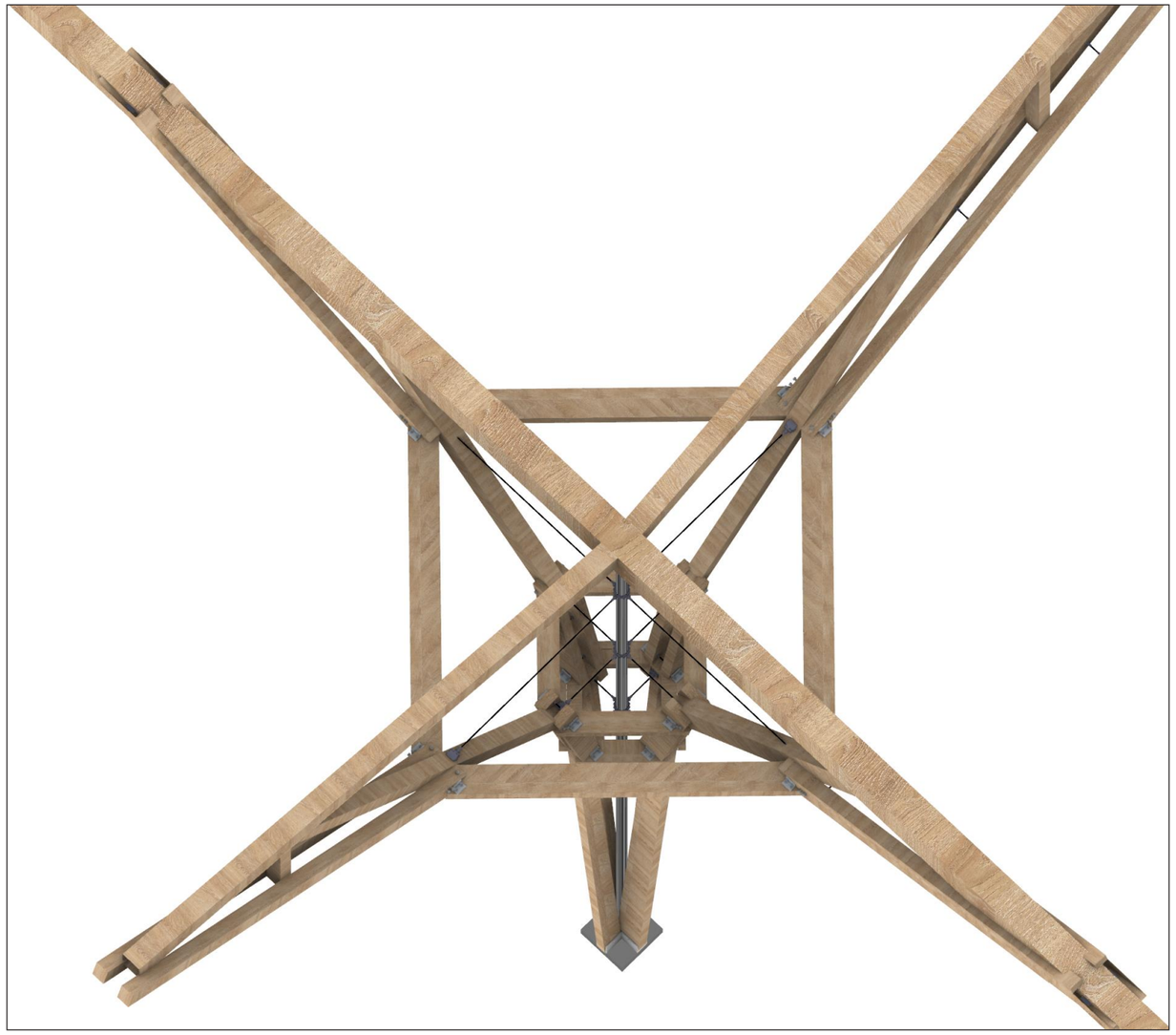


From Heavy to Light

Second Life of The Hague National Archive

Architecture Engineering Studio
Student: Jing Qi
Design Tutor: Thomas Offermans
Building Technology Tutor: Paddy Tomesen
Research Tutor: Mauro Overend
Delegate Examiner: André Mulder

CONTENT

Lightness

Contemporary architects and artists are rethinking the interrelationships of architecture, visual perception, and structure. Influenced by aspects of our culture including electronic media and the computer, they are investigating the visual and material qualities of architectural surfaces and the meanings they may convey. In their work, notable for its artistic and technical innovation, a new architectural sensibility is emerging. It is characterized by the term "light" in several senses, including luminosity and apparent weightlessness, as well as by a new relationship between the viewer and the architectural object, which in many cases is no longer apprehended directly but is instead veiled or distanced from the viewer.

LightConstruction

This new sensibility reflects the distance of our culture from the machine aesthetic of the early twentieth century and also marks a fundamental shift in emphasis after three decades when debate about architecture focused on issues of form. Most of the thirty-four projects represented in this exhibition, created in response to commissions and competitions in ten countries, have been or are being built. Creatively responding to often daunting site restrictions and successfully realizing complex programs, they engage their environments not as theoretical constructs but as material constructions. They are seen here in a broad, synthetic context, in which both their cultural and aesthetic dimensions may be considered.

Terence Riley, Chief Curator, Department of Architecture and Design

This exhibition is made possible by generous grants from Lily Auchincloss and Mrs. Arnold L. van Ameringen.
Additional support has been provided by the Contemporary Exhibition Fund of The Museum of Modern Art, established with gifts from Lily Auchincloss, Agnes Gund and Daniel Shapiro, and Mr. and Mrs. Ronald S. Lauder.

LightConstruction

"After modern architecture has experienced monumentality, brutalism and other overly heavy manifestations, lightness, elegance and refinement will become the essence of architecture in the next century."

—— *A Prediction*,
Light Construction Exihibition,
1996, MoMA, New York

For a renovation project, what's the meaning of lightness?

- Sense of lightness in visual

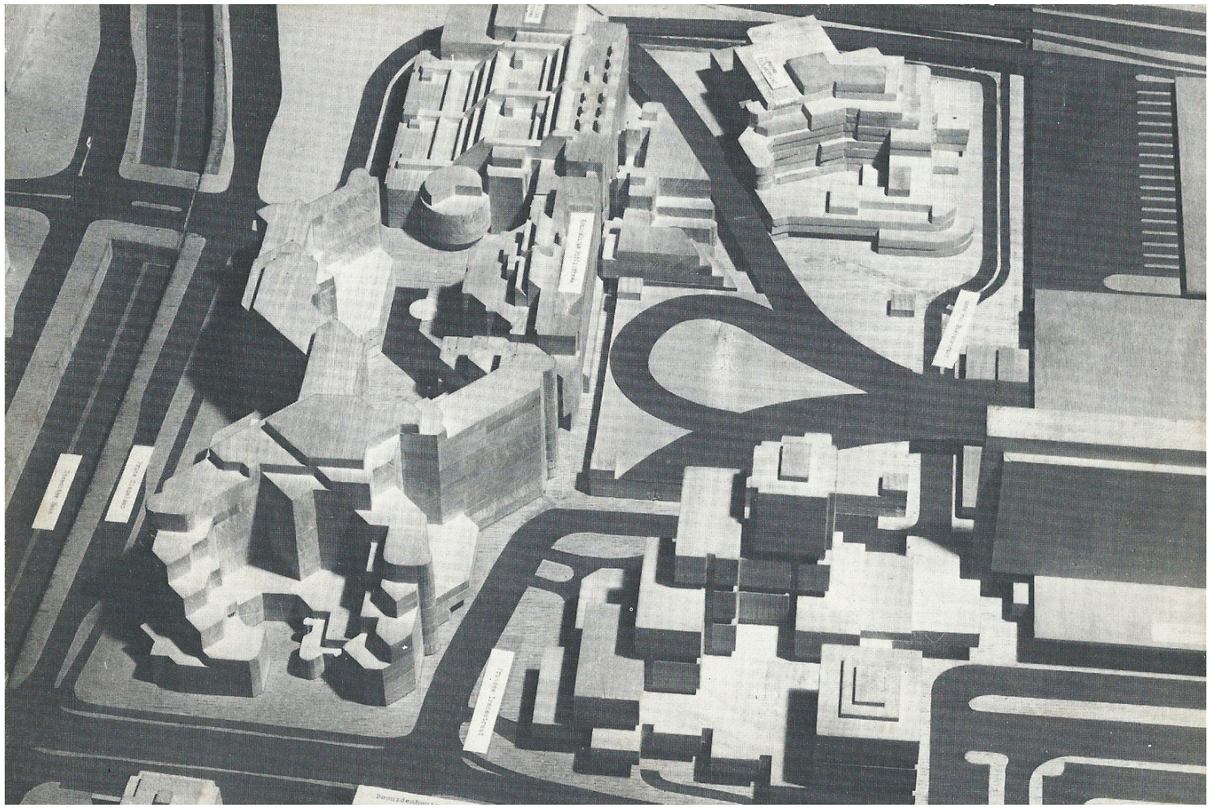
- Intervene lightly in the original building

- Reduce building's energy consumption

After the two world wars, the development of functionalism, mega-architecture thoughts, and brutalism has led to the emergence of more and more concrete buildings.

National Archive

The Hague, 1979, Atelier PRO

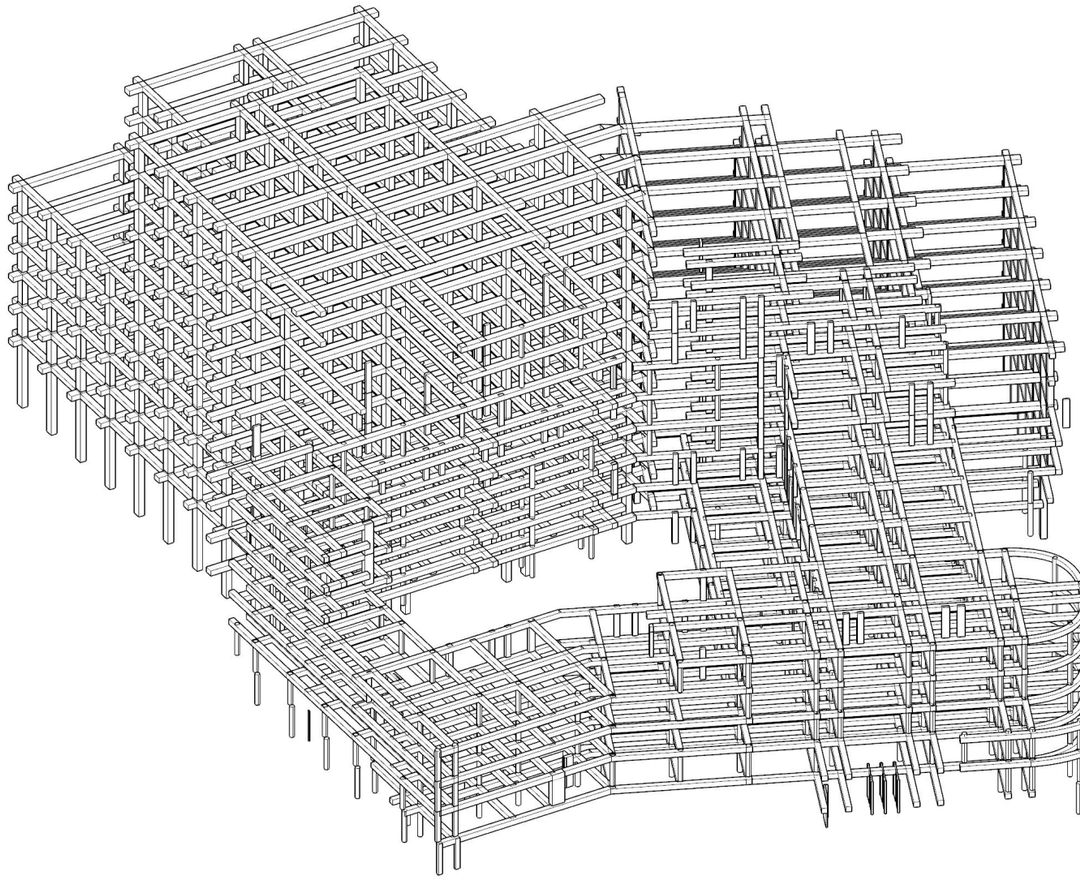


Function
The largest and national archive of Netherlands

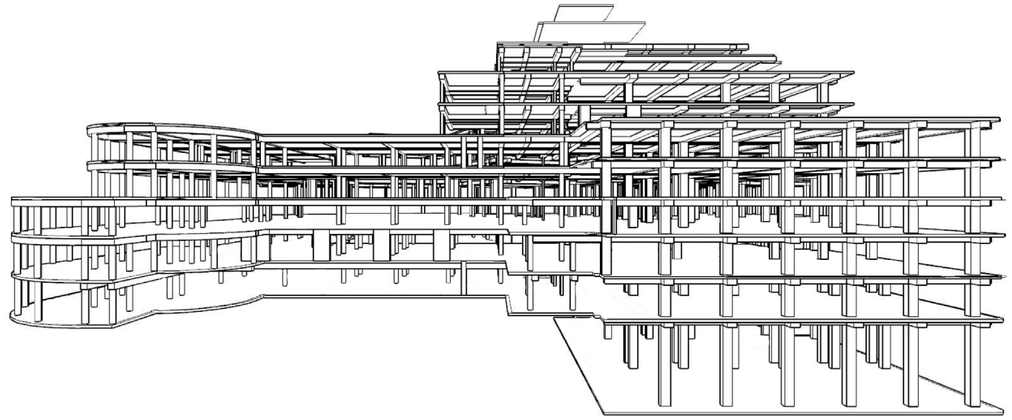
LOCATION
In the center of the Hague

LIFETIME
Has been used for more than 40 years

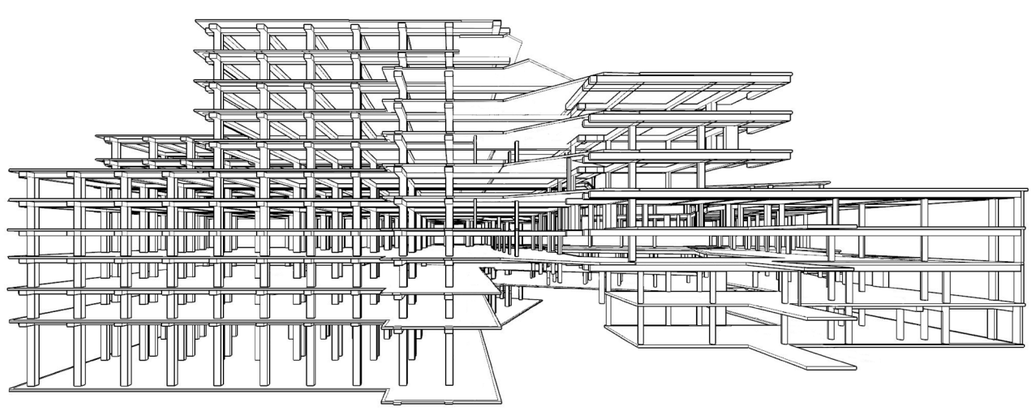
Value
Store many documents and has a very high historical value



Structure System



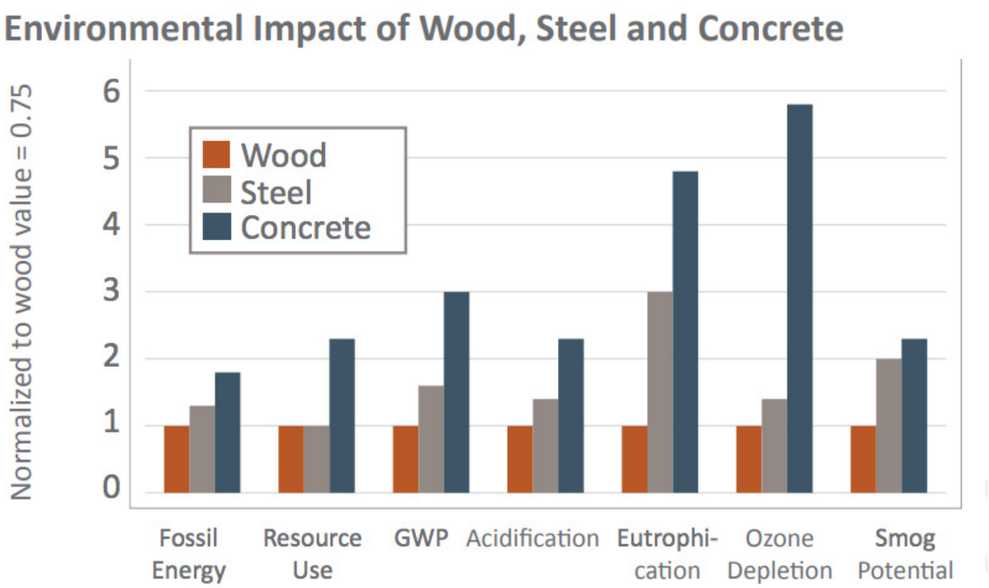
Structure 1

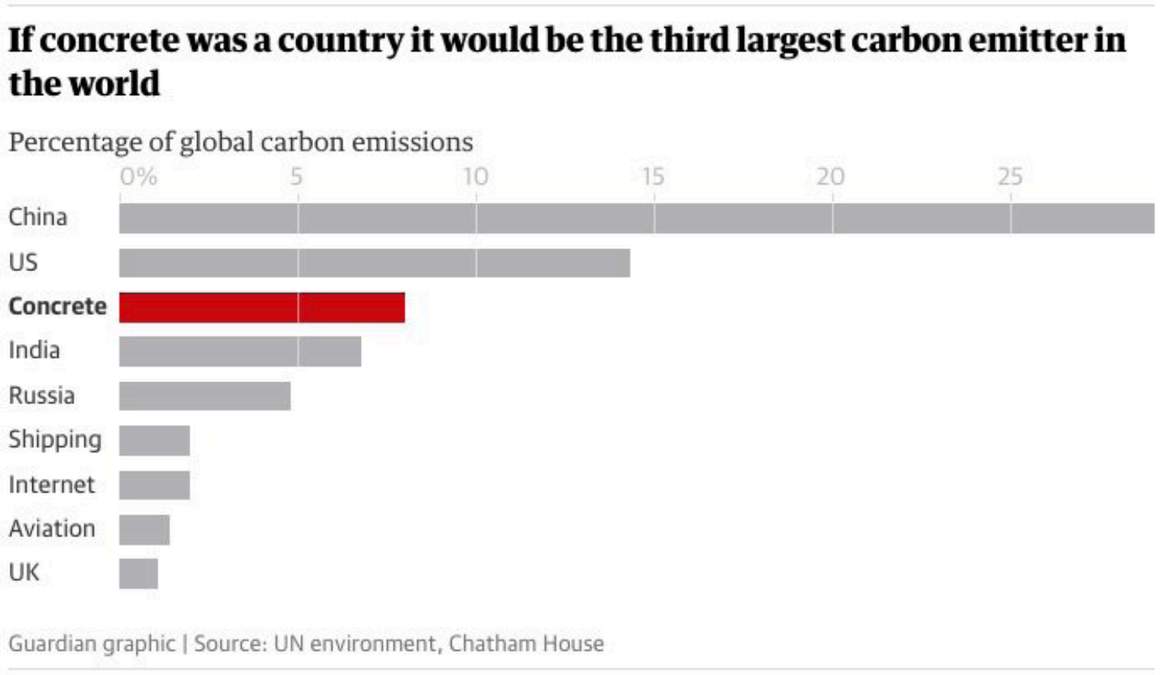


Structure 2

Problem Statement

1. Energy Waste





Each square meter of building area supported by a steel beam requires up to 40 kg of carbon dioxide emissions and 516 megajoules of energy. For concrete, its carbon dioxide emissions are 27 kg and energy consumption is 290 megajoules. Only 4 kilograms of carbon dioxide and 80 megajoules of energy are required to build each square meter of building area supported by wooden beams.

The life-cycle emissions of wooden houses are 74% lower than steel-structure houses and 69% lower than concrete houses.

2. Society Need

What does history mean for a city?
What function should be included in an archive building?
What kind of space should archive building provide for a city?

Storagy/Exhibition/Library/Communication/Monument/Media Center...

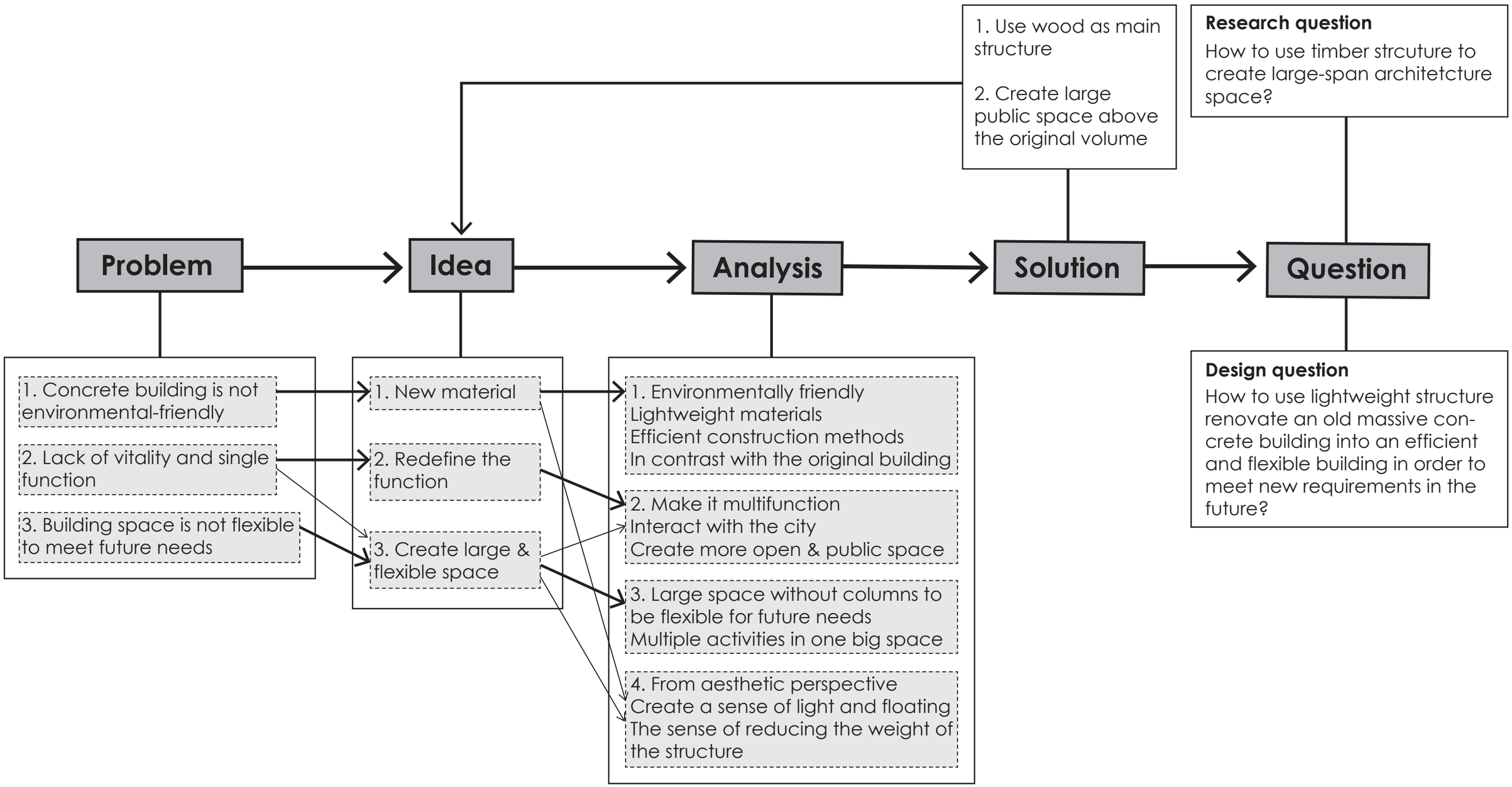
3. Flexible for Future

What should an archive building be in the digital future?

The question of the archive is not, I repeat, a question of the past…but rather a question of the future, the very question of the future, question of a response, of a promise and of a responsibility for tomorrow. The archive: if we want to know what this will have meant, we will only know tomorrow.

—Jacques Derrida

Design Question


Problem
Idea
Analysis
Solution
Question
1. Use wood as main structure
2. Create large public space above the original volume
Research question
How to use timber strcuture to create large-span architetcture space?
1. Concrete building is not environmental-friendly
2. Lack of vitality and single function
3. Building space is not flexible to meet future needs
1. New material
2. Redefine the function
3. Create large & flexible space
1. Environmentally friendly
Lightweight materials
Efficient construction methods
In contrast with the original building
2. Make it multifunction
Interact with the city
Create more open & public space
3. Large space without columns to be flexible for future needs
Multiple activities in one big space
4. From aesthetic perspective
Create a sense of light and floating
The sense of reducing the weight of the structure
Design question
How to use lightweight structure renovate an old massive con-crete building into an efficient and flexible building in order to meet new requirements in the future?

Design Objective

- Creat more public space to attract more users

- Use wood as main structure to creat the sense of lightnss to form a contrast with the original building

- Solve the energy problems to make the original building more sustainable

Research

RESEARCH QUESTION:

HOW TO USE TIMBER STRUCTURES TO CREATE LARGE SPACE?

1. MATERIAL

2. TYPOLOGY

3. CONSTRUCTION

4. JOINT

5. SUSTAINABILITY

Properties
Type of timber

Baesd on force

Characteristics
Classification
Applicable span
Applicable Condition

Match construction methods
different structure systems

Construction method

Match jonts with different
structure systems

Classification
Connection of hybrid structure

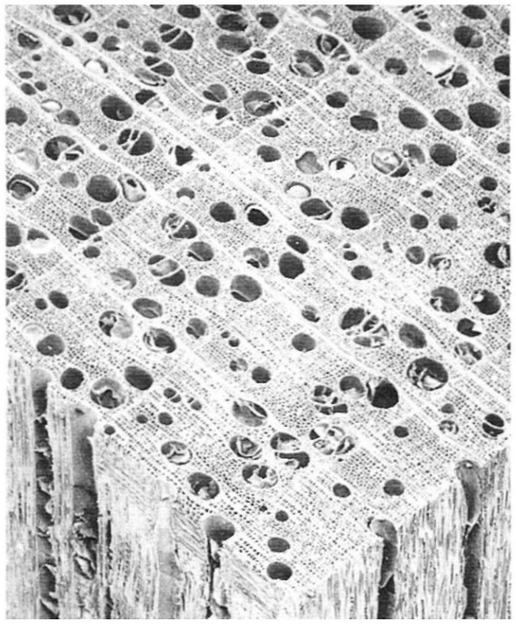
Connectin of concrete structure and timber structure

Sustainability of timber structure
Building envelopes in large public space
- Glass curtain wall, roof, equipment

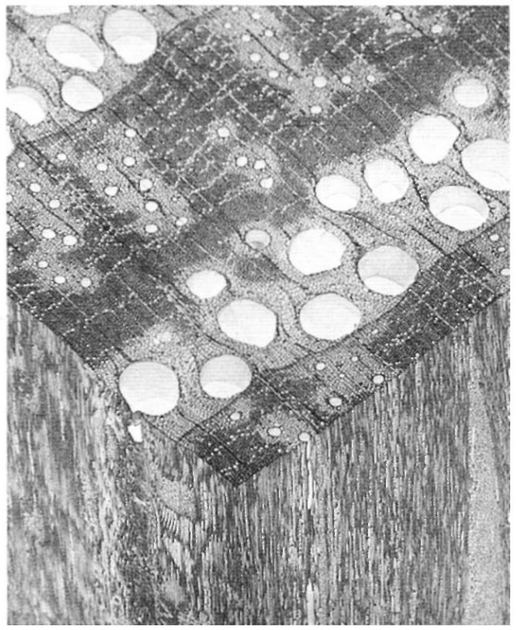
Decide suitable
timber structure
system

Solutions can be
used in design

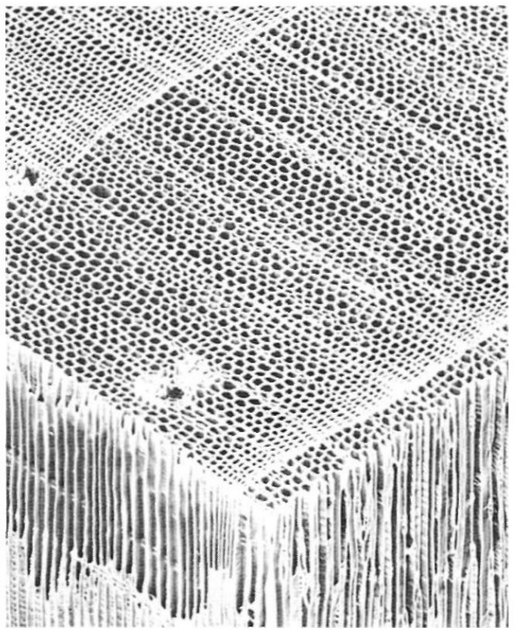
Material Properties



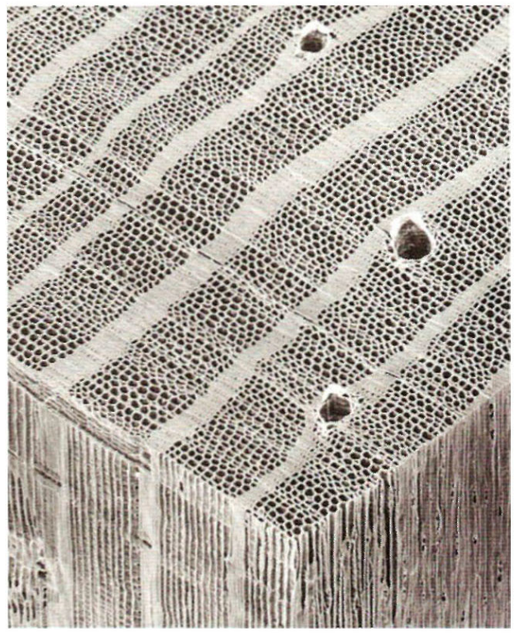
BLACK WALNUT



RED OAK



EASTERN WHITE PINE



SOUTHERN YELLOW PINE

Porous

Low thermal conductivity, mechanical elasticity, buoyancy; high porosity, large amount of stored air, easy to breed rotting bacteria; suitable for antiseptic.

Anisotropic

The tensile strength of wood along the grain is 40 times that of the horizontal grain; the compressive strength of the wood along the grain is 5-10 times that of the horizontal grain.

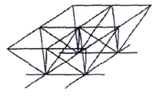
Good tensile strength

Wood has a good strength-to-weight ratio, and its strength-to-weight ratio is 3 times that of concrete and 3-4 times that of steel. In addition, wood has good tensile and compressive properties and weak shear resistance.

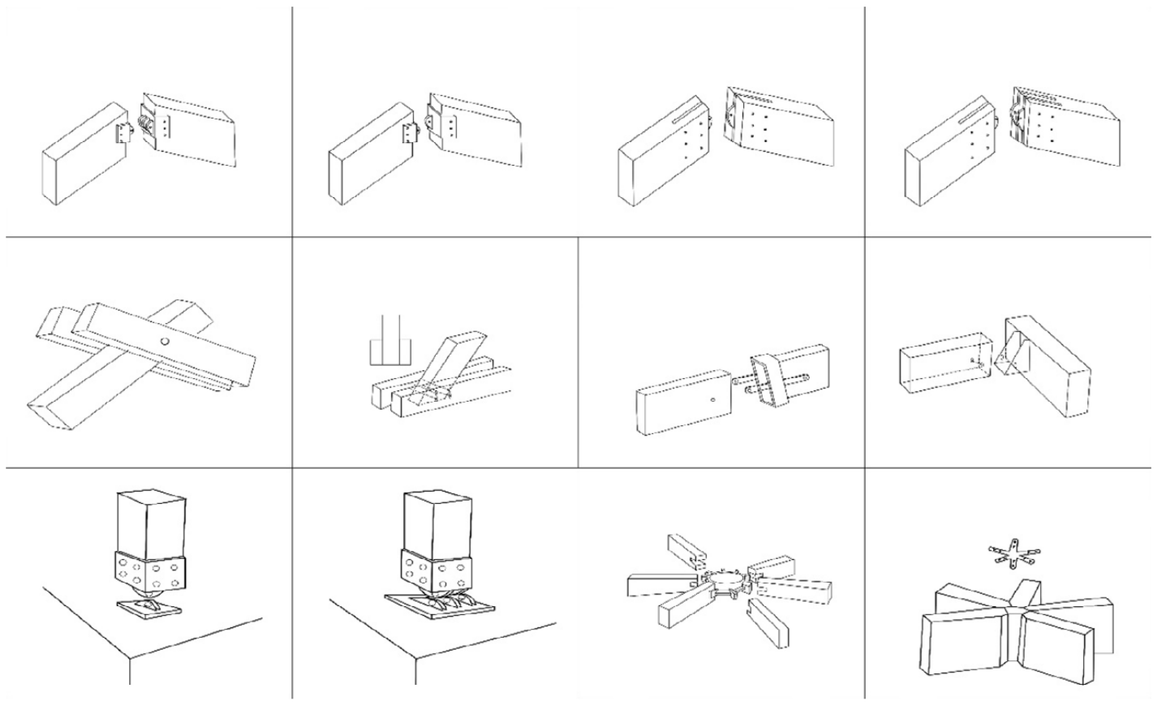
Light-weight

As a building material, wood is lighter in quality than other materials.

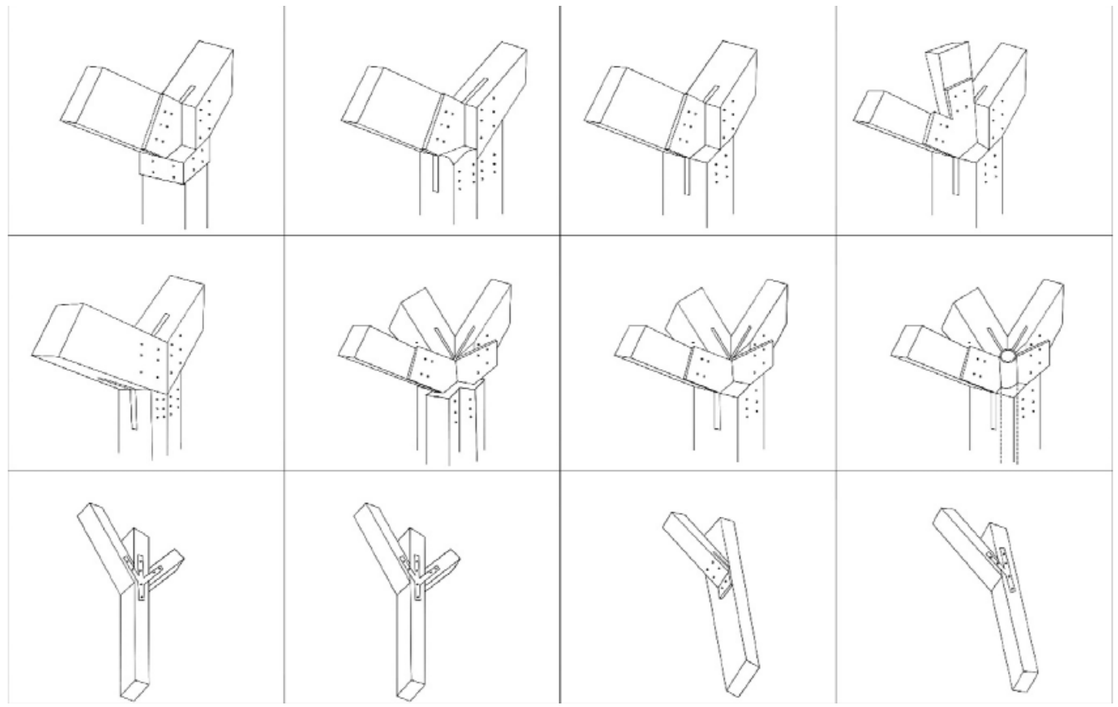
Structure System

	Schematic Diagram	Load Condition	Structure Member	Construction Method	Applicable Joints	Applicable Span	Rise-Span Ratio	Main Features	Pros and Cons
Wooden Suspension Structure		Tensile stress	Wooden diagonal brace, Steel-wood hybrid roof/Steel cable	Lifting construction	Hinged connection	50 - 200m	1/20 - 1/10	Steel-wood combination, Hybrid	-Large span -Single form
Cable Composite Structure		Tensile stress	Wooden column and arch, Steel cable	Lifting construction	Hinged connection	30 - 150m	1/20 - 1/8	Thin roof, Membrane, Hybrid	-Light-weight -Few connected joints
Arch Structure		Compressive stress	Wooden column, Wooden arch, Secondary connecting member	Jacking construction	Pin connection	18 - 200m	1/8 - 2	Small bending moment, Good compressive performance	-Small span -Single form
Portal Frame Structure		Bending-shearing stress	Wooden column, Wooden beam and secondary member	Jacking construction	Pin connection	18 - 60m	1/10-1/2	Large internal space, Heavy weight	-Small span -Single form
Truss Structure		Tensile & Compressive stress	Wooden column, Wooden truss and secondary member	Lifting construction	Pin connection	10 - 75m	1/10-1/5	Plane geometric form, Weak stiffness	-Good stability -Single form -Simple construction
Space Truss Structure		Tensile & Compressive stress	Wooden supporting column, Wooden members	Lifting construction	Metal ball connection	20 - 80m	1/14 - 1/10	Component standardization, Strong stiffness	-Heavy weight -More consumables
Grid Structure		Tensile & Compressive stress	Wooden roof, Supporting system	Hoisting construction	Embedded connection	15 - 120m	1/20 - 1/10	Various forms, Integration	-Rich in form -Light-weight -Difficult construction

Joint



Hinged connection



Pin connection

Literature study **Case study** **Combine with the context**

Conclusion

- Structure landing part is small
- The structure grows from bottom to top
- Support a large and continuous roof
- Start from unit to a whole system

Design

Context

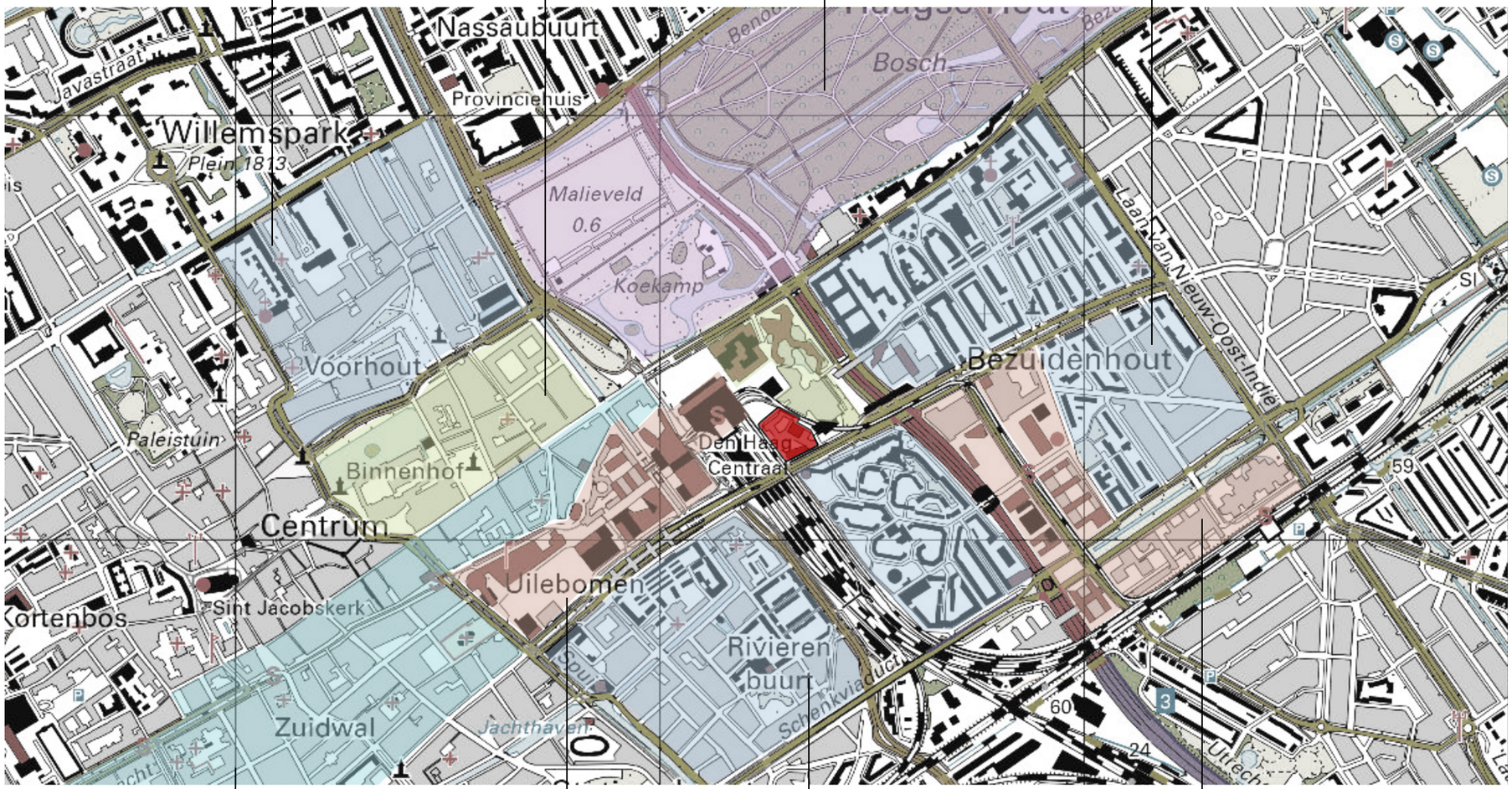

Nassaubuurt
Javastraat
Provinciehuis
Bosch
Willemspark
Plein 1813
Malieveld
0.6
Koekamp
Laan van Nieuw-Oost-Indië
Schenk
Voorhout
Bezuidenhout
Paleistuin
Binnenhof
Den Haag
Centraal
Centrum
Uilebomen
Sint Jacobskerk
Rivieren
buurt
Spui
Schenkviaduct
Zuidwal
Jachthaven
Utrecht

Old District
(Main functions are museums, commercial district and some government offices)

Government Office
(Mainly used as some government institutions)

Park
(Natural landscape and man-made park)

Residence
(Most of them are Multi-storey apartment house)

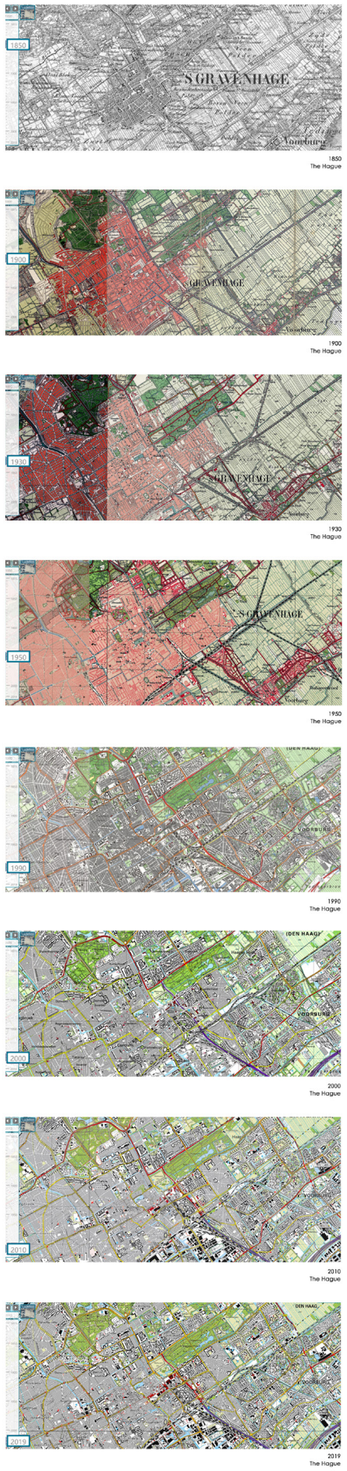


Commercial District
(Consisting of shopping malls and shops along the street)

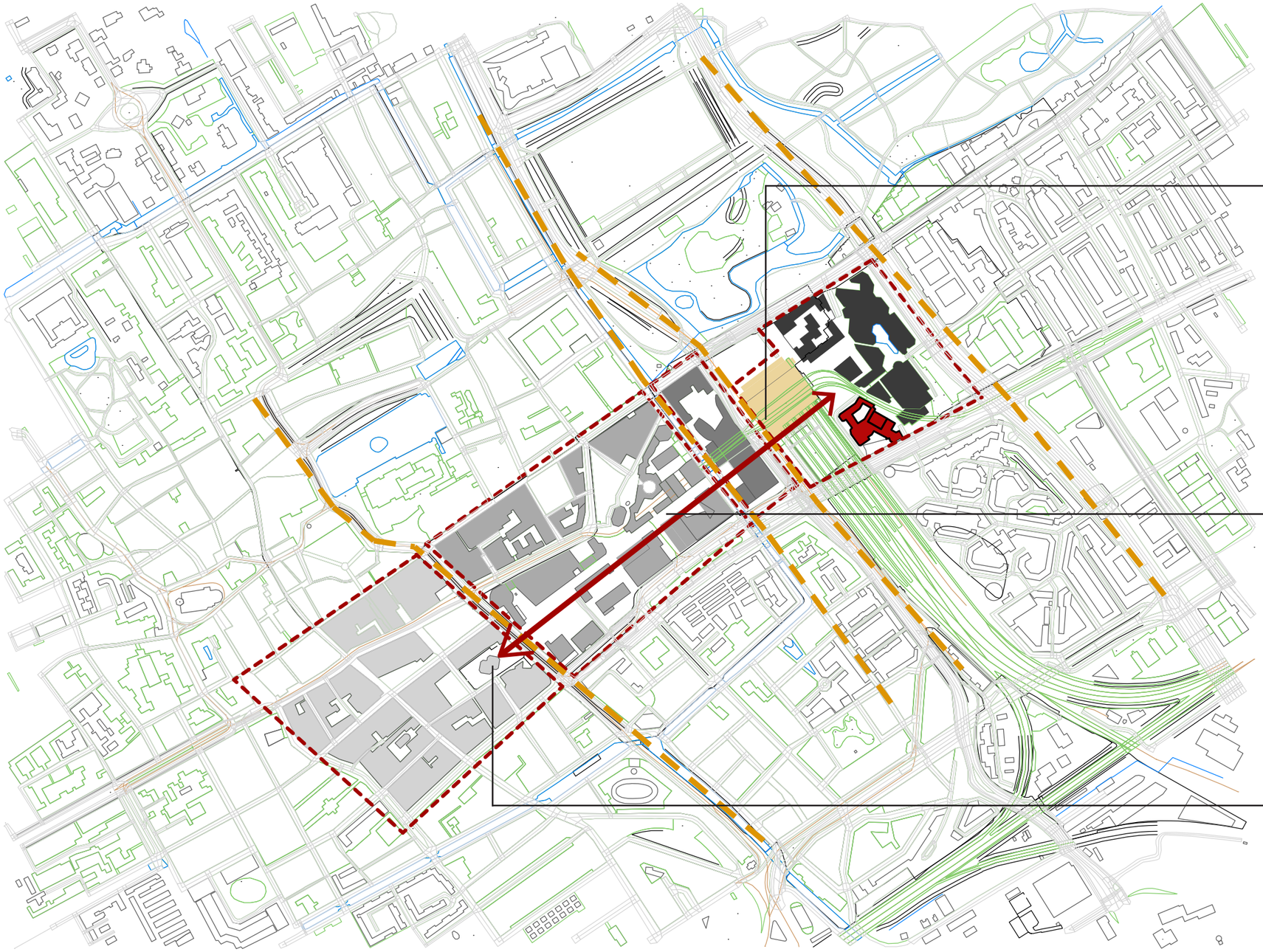
Central Business District
(Consisting of Office buildings, high-rise residential buildings, hotels)

Residence
(Consisting of Old-fashioned single-family houses)

Public Building
(A new business district)

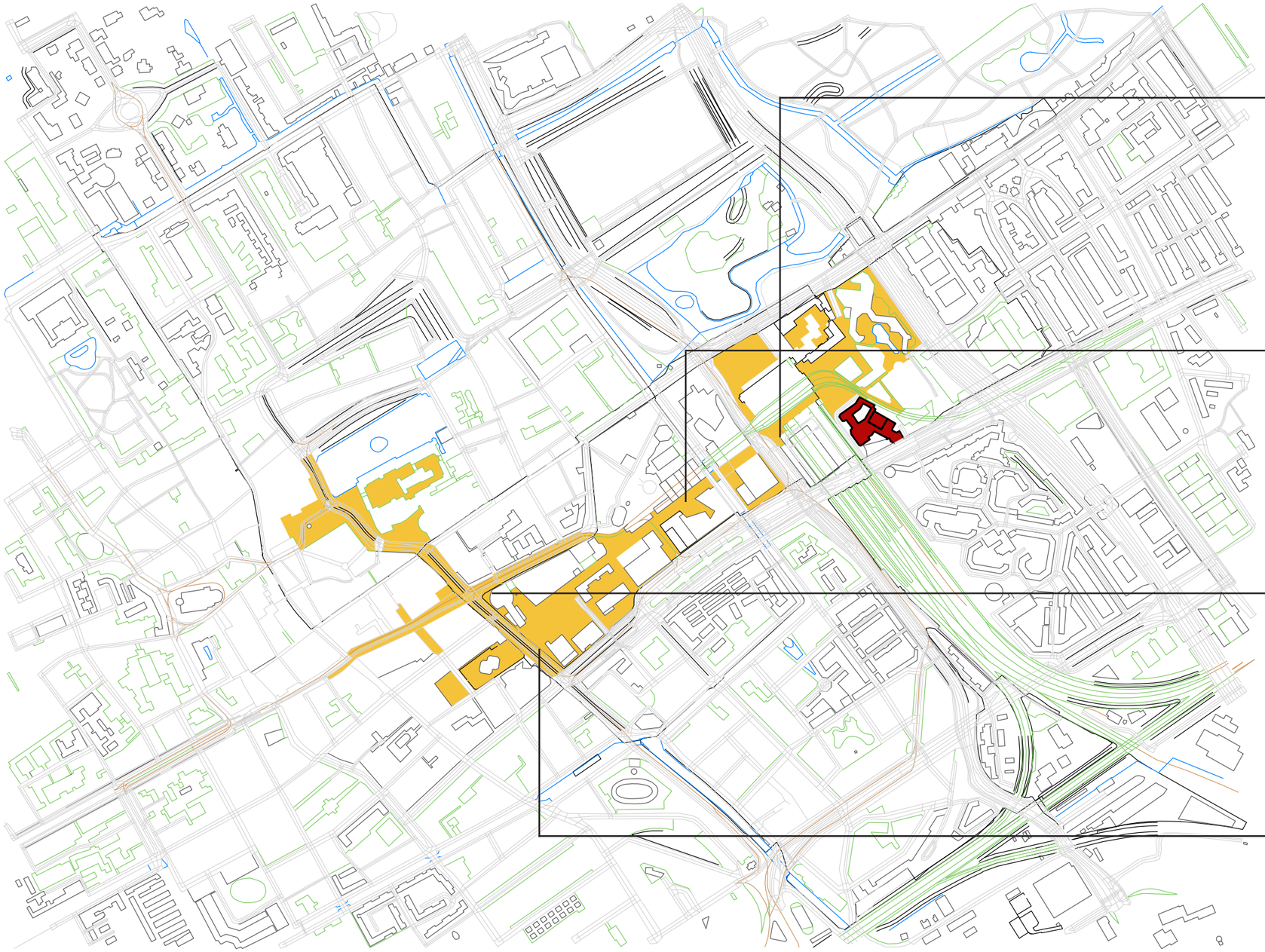


Space Sequence



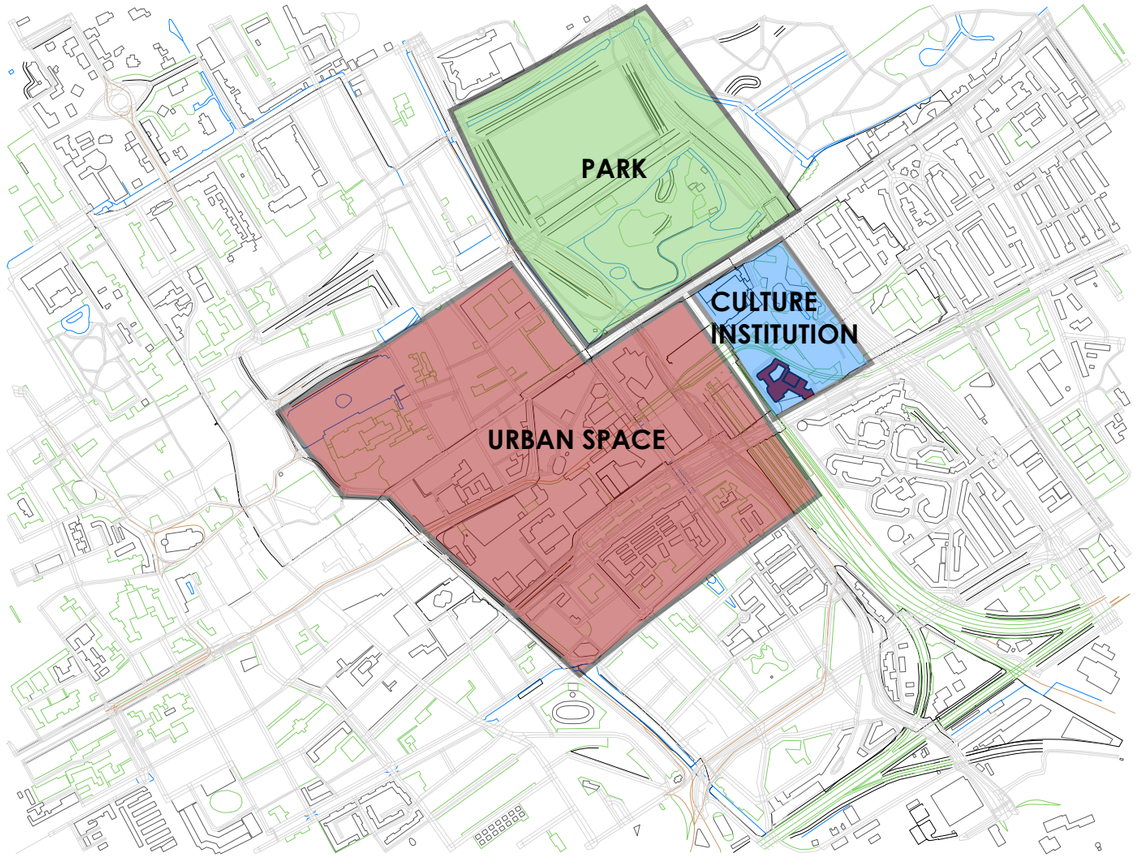
The end of the public building's axis

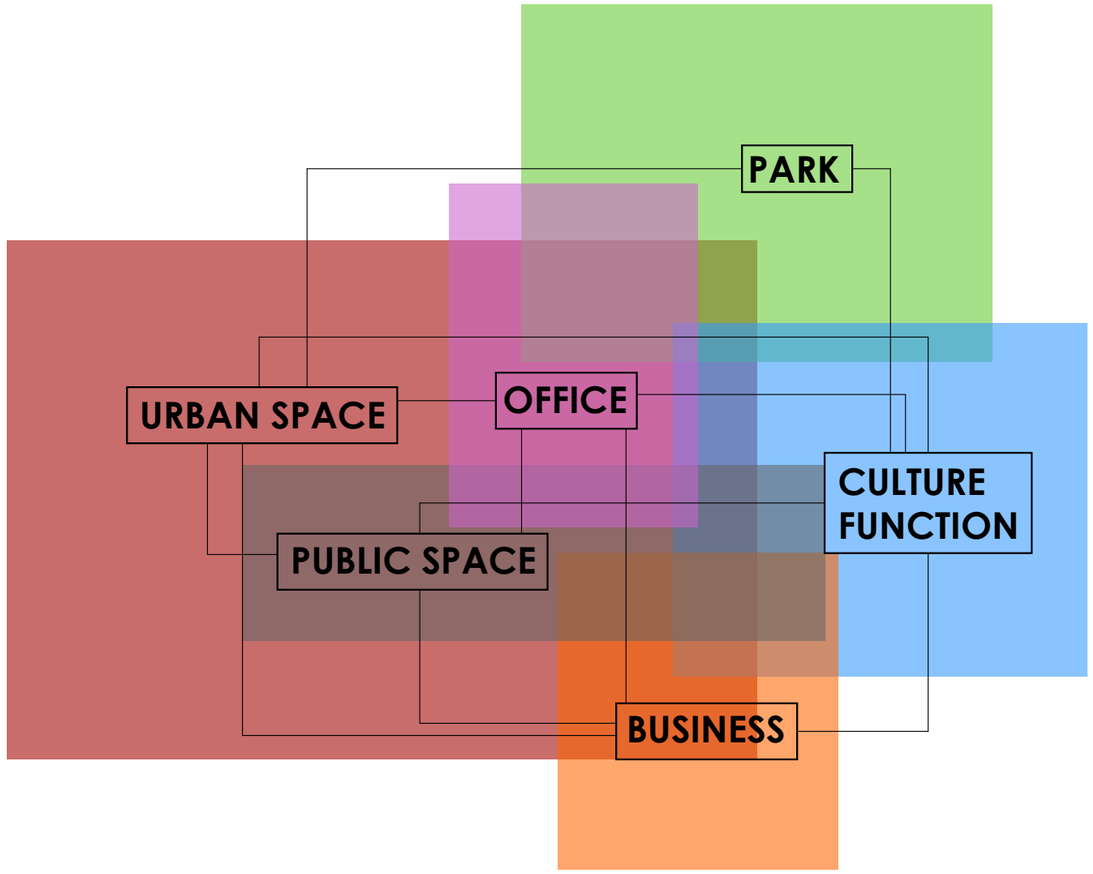
Public Space



Public space are fragmented and not enough

Function Intersection

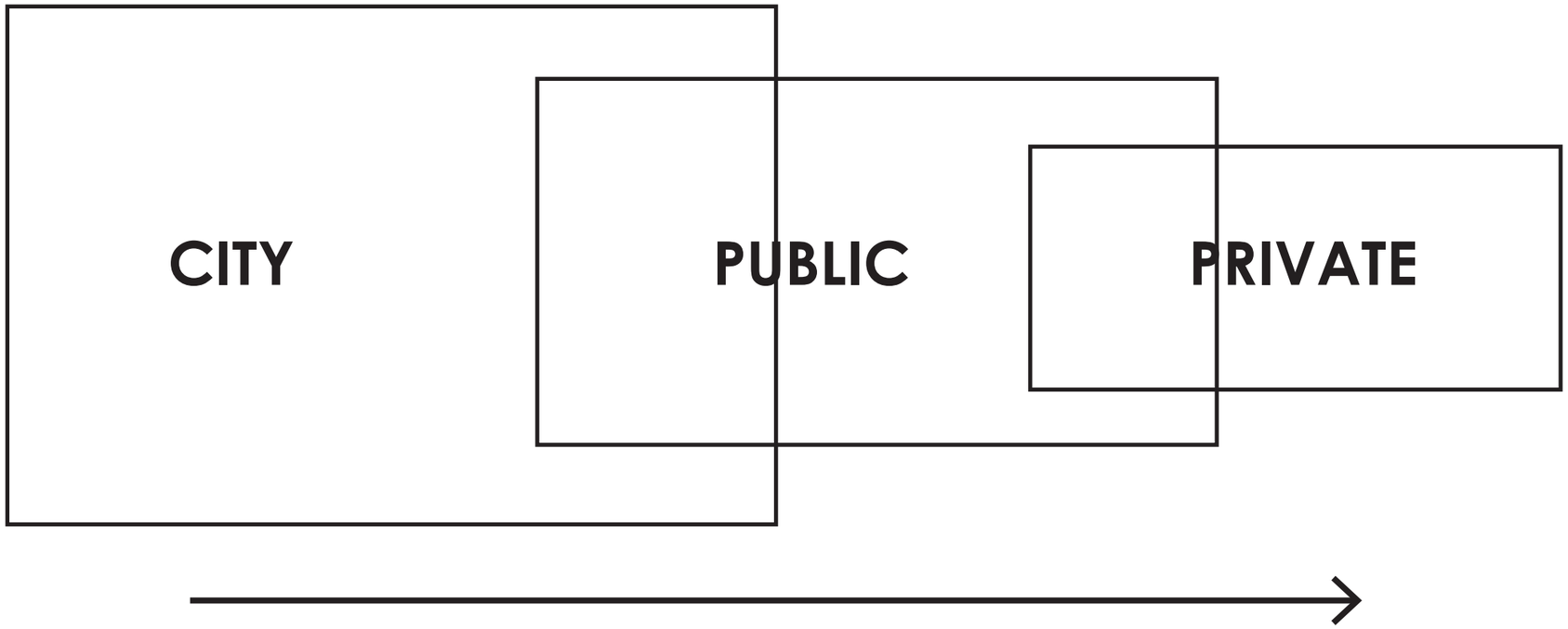


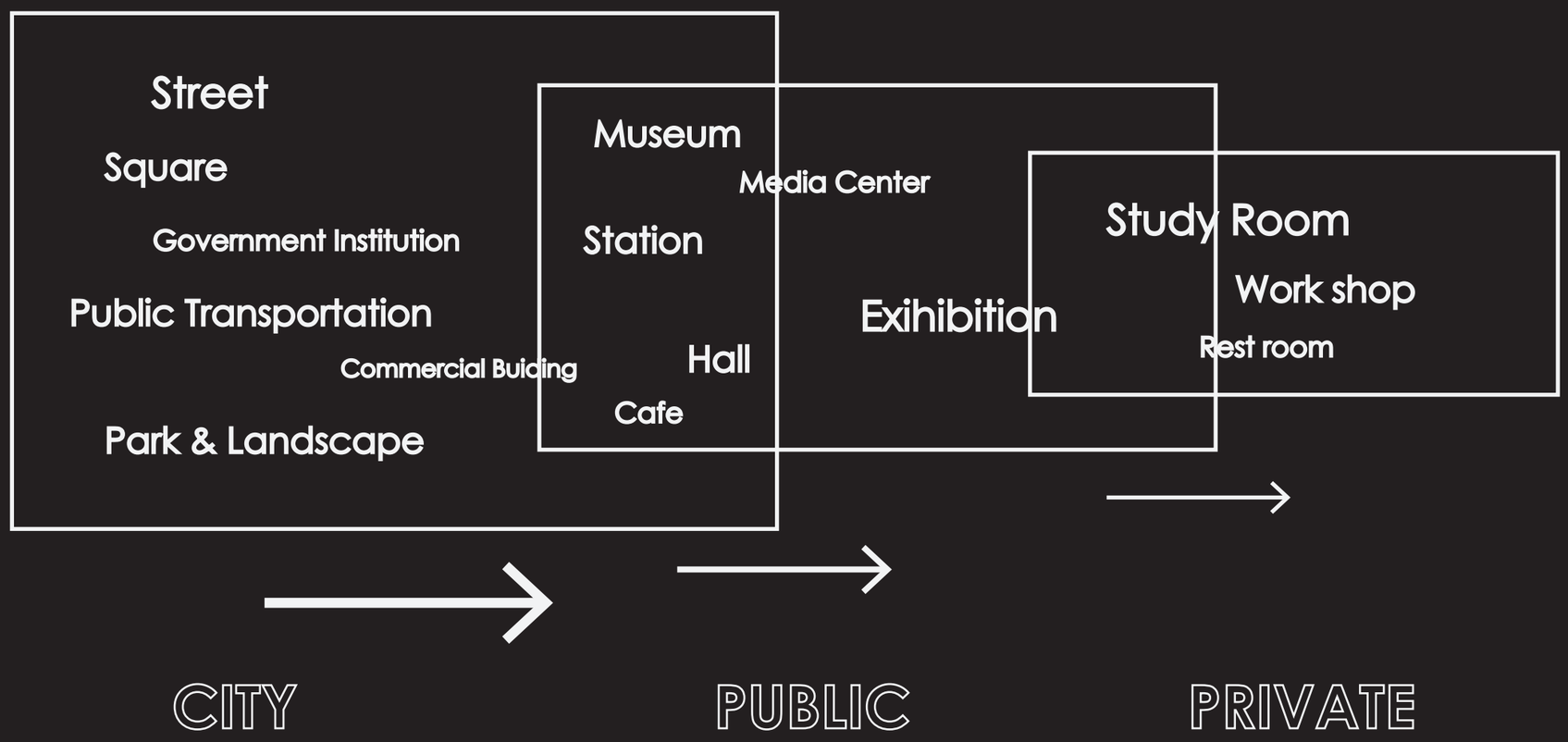


The site is located in a multifunction urban space

Various spaces with different functions influence each other

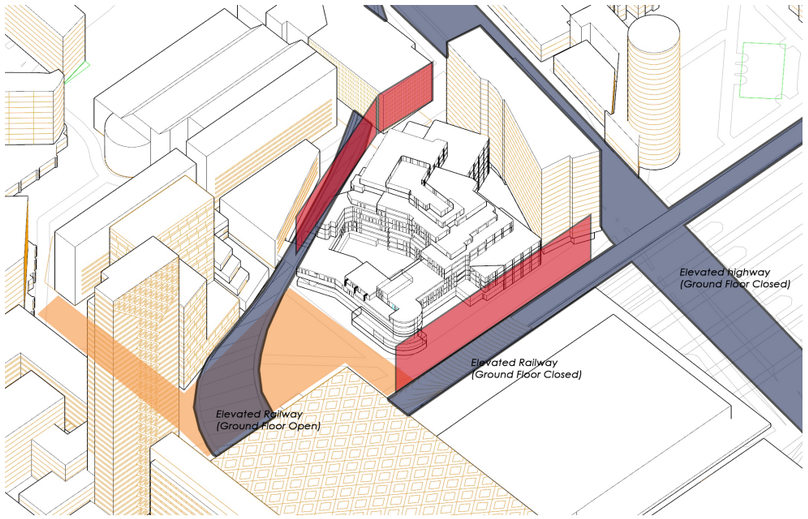
The frequency of space use is large, and the flow of people is large


CITY
PUBLIC
PRIVATE


Street
Square
Government Institution
Public Transportation
Commercial Buiding
Park & Landscape
Museum
Media Center
Station
Hall
Cafe
Exihibition
Study Room
Work shop
Rest room
CITY
PUBLIC
PRIVATE

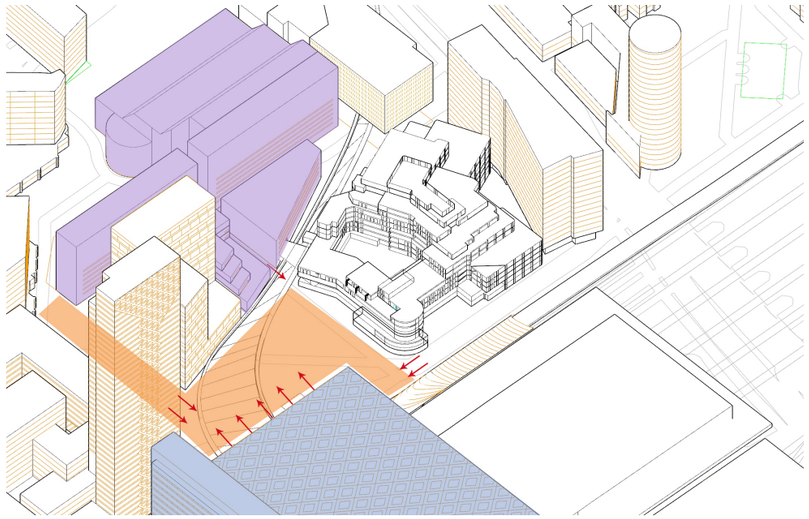
Site Analysis

Surrounding status



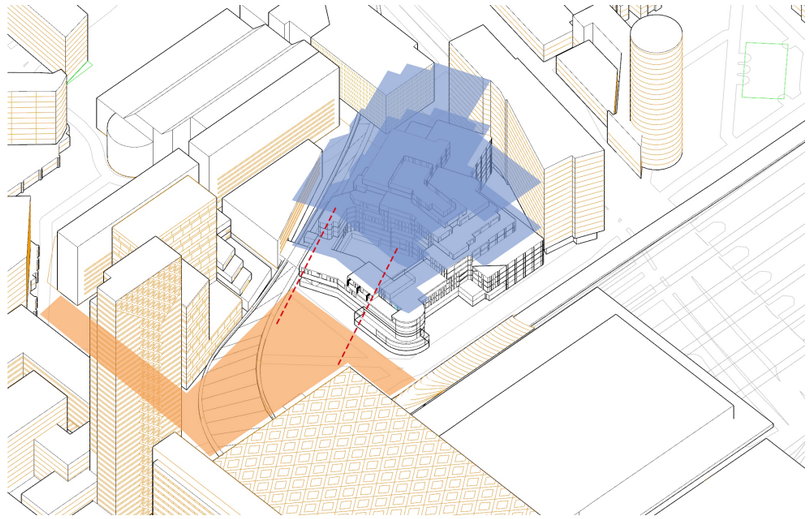
Road Restriction

There are several railways and highways around the original building, and the renovation space is limited and it is difficult to expand outward



Surrounding Function

In front of the original building is a square, surrounded by museums and The Hague Central Station

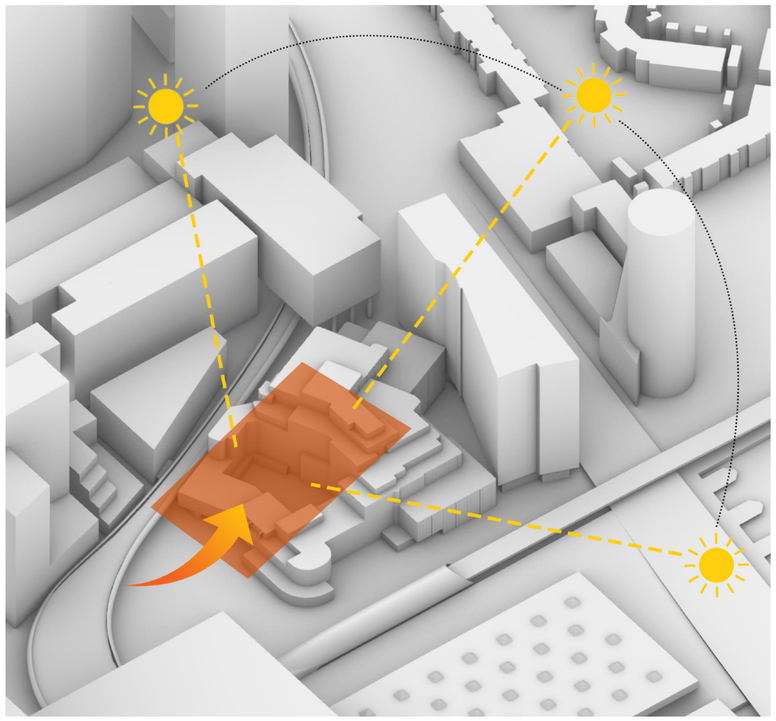


Available Space

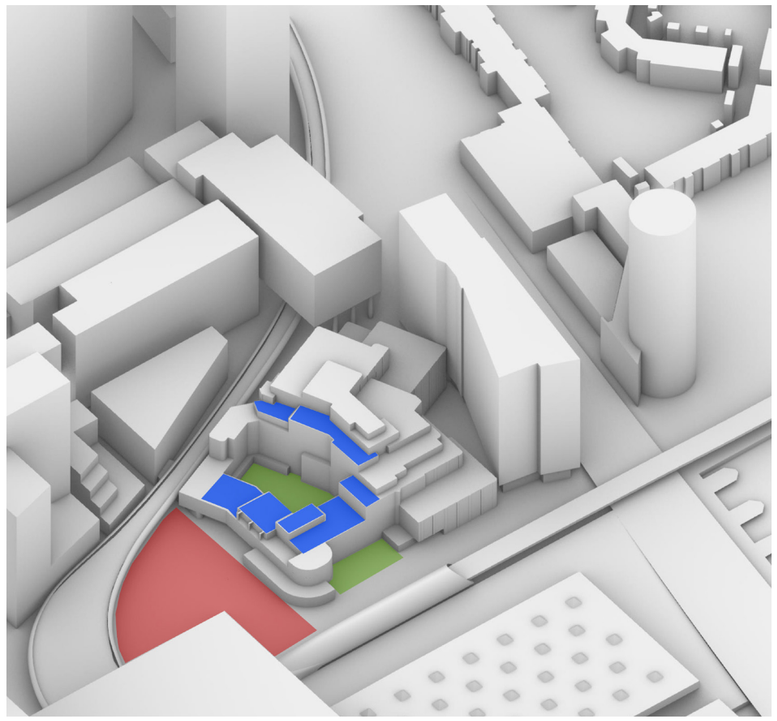
The space suitable for expansion is the square in front of the entrance and the space above the original building

Site Analysis

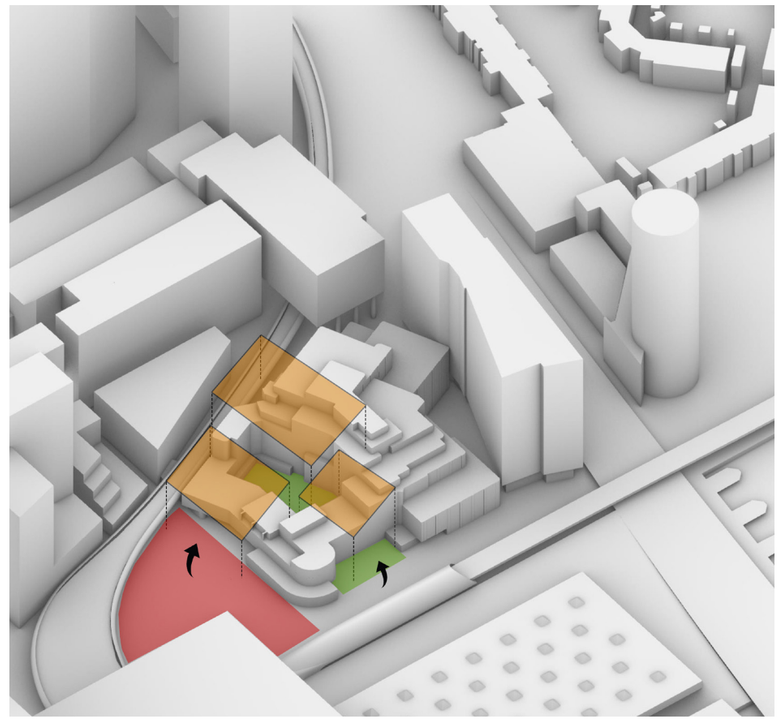
Original Building



The file storage space is blocked by the apartment building from direct sunlight from the south, and the newly built part on the north side of the building also needs a lot of shelter



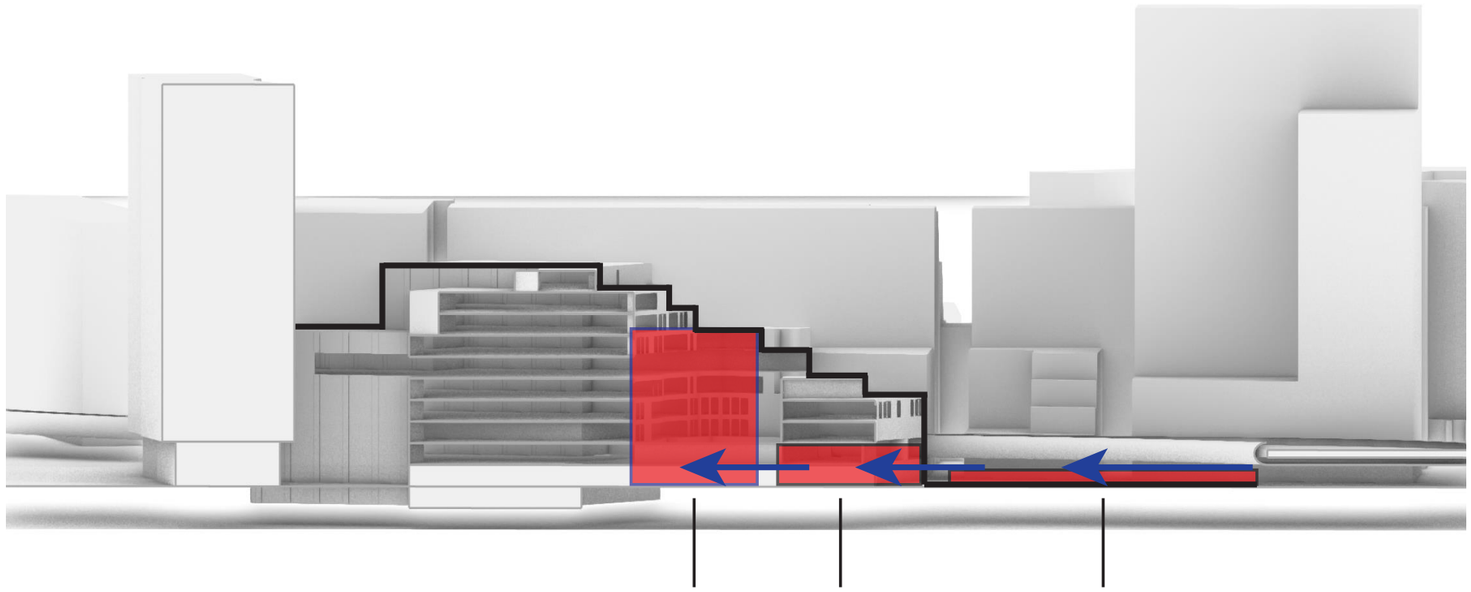
The original building has many roof terraces on different floors, and the height increases from south to north. These different volumes have rich spatial relationships and can be used

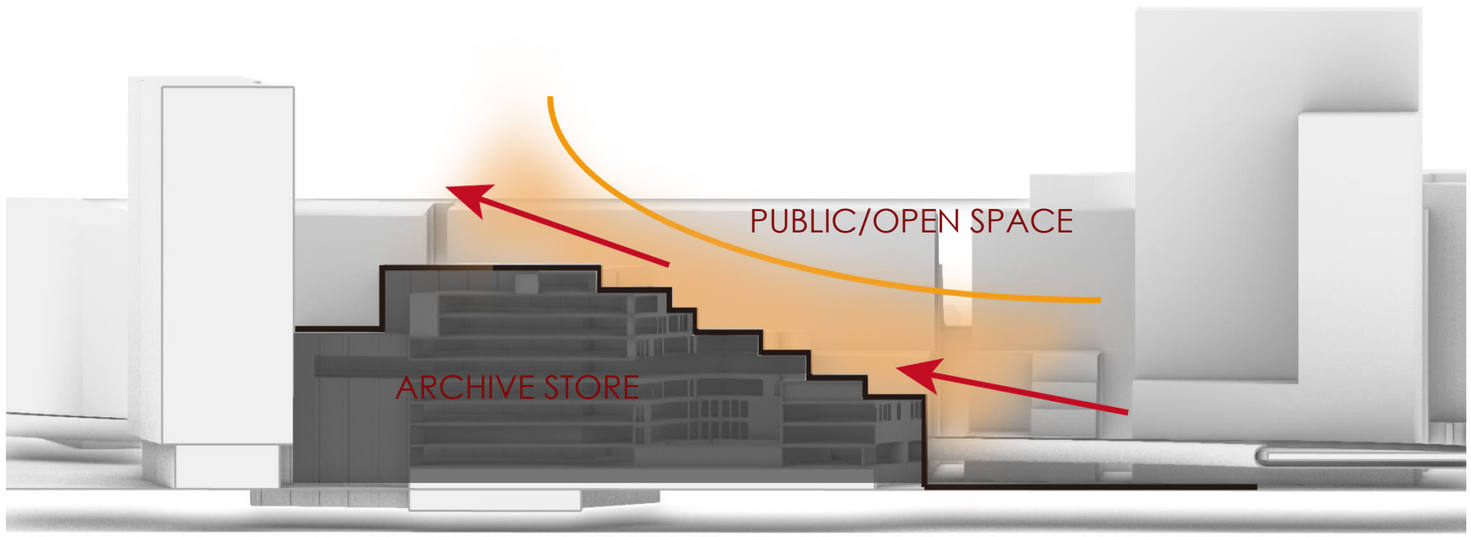


The square in front of the original building, the atrium, and the green space on the west side can all be used, and the large-area roof is implanted to transform it into different public spaces

Site Analysis

Circulation



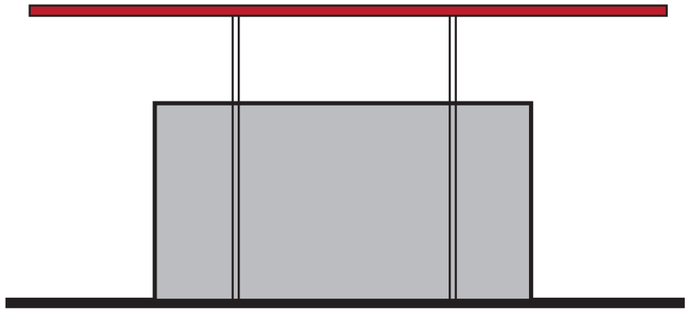


Strategies

Canopy

1

Detaching

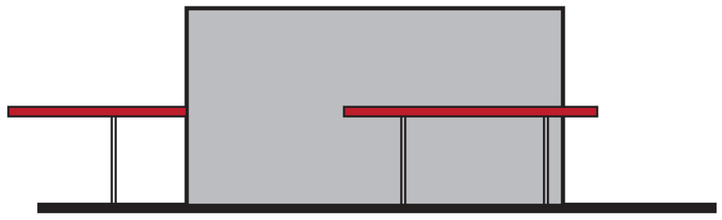


- Creat a large and continuous public space without intervening original building

New Volume

2

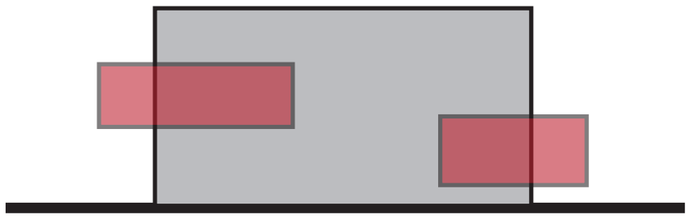
Attaching



- Creat more public grey space for city by attaching the orignial building

3

Insert



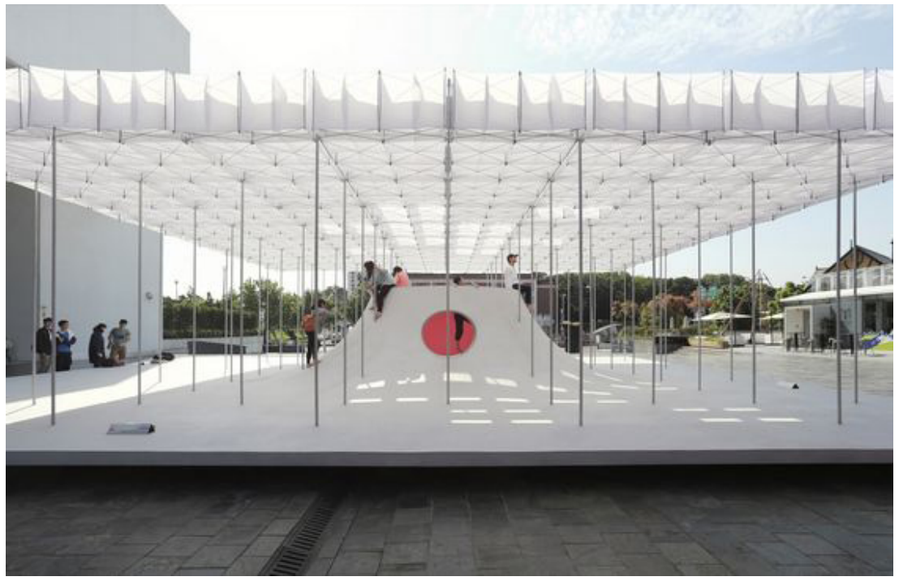
- Renovate the inside public space of the original building

Canopy

Detaching

Vieux Port, Marseille
Norman Foster

Children Village, Brazil
Aleph Zero & Rosenbaum



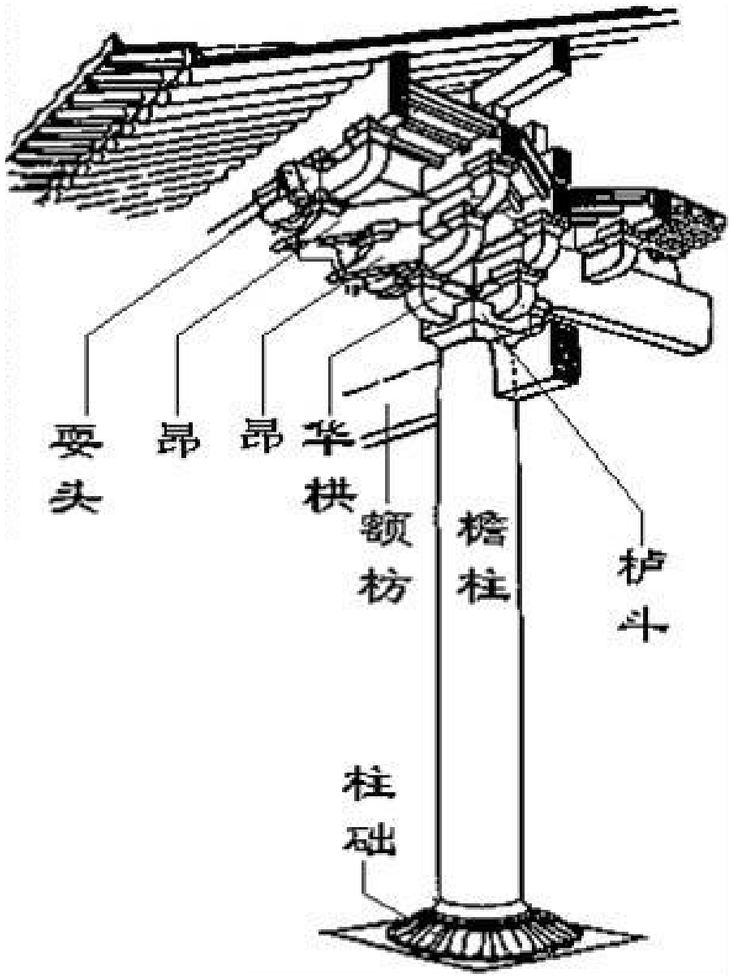
Floating Pavilion, Taiwan
Shen Ting Tseng

Stavros Niarchos Cultural Centre, Athens
Renzo Piano

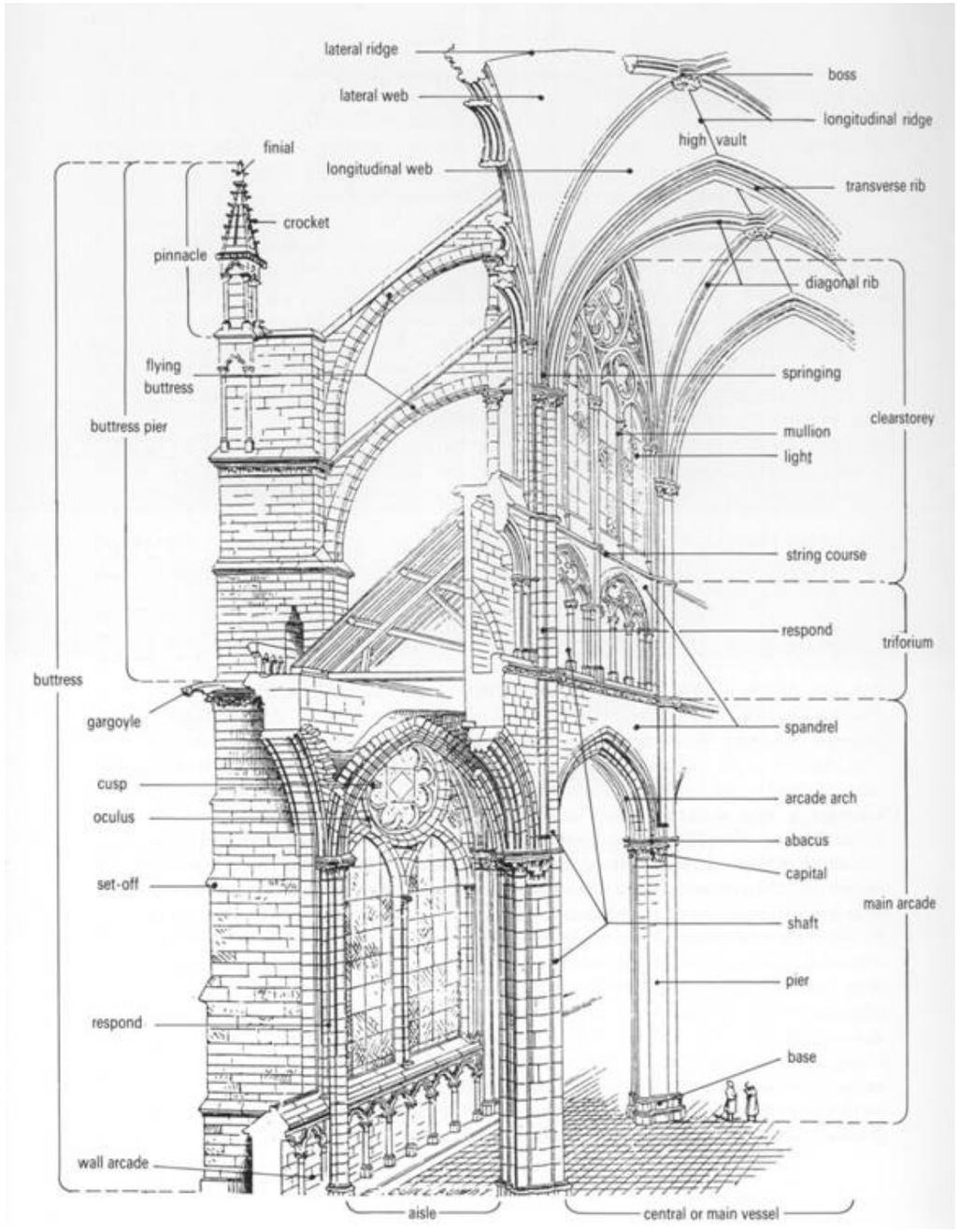
Structure Design

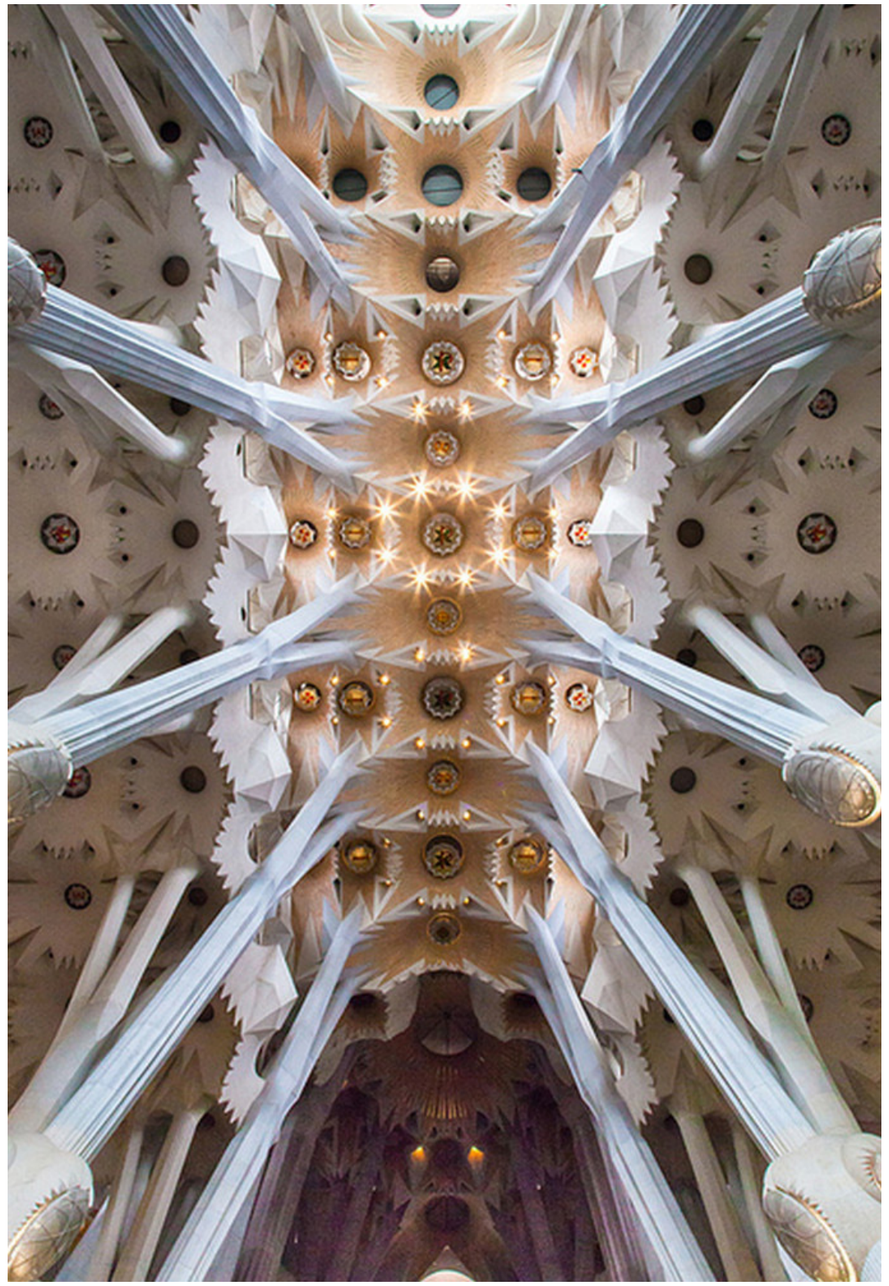
Requirements

- Structure landing part is small
- The structure grows from bottom to top
- Support a large and continuous roof
- Start from unit to a whole system



Dou Gong

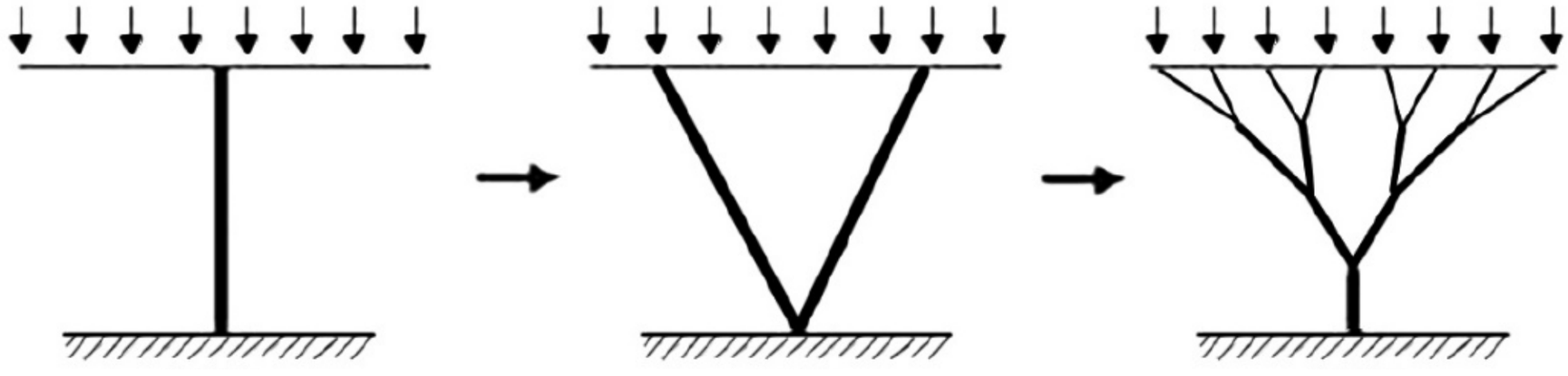




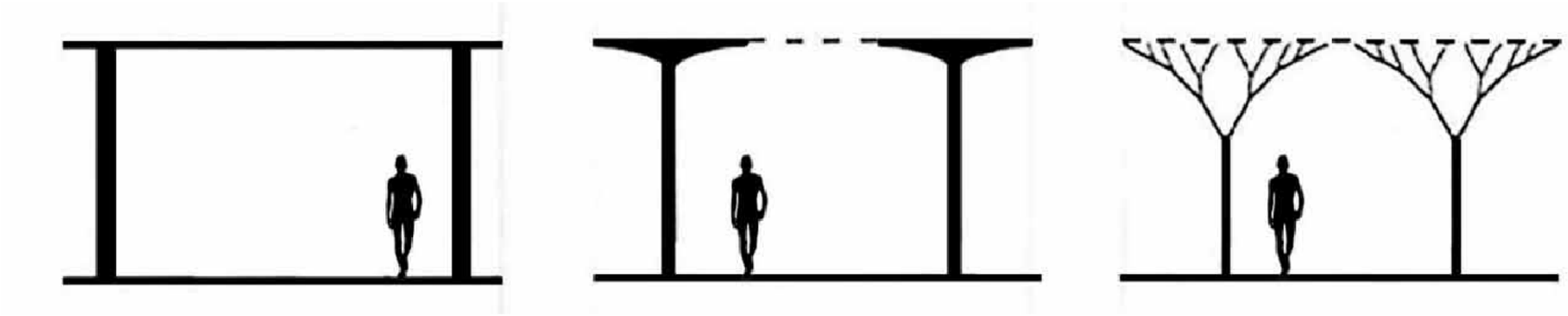
Antoni Gaudí, Sagrada Família

Structure Design

Tree shape column



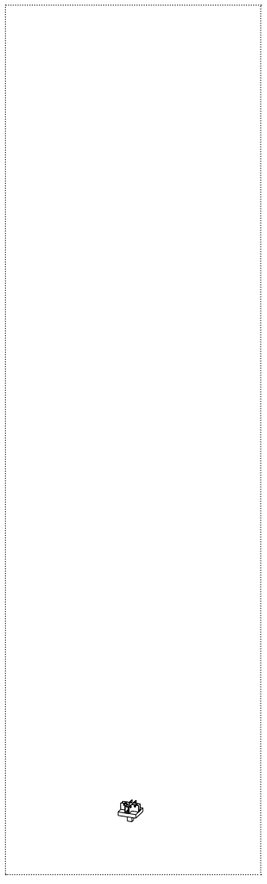
Traditional column V shape column Tree shape column



Space form of tree shape column

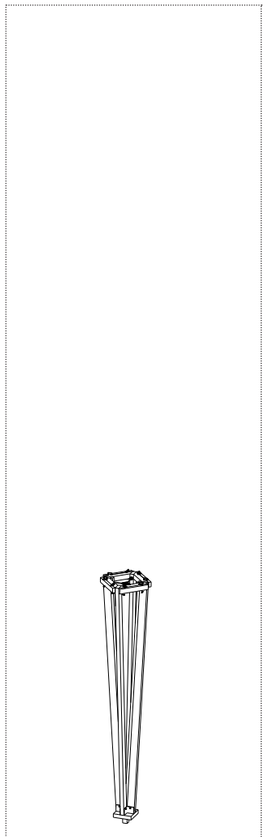
Structure Design

Base structure



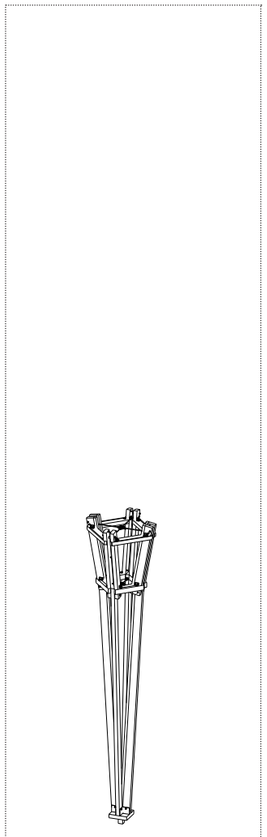
Four sets of steel plates connected to the main steel base plate of 1000/50mm and placed in a concrete base

Bottom part



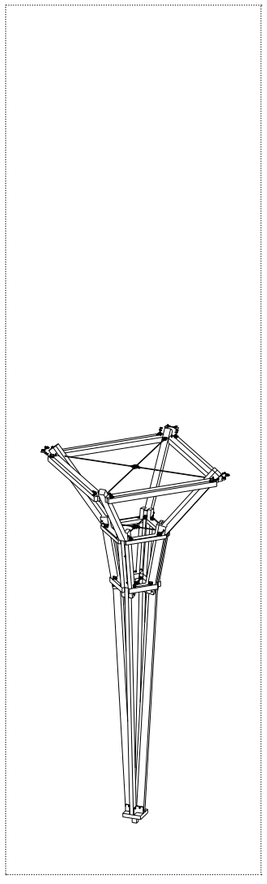
Four Glulam Timber columns connected with fixed wooden components and steel cables

The first branch expansion



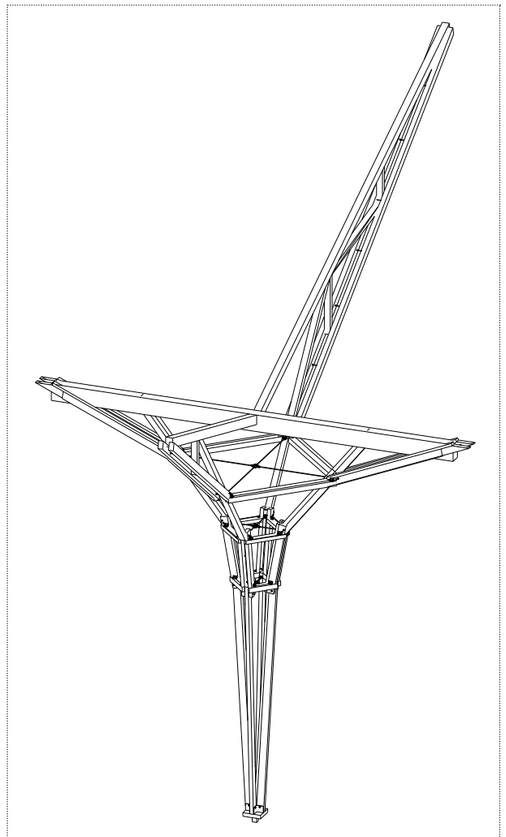
Two timber components form a group connect with the main bottom structure and then also fixed with other components on the top

The second branch expansion



Four structural branches expand and connected with the main structure with pin connection by bolts and steel plates

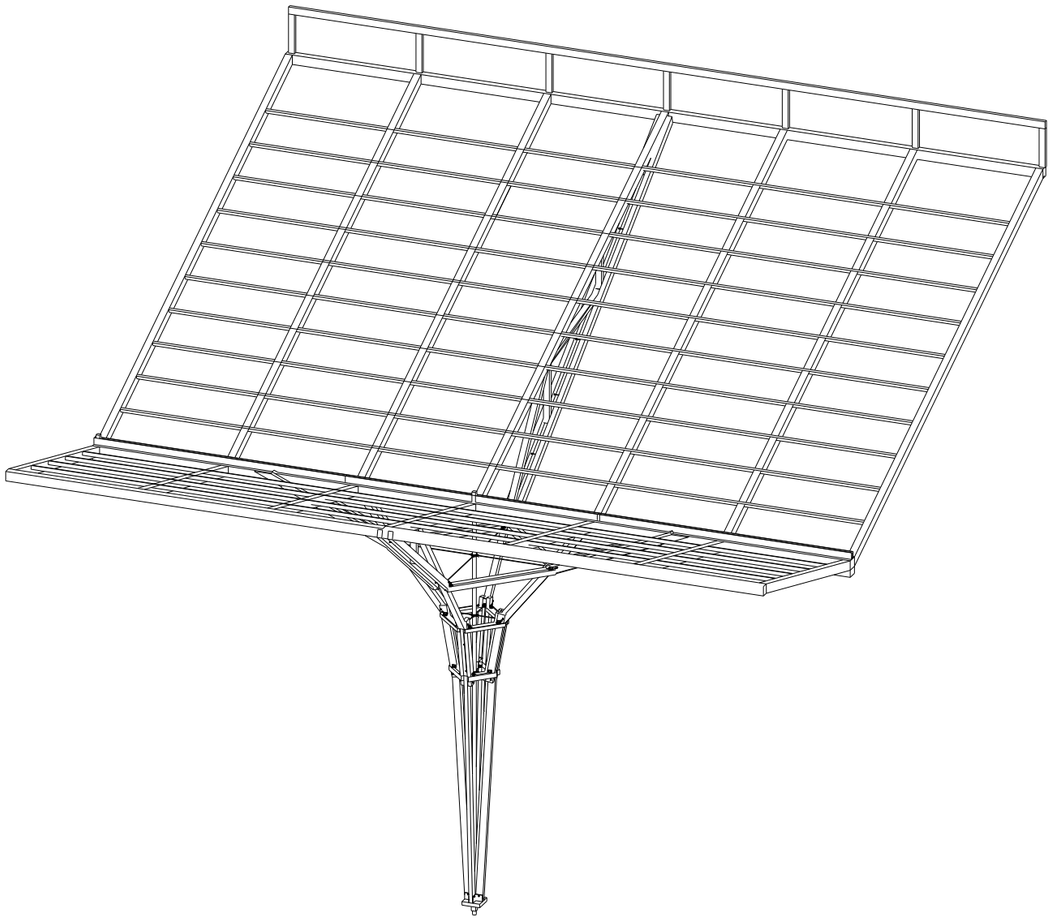
The last expansion connecting main beam



Again the two timber components connect with the main structure with pin connection by bolts and steel plates. And then they connect with the main timber beam

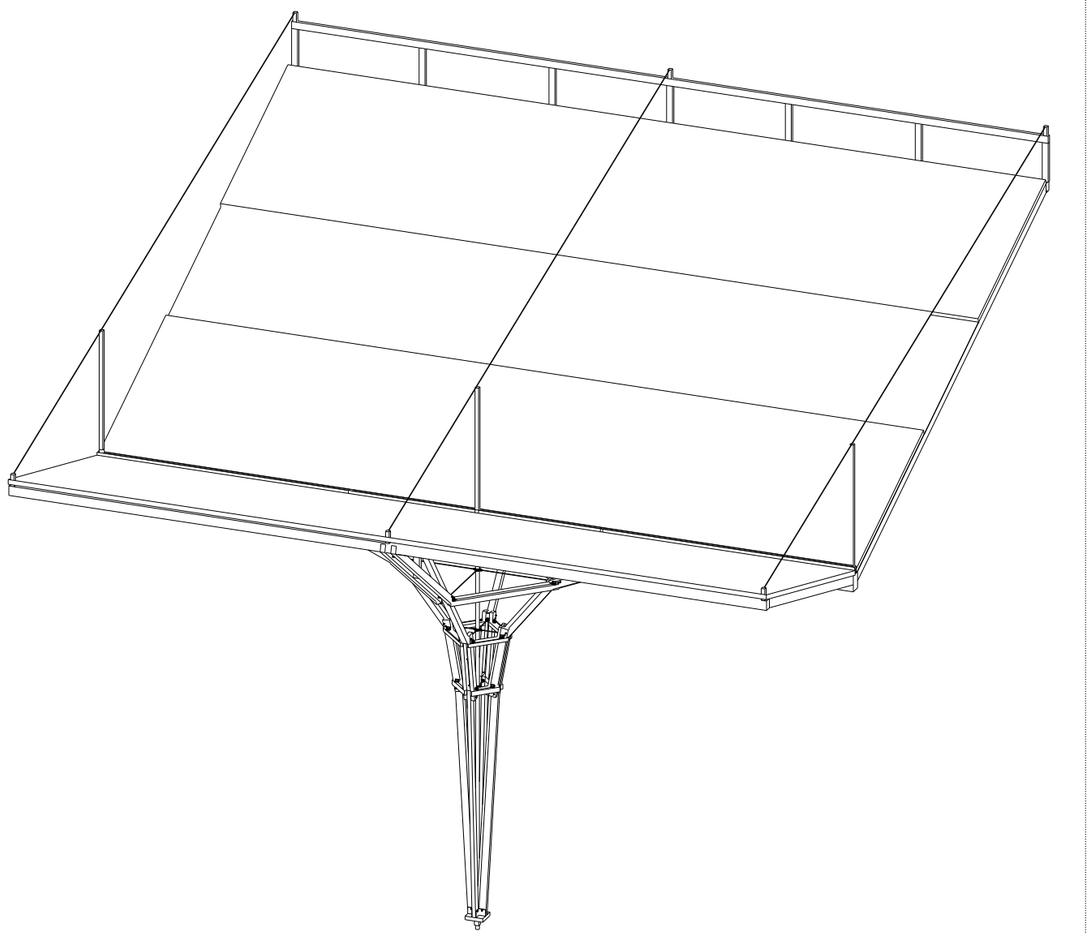
Structure Design

Roof strcuture



The main beam is connected by small-size secondary beams to form an integral roof structure (a grid wooden structure roof), which forms an integral unit structure with the main supporting structural columns at the bottom

Roof components



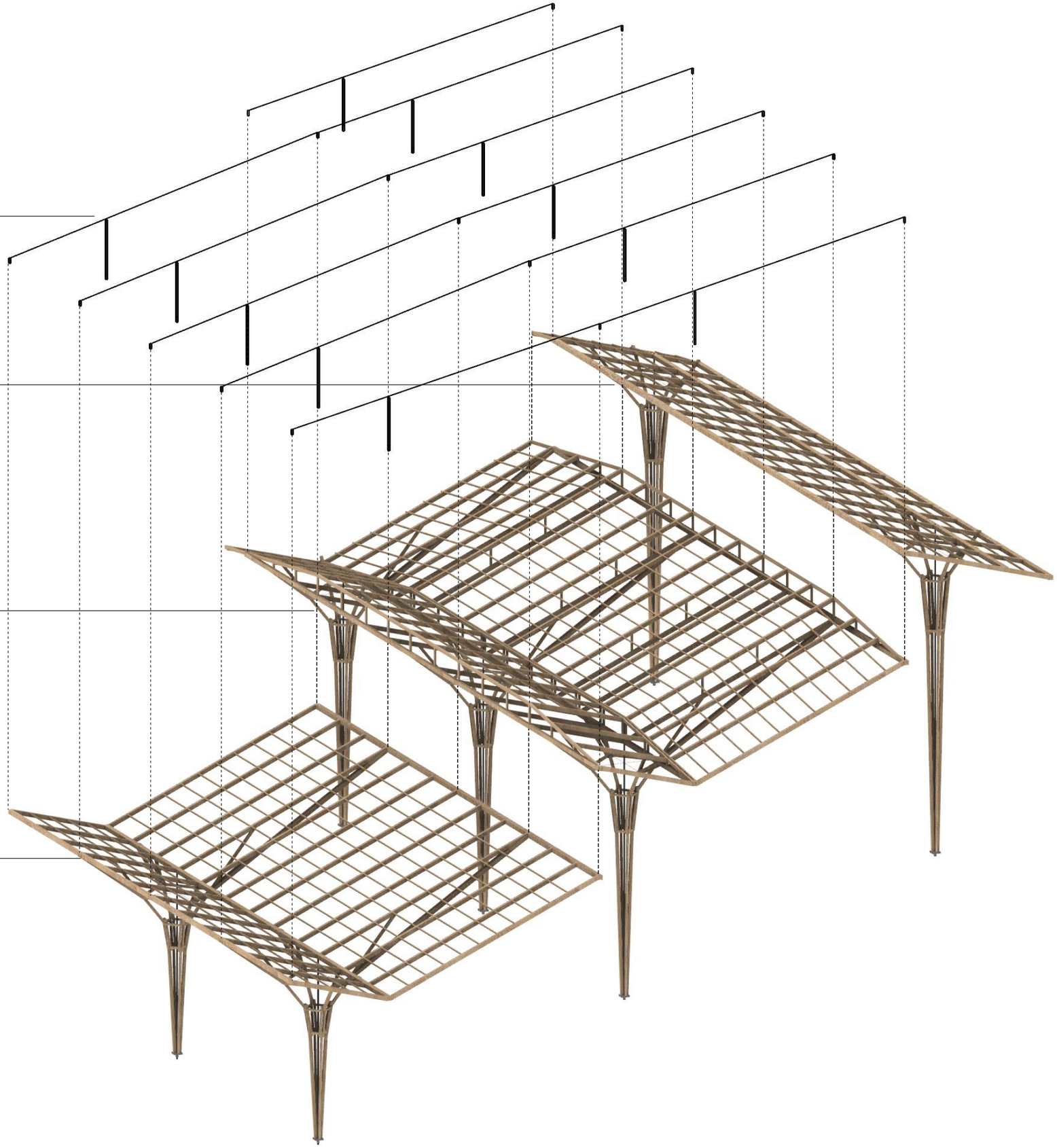
Lay roof panels, skylights, drainage ditches and other components on the roof structure. Steel cables are used as a tensile structure at the main structure to strengthen the stability of the entire roof

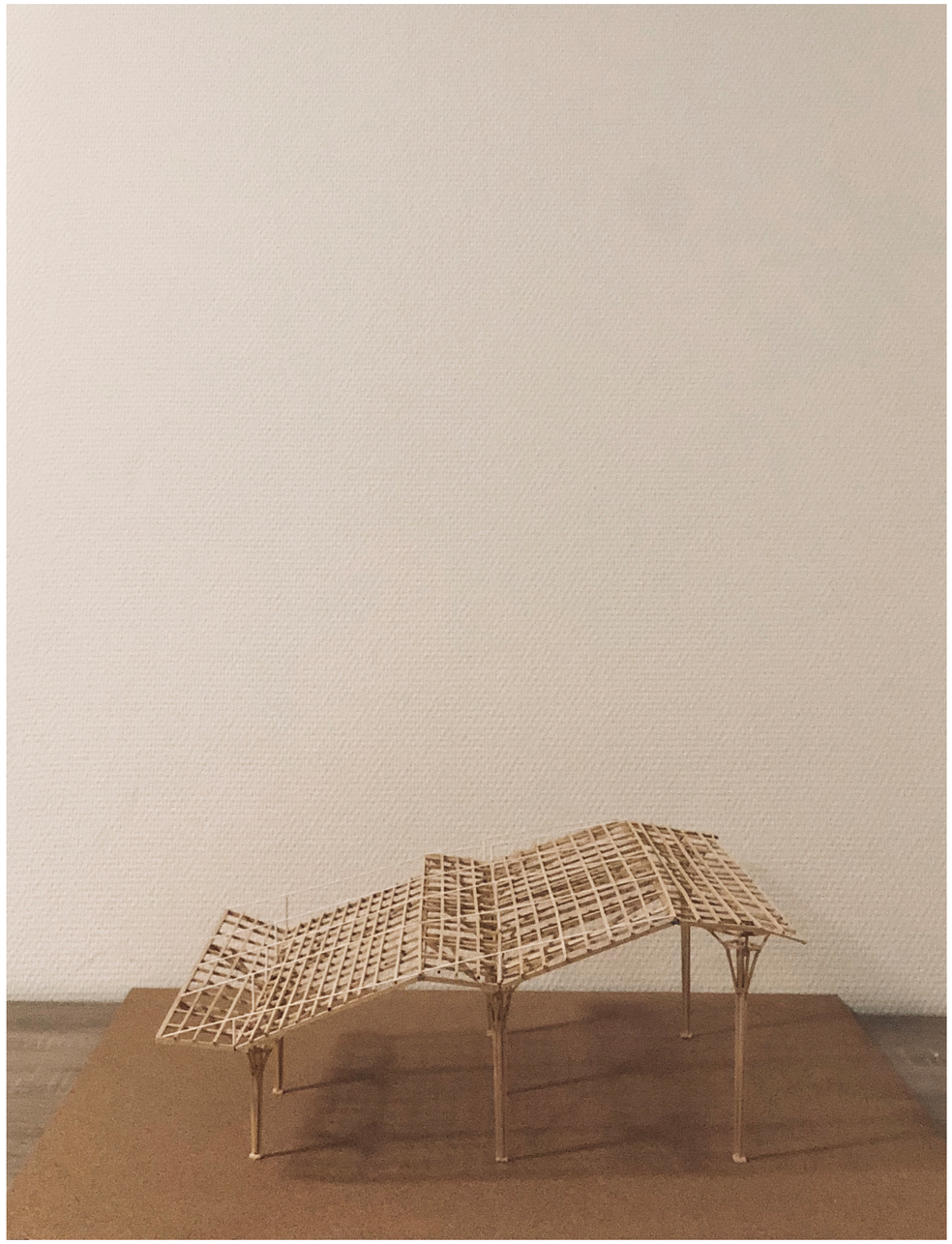
The top is stretched by a steel cable structure, which fixes the main beam and the main structure together to form a stable overall structural system

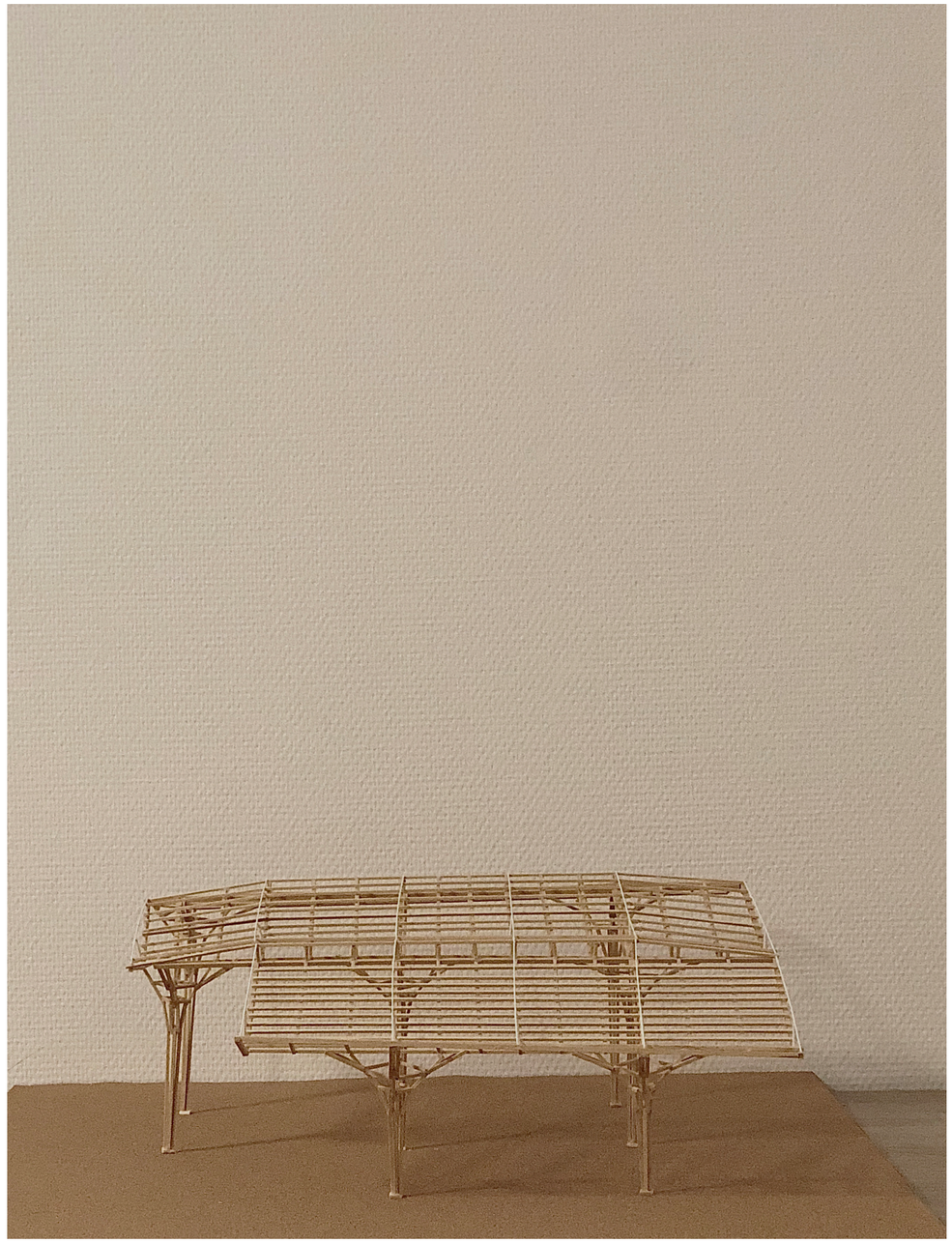
The third structure consists of two units forming a large roof with a height of about 30 meters

The second structure is composed of three unit bodies with a height of about 25 meters. The two wings of the roof are inclined downwards, the cross-section of the roof is trapezoidal, and a cavity is formed in the middle

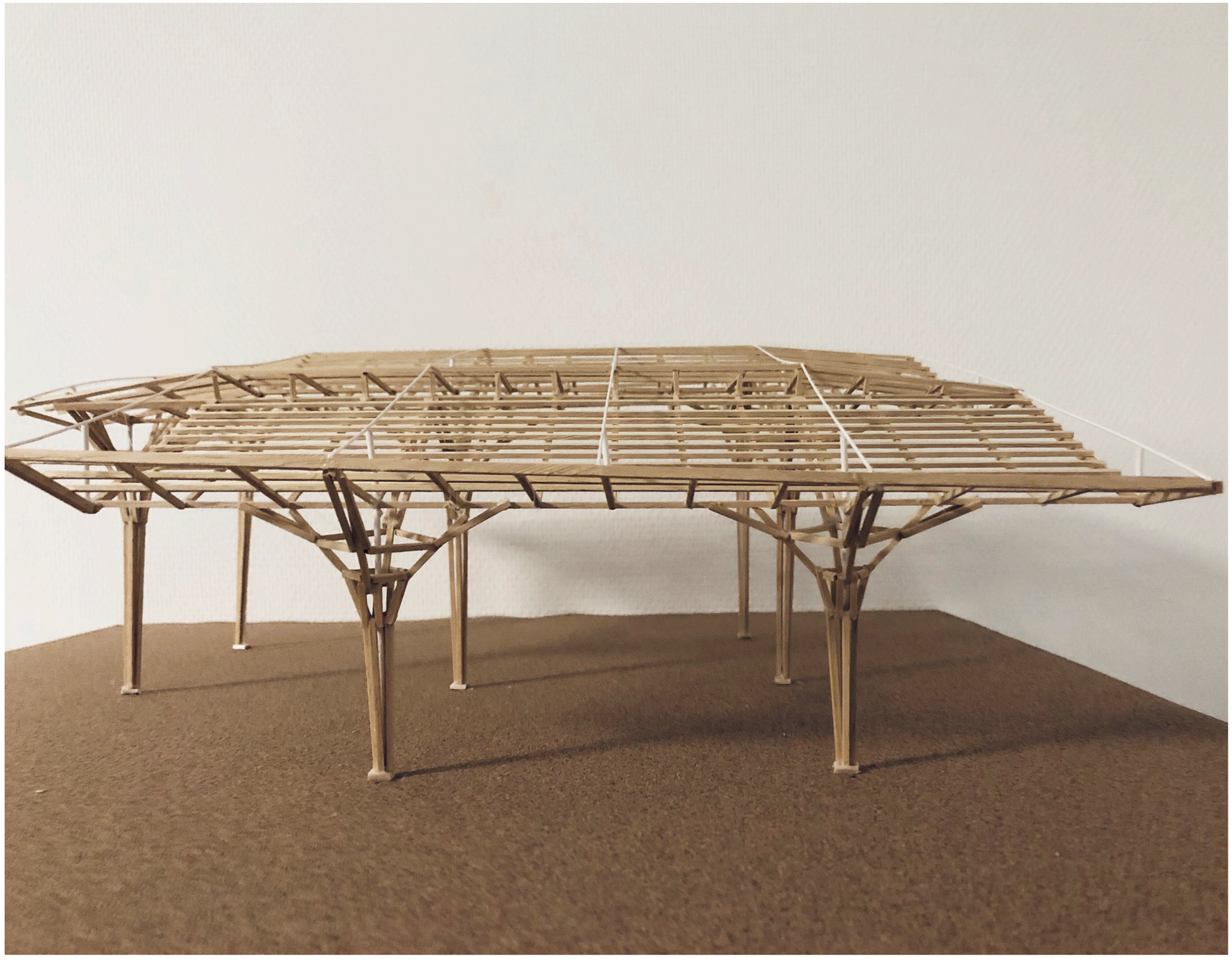
The first group of structures is composed of two units with a height of about 17 meters



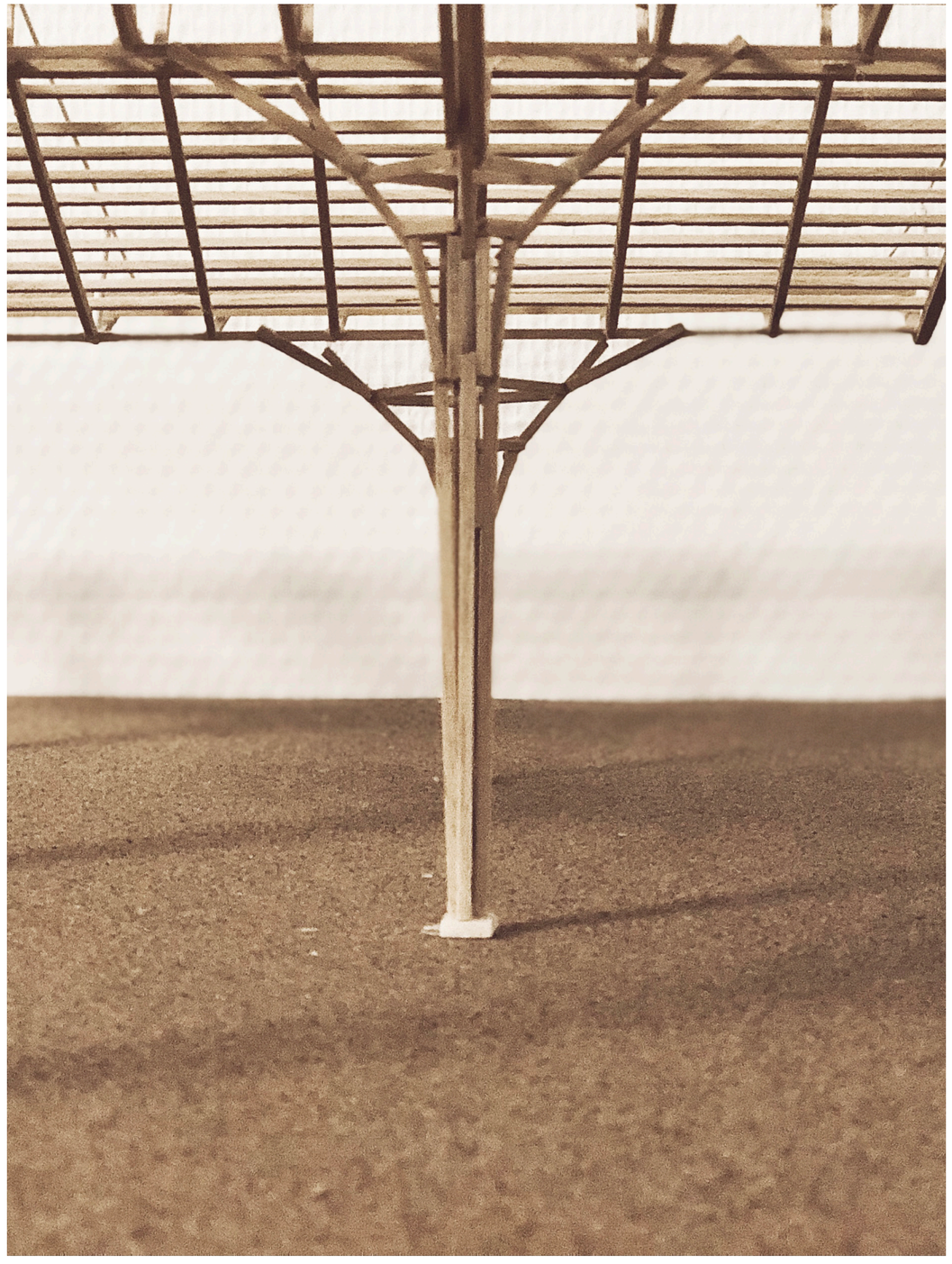




Structure Model



Structure Model



Structure Model - Unit

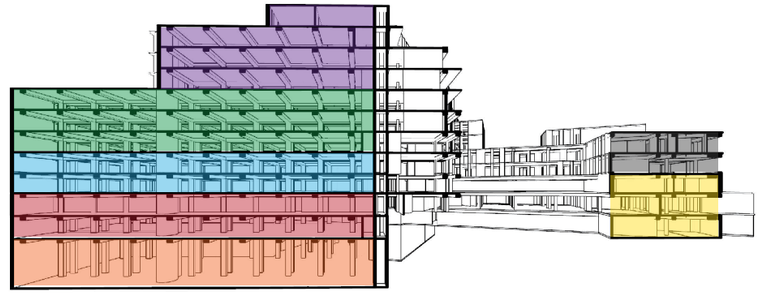
New Volume

Attaching + Insert

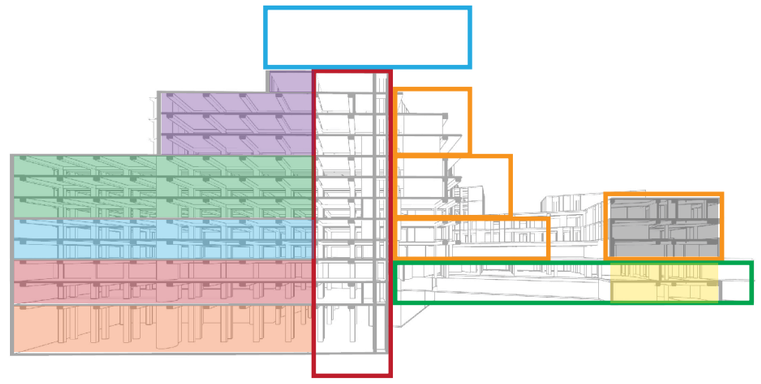
Function

Original Function

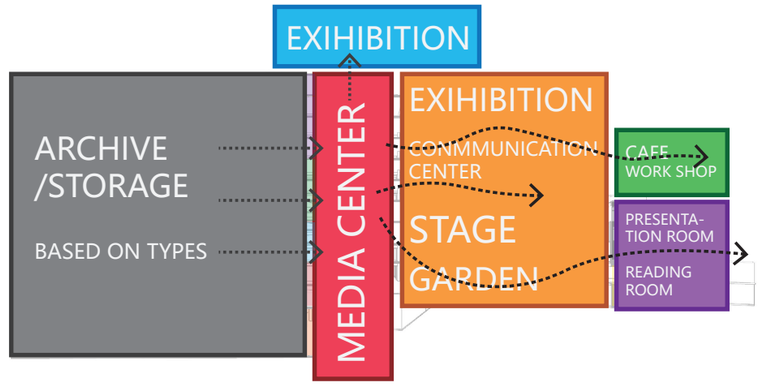
New Function



Original Building



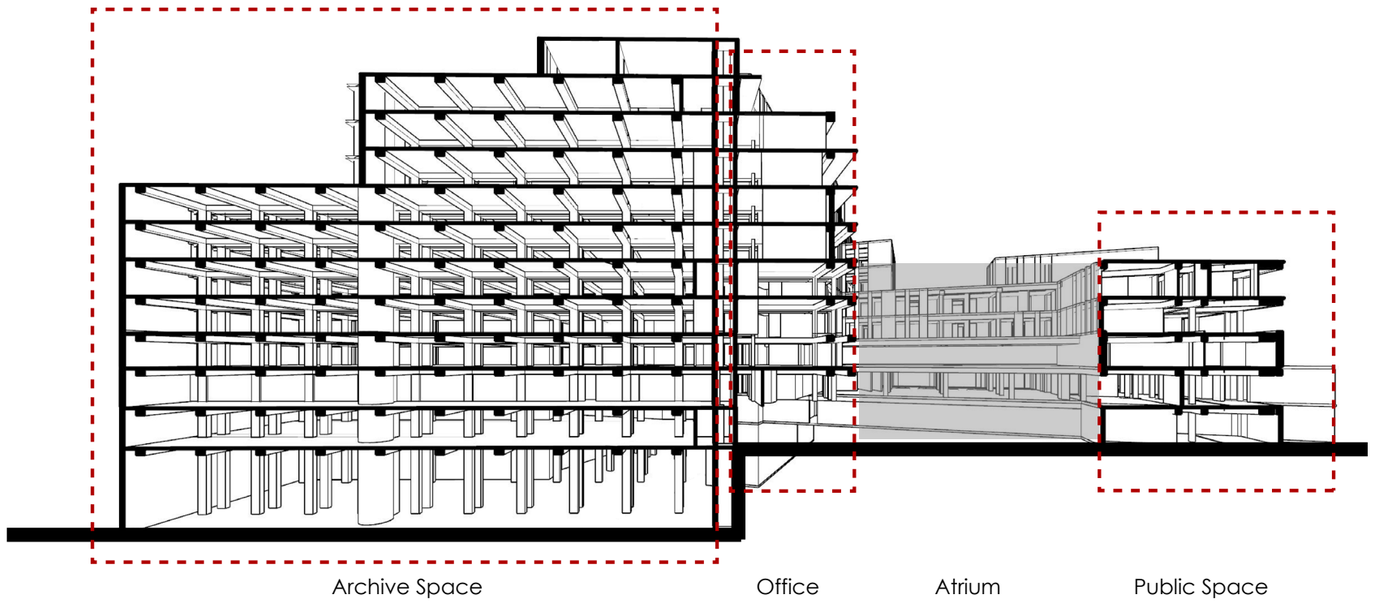
Space Redefine



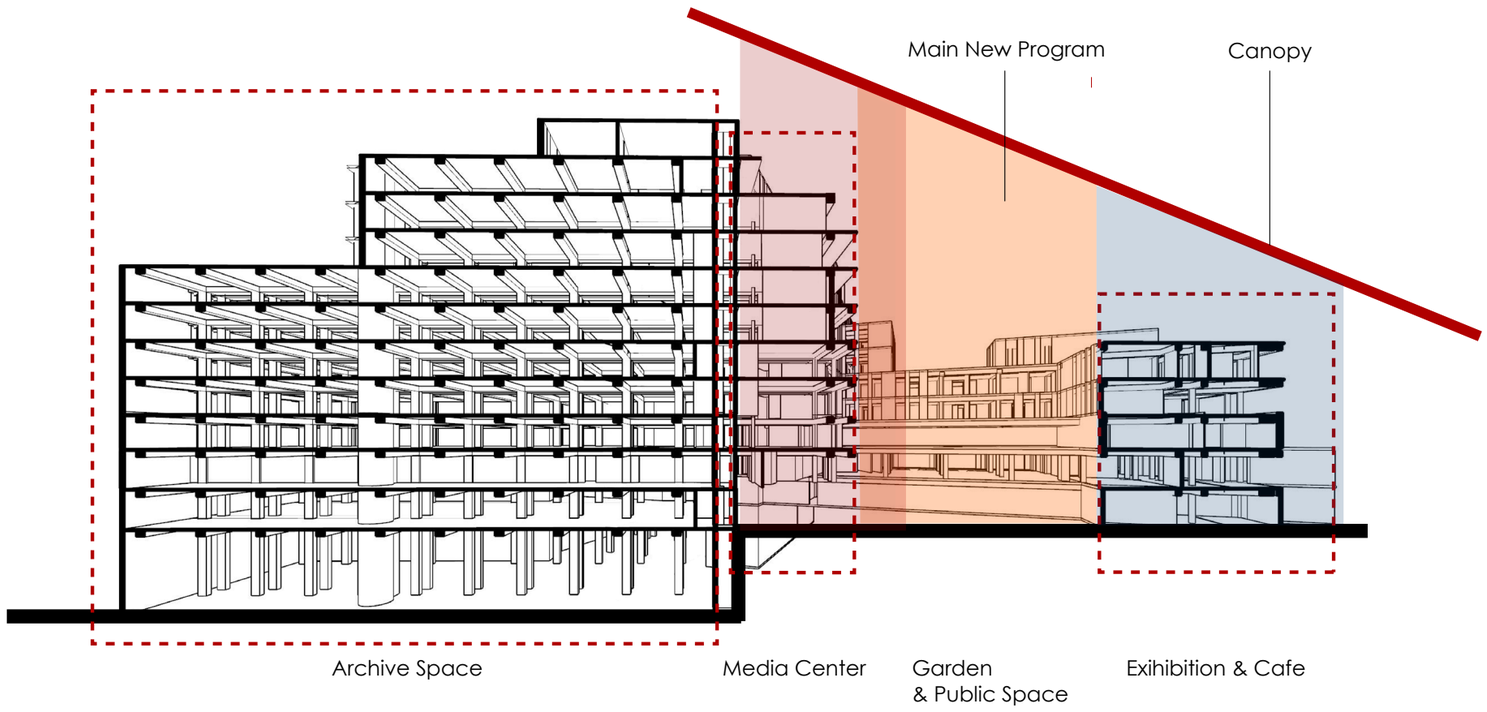
New Space Relationship

Space Relationship

Original



New

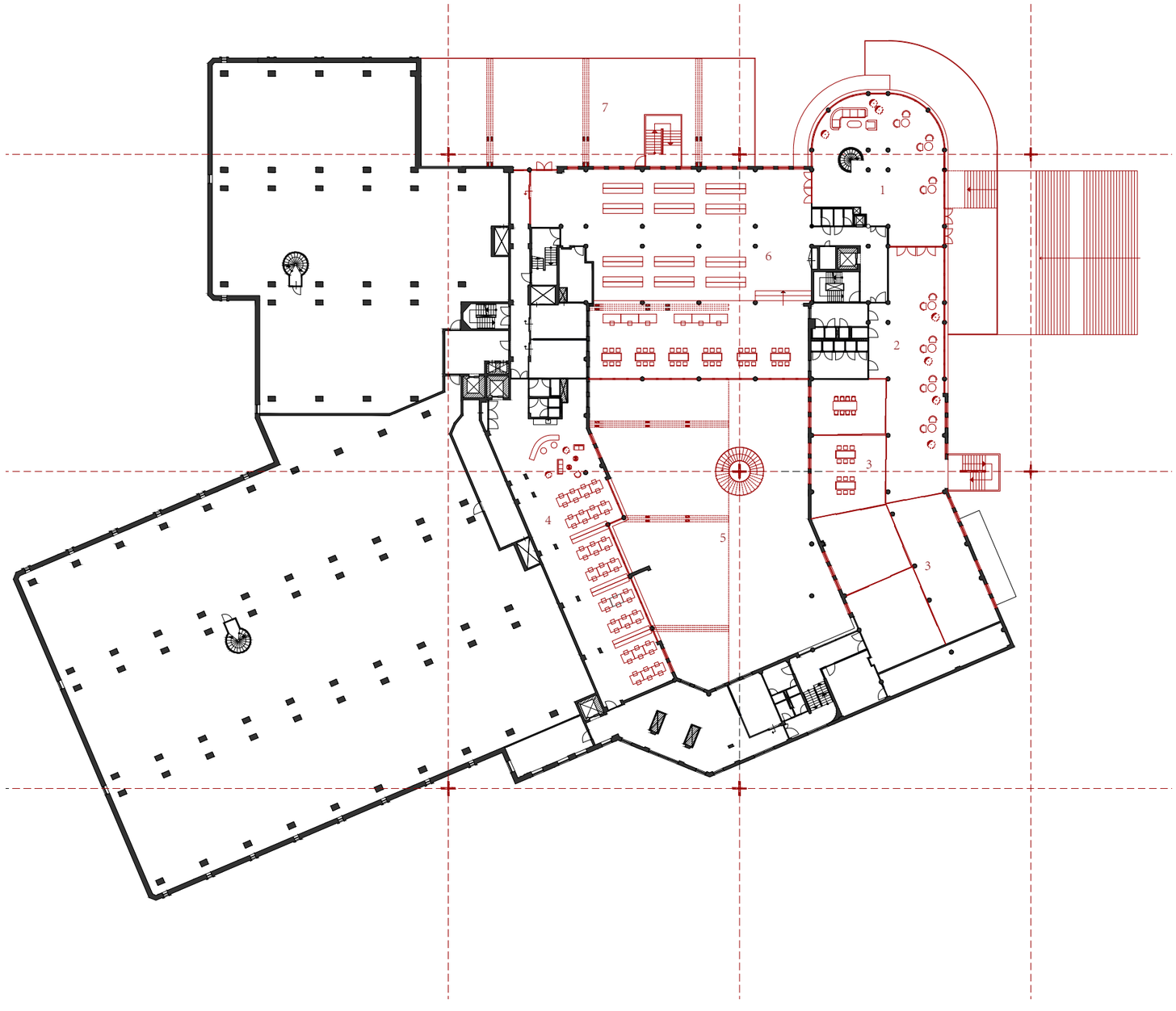


Plan

1 Public Hall
2 Temporary Exihibition
3 Shop
4 Atrium
5 Reading Center
6 Showroom

Floor L1 Plan 1:500

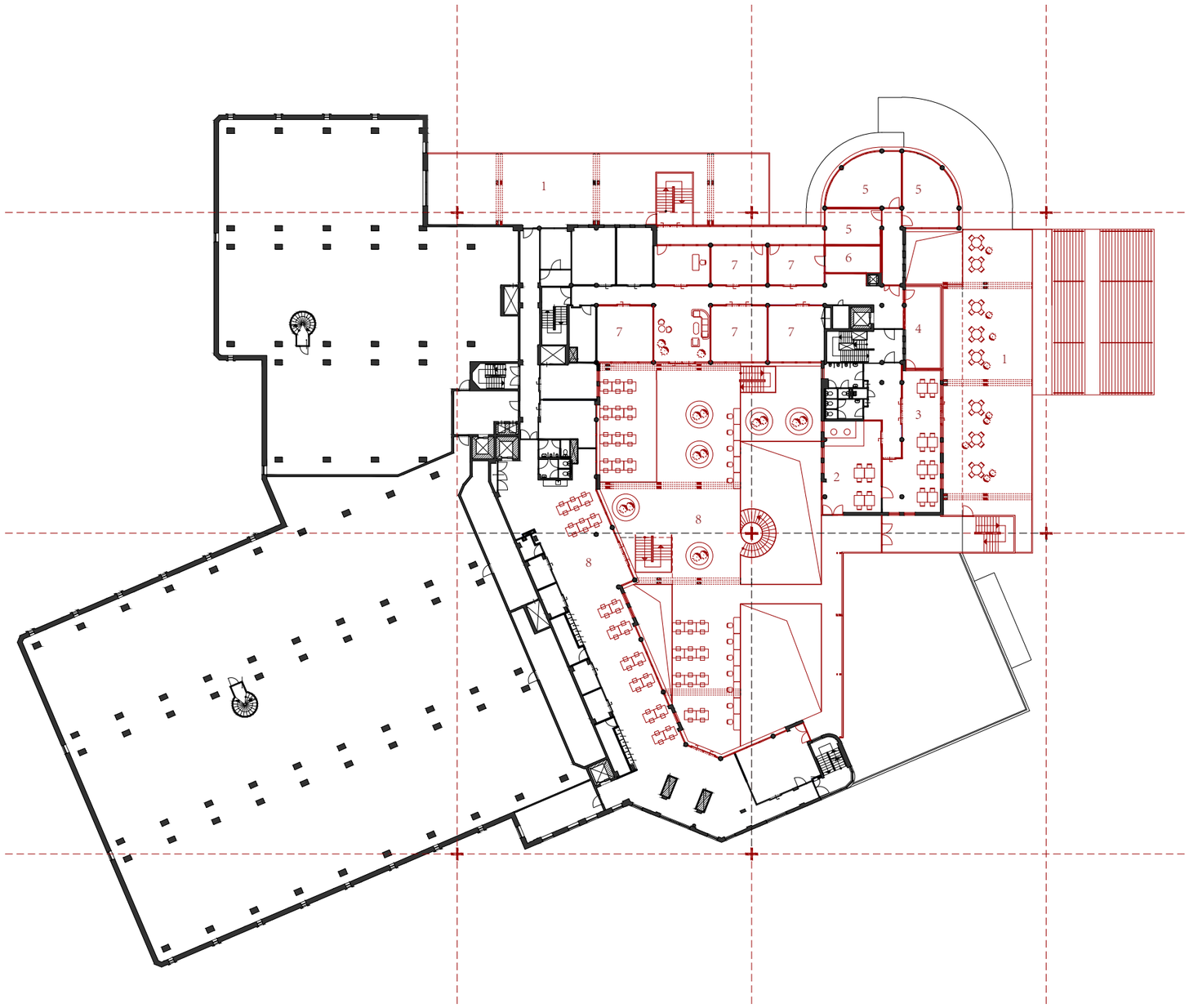
Plan



Floor L2 Plan 1:500

1 Public Hall
2 Lounge
3 Exihibition & Workshop
4 Office
5 Atrium
6 Reading Center
7 Terrace

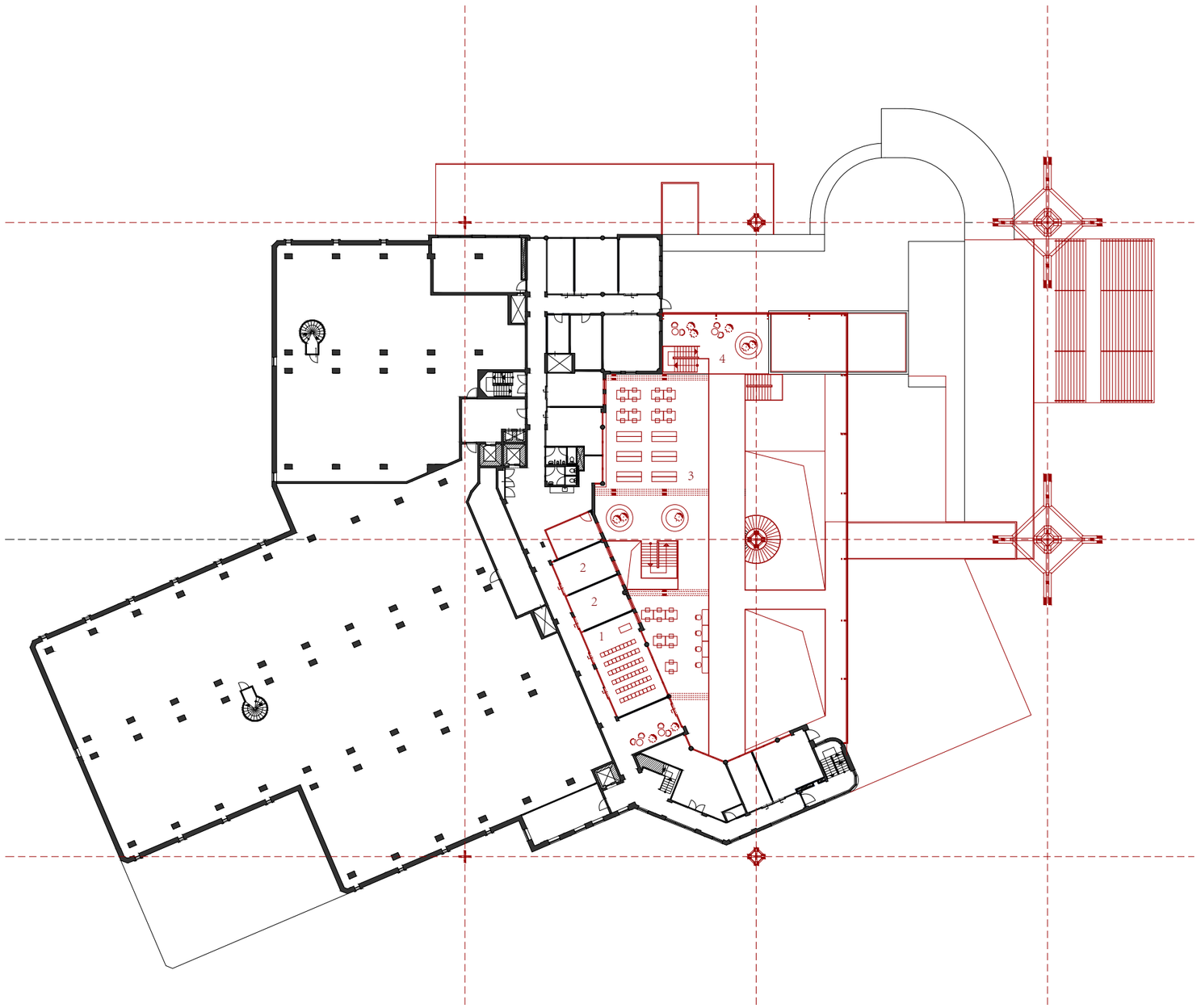
Plan



1 Terrace
2 Reception
3 Cafe
4 Smoking Room
5 Presenting Room
6 Store Room
7 Study Room
8 Media Center

Floor L4 Plan 1:500

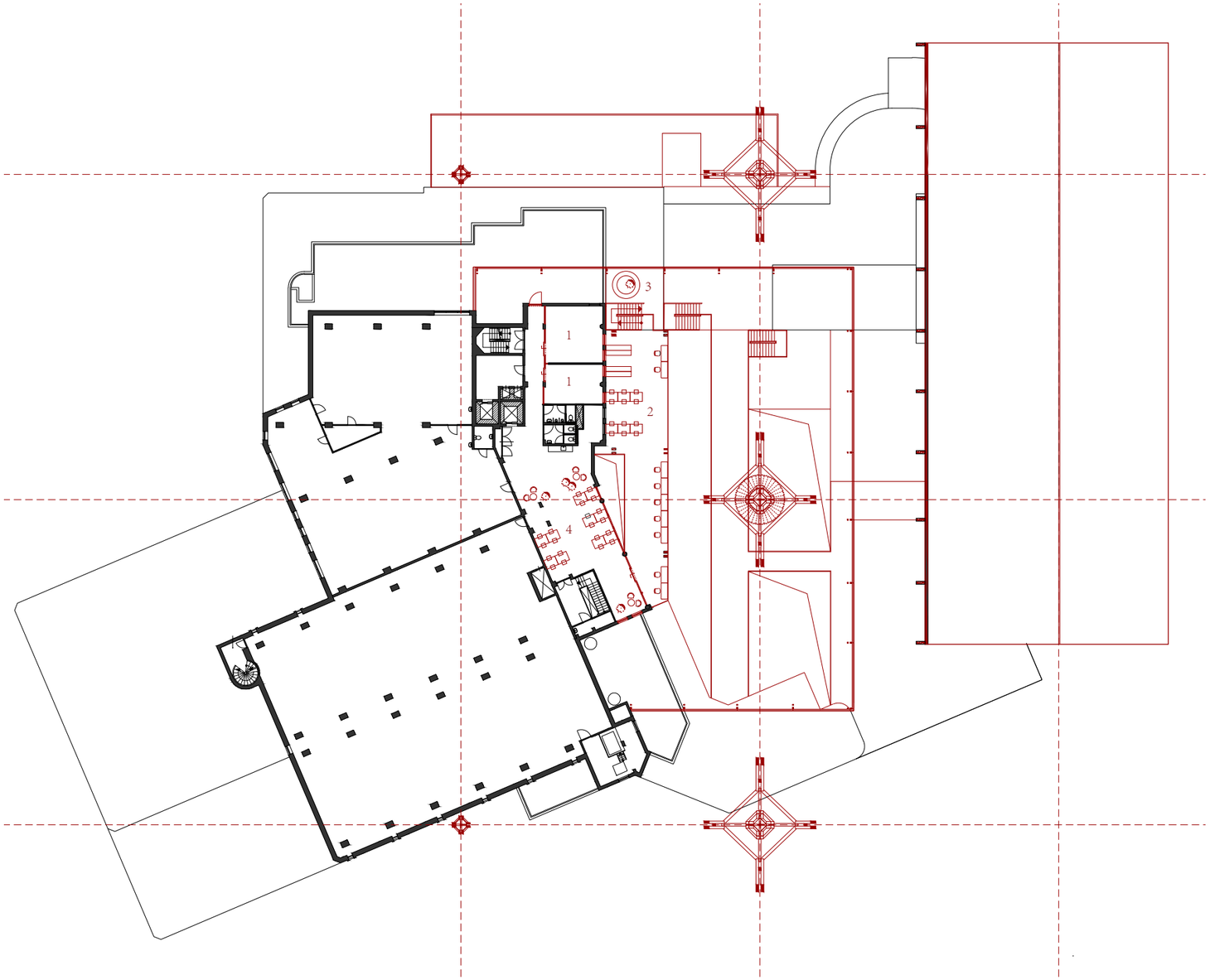
Plan



1 Presenting Room
2 Meeting Room
3 Media Center
4 Rest Area

Floor L6 Plan 1:500

Plan

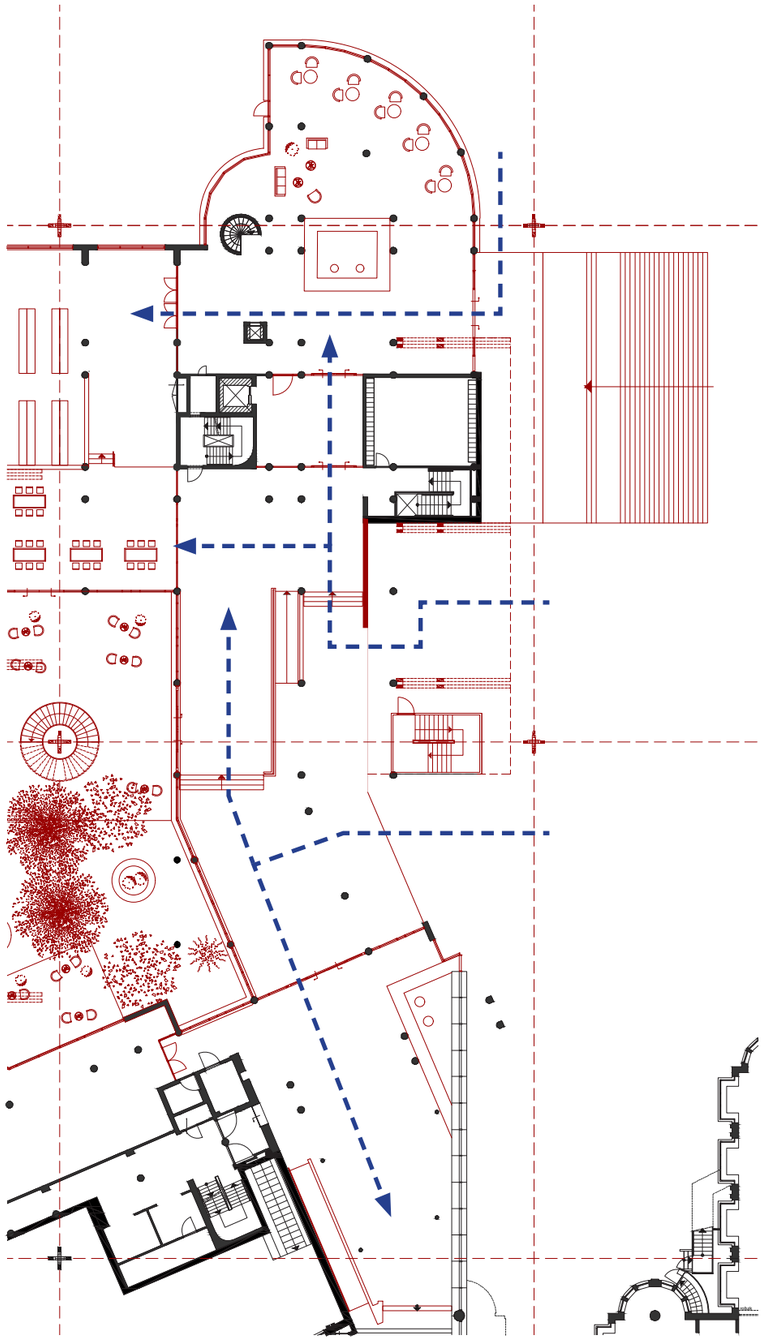


1 Office
2 Media Center
3 Rest Area
4 Public Education

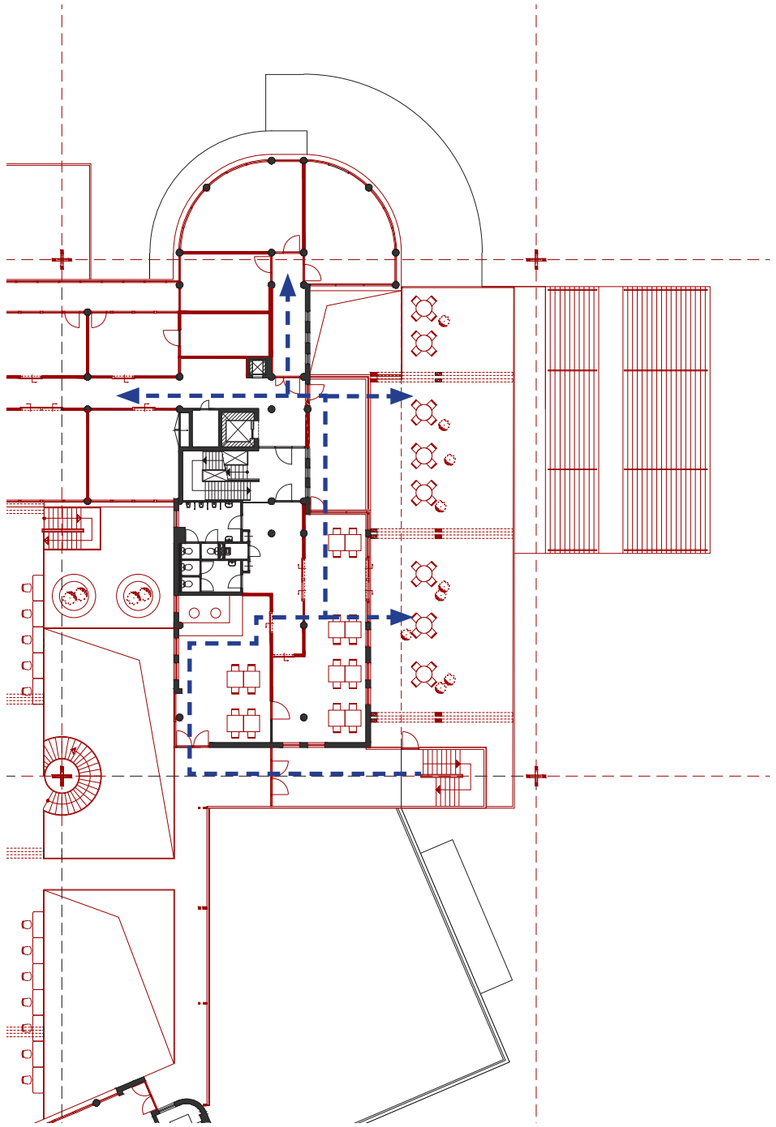
Floor L8 Plan 1:500

Entrance & Terrace

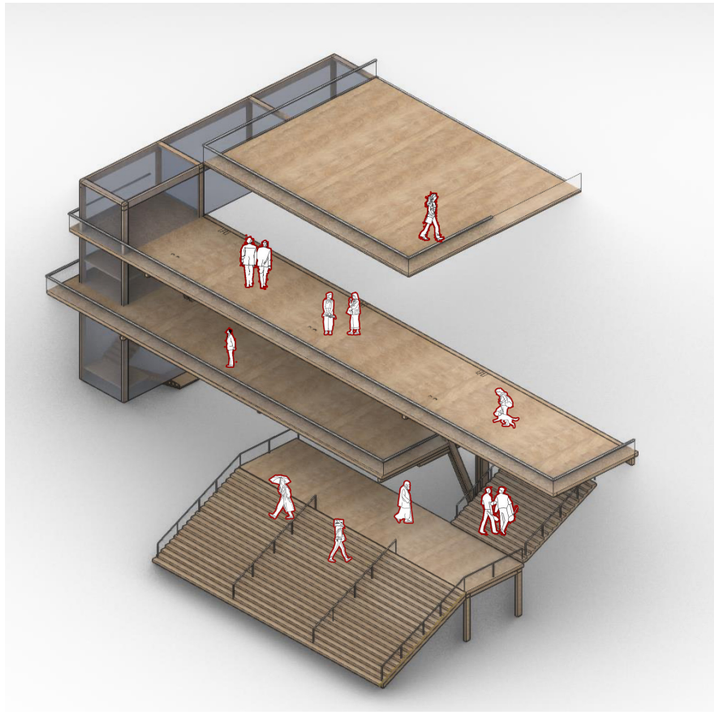
Attaching

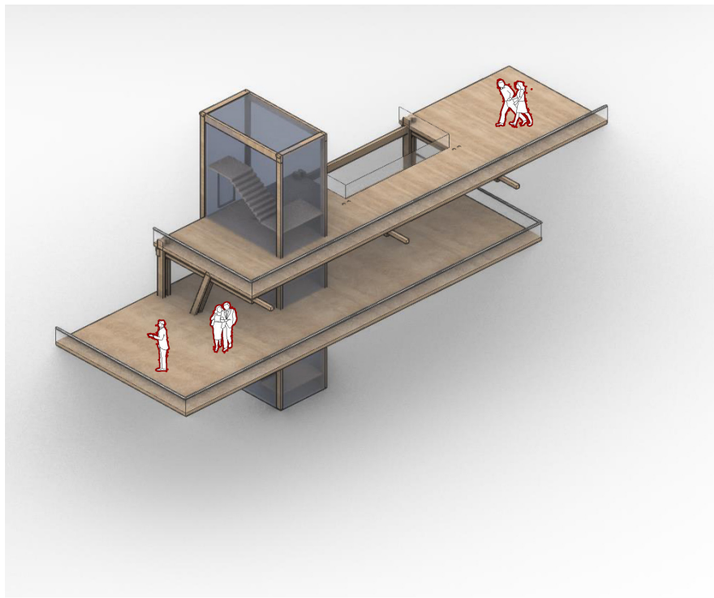


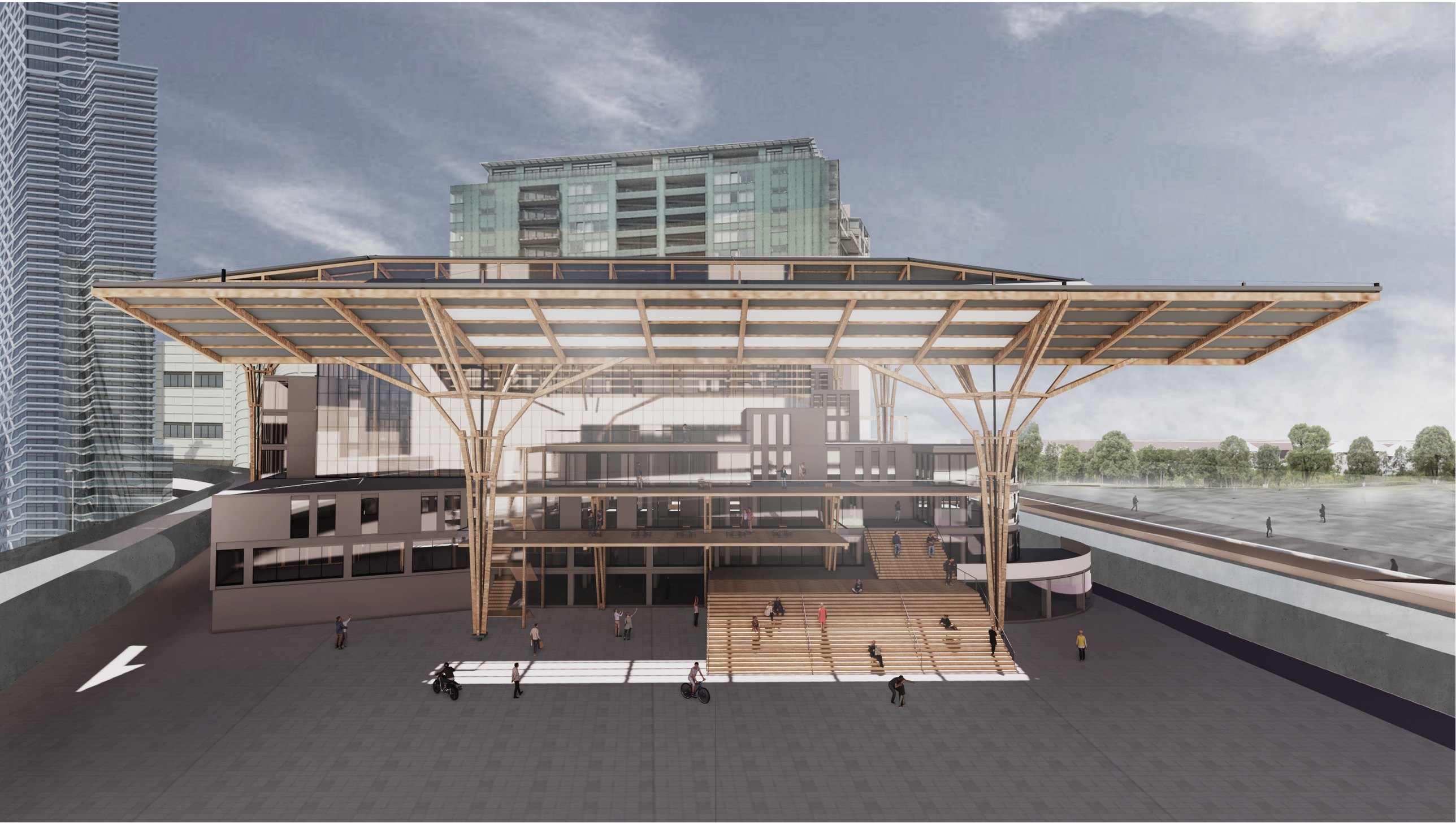
L1 Floor Plan



L4 Floor Plan

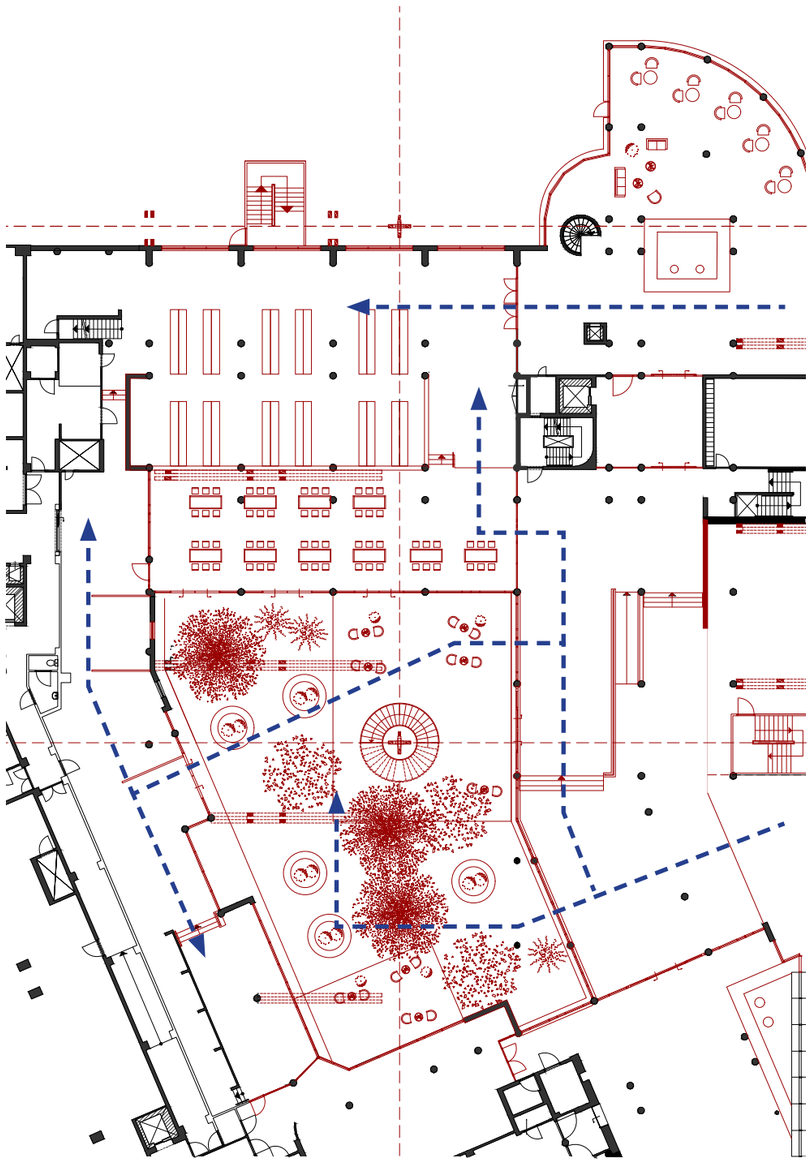




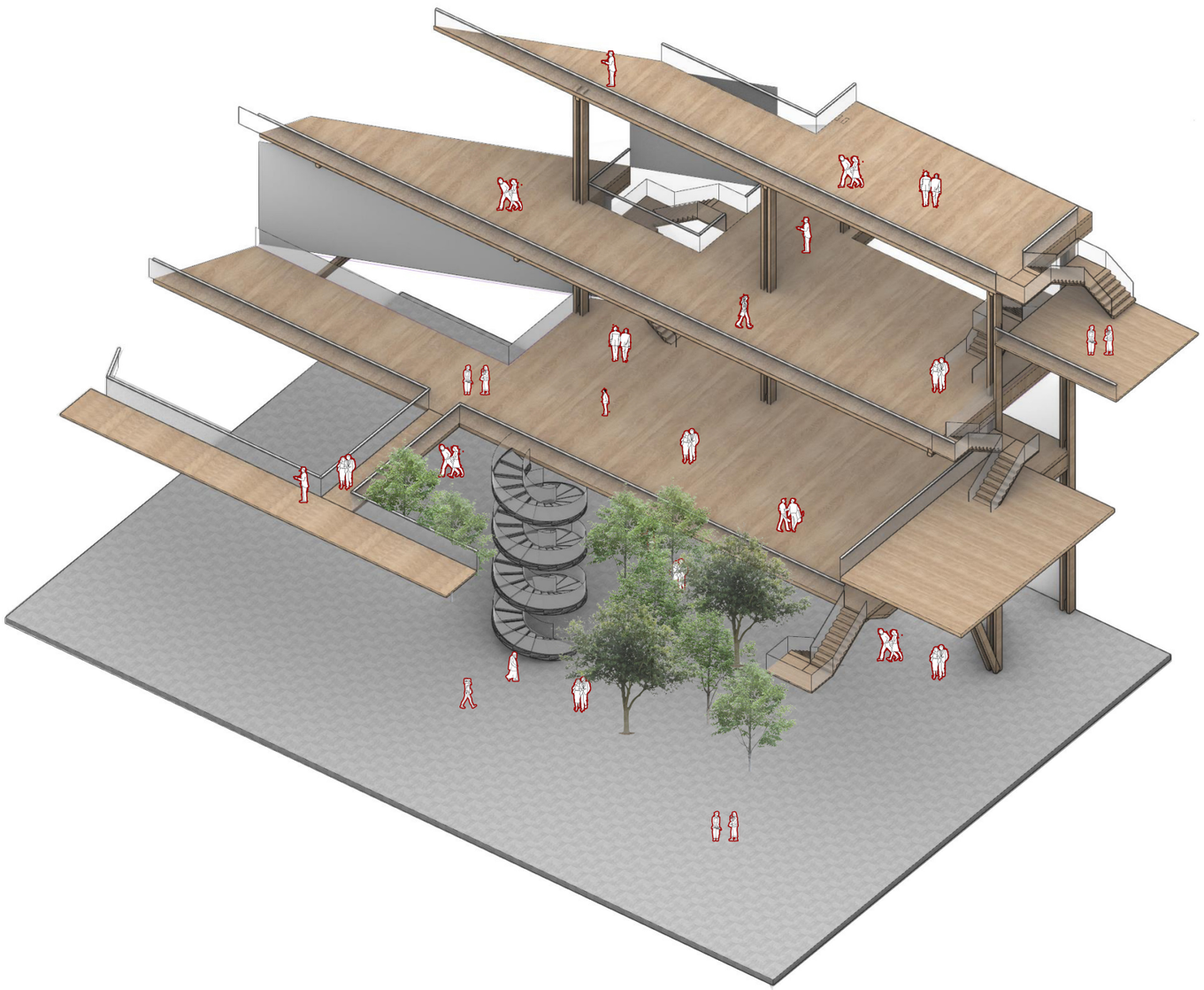


Atrium & Media Center

Attaching

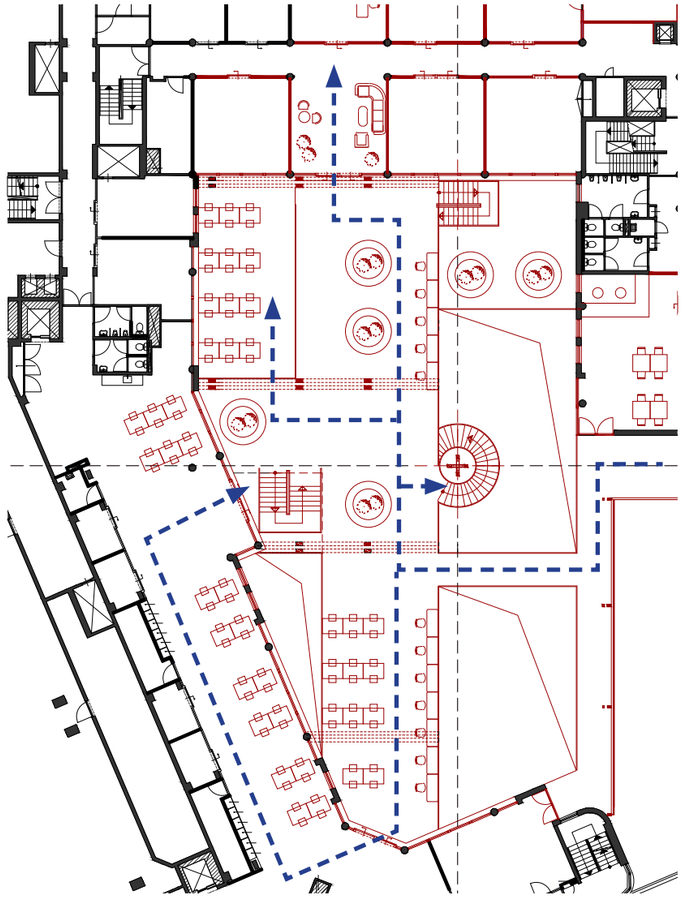


L1 Floor Plan

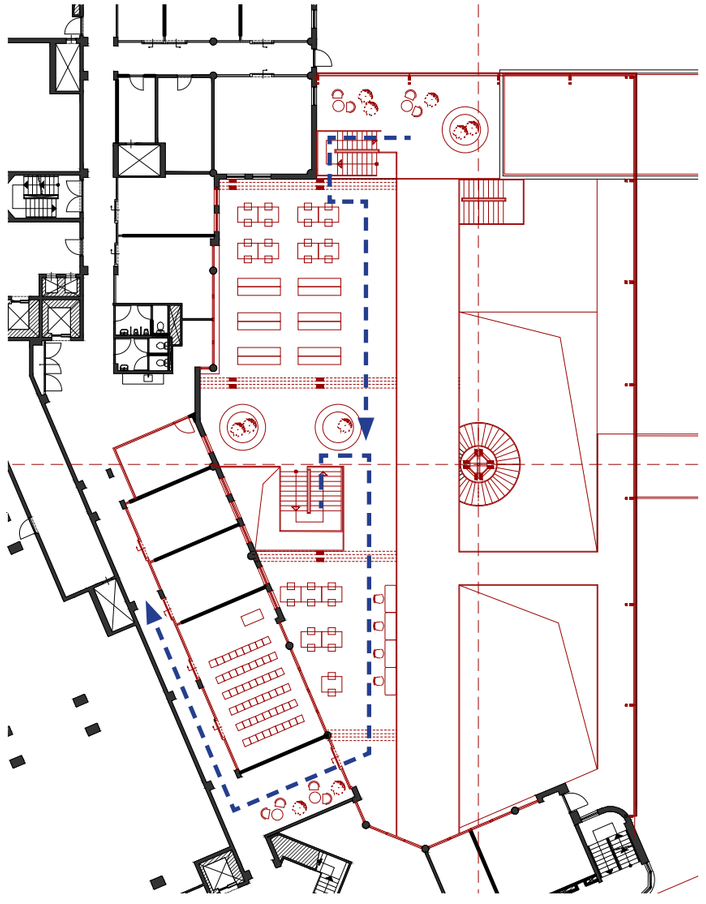


Atrium & Media Center

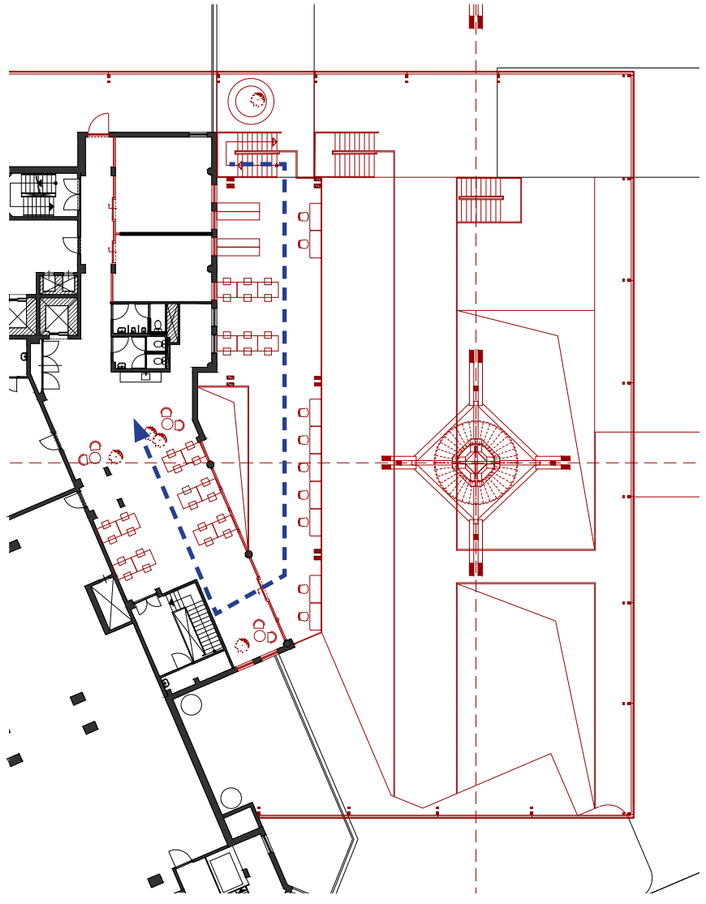
Attaching



L4 Floor Plan



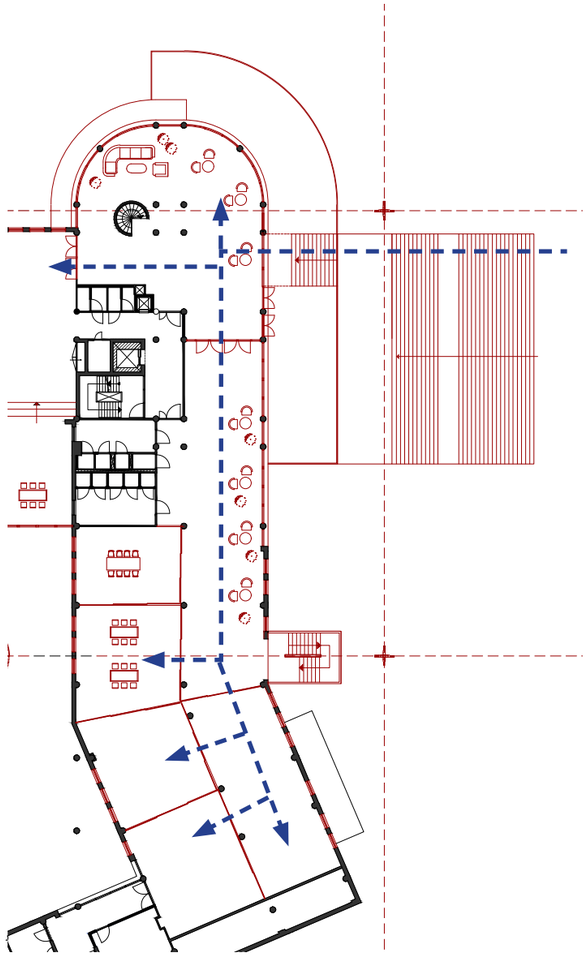
L6 Floor Plan



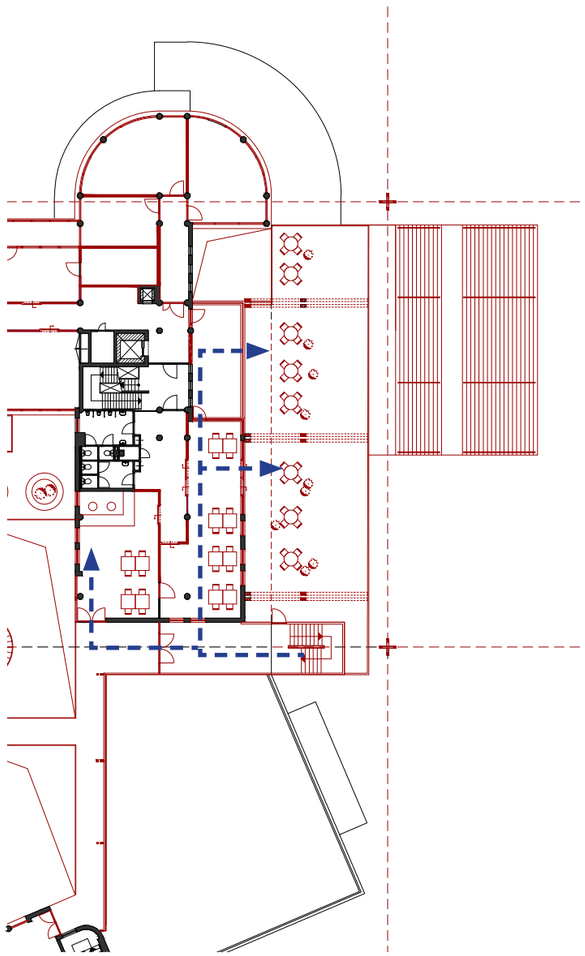
L8 Floor Plan

Exihibition & Cafe

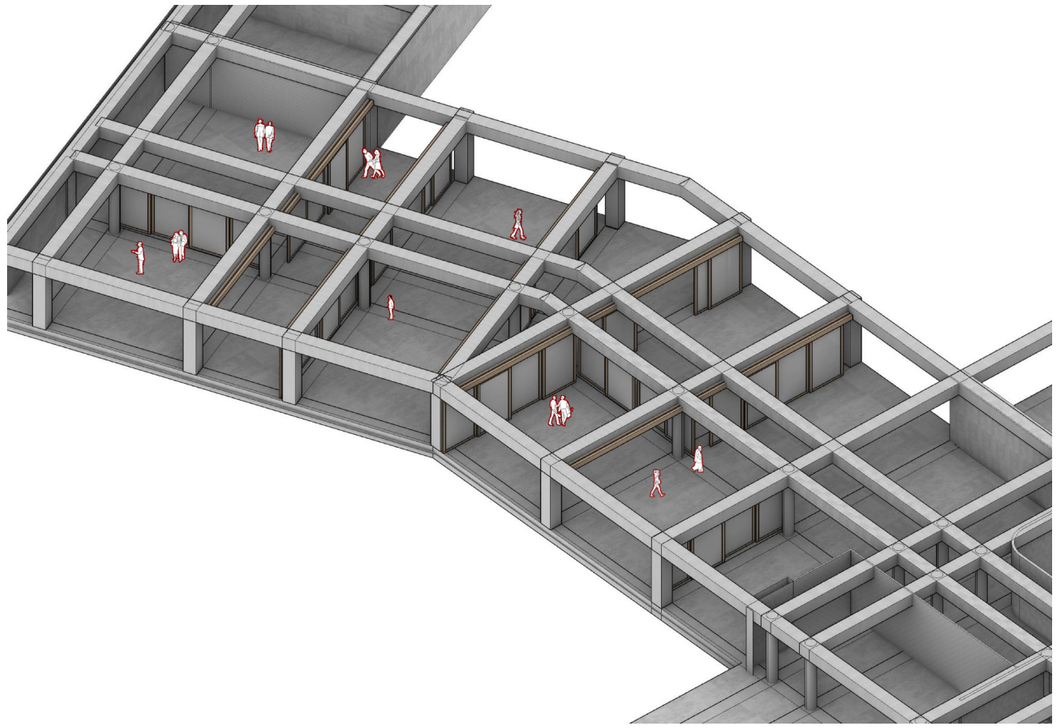
Insert



L2 Floor Plan

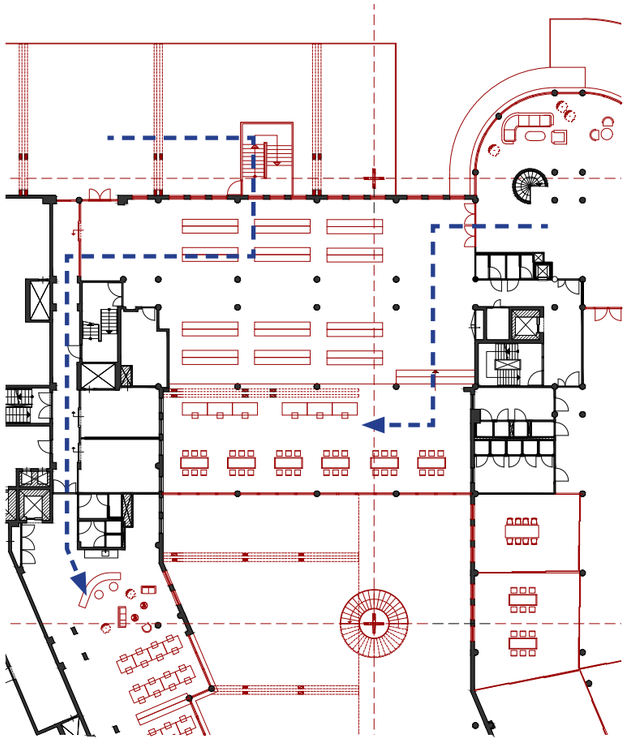


L3 Floor Plan

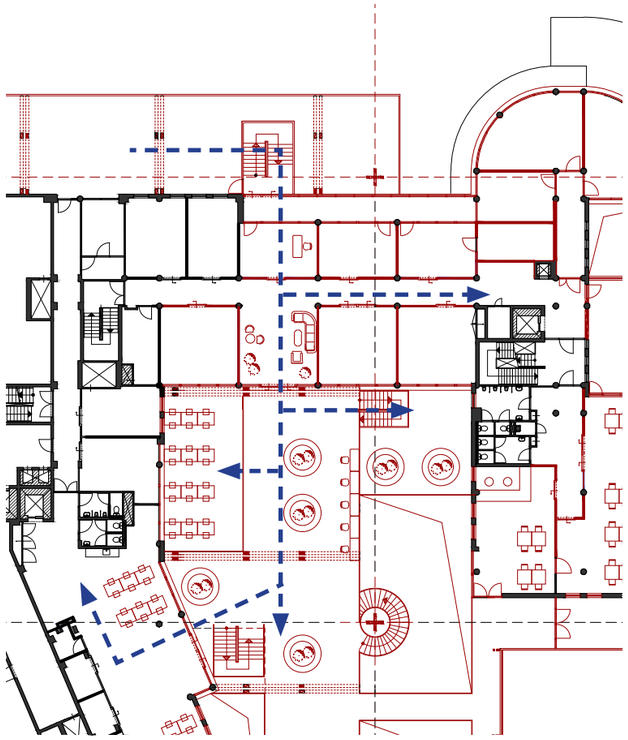


Reading Center & Study Room

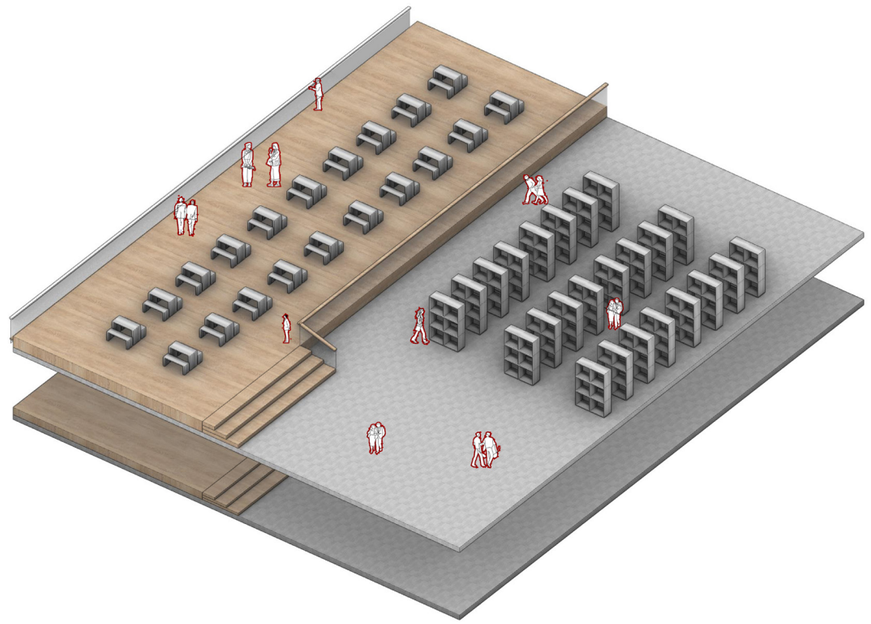
Insert

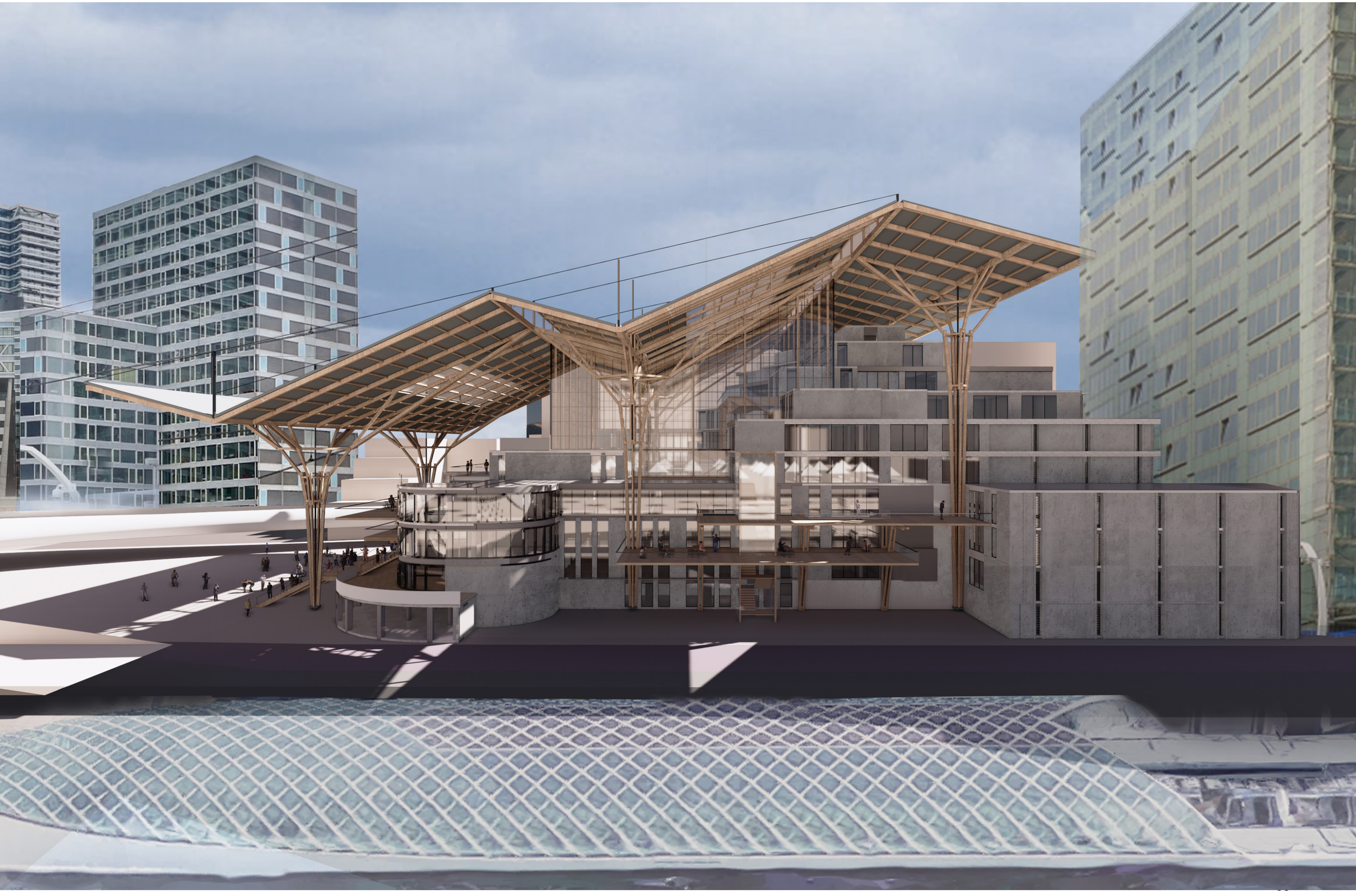


L2 Floor Plan

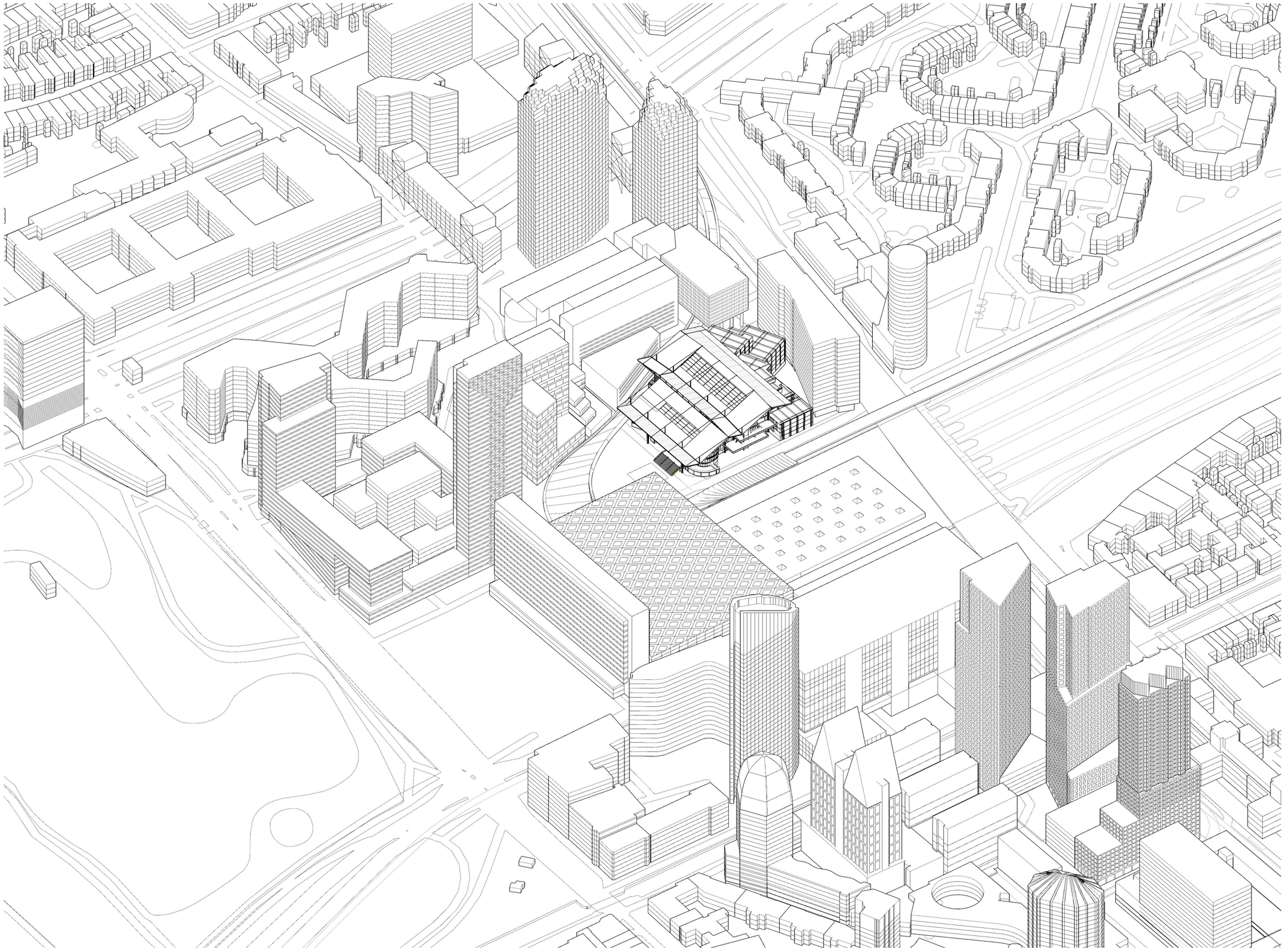


L4 Floor Plan

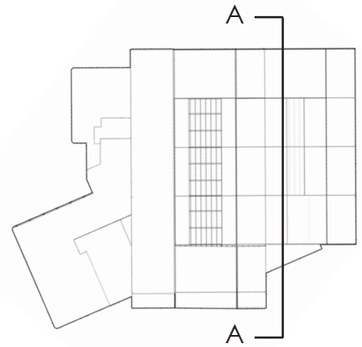


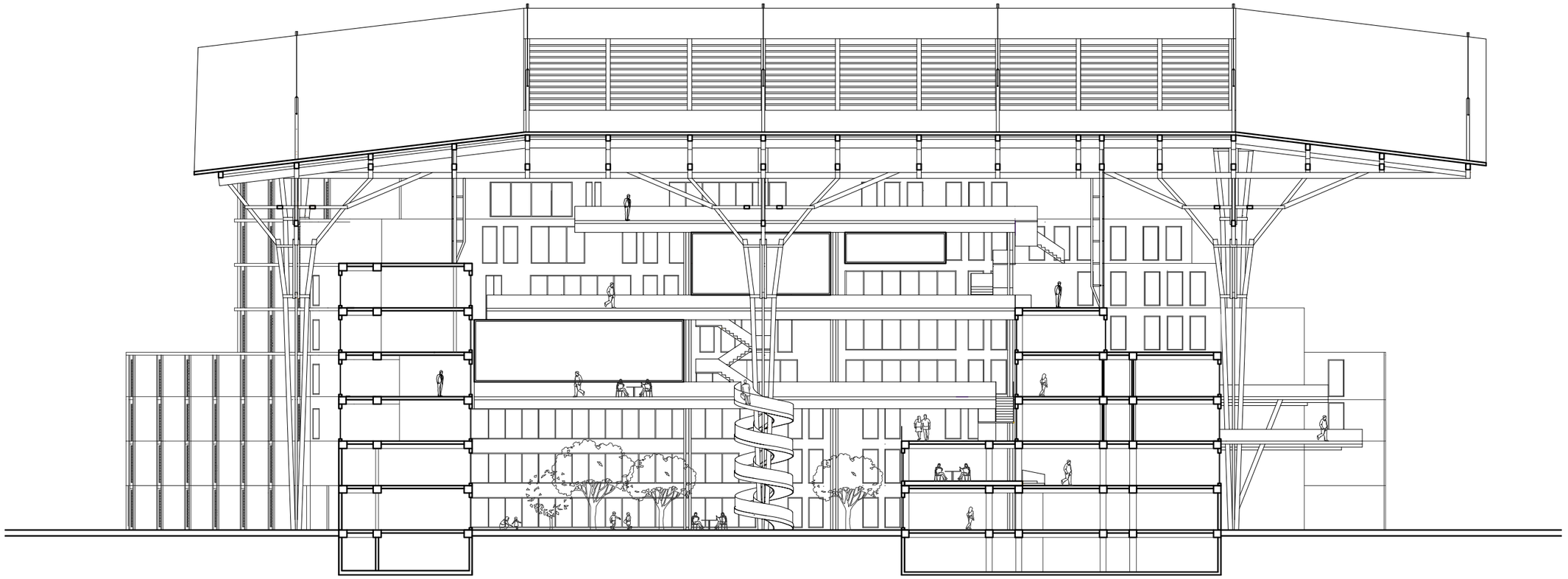


Site Plan



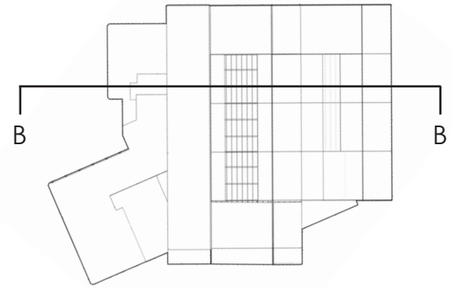
Section

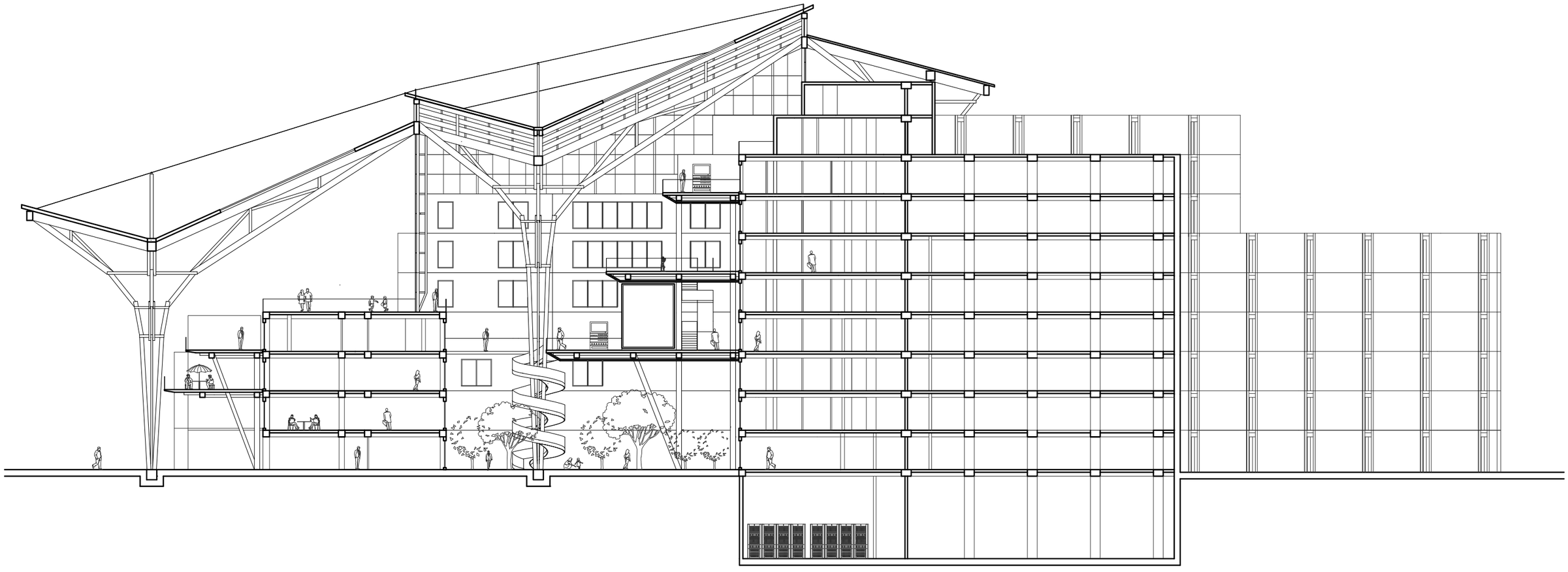




Section A-A

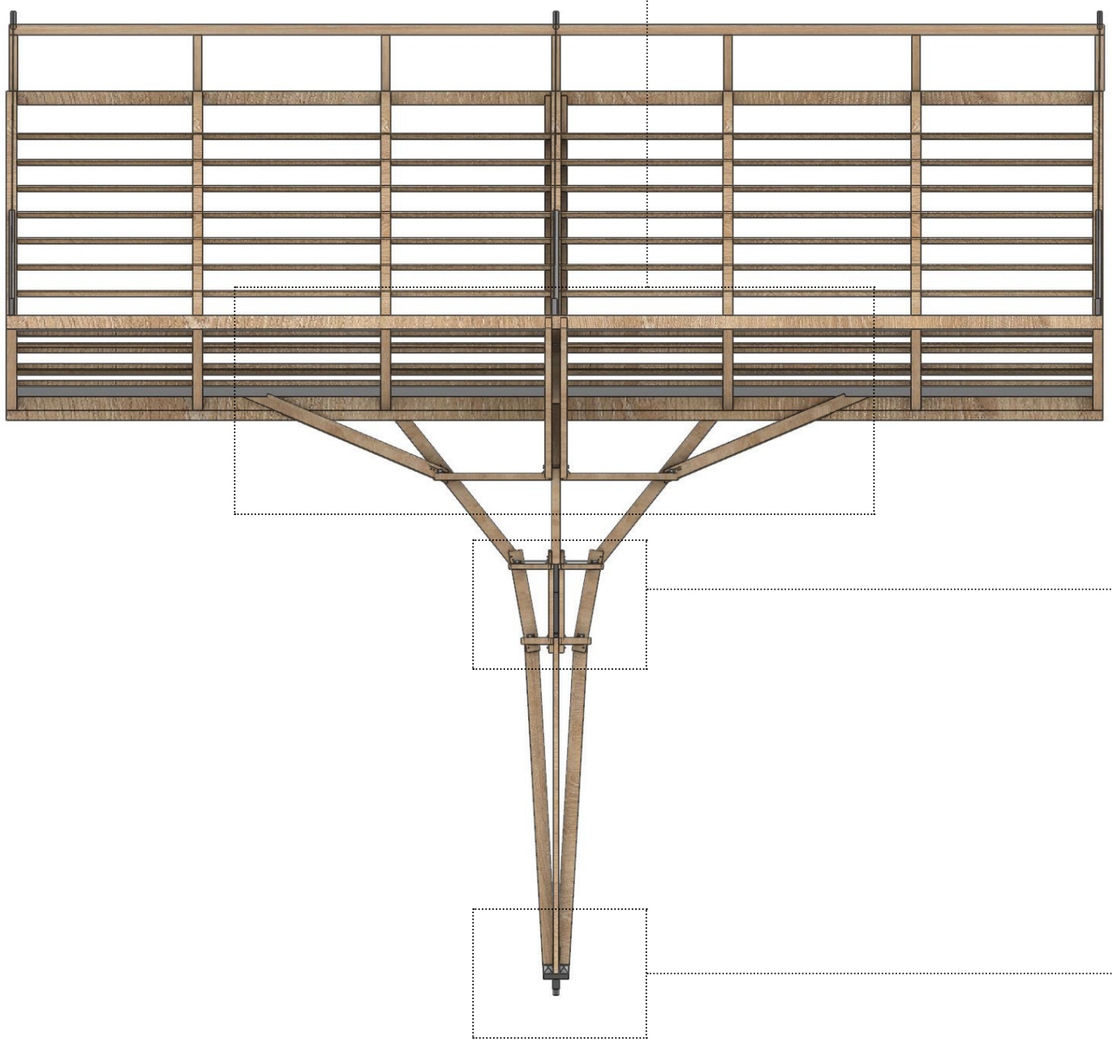
Section



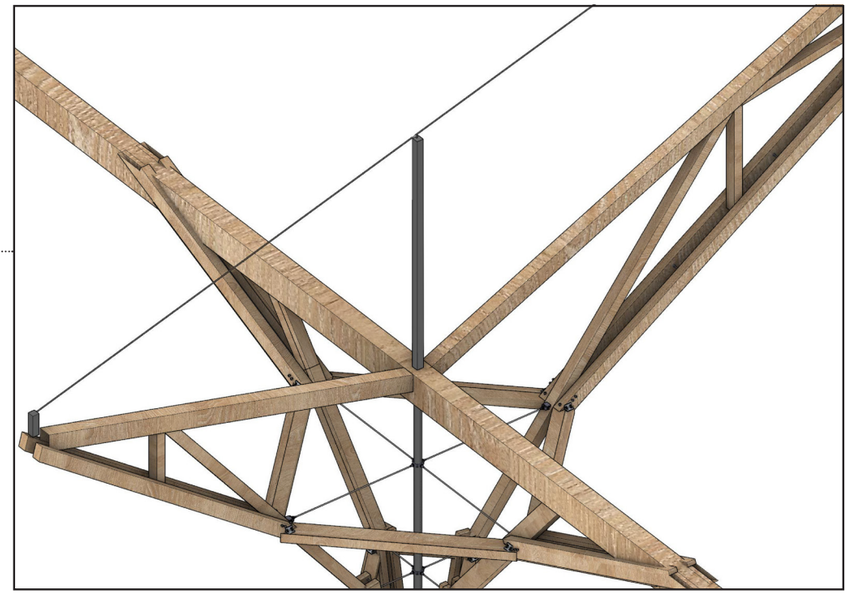


Section B-B

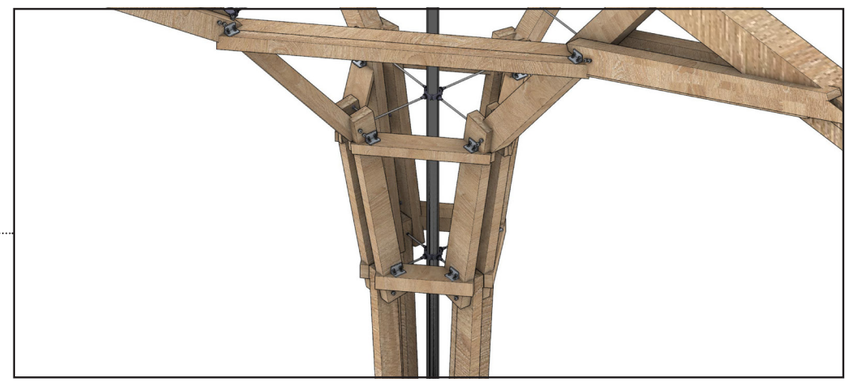
Unit Construction



Top Part

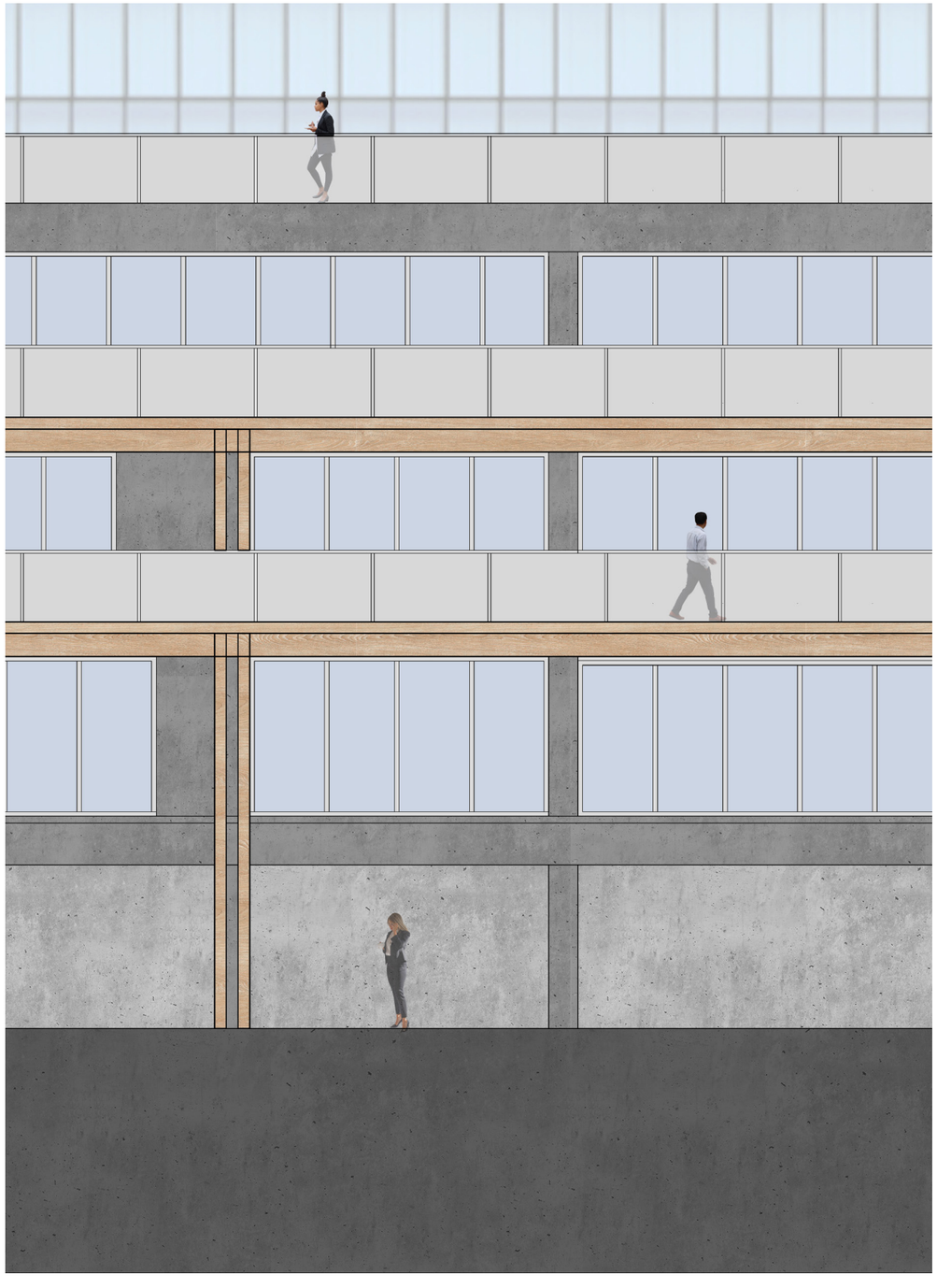


Middle Components

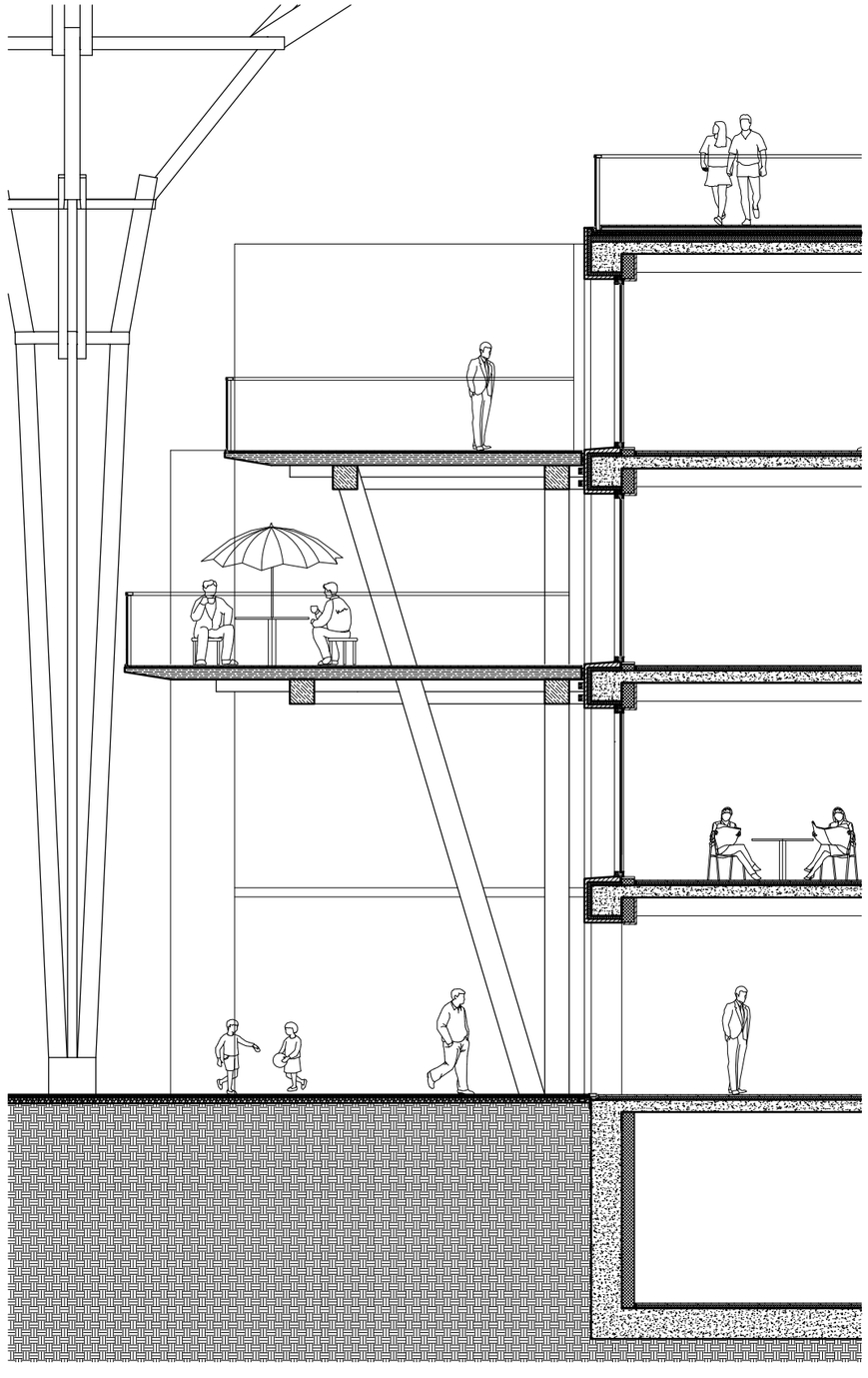


Base Part

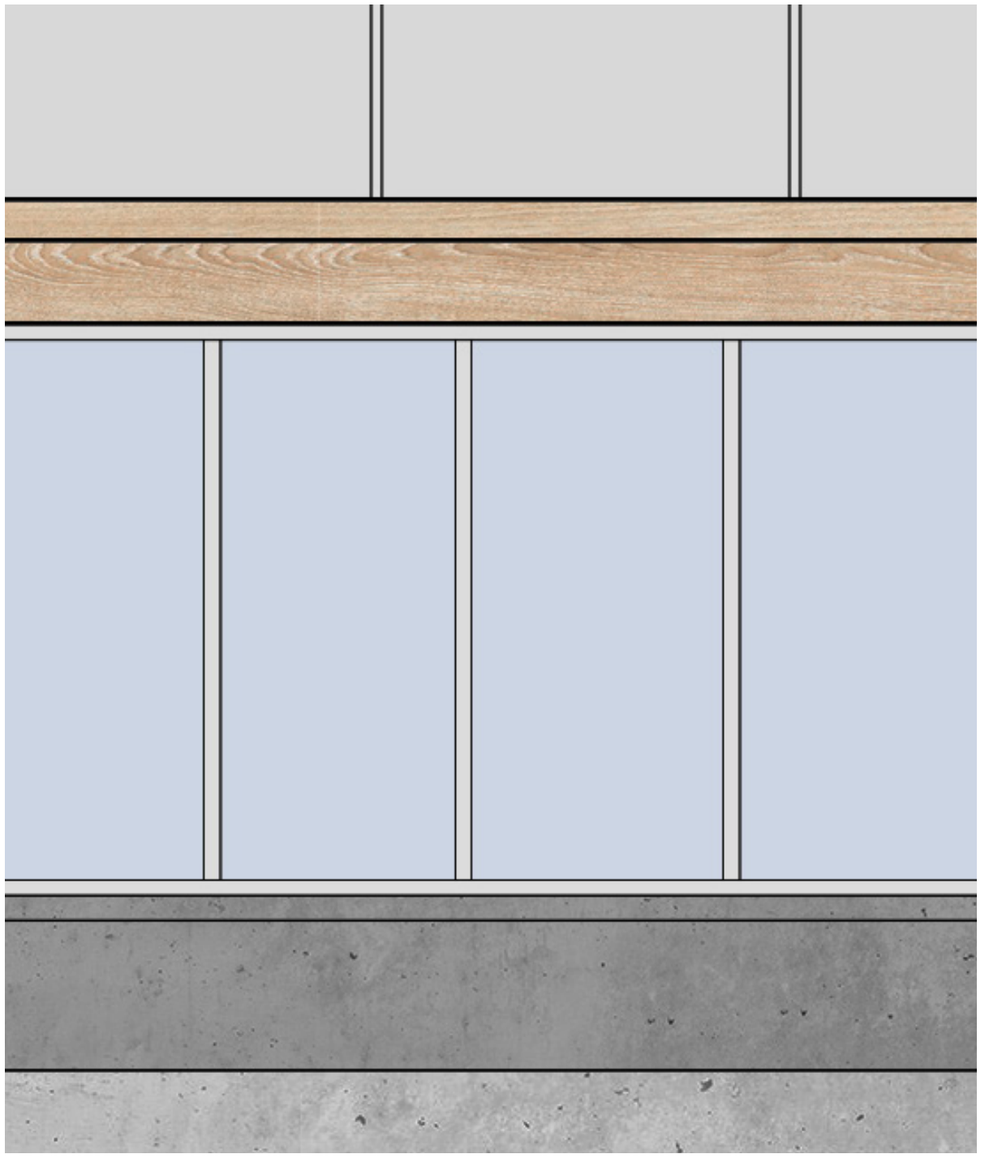
Facade Design

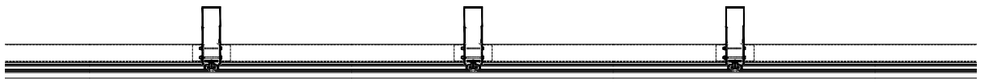


Facade Elevation 1:100

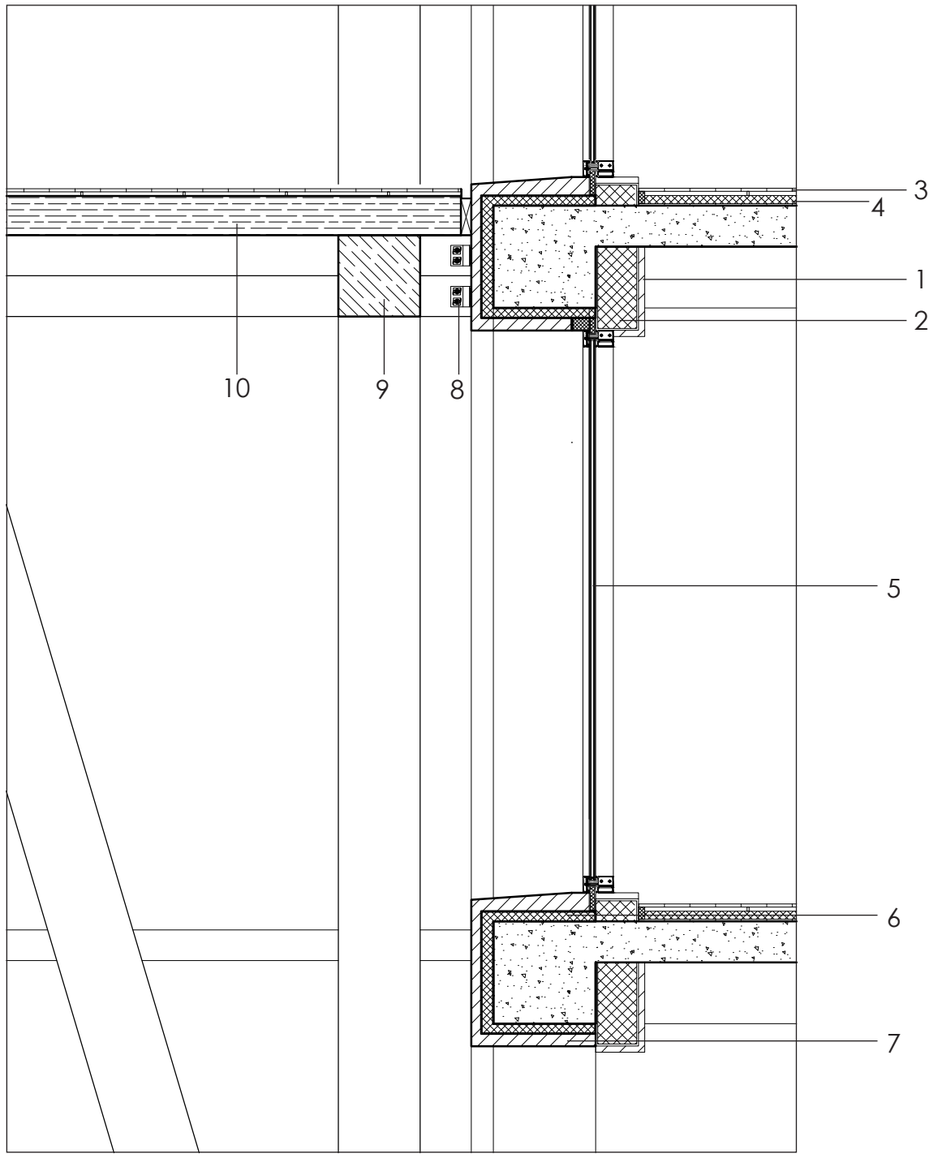


Facade Fragment Vertical Section 1:100





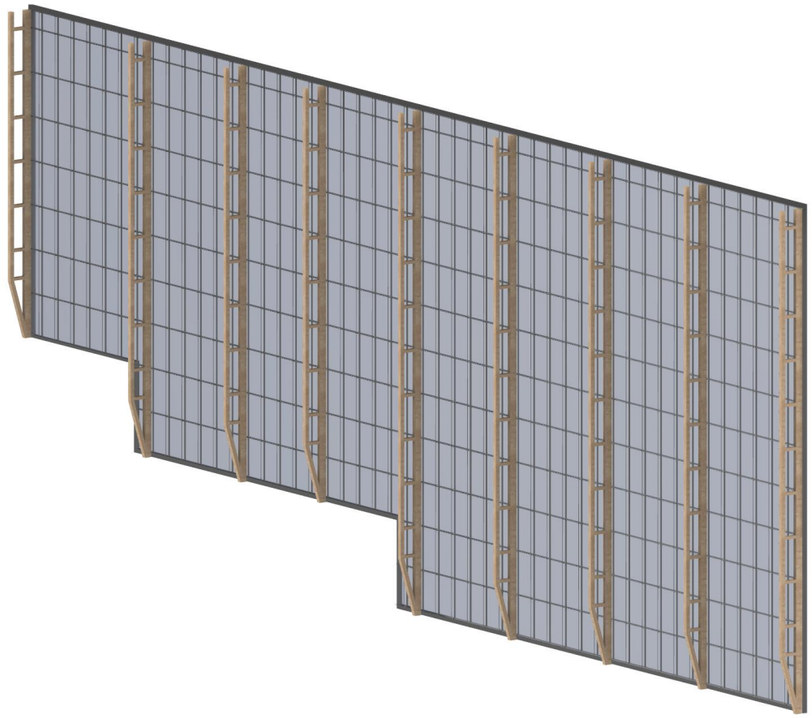
Facade Detail Horizontal 1:30

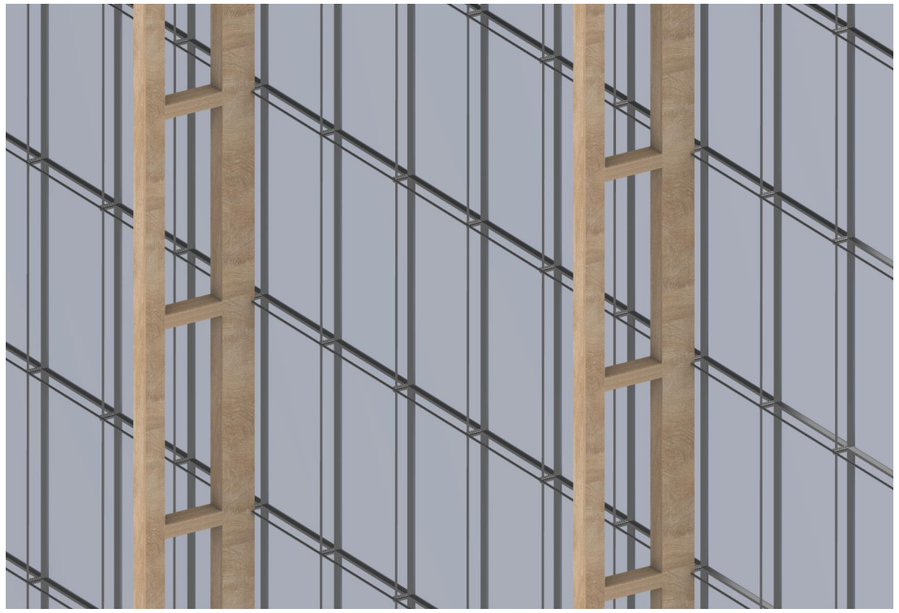


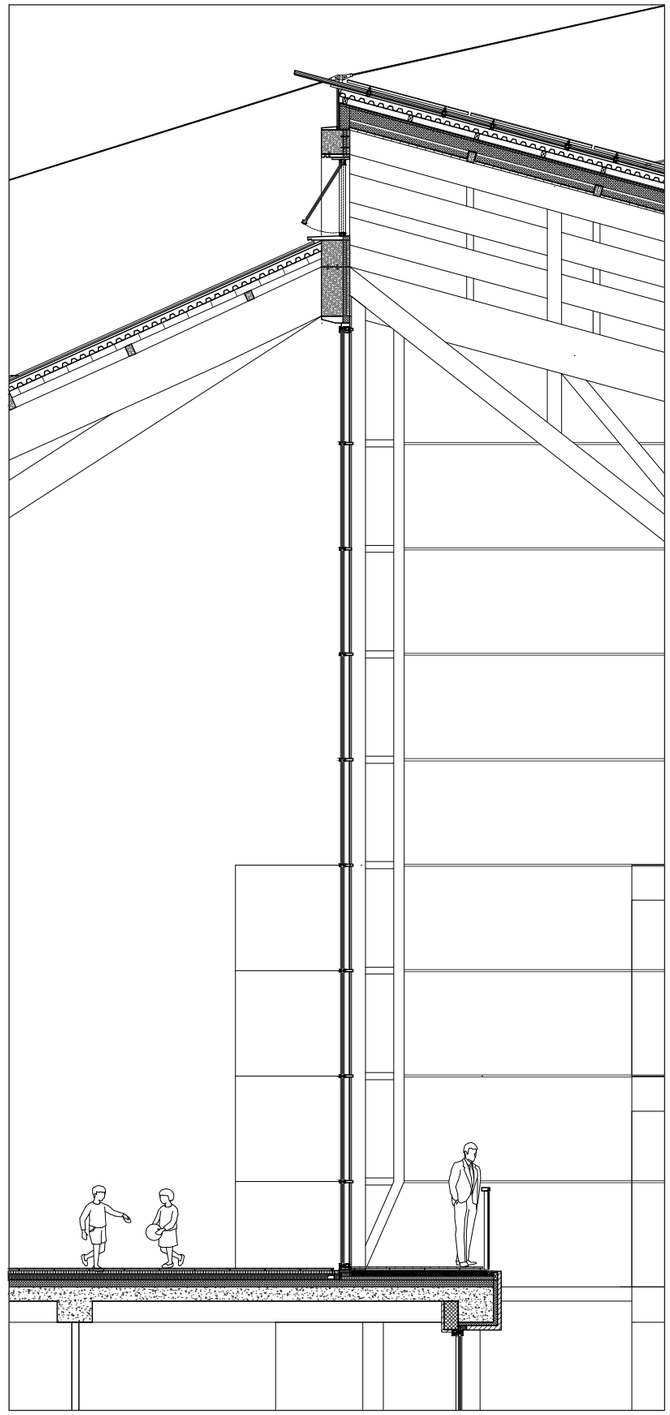
Facade Detail Vertical 1:30

1- Cedar Siding
2- Rigid Insulation Foam
3- 15mm Conifer plywood
4- 40mm Impact-sound Insulation
5- Double glazing: 6mm Toughened Glass + 12mm Cavity + 6mm Lam.Safety Glass
6- 50mm Mineral-wool Thermal Insulation
7- 50mm Lightweight Concrete Panel
8- 6mm Mrtal Angle Iron
9- 350*350mm Douglas Fir Beam
10- 150mm Structural Polywood Slab

Facade Design

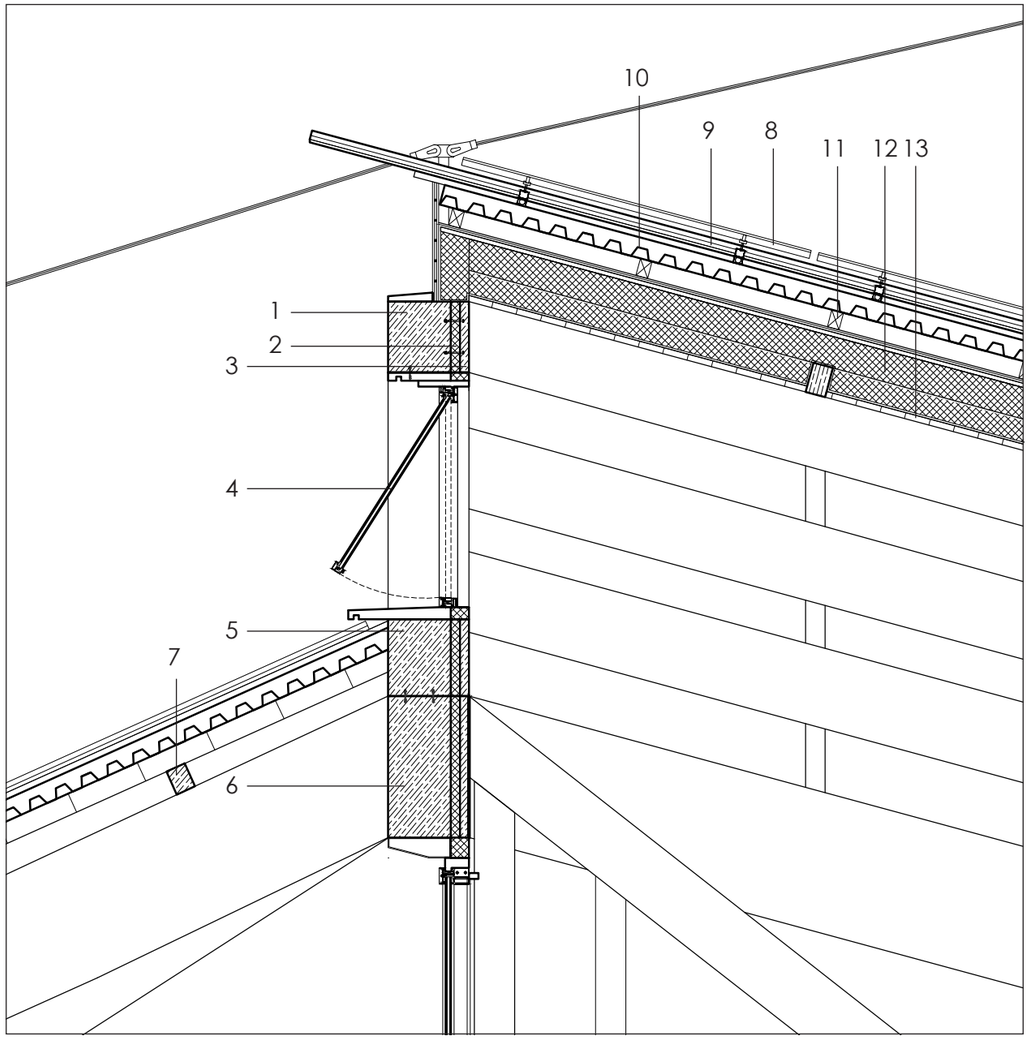


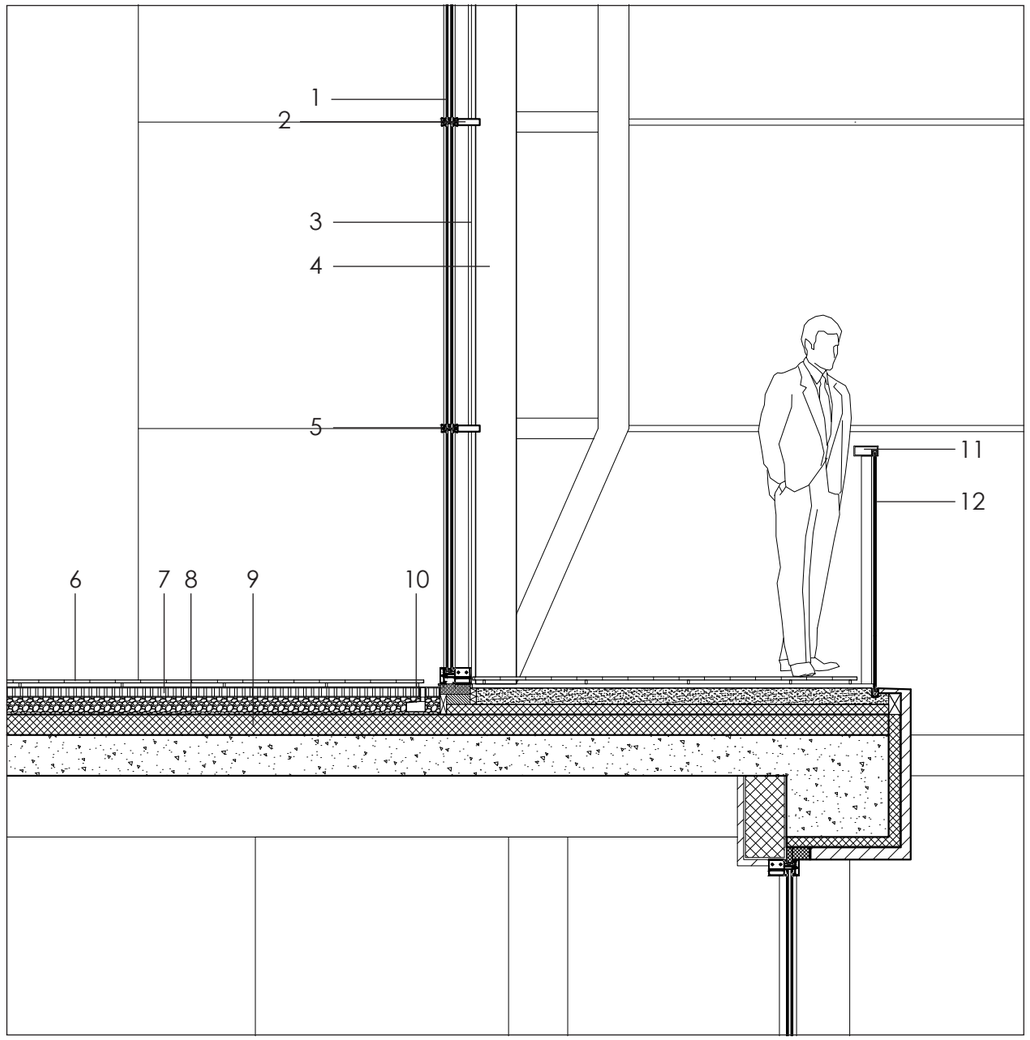




Facade Detail Vertical 1:100

Facade Detail



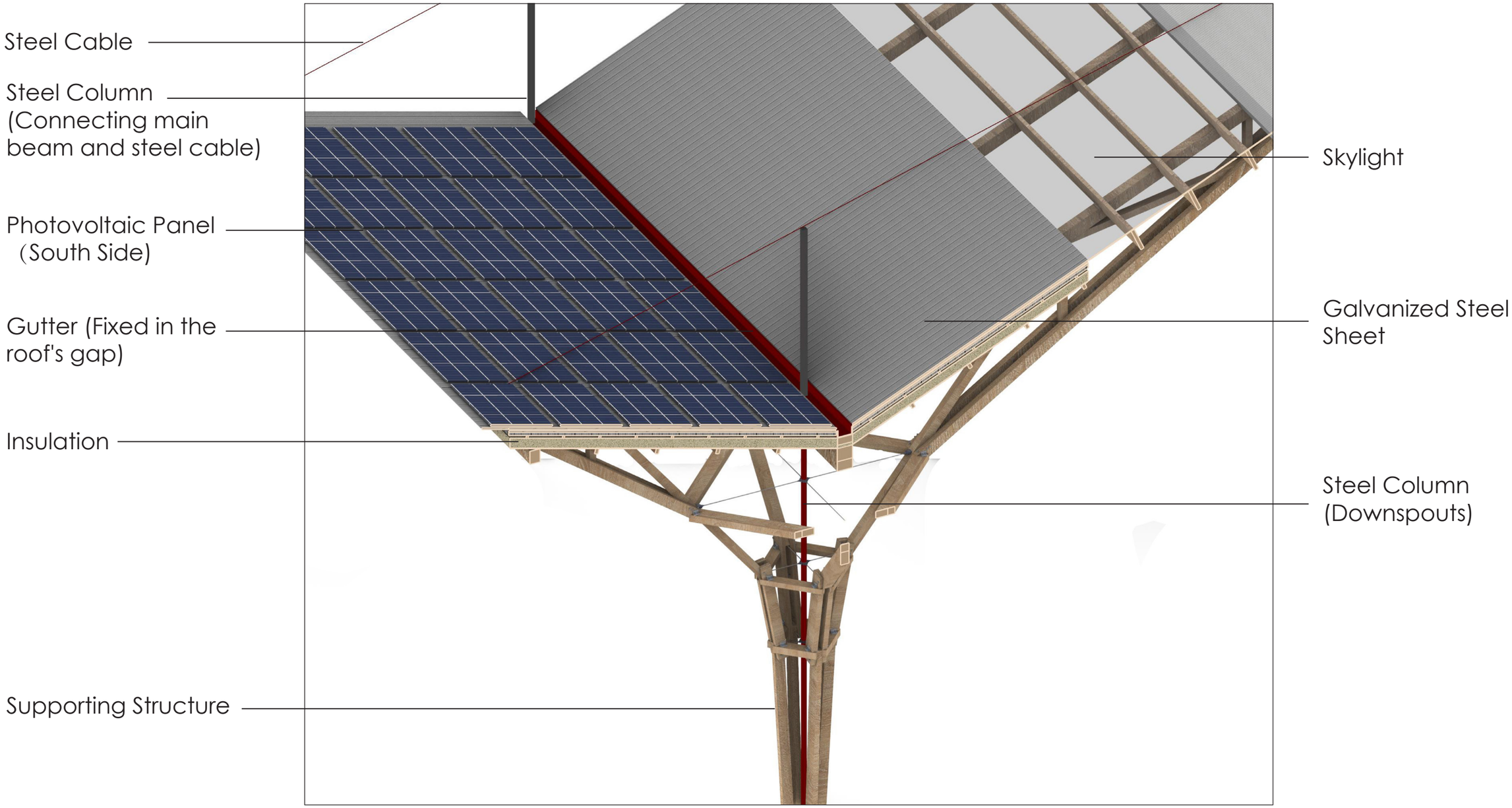


Facade Detail Vertical 1:30

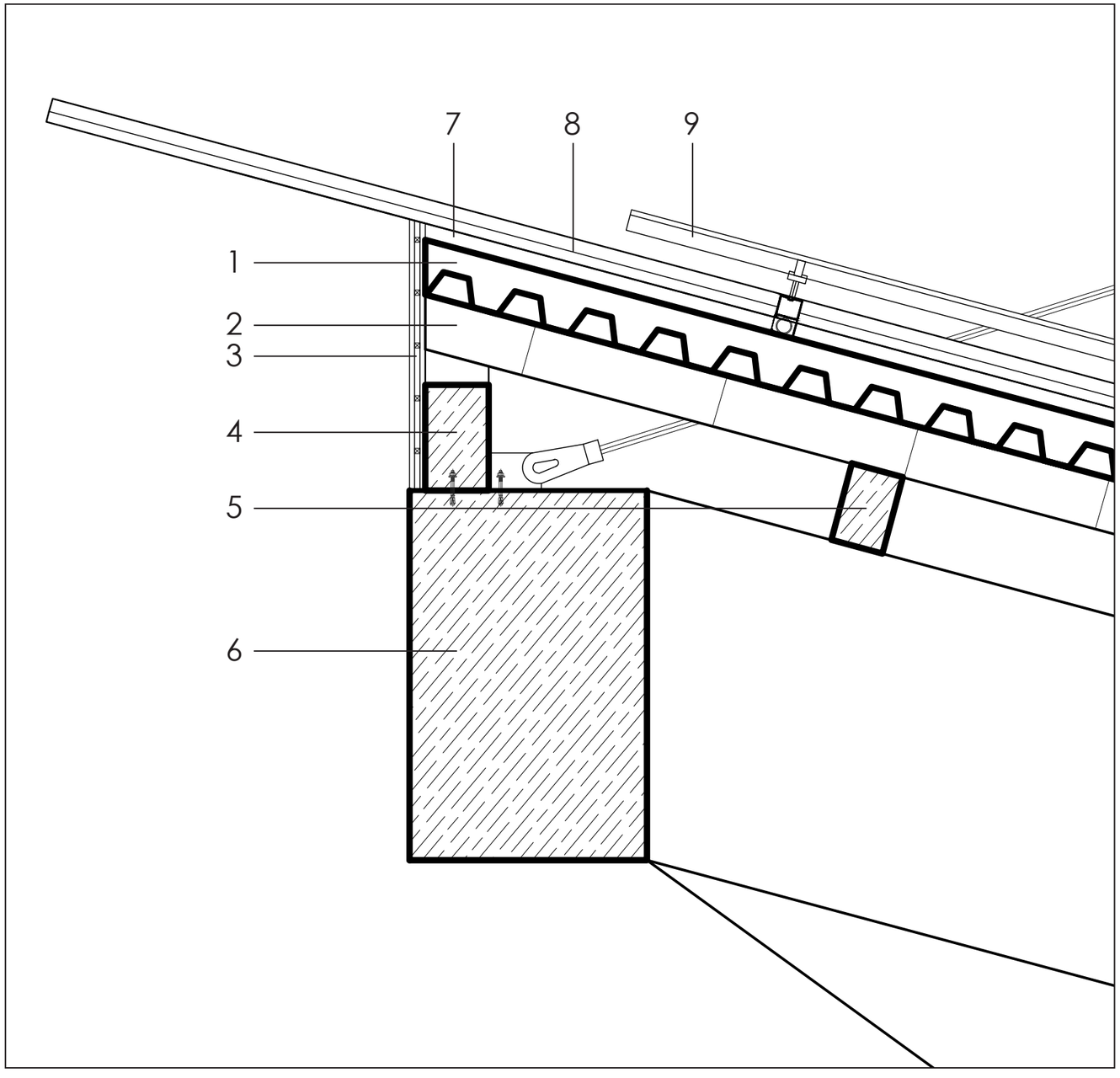
1- 350*400mm Douglas Fir Beam
2- 50mm Gutex Wood Fiber Insulation
3- 60mm Douglas Fir
4- Double glazing: 6mm Toughened Glass + 12mm Cavity + 6mm Lam.Safety Glass
5- 350*400mm Douglas Fir Beam
6- 350*700mm Douglas Fir Beam
7- 60*80mm Douglas Fir Beam
8- 1650*990mm Photovoltaic Panel
9- 35mm Galvanized Steel Sheet
10- 120mm Corrugated Sheet Steel
11- 30*50mm Douglas Fir Beam
12- 160+140mm Foam-glass Thermal Insulation
13- 30mm Tongue-and-groove Softwood Boarding

1- Double glazing: 6mm Toughened Glass + 12mm Cavity + 6mm Lam.Safety Glass
2- 20mm Galvanized Steel Cable Joint
3- Φ16 mm Steel Cable
4- 300*250mm Douglas Fir Column
5- Galvanized-steel RHS Frame
6- 15mm Conifer plywood
7- 50mm plywood Board
8- Macadam
9- 100mm Rigid Insulation Foam
10- 10mm Steel Gutter
11- 120*50mm Galvanized Steel Handrail
12- 16mm Lam.Safety Glass

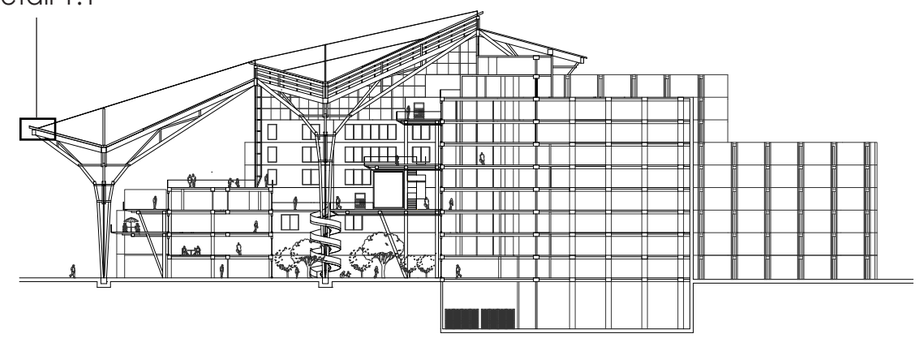
Roof Design


Steel Cable
Steel Column (Connecting main beam and steel cable)
Photovoltaic Panel （South Side)
Gutter (Fixed in the roof's gap)
Insulation
Supporting Structure
Skylight
Galvanized Steel Sheet
Steel Column (Downspouts)

Roof Design



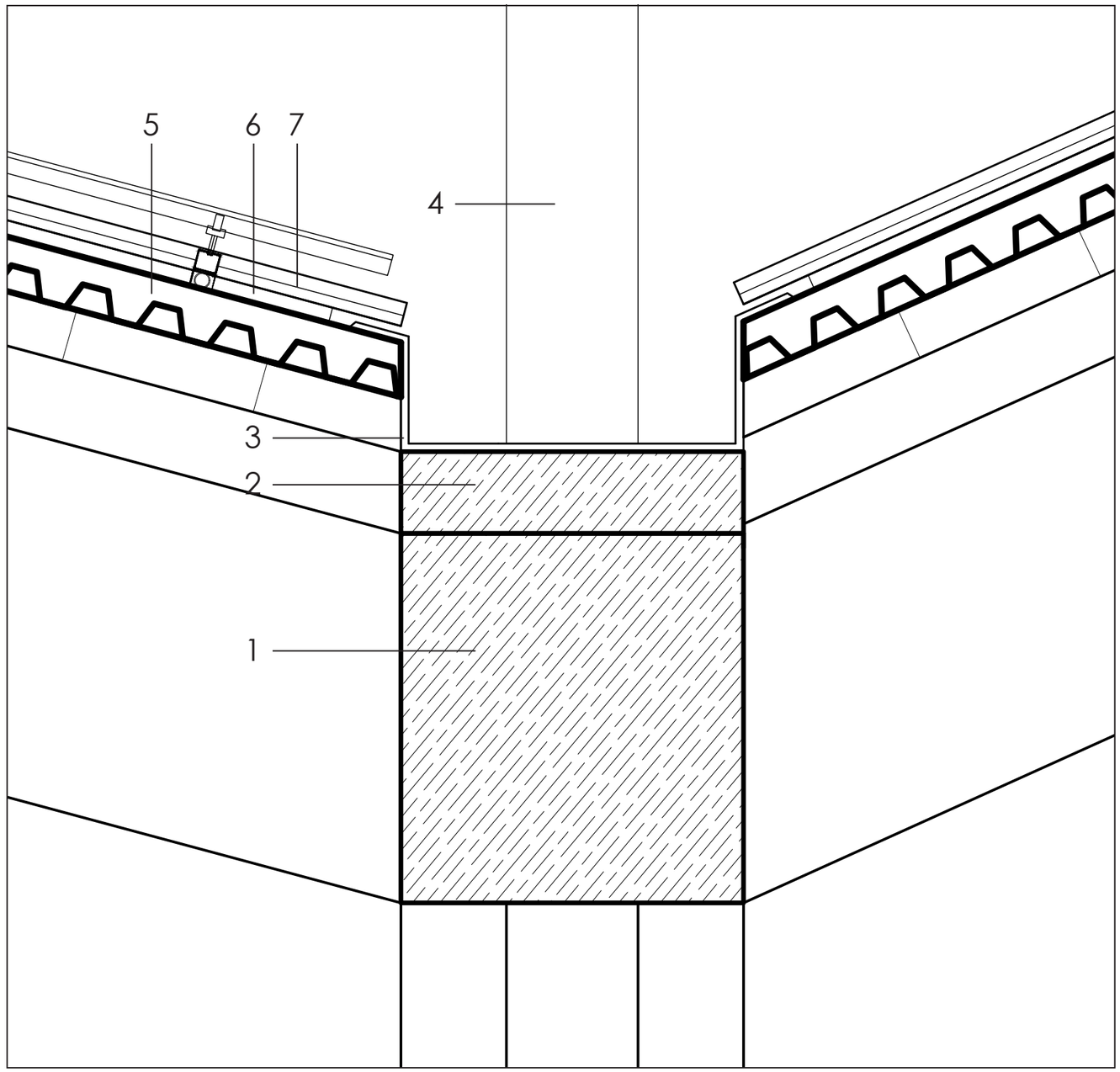
Detail 1.1



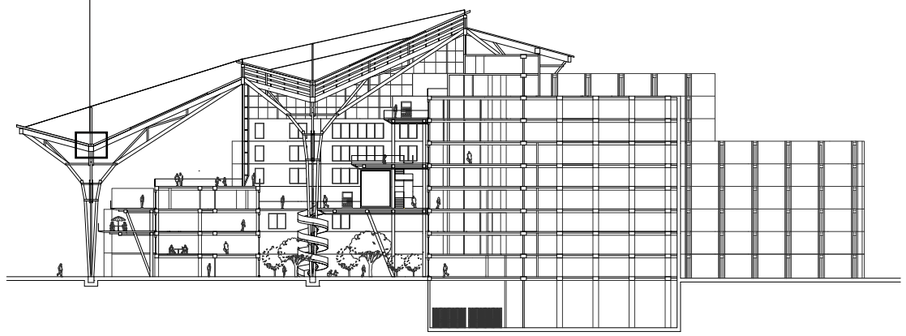
1- 120mm Corrugated Sheet Steel
2- 50mm Pine Battens
3- 20mm Rough-swan Softwood Boarding
4-60mm Douglas Fir 5- 60*80mm Douglas Fir Beam
5- 400*600mm Douglas Fir Beam
6- 30mm Softwood Boarding
7- 35mm Galvanized Steel Sheet
8- 1650*990mm Photovoltaic Panel

Detail 1.1 1:10

Roof Design



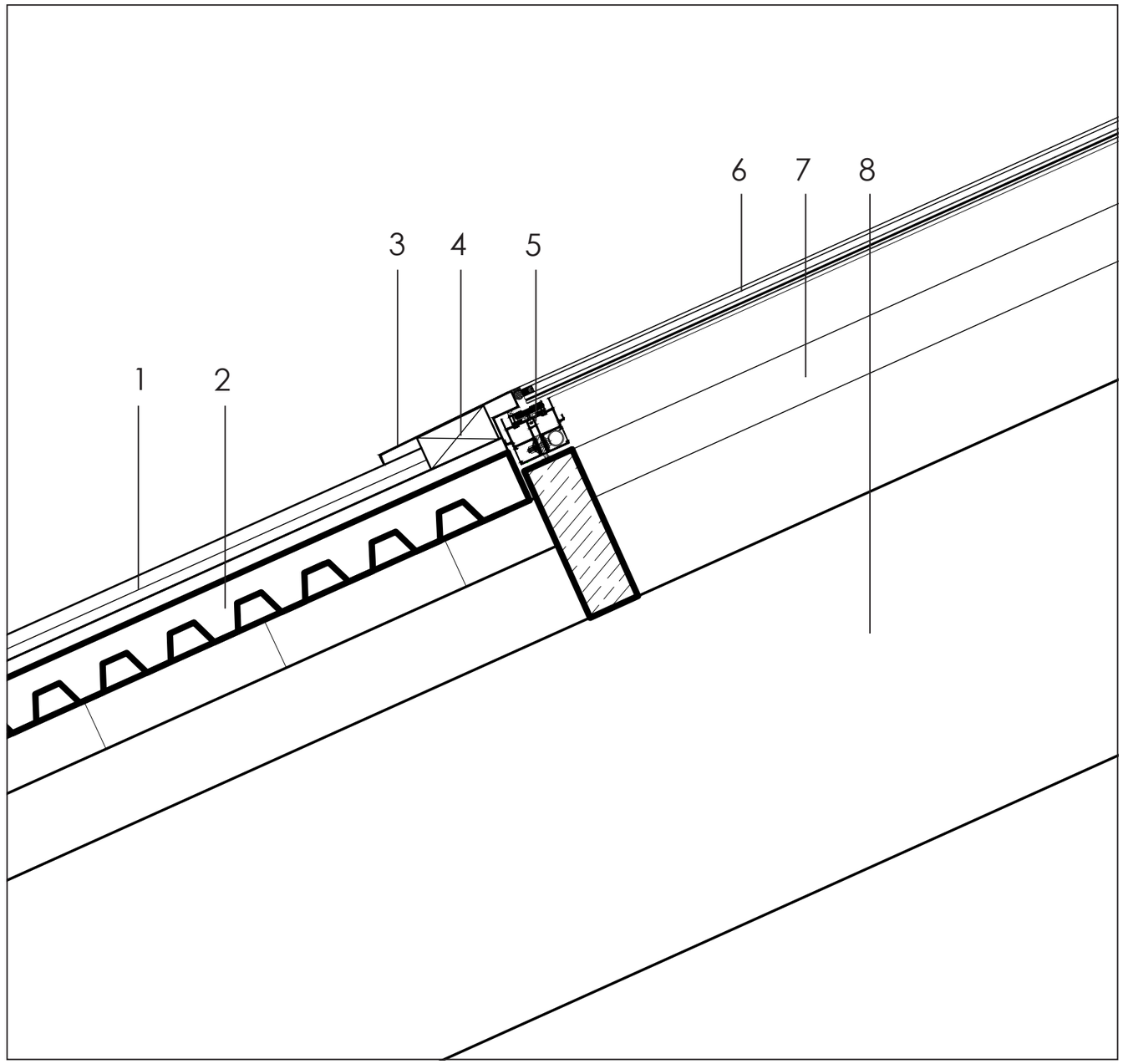
Detail 1.2

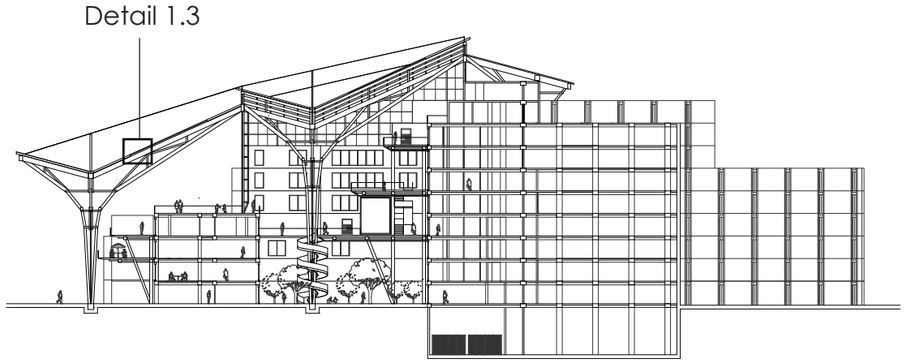


1- 500*600mm Douglas Fir Beam
2- 500*120mm Douglas Fir
3- 10mm Steel Gutter
4- 250*250mm Steal Column
5- 120mm Corrugated Sheet Steel
6- 30mm Softwood Boarding
7- 35mm Galvanized Steel Sheet

Detail 1.2 1:10

Roof Design

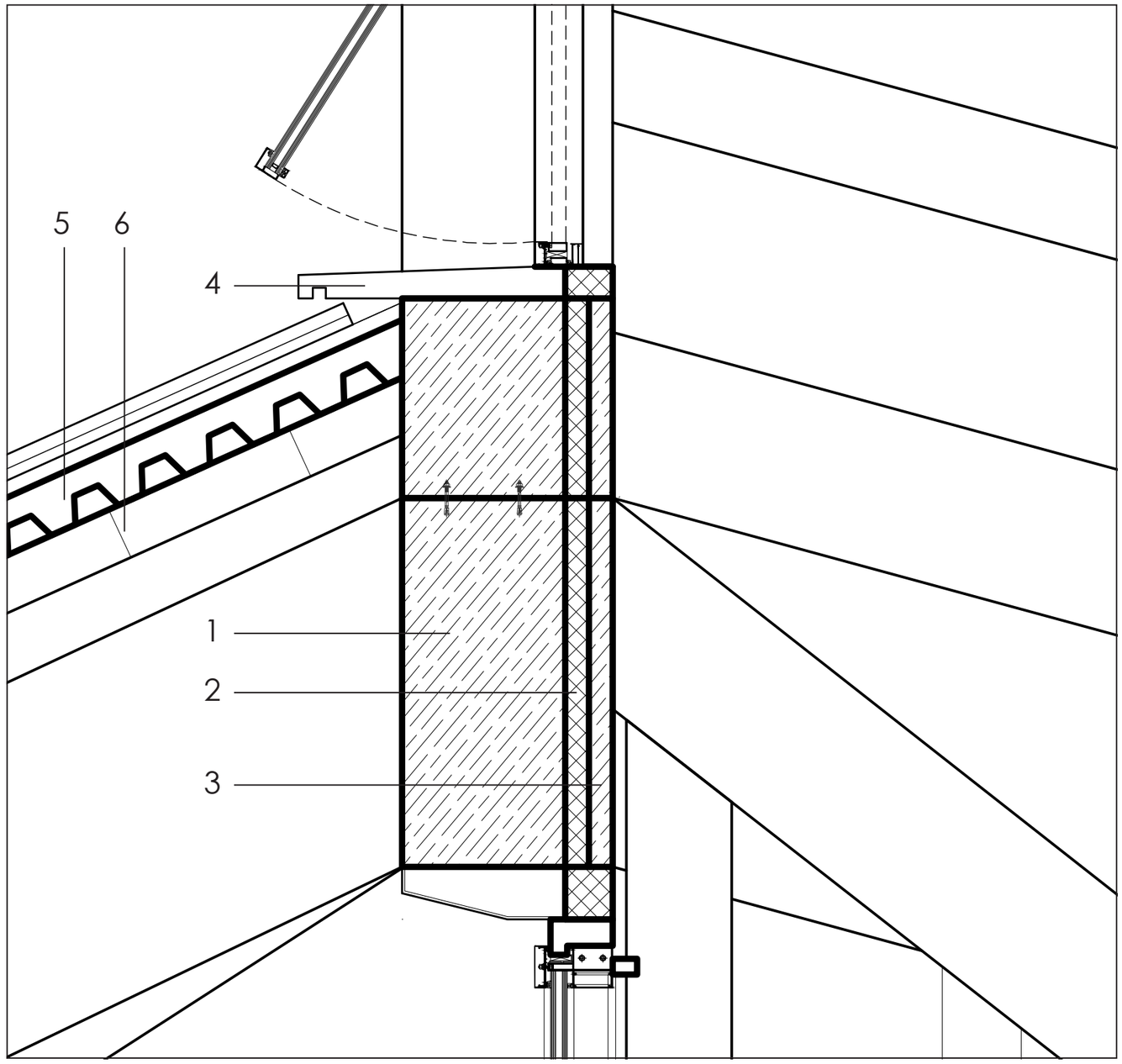




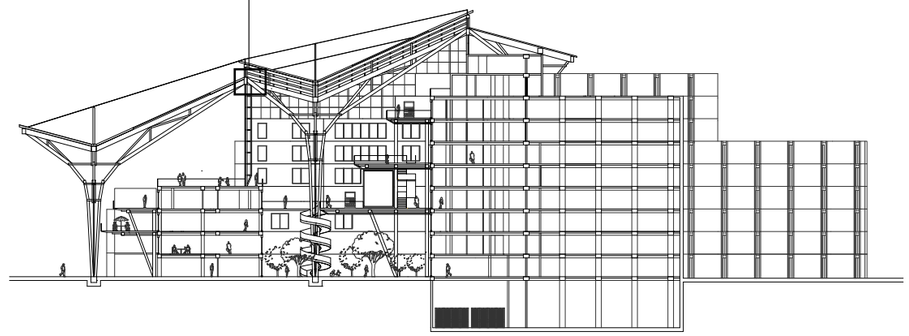
1- 35mm Galvanized Steel Sheet
2- 120mm Corrugated Sheet Steel
3- 6mm Steel Sheet
4- 100*30mm Wood Piece
5- 120*120mm Galvanized-steel RHS Frame
6- Double glazing: 6mm Toughened Glass + 12mm Cavity + 6mm Lam.Safety Glass
7- 120mm Douglas Fir Beam
8- 600mm Douglas Fir Main Beam

Detail 1.3 1:10

Roof Design



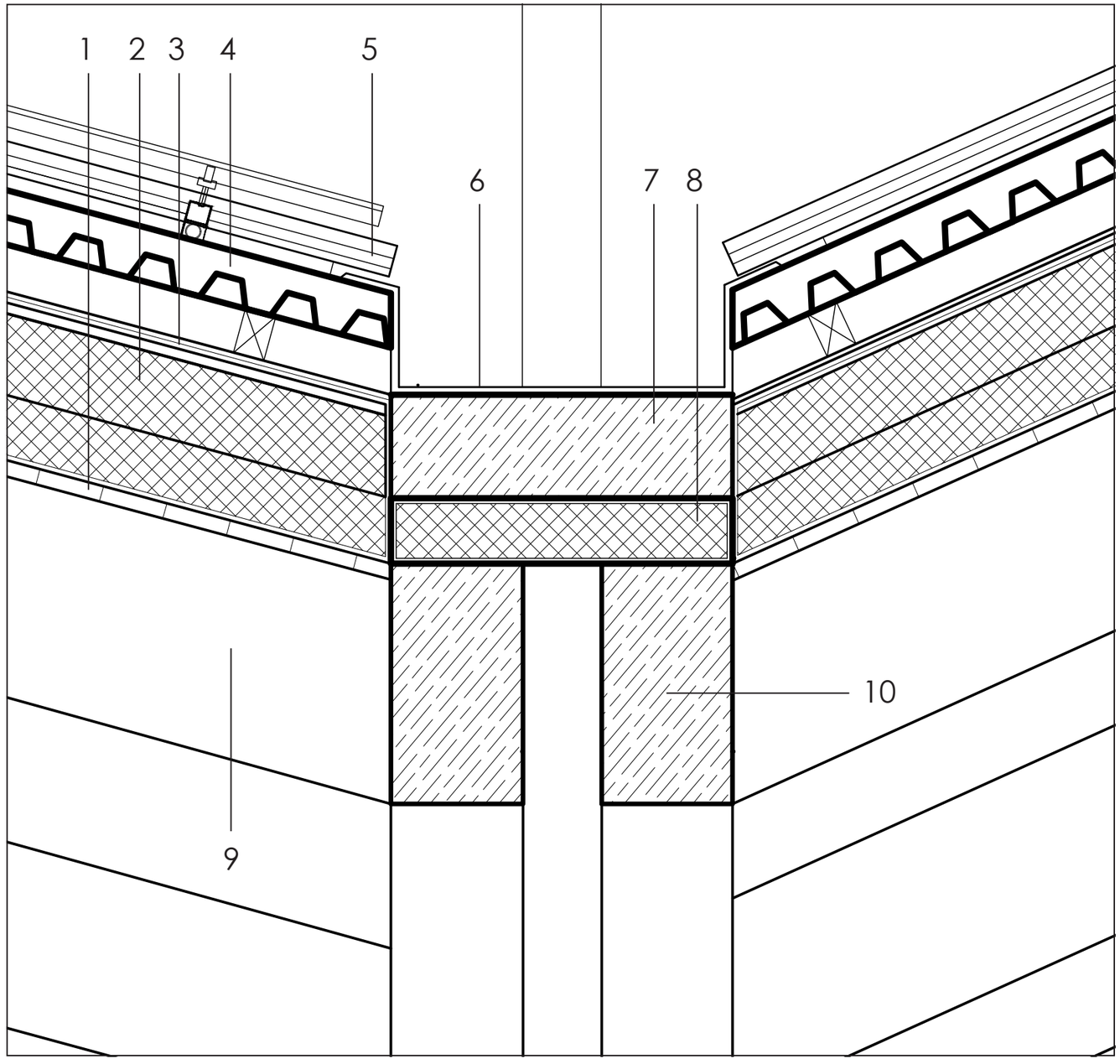
Detail 1.4



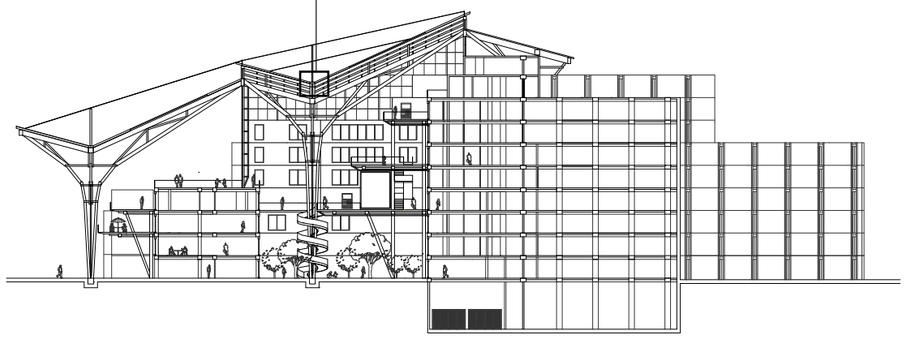
1- 350*400mm Douglas Fir Beam
2- 50mm Gutex Wood Fiber Insulation
3- 60mm Douglas Fir
4- 50mm T Window Sill
5- 120mm Corrugated Sheet
6- 50mm Pine Battens 7- 120mm Douglas Fir Beam
7- 300*300mm Douglas Fir Beam

Detail 1.4 1:10

Roof Design



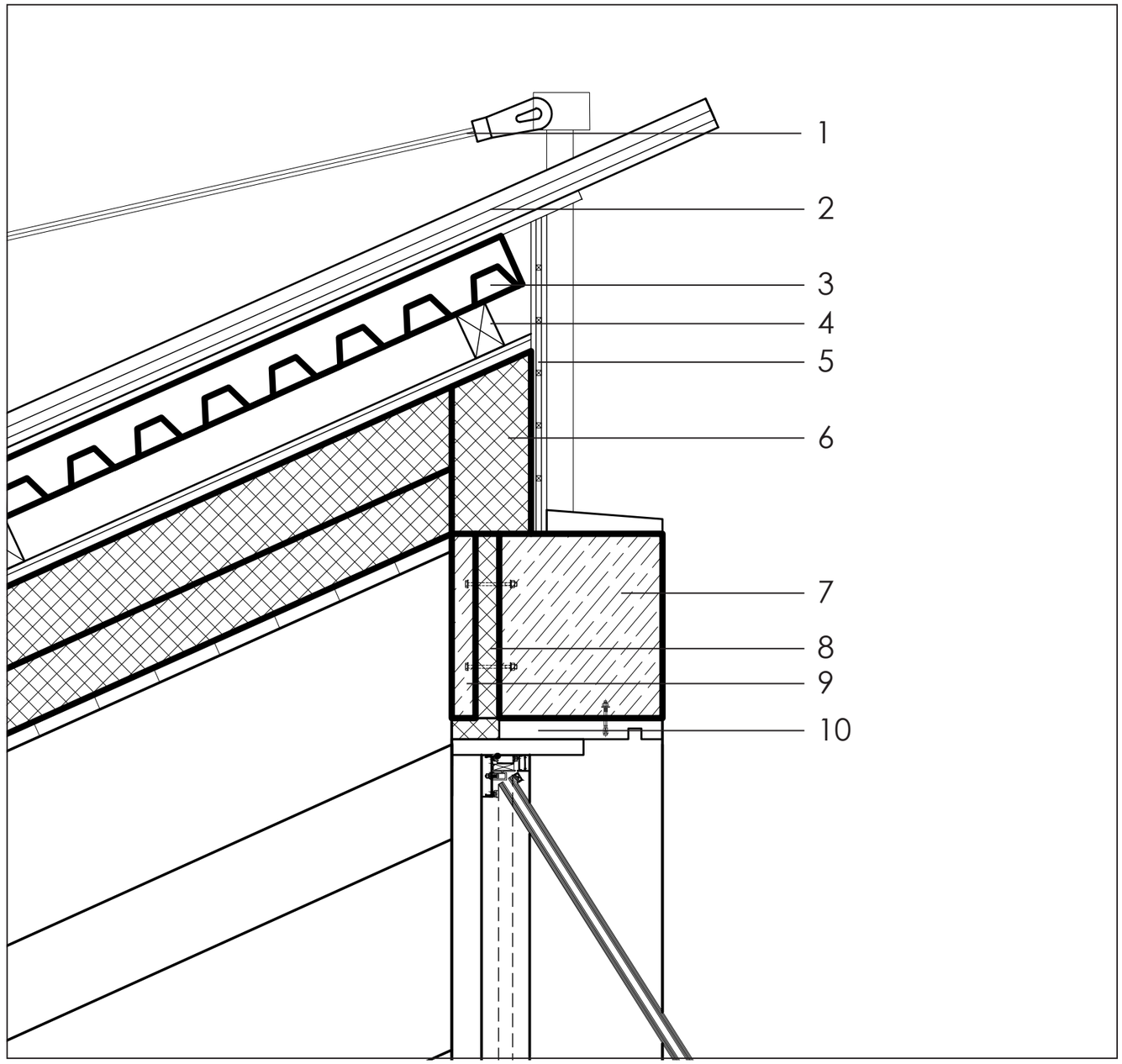
Detail 1.5



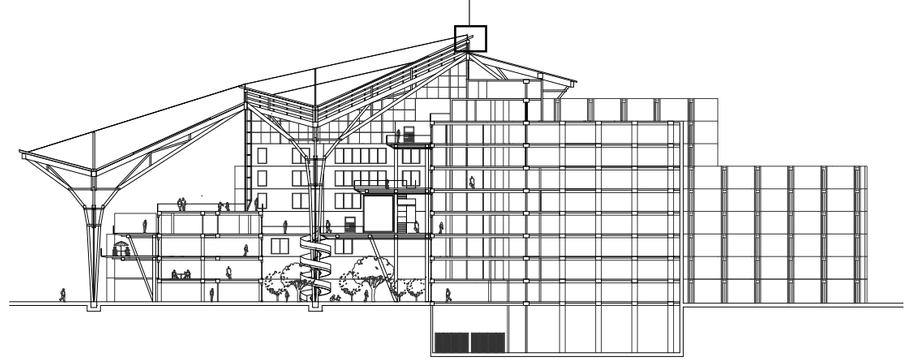
1- 30mm Tongue-and-groove Softwood Boarding
2- 160+140mm Foam-glass Thermal Insulation
3- 20mm Timber Board
4- 120mm Corrugated Sheet
5- 35mm Galvanized Steel Sheet
6- 10mm Steel Gutter
7- 500*120mm Douglas Fir Beam
8- 500*80mm Rigid Insulation
9- 400*400mm Douglas Fir Beam
10- 200*400mm Douglas Fir Beam

Detail 1.5 1:10

Roof Design



Detail 1.6

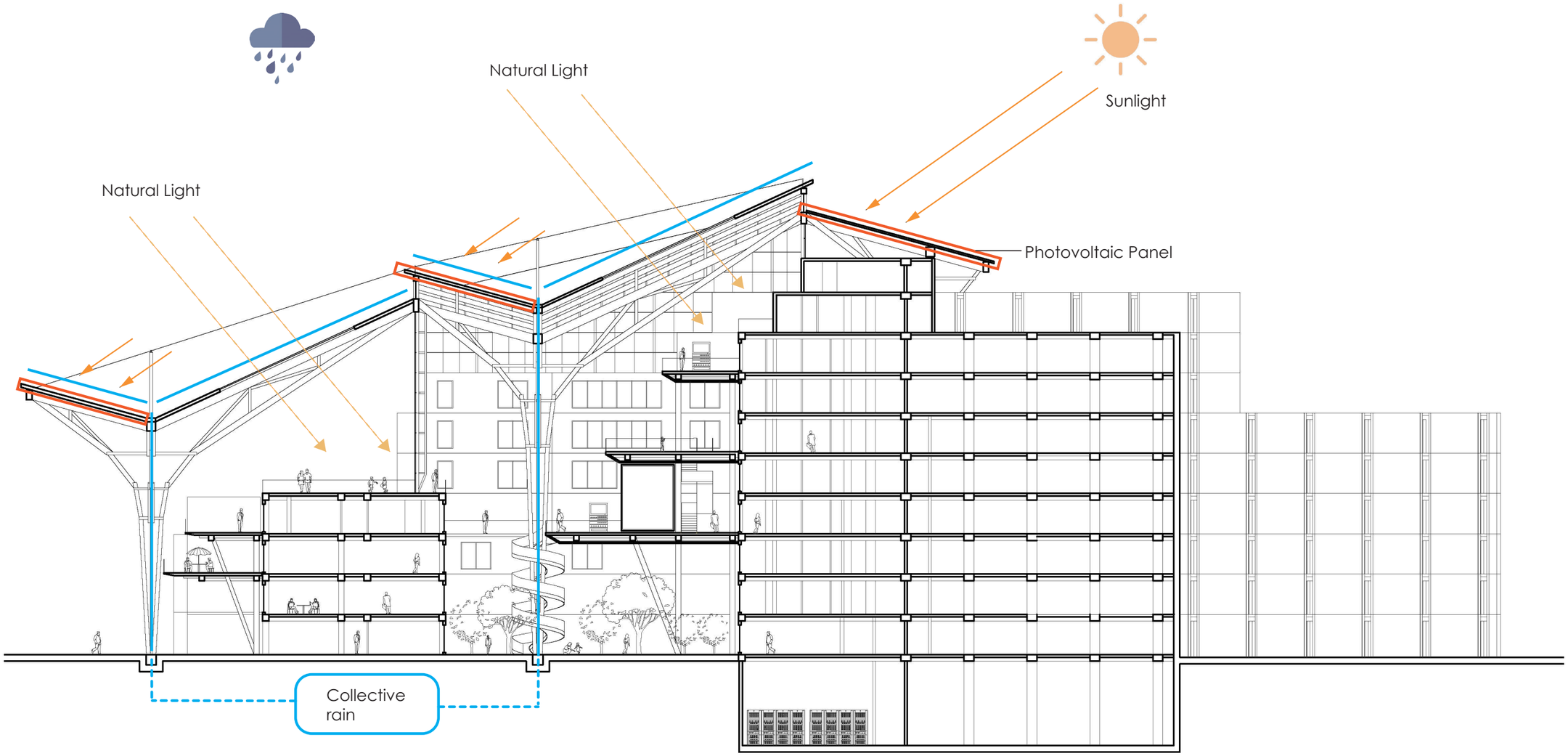


1- Φ20 mm Steel Cable
2- 35mm Galvanized Steel Sheet
3- 20mm Timber Board
4- 120mm Corrugated Sheet
5- 20mm Rough-swan Softwood Boarding
6- Rigid Insulation
7- 350*400mm Douglas Fir Beam
8- 50mm Gutex Wood Fiber Insulation
9- 60mm Douglas Fir
10- 50mm Timber Board

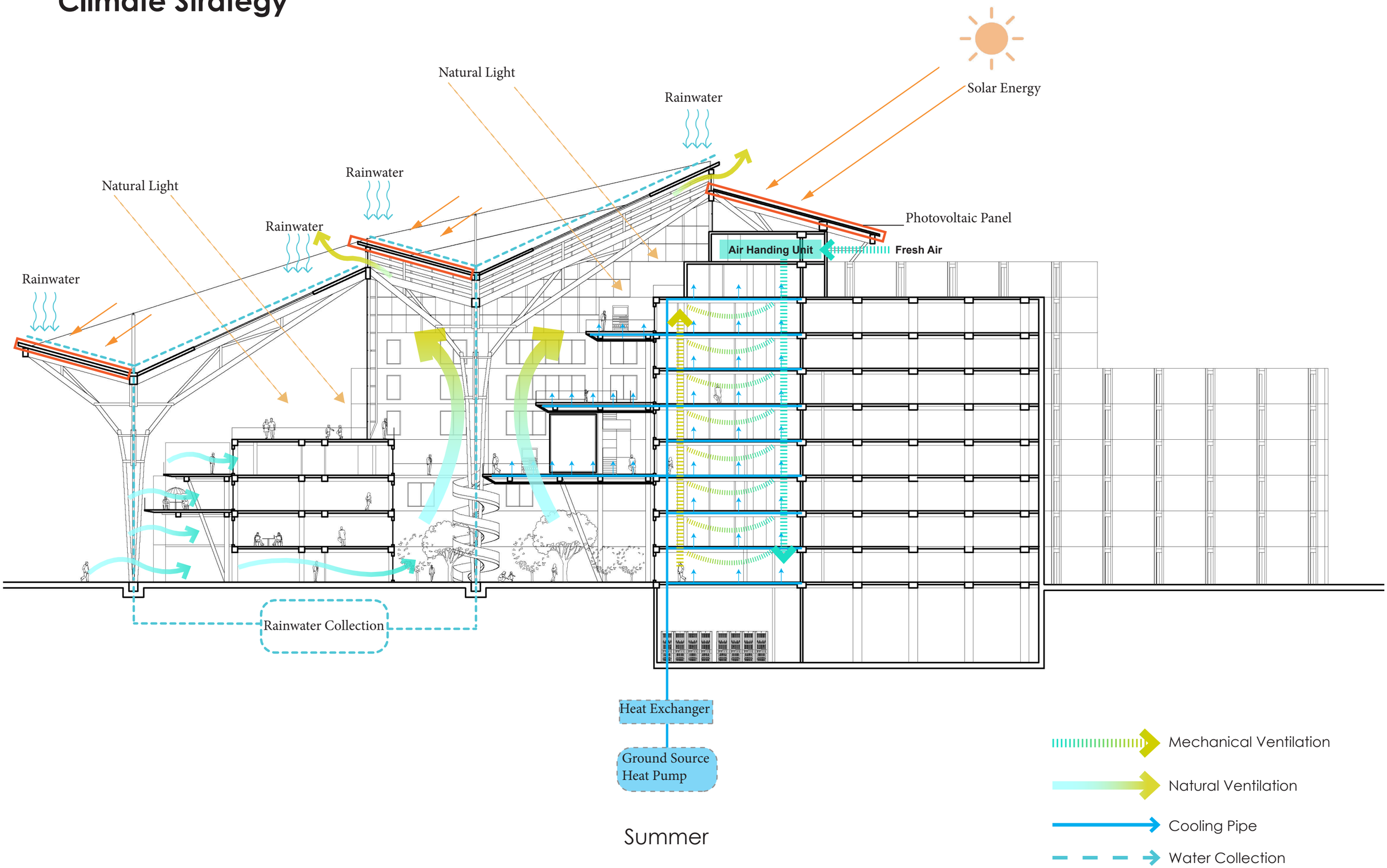
Detail 1.6 1:10

Climate Strategy

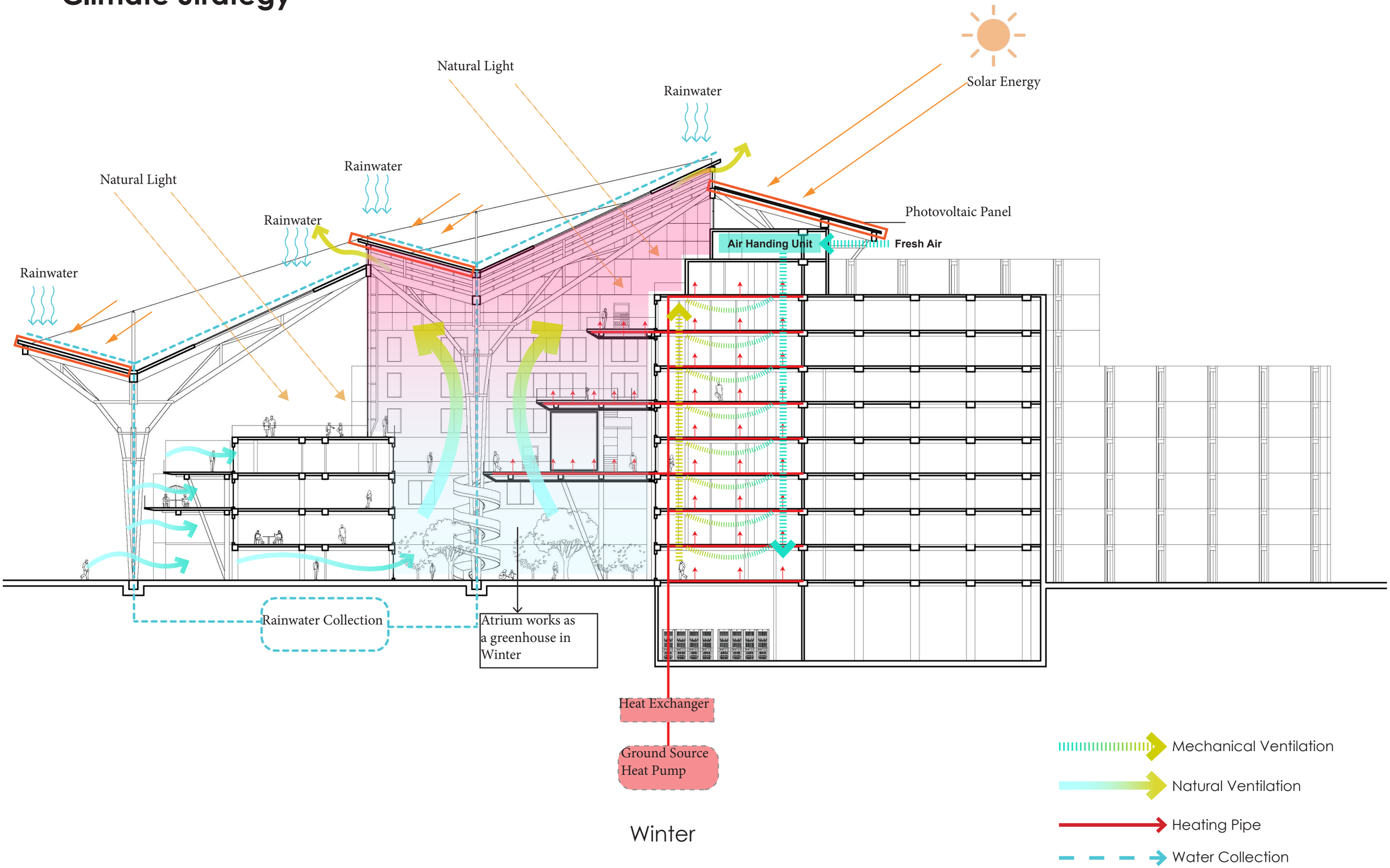
Light & Rain



Climate Strategy



Climate Strategy



Reflection

Potential application *- Renovation for old concrete buildings*
- Flexibility for production and construction
- Sustainability

Issues *- Relationship between research and design*
- Relationship between structure and building

Thank you for all the help in the past tough year.

From Heavy to Light

Second Life of The Hague National Archive

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