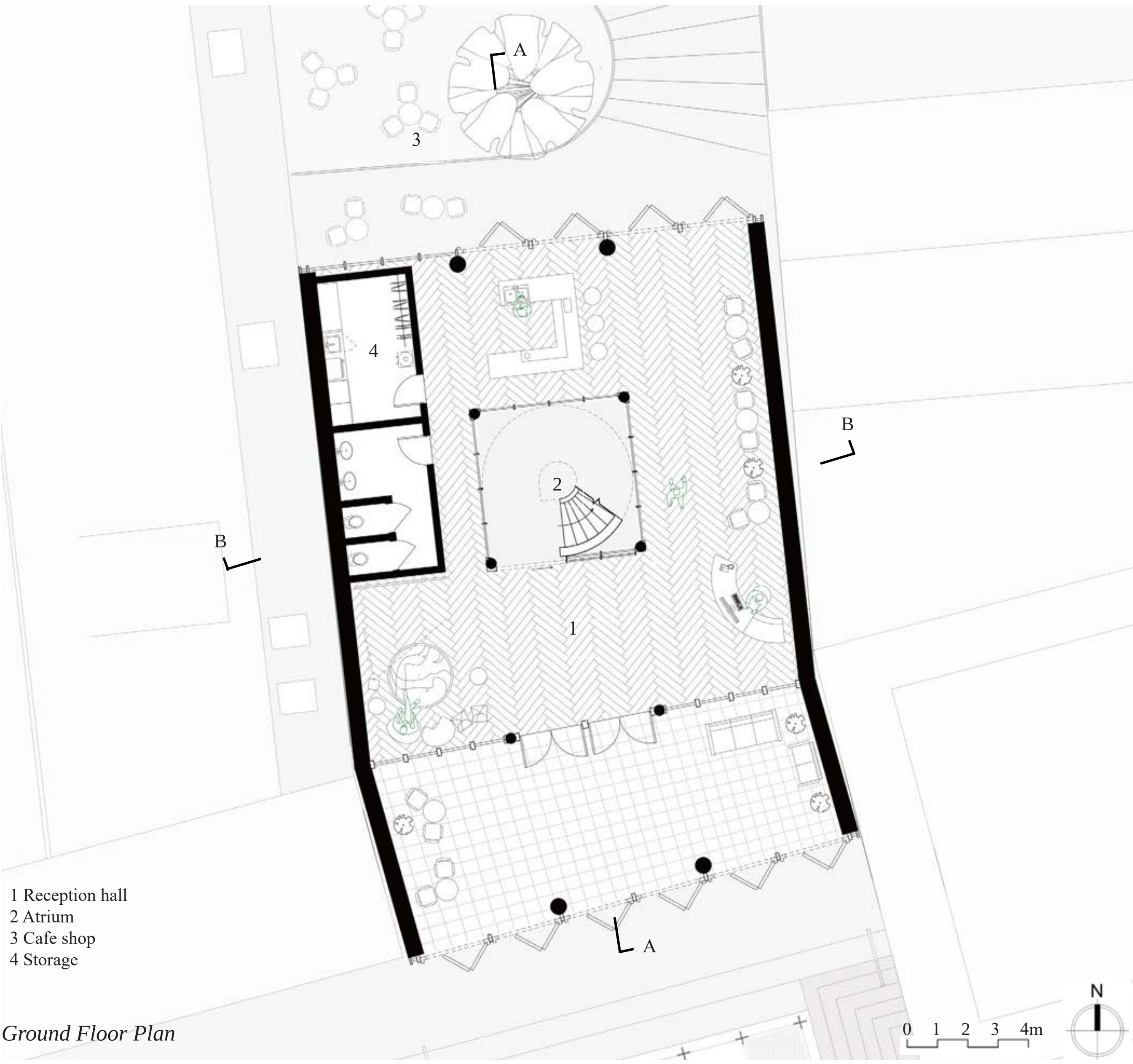

Grid


Atrium


Structure


Envelope

Urban concept

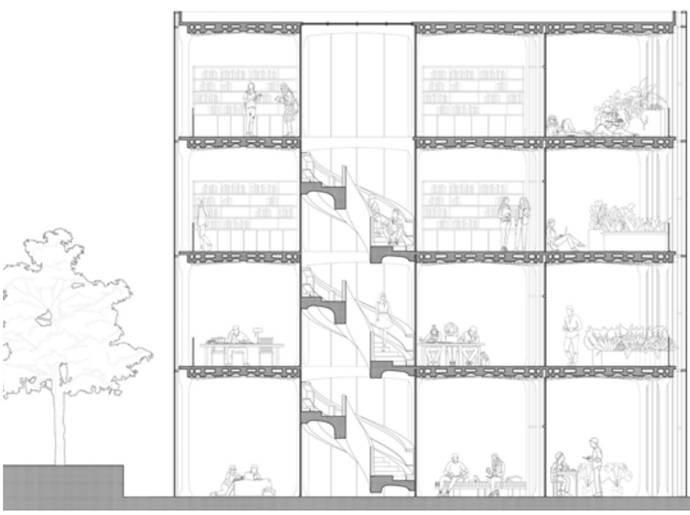


Ground Floor Plan

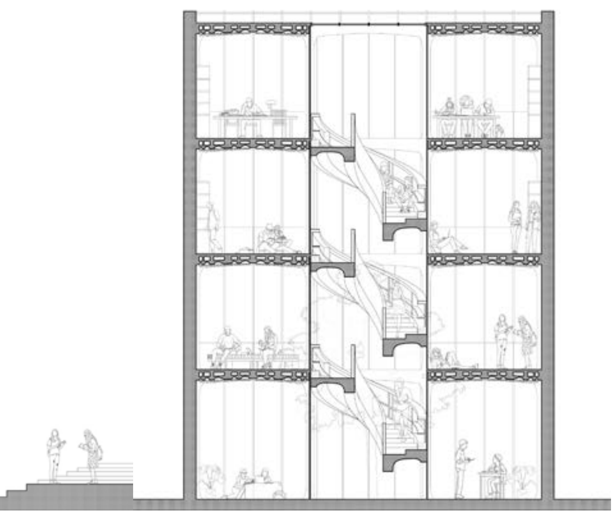
Vault House

Design Concept

Elevation

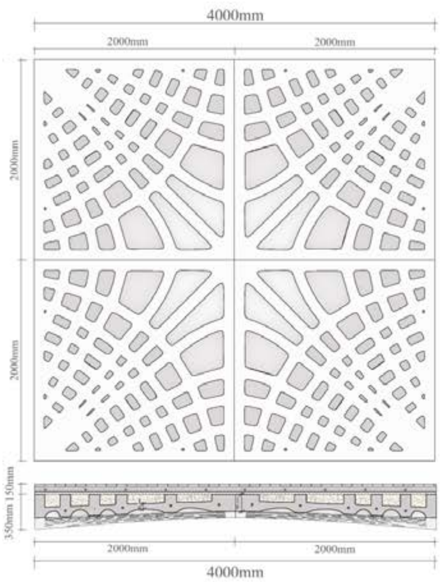


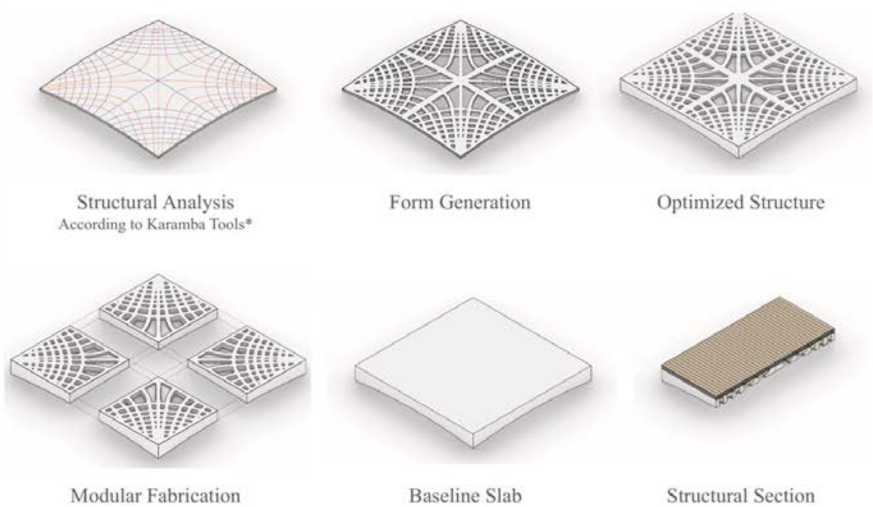
Section A-A



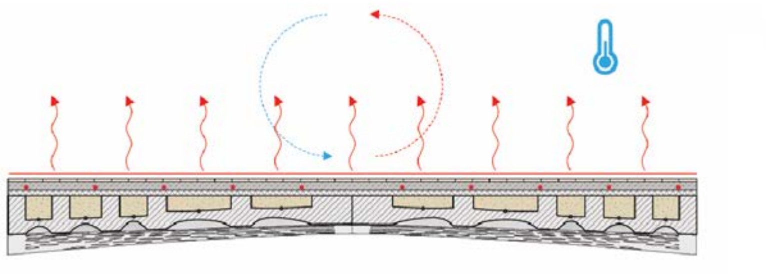
Section B-B

Model

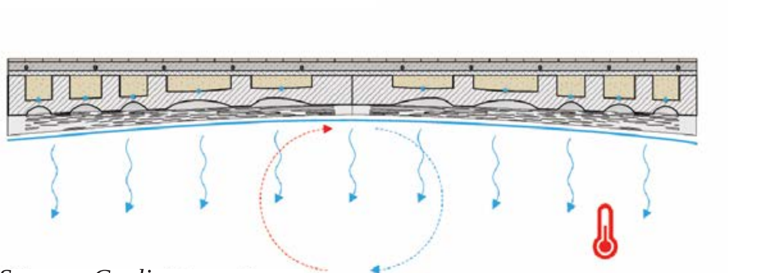




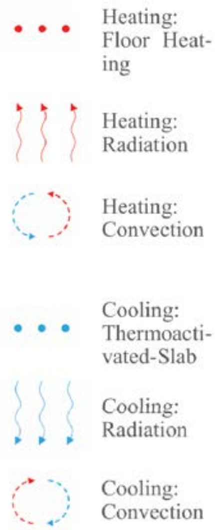
Slab Details

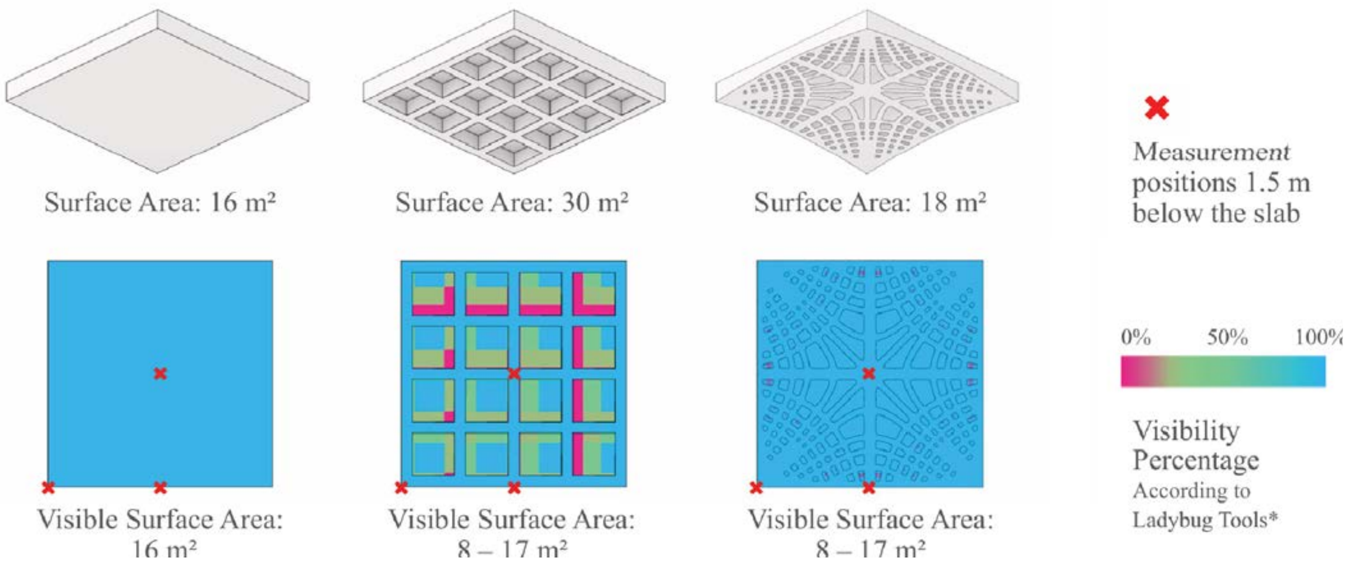


Winter Heating

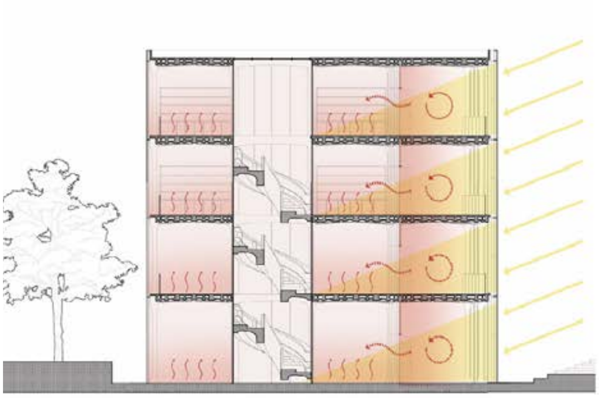


Summer Cooling

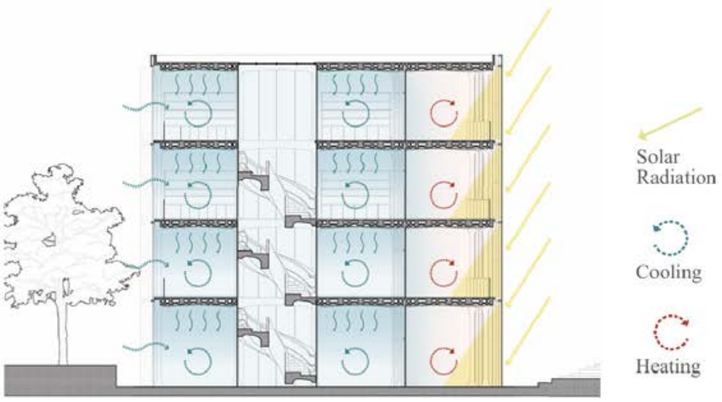




Visibility Percentage Comparison



Winter: 17° (Min. Incidence angle)

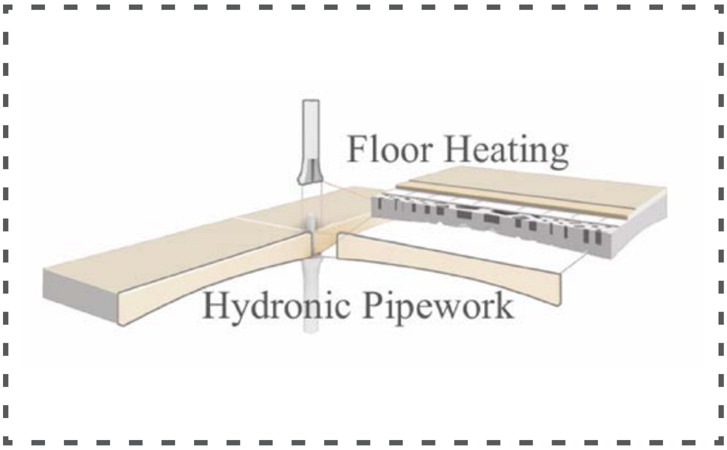


Summer: 64° (Max. Incidence angle)

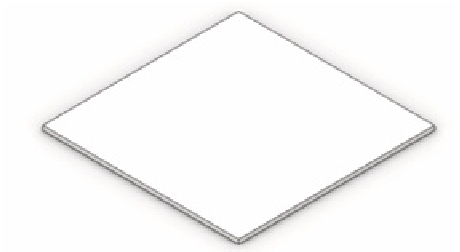
Visualization Interior

Day Scene from the Main Square

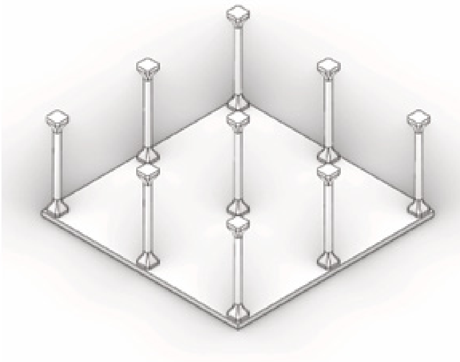
Fabrication Concept



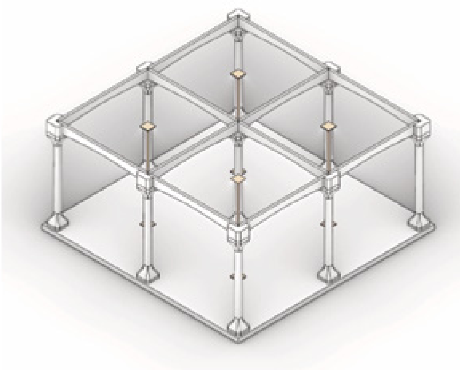
Isometry



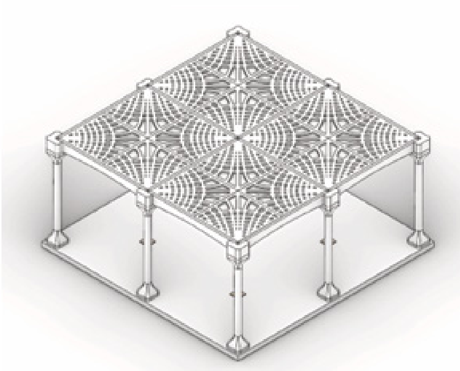
Basement



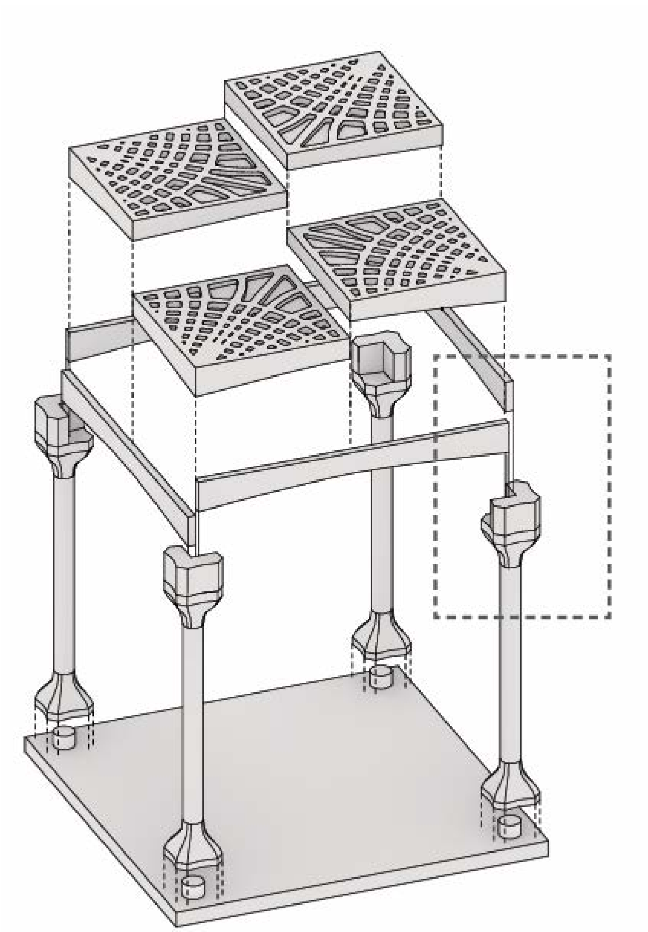
Columns



Arched Frames + Central Support



Add Vaults



Construction

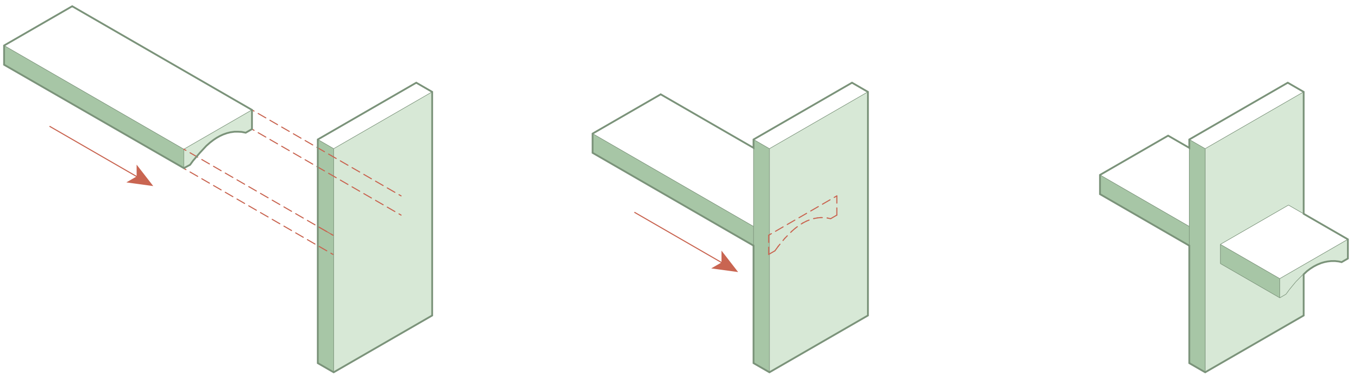
Capped by SPI

Quanhua Yang, Dawid Mazanek, Lennart Kremerskothen

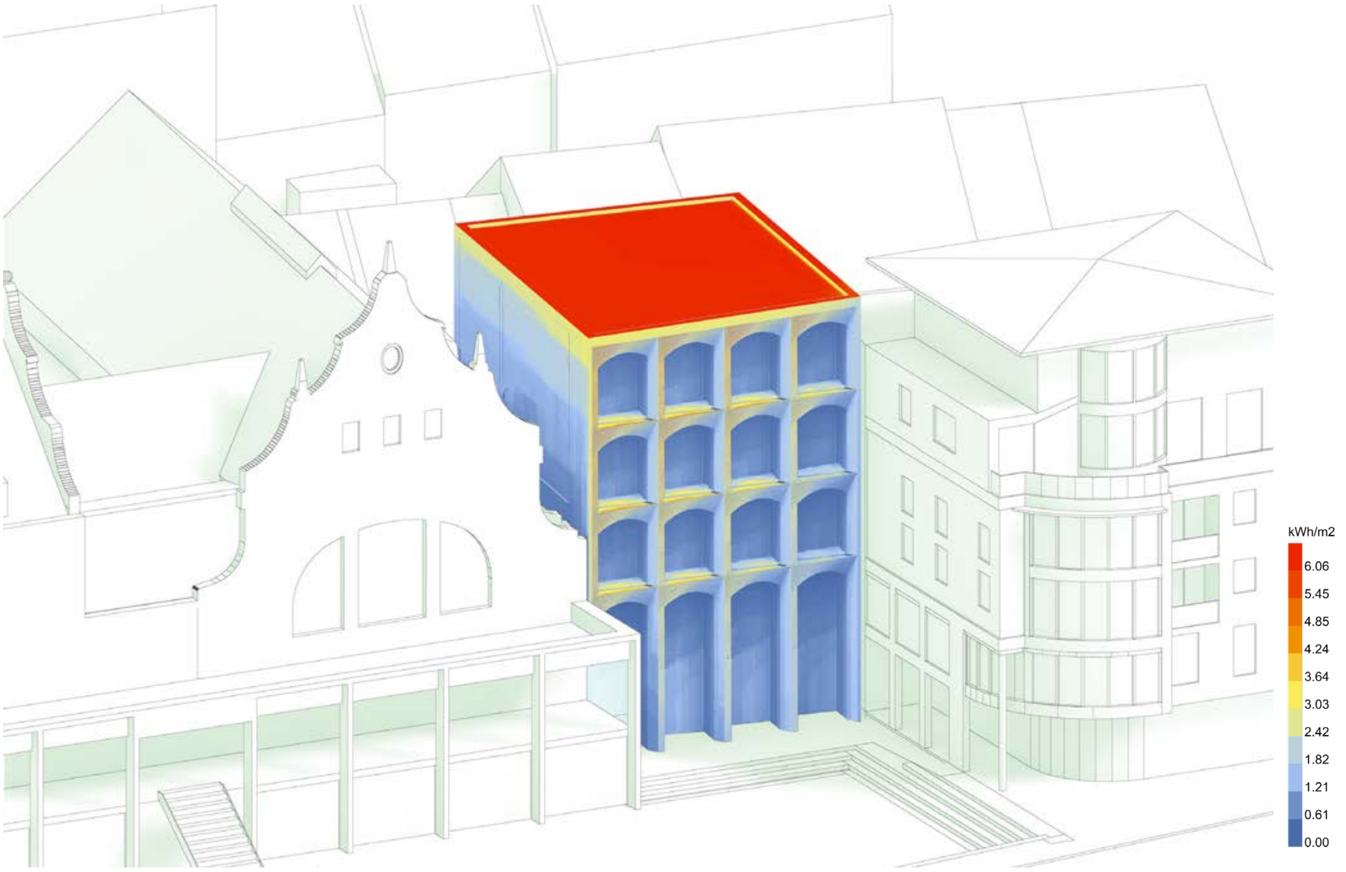
The ‘Capped by SPI’ project explores the innovative application of the Selective Paste Intrusion (SPI) 3D printing process in architecture. The design concept was inspired by using an effective arched supporting structure in capped ceilings, which can better absorb the building’s loads and reduce the need for reinforcement. These capped ceilings are intended to merge seamlessly with the façade structure, creating a unique architectural design language. The element is deliberately extended outward, serving as a design feature and providing shade for the floors below, contributing to a passive solar design. This concept combines the efficiency and precision of modern 3D printing technology, such as micro-shading, with sustainable construction methods. The segmented capped ceilings are supported by timber beams, resulting in a hybrid and material-efficient load-bearing structure. ‘Capped by SPI’ demonstrates how additive manufacturing can offer innovative solutions for functional, aesthetic, and sustainable architecture.

Outside view in urban context

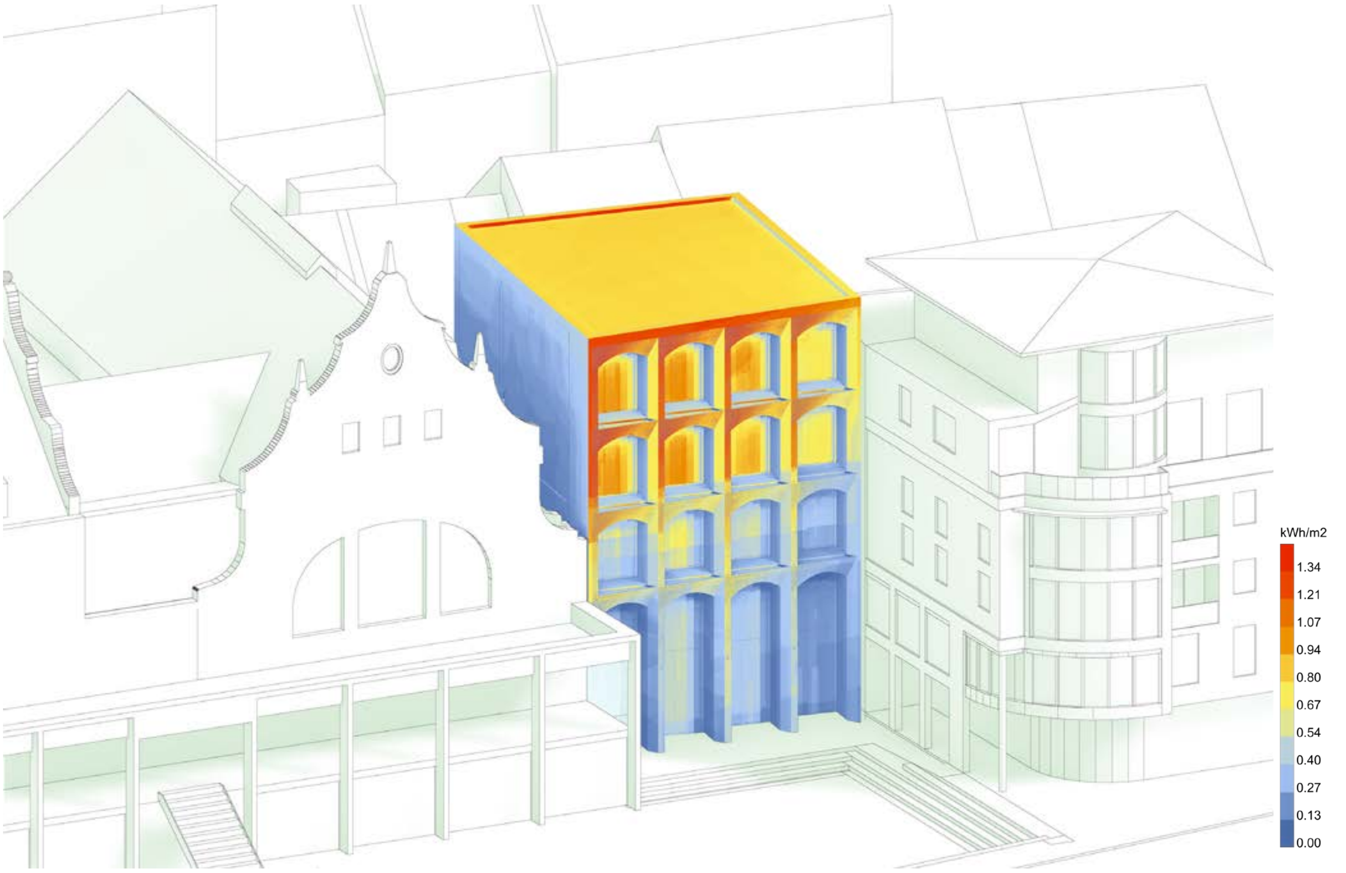
Urban context



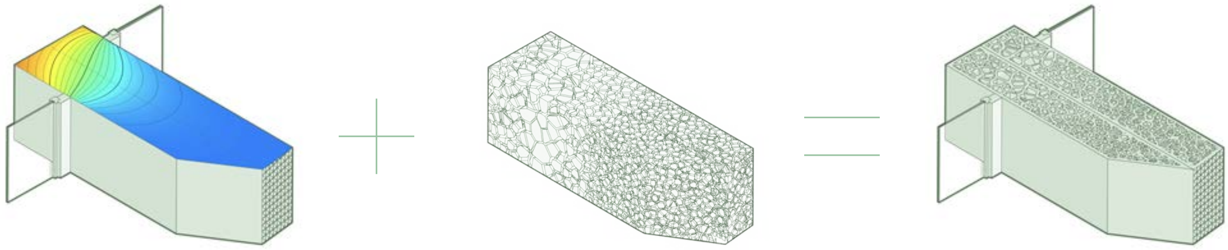
Design concept



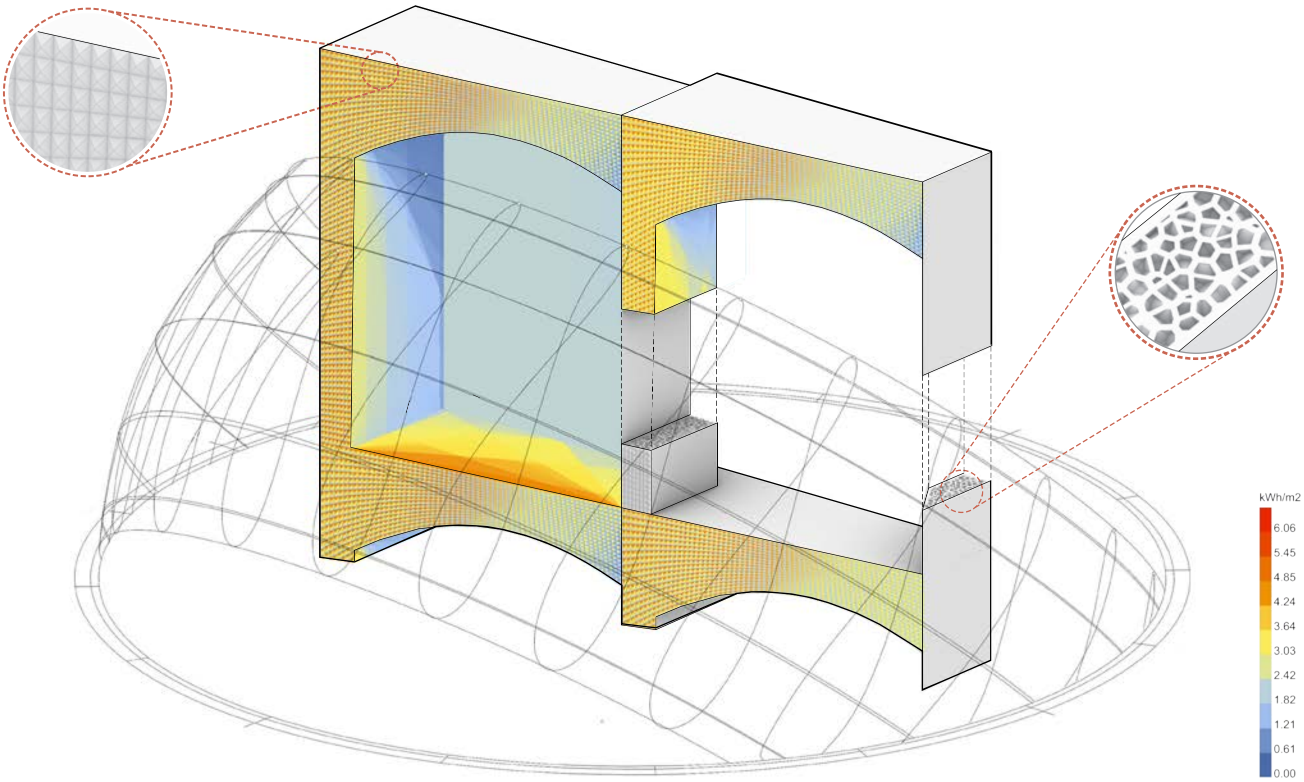
Solar radiation on façade during summer



Solar radiation on façade during winter

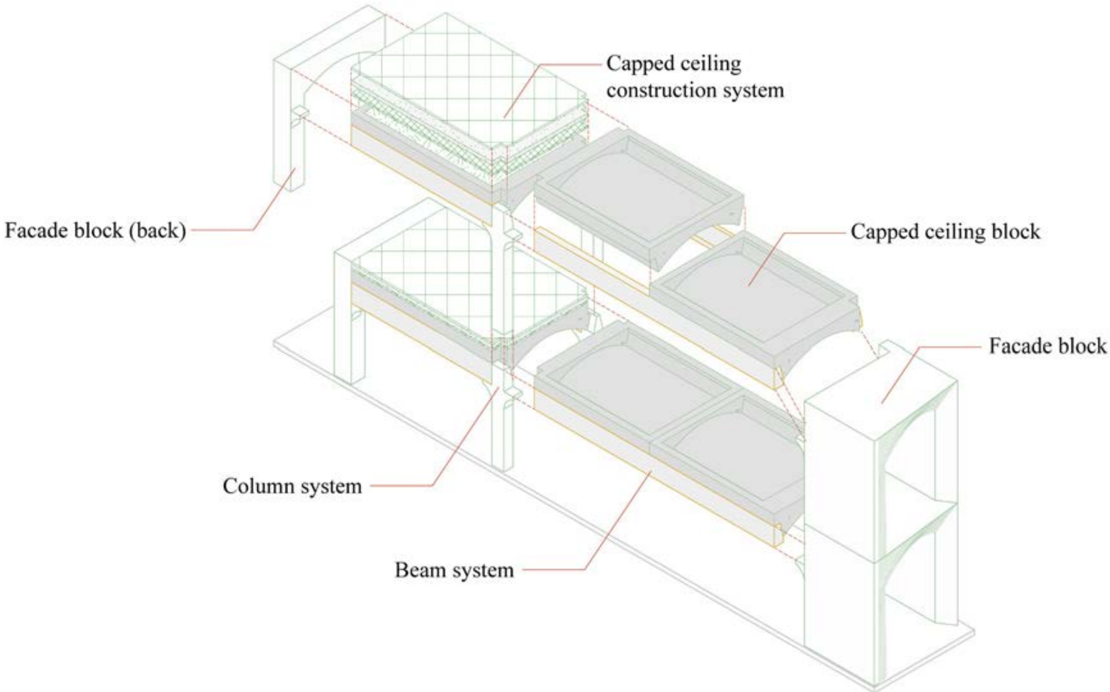


Inside Voronoi structure adapts to cold bridge analysis

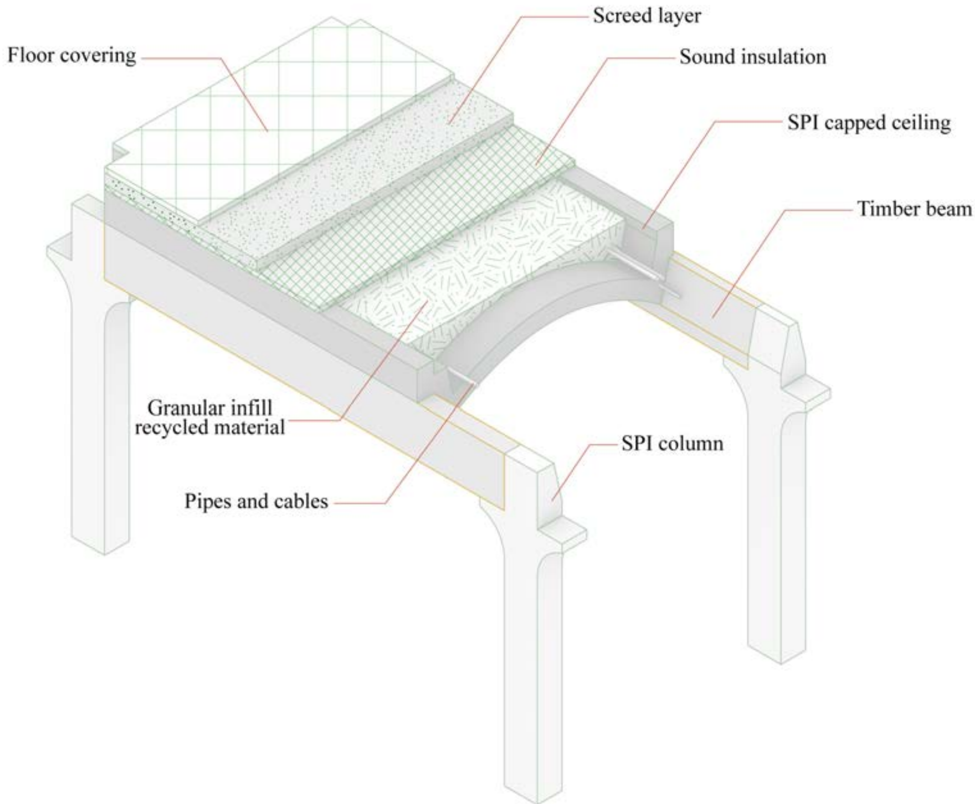


Solar simulation of building block

Capped by SPI



Fabrication system

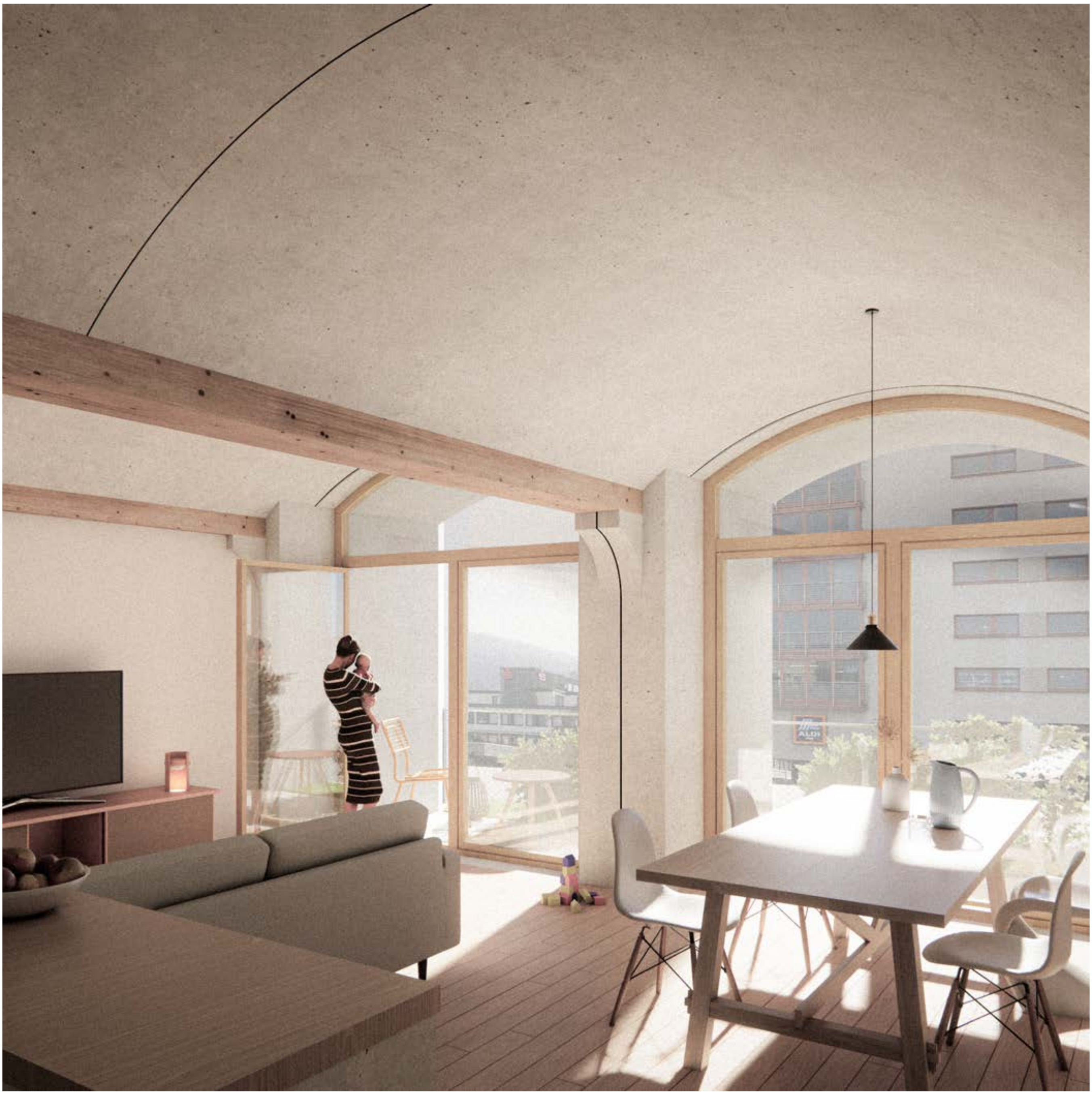


Detailed structure of capped ceiling and support structure

Section A-A

Ground floor

Apartment floor



Apartment view

Capped by SPI

Construction of the model

Model elements

Full model of the construction system

Framing The Square

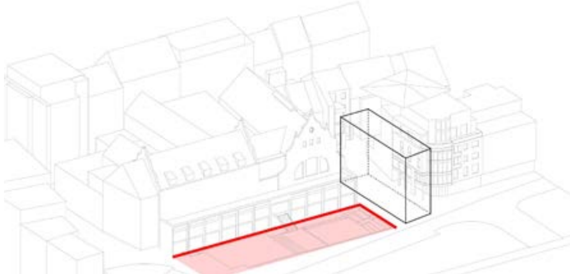
Hyeonji Kim, Peter Hartenstein, Dimitri Aleksandrov

The project explores the potential of Selected Paste Intrusion, using concrete and recycled glass granulate. Set within the extension of the Altes Hallenbad, a public building in Heidelberg, the new structure acts as a quiet architectural backdrop to the Jugendstil building. By framing the square in front of it, it subtly enhances the historic setting—hence the name "Framing the Square." At the heart of the design is a multifunctional SPI-printed concrete block, seamlessly integrating thermal, structural, shading, and assembly functions. Its hexagonal infill structure balances strength and insulation, with bound material forming a skeleton and unbound material providing thermal insulation. Simulations tested its thermal efficiency in both horizontal and vertical directions. Beyond insulation, the infill structure actively responds to stress, aligning its walls perpendicularly to loads, thickening where needed, and minimizing material where possible. Shading elements, directly integrated into the blocks, are fixed and tailored to each façade for optimal sun control. To simplify construction, an interlocking system aids with quick alignment and assembly on the construction site and prevents shifting from loading. Through strategic spatial planning and material innovation, the project establishes a dialogue between past and future. It demonstrates how SPI technology can be applied not only in modern construction methods but also in historical contexts, respecting cultural heritage while contributing to responsible, forward-thinking urban design.

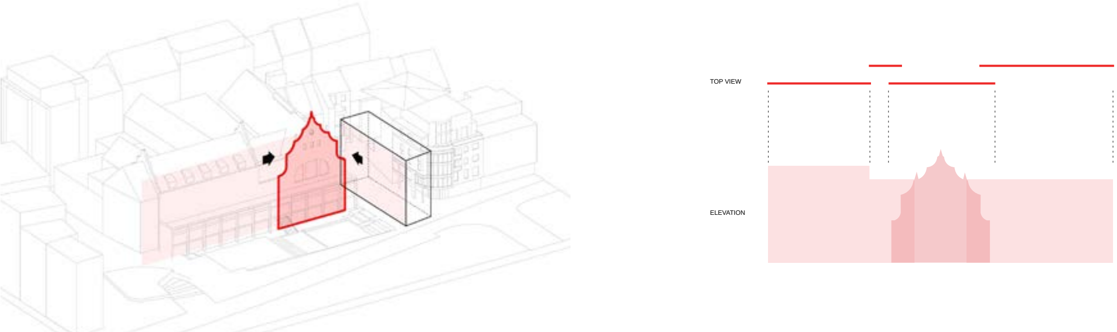
View from Poststraße

Design Concept

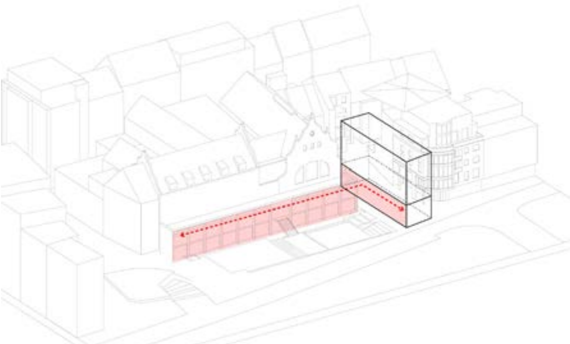
1. Surrounding context



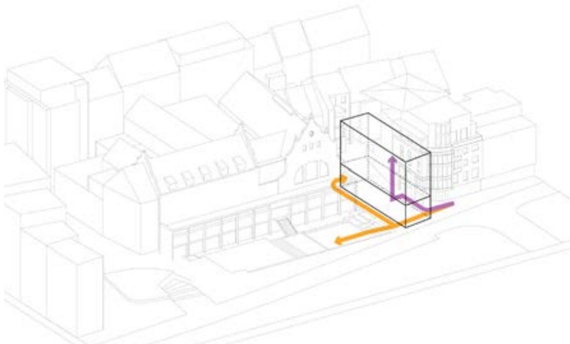
2. Redefine the square by creating a boundary.



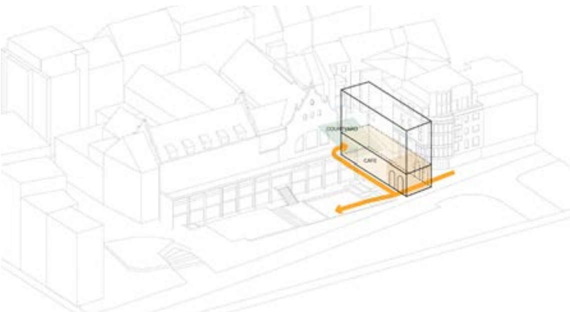
3. Facade of Altes Hallenbad becomes the centrepiece, as volumes of either side goes back.



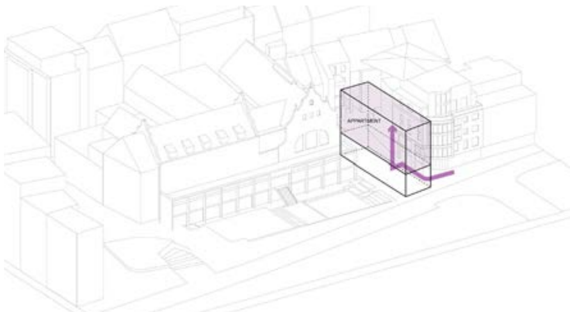
4. Separate the ground floor of the building into two volumes, extending the colonnade.



5. Separate the access for public and residents.

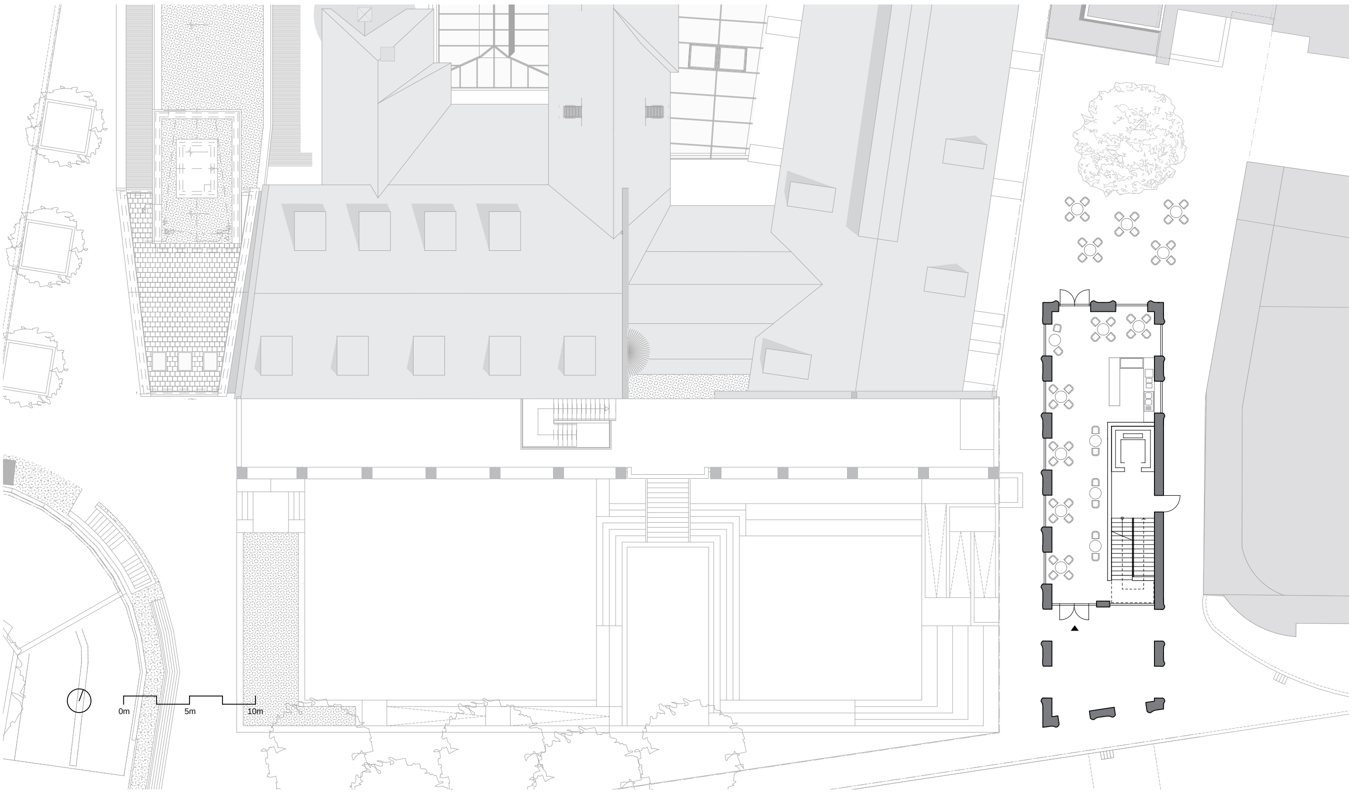


6. Ground floor program: passageway, cafe and courtyard

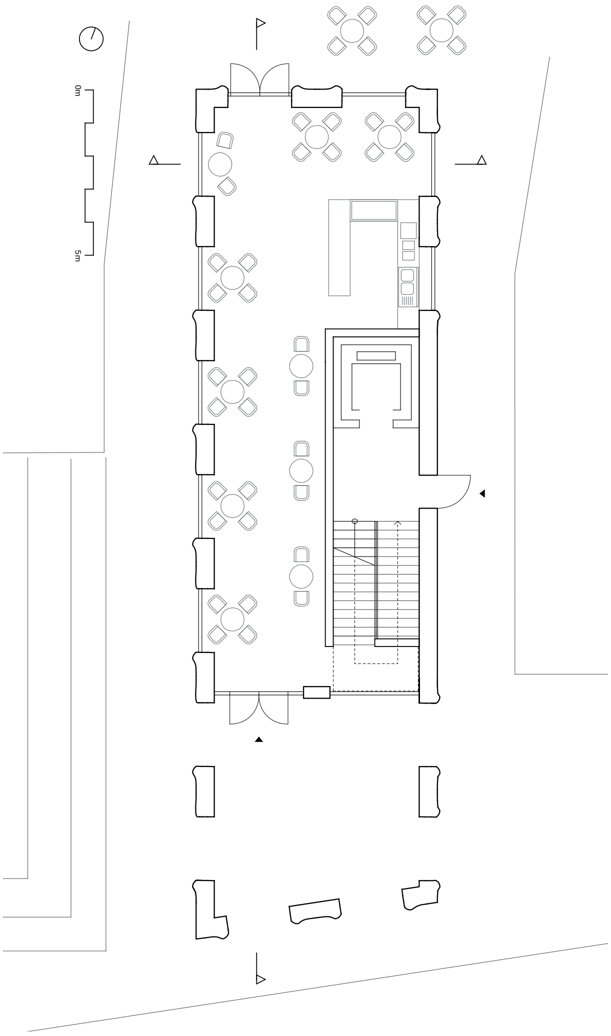


7. Upper floors program: Apartment

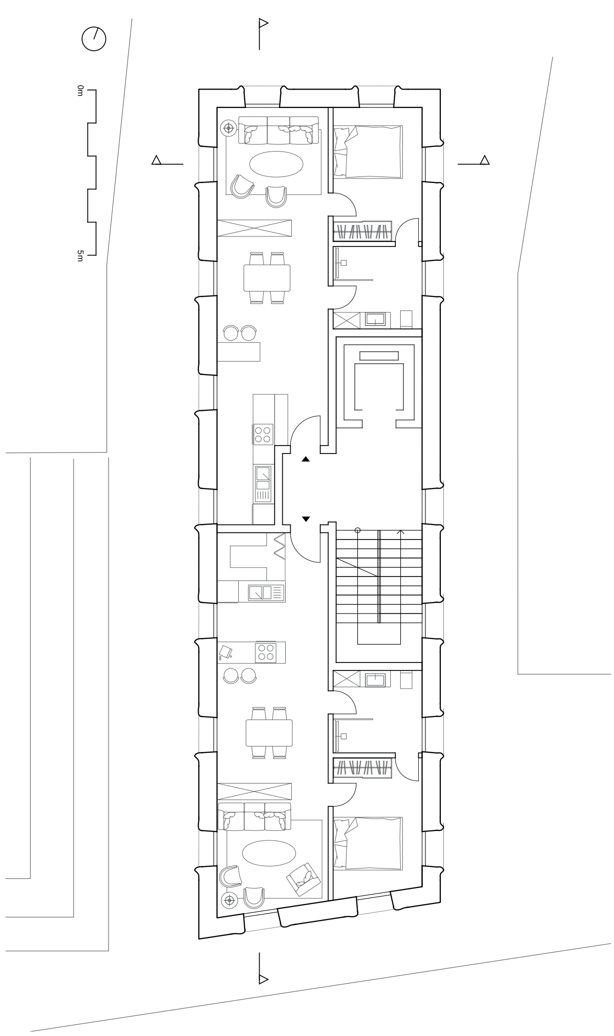
Framing The Square



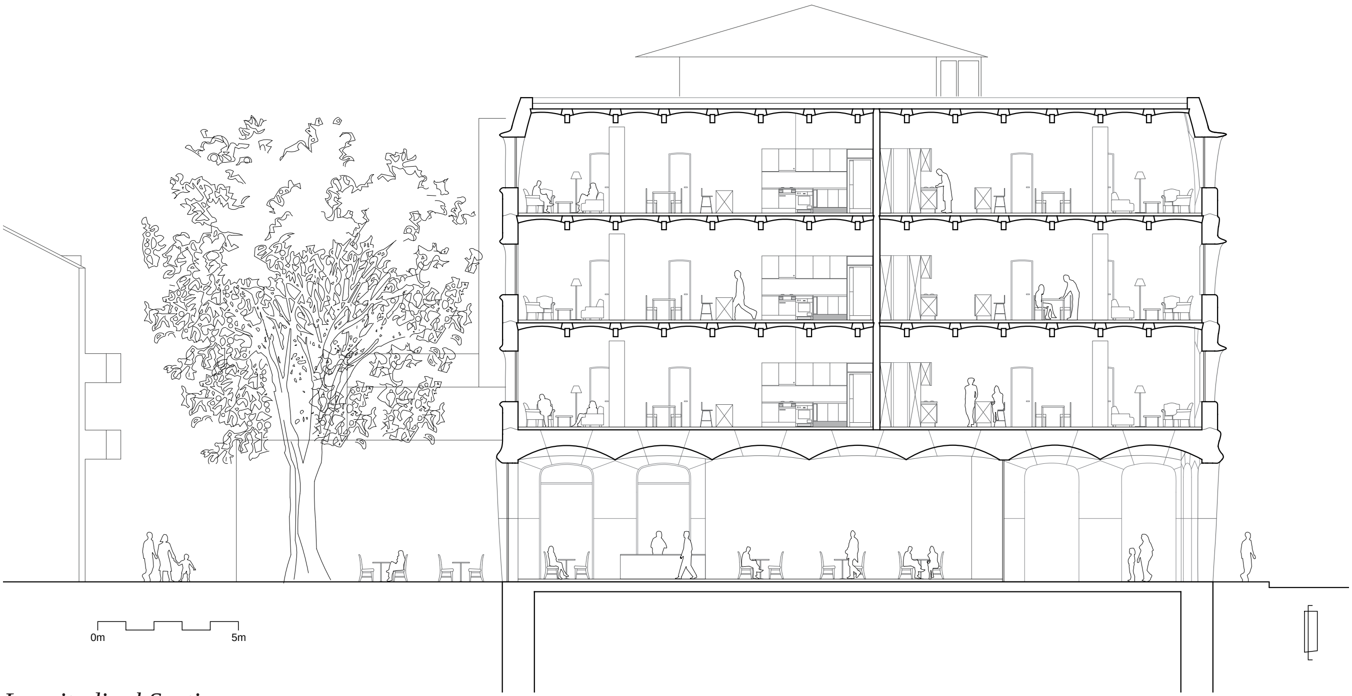
Site



Ground Floor - Café



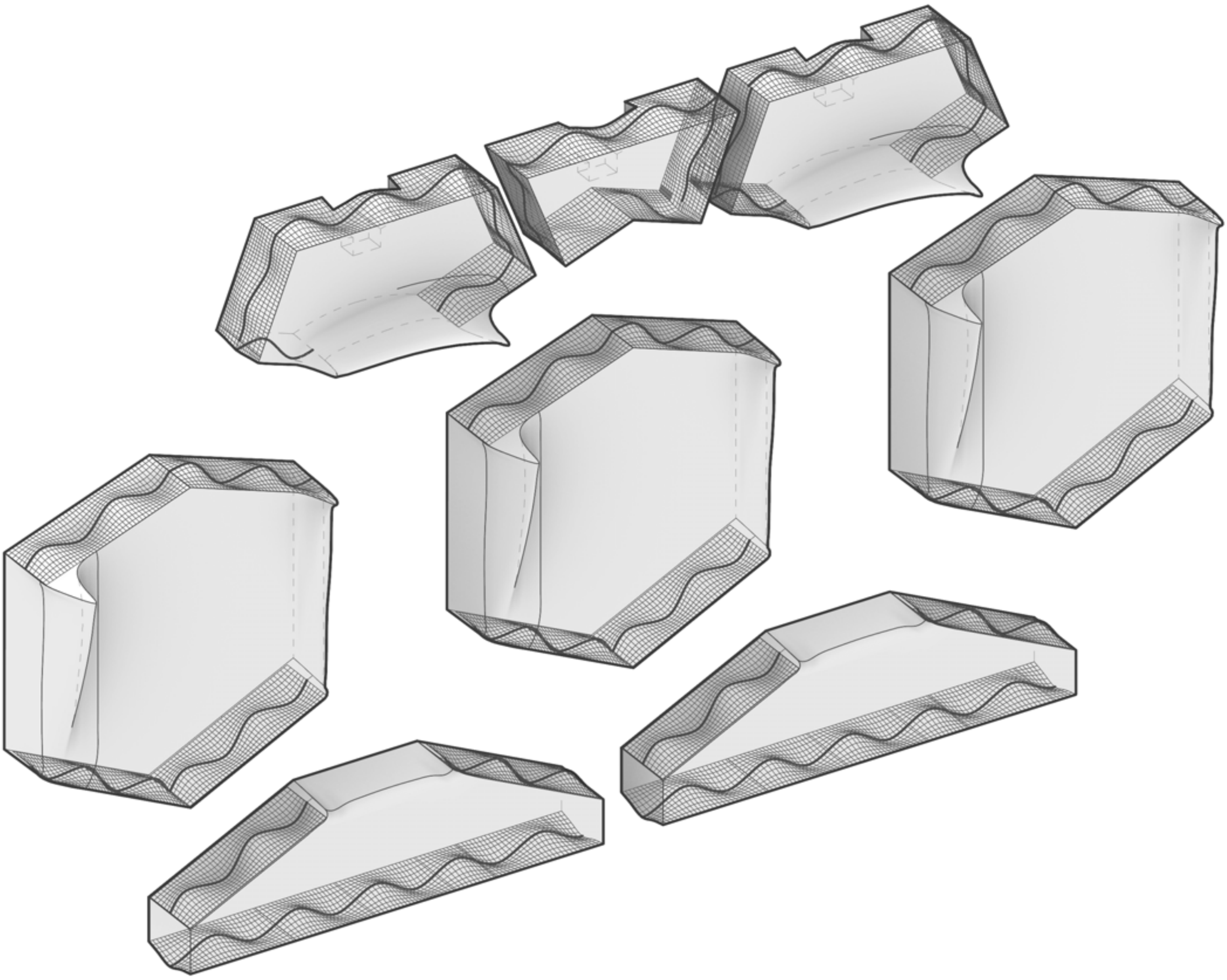
Upper Floors - Apartments



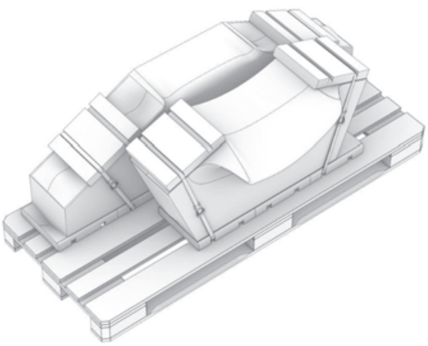
Longitudinal Section

Cross Section

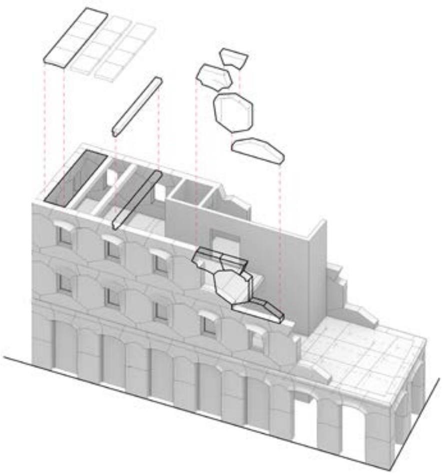
Framing The Square



Segmentation



Transportation

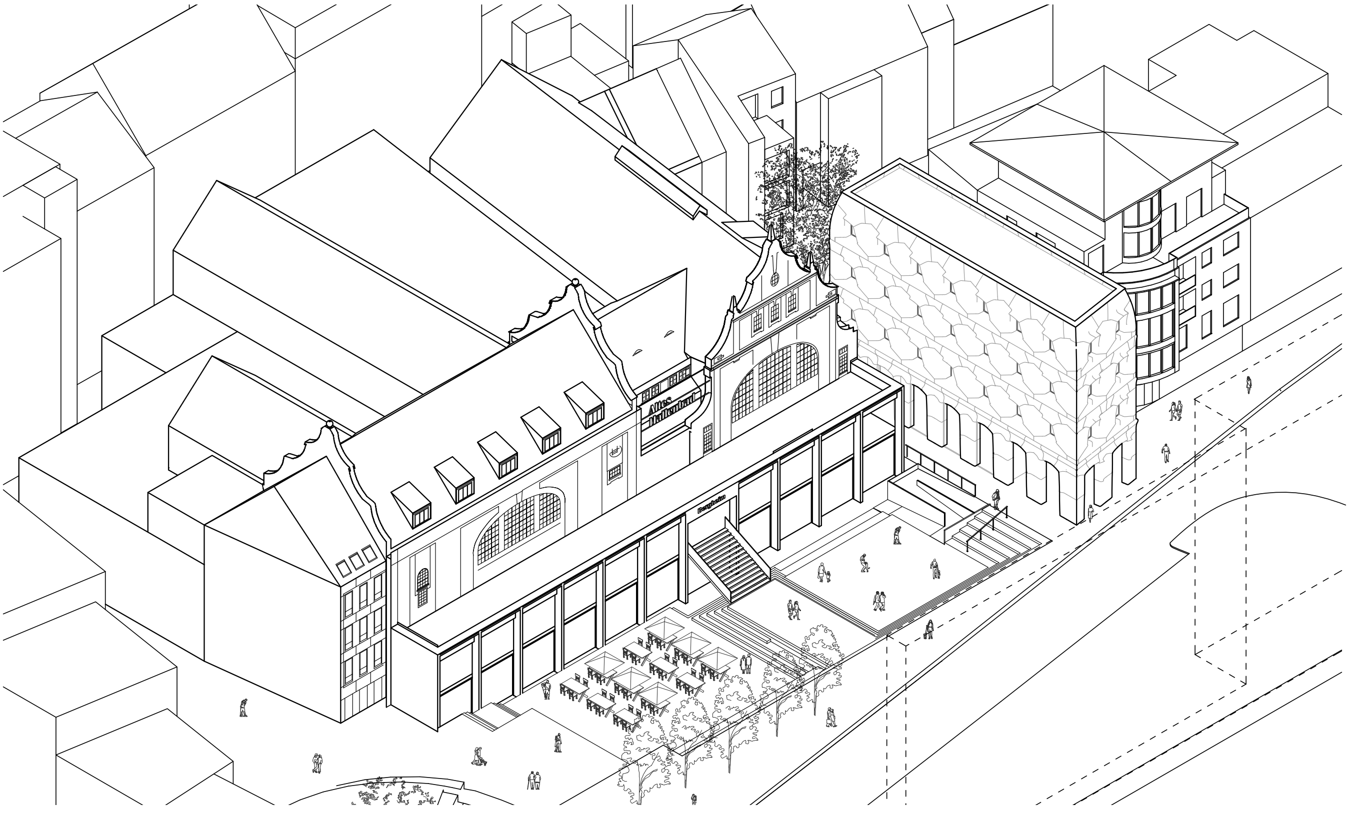


Assembly

Interlocking blocks

Ground floor - Café

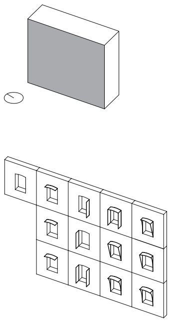
Upper floors - Apartments

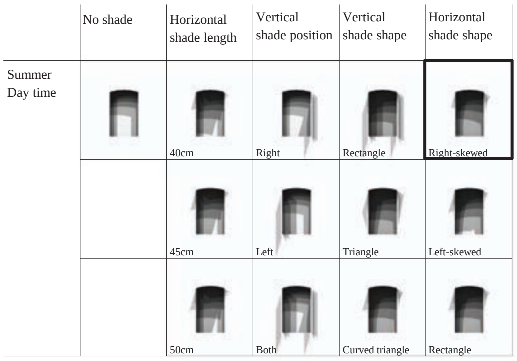


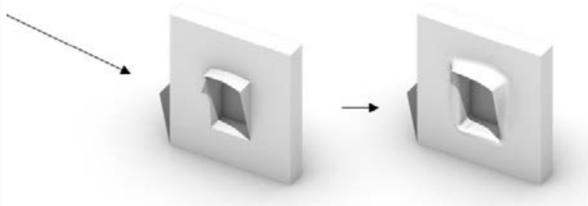
New Situation of the public square

Framing The Square

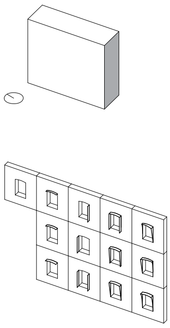
Climate Concept

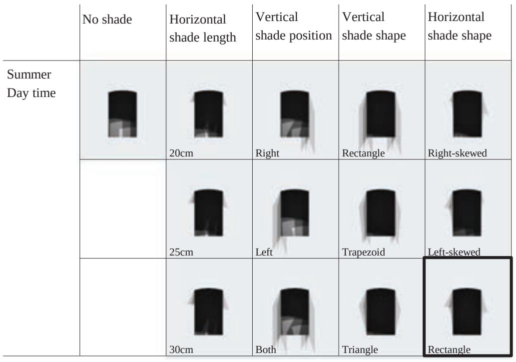


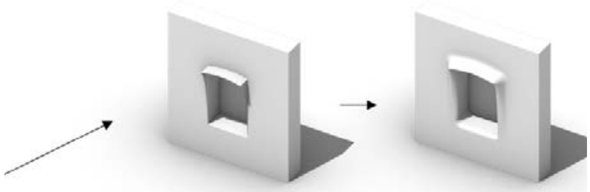




Western facade shading



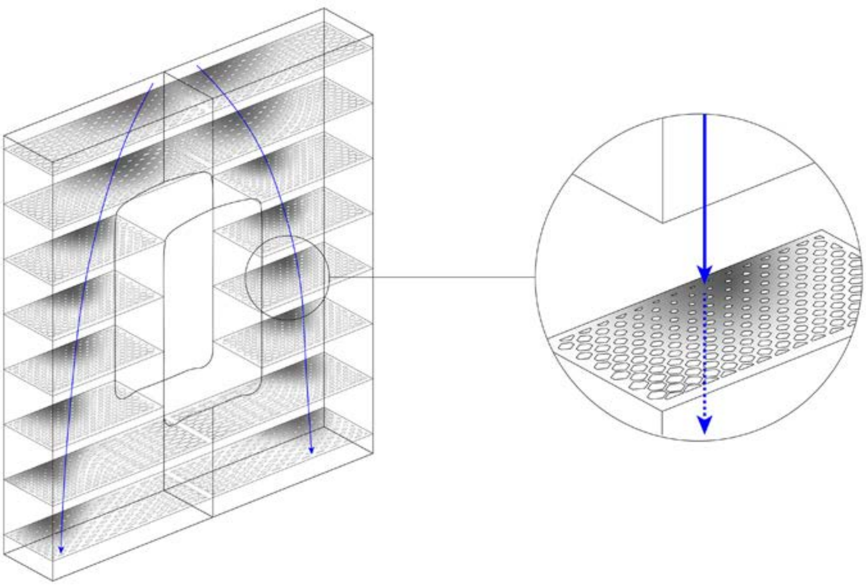


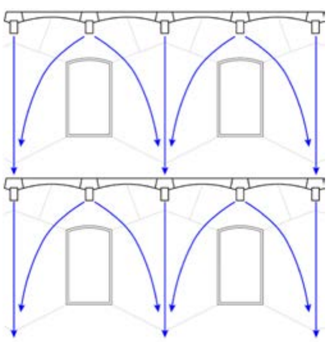


Southern facade shading

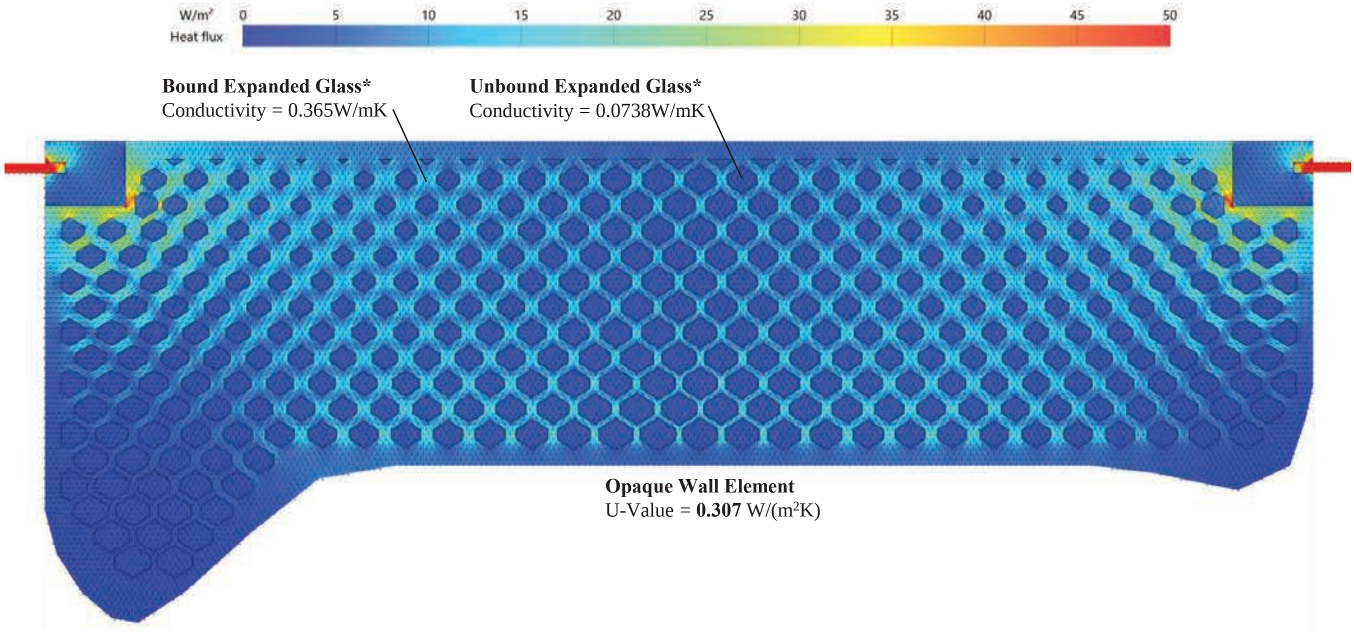
Sun shading simulation for optimizing facade elements

Structural Concept

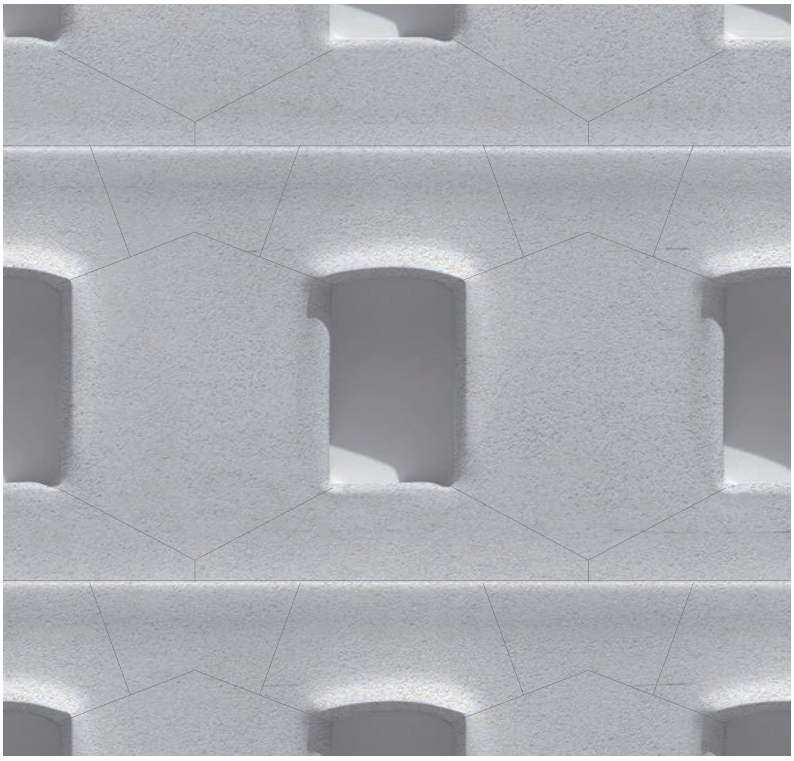


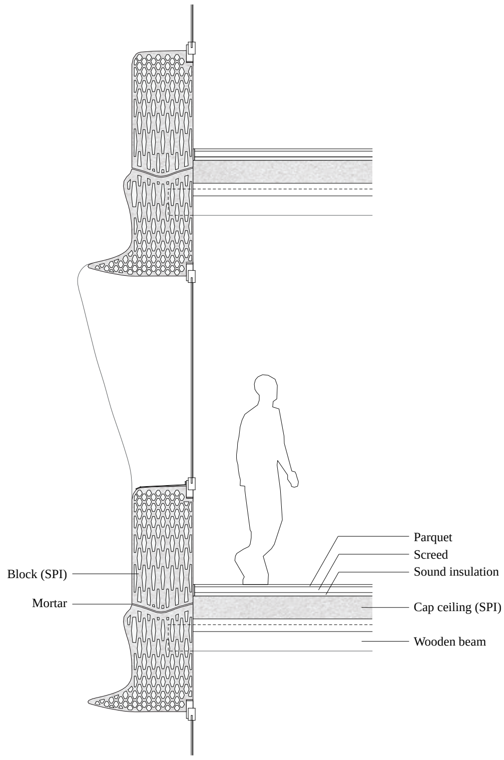


Distribution of bound material, according to structural demands



Heat flux simulation of building block





Facade elevation, section

Segmentation (1:10)

Infill (1:2,5)

Domus Solaris

Selina Fischer, Julia Voitl, Martin Zott

Our design for the extension of the *Altes Hallenbad* in Heidelberg combines the principles of build simple with the potential of SPI printing technology to develop an energy-efficient, durable, and comfortable building that addresses complex climate-related challenges - both now and in the future. For us, the 4 main factors in achieving this goal are **compactness** in the urban situation, **thermal comfort**, **visual comfort** and **material-appropriate construction**.

Domus *f (noun)* *Townhouse in ancient Rome, with rooms arranged around a central atrium. It usually included a peristyle (a columned garden) and an impluvium (a water basin).*

Solaris *(adj.)* *Derived from the Latin term sol (sun), meaning „belonging to the sun“ or „sun - related“. In this context, it refers to the sustainable orientation of the building‘s design, emphasizing energy efficiency and natural daylight, both ensured by the sun.*

Visualisation Balcony 2.Fl

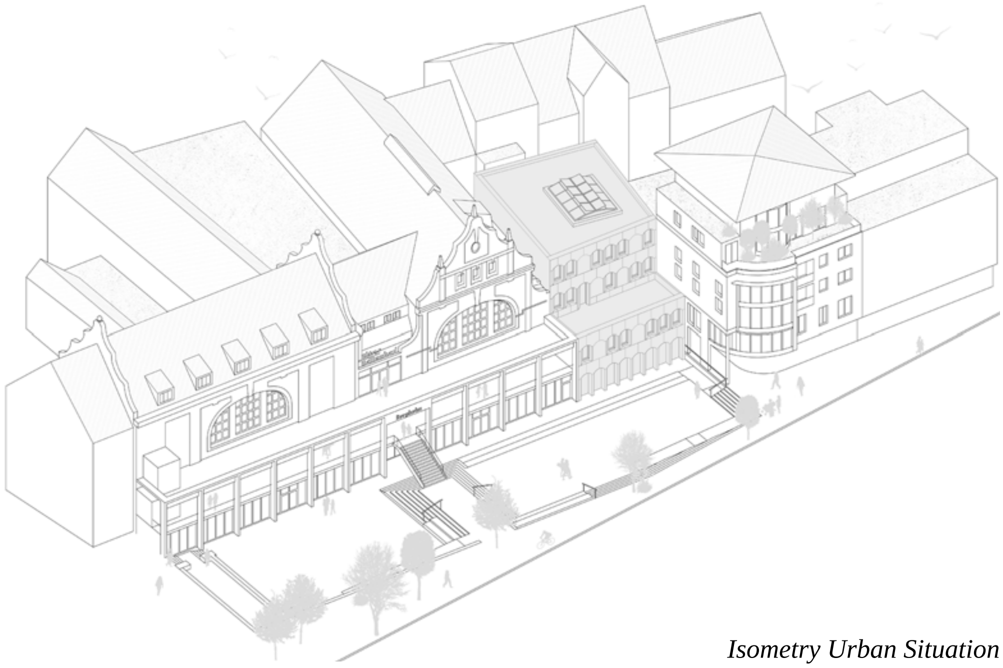
Design Concept

reduction of heat losses

reduction of heating requirements

density

closing the gap



Isometry Urban Situation

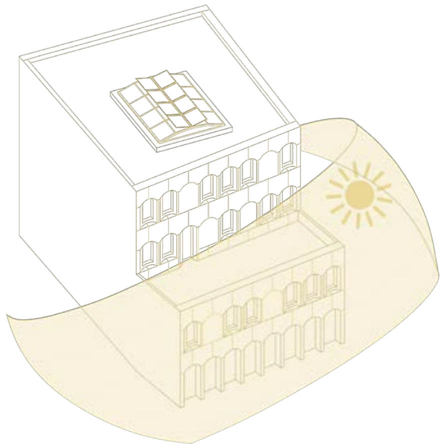
The compact structure adopts the architectural language of the existing building and its forecourt, closes the existing gap in the urban fabric, and extends the urban context - the “pulse of the city” - in the heart of Heidelberg. The building’s density reduces heat transmission losses through the building envelope and addresses the more extreme temperature circumstances caused by climate change.

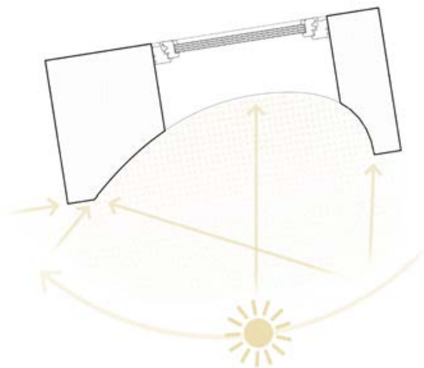
10 20 50

Masterplan 1-500

Domus Solaris

The additively manufactured components, combined with insulating substrates, exhibit significant thermal mass. Their orientation and design enable solar gains in winter and self-shading in summer. The intricate microstructures of the components enhance these effects, ensuring a comfortable indoor climate for occupants throughout the year.





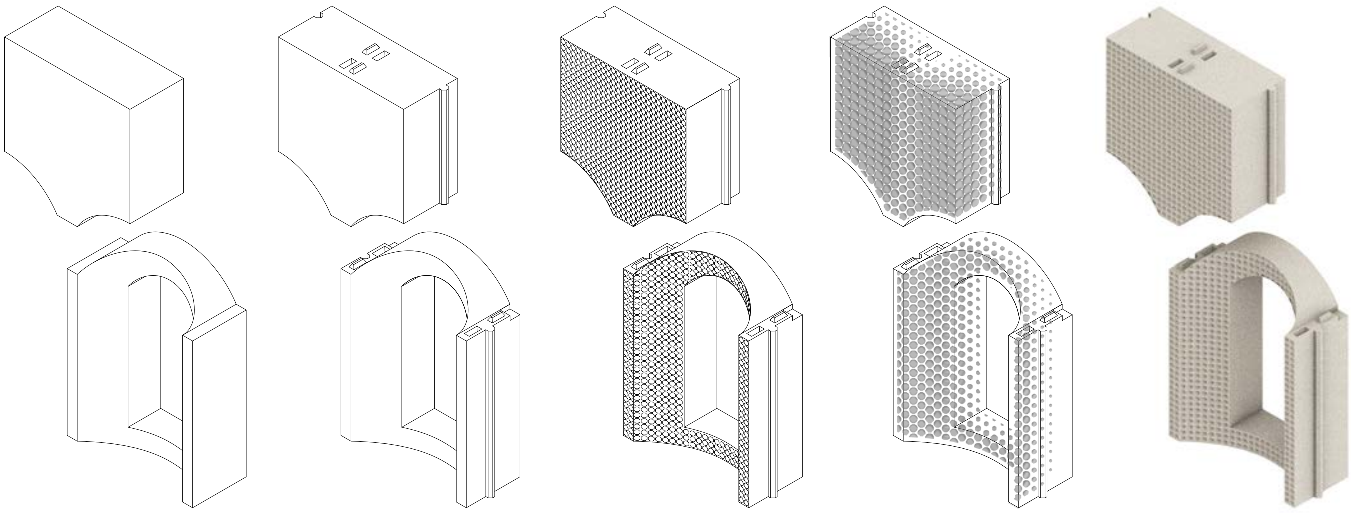
SPI potential

- solar gain optimisation
- microstructure
- inner cell structure

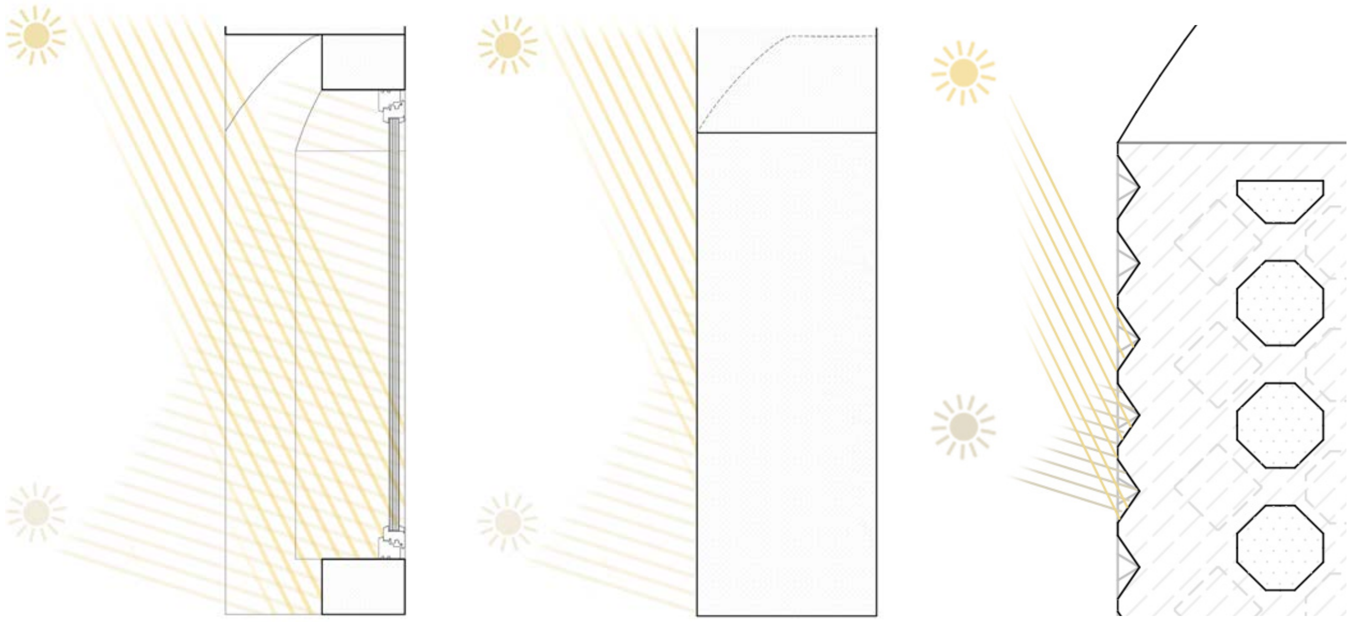
build simple guidelines

- thermal mass
- night cooling
- windows on the inside

Elevation South 1-100



Building Block: Sun Curve > Interlocking > Microstructure > Inner Cell Structure > Material



Building Block: Solar Optimisation

Concrete
cell wall: min. 20 mm
material: evoBuild®
(Heidelberg Materials)

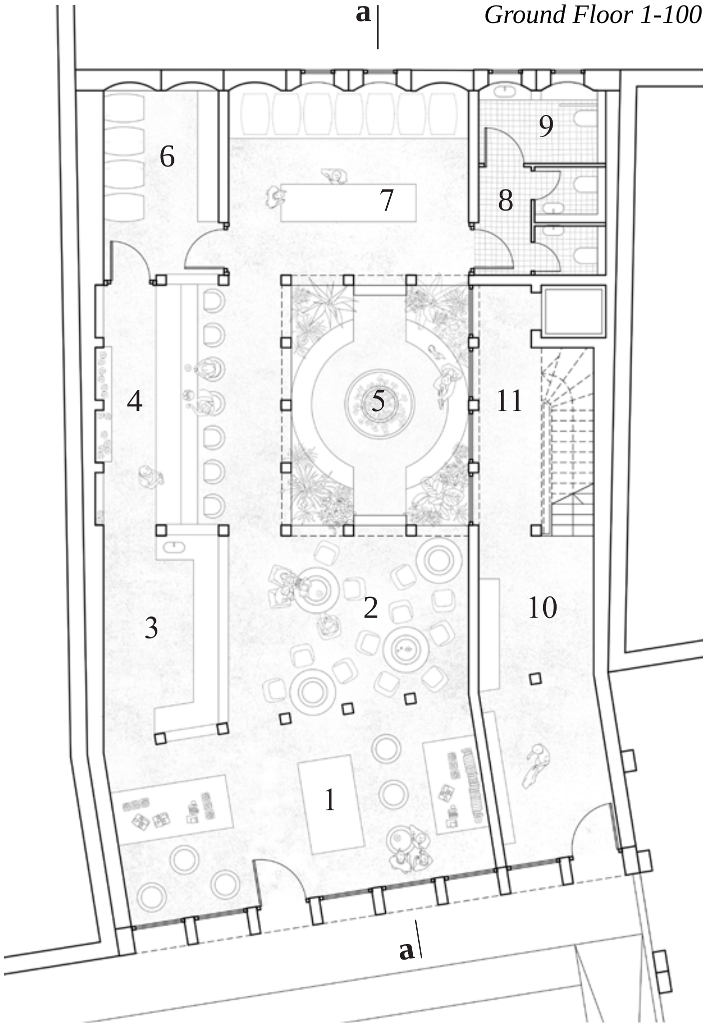
Substrat
partical size: 1-2 mm
material: Lignin bioaerogel
AKL (aerogel it)

Cell Structure: Material

Domus Solaris

The orientation and architectural design of the southern façade elements provide ample natural light during winter while avoiding glare in summer. The arrangement of spaces around the central thermally enclosed courtyard ensures sufficient natural daylighting within the elongated building volume.

Ground Floor 1-100



SPI potential

light gain optimisation

shading (summer)

build simple guidelines

min. 10-15% window/ room

no solar glazing

Visualisation Wine Bar Atrium (GF)

Legend (GF + 1.FL)

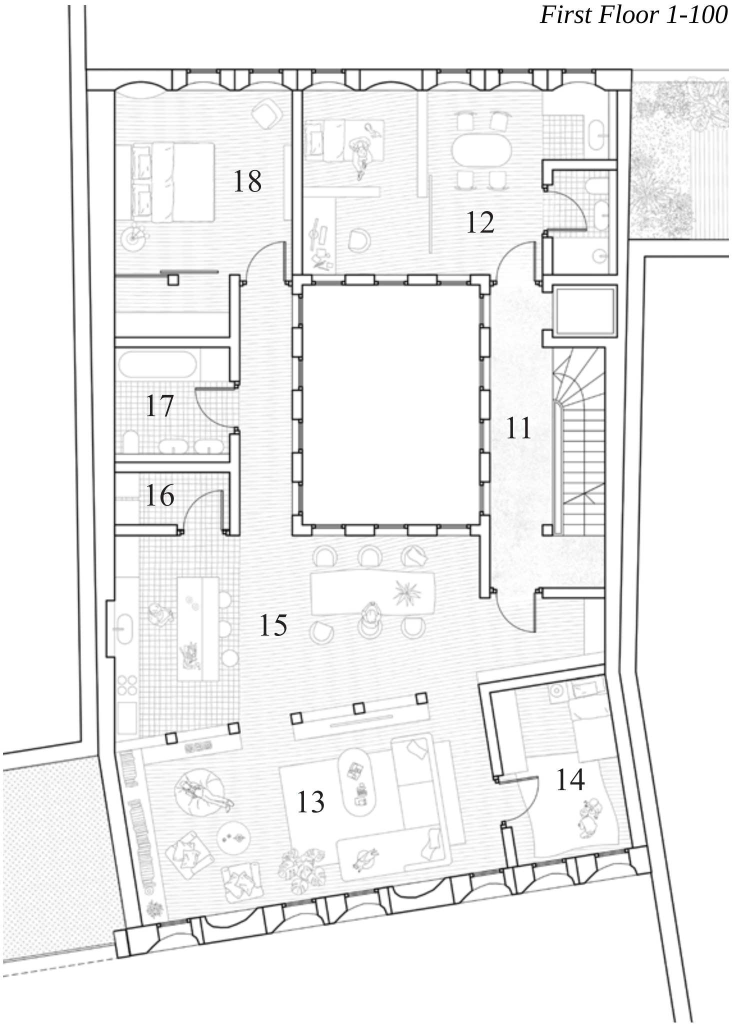
Wine Bar/ Entrance (GF)

1	wine sales and tasting
2	wine and dine
3	bar area
4	tasting 2
5	atrium
6	wine storage
7	tasting 3
8	toilet diverse
9	toilet accessible
10	private entrance
11	staircase

Apartments (1.FL)

12	one-room apartment
13	living room
14	child
15	kitchen and dining
16	laundry/ storage
17	bathroom
18	master bedroom

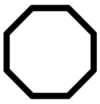
First Floor 1-100

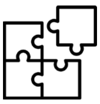


Visualisation Apartment (1.FL)

SPI potential

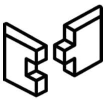

component variety
(without additional effort)


complex microstructure
(without additional effort)


interlocking


material reduction

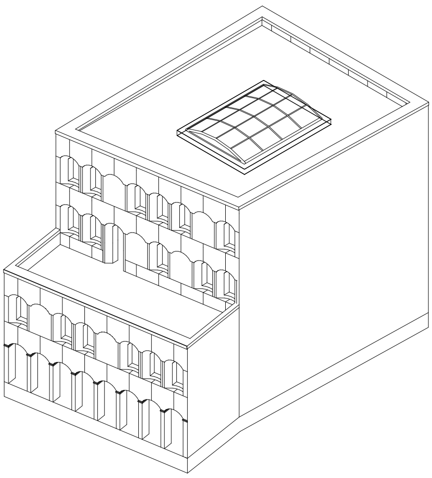
build simple guidelines

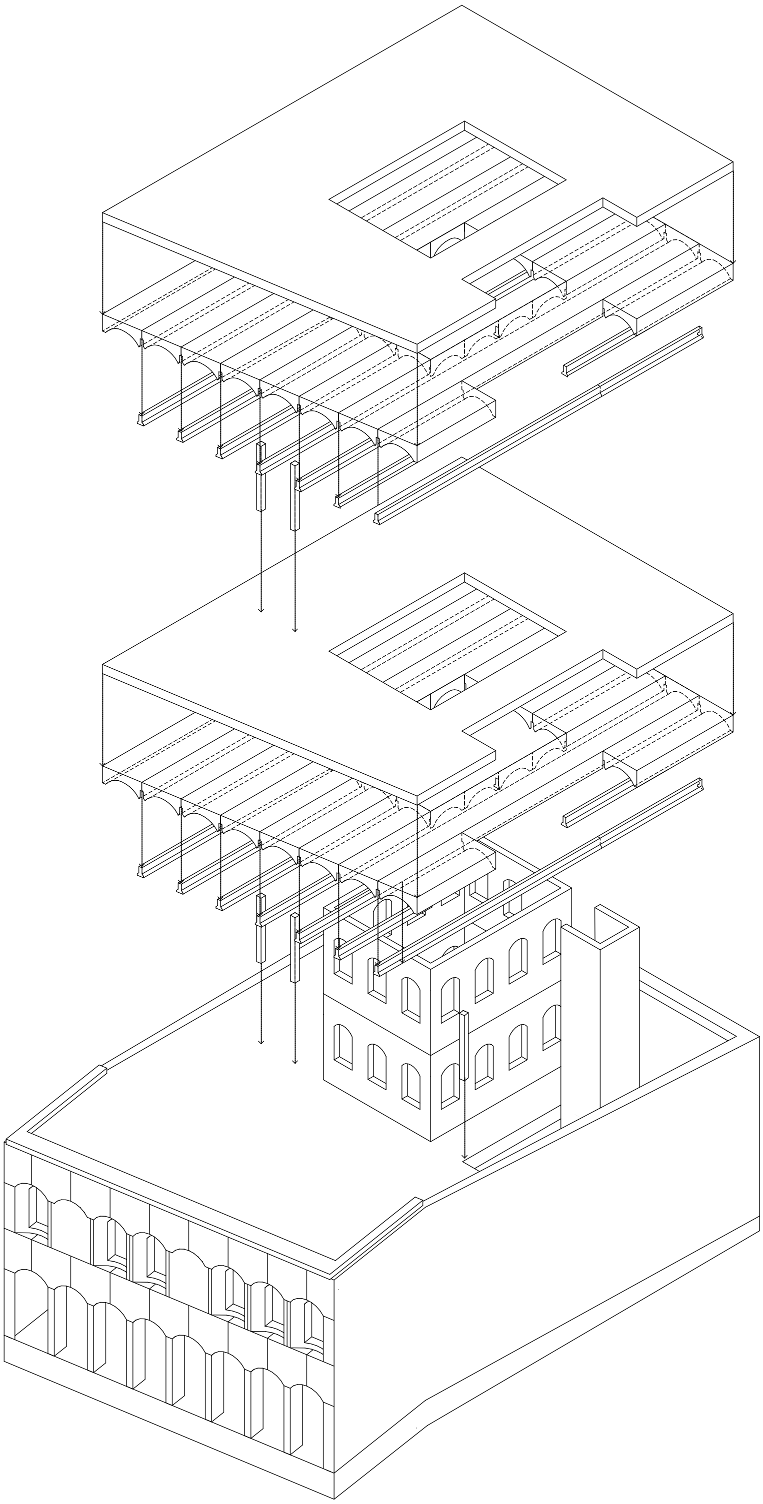

simple joints
(time, costs)


prefabrication


transfer of forces in
concrete through arches


separation of layers

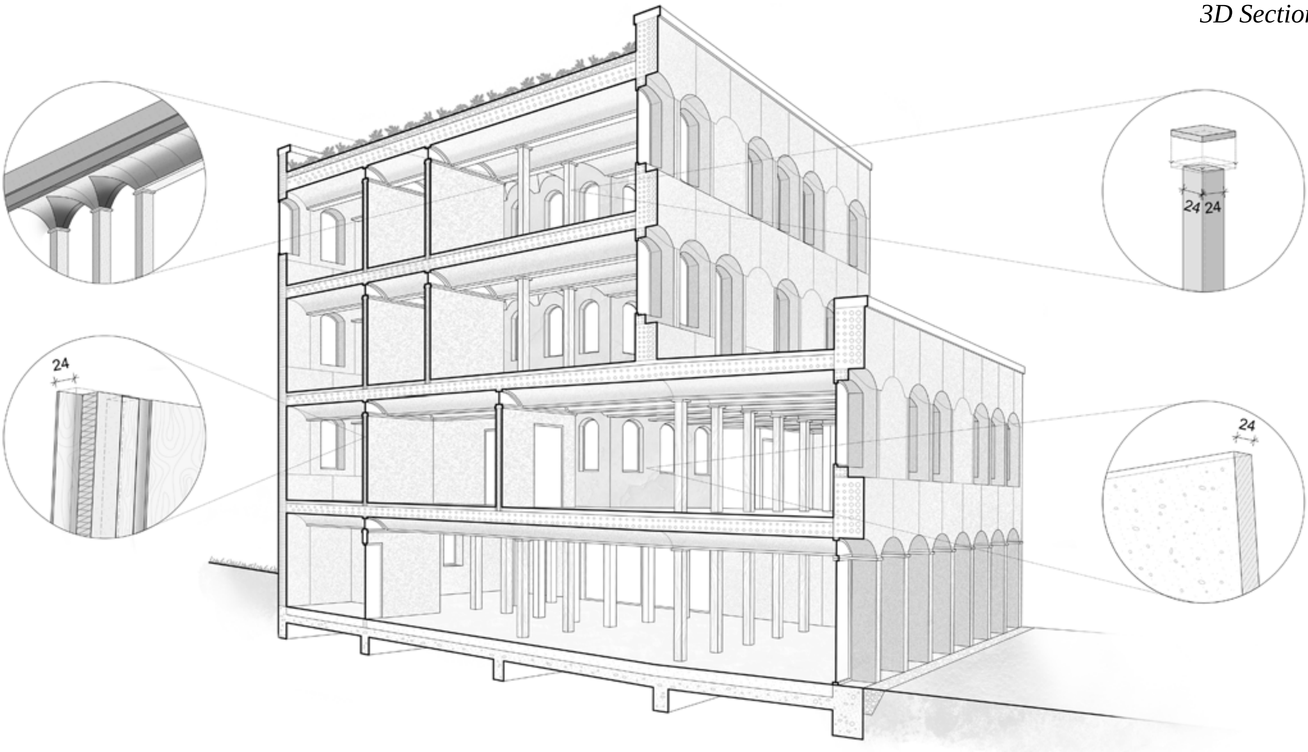




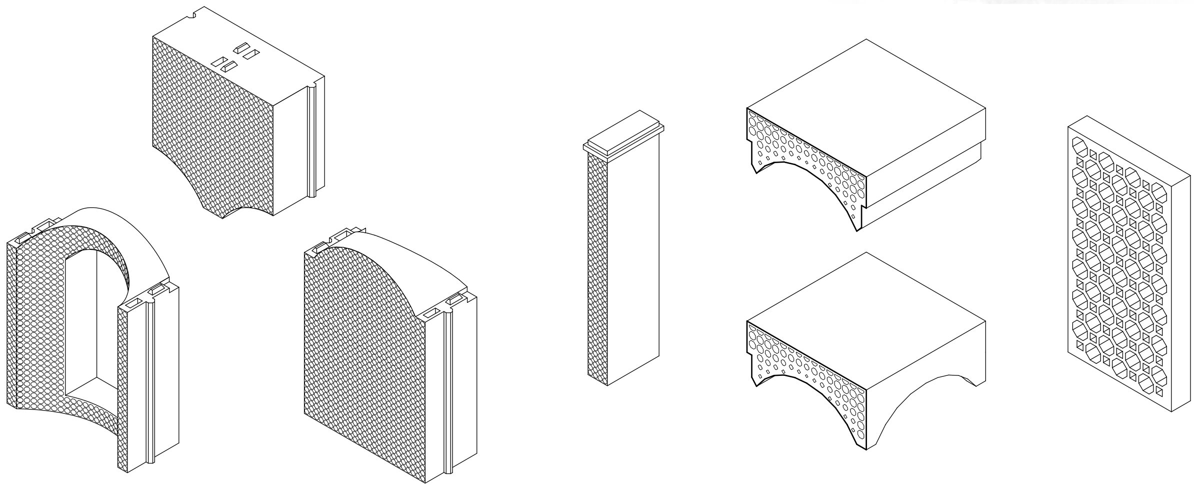
Explosion Axonometry

The construction is prefabricated in a factory and assembled on-site using simple methods. The chamber system of the components minimizes concrete usage to the structurally necessary areas, with loads efficiently distributed via segmental arches. The printing process allows for a variety of component designs without additional effort, which is evident in the intricate microstructure, utility integration, and interior design.

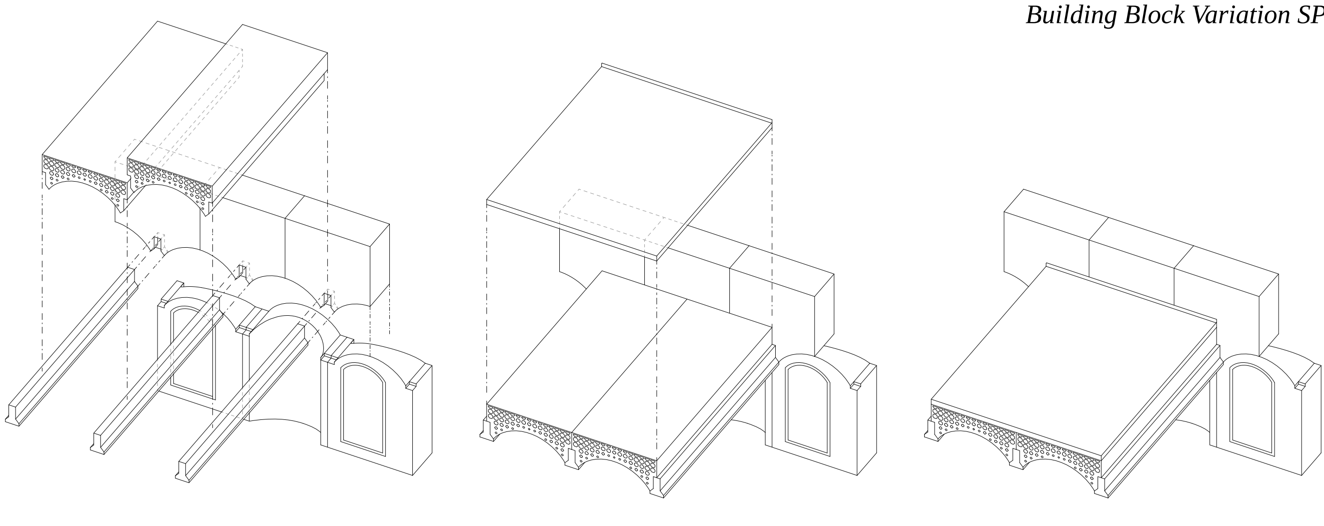
Fabrication Concept



3D Section



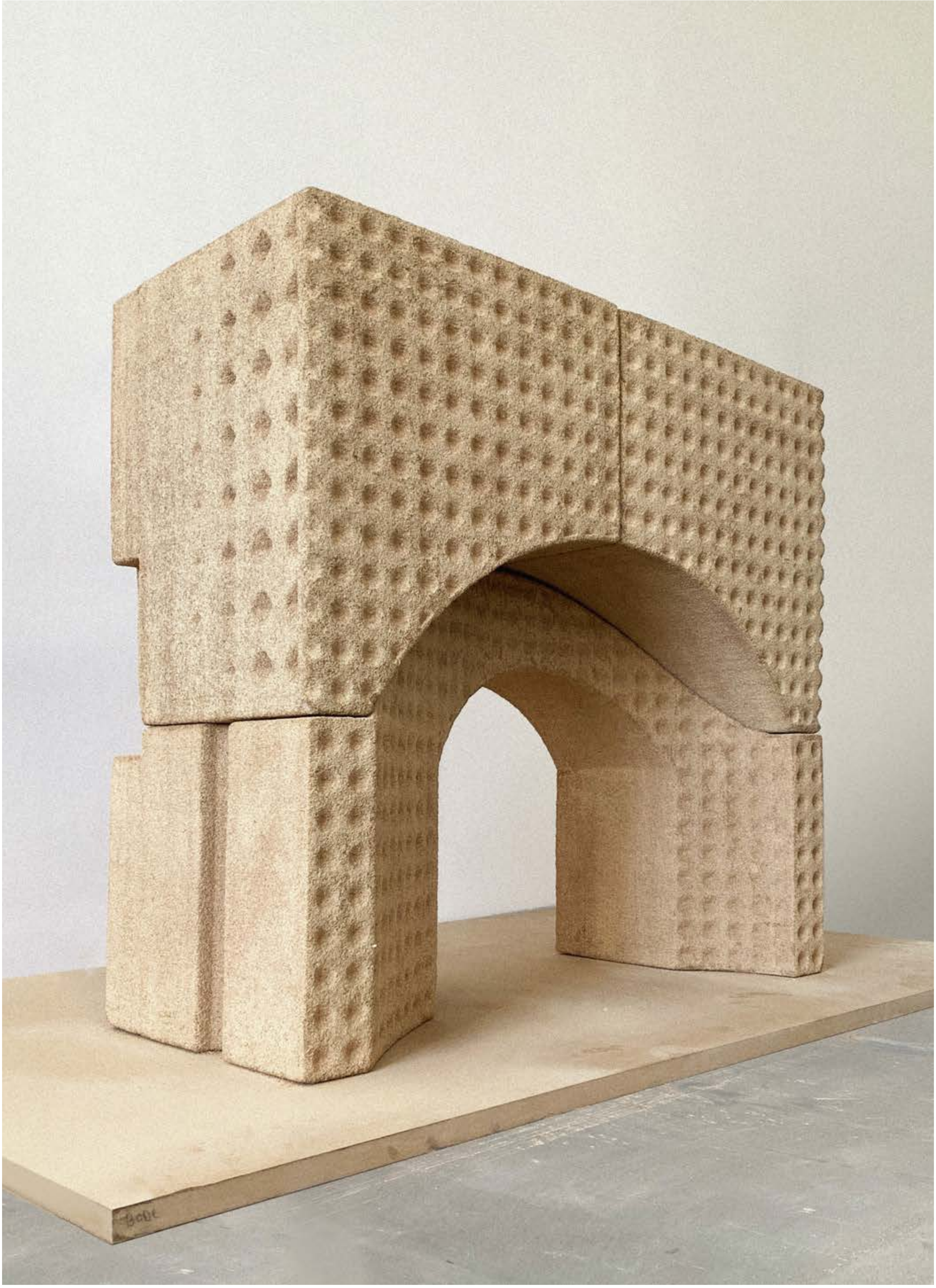
Building Block Variation SPI



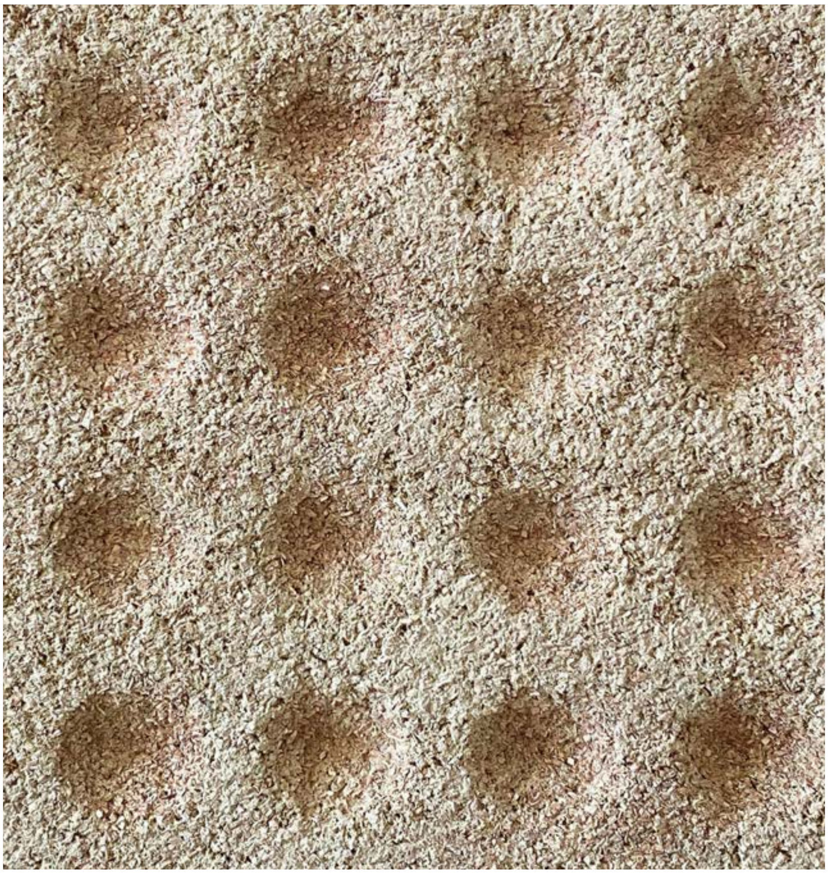
3D Detail Joints: Façade and Floor Construction

Domus Solaris

Model



Buidling Block Overview



Details Interlocking - Microstructure - Inner Cell Structure

Final Presentation

Pavillon 333
12th of February, 14.00-18.00

Guests:
Dipl.-Ing. Jan van der Velden-Volkmann / SSV Architekten
Bruno Knychalla M.Sc. / Additive Tectonics
Prof. Anne Niemann / TU Rosenheim

Photos: Tizian Rein


to pipe a house


how to pipe a house


Framing the Square

Project MA / WS 2024-2025

Professorship of Digital Fabrication
Prof. Dr. Kathrin Dörfler / Iuliia Larikova, M.A.

Chair of Building Technology and Climate Responsive Design
Prof. Thomas Auer / Dr. Sandra Persiani / David Briels, M.Sc.