The Wall of Porta Romana

The BEIC Library in Milan

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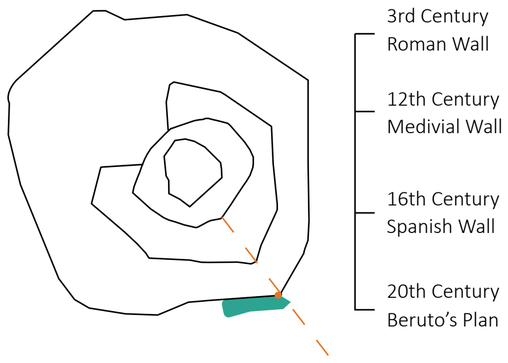
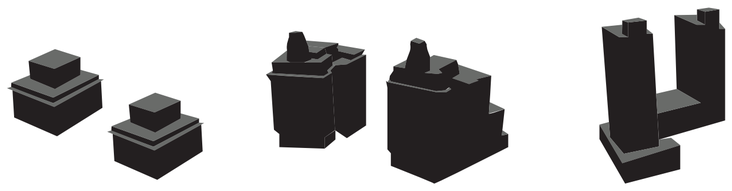
City Approach: Milan

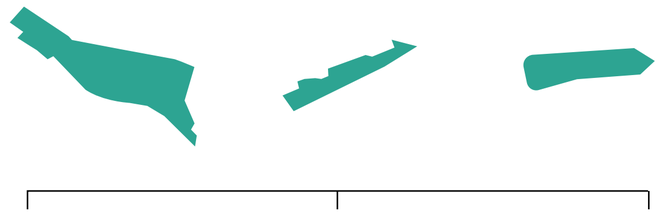
Urban Rings of Milan Evolution Vs Portas of Rings



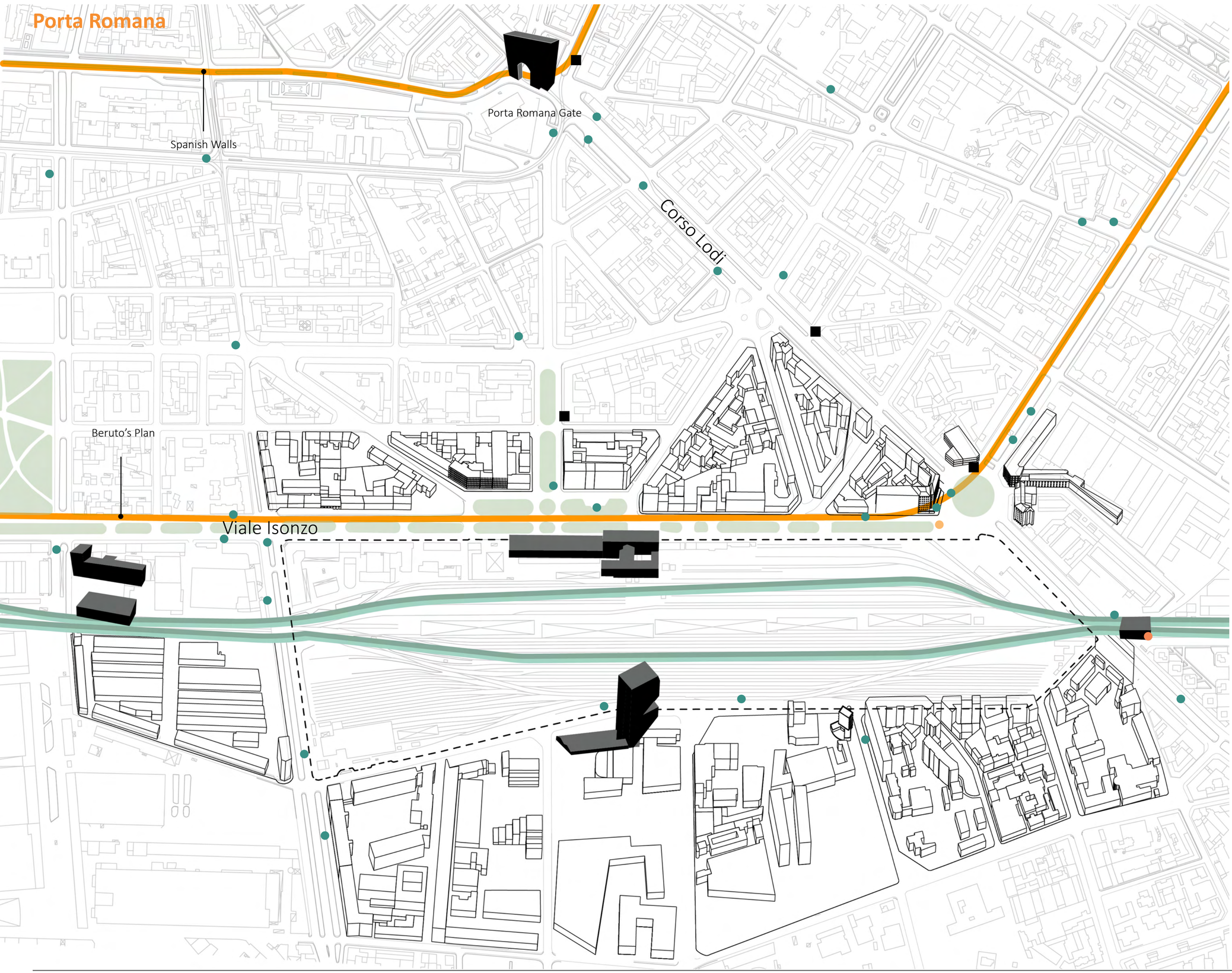
The Twin Buildings



The Abandoned Railway System Plots



Porta Romana



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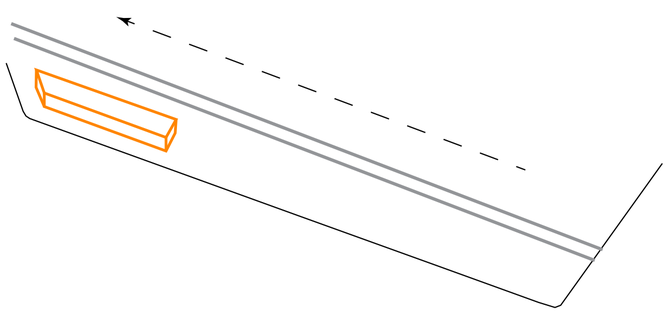
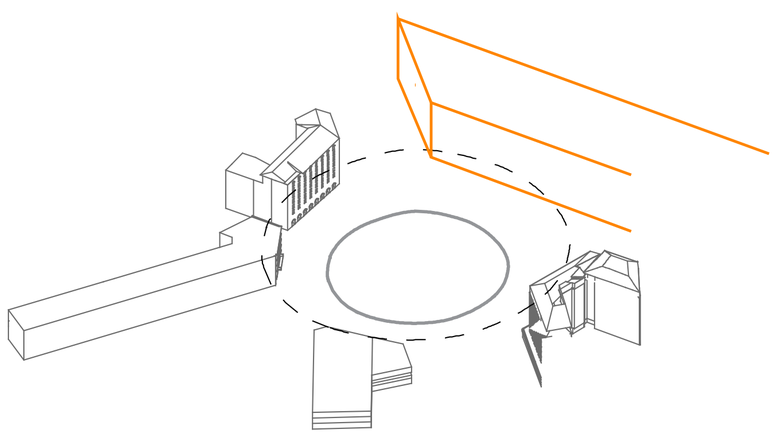
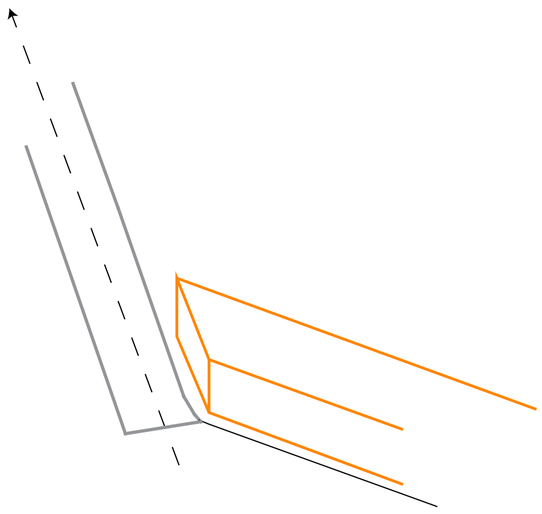
Urban Strategy: Area Continuation



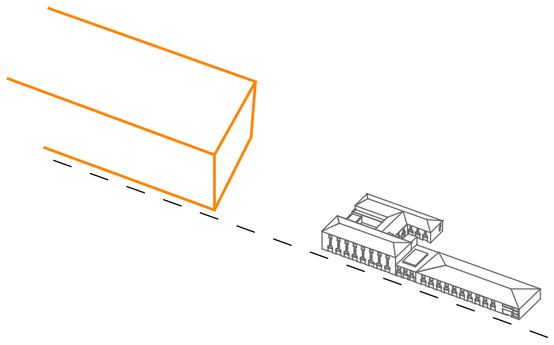
1 Adapting to Site Horizontality



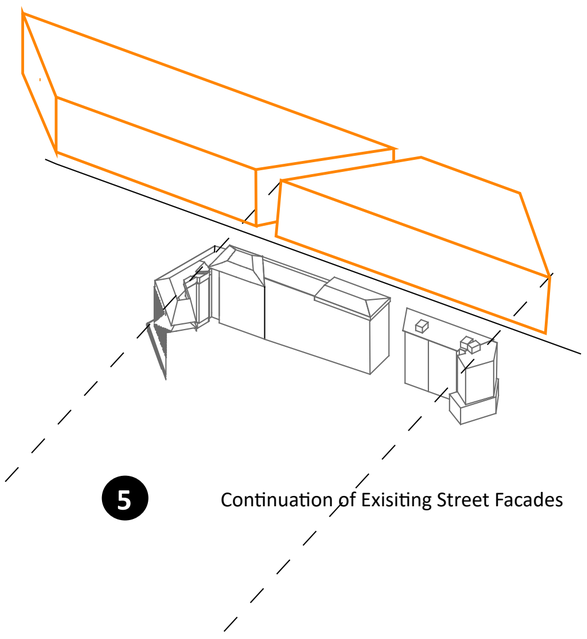
2 Continuation of Piazza Lodi



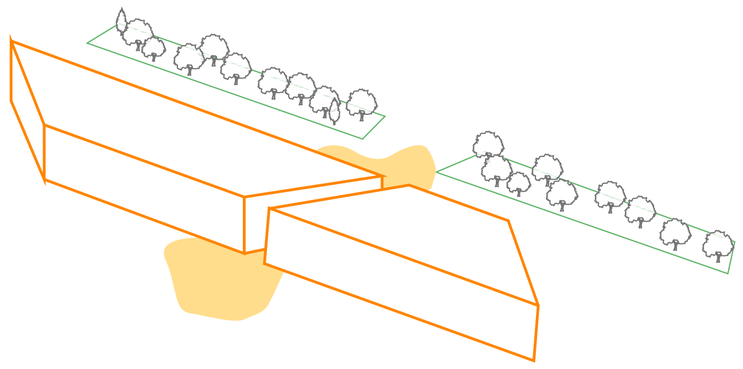
3 Continuation of Corso Lodi



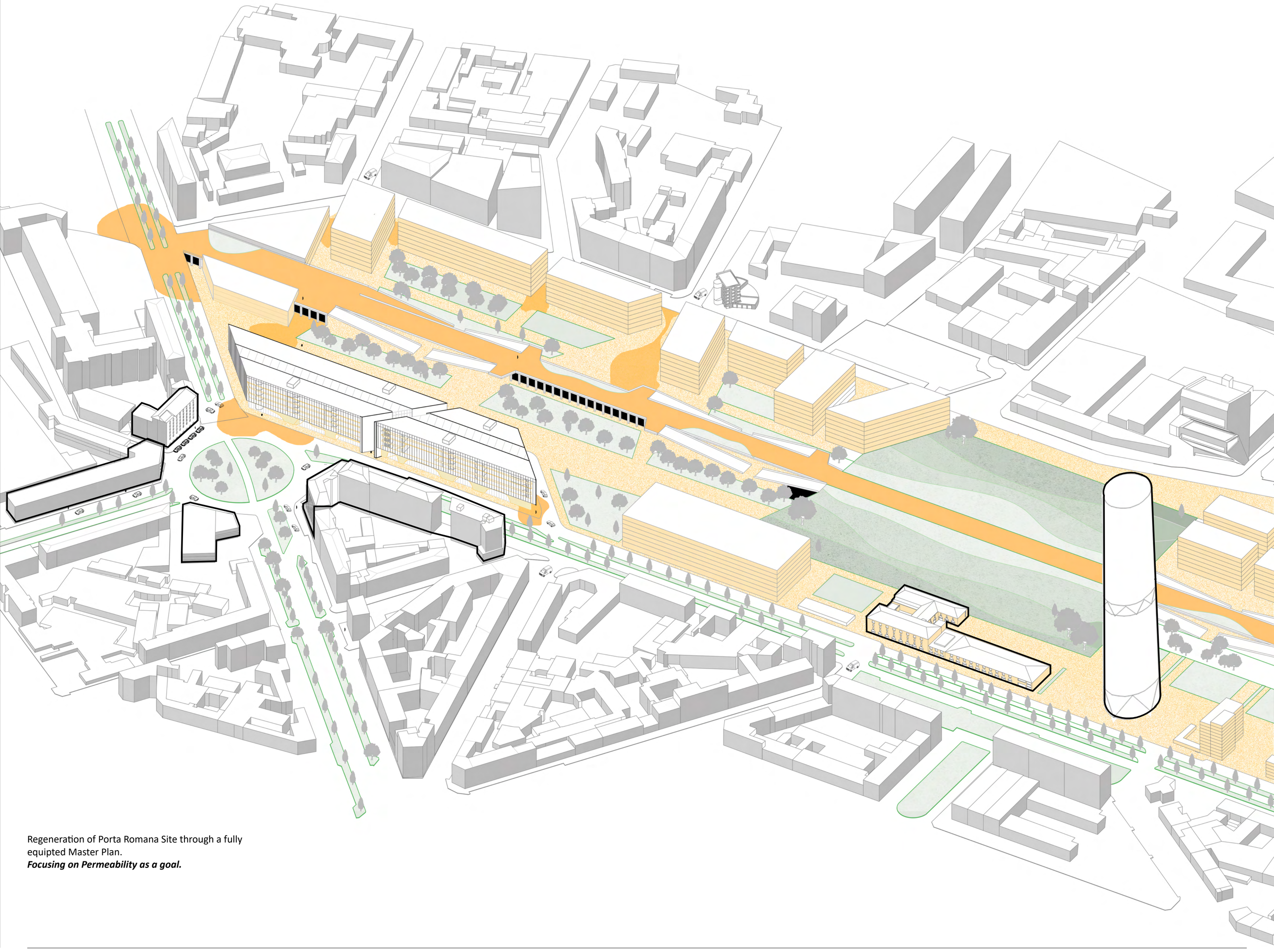
4 Respecting exisitng historical buildings on Site



5 Continuation of Exisiting Street Facades



6 Permeable Site passage to the other side of the Area



Regeneration of Porta Romana Site through a fully equipted Master Plan.
Focusing on Permeability as a goal.

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Functions

1. Residential
2. Offices
3. Commercial
4. Incubator
5. BEIC Library

Existing

1. Ex-Industrial Building
2. Foundazione Prada
3. Residentail Blocks
4. A2A Skyscrapper
5. Piazza Lodi
6. Piazza Trento

New

1. Eco-Zone
2. Public-Park Hill
3. Sports Camp
4. Highline Park
5. Railway
6. Porta Romana Train Station
7. Olympic Village
8. Prada Offices

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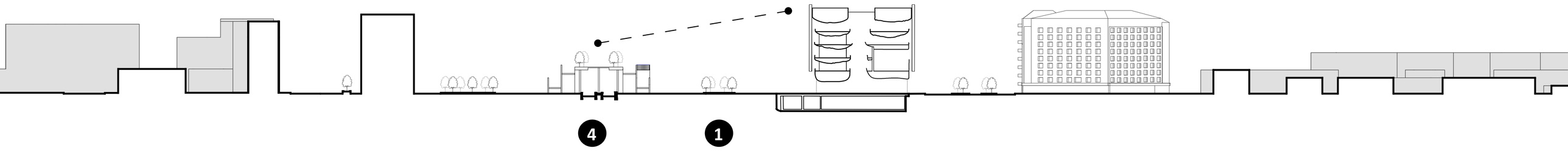
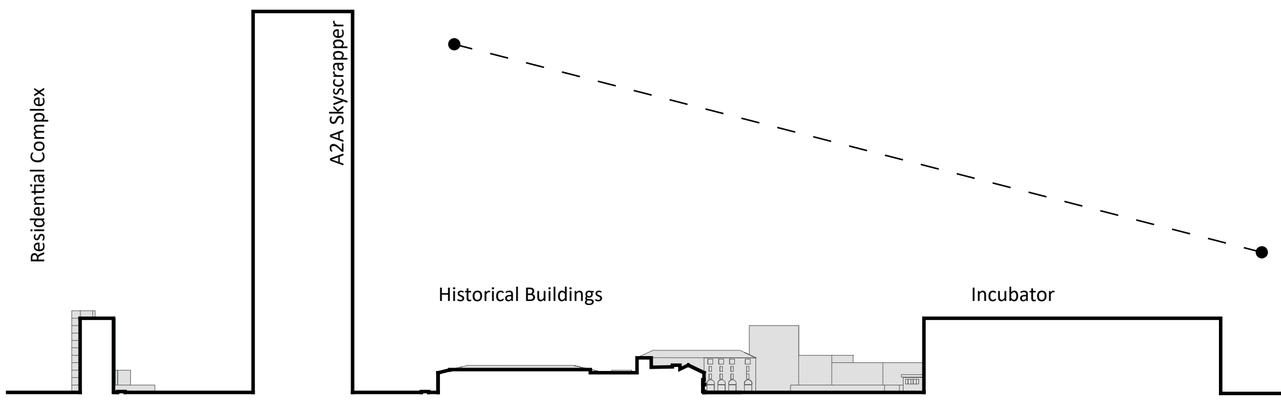


1 Backside of BEIC

2 Bike Stations

3 Porta Romana Train Station

4 Highline of Milan



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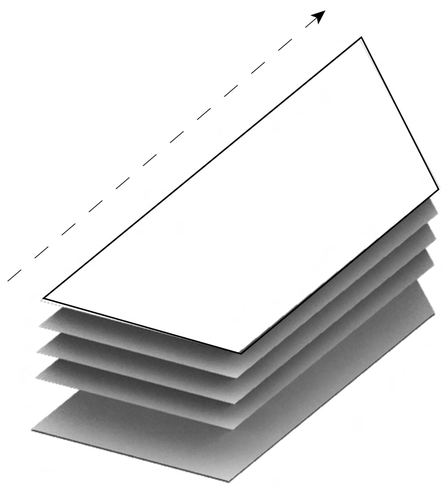
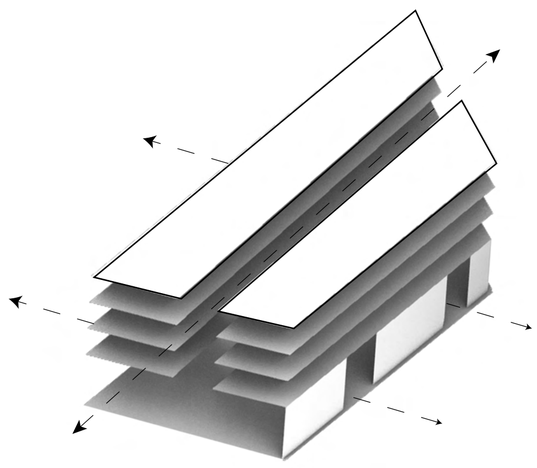
Concept and Composition: Architecture



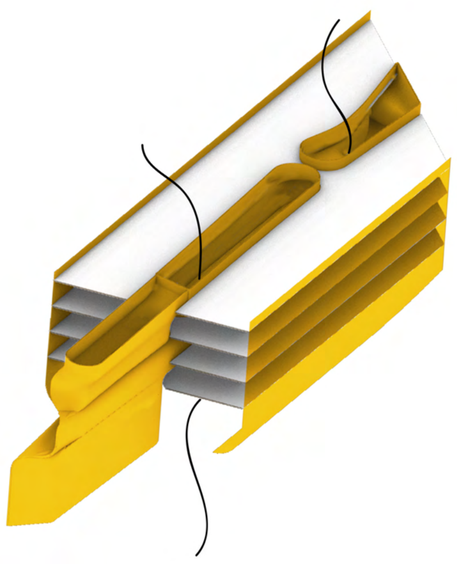
1 ***General Typology***

Adapting to Height and
Floors Needed



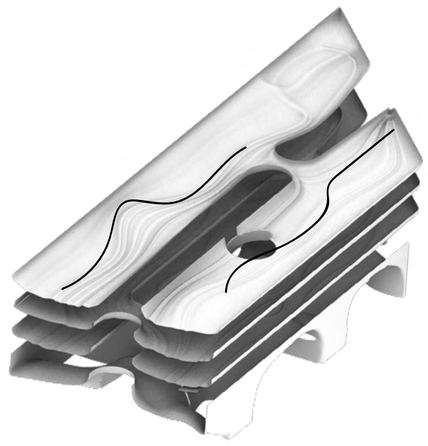
2 ***Horizontal Flow***

Adapting Horizontal Flow in the Middle Void and an
open ground floor



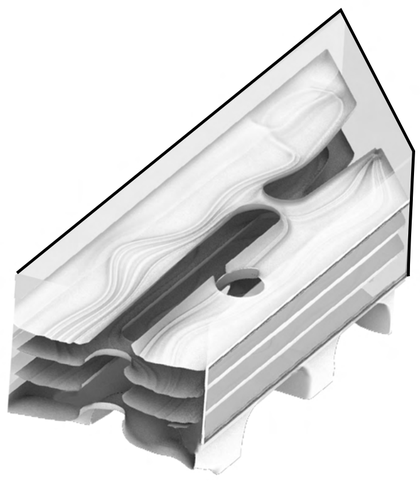
3 ***Vertical Flow***

Adapting Vertical flow through a continuous inner void
and floors walls being embraced vertically



4 ***Sculpture***

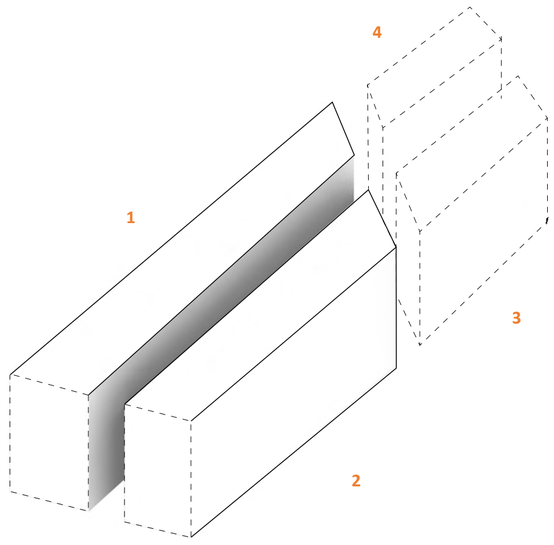
Vertical and Horizontal Flow adapting to each other
creating a sculpture of organic movement



5 ***Box***

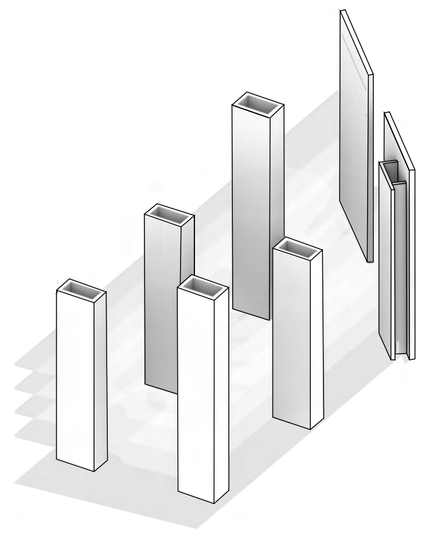
Facade taking a role of a calm element of a box which is adapting to
it's presence in the surrounding

Concept and Composition: Structure



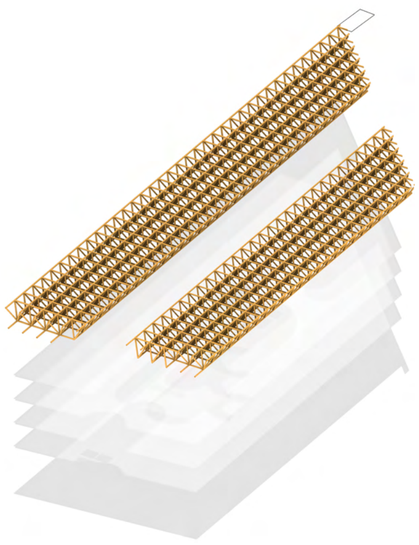
1 ***Structural Configuration Division***

Building Configuration follows four different parts



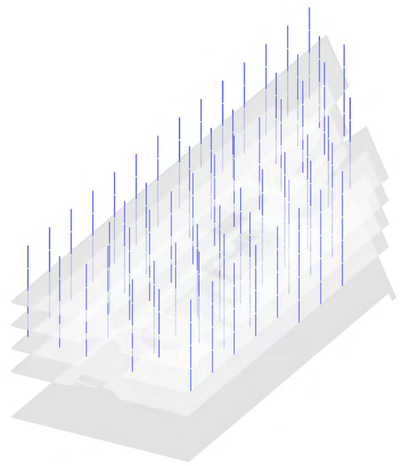
2 ***Core and Shear Wall Distribution***

Shear and Cores heavily distributed around the edges of the building



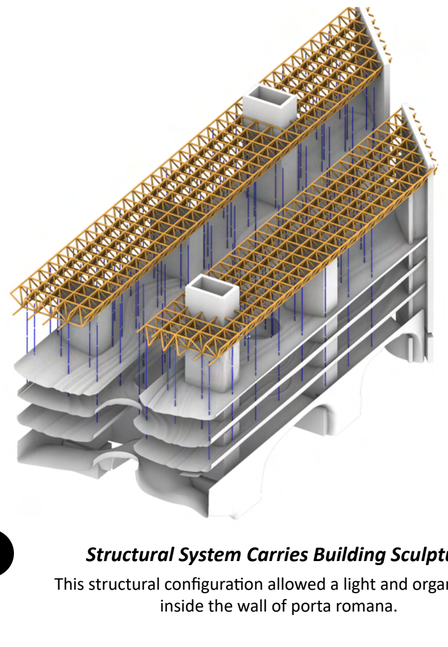
3 ***Cores Carried By Rooftop Truss***

Rooftop truss and special trusses were diributed as the
main structural carrier.



4 ***Cables Suspended From Truss***

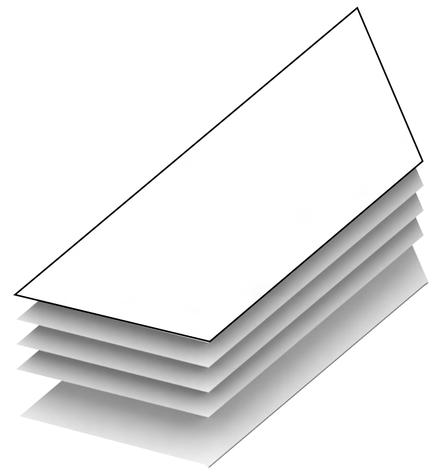
Narrow cables suspended from the trusses



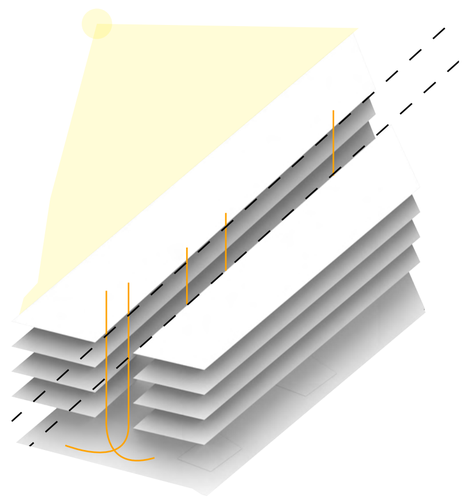
5 ***Structural System Carries Building Sculpture***

This structural configuration allowed a light and organic flow
inside the wall of porta romana.

Concept and Composition: Technology

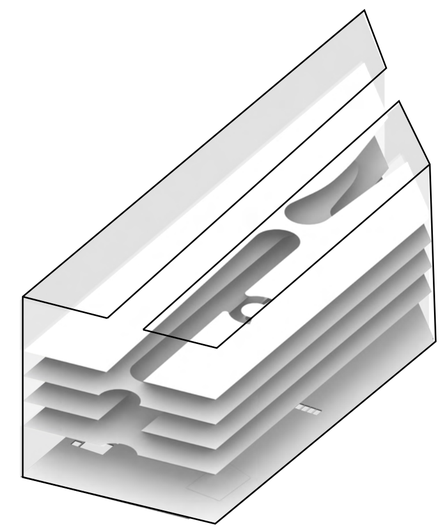


1 ***Understanding of Typology***



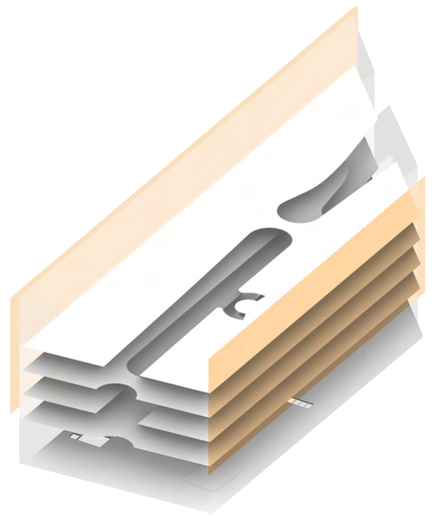
2 ***Inner Void Division***

Adapting to Ventilation and Light conditions



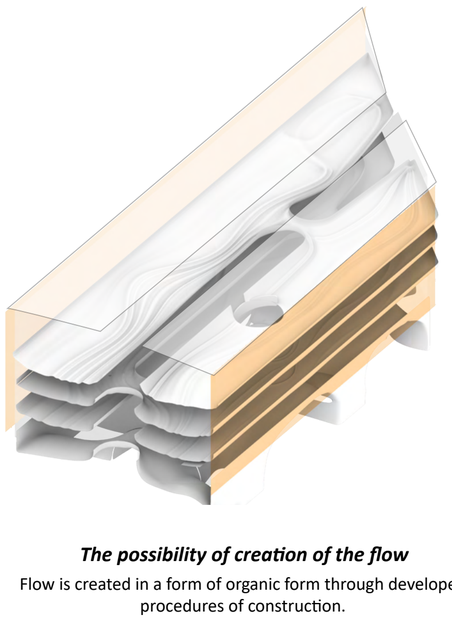
3 ***Facade Envelope***

Facade Envelope to accomodate building conditions



4 ***Design of Facade System***

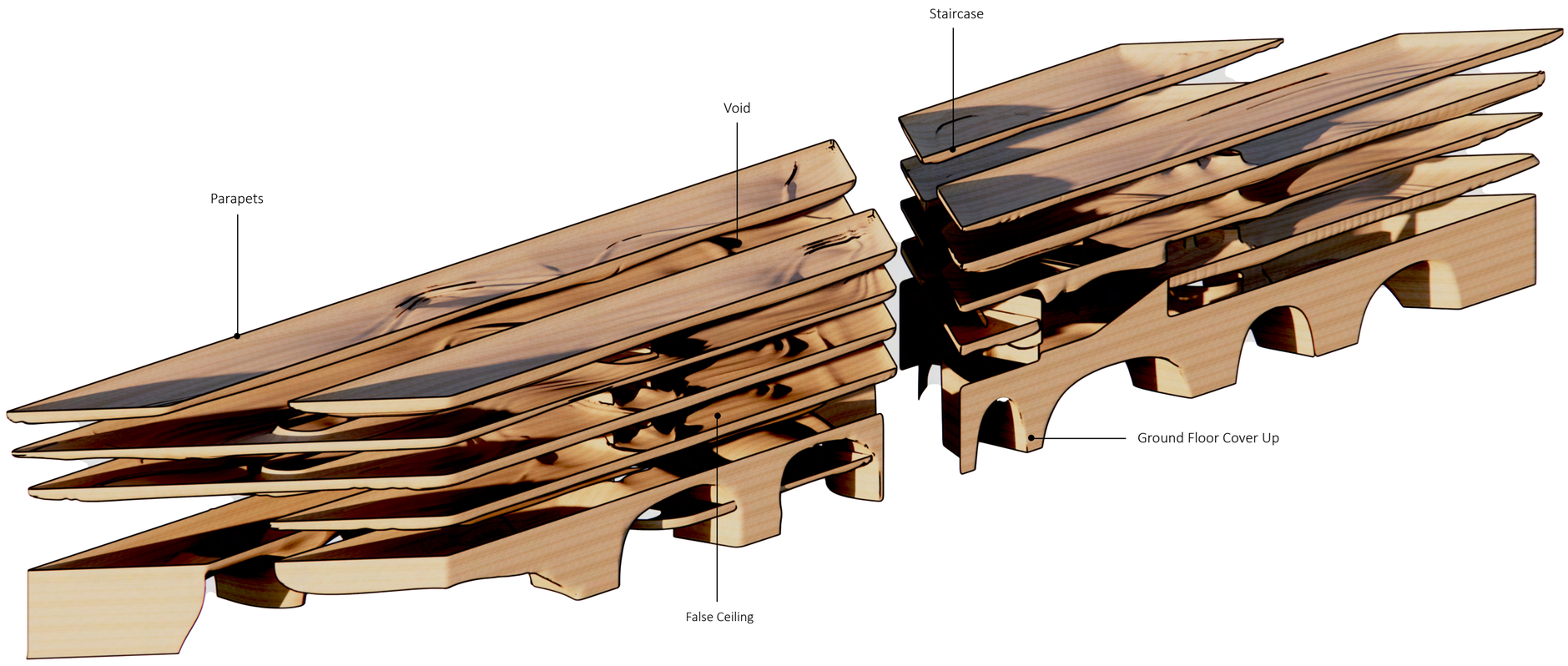
Adapting to inner functions and exterior conditions



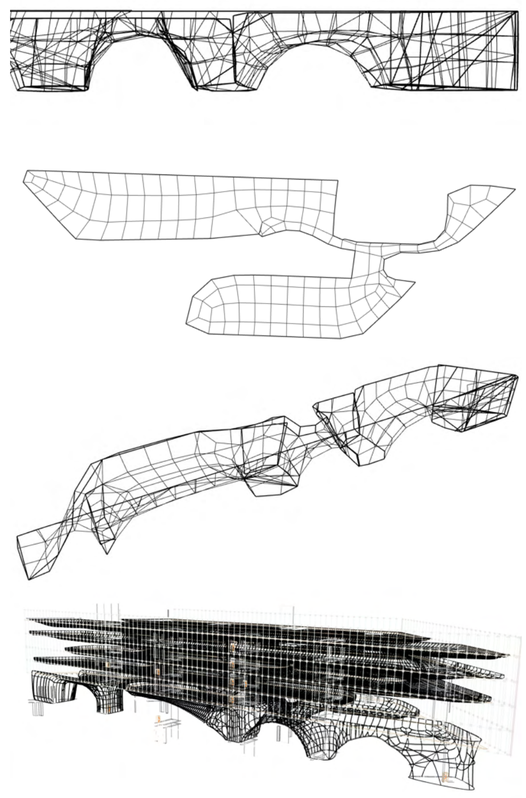
5 ***The possibility of creation of the flow***

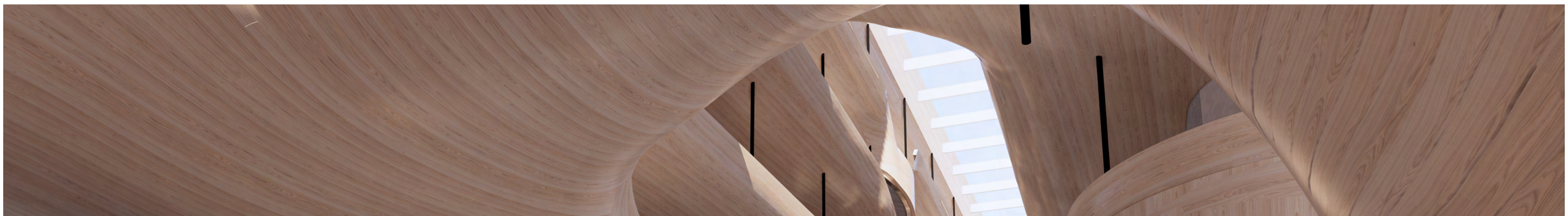
Flow is created in a form of organic form through developed
procedures of construction.

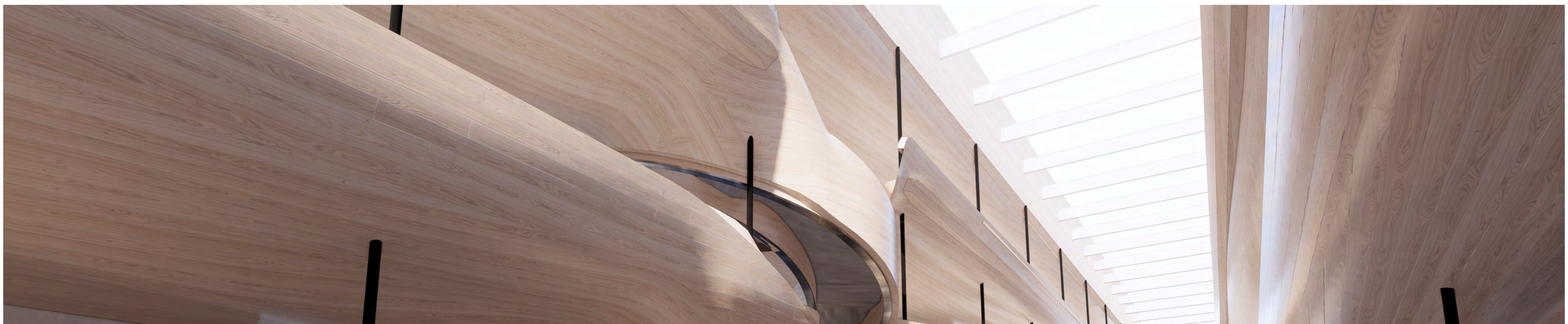
The Sculpture: Composition



Process of Thinking







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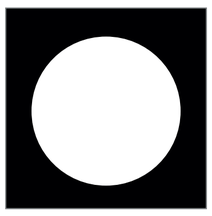
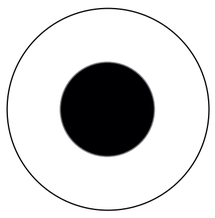
Building Typology Concept: From Typical Library Typology to Fluid Horizontal Typology

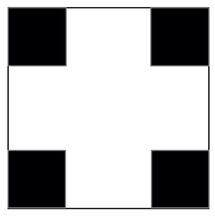
Classical Library Typologies



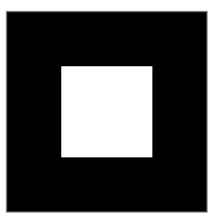
Stockholm Public Library



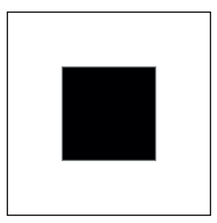
Library of the Federal Technical University, Zurich



Biblioteque Nationale, Paris

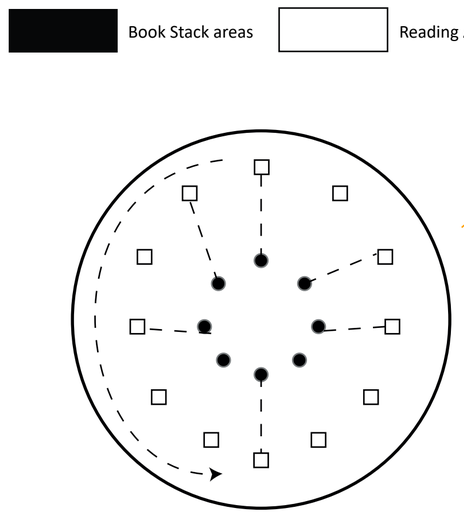


Library of Congress, Washington



Sri Lanka National Library

Iowa State University Library



Radical Typology

Book Stack areas

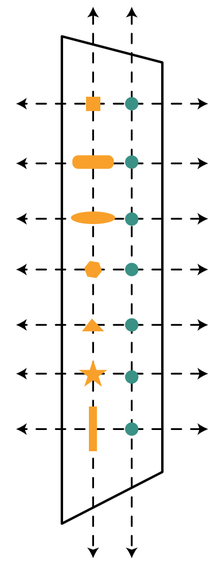
Reading Areas

Book Stacks Vs Reading Areas

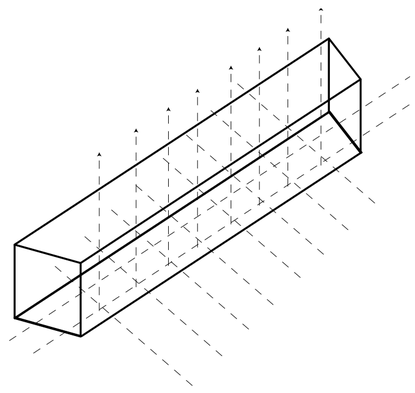
Horizontal Flexible Library

Book Stack areas

Gathering/Reading Areas



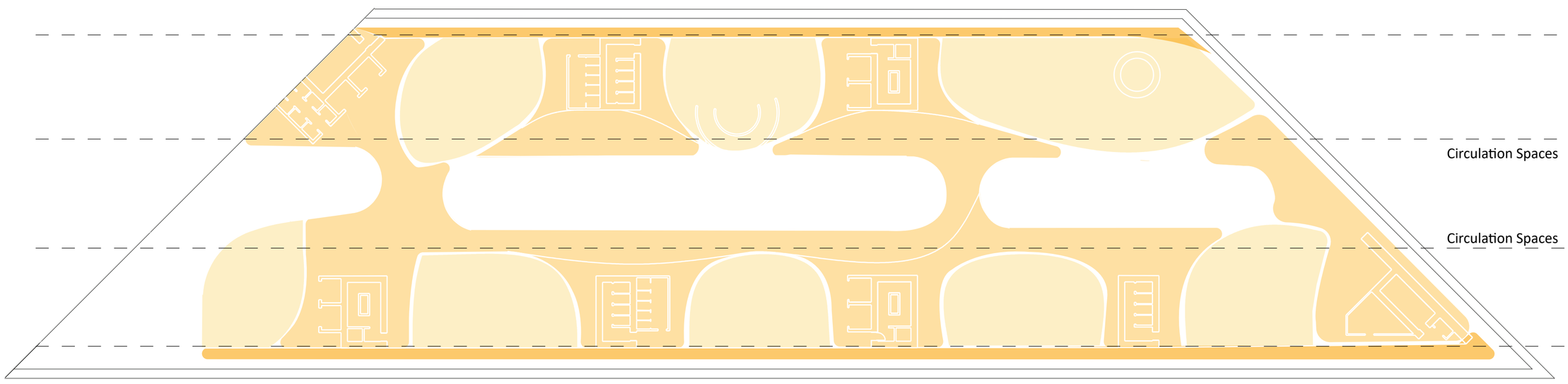
Flexible Typology



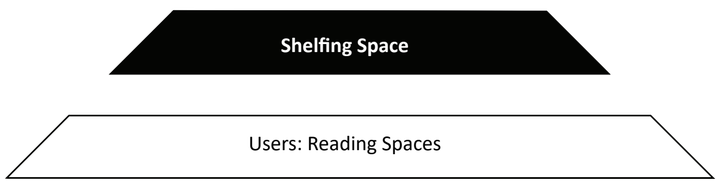
21st Century Library of Flexible Horizontal and Vertical Flow

Re-Interpretation of Flow in Library Plan Typology and False Ceiling Typology

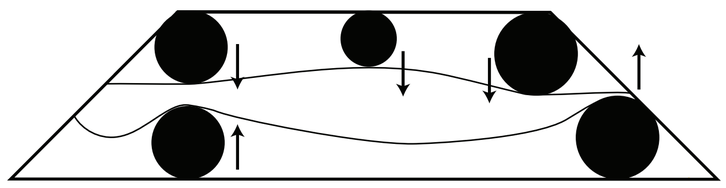
Typical Floor Plan



Horizontal Flexible Library

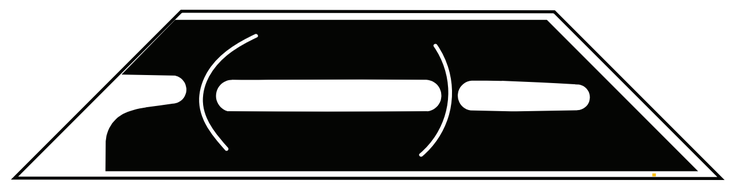


Highlighting Functions

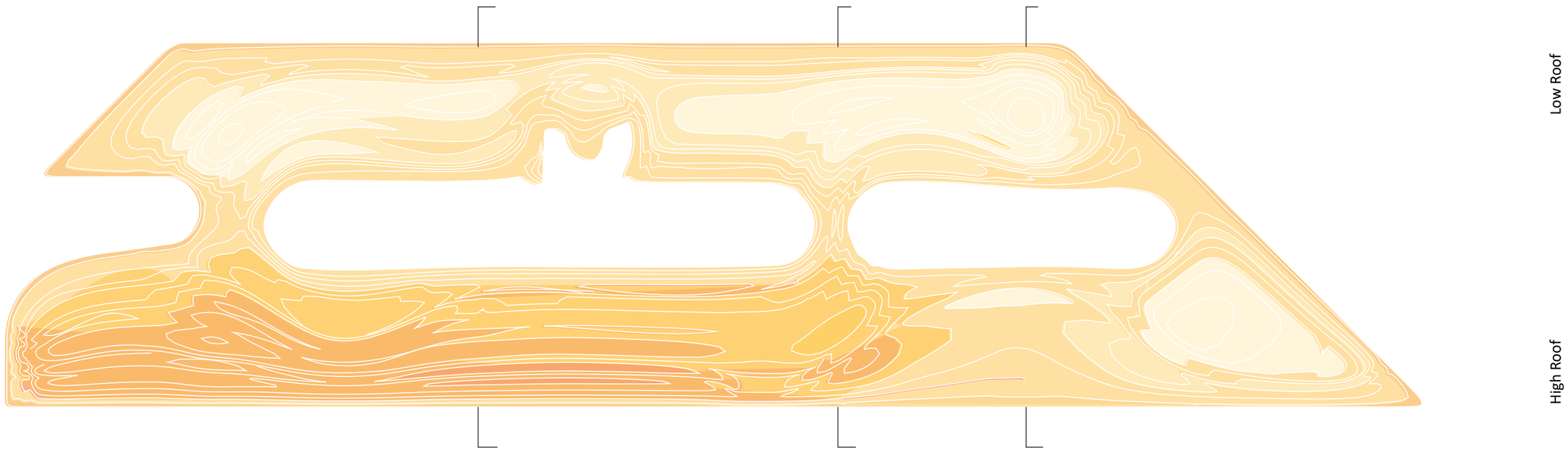


Special spaces

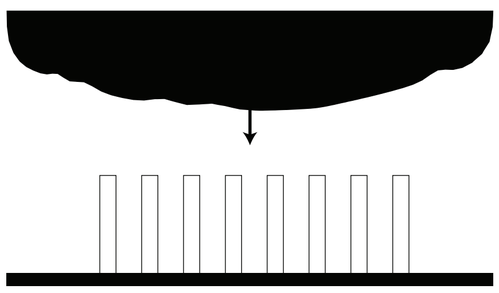
Flexibility



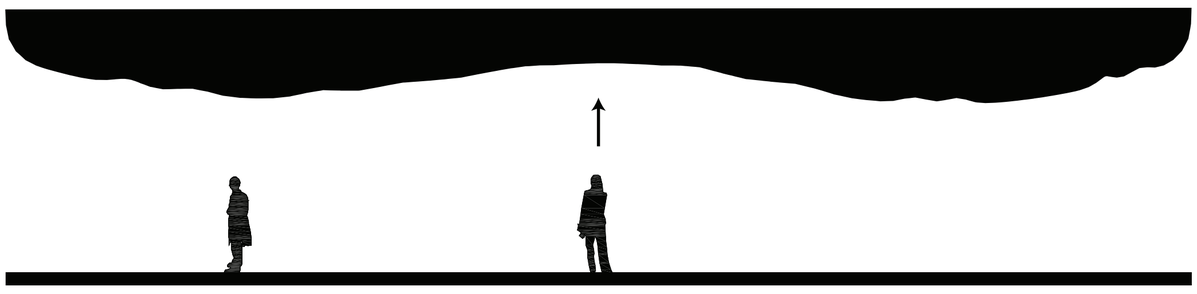
Typical False Ceiling of Floor Plan



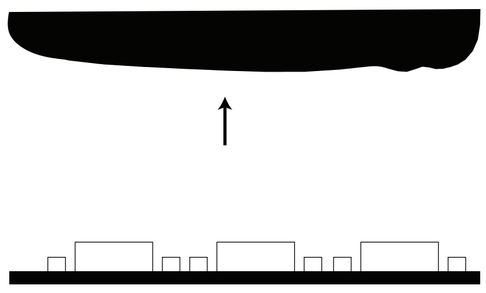
Shelfing Spaces



Circulation: Bridges



Reading Spaces



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Functional Distribution Throughout Building

Fourth Floor

Panaramic Terrace

Internal Services

Science and Technology Storage

Science and Technology Reading Spaces

Function	Area	Books	Shelves	Users
Departments	2000	19000	5000	430
Auditorium	1200	-	-	45
Internal Services	800	-	-	46

Third Floor

Music, Entertainment, Gaming, and New Media

Grow and Learm Space

Humanities and Social Sciences Storage

Humanities and Social Sciences Reading Spaces

Function	Area	Books	Shelves	Users
Departments	2000	190000	5000	430
Imaginarium	900	-	-	21
Forum	650	-	-	78

Second Floor

Laboratories and Multi=Purpose Rooms

Auditorium

Discover and Play Space

Arts and Literature Storage

Arts and Literature Reading Spaces

Function	Area	Books	Shelves	Users
Departments	2000	90000	5000	430
Auditorium	350	-	-	-
Imaginarium	600	-	-	60
Forum	700	-	-	23

First Floor

Exhibition Space

Auditorium

Imagine and Create Space

Cultural Heritage Digitsation Centre

Innovation Lab

Function	Area	Books	Shelves	Users
Digital Department	1750	180000	1000	311
Auditorium	1200	-	-	300
Imaginarium	650	-	-	56
Forum	450	-	-	16

Ground Floor

Foyer

Mezzanine: 24/7 Rooms

Commercial Area

Function	Area	Books	Shelves	Users
Departments	2000	190000	5000	430
Imaginarium	900	-	-	21
Forum	650	-	-	78

Basement Floor

MEP

Internal Services Storage

Parking

Ramp

MEP

Automated Central Storage

Function	Area	Books	Shelves	Users
Departments	2000	19000	5000	430
Auditorium	1200	-	-	45
Internal Services	800	-	-	46

1. Entrance
2. Automated Central Storage
3. Auditorium
4. Digital Department
5. Imaginarium
6. Departments
7. Forum
8. Internal Services

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Entrance
A1 Promenade
Circulation Space
Guard Booth
Book Return Station
Lockers
Print on Demand Area
Cafeteria
Pop Up Store
A2
Reception
Back-office Workspace
OPAC Consulation
Infopoint Area
Smart Lockers
A3
Consulation Desks

A4
Expositions of Magazines

A5
Exhibition Area

A6
Toilets
Cleaning Rooms
Bookstore

Auditorium
Foyer
Ticket Office/Reception
Cloakroom
Translation Booths
Exhibition Space
Toilets

Commercial
Bistro
Bookshop
Exhibition Walk Space
Pop Up Booth

Ground Floor Plan + 00.00

Perspective Transversal Section through the Atrium

4 8 12 16

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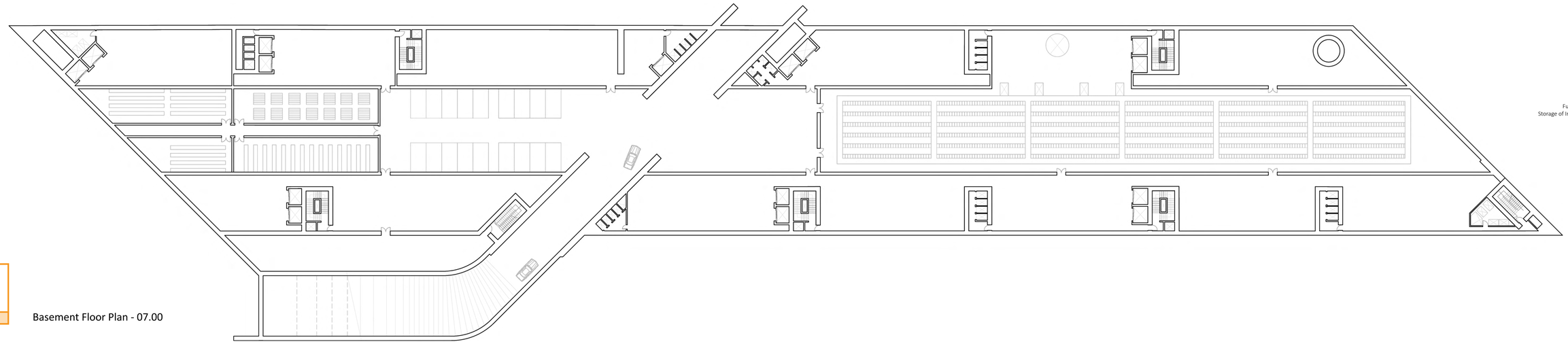
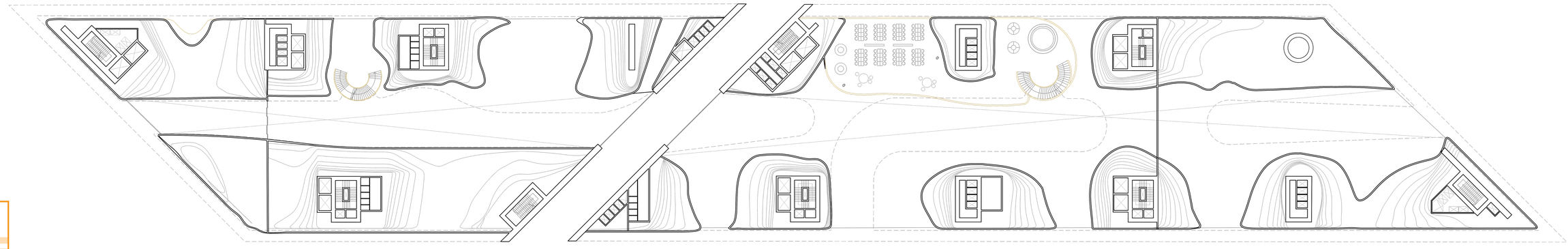


Basement Floor Plan - 07.00

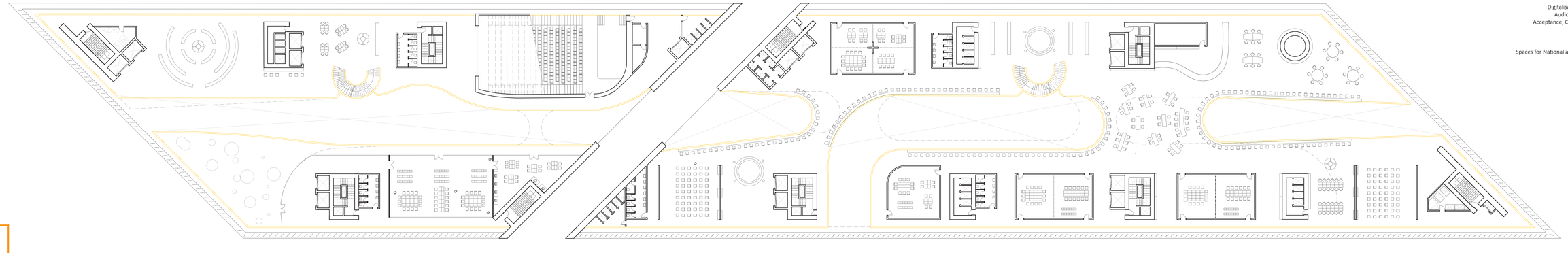
Automated Central Storage
Storage Space
Automated Robot Machine

Internal Services
Bibliobus Collection Storage
Consumables Storage
Furniture and Equipment Storage
Storage of Incoming and Outgoing volumes
Parking Spaces
Truck Exterior Ramp



Mezzanine Floor Plan + 05.00

Departments
24/7 Hour Study Rooms
Bathrooms



First Floor Plan + 10.00

Digital Department
F1
Quality Control
Digitalisation of Books and Manuscripts
Audio, Video, and Object Digitisation
Acceptance, Control, and Deposit of Volumes
Special Project Room
Autism and Down Syndrom
Data Processing Centre
Spaces for National and International Collaborations
F2
AI and Machine Learning Lab
VR Lab
Robo Lab

Forum
E1
Exposition of Volumes
Exposition of Newspapers
Unsystemetic Consultation
Gaming Stations
Temporary Exhibitions

Auditorium
Entrance
Seating
Stage
Changing Rooms

Imaginarium
B4 Grow and Learn Space
Play and Relax Activities
Coding Laboratory
Green Indoor Space

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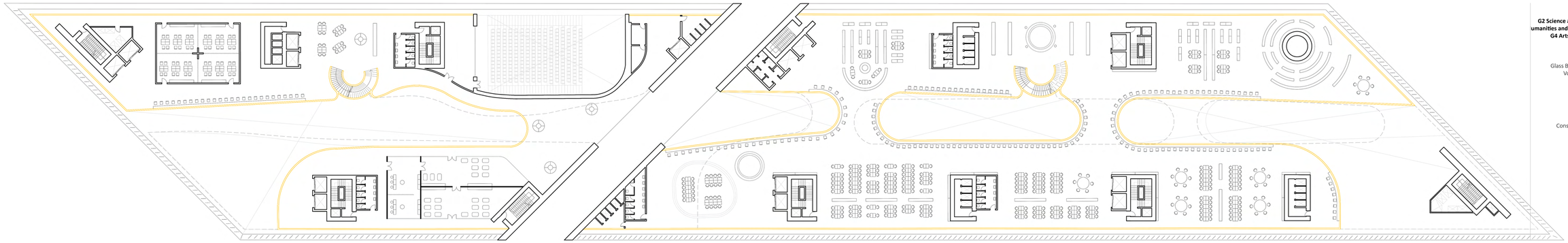
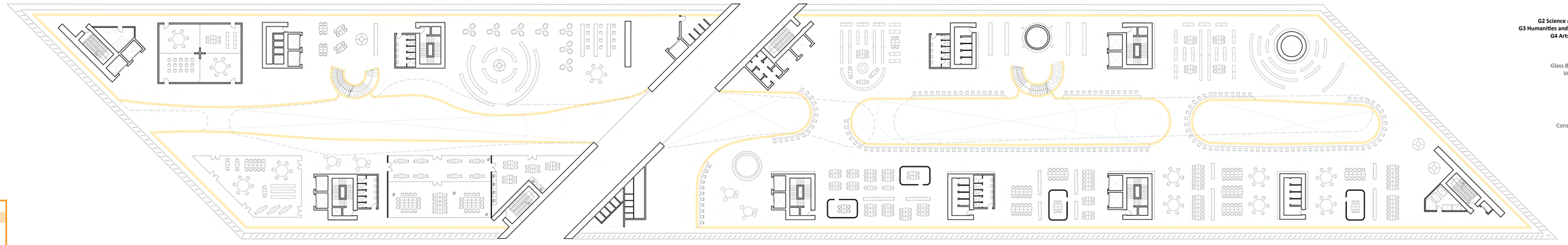


Second Floor Plan + 15.00

Deparments

G2 Science and Technology Department
umanities and Social Sciences Deparment
G4 Arts and Literature Department

Librarian Counter
Back-office Spaces
Glass Box for Advice and References
Volumes for Specialized Advice
Display of Volumes
Thematic Area A
Thematic Area B
Thematic Area C
Display of Periodicals
OPAC Consultation
Consultation for Digital Resources
Consultation of Microforms

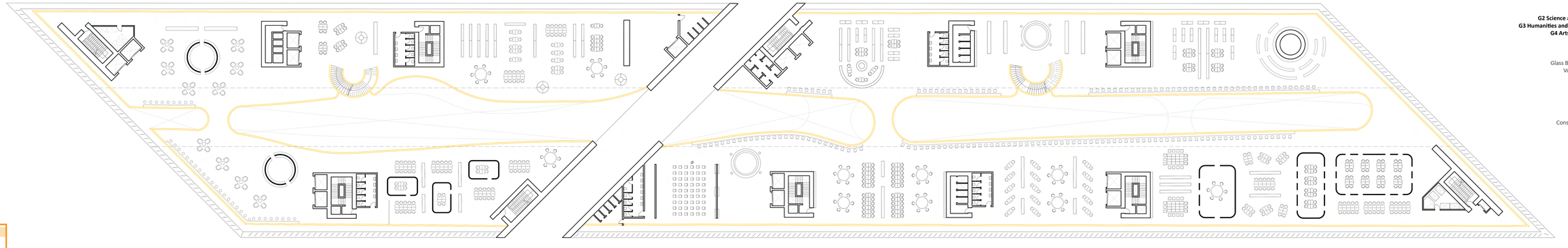


Third Floor Plan + 20.00

Deparments

G2 Science and Technology Department
G3 Humanities and Social Sciences Deparment
G4 Arts and Literature Department

Librarian Counter
Back-office Spaces
Glass Box for Advice and References
Volumes for Specialized Advice
Display of Volumes
Thematic Area A
Thematic Area B
Thematic Area C
Display of Periodicals
OPAC Consultation
Consultation for Digital Resources
Consultation of Microforms



Third Floor Plan + 25.00

Deparments

G2 Science and Technology Department
G3 Humanities and Social Sciences Deparment
G4 Arts and Literature Department

Librarian Counter
Back-office Spaces
Glass Box for Advice and References
Volumes for Specialized Advice
Display of Volumes
Thematic Area A
Thematic Area B
Thematic Area C
Display of Periodicals
OPAC Consultation
Consultation for Digital Resources
Consultation of Microforms

4 8 12 16

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Reading Spaces

Shelfing Spaces

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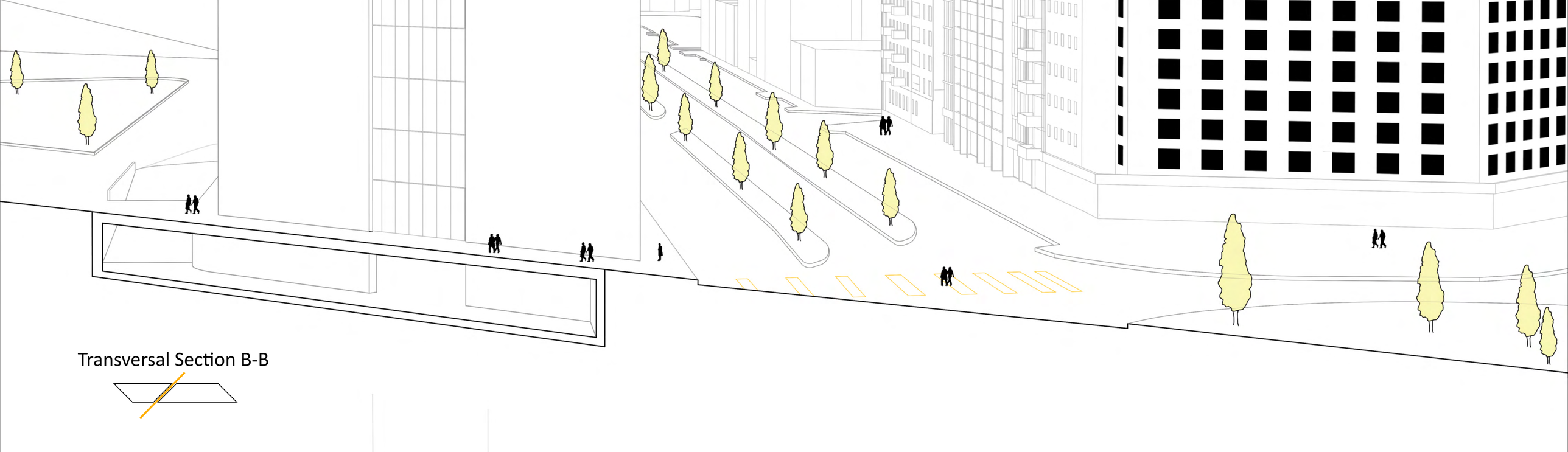
Journey throughout the Building

Transversal Section A-A

Transversal Section B-B



Transversal Section C-C

4 8 12 16

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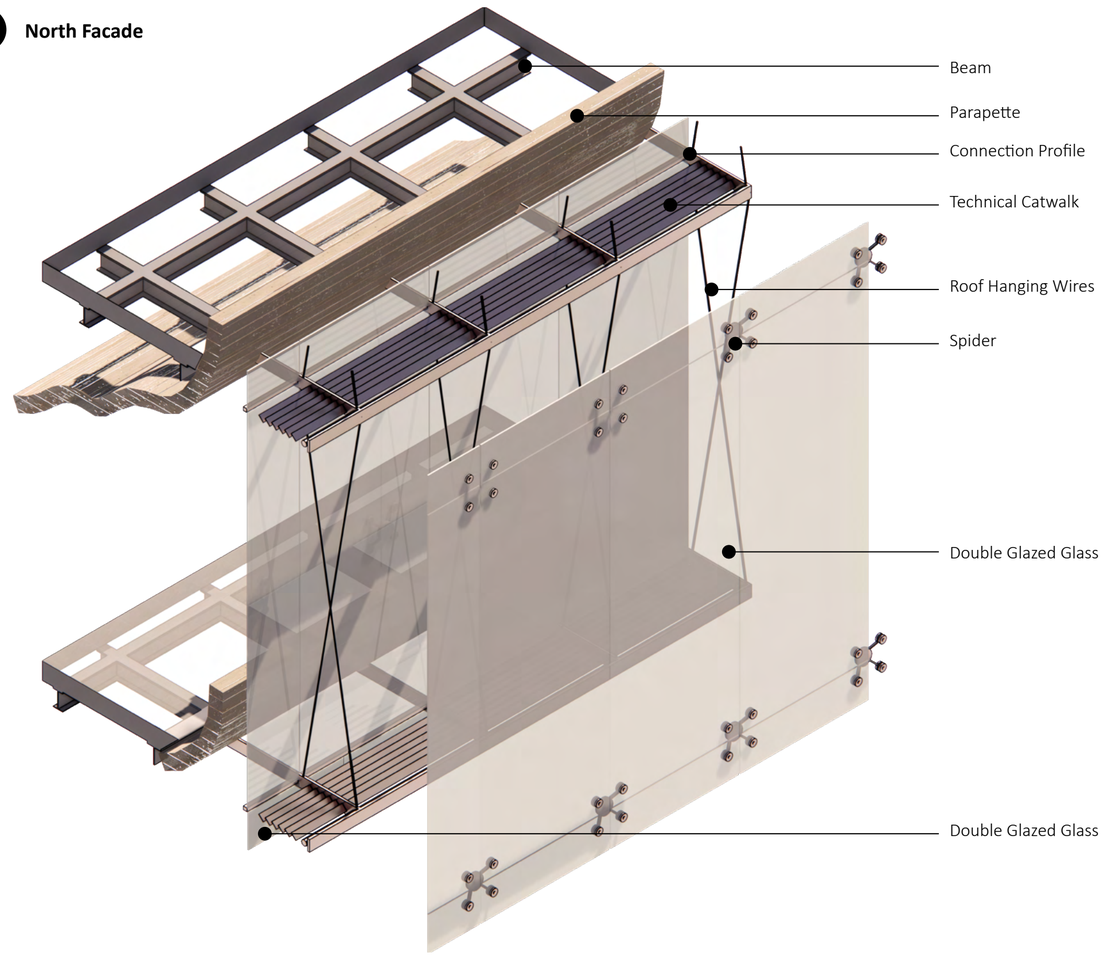
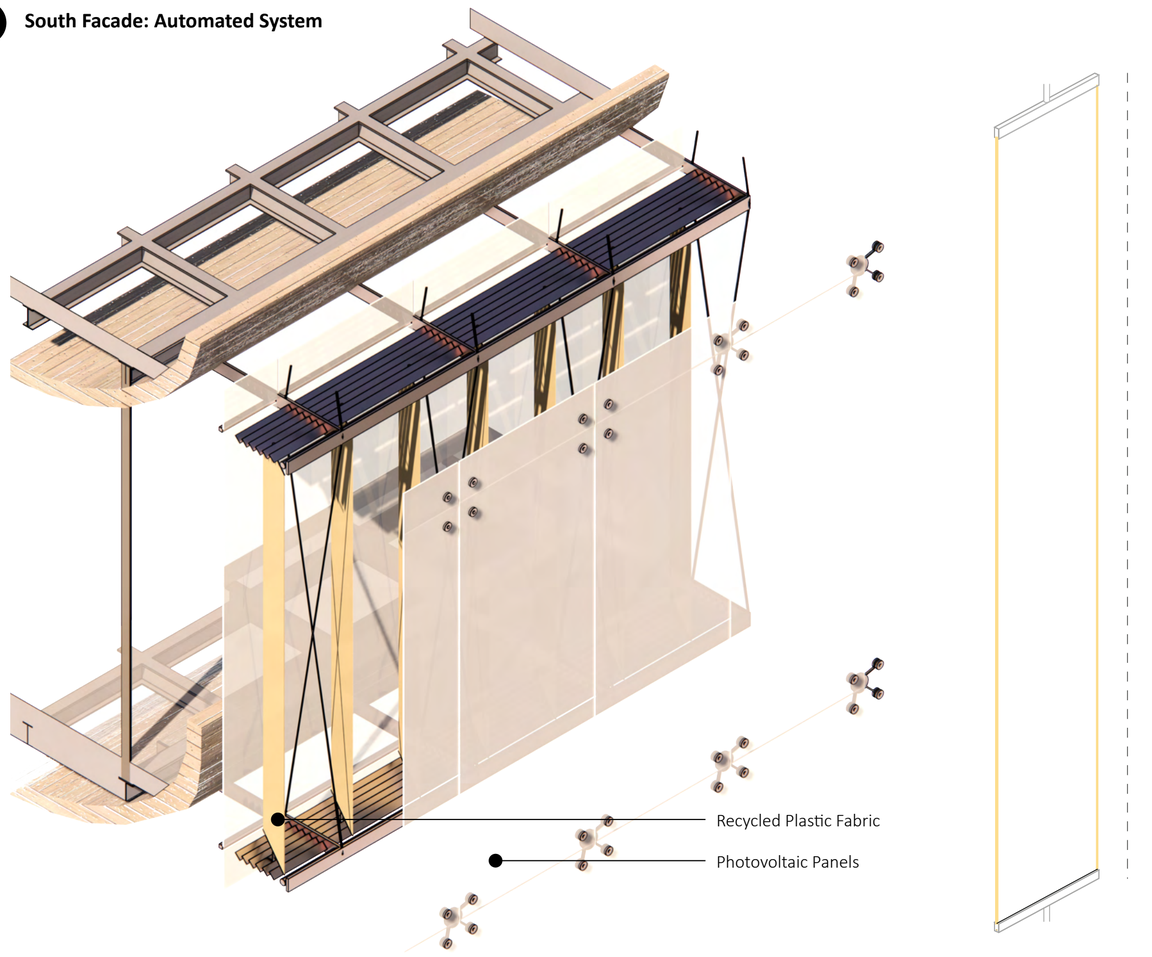
Double Skin Facades

1 **North Facade**



2 **South Facade: Automated System**



Facade Mechanism

Daylight Goal 6%

Daylight Goal 10%

Daylight Goal 13%

Facade to Structure Relation

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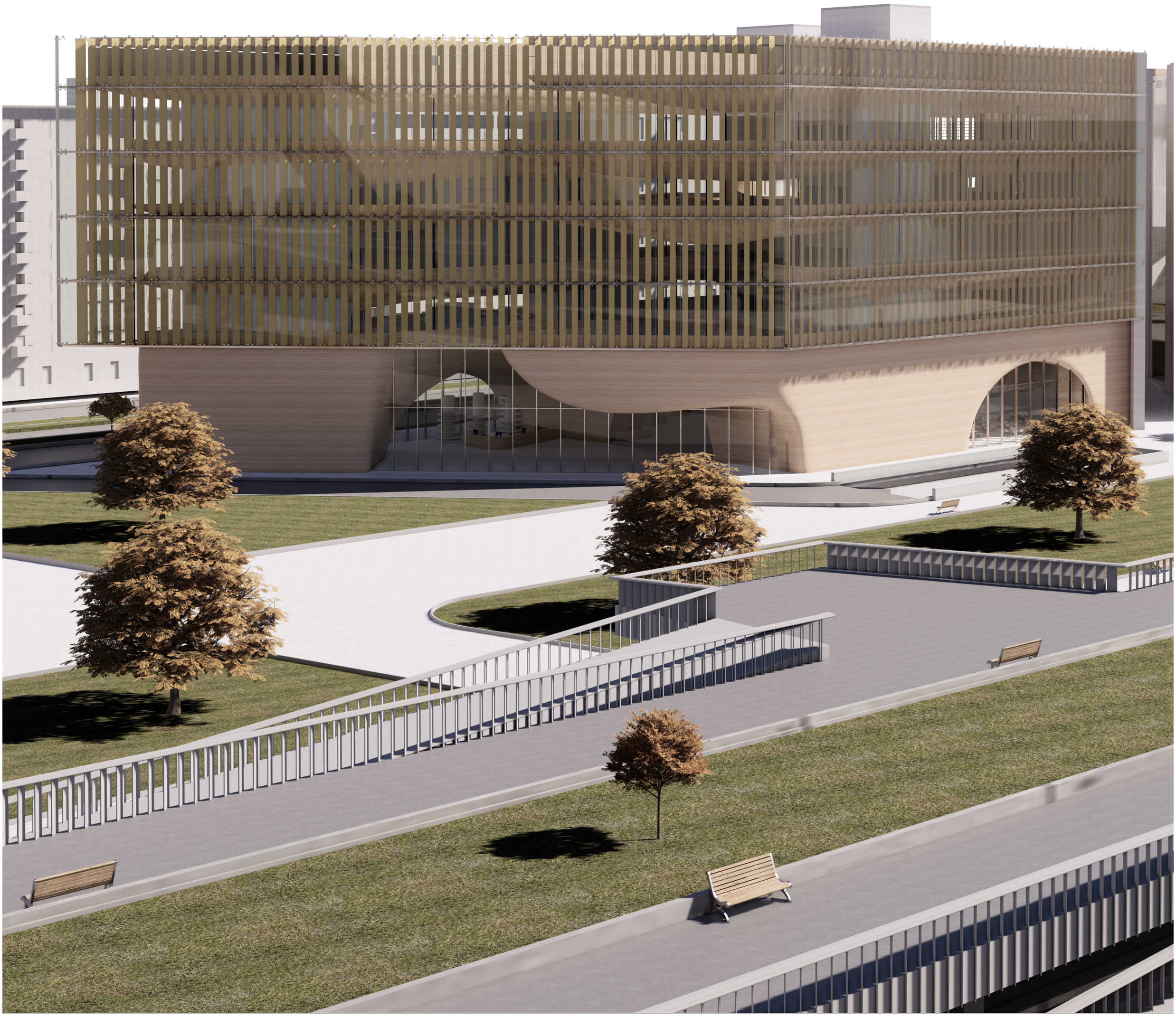

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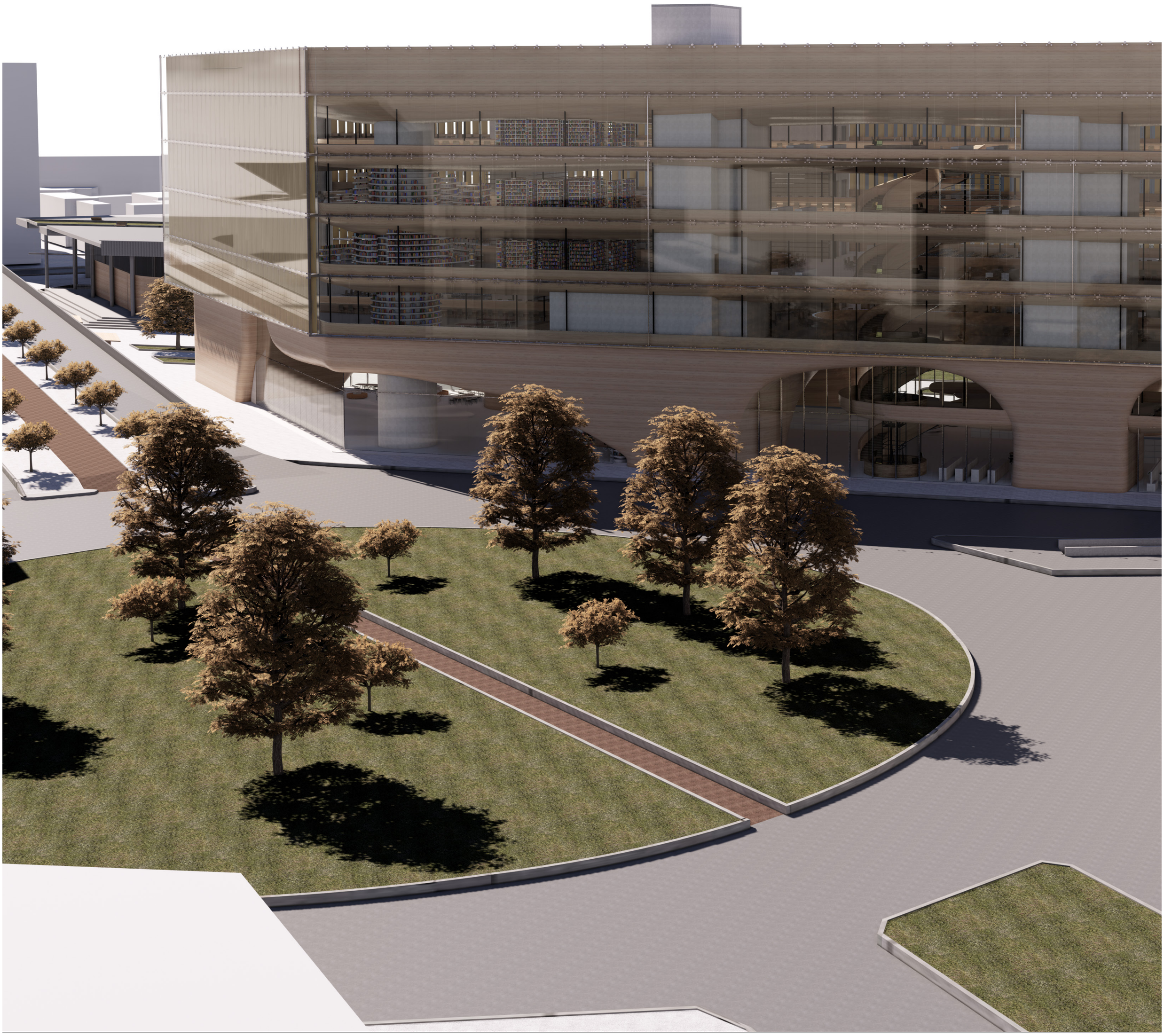

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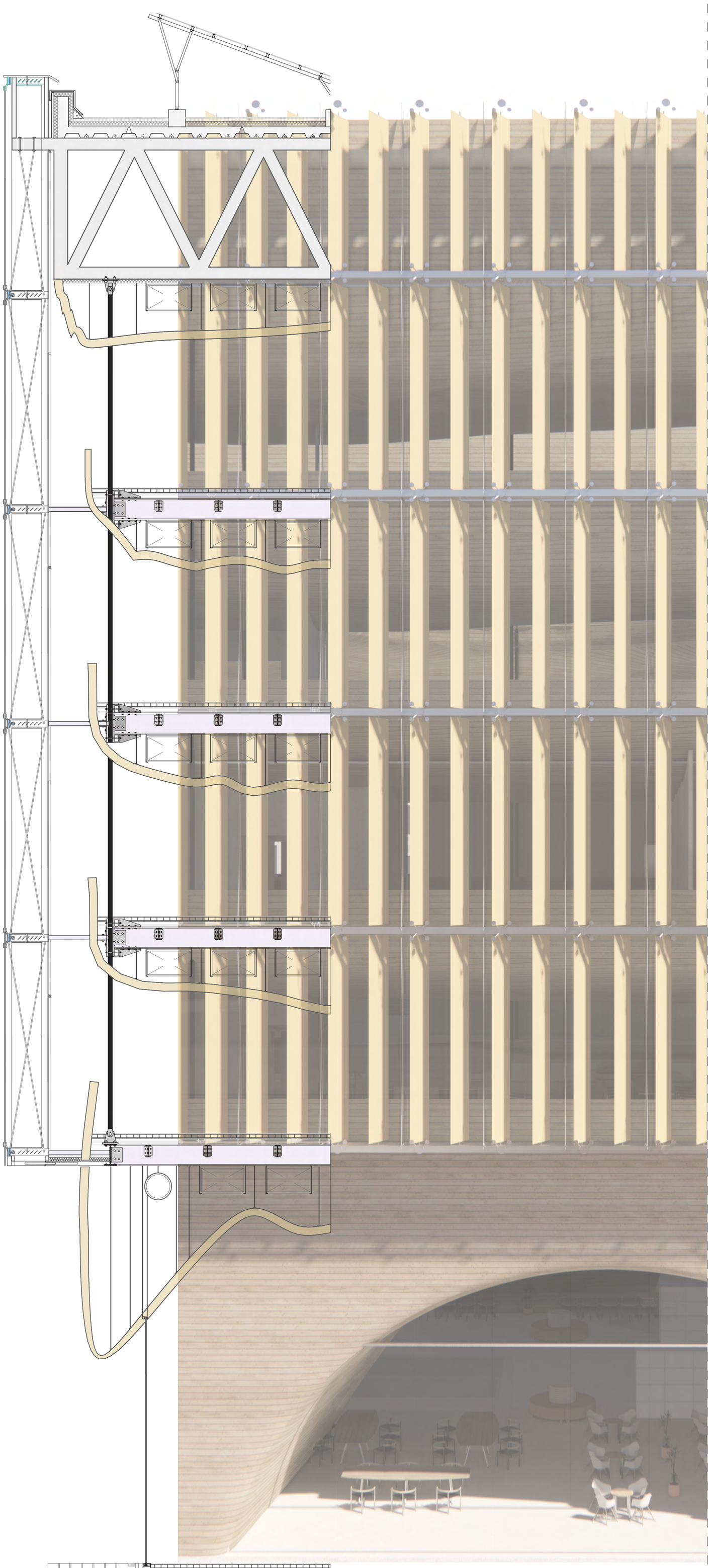
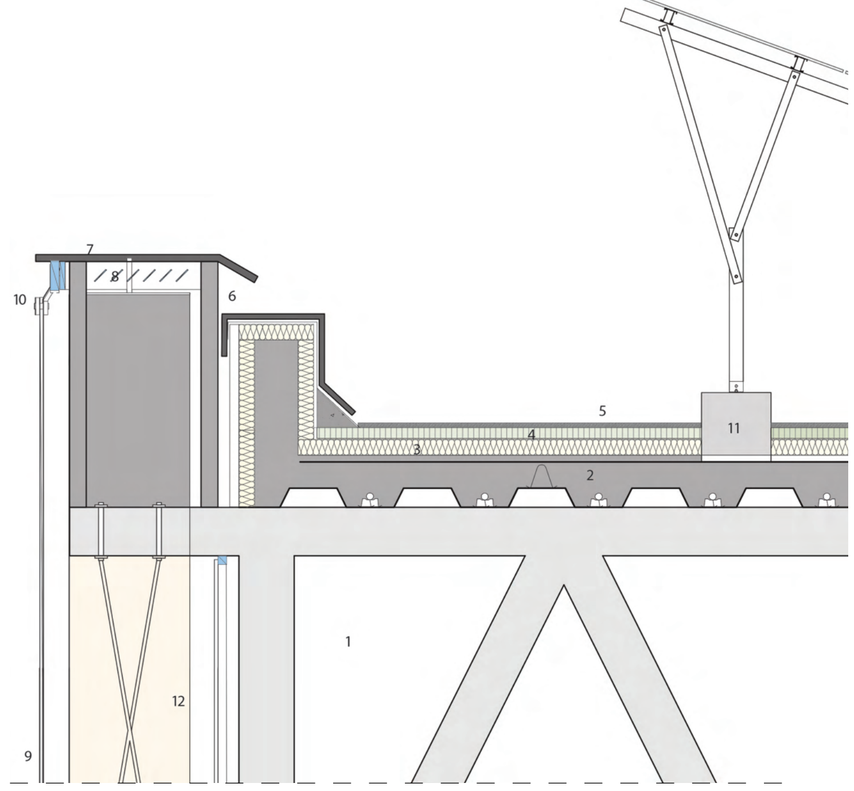
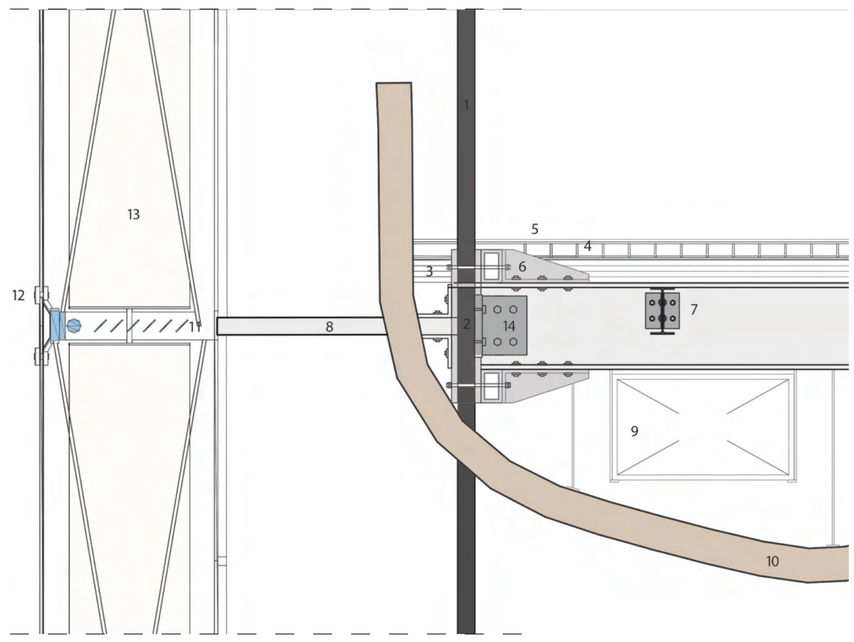
Building Facade: Details to Materials

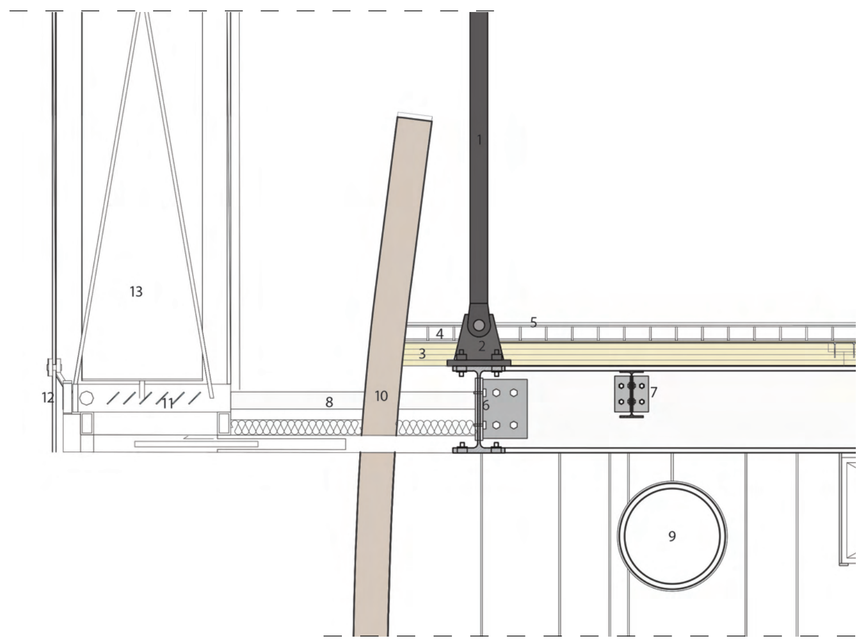




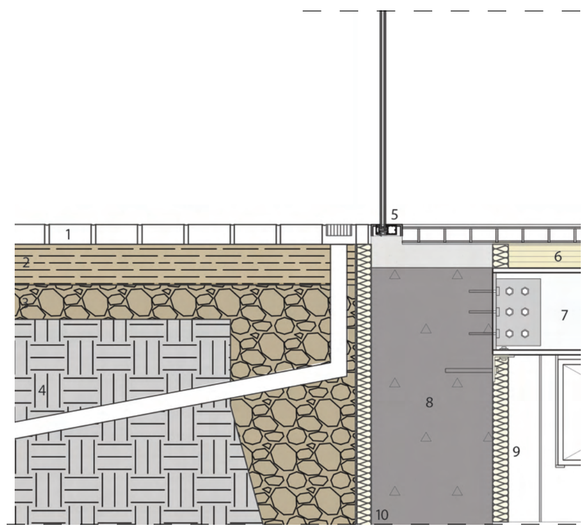
01 Tubular profile CHS 219.1x10 S275
02 Reinforce Concrete Slab
03 Insulation Board
04 Membrane Drainage
05 Gravel Finishing
06 Metal Profile Formed
07 Metal Profile Formed
08 Maintenance Catwalk
09 Double Layer Glass
10 Spider Connection
11 Concrete Dice
12 Technical Fabric



01 Tubular profile CHS 101.6/10 S275
02 Joint Tube
03 CLT Panel 105 mm
04 Basket Raised Floor
05 Finishing Floor
06 Bolted Bracker Plate
07 Beam IPE 270
08 Tubular Profile CHS 76.1x10 S275
09 Ducts For Ventilation and MEP
10 False Cealing Spruce Wood
11 Maintenance Catwalk
12 Spider Connection
13 Technical Fabric
14 Shear Tab with Slotted Holes



01 Tubular profile CHS 101.6/10 S275
02 Fork Socket for Stay Cable
03 CLT Panel 105 mm
04 Basket Raised Floor
05 Finishing Floor
06 Beam HEB 500
07 Beam IPE 270
08 Tubular Profile CHS 76.1x10 S275
09 Ducts For Ventilation and MEP
10 False Cealing Spruce Wood
11 Maintenance Catwalk
12. Spider Connection
13. Technical Fabric



01 Aco Brick Slot
02 Minimun Sub Base
03 Smoothing Aggregate
04 Ground Soil
05 Curtain Wall Frame
06 CLT Panel 105 mm
07 Beam HEB 500
08 Reinforce Concrete Shear Wall
09 Waterproof Membrane
10 Drainage Membrane

Facade Details

0.4 0.8 1.2 1.6

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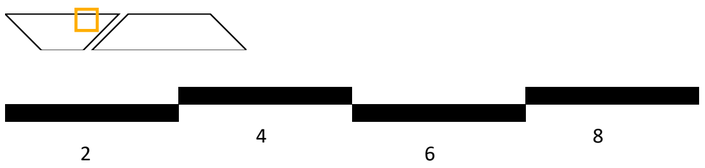
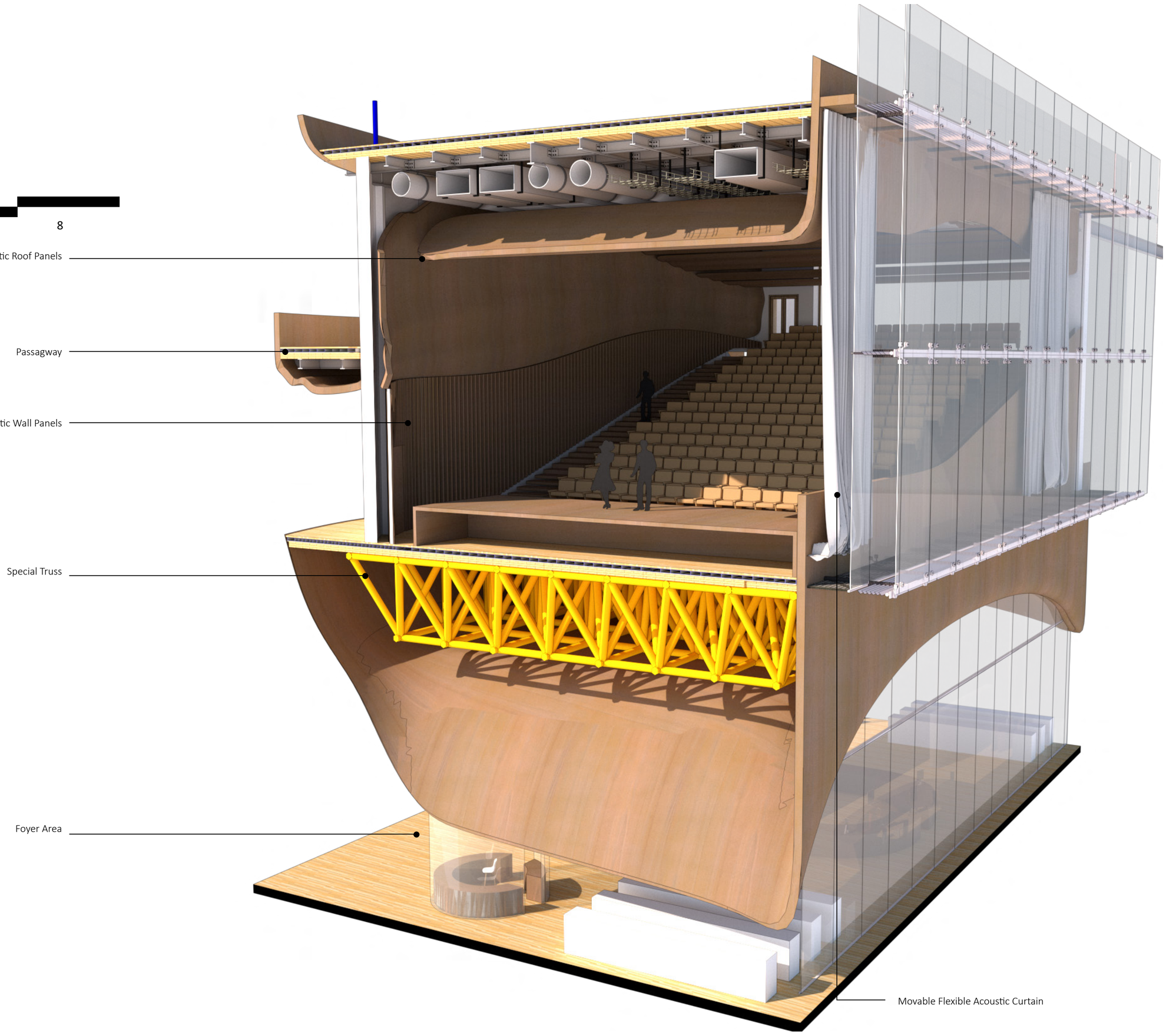
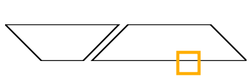
Design Details

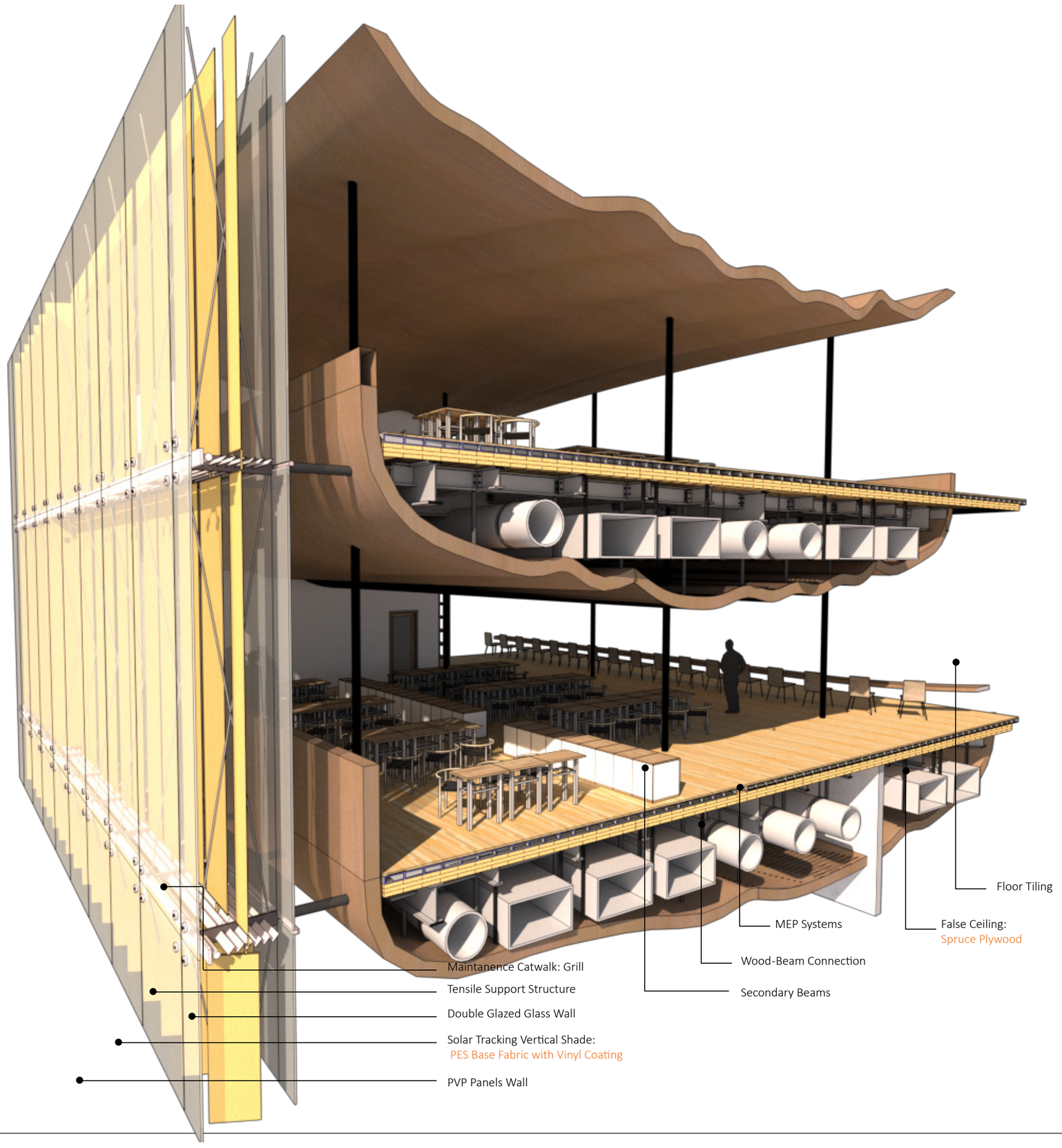
Auditorium Composition and Detail





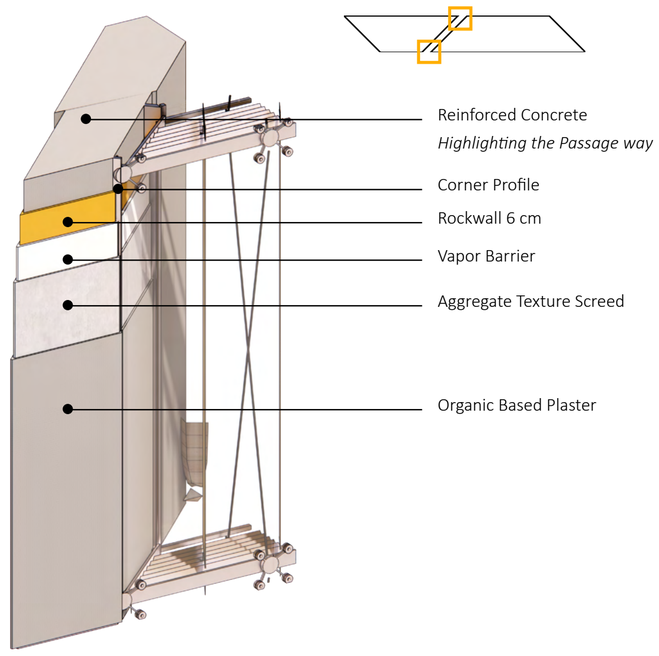
Facade and Interior Dialogue Detail





Corner Detail Types

1



2

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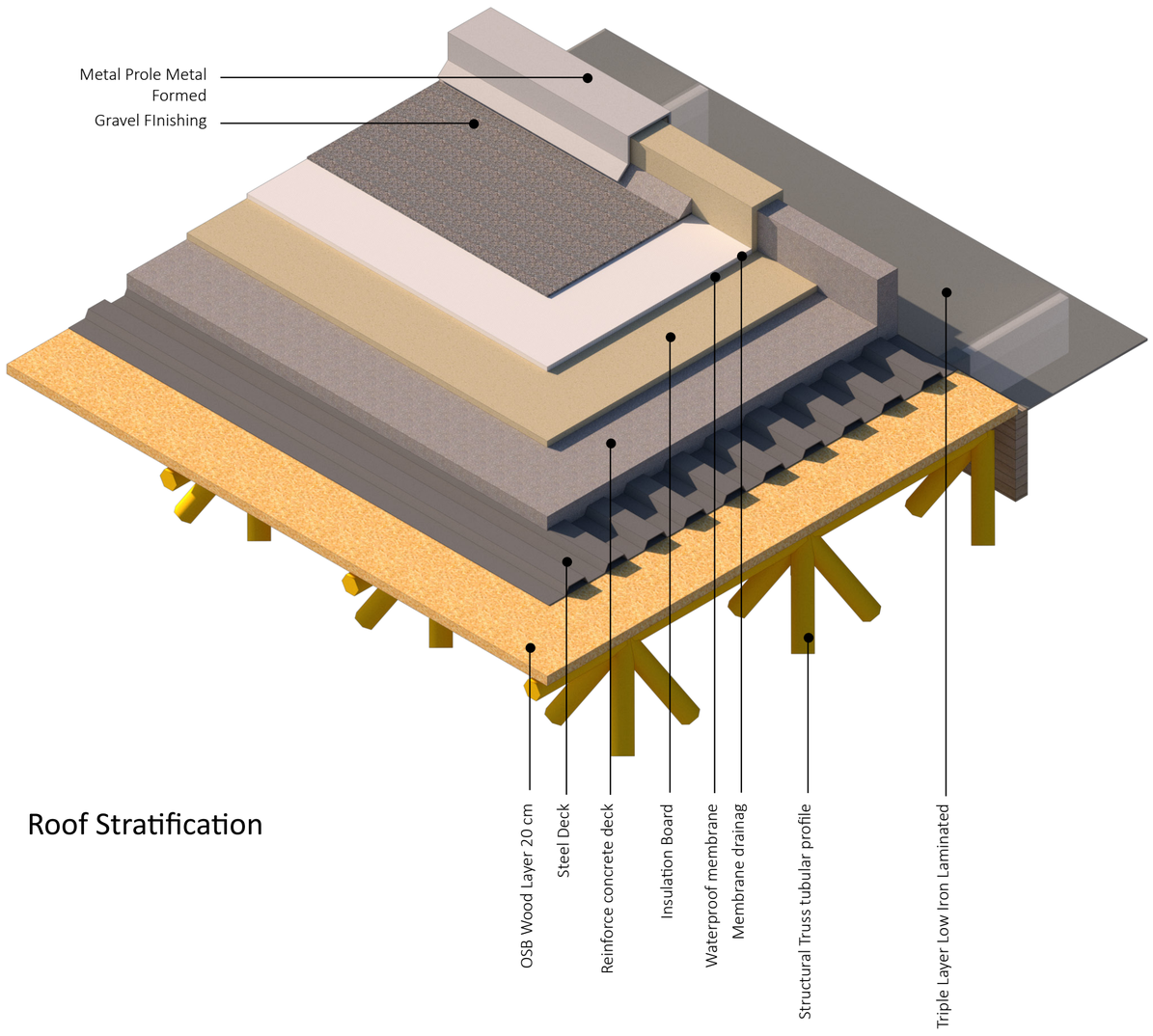
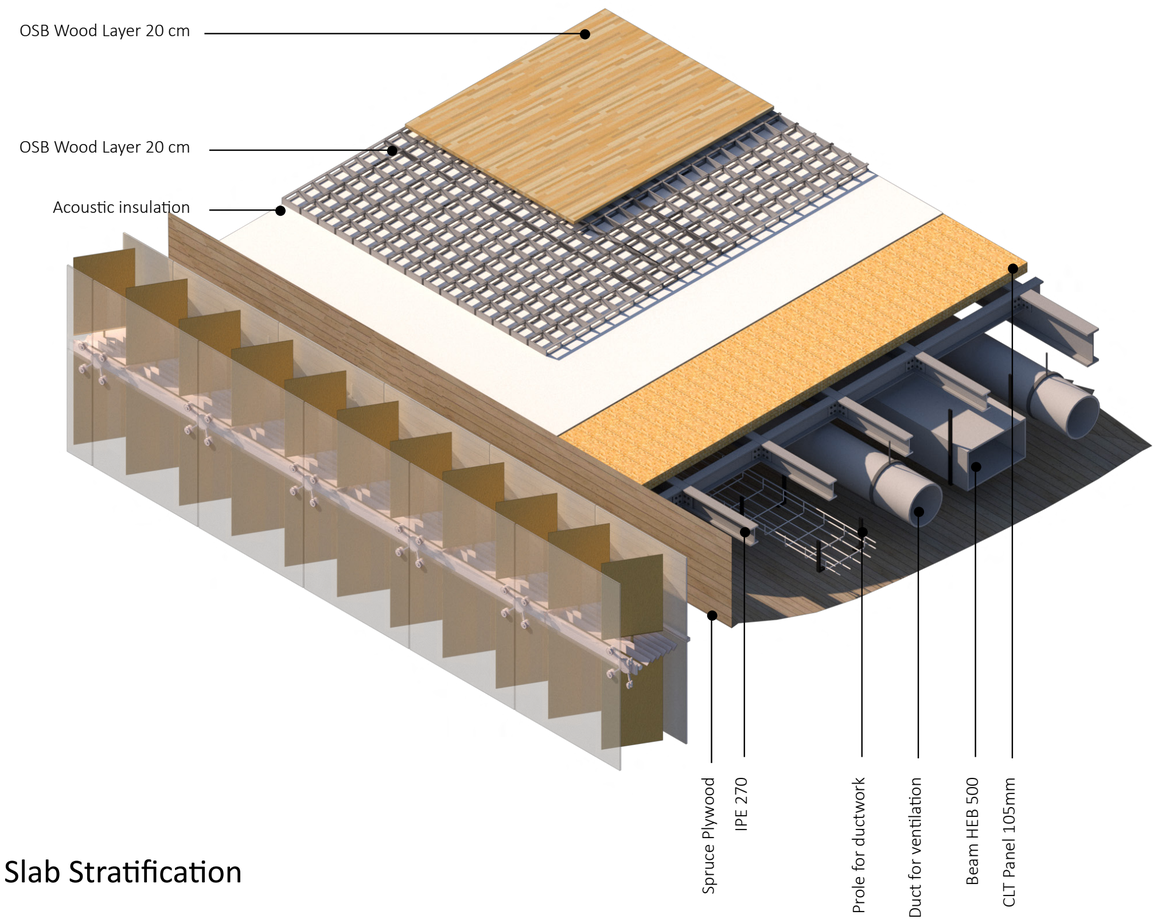
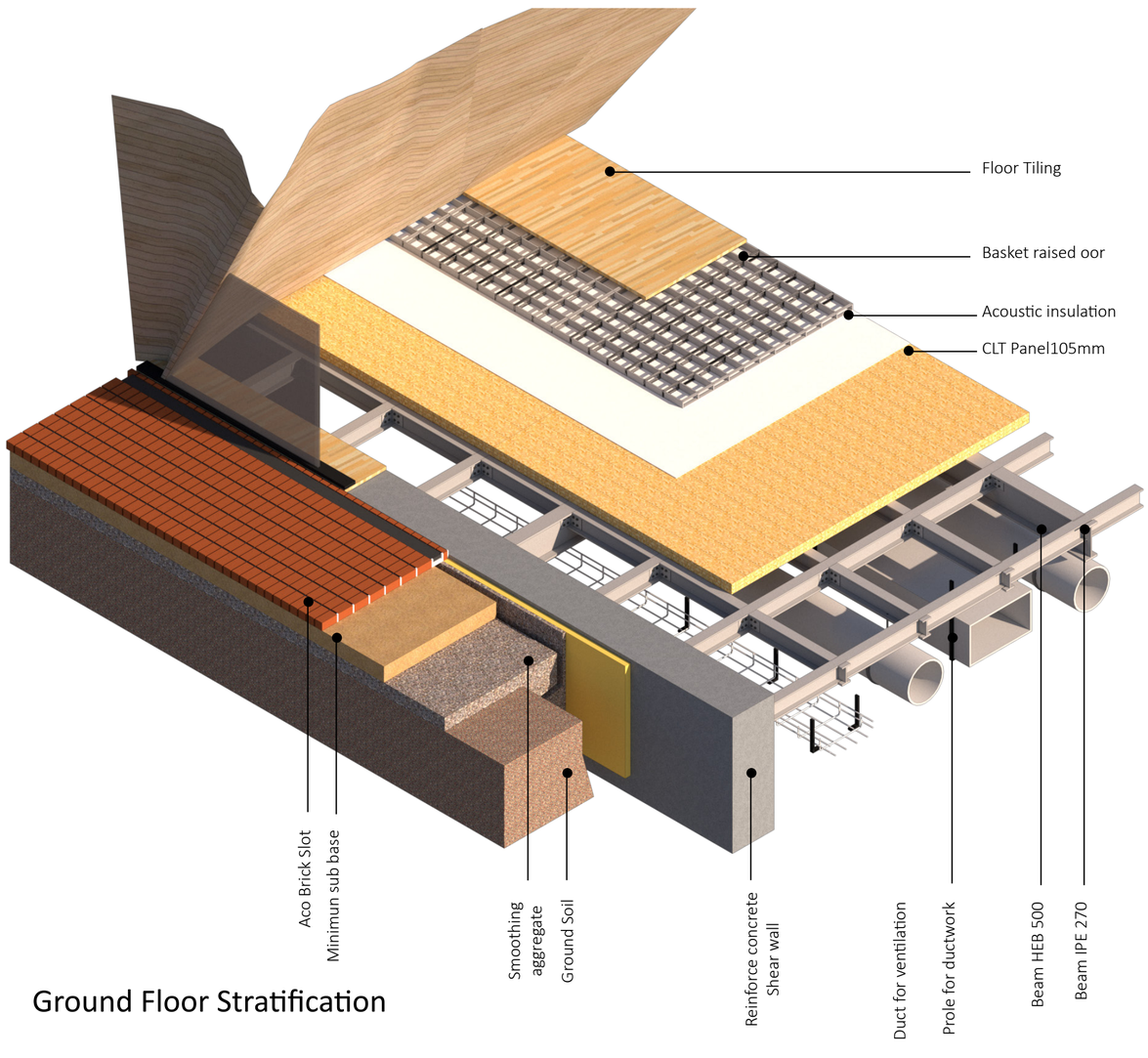
Materials and Stratification



Roof Stratification



Slab Stratification



Ground Floor Stratification

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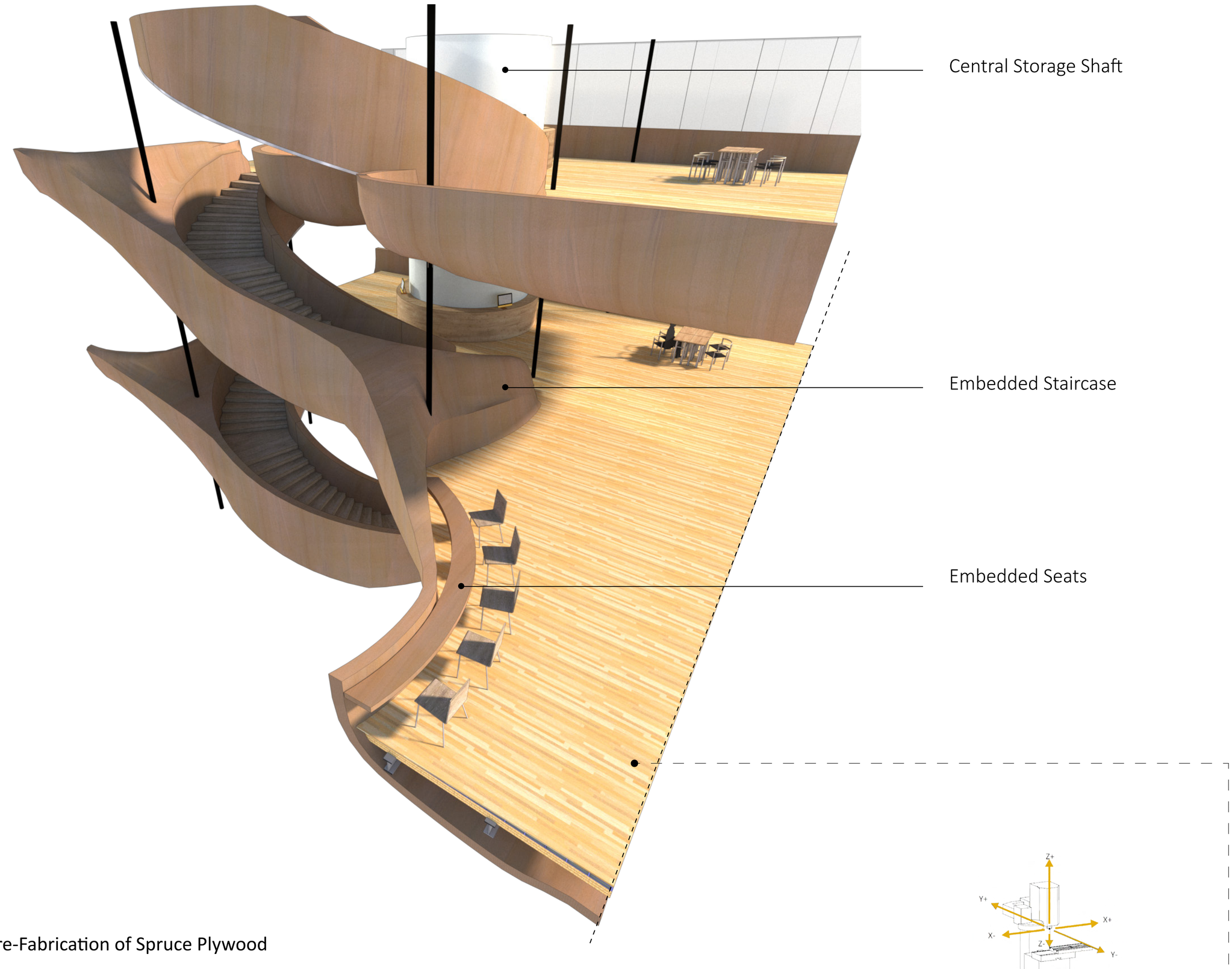
Fabrication

Interior Carving: Material and Procedure

Sustainably-forested spruce plywood: Non-toxic water-based glue.

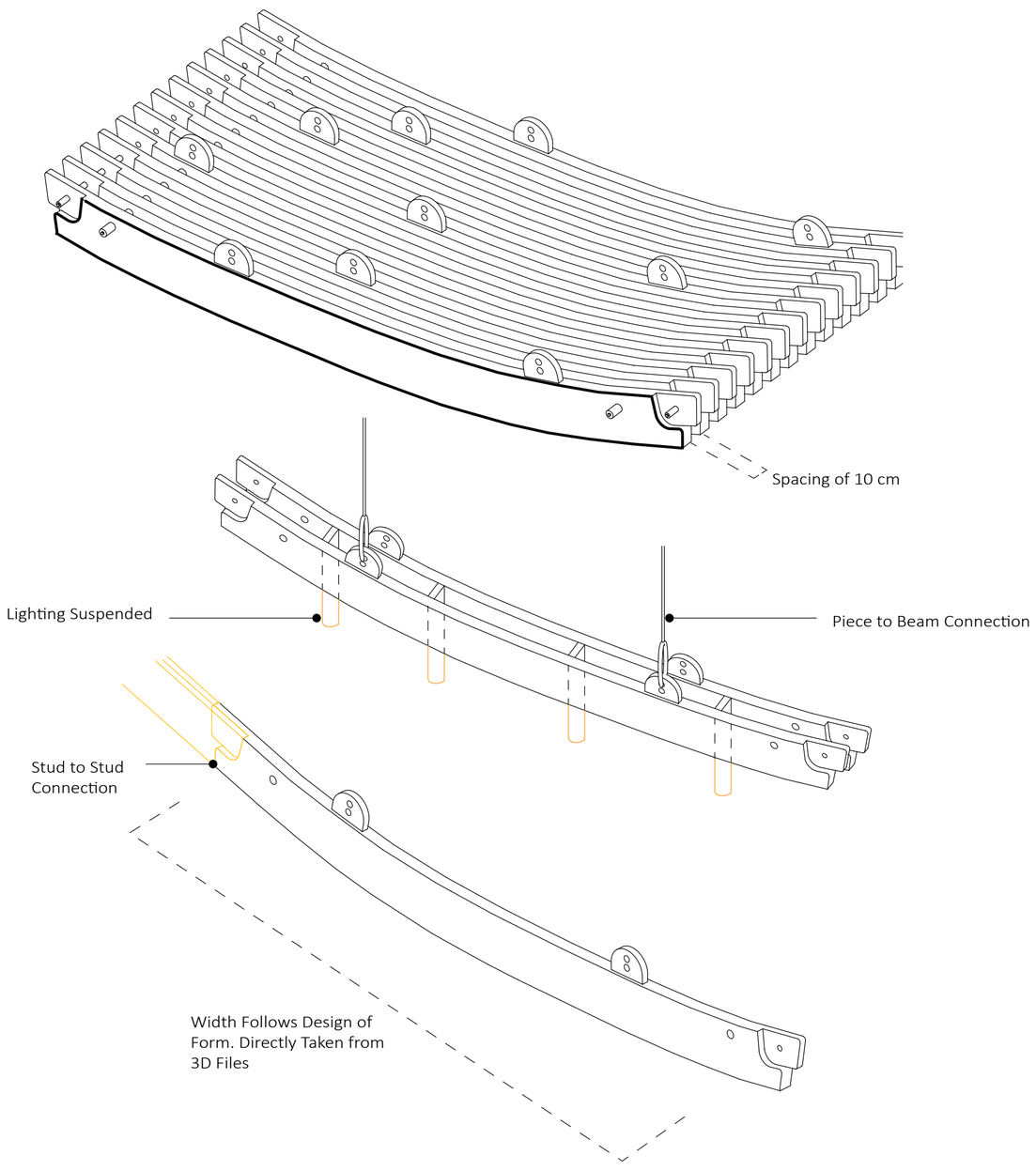


Pre-Fabrication of Spruce Plywood Process

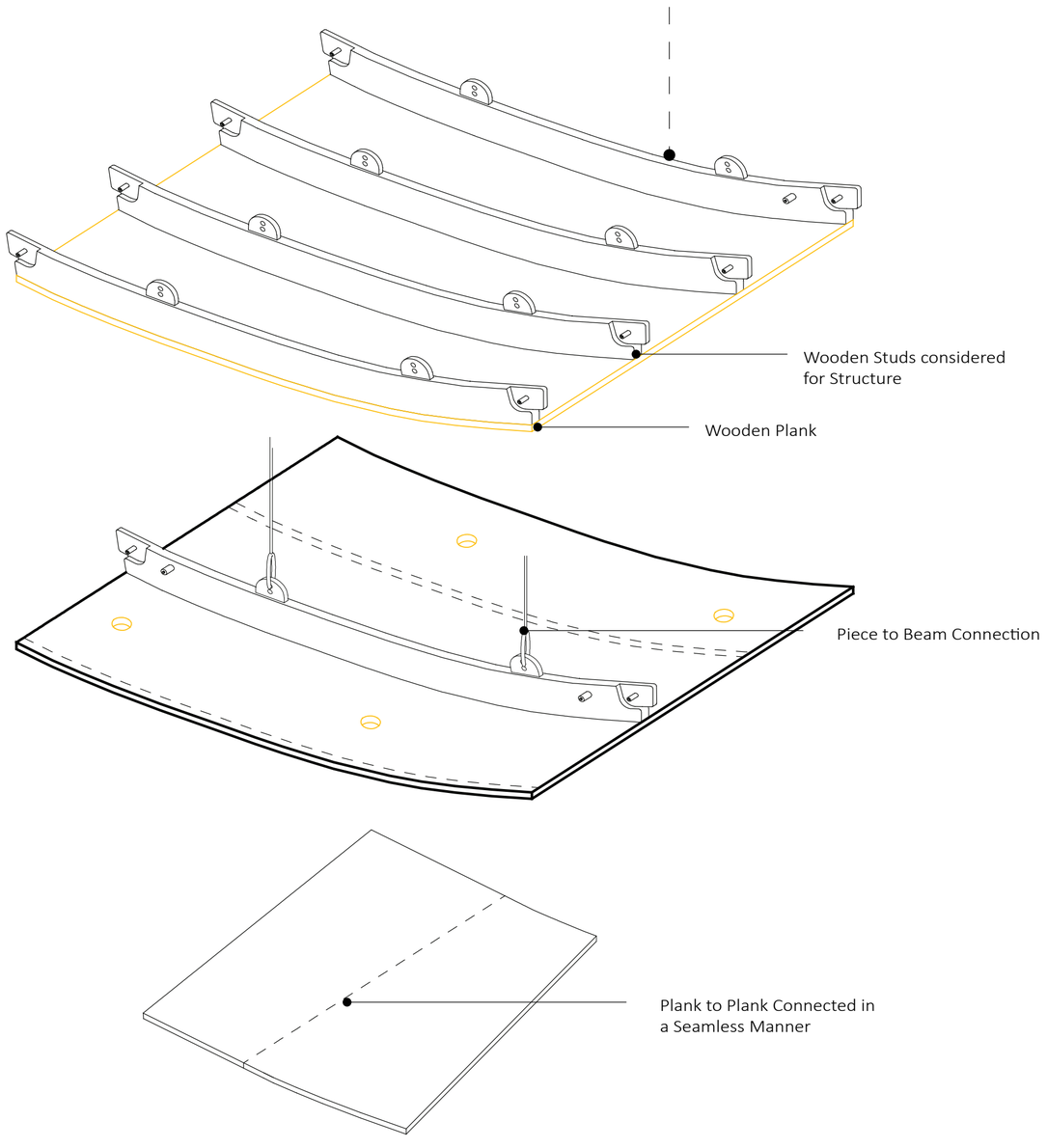
1 Milling Files: Developed automated algorithms to generate milling files from the design.

2 3-axis CNC Router: Used for milling, carving the ply sections according to the pre-scribed tool paths. Big Pieces of wood used for carving.

Gapped Spacing for Reading Rooms: Acoustic and Ventilation Purposes



Smooth Wooden Surfaces



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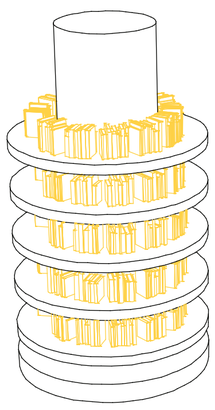
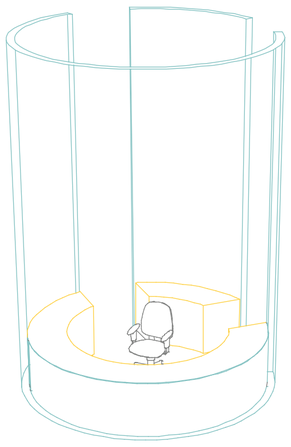
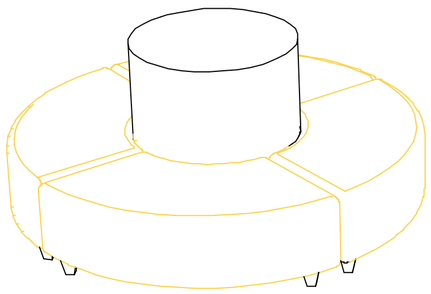
Furniture pieces of BEIC Library: Designed according to the The Wall of Porta Romana Building Language



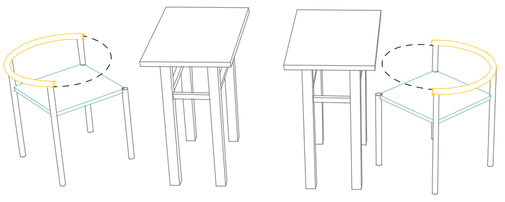
Column Bookshelves



Translation Booths

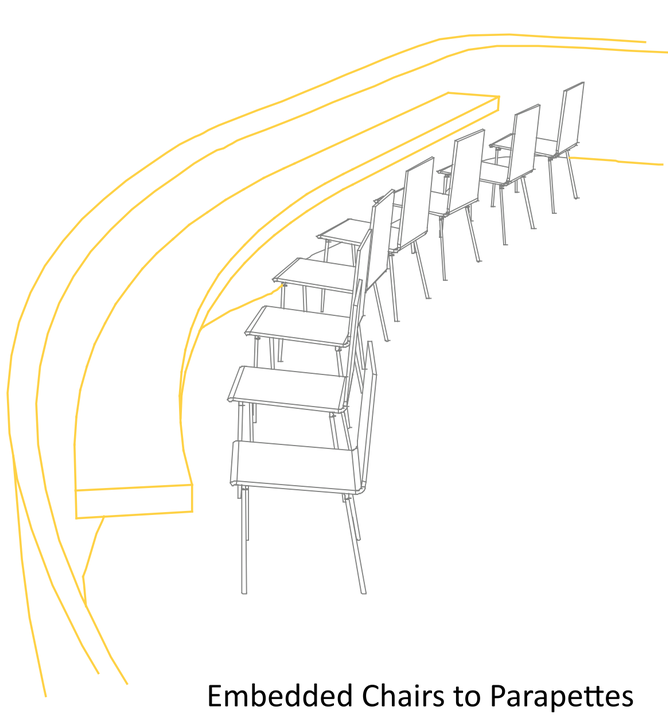


Seat Column

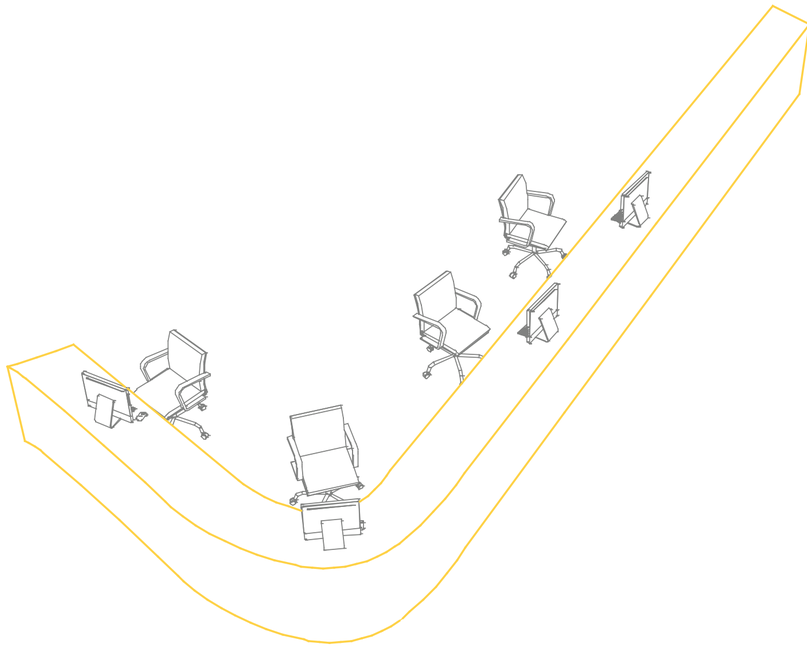


Modular Chair and Desk

Automated Central Storage Shaft



Embedded Chairs to Parapettes



Reception Desk/Info Point
(each having a unique shape)

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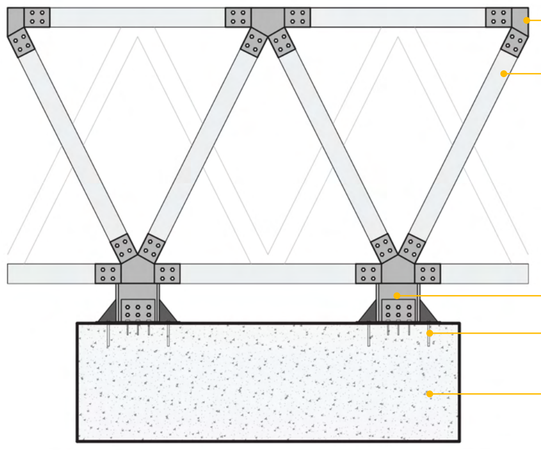
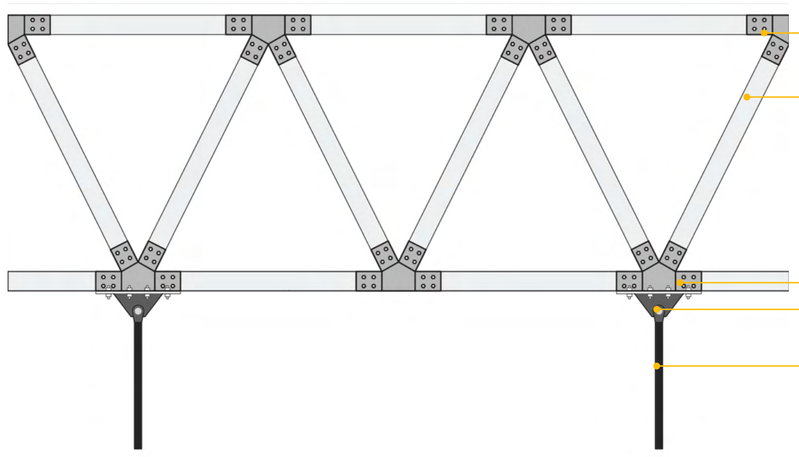
1



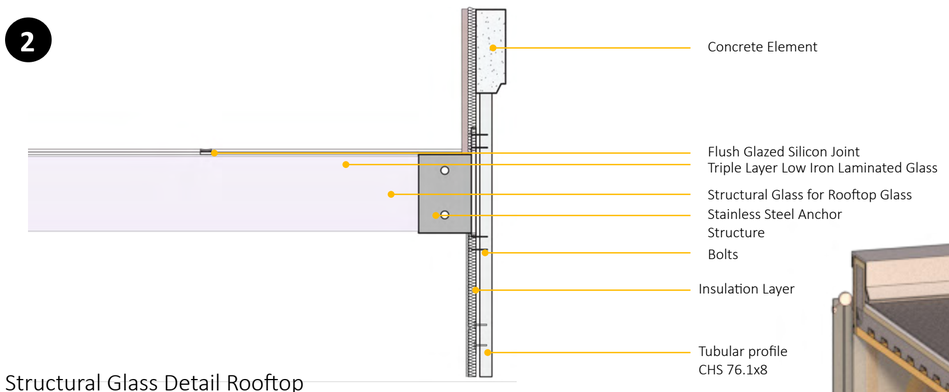
Rooftop Truss - Core Connection

8



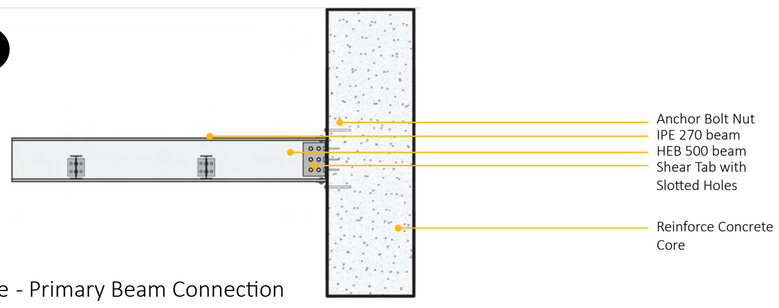
Rooftop Truss - Cable Connection

2



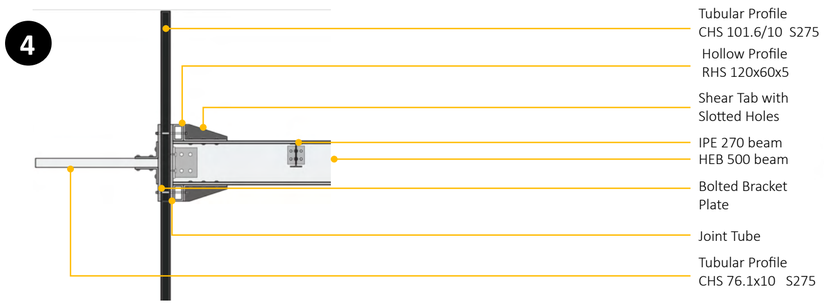
Structural Glass Detail Rooftop

3



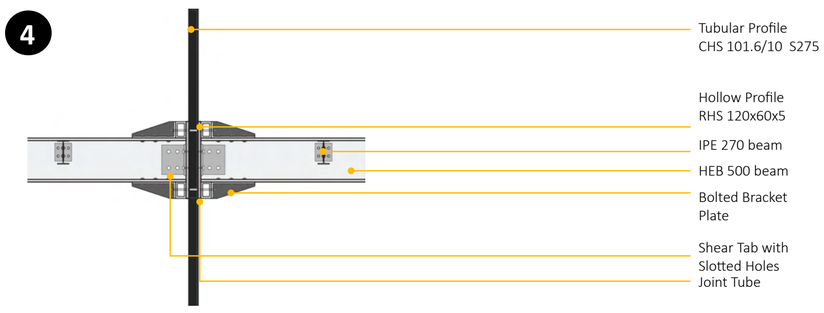
Core - Primary Beam Connection

4



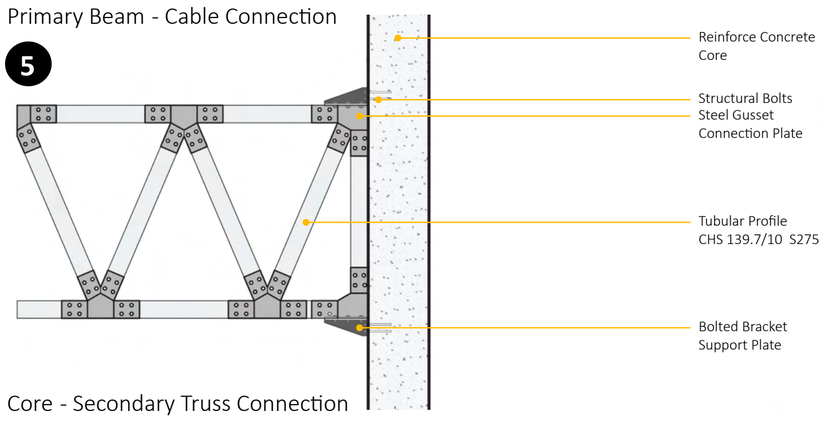
Primary Beam - Cable - Facade Profile Connection

4



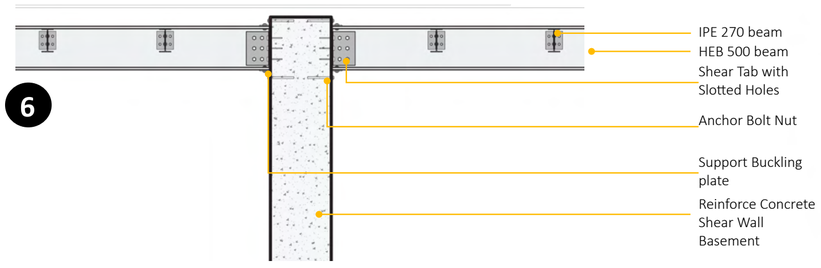
Primary Beam - Cable Connection

5



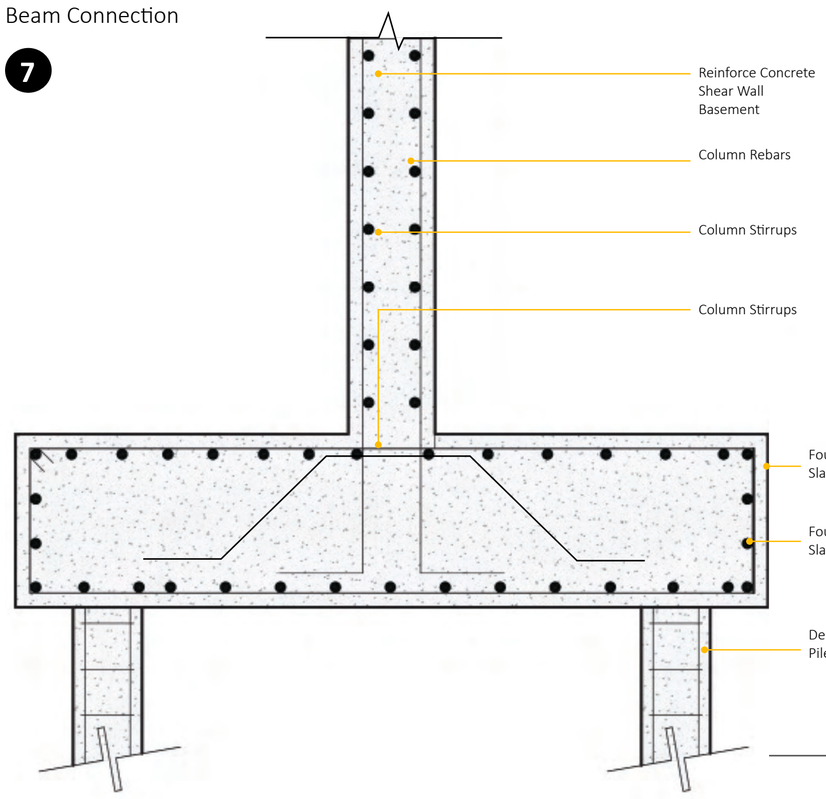
Core - Secondary Truss Connection

6



Basement Shear Wall - Primary Beam Connection

7



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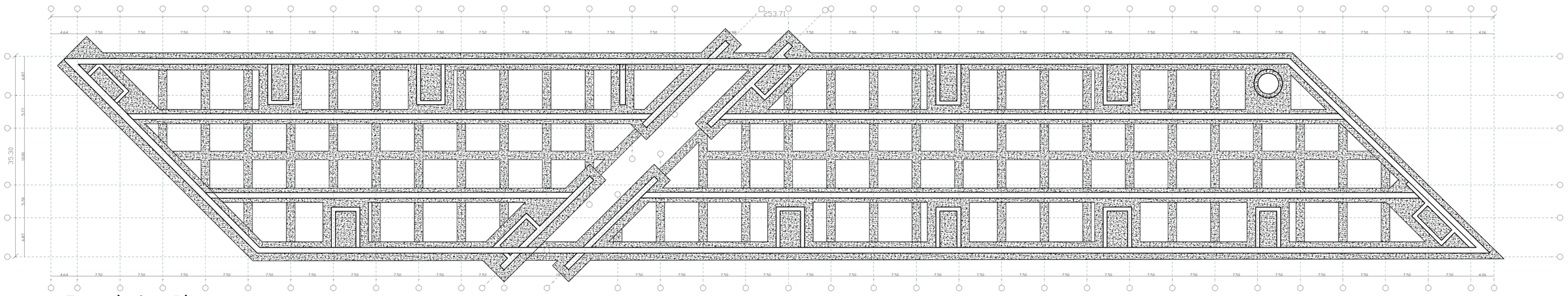
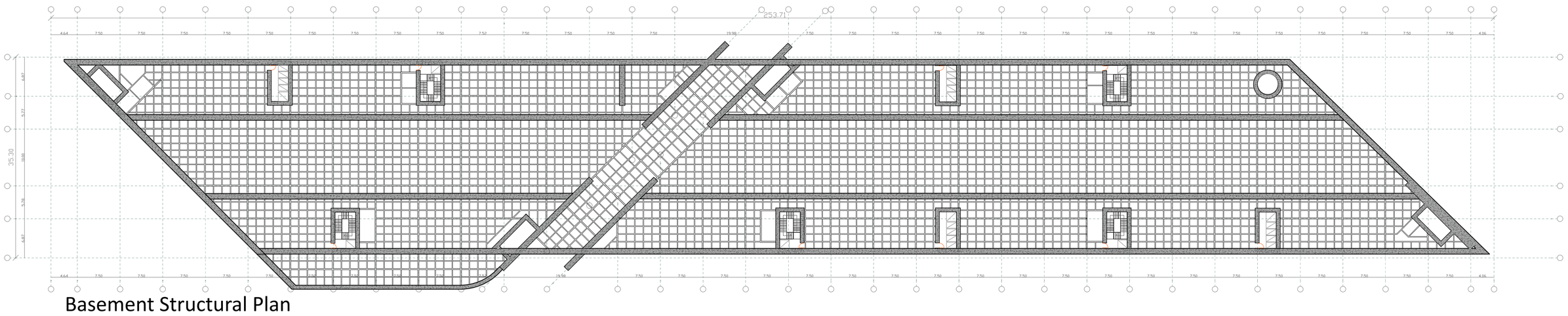
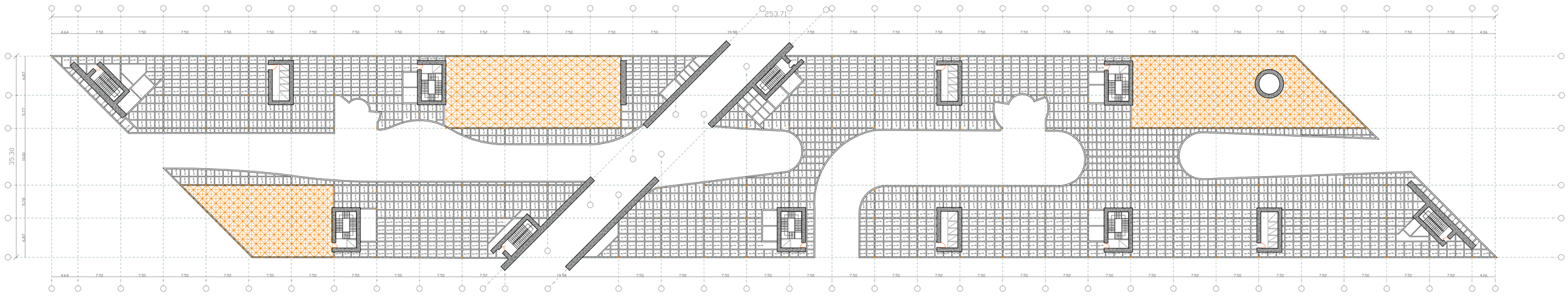
Structural Plans



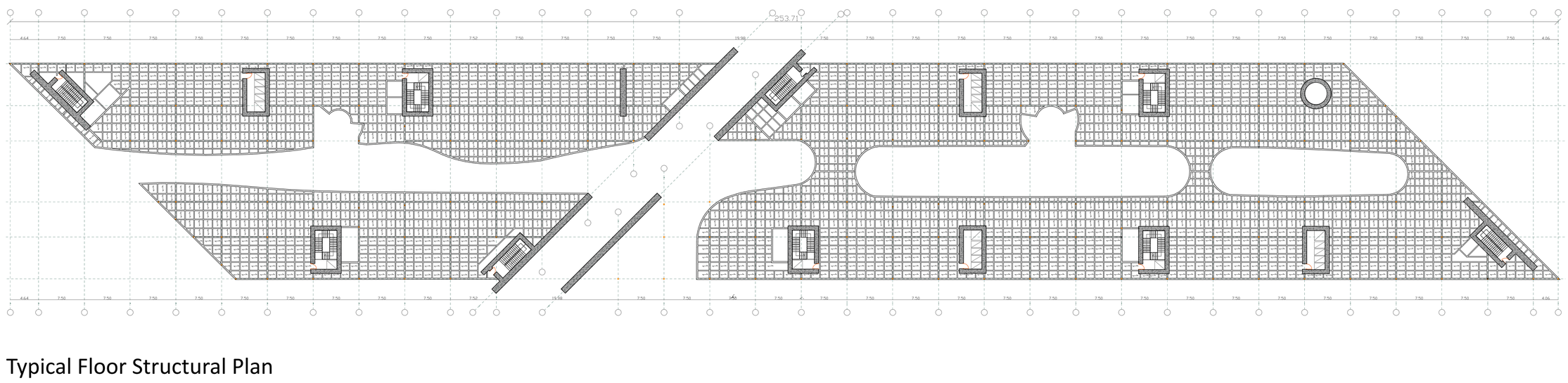
Foundation Plan



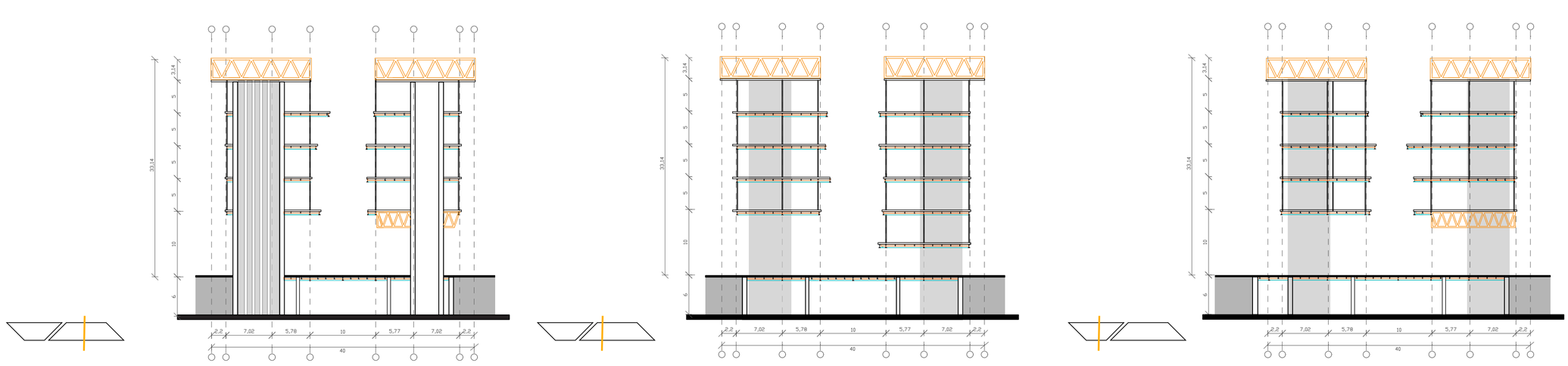
Basement Structural Plan

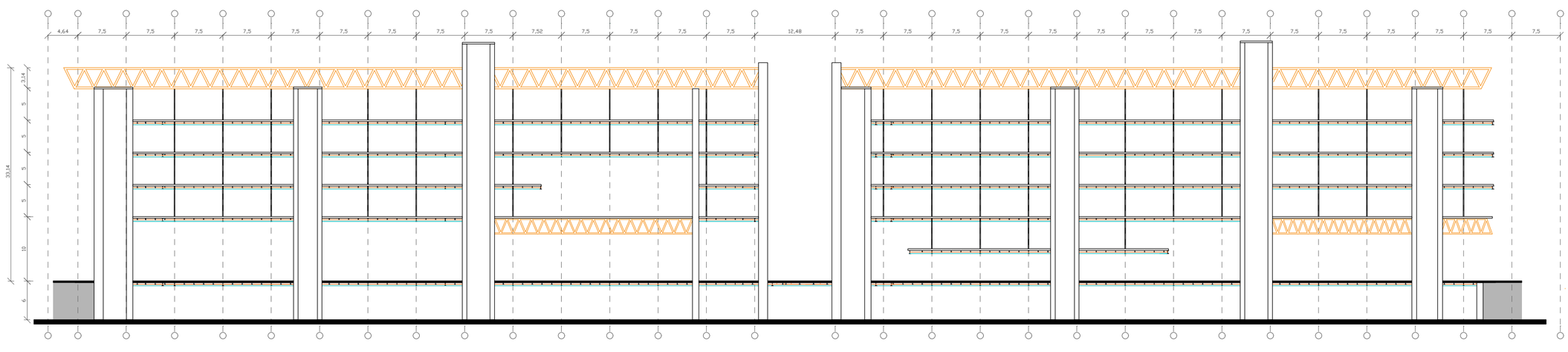


First Floor Structural Plan



Typical Floor Structural Plan





Transversal Structural Sections

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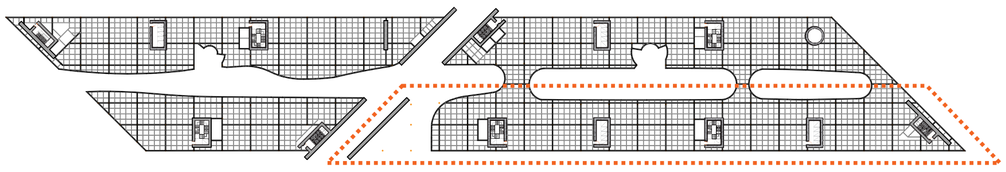
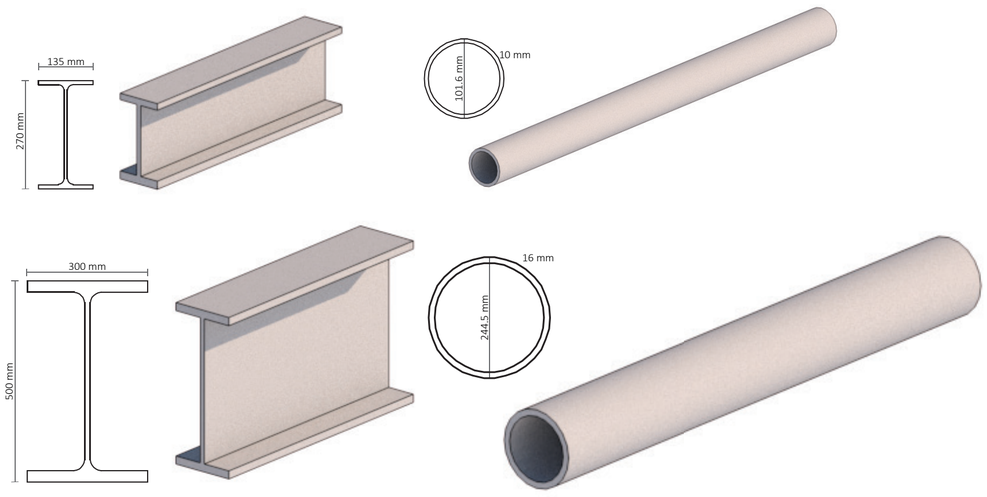
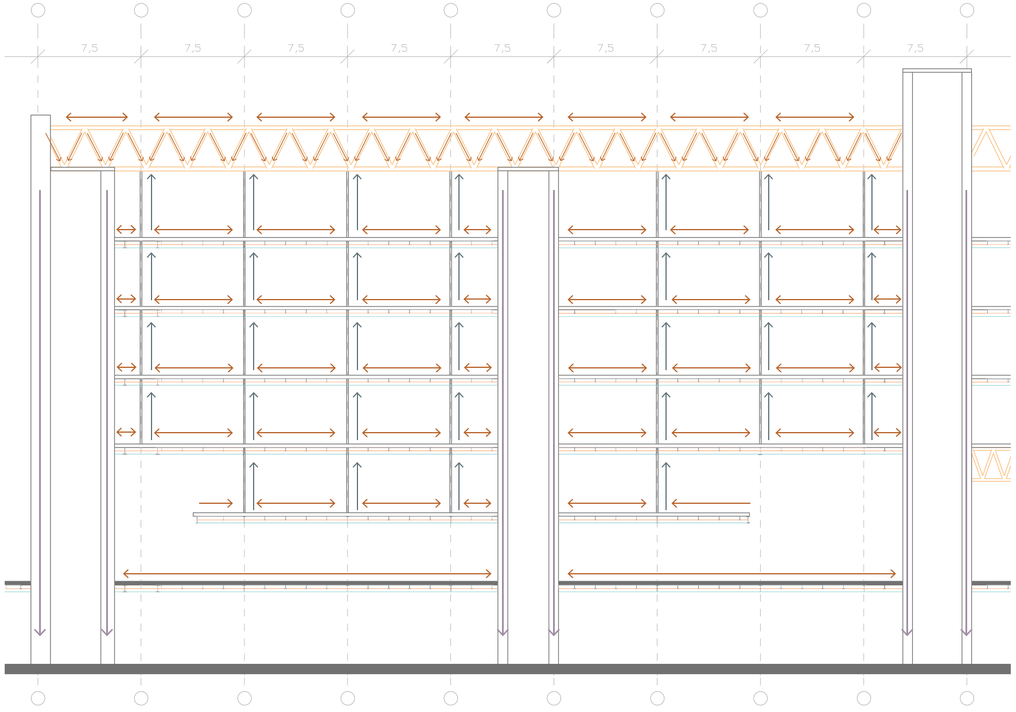
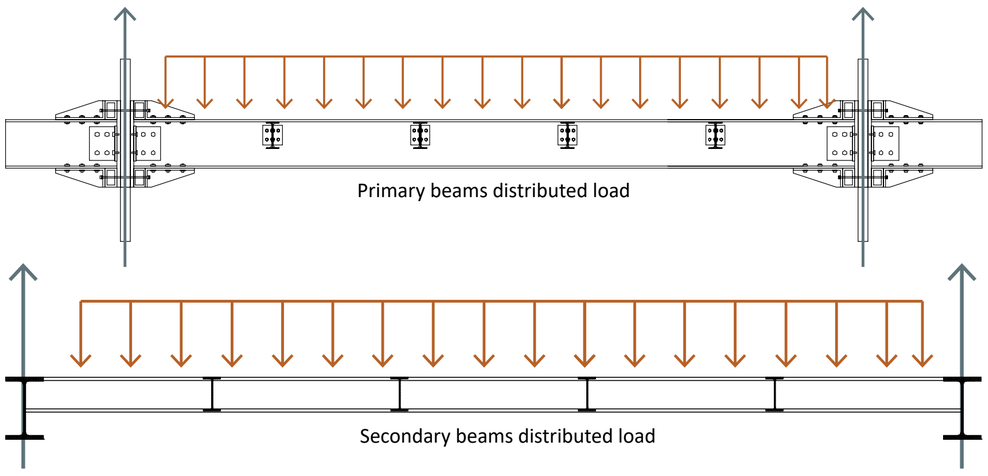


The selected area is an area that comprises different singularities within the structure, but at the same time it is the one that most closely represents the behavior of the structure and the loads encountered. In this area we can define how the structure behaves as a beam and the different cores as supports to understand the behavior of this system.

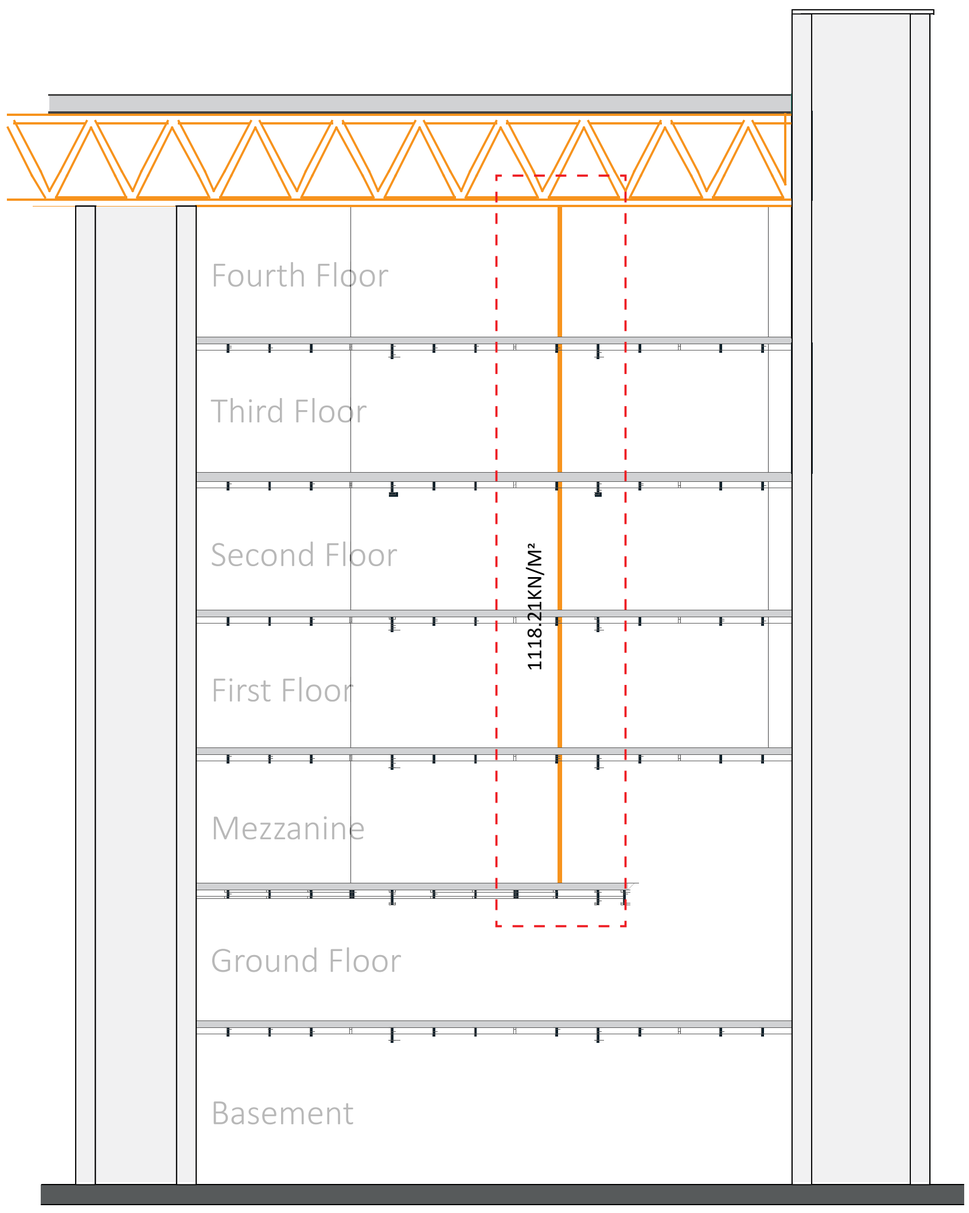


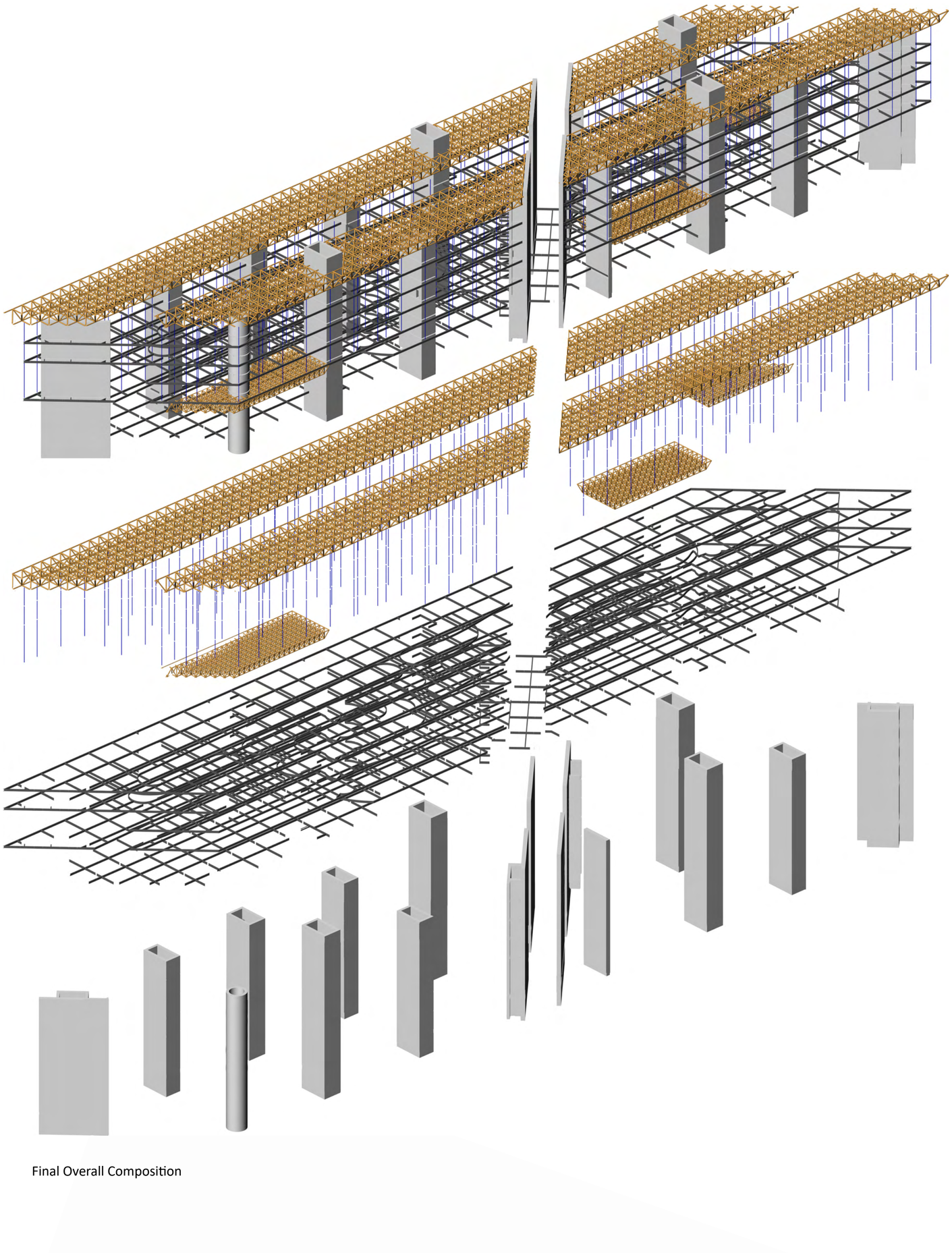
The structural elements used in the project are composed of primary and secondary beams with HEB 500 and IPE 270 respectively. The slabs in order to make them lighter, we use CLT for it characteristics and behavior. Also, in the decisions of the materials, we use steel tubular profiles CHS 244.5x20 for the space truss.



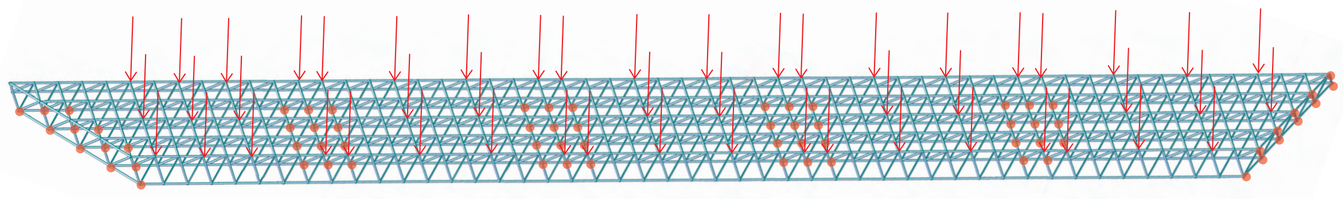


In the scheme of loads, we explain how the slabs working are compression and at the same time we use the cable that works in tension to behave as organize structural elements that support the structural behave of the building. Also the space truss helps in order to reach big distances without structure when at the same time carry the load of the beams and transfer it into the cores.





Final Overall Composition



In the first part of the analysis made by MIDAS, we evaluated all the structural elements of the space truss located in the rooftop of the building. The model was imported from Archicad to Autocad and then to MIDAS.

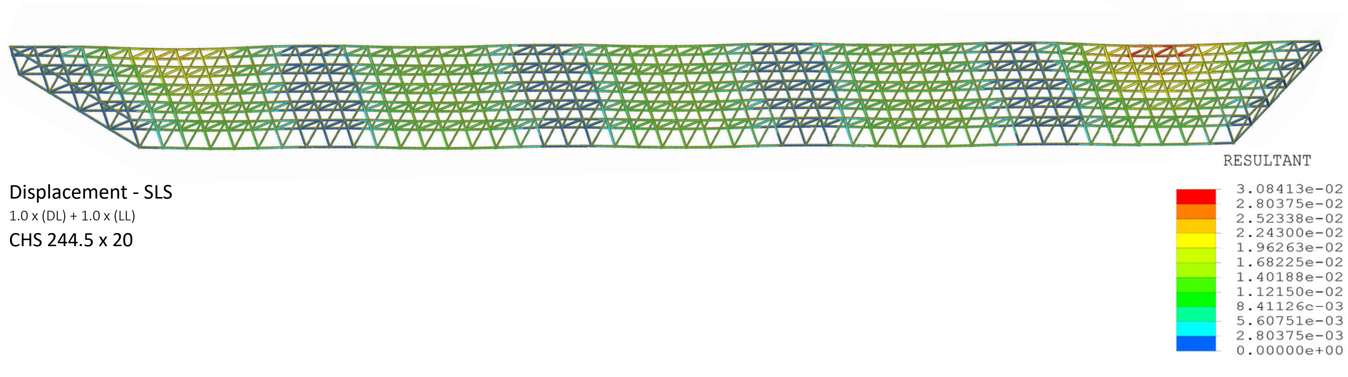
Puntual Load- 1118.21 kN/m²

Restrains- Connection Truss / Cores

With this configuration we also include the distributed load of the rooftop that included the dead load of 6 kN/m²(DL) where is the structure and the slab . Also we included the snow load (SL) that have a load of 1.5 kN/m².

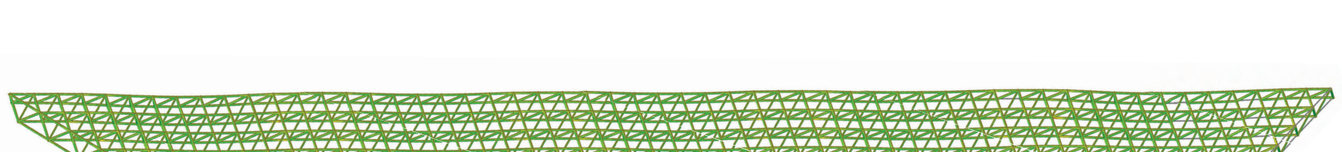
ULS
Ultimate Limit State
1.3 x (DL) + 1.5 x (LL)

SLS
Serviceability Limit State
1.0 x (DL) + 1.0 x (LL)



Displacement - SLS
1.0 x (DL) + 1.0 x (LL)
CHS 244.5 x 20

At the beginning of the model, the restrains that connect the cores and the truss were fixed about displacement and free about rotations, also for the model we did not include any hinge to make connections between the bars. In the displacement analysis we can see how in the zone where the greatest deformation is found, is the right zone, where the greatest distance between supports is found, in addition to having the same amount of point loads. this displacement is 0.03 m or 3 cm.



MOMENT in Y - ULS
1.3 x (DL) + 1.5 x (LL)
CHS 244.5 x 20

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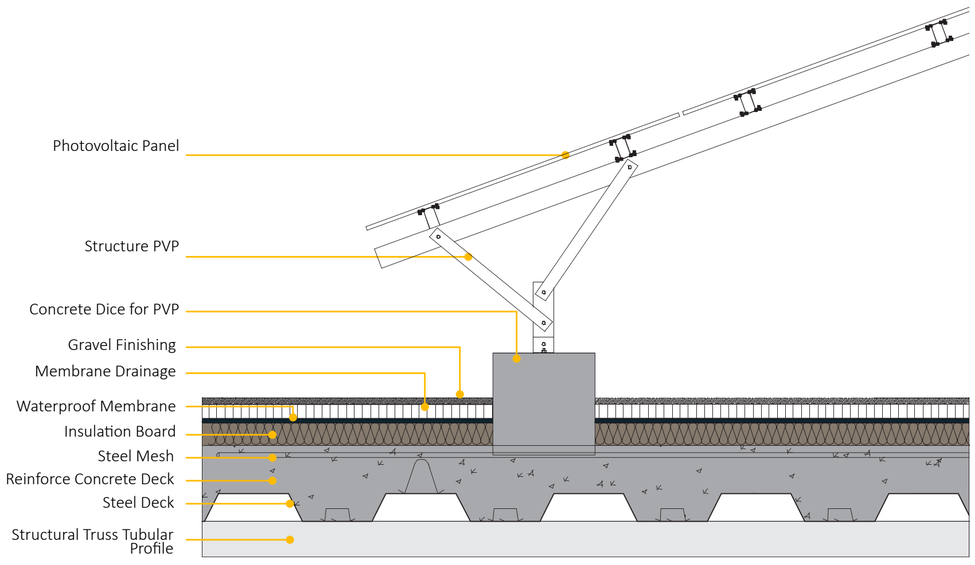
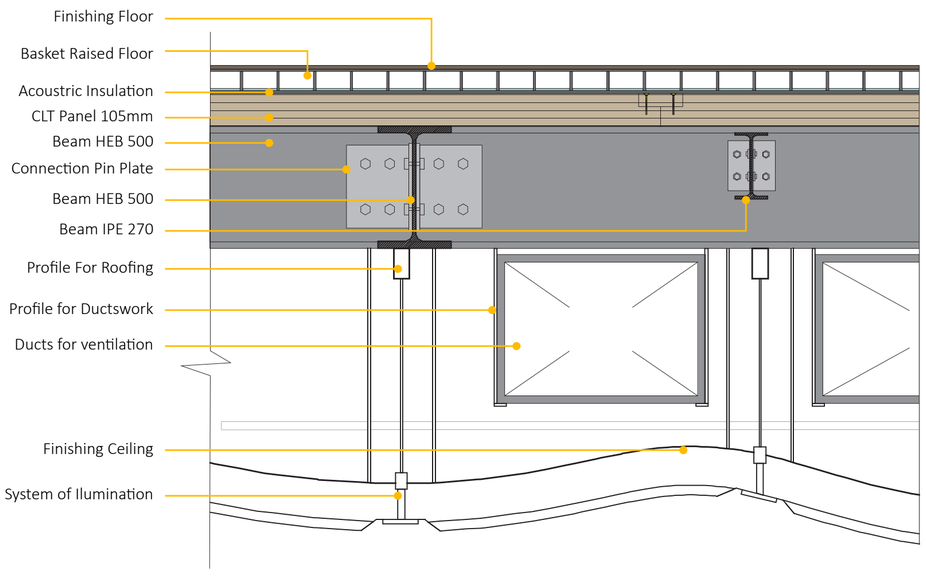
In the calculation of the weight of the slabs, we can appreciate the use of the CLT and the only slab that have different characteristics is the rooftop, in which we use a reinforce concrete slab, this due the behave of the CLT slabs in outside conditions like rain, ice and sun. Also, the idea is to create light structure with the same concept for the slabs to control the dimension of the elements, in order to reduce costs have a better composition in the project.



Typical Rooftop

Rooftop Slab				
Dead Loads				
G1	Space truss	Circular Hollow section	0,294	[kN/m]
		139,7 mm Diameter 10 mm thickness		
G1			0,294	[kN/m]
G2	Slab Distribution			
		PVP with structure (aprox)	0,50	[kN/m2]
		Gravel Finishing 2 cm deep	0,34	[kN/m2]
		Waterproof membrane	0,00	[kN/m2]
		Insulation Board	0,10	[kN/m2]
		Reinforce concrete deck	4,80	[kN/m2]
		Steel Deck	0,16	[kN/m2]
		Insulation board	0,10	[kN/m2]
		Total	6,00	
G2 Principal Beam			44,978	[kN/m]
G2 Secondary Beam			8,276	[kN/m]
Q	Live Loads Library			
		Linear Load Library	4,0	[kN/m]
		Snow Load Library	1,3	[kN/m]
		Total	5,30	
G2			39,8	[kN/m]

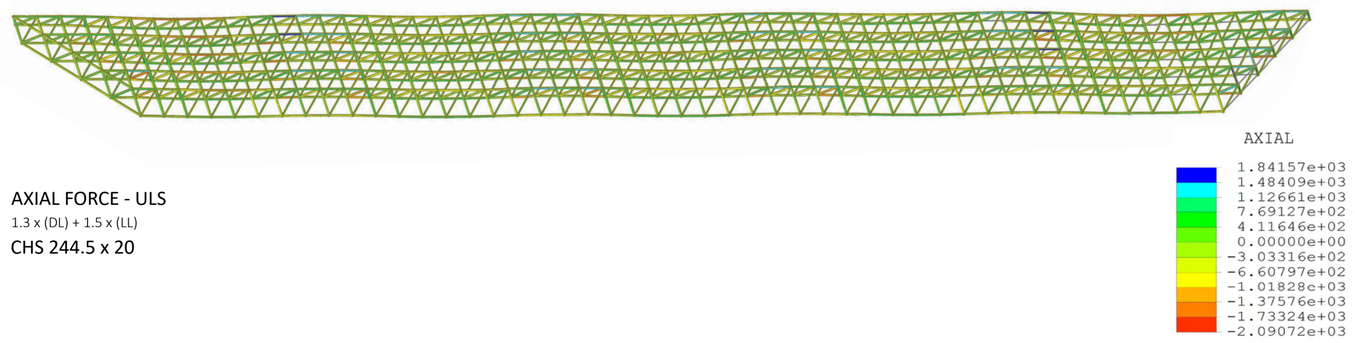
The roof has a construction system of a reinforced concrete slab, while steel deck sheets are used. This in order to avoid any type of water ingress. In addition to these elements, waterproof membranes are used. This structure is also designed to support the multiple photovoltaic panels that are installed on the roof, in order to supply



Typical Slab

Typical Slab				
Dead Loads				
G1	Primary Beams	HEB 500	1,873	[kN/m]
	Secondary Beams	IPE 270	0,361	[kN/m]
G1			2,234	[kN/m]
G2	Slab Distribution			
		PVC floor panel + System	0,26	[kN/m2]
		Impact insulation layer	0,09	[kN/m2]
		Acoustic insulation x2	0,06	[kN/m2]
		CLT panel	0,44	[kN/m2]
		AC system	0,39	[kN/m2]
		Finishing - Wood Element	0,60	[kN/m2]
		Total	1,84	
G2 Principal Beam			13,800	[kN/m]
G2 Secondary Beam			2,539	[kN/m]
Q	Live Loads Library			
		Linear Load Library	4,0	[kN/m]
				[kN/m]
		Total	4,00	
G2			30,0	[kN/m]

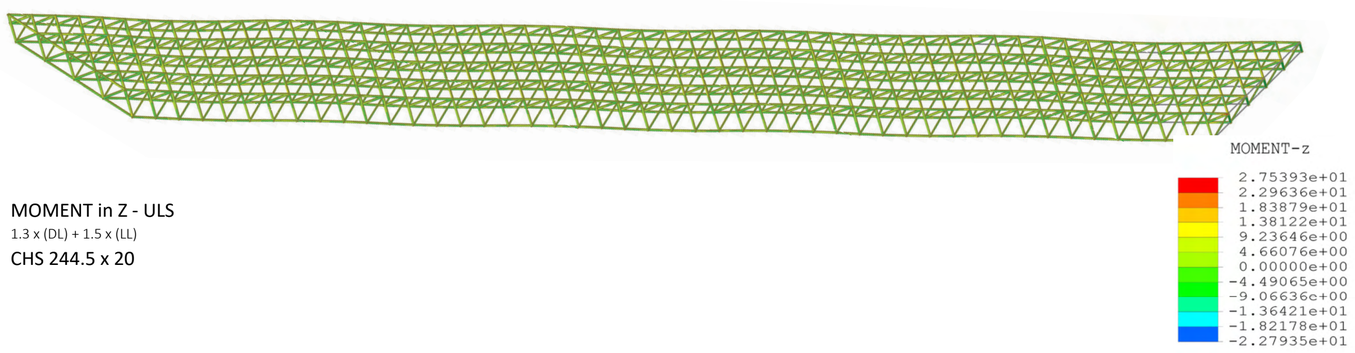
The slabs are composed of the use of main and secondary beams generating a framework. This also with the use of CLT panels with the function of reducing the load of the structure. These elements also with the idea of using materials and methods that are sustainable.



AXIAL FORCE - ULS

1.3 x (DL) + 1.5 x (LL)

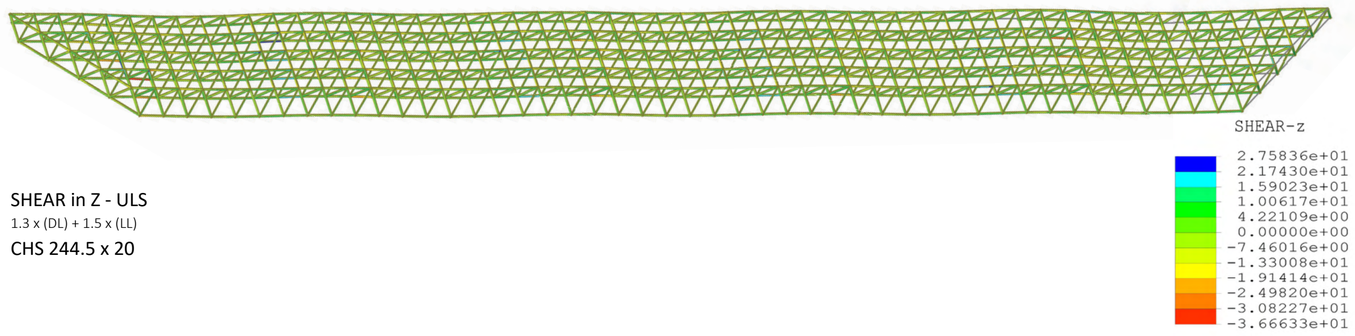
CHS 244.5 x 20



MOMENT in Z - ULS

1.3 x (DL) + 1.5 x (LL)

CHS 244.5 x 20

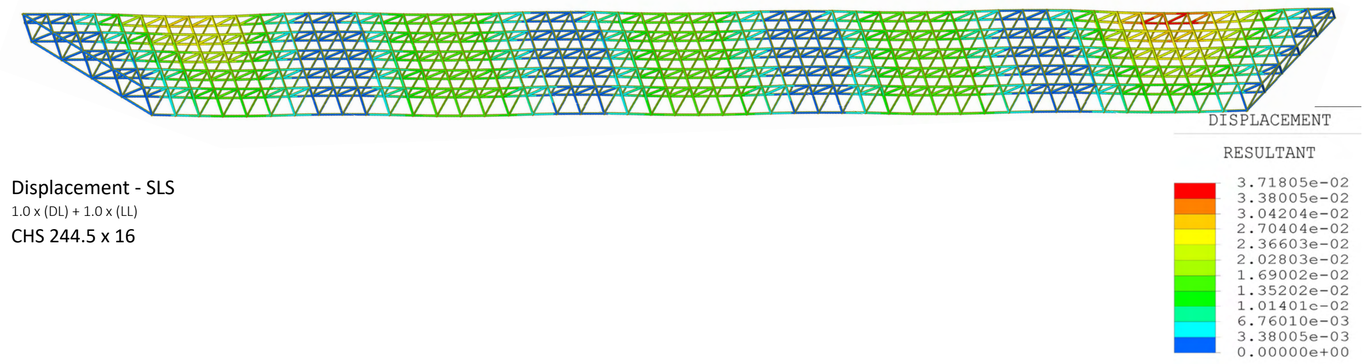


SHEAR in Z - ULS

1.3 x (DL) + 1.5 x (LL)

CHS 244.5 x 20

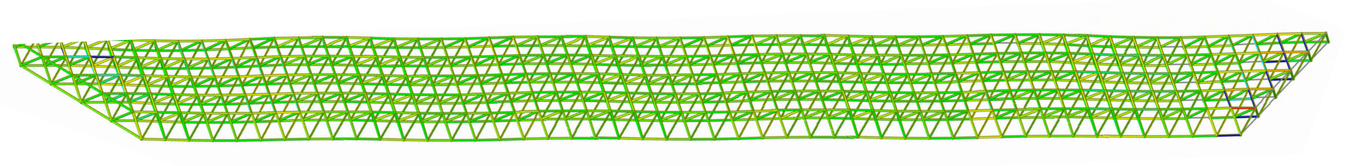
In making the different analyses, tests were also carried out with other sections, looking for the best configuration according to the behavior and the results of the analysis. One of these comparisons was with the execution of the analysis with CHS section 244.5x16 and section 216.1x20. With the first section we see how the displacement increases as the steel code checking result analysis shows that failures are present. With the second section, in spite of having the same thickness as the current one, due to the diameter, we find failures in the steel checking results, while generating a displacement similar to that found with the CHS244.5x16 section.



Displacement - SLS

1.0 x (DL) + 1.0 x (LL)

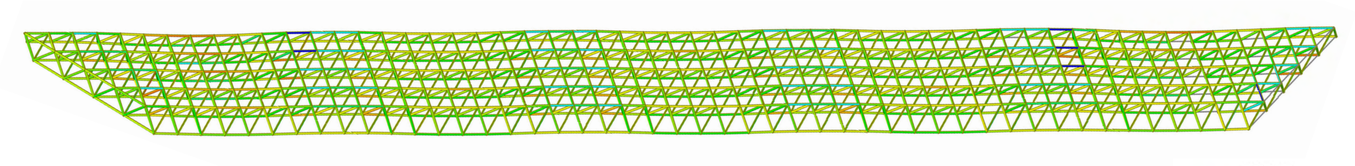
CHS 244.5 x 16



SHEAR in Y - ULS

1.3 x (DL) + 1.5 x (LL)

CHS 244.5 x 16

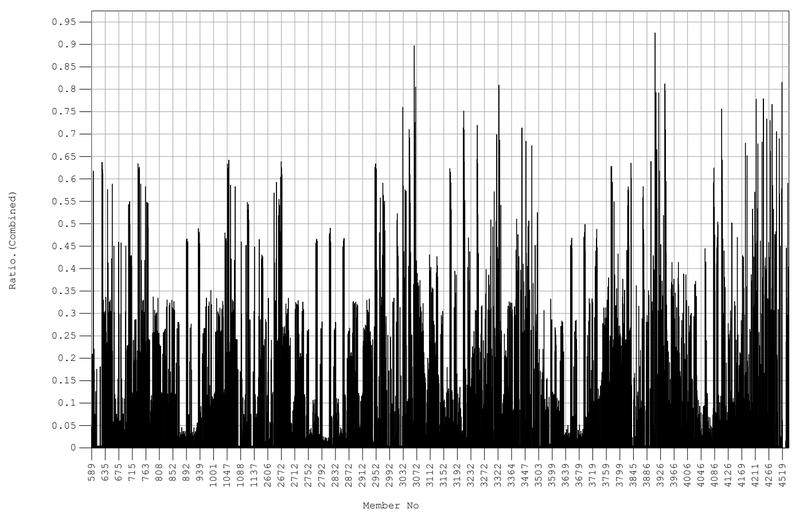


AXIAL FORCE - ULS

1.3 x (DL) + 1.5 x (LL)

CHS 244.5 x 16

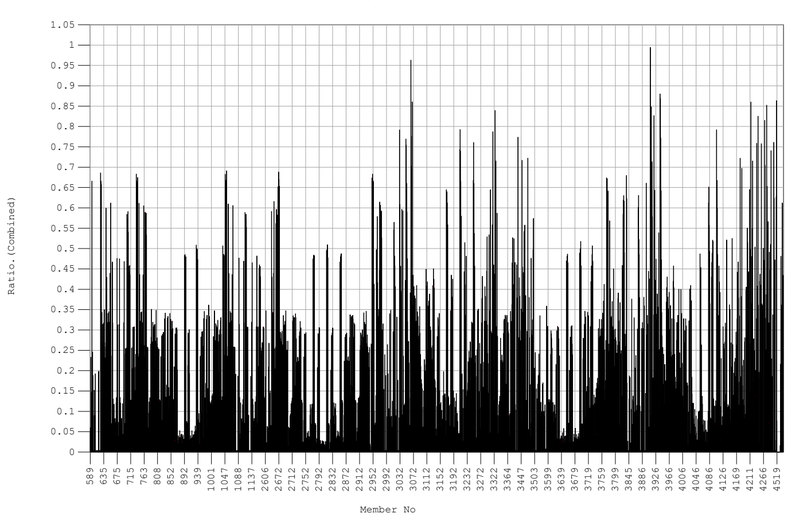
Steel Code Checking Result Ratio.(Combined)



CHS 216.1 x 20

As part of the exercise, an analysis of the loads is also made but with the CHS 216x20 section where we see that despite reducing the diameter in order to reduce the size of the profile, it manages to pass the Steel Code Checking, but when the displacement is reviewed, we find similar results to those used in the CHS244.5x16 profile, which gives us to understand the need to increase the profile and the diameter.

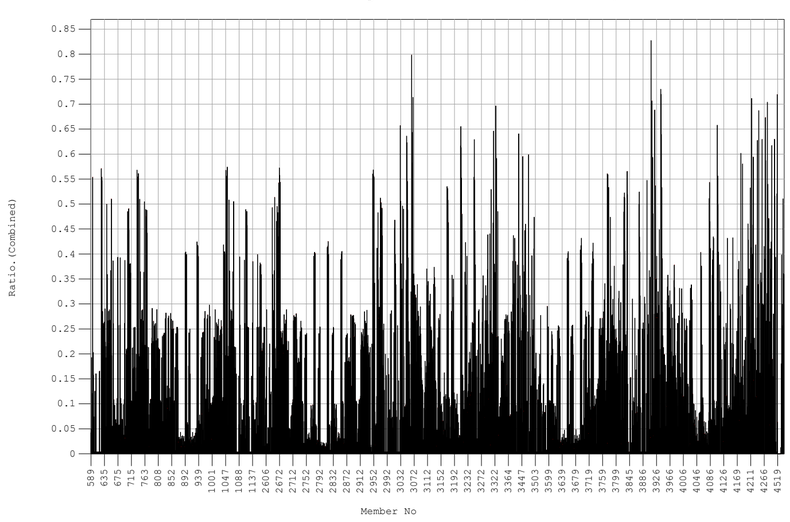
Steel Code Checking Result Ratio.(Combined)



CHS 244.5 x 16

In this analysis we see how this section (CHS2445x16) despite having a larger size, still presents failures in the steel code checking. This can also be seen in the deformation and displacament found in the analysis. By examining the options according to the need, we can see that even by increasing the section diameter, the result does not vary in comparison to the option of increasing the thickness.

Steel Code Checking Result Ratio.(Combined)



CHS 244.5 x 20

The steel code checking shows how all the sections are below 1.0 and only a few are close to 0.85. The great majority is below 6 which gives us to understand how the structure, in spite of the section and the multiple loads it is subjected to, manages to resist. This also demonstrates how in the end, despite having a 3.0 cm deflection in the SLS, the structure performs adequately for the need.

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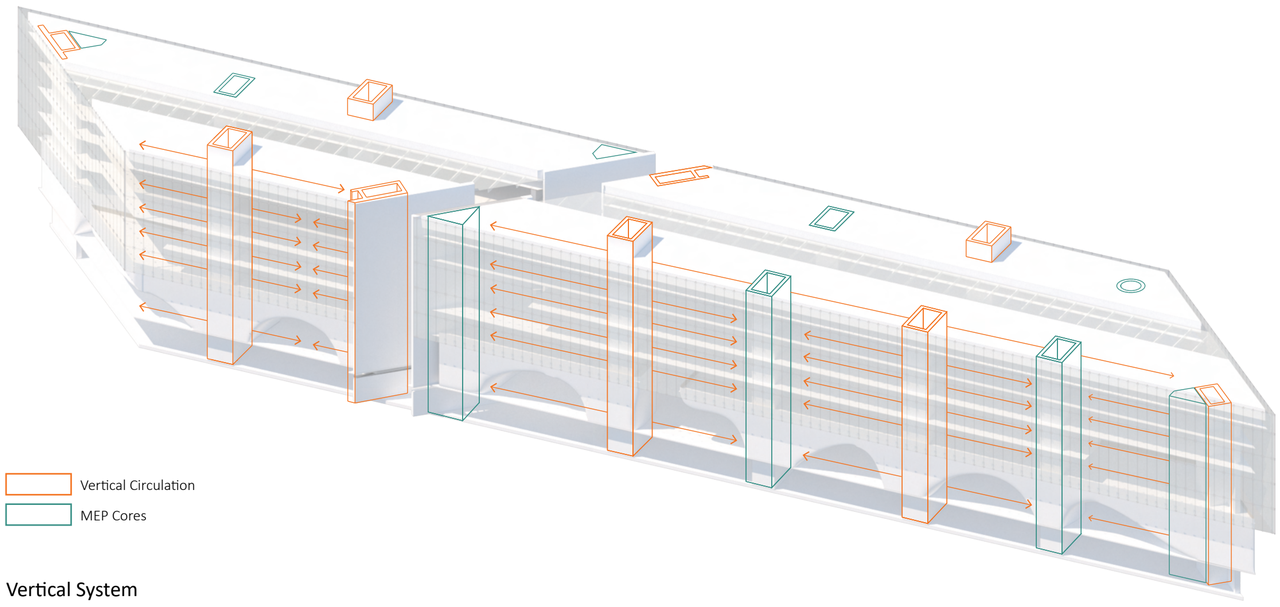
MEP System Composition

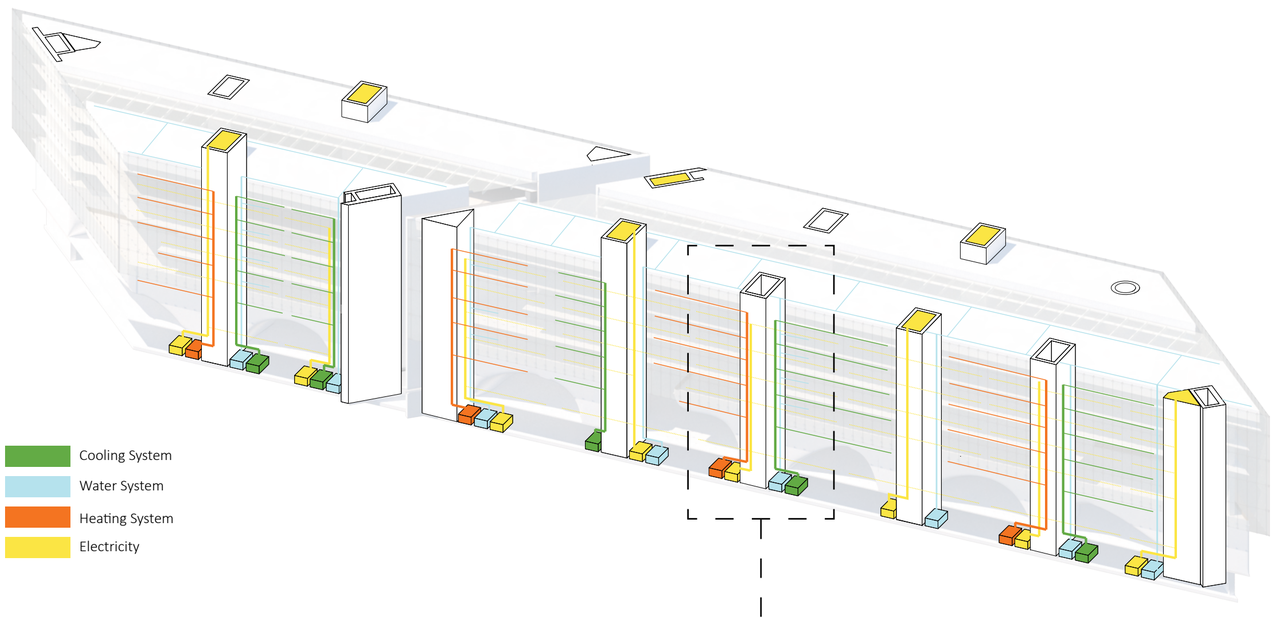
Cores Distribution



Vertical Circulation

MEP Cores

Vertical System

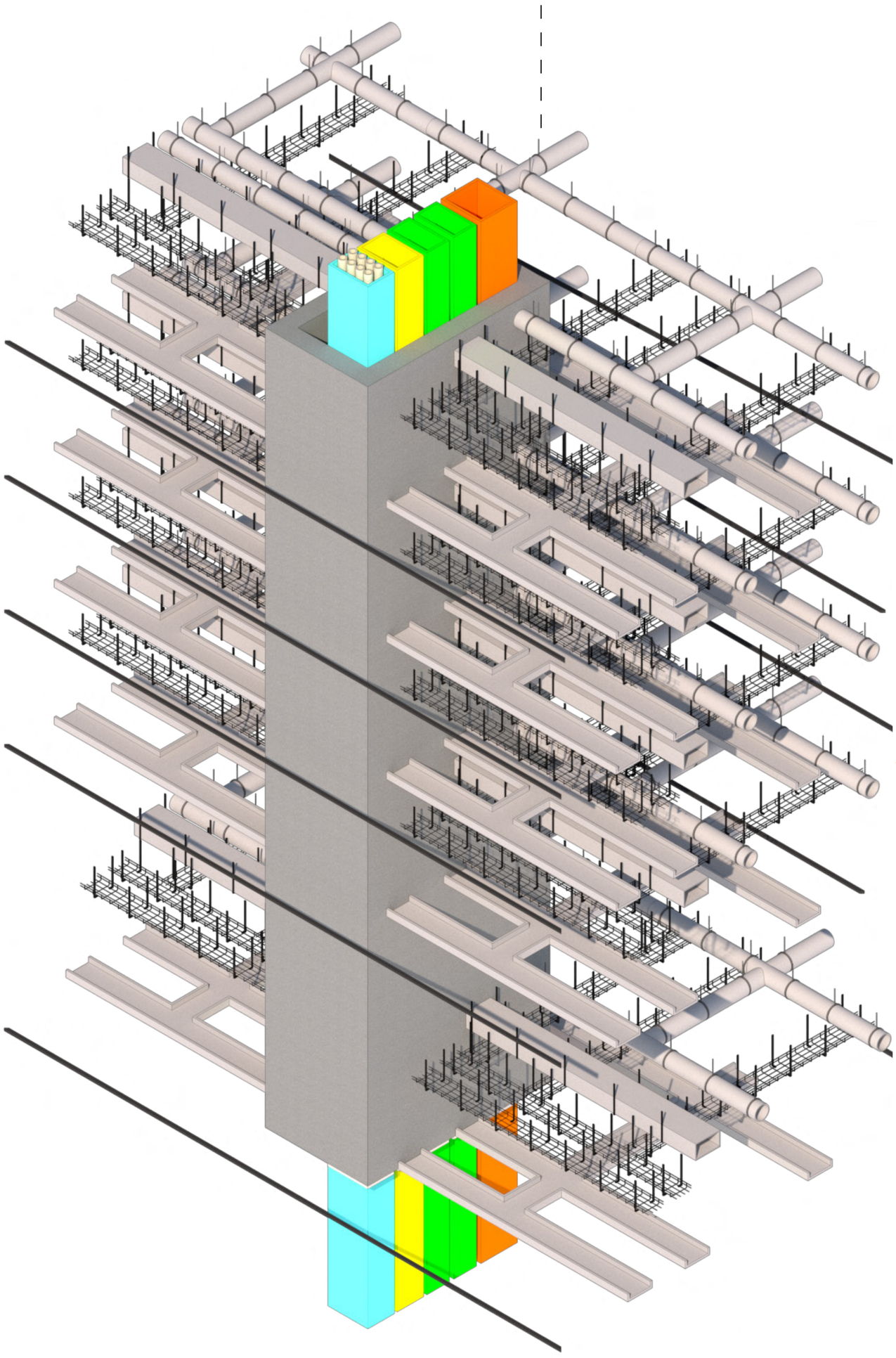


Cooling System

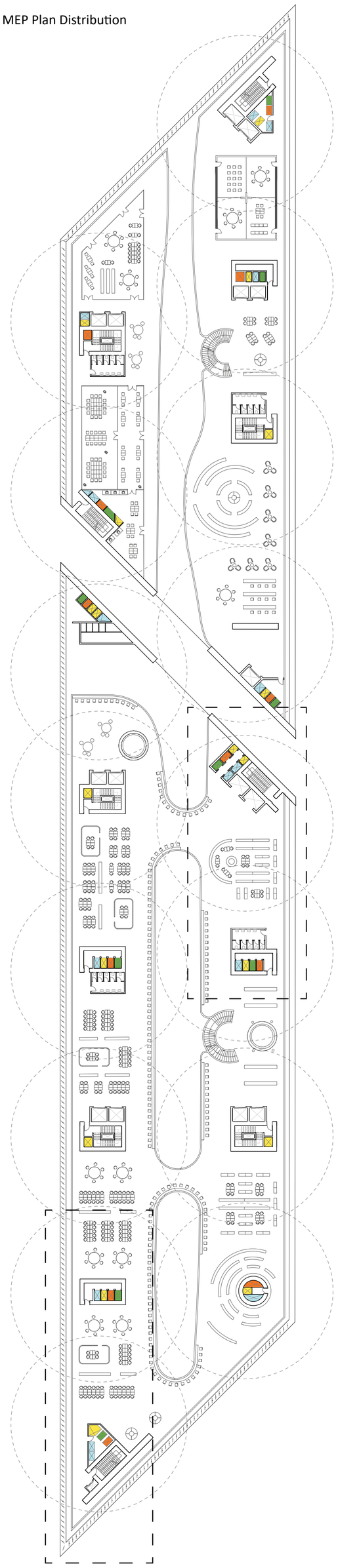
Water System

Heating System

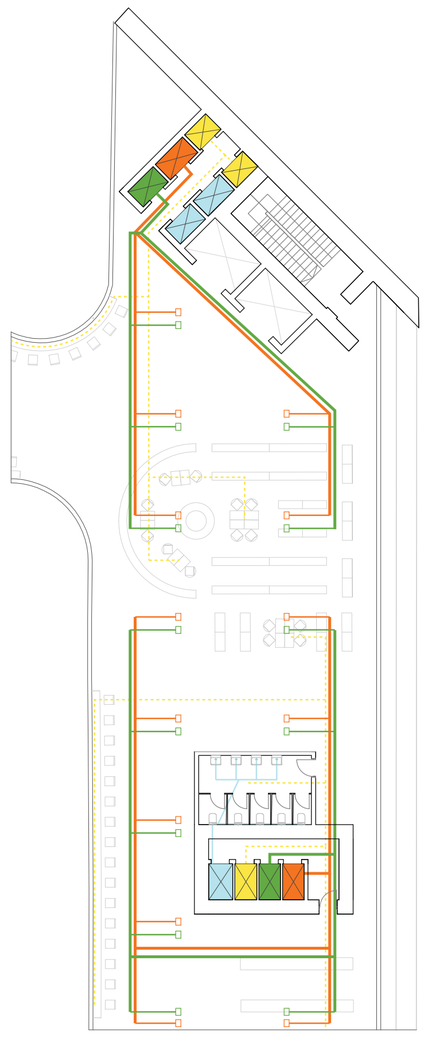
Electricity

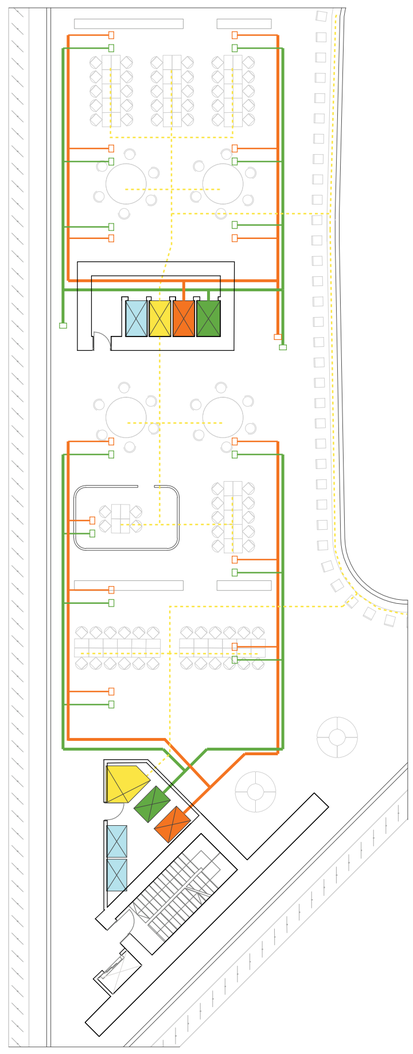


MEP Plan Distribution

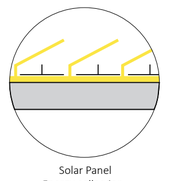


Detailed MEP Plan



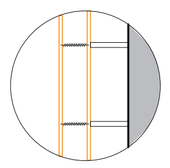


Natural Ventilation Scheme

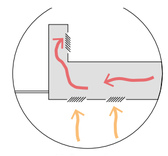


Solar Panel
Energy collection

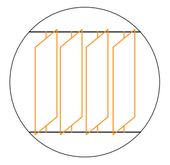
Water Collection
Tank for reuse water



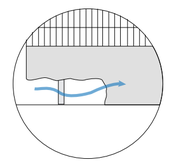
Double Glass
Glazed Glass- PVP Glass



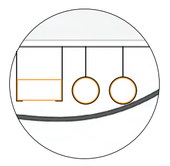
Air Extraction
Air circulation and ventilation



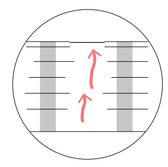
Louvers
Technical Fabric



Air Entrance
Circulation of Air



MEP Ducts



Chimney Effect

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