# Tolerance Space

A physical spatial study about intermediate spaces

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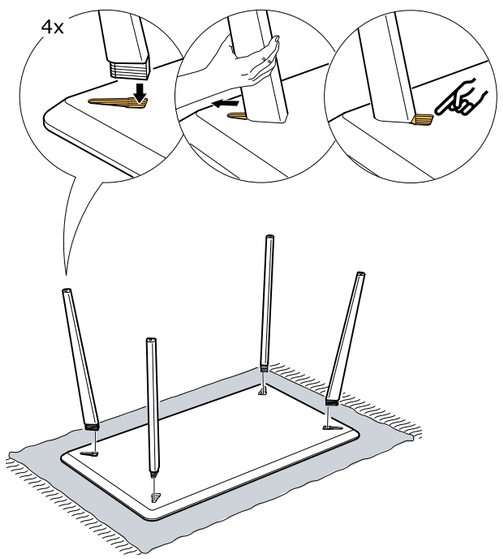
## Phase 1: Introduction of Tolerance space

**Contents**








Tolerance — joints (The Wedge Dowel Joint of IKEA)

I've liked assembling things from my early age. The process from fragments to the whole brings me a lot of pleasure. When I make a model or furniture, I make it as an assembly of different parts that fit together. Usually, it takes much more time than to glue or nail things together, but I just can't help thinking the meetings between different parts.

To assemble a model or furniture successfully, you must consider the tolerance in the joint. No matter how tight the joint is, there must be a degree of tolerance in it. The tolerance is the balance between the loose and tight.

I like IKEA, not all of their designs, but their flat pack and self-assemble systems really capture my interest. The first time I saw the "Wedge Dowel" joint in their *Lisabo* tables, I was excited about this smart design. The joint between legs and surface is designed from a fixed tolerance value to a dynamic tolerance value, the void around the legs shift from front to back during the assembly process. The table surface and the legs fit tightly together with friction and gravity, but leave room to maintain the possibility to disassemble. The surface and legs give the table an interdependent totality.



Tolerance — space (Beijing Housing)

I found this type of housing when I travel to and from work on the bus in Beijing. I was immediately attracted by their robust facades – the overlap of different elements on the facade creates a depth with light and shadow. It stirs my curiosity to find out what is inside. When I got inside oneday, I visited the gallery, the staircase, not the apartment, then I found the facade elements are separated from inside. It is hard to imagine this relationship from outside. Later, when I realized this organization was generated by the fire escaping norms and economic reasons, I was a little bit disappointed, but I am sure of the spatial qualities in these facades. The horizontal voids between each corridor connect adjoining floors, and the vertical voids behind the corridors separate two adjoining apartments. These two surplus void spaces interweave with the solid elements to create these particular facades together. I call those surplus void space the *tolerance space.*

void
gap
threshold
border
surplus
residual
by product
interstitial
in between
meeting
.
.
.





## 2.1 In between

The tolerance space is a space among the main elements of the architecture. It acts as a buffer zone/the intermedium to connect the different spaces of the architecture.

## 2.2 Void

The tolerance space is a void space. If this void disappears, the quality of the space is nonexistent.
The architect Simone Pizzagalli has expressed it as following:

*"void contains in itself all the potential of the space, all the relation not written and experienced. [..] Void is the place of tension of something that will be, a space in power, but also the only place where the recollection of reality, the composition of the parts, fragments, of life can happen."* [1]

## 2.3 Adaptable / Flexible

The tolerance space is a gap space clamped by different layers/elements of the architecture, the form of the tolerance space varies with the transformation of those layers/elements.

## 2.4 Backstage

The tolerance space is a space behind the scenes. Without the tolerance space, the play of architecture loses continuity and become fragments.

[1] Simone Pizzagalli, Space, Poetics, Voids (Architectura & Natura Press, 2013)

3.1 Porosity / Penetrable

The tolerance space improves the living qualities of the building on different aspects, such as lighting, ventilation, view and activity.

3.2 Construction friendly

The tolerance space facilitates the construction, making room for the assembly of different components of the architecture, especially for prefabricated architecture. It is the natural position of structure separation/tolerance joint in large scale architecture.

3.3 The Interdependent totality[2]

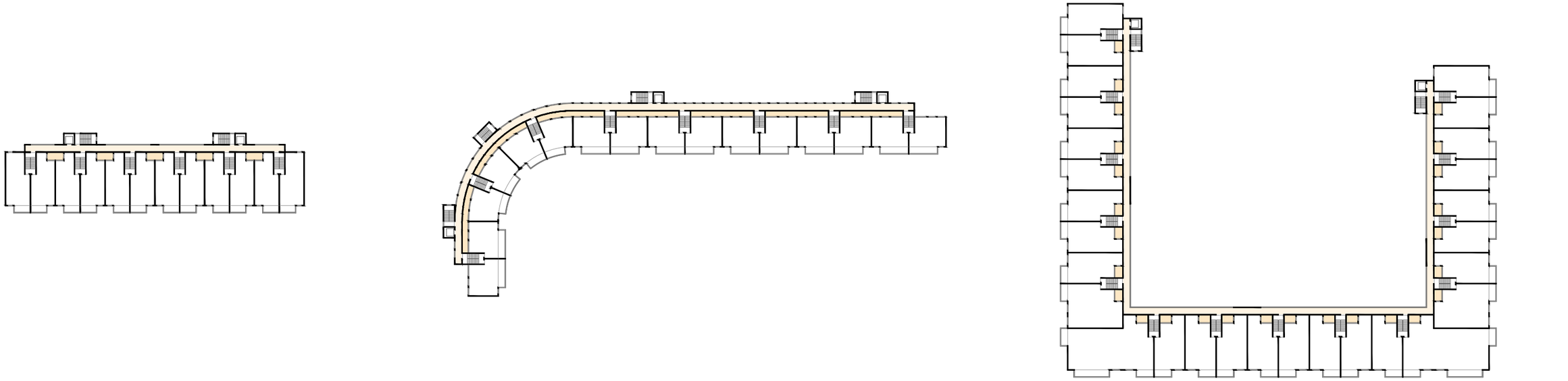
The tolerance space provides distance to other elements/spaces in the architecture, but keeps the totality of the architecture.

3.4 The phenomenal transparency[3]

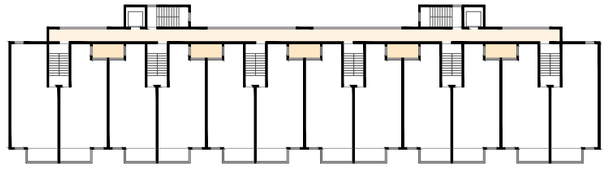
The tolerance space gives a hint to the interior space and enriches the spatial depth on facades or plans.

[2] Angela Deuber, The poetics of space, logic of material, and the interdependent totality, Lecture in AHO, Oslo, 2014. http://kaltura.aho.no/media/t/0_tzqlanxd/361072

[3] Colin Rowe and Robert Slutzky, Transparency, 21.




This housing is developed from one prototype. The tolerance spaces in this type of housing are varied. The horizontal galleries and vertical patios overlap on the facade. Several layers of tolerance space mix together and weave this complicated facade. The whole building also contains another aspect of tolerance – to fit into different sites by different transformations.

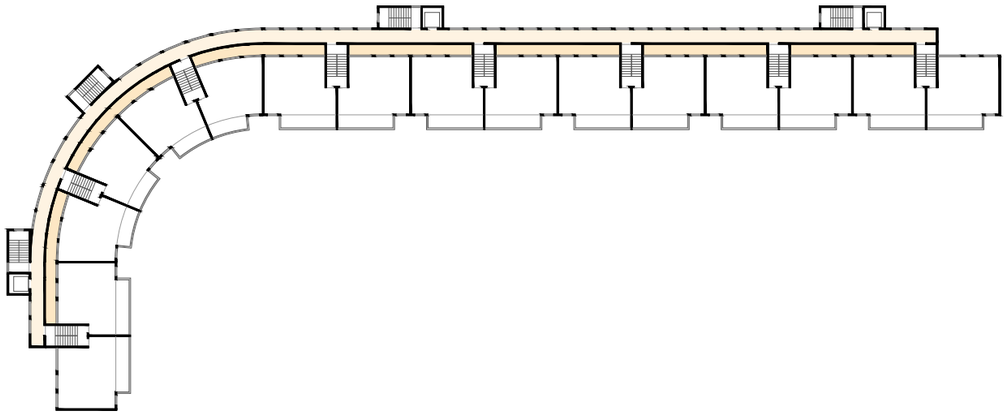


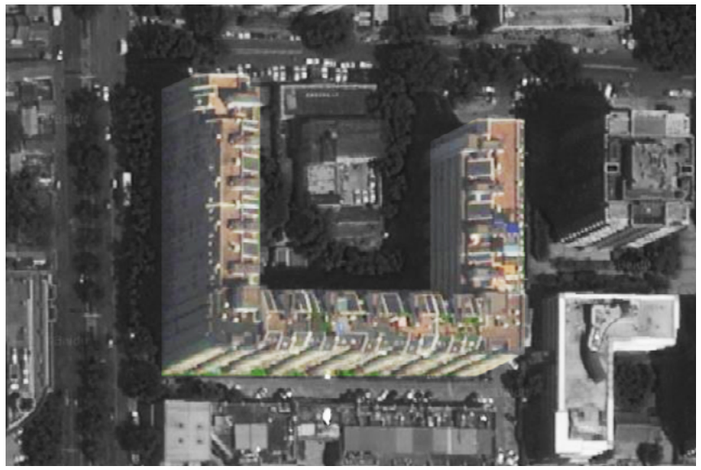
*Straight linear type:*

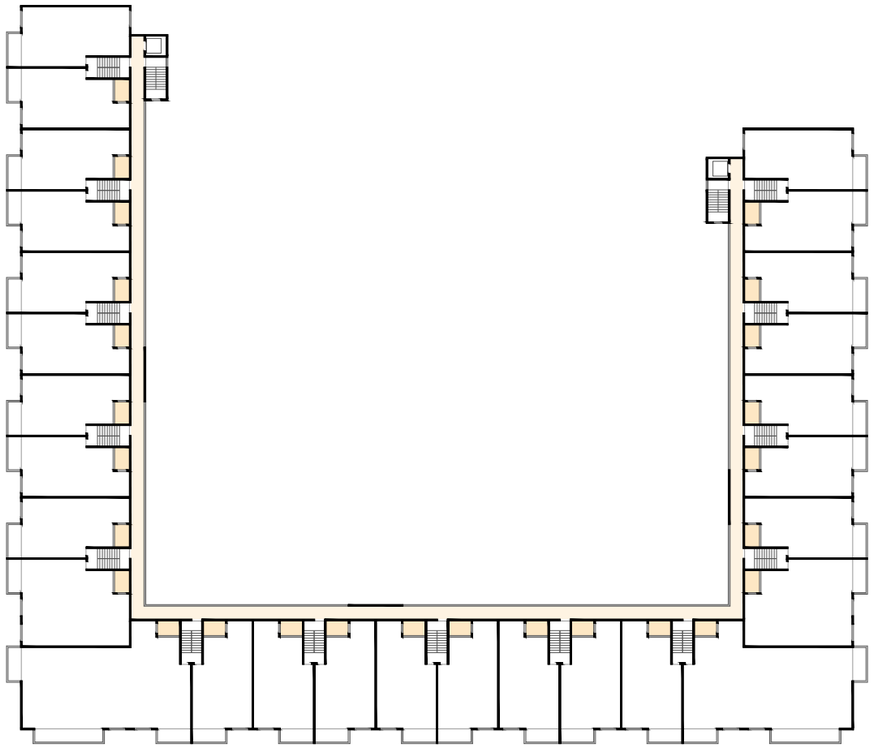
Galleries and patios are clamped by the extra circulation cores on the north and ordinary staircases and apartment units on the south. The patio provide the light, view and ventilation for the kitchen and bathroom of the apartment unit. The gallery are the connection of two escaping routes. Both of the tolerance spaces maintain the void status waiting for something to happen.

*Curve type:*

The housing located on the corner of the block, close to the fourth ring road of Beijing. The galleries and patios act as a buffer zone to reduce the noise on the road. They transform to the curve shape to follow the particular site situation.





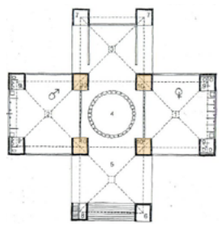


*U type:*

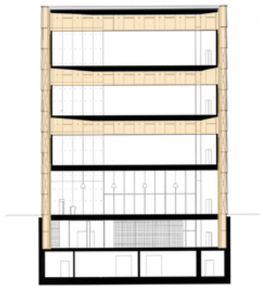
The U type housing forms a more closed block with housing building on three sides and some public facilities in the center. The galleries and patios act as an interstitial layer to separate the private and public space but also keep a degree of connecting between them.

0 10 20m

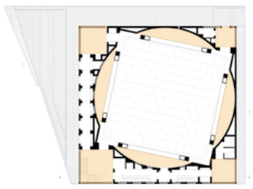
Border



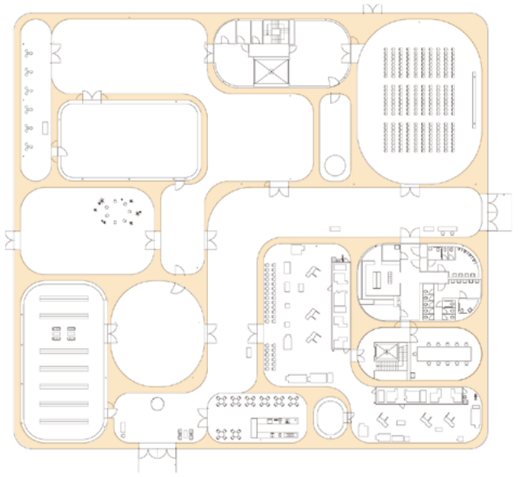
Light



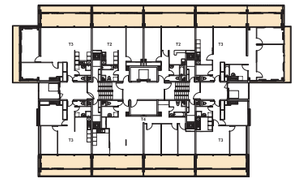
Wind

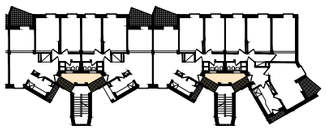


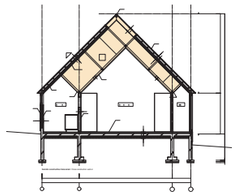
View

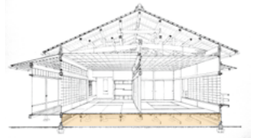


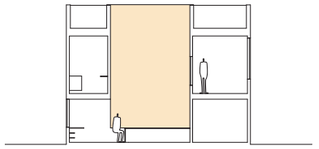
Activitiy

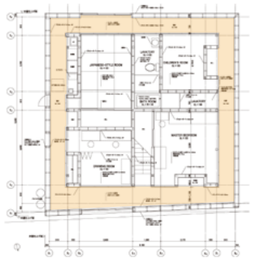












Different tolerance spaces have different properties. Different properties give different roles to the tolerance spaces to collaborate with other spaces in whole architecture. For now I sum up those properties to five aspects: border, light, wind, view, and activity.

I categorize these references to better grasp the core of the tolerance space. Some tolerance spaces also contain other aspects/qualities.

By analysing these references, I aim to find principles to direct study models in the beginning of the diploma semester. These principles are generated from the different relations among elements.



*Border:* The space is a preparation for the next space behind it. You will perceive another sense of territory after it. It acts as a threshold between two or more spaces.

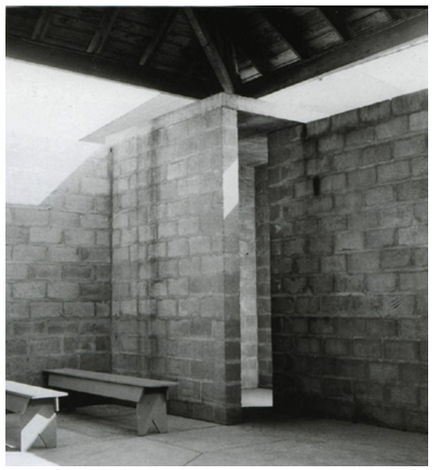
*Light:* The space is created for better light conditions or the atmosphere of the adjoining spaces.

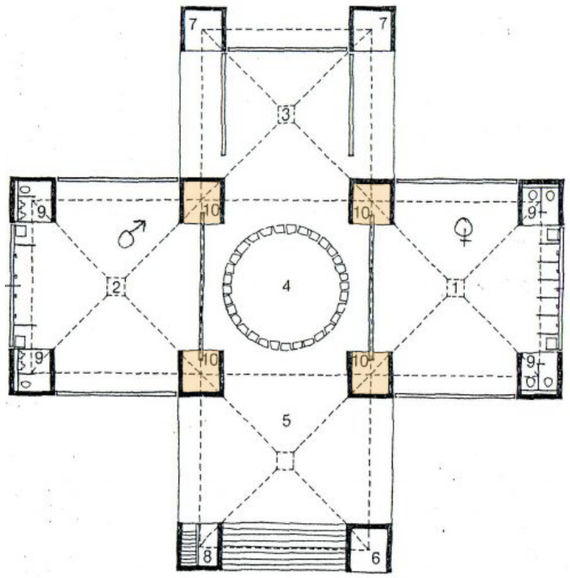
*Wind:* The space is created for better ventilation of the adjoining spaces.

*View:* The space exists for view connection, separation or transformation.

*Activity:* The space acts as a backstage/vessel containing the circulation and activities to support the operation of the whole architecture.

The tolerance space is transitional border between the public and private space.
It provide a preparation period to adjust your mood before you enter another territory.

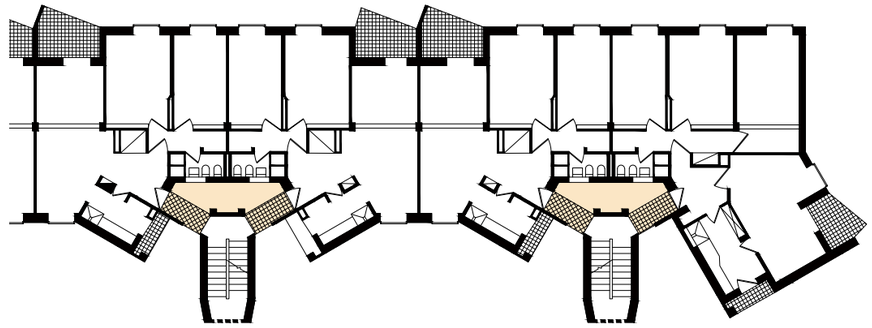





Trenton Bath House _ Louis Kahn, Anne Tyng _ 1954-1959

0 5 10m





Quartiere IACP Mangiagalli II _ Franco Albini & Ignazio Gardella _ 1950-1952

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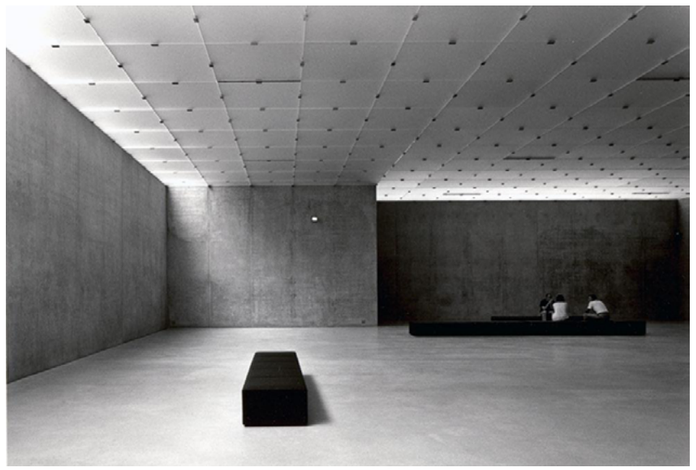
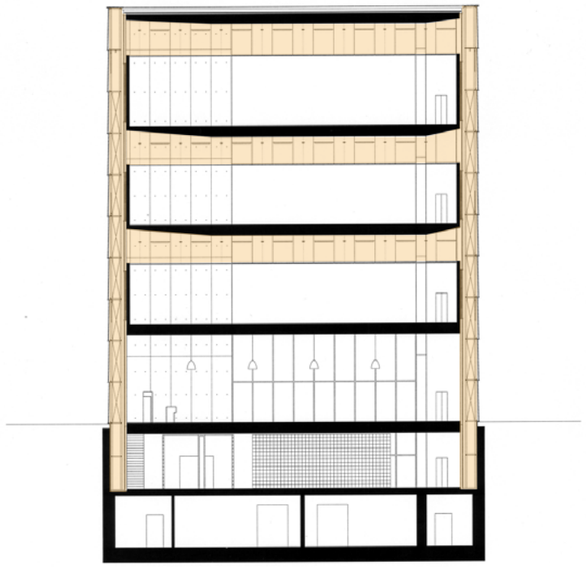
The tolerance space filters the direct light form outside to soft light inside.
It create a different atmosphere for the adjoining space.





Kunsthaus Bregenz _ Peter Zumthur _ 1990-1997

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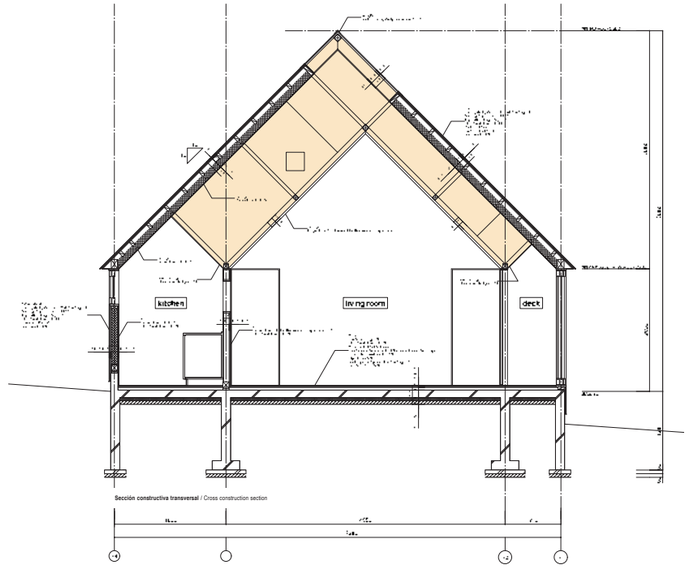
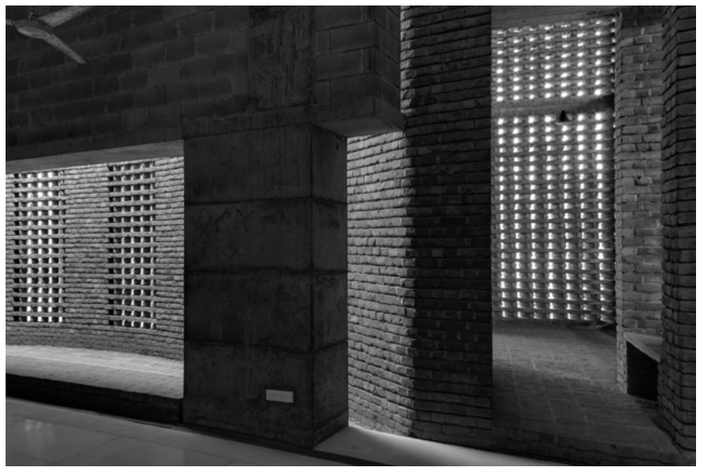
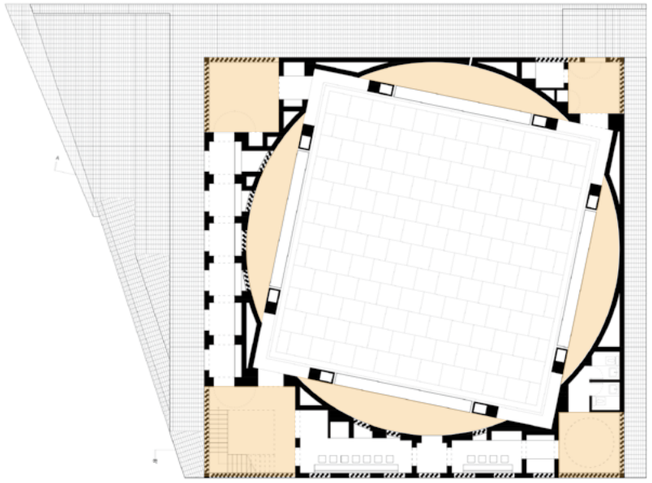



House in a Forest _ Go Hasegawa _ 2005-2006

0 1 2m

The tolerance space is a tunnel to allow air go through and adjust the temperature inside.

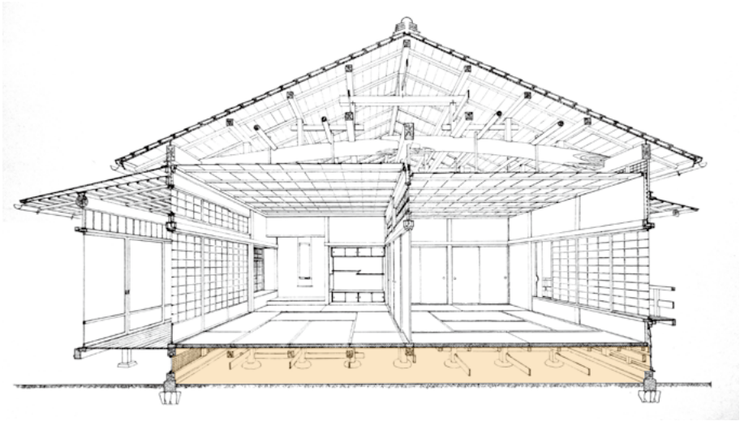




Bait Ur Rouf Mosque _ Marina Tabassum _ 2012

0 5 10m

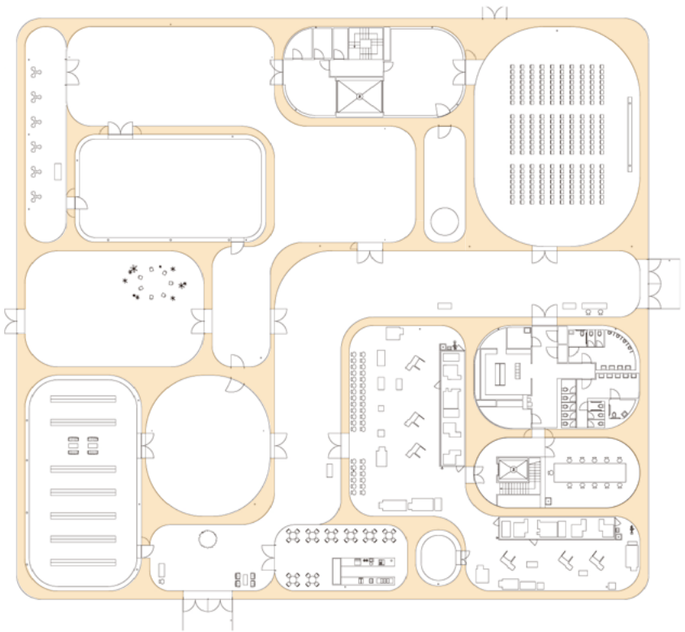




Shoin-zukuri _ Japanese residential architecture

0 1 2m

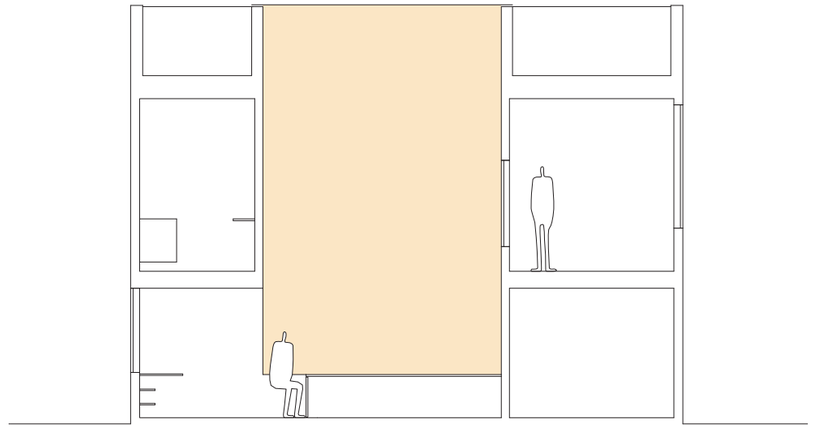
The tolerance space connects different views from separated spaces.
It is a void space with views communication and transformation.



Glass Pavilion at Toledo Museum of Art _ SANAA _ 2001-2006

0 5 10m

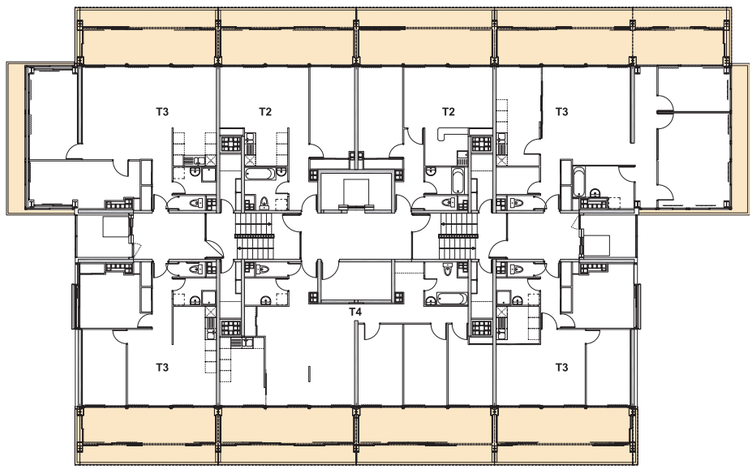




House in Sakuradai _ Go Hasegawa _ 2005-2006

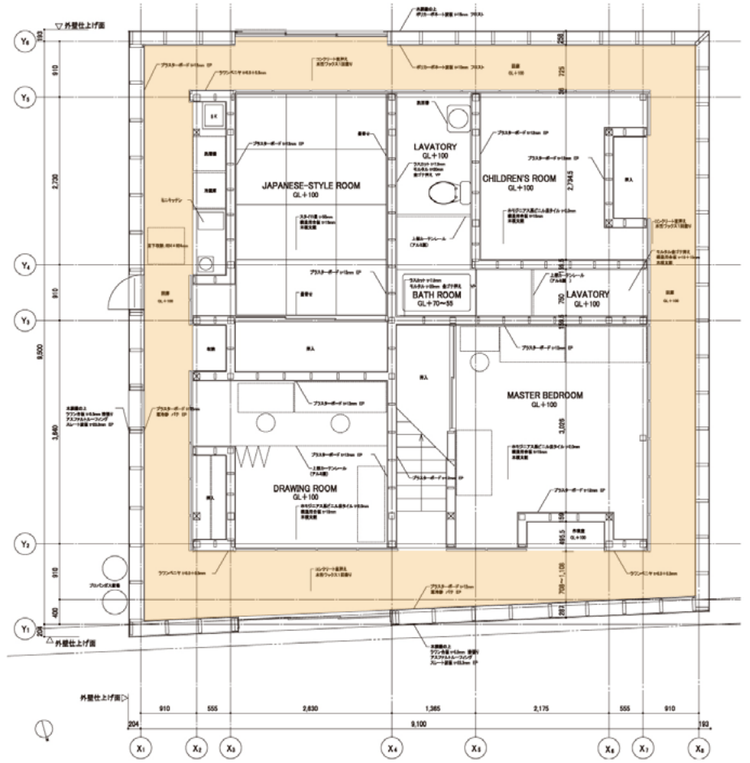
0 1 2m

The corridors and balconies around the building are non-programmed spaces to connect other activities inside the building and keep proper functioning of other spaces.




Transformation of Bois-le-Prêtre Tower _ Lacaton & Vassal _ 2005-2011

0 5 10m




S House _ SANAA _ 1995-1996

0 1 2m

## Phase 2: Atlas of Tolerance space

# Contents



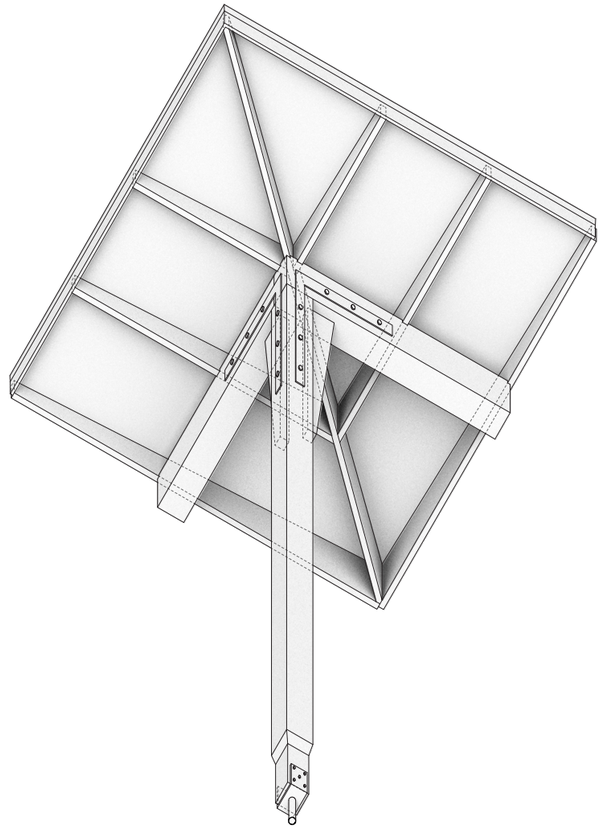
The Atlas is a collection of some fragments (spaces/objects/sceneries…) relevant to the Tolerance theme by photography, drawings and texts. I make an observation trip and collect these fragments during the summer holidays before the diploma semester. The collection of these fragments will become an archive to direct/inspire the next phase.

I concentrated on three types of tolerance spaces/objects: Column, Hall and Passage. I choose these there because first of all, they are all independent space inside the building or in urban environment. They are all containers, maintian the void state/capacity to accommodate different possible situations/ activities inside themselves. Second, they can become connection elements to influence adjoining components. The tolerance spaces exist inside themselves and the surroundings in the same time.

# Column

A column is a tolerance space of force.
A column likes a tree, it could be a start point of a space.
It connects the ceiling and ground, transmit force from top to bottom.
It is a vessel of force transmission.
Single column has no direction, it anchors space around it.
When columns come in groups of two or more, the boundary of space appears, different space arise around columns.

Different sections of the column express different force transmission inside the column. Different parts of the column have different relations with the space around it: the bottom part is thin and exposed to the surrounding space. The top part extends two wings to connect beams, covers space around it and form an anchored corner.

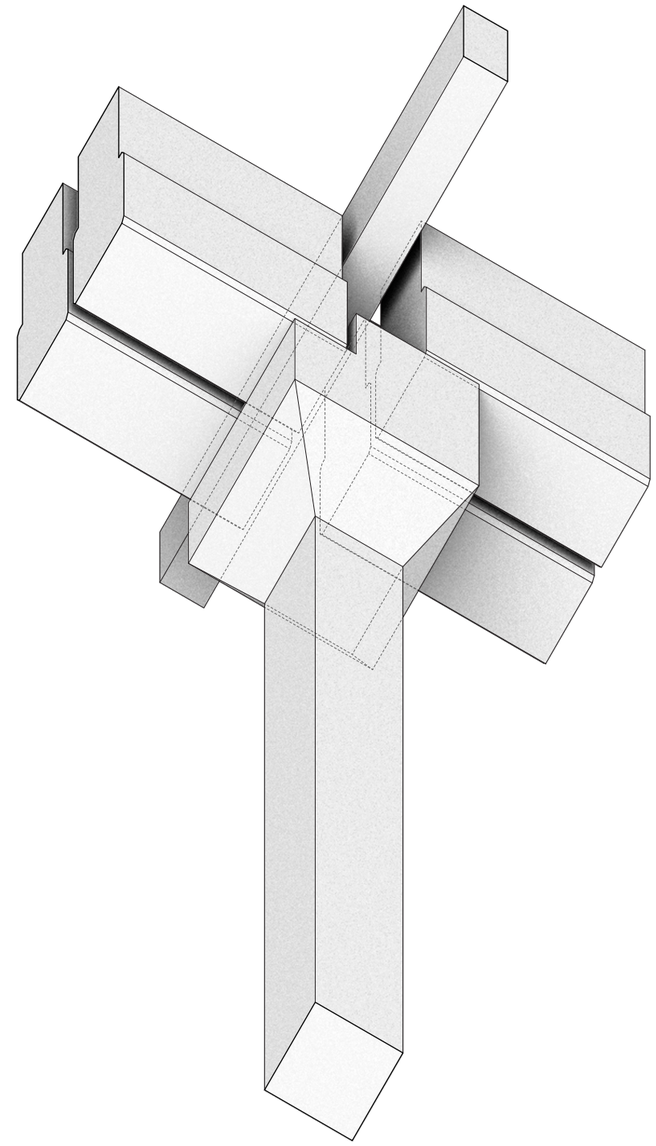


Oberwesel Station Platform, Germany

0 0.5 1m


The column cap was bitten by the beams with different spans requirments. This broadened cap of the column maintains a tolerance possibility to adjust the beams heights, positions and directions.

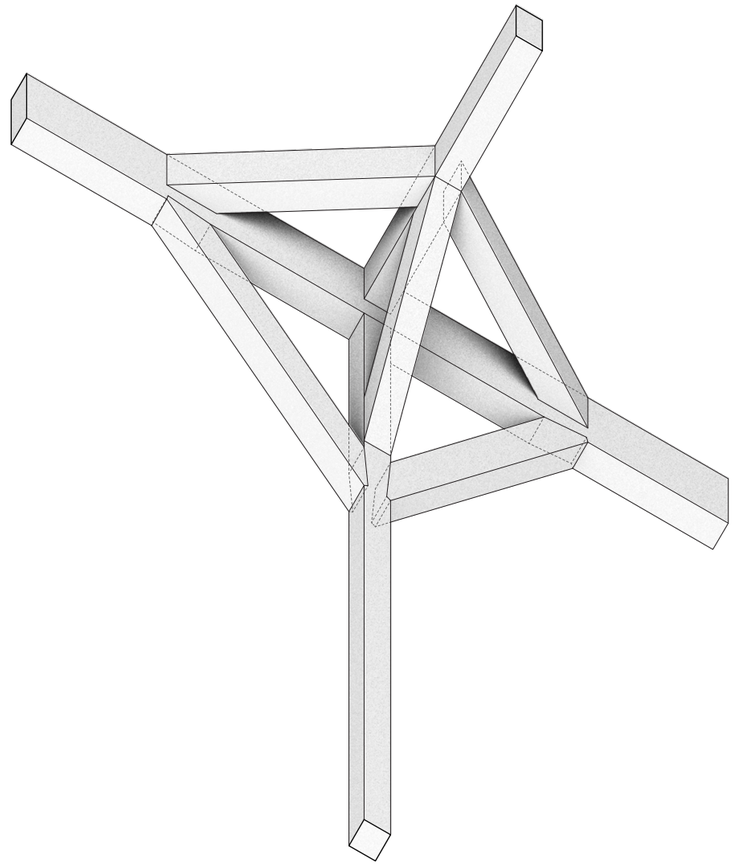




Parkering Mølla P-hus, Oslo

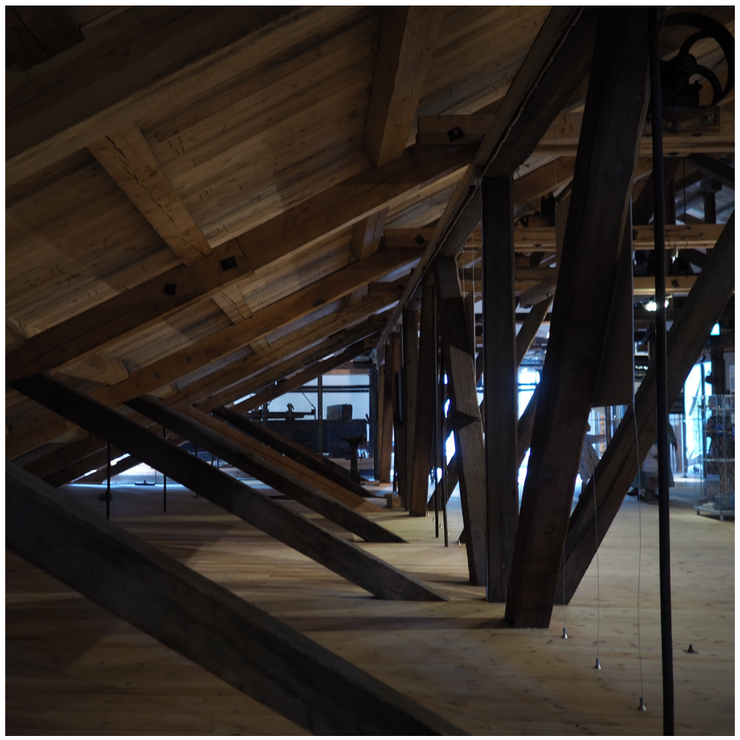
0 0.5 1m

When the solid column cap dissolved to the frame, airs get inside the cap and form a space. Similar section and material bring an ambiguity between the column and beam.



Cross Chapel, Venice _ Terunobu Fujimori _ 2018

0 0.5 1m

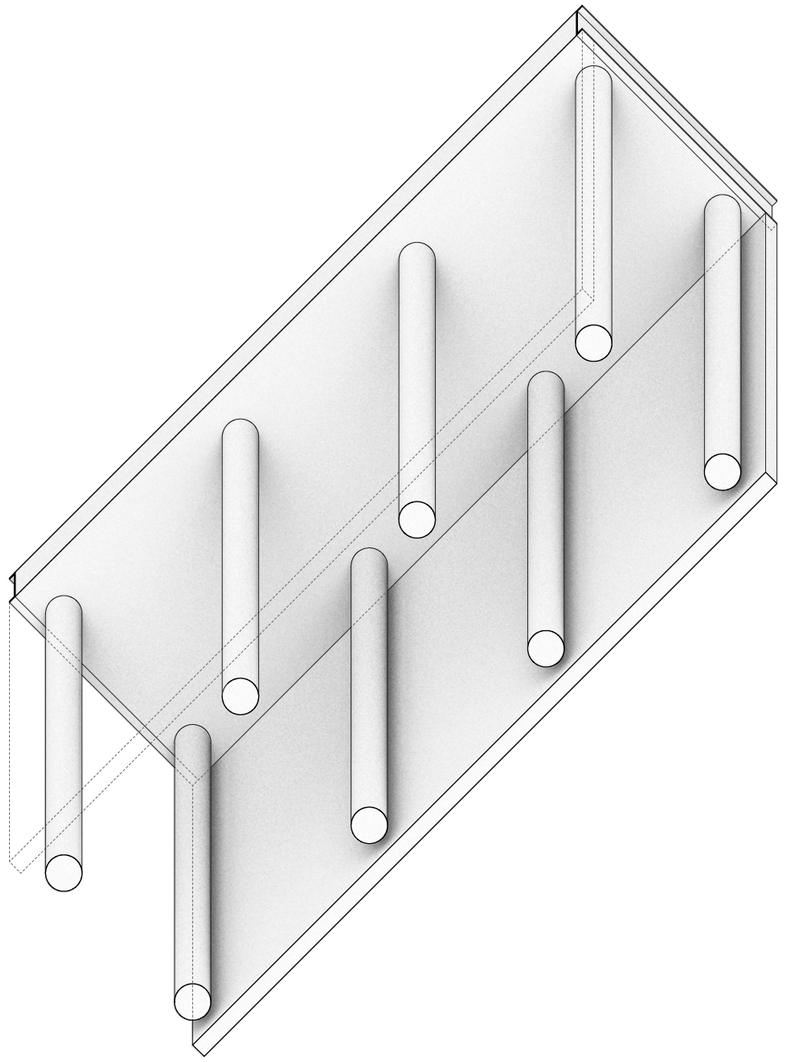


With the floor level lifted, the cap frames become columns,
the hanging space in the cap come to the ground.



axo_need to update

Sliperiloftet/Pulp mill attic, Kistefos _ Peder Hansen _ 1890



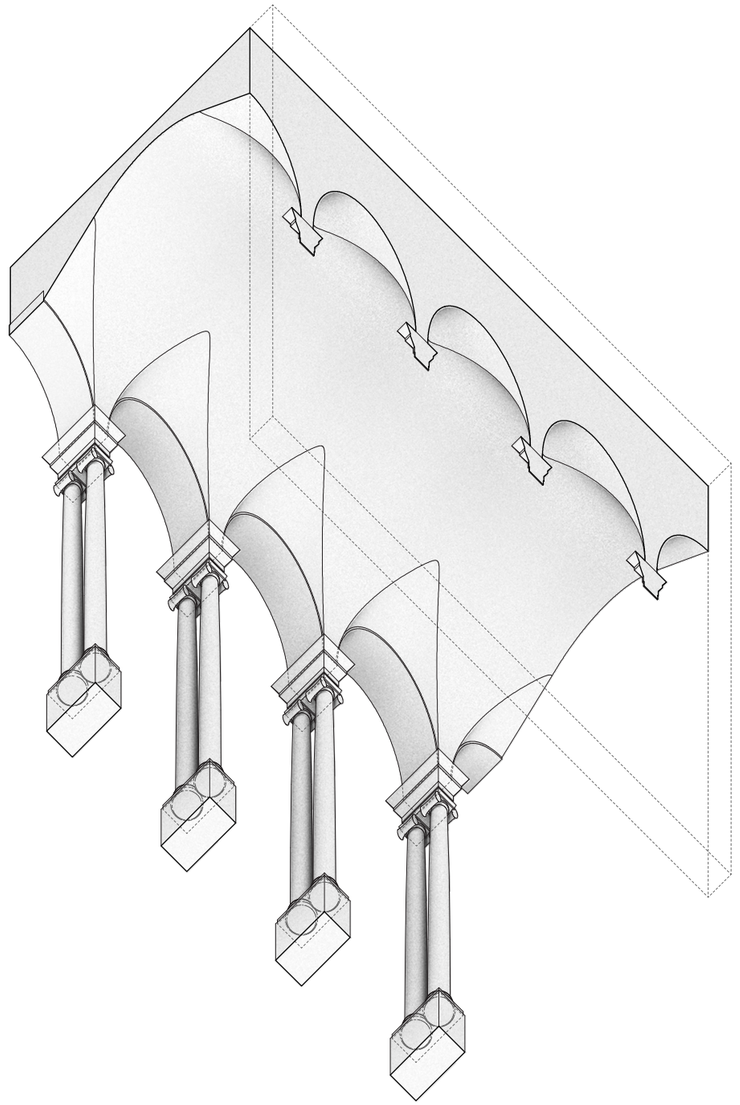
Pairs of columns emphasis the depth of the field inside this passage. Columns detach from the walls brings individuality to the columns and passage. The gaps are the by-products of the idea of interdepend elements, only allow views, wind and sound, shadow and light to go through.

Social Housing in Giudecca Venezia _ Aldo Rossi _ 1983

0 1 2m

The narrow corridor between the two columns is a gap between the cloister and courtyard. One column support the cloister with the inside wall, another one become the element of the courtyard facade.



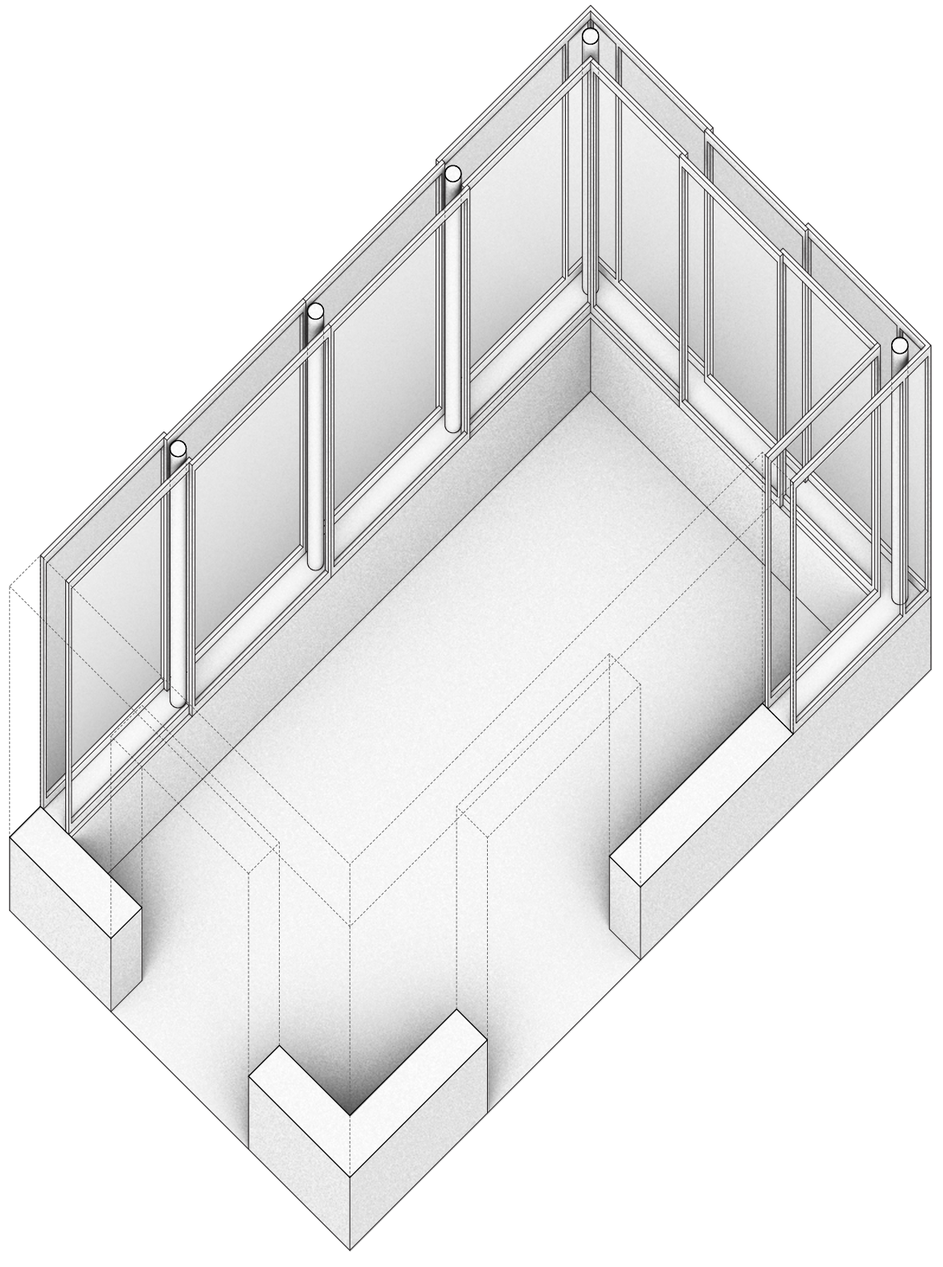


The Palladian Cloister, Fondazione Giorgio Cini, Venice _ Andrea Palladio _ 17th

0 1 2m

The columns covered by two layer of glass windows, hiding in this transparent facade both from interior and exterior view. The greenery inside this narrow greenhouse blur the boundary of inside and outside.





Villa Necchi Campiglio, Milan _ Piero Portaluppi _ 1935

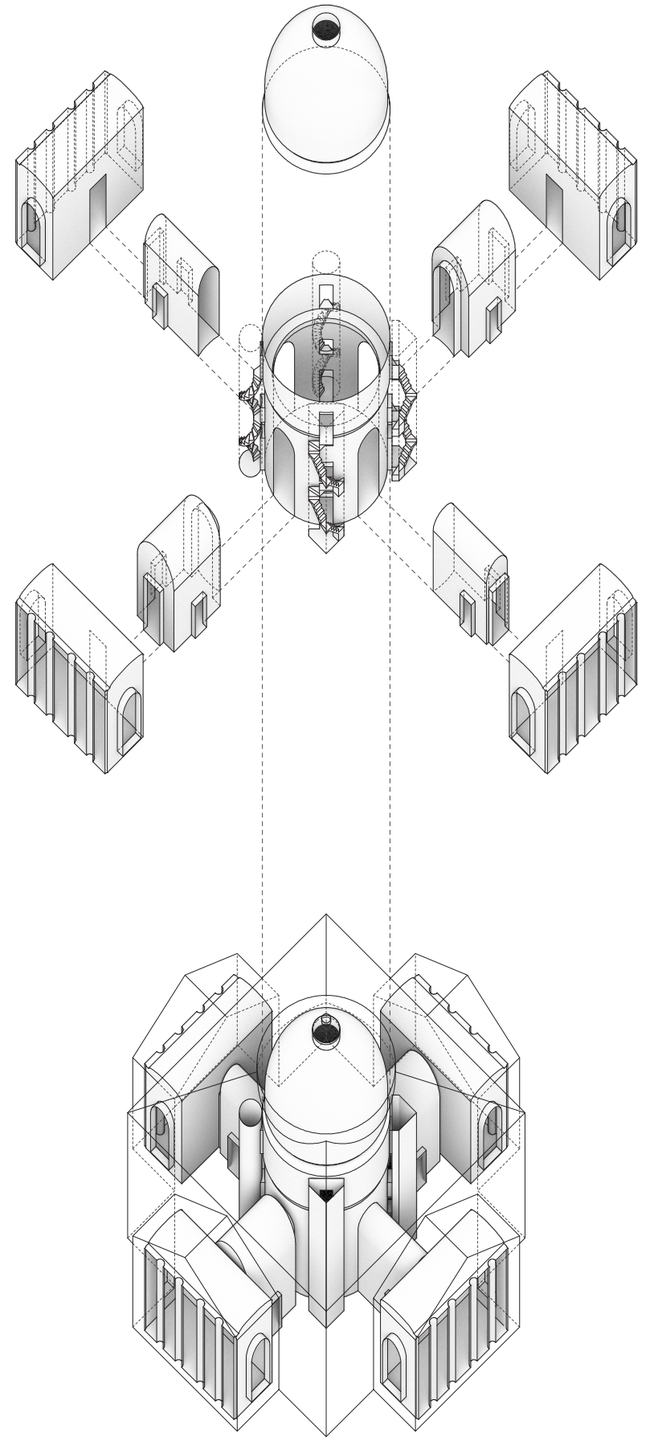
0 1 2m

# Hall

A hall is a empty room enclosed by walls, waiting for activities.
A hall likes a hollow column. It has no direction neither. It is a centralized space.
The walls cover the hall are surfaces of this hollow column.
These surfaces maintain a degree of thickness. It like the grooves on the Greek columns surface, bite the boundary of the hall, and expend the influence from the center to surrounding, on the other hand, introduce the outside to inside.

Four tunnels extend from the loggias, and one oculus skylight connect the central hall with the exterior environment, introduce light, view and wind inside the building. The hall is the main tolerance space unprogrammmed for various activities.  Four staircases in the corners as the interstitial spaces among the circular hall and surrounding rooms anchor the hall in the centre, and connect activities among different levels. It become the secendery tolerance space behind the main tolerance space.



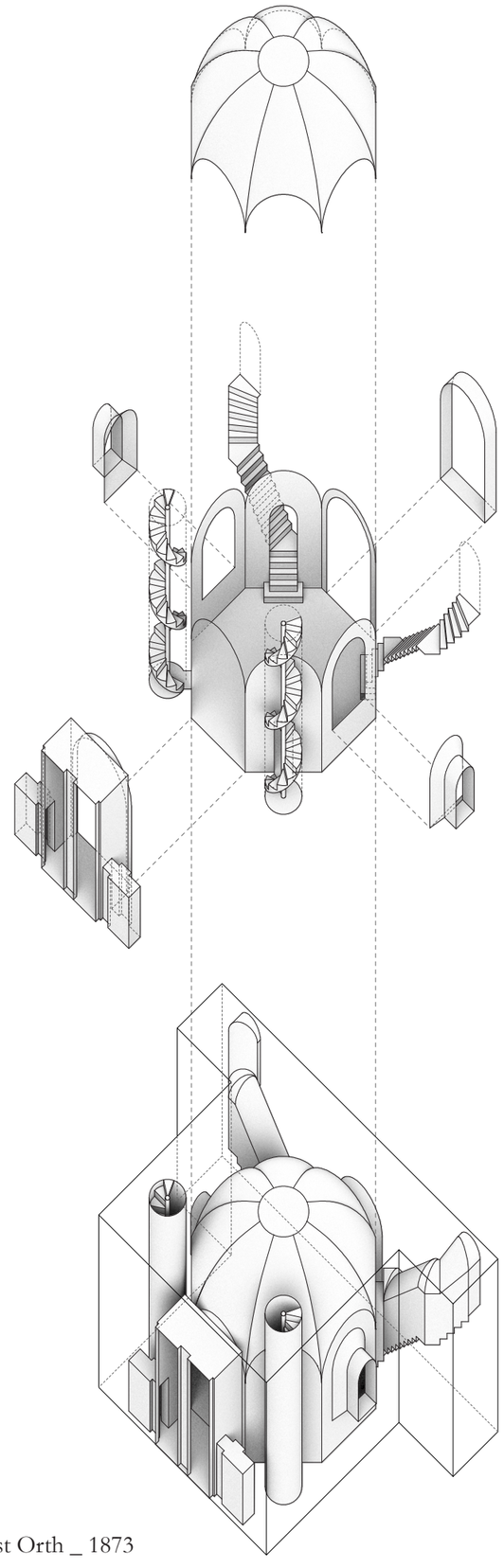


Villa La Rotonda, Vicenza _ Andrea Palladio _ 1571

0 5 10m

Four openning on the four sides of the hall, and four staircases hide inside four corners. This small entrance hall is penetrated by light and circulation from eight directions.





Zionskirche, Berlin _ August Orth _ 1873

0 2.5 5m

# Passage

A passage is a tunnel enclosed by continous walls/colonnades with clear direction.
A passage likes a horizontal column, transimits flow instead of force.
Contrast with outside, the passage is always more narrower, closer and darker.
It is a dilated border seperates two larger spaces and connects another two larger spaces.

The silhouettes of structure overlap on the framed landscape. The space between the structure elements and elevation openings break the two-dimentional effect in the dark environment.



axo_need to update

Hallingskeid Station Platform, Norway

The continous arches form the main structure of this bridge. Some parts of the ground follow the main structure and some parts not. The structure and the ground interlace togather.
The curved ground twist the space and views.
Skeleton of the facade covers on the structure.



axo_need to update

Überseebrücke, Hamburg _ HCE Eggers _ 1927

Two different accesses connects the end of the under corridor and intervine outside. The column in the middle of the under corridor pre-divide the space and circulation to different destinations.



axo_need to update

Sotoportego del million, Venice

## Phase 3: Spatial study of Tolerance space

Based on the Atlas, I start to make objects to represent the space qualities of these tolerance spaces. The Objects are not simple rebuild the fragments, they absorb the traits of fragments and generate the new body.
I made four objects named them with the same title of the Atlas: Column, Hall and Passage. It doesn't mean each object only inspire/influence by the same type of fragements. One object may contain characters from other types in some aspects.

The four objects maintain some common characters as follows:

Structure:
They consist of the skeleten(the core) and the skin(the envelop). The skeleton is the main structure to resist compression. The skin is hanging/strianing on the skeleton, enclosing the space and seperate the inside and outside.

Material:
The skeleton made by the solid walnut and the skin is made by 0.6mm birch plywood. Due to the thin thickness, the skin is translucent and filter the light from outside to inside.

Cosntruction:
The skeleton and skin are independent structures in each object. They are detach in most part, only connect together with some particular joints.

Space:
Most part of the object is enclosed by the skin. The skeleton and joints are hide behind the skin, only exposed on particular edges, ends and gaps. The light is diffuse inside the object through these slits.

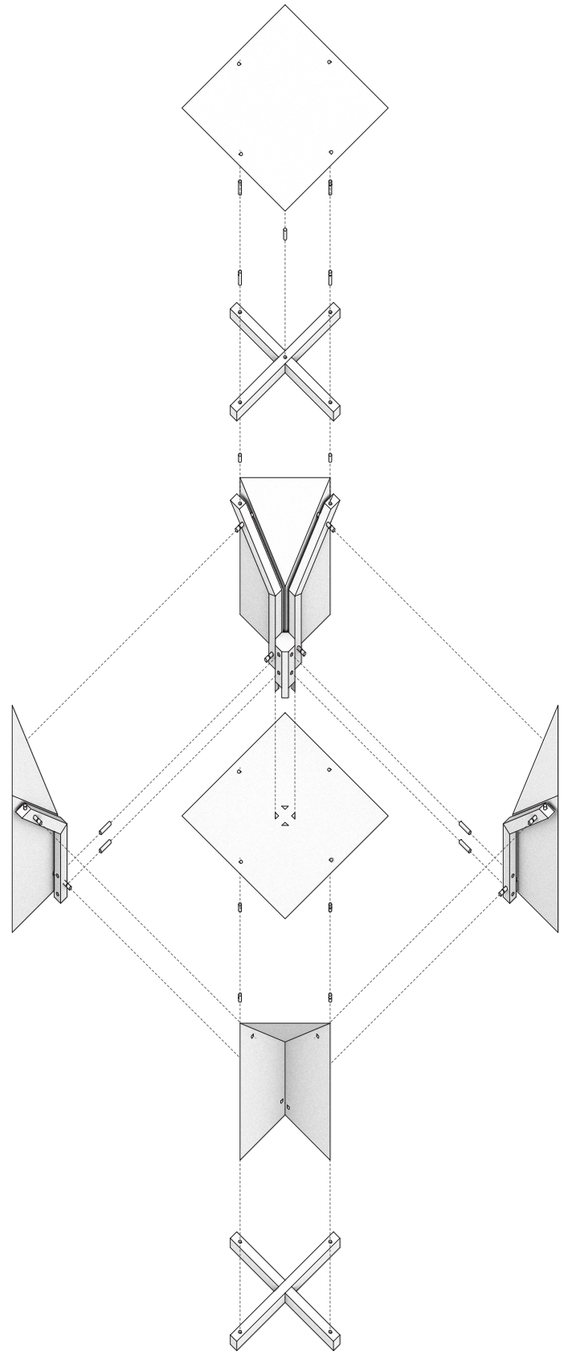
Contents

# Column

Tolerance spaces not only stay inside the column, but also exist around it. When the space anchored by the column, the column no long only exists for the column, it becomes the director hides behind the space, organises the relations on stage.

The column grows up from the central bottom, split to four branches from the middle height, and connects by the cross beam on the top. It supports the ground, ceiling and hangs four L shape walls. The walls clamp the column in the center and form four seperated space assist with floor and ceiling in four corners. The column transforms from one solid point on the bottom to a void reversed pyramid on the top. Each branch of the column occupys one gaps between adjoining corners.





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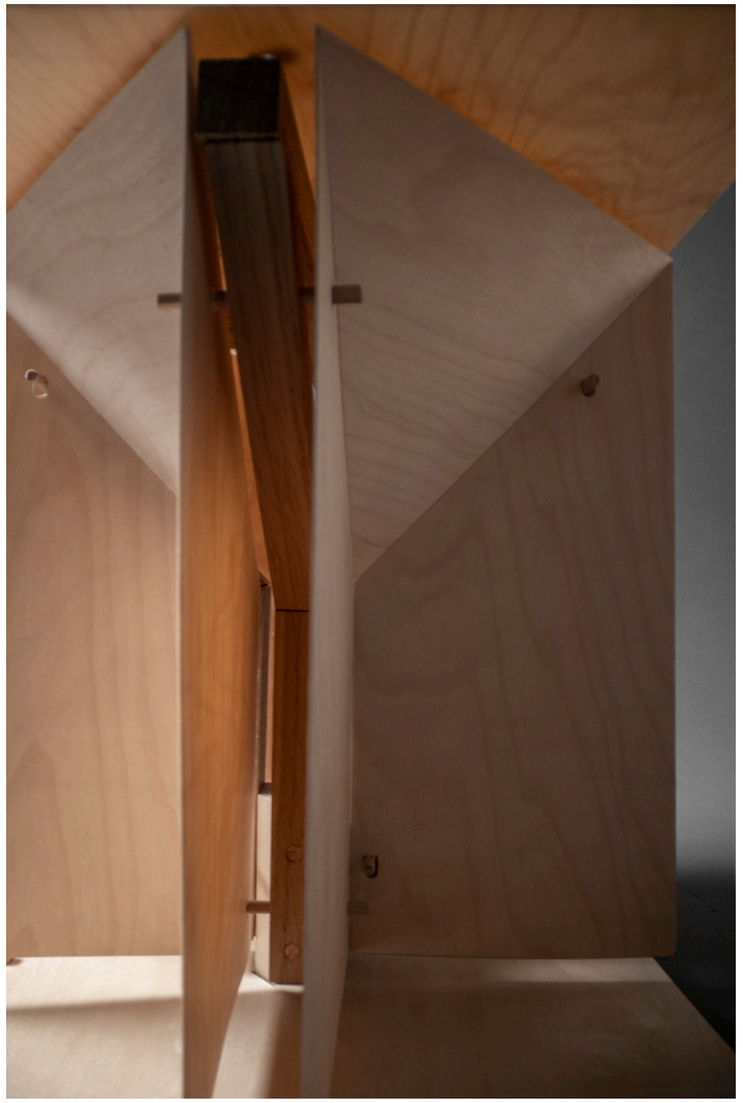

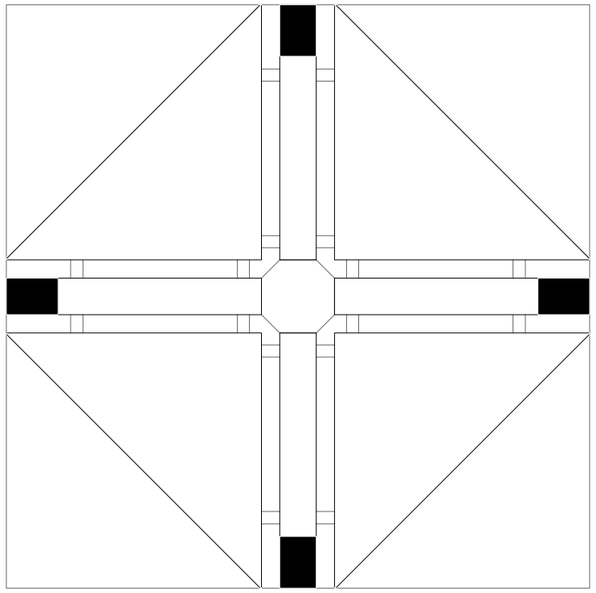

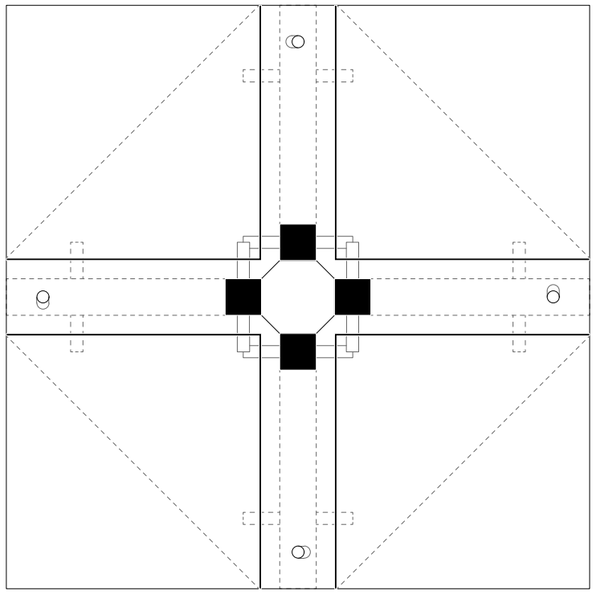

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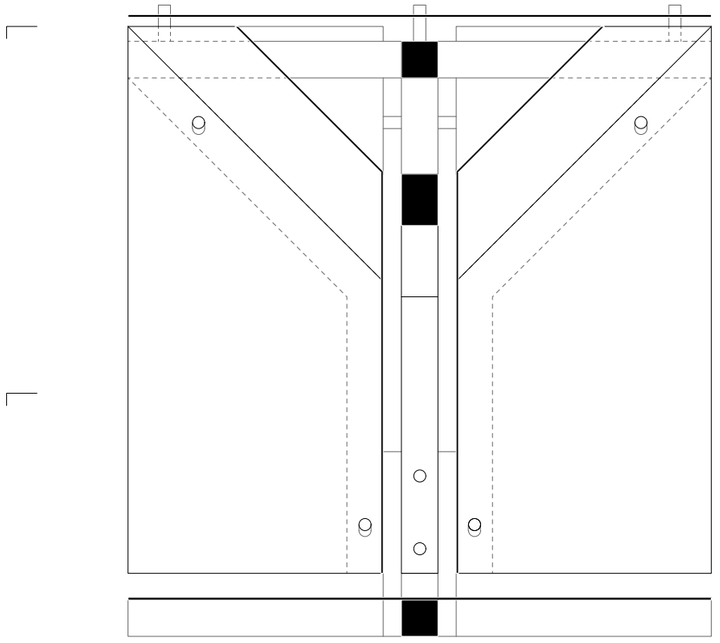

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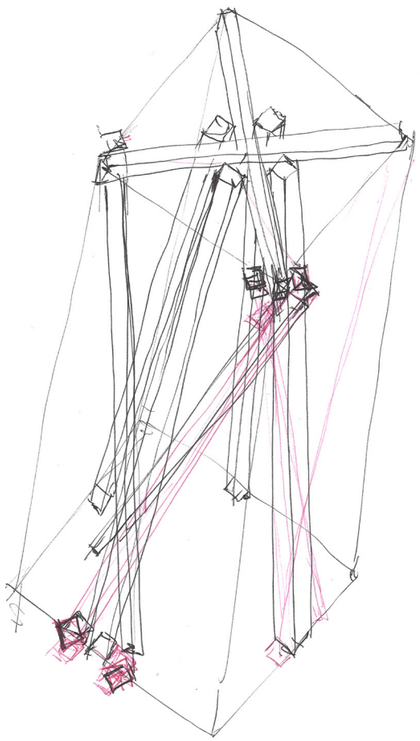
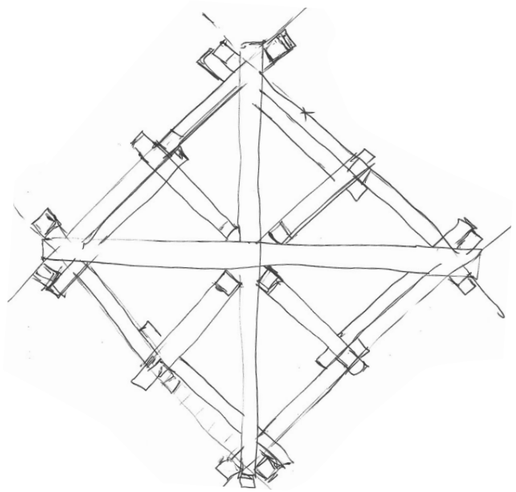




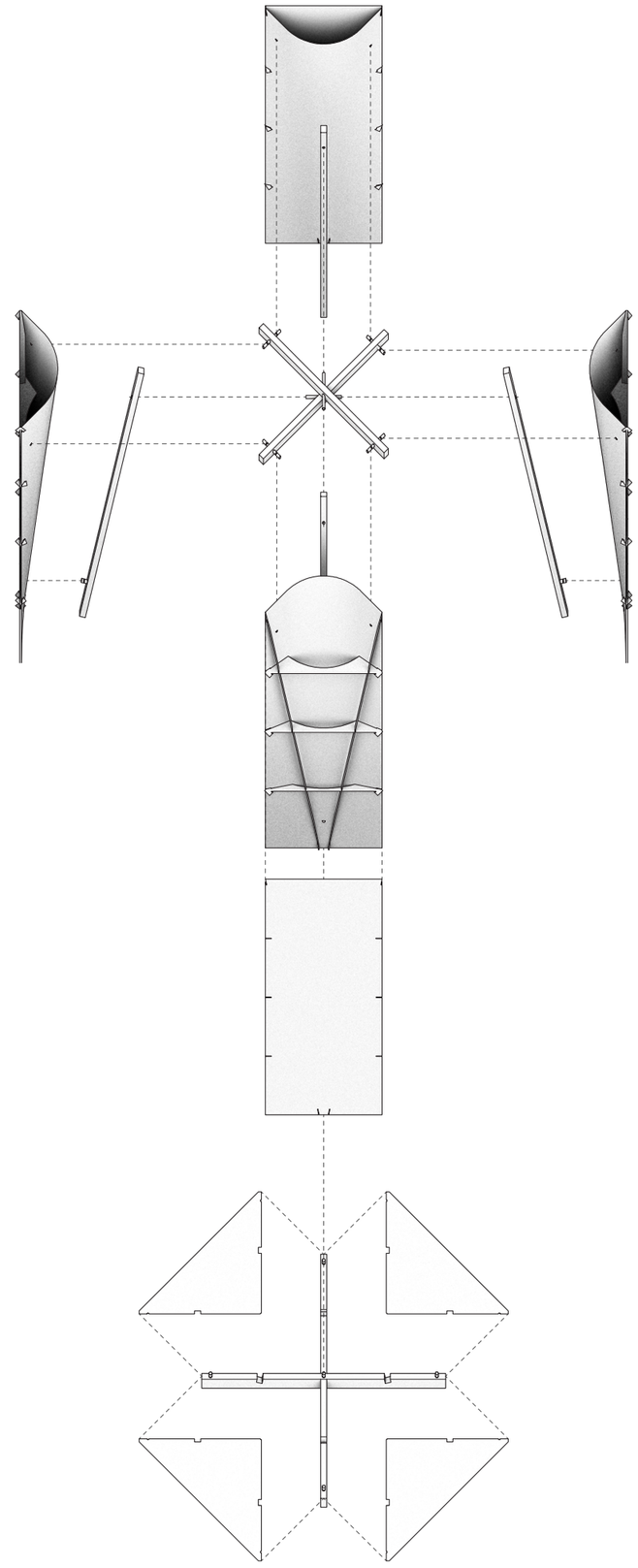


# Hall

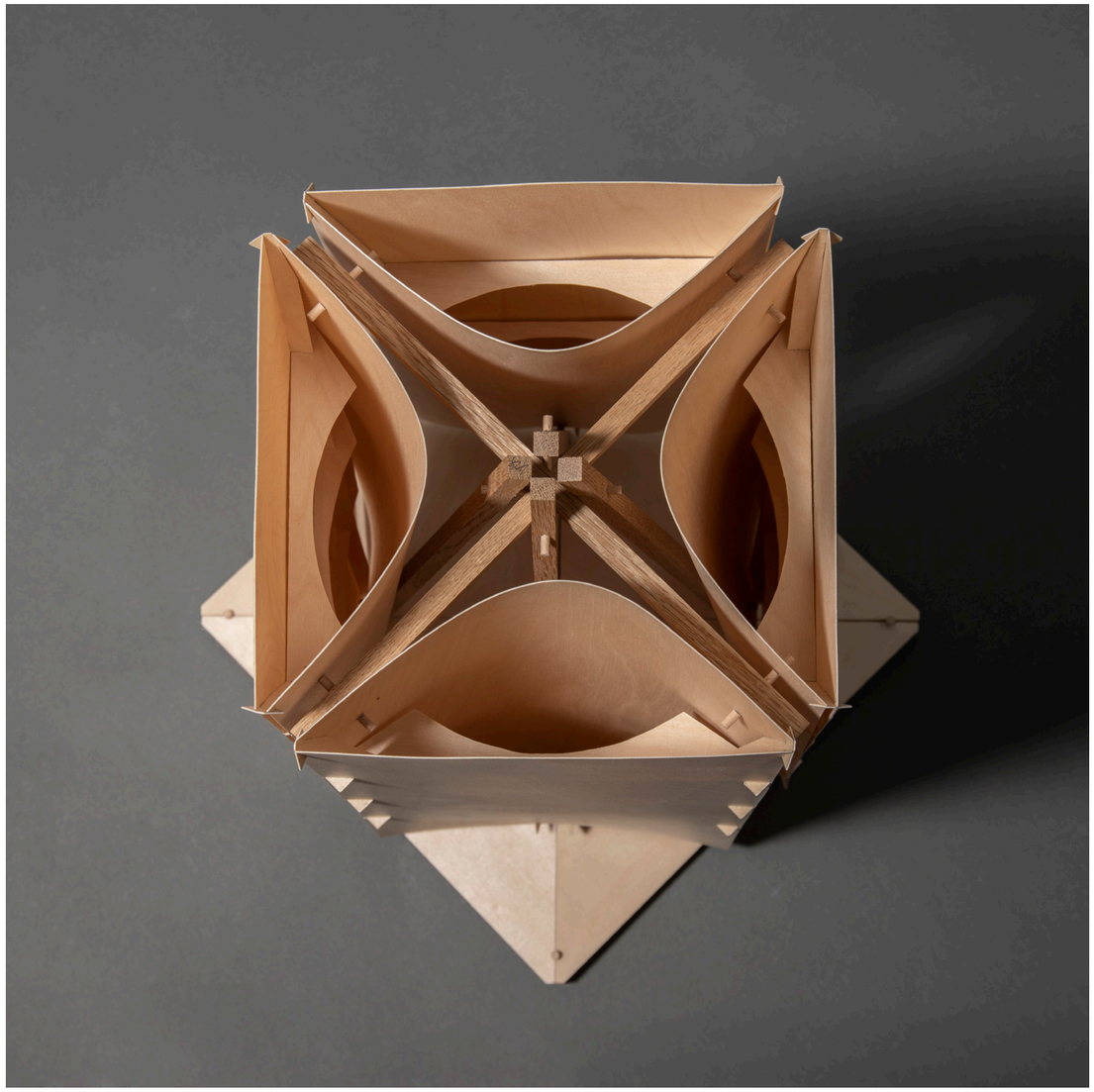
A hall can never be a airtight hollow column.
It is a hollow column with various outlets,
or it is a solid column maintains high porosity.
There is no columns inside the hall, the hall is the column.

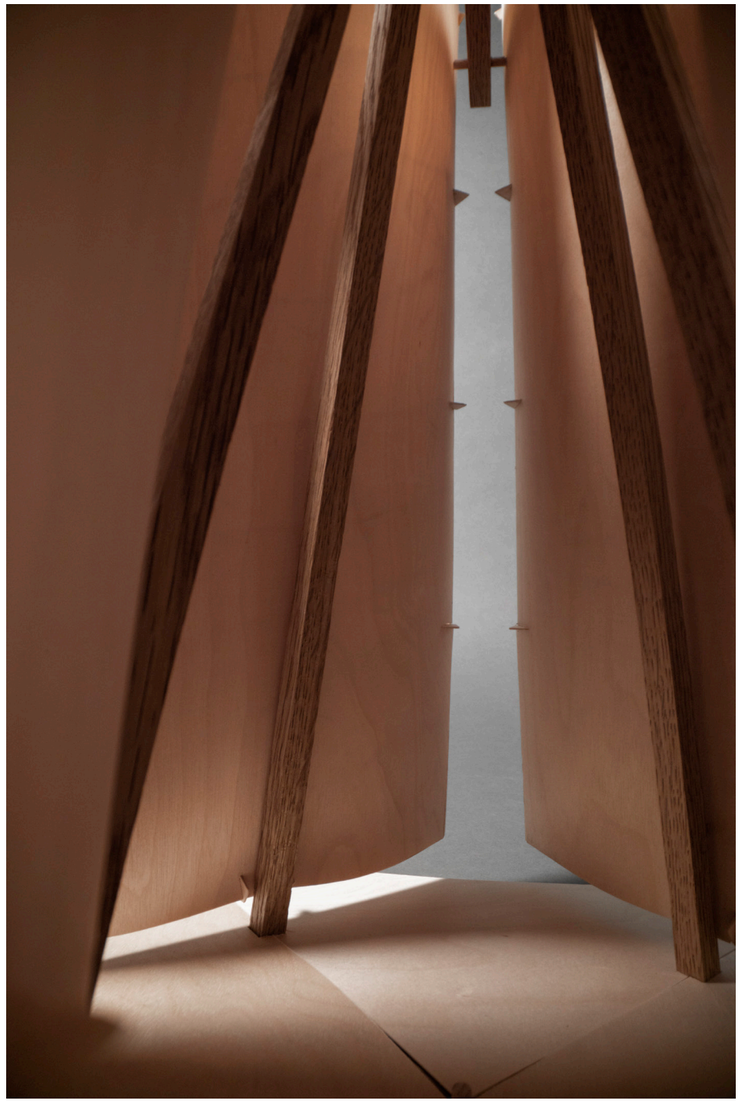
The Hall is enclosed by four walls, each wall is supported by the tilted column rises from the middle of each edge on the bottom. These four tilted columns coverge on the top and clamps the cross beam. The wall's thickness is changing from bottom to top gradually: from one line on the bottom to a mouth shape opening on the top, so the hall's shape is transforming with it: from a square on the bottom to a cross opening on the top.

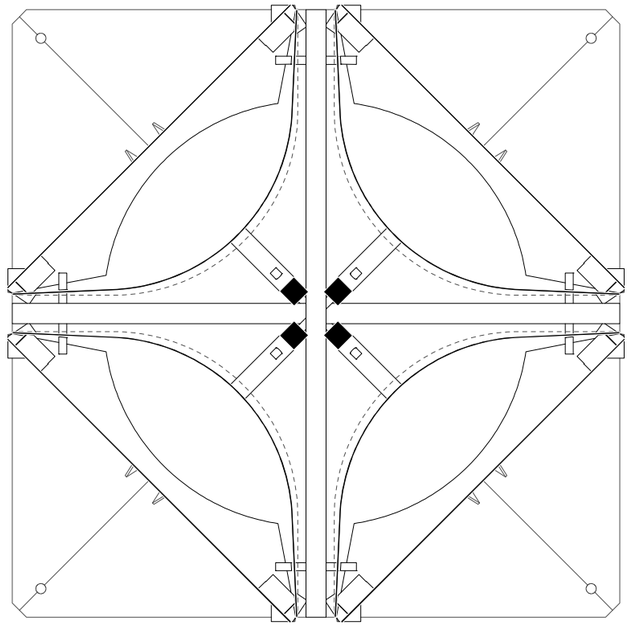


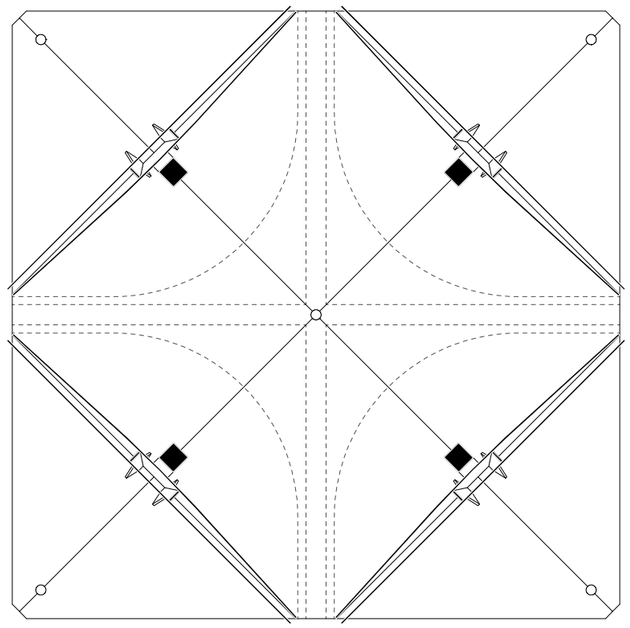






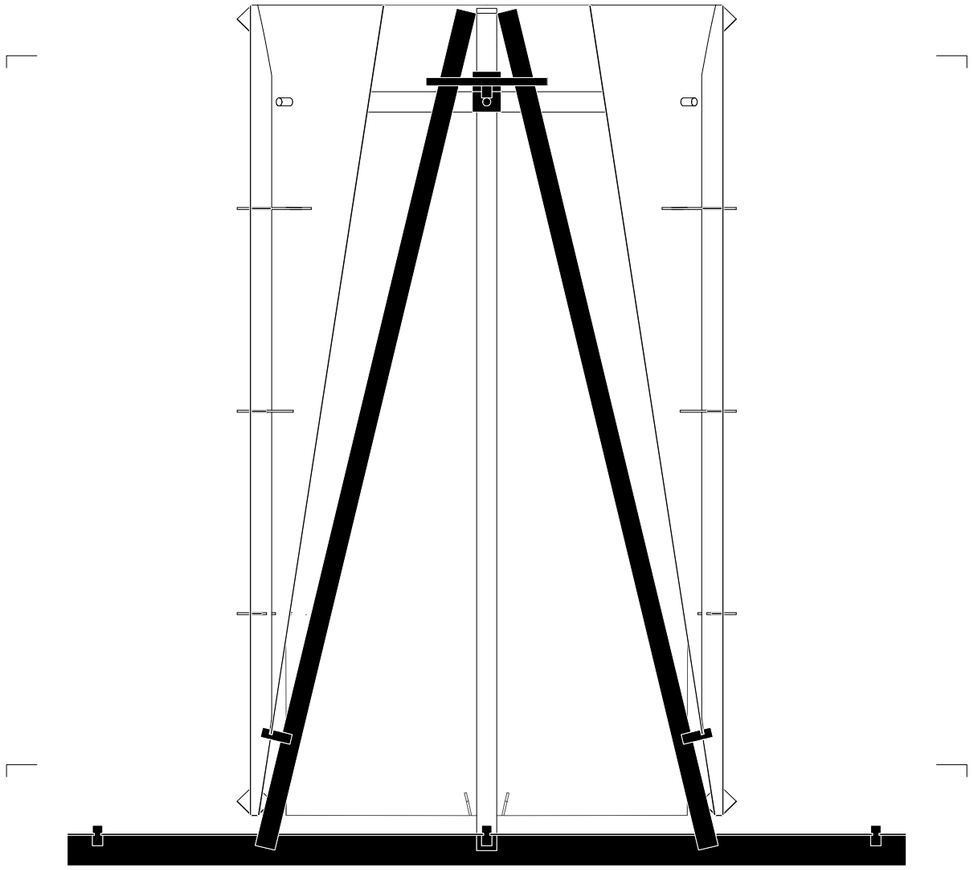






Plans





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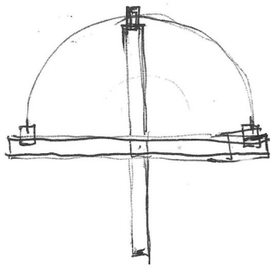
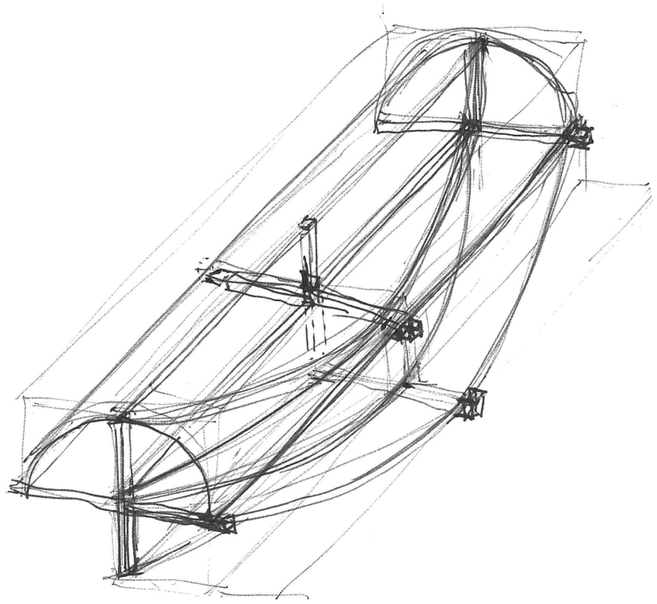
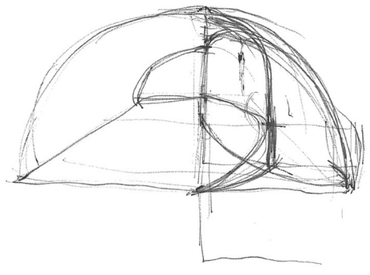


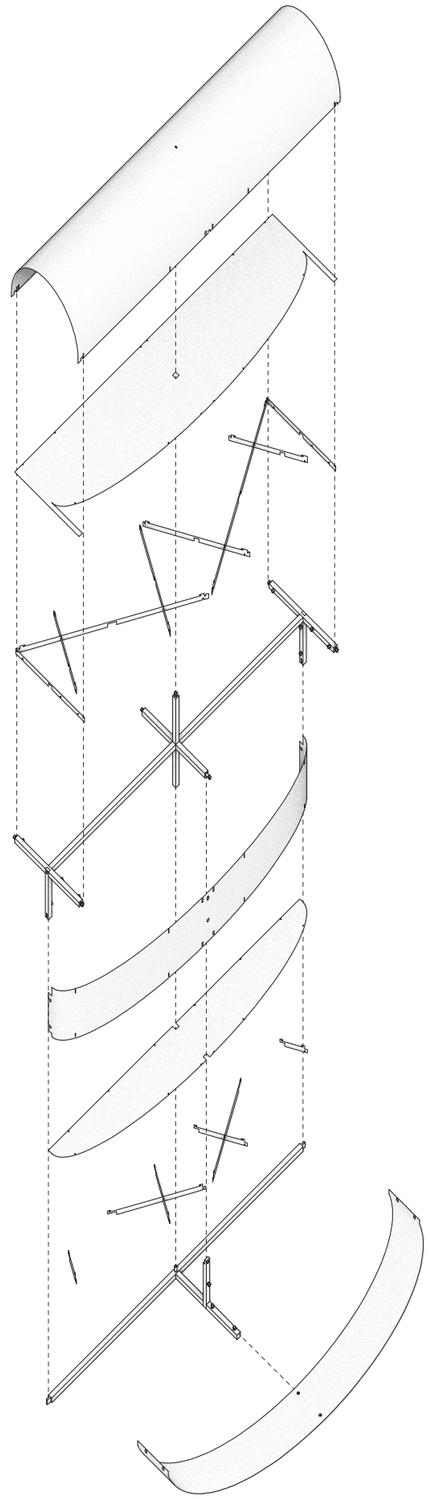






# Passage_1

The cross structure divide the passage to four quarters in section.
A passage with four entrances and outlets.
The four passages constrain each others and connect by the skeleton.
Four passages converge in one on the ends.
The role of skeleton changes from the dividion from the ends to connection in the middle.



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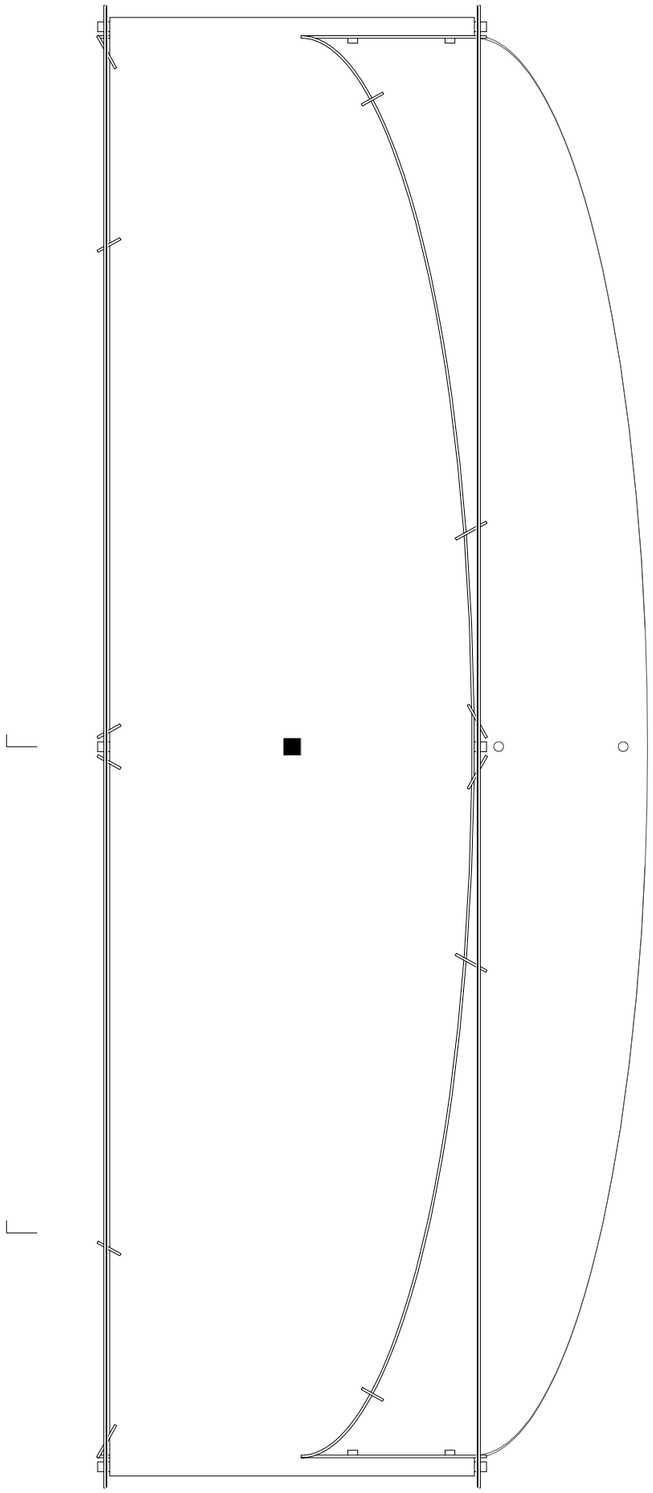

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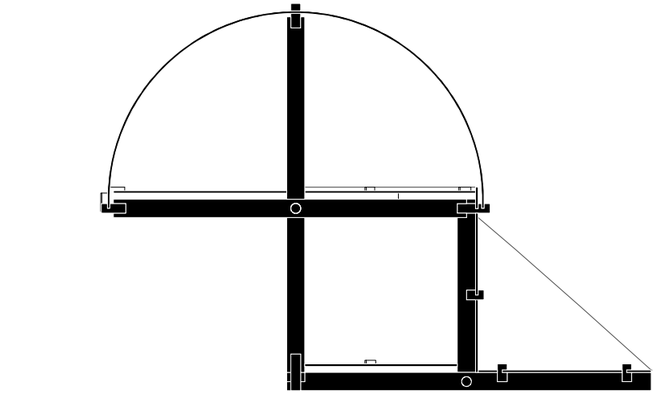

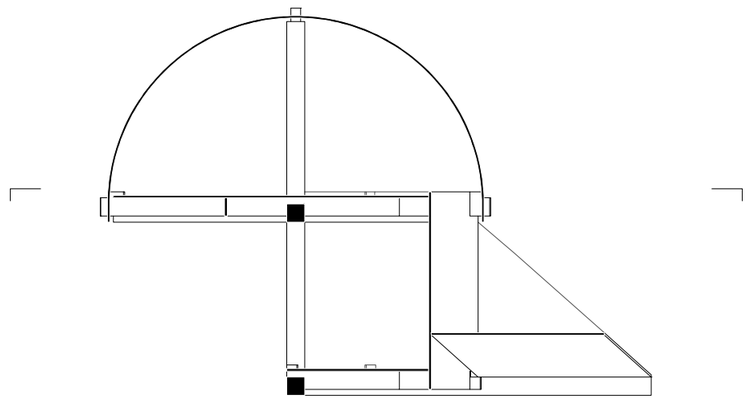

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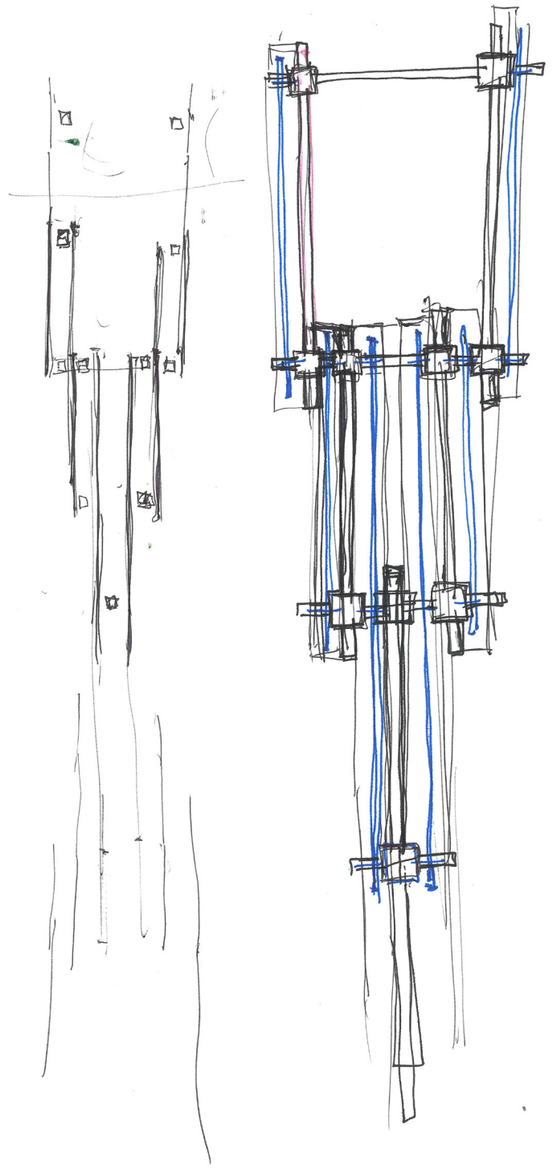
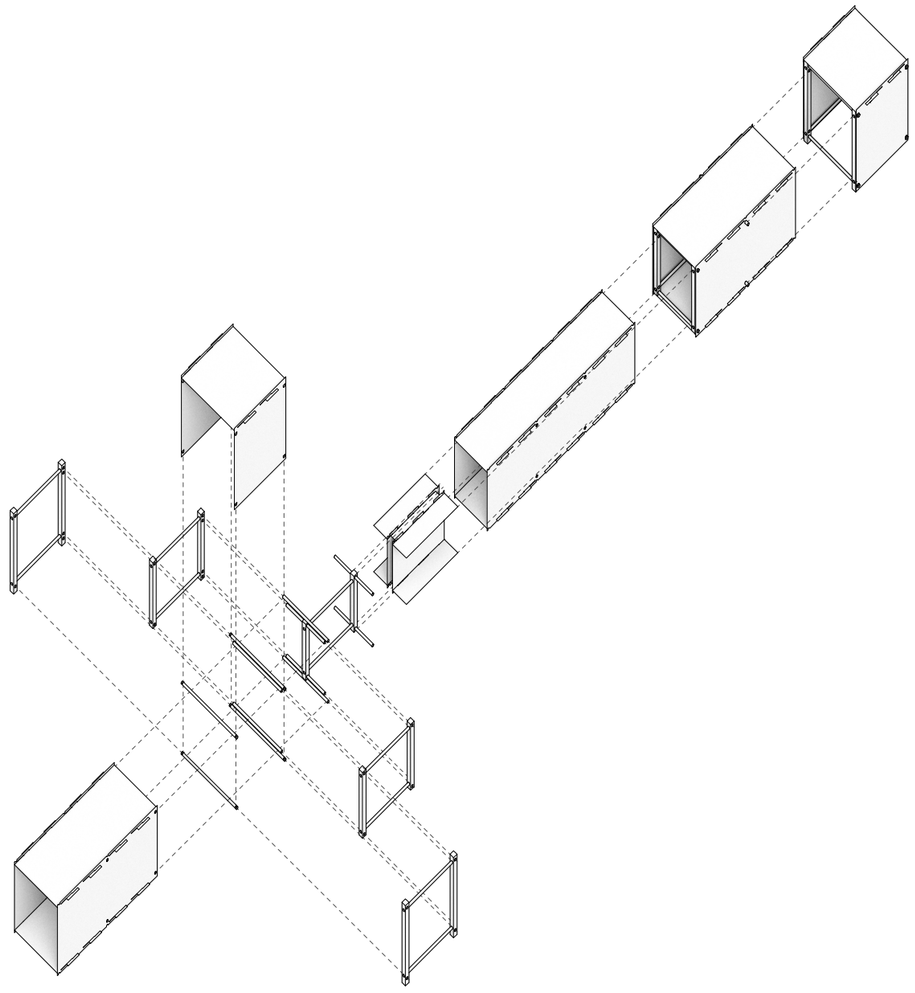


# Passage_2

A passage starts from one wall.
A wall is a minimal passage. The passage is a dilated wall.
When a passage is growing in a passage, the continue wall was broken and the light come in, a light passage appears between the two passages.
The shift of light follows the shift of walls, lighting the shift of the structure.



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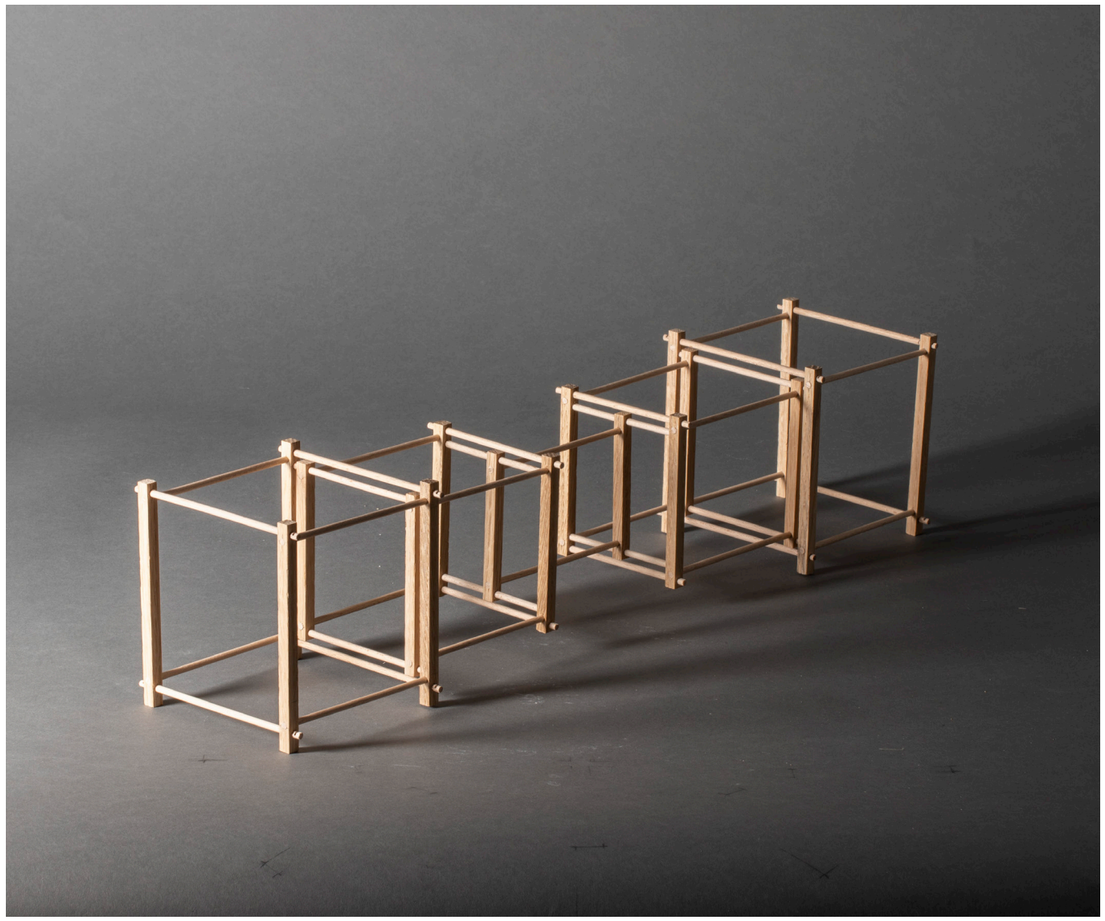



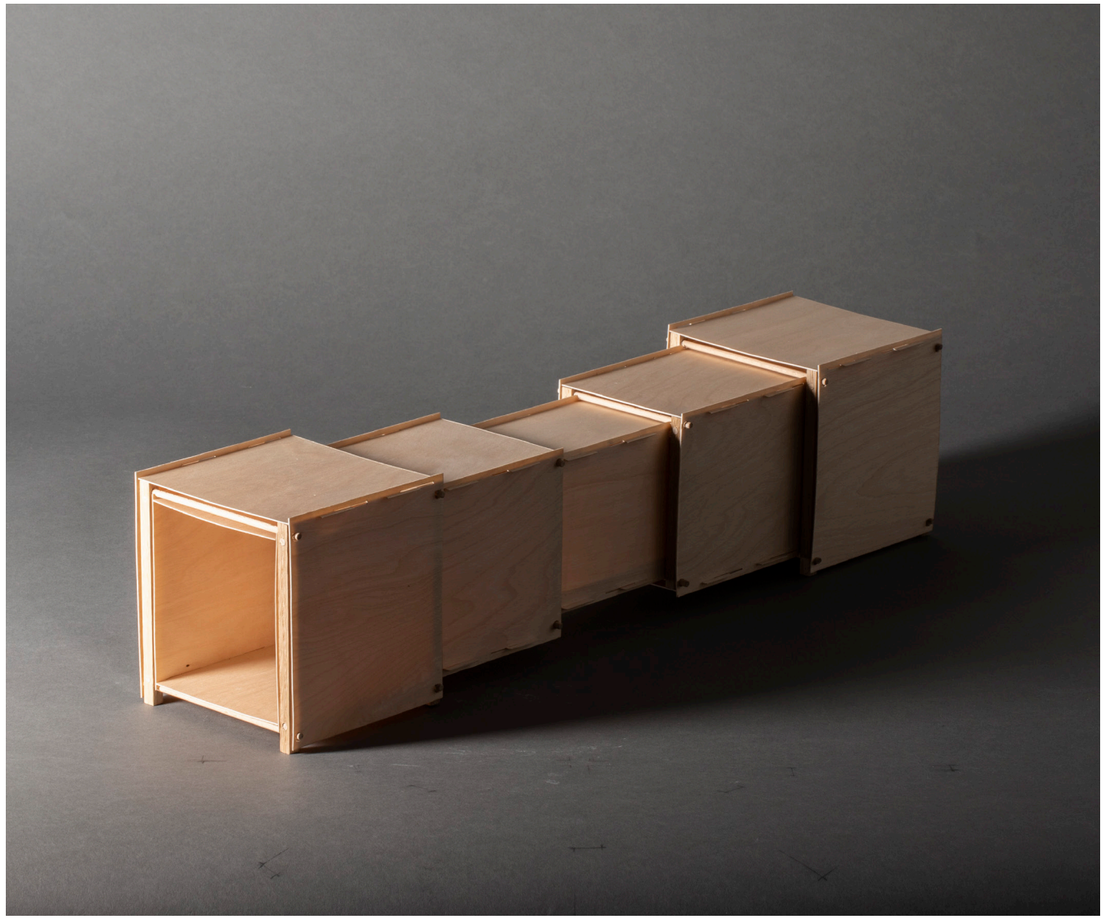

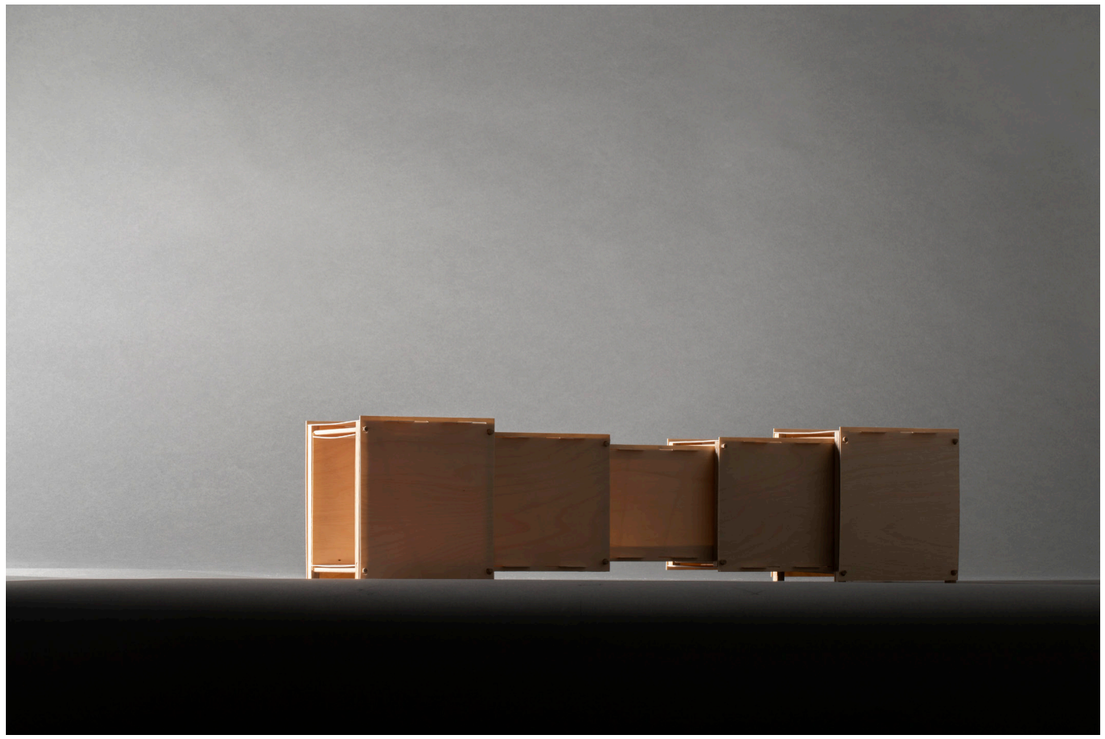

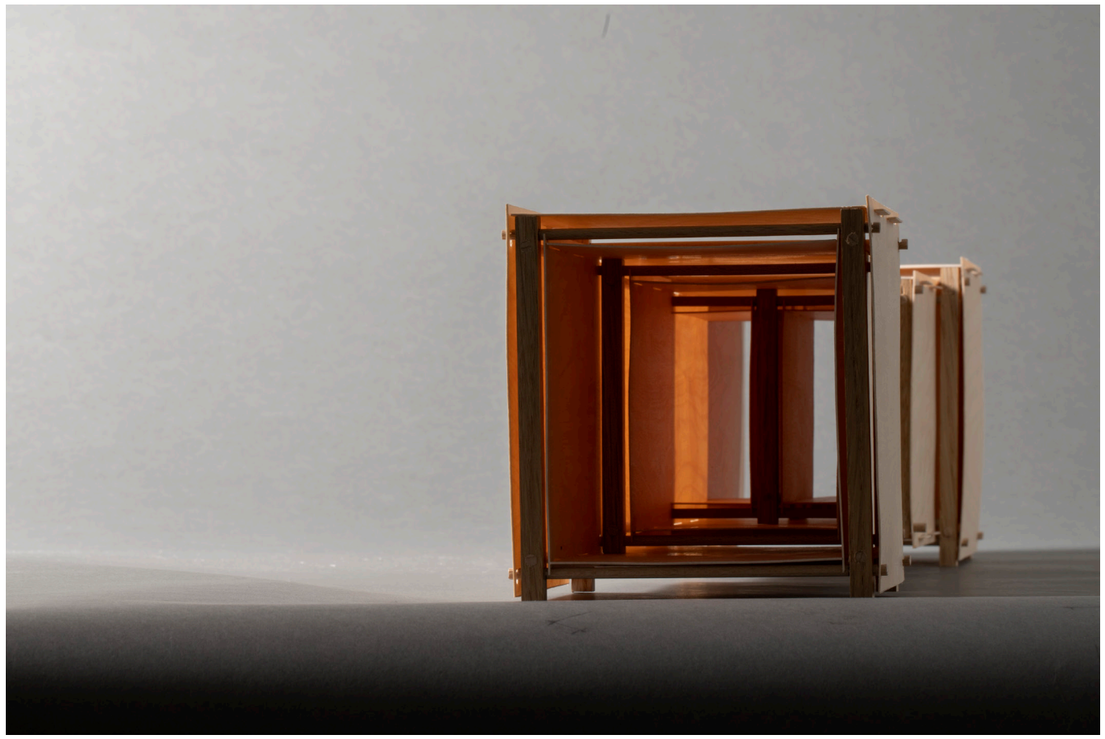

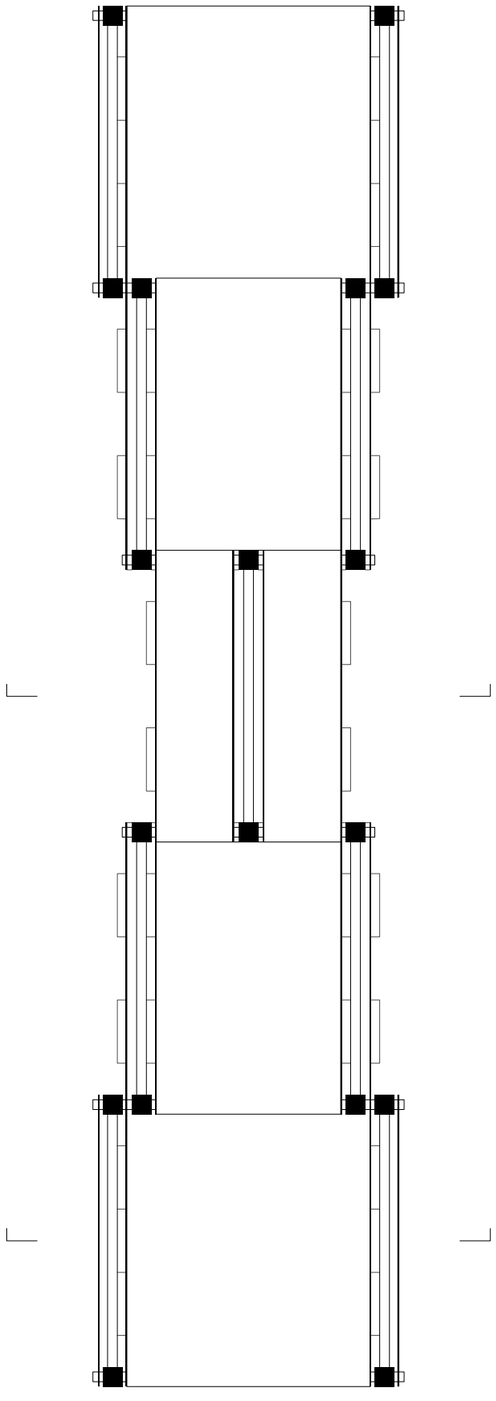

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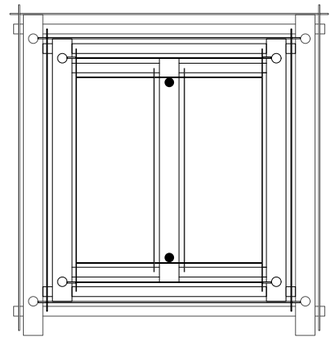

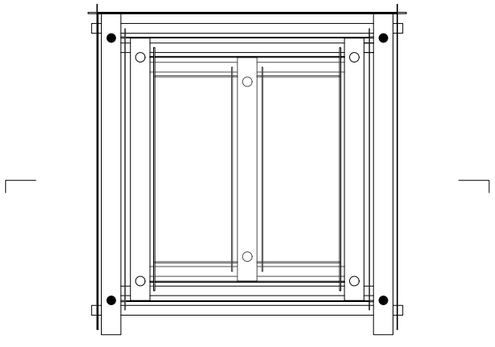

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