Interactive Architecture Studio

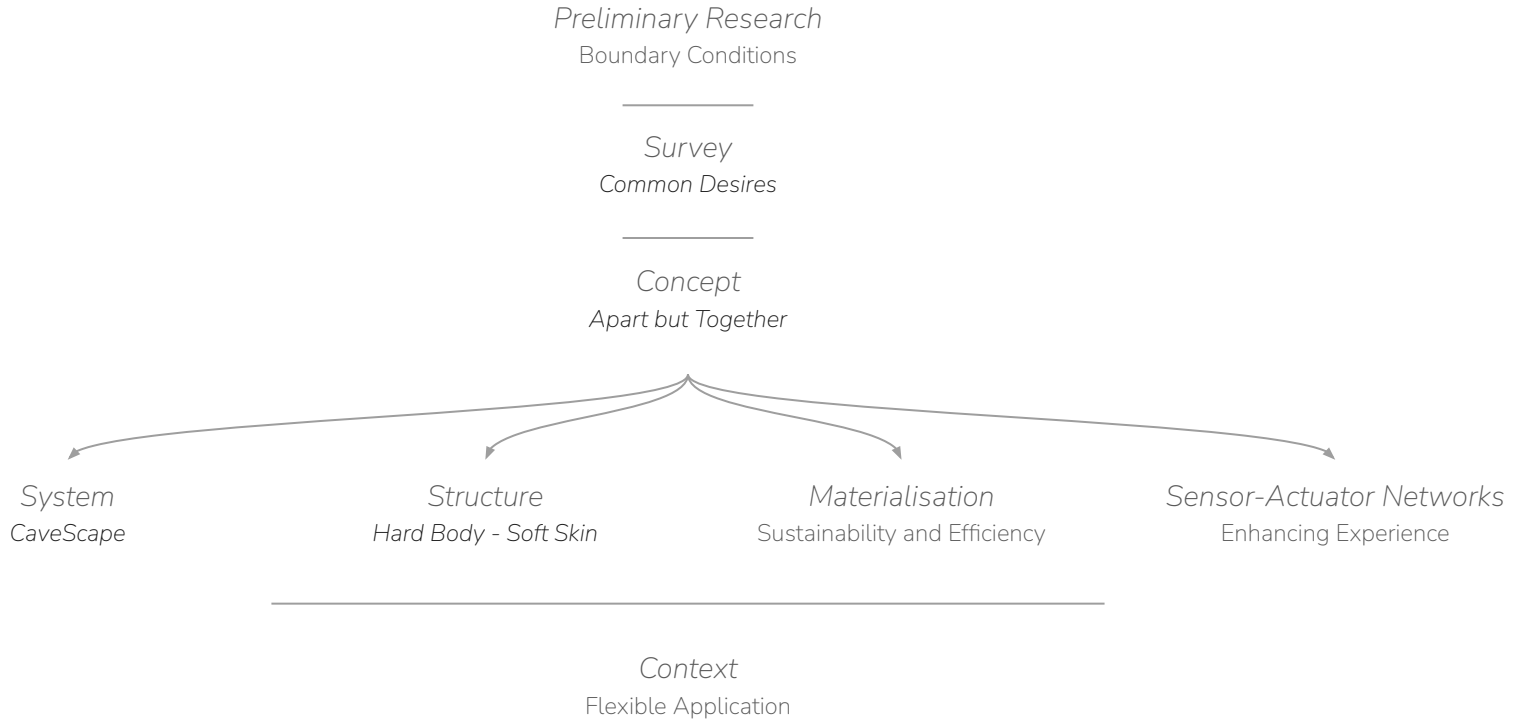
W4 Midterm

Group 1

Ani DOSHEVA *Emir EROLSUN* *Simon KNETTIG* *Gyeongri PARK*

Design Methodology

Introduction



Our Desires

Preliminary Research

- Comfortable seating
- Lay down - rest, sleep

- Quiet area to work in
  - Exhibition area
  - Mounting structures for pictures, statues, panels
  - Couch level of convenient seating
- Acoustics that is not disruptive
  - Cinema area
  - Knowledge about free seating in the library = real-time feedback on spaces occupation
    - Privacy rooms that can be quickly changed to public
    - Door, curtain, partitions
    - “Sport” activity area? - stretching yoga, just to relax from the brain pressure
    - Tables - writing area, area to put your laptop in
    - Charging spots anywhere I sit
    - Larger screen areas that I can borrow - expandable size
    - Heating/cooling possibilities around a person; heatable chair-furniture blanket
    - Whiteboard for sketching
    - Lighting structure - maybe even spotlight possibility
    - Avoiding disturbance of others
    - Air ventilation/air quality assurance
    - Drink holder
    - A clock to see time
- Subdivision of spaces for smaller groups
  - Setting up my space in advance = save my configurations and set them up via a mobile app
  - Booking my spot in the library
  - Fruit machine (something more healthy then a panini) = vending machine
  - Praying spaces
  - Meditation spaces
  - Entertainment Space - interactive walls
  - Interactive (3D) flooring - bringing the outside in; smart heating 3D carpet

- Quickest way to get to my desired location (entrance, toilet, quite area, free spot, ...) = spatial distance + navigation
  - How can we inform the users with our design intention/constraints?
  - : various degrees of silence(silent/quiet/talk/etc.) > noise
  - : various degrees of close/openness (privacy/public) > color?
  - > Meeting room (always occupied). The furniture can provide a temporary private meeting space?
  - : different activity
  - : transition from active to inactive/ public to private/ open to close
  - security/safety: when going out for lunch for an hour leaving laptops and books
  - One person scale vs. multiple people scale in movement
  - : what is the maximum(or minimum) area required for a person to be active in the library? Sitting, chilling, eating, walking, resting, gaming,
  - : what is different for a group of people (2-4)? Talking, group meeting,
  - What kind of programs/elements are possible to be integrated in the library to transform the traditional library to a multi-functional library?
  - : meeting point
  - : social events
  - : just for a cup of coffee?
  - : public events
  - : more active movement: drawing, dancing, running, ...
  - Way to integrate existing programs such as VR lab and exhibition.
  - Inactive > active
- How to inform people that it is free to use and adjust in whatever way they want? It is touchable. It is not an exhibition but a piece of furniture!
  - > draw people’s attention/how to make it attractive?
  - How many seats can/will be removed/ increased by installing the furniture?
  - Environmental problems
  - : too much direct light/ too little light > lamp
  - : leaking problem especially during the winter

Boundary Conditions

Preliminary Research

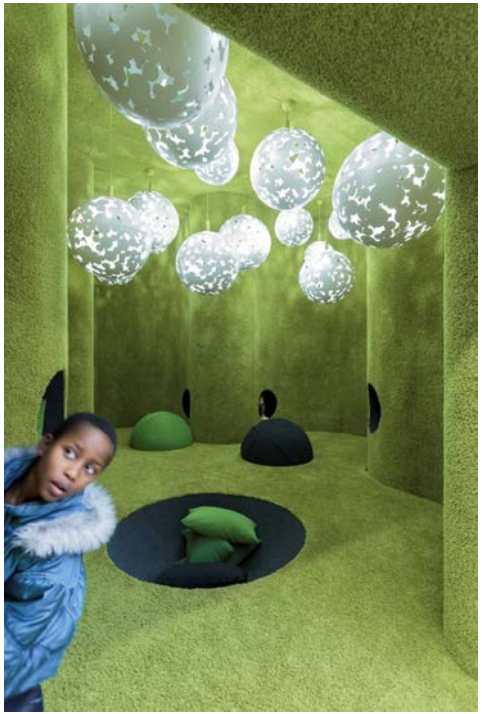
Maximum Size of the Module	*Width: 1m | Length: 1m | Height: 0,6m*
Weight	*Body limit: 13-16kg | Body comfort: 6-10kg*
Floor Area	  -
Space Requirements for Different Functions	-
Electricity	*Charging without limitations*
Load-Bearing Requirements	*Without self-support: 110kgi | With self support: -*
Data Privacy	*Interactivity without a violation of human rights*
Cultural Preferences	*Design for the multinational university*
Maintenance	*Hygienic, durable, cleanable*
Ergonomics	*Height level definition, and supporting curvature*

Reactions to References

Survey

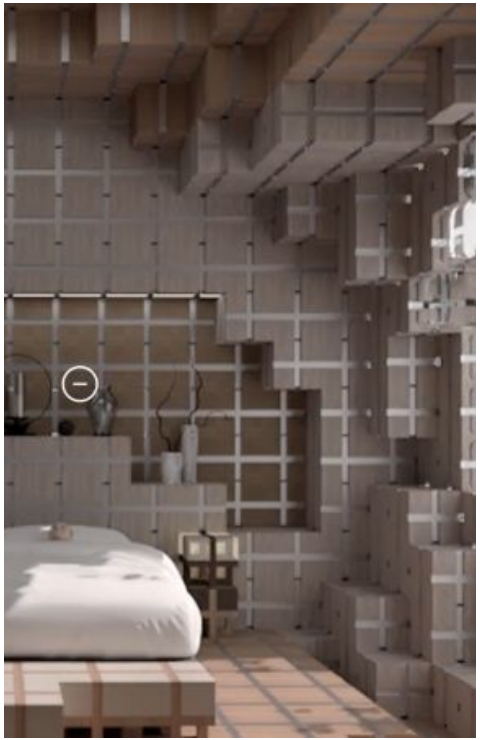
Reactions to References

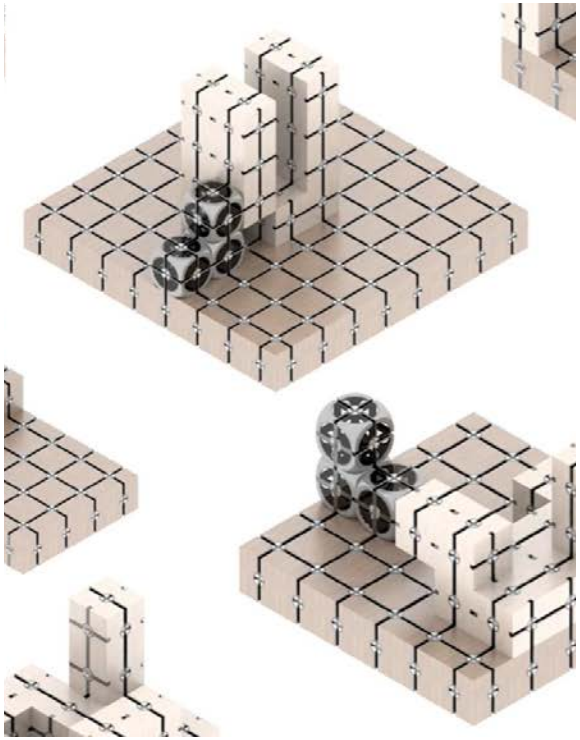
Survey



Reactions to References

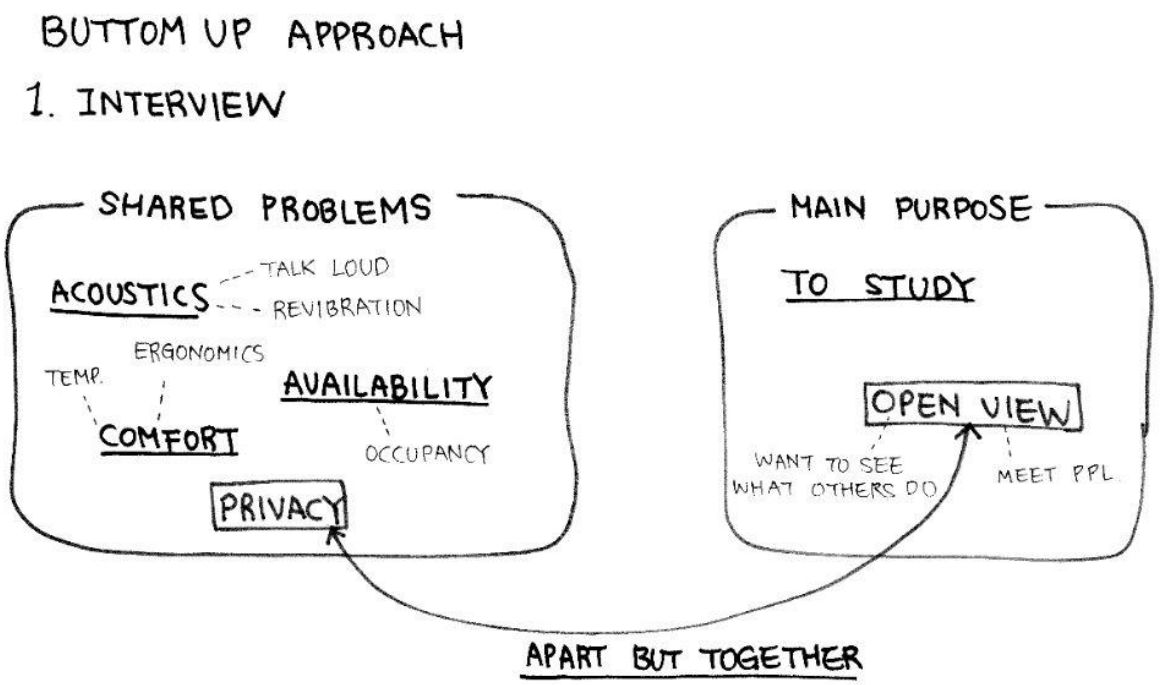
Survey





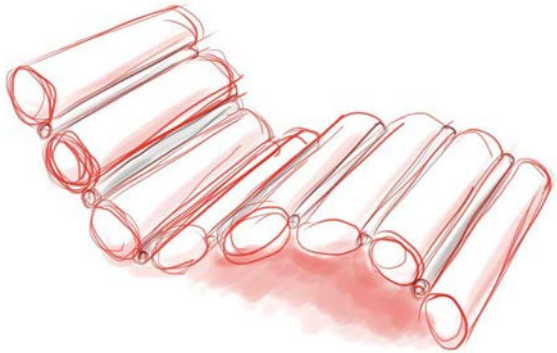
Common Desires

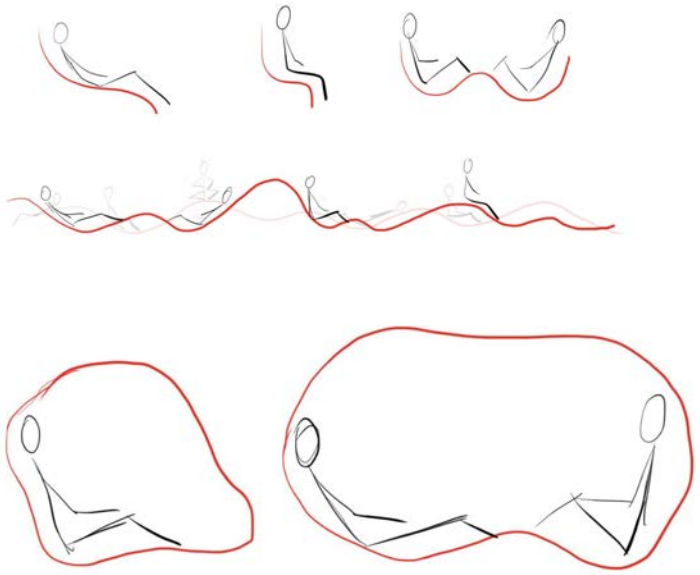
Survey



Pros and Cons

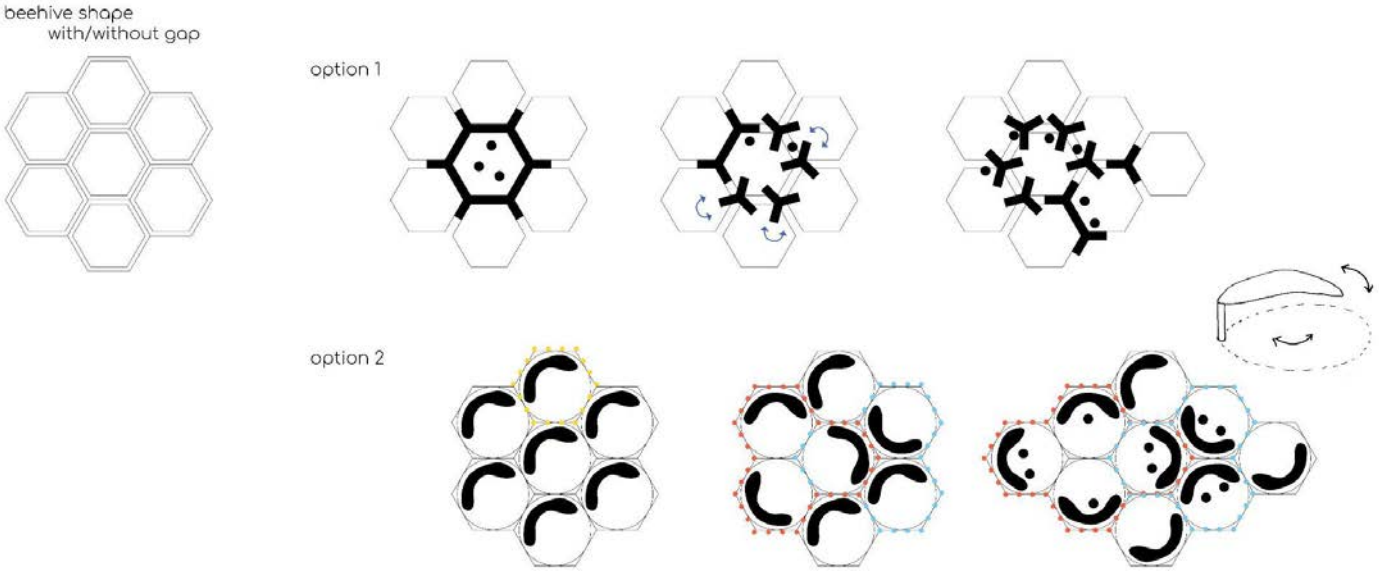
Previous Concepts





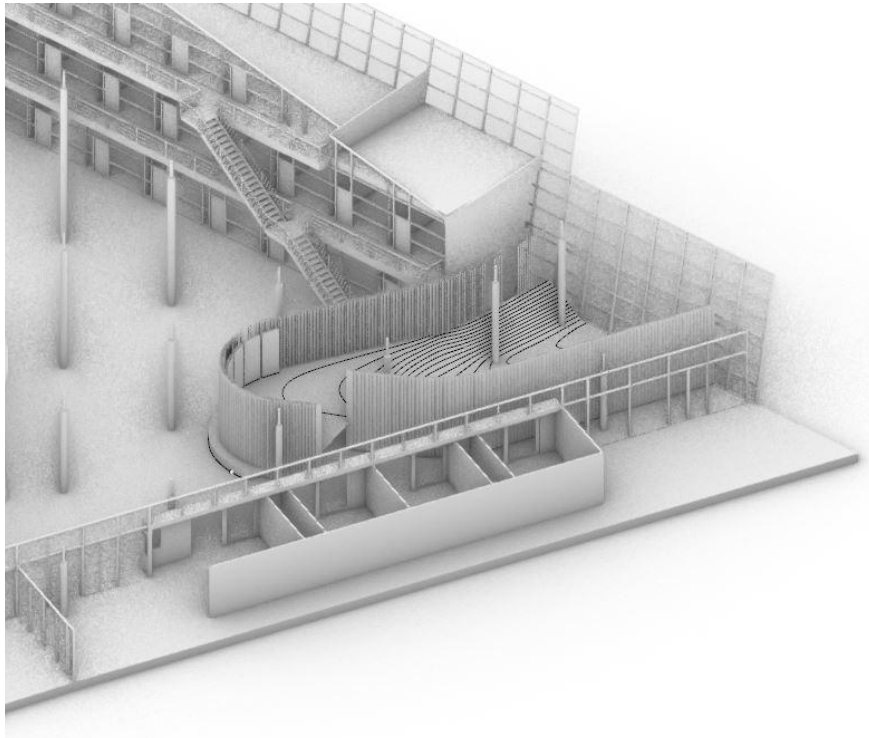
Pros and Cons

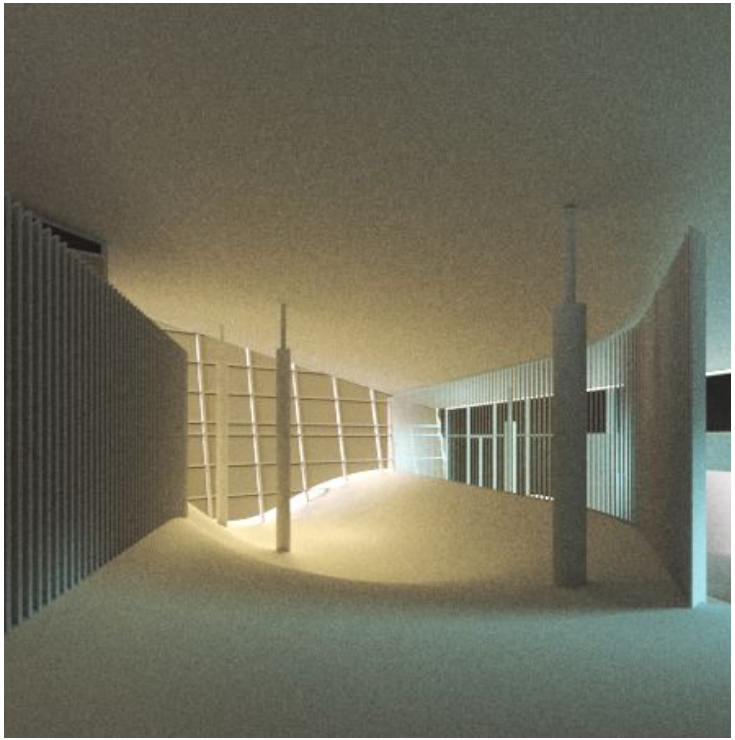
Previous Concepts



Pros and Cons

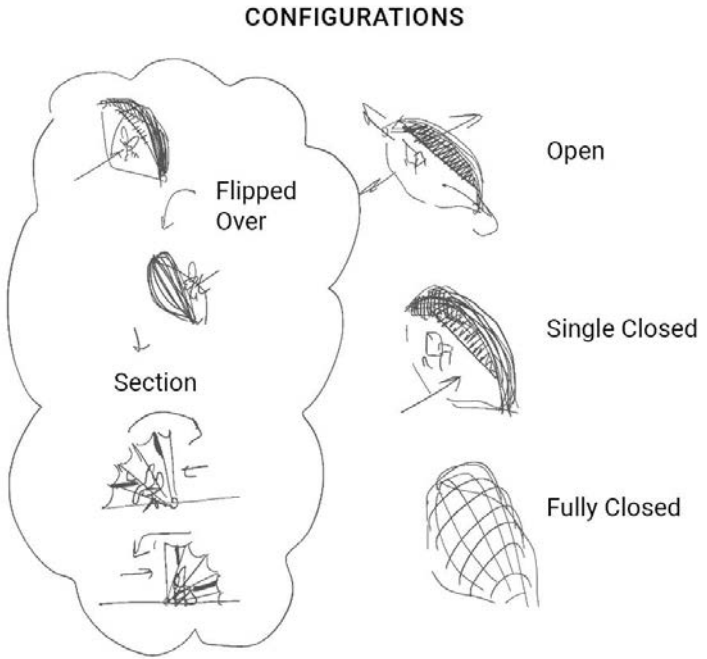
Previous Concepts





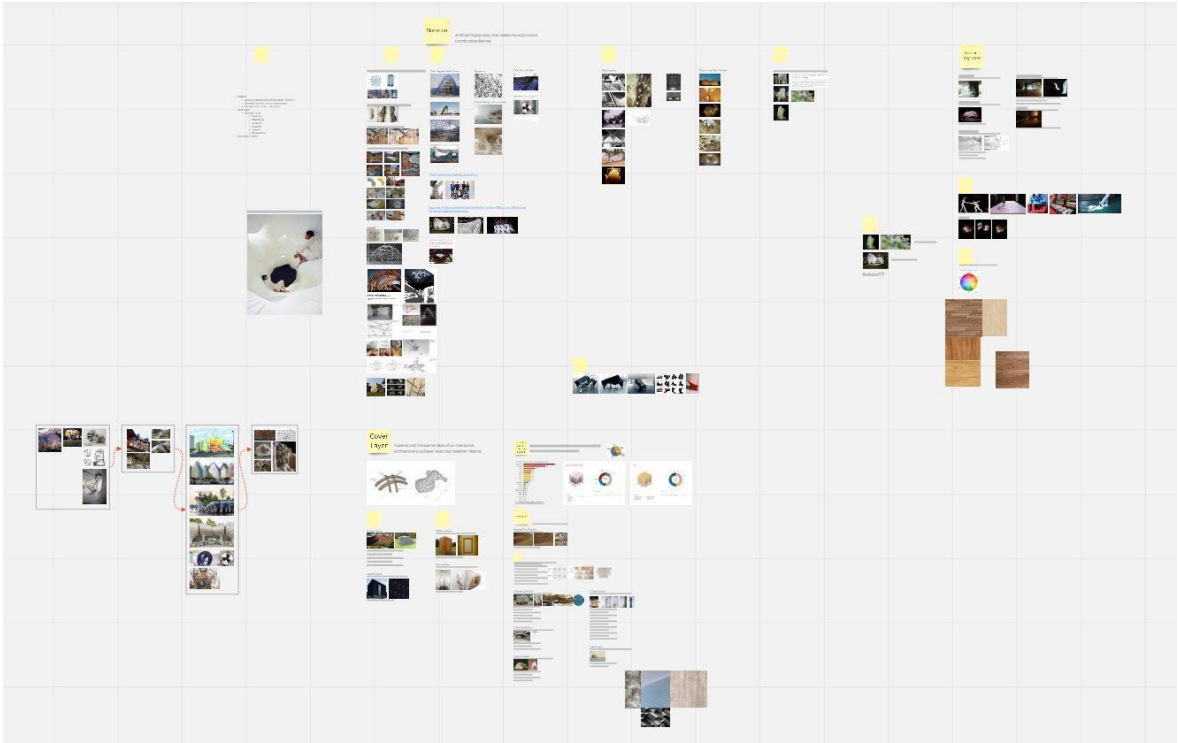
Pros and Cons

Previous Concepts



Research on Unification of Concepts

Previous Concepts

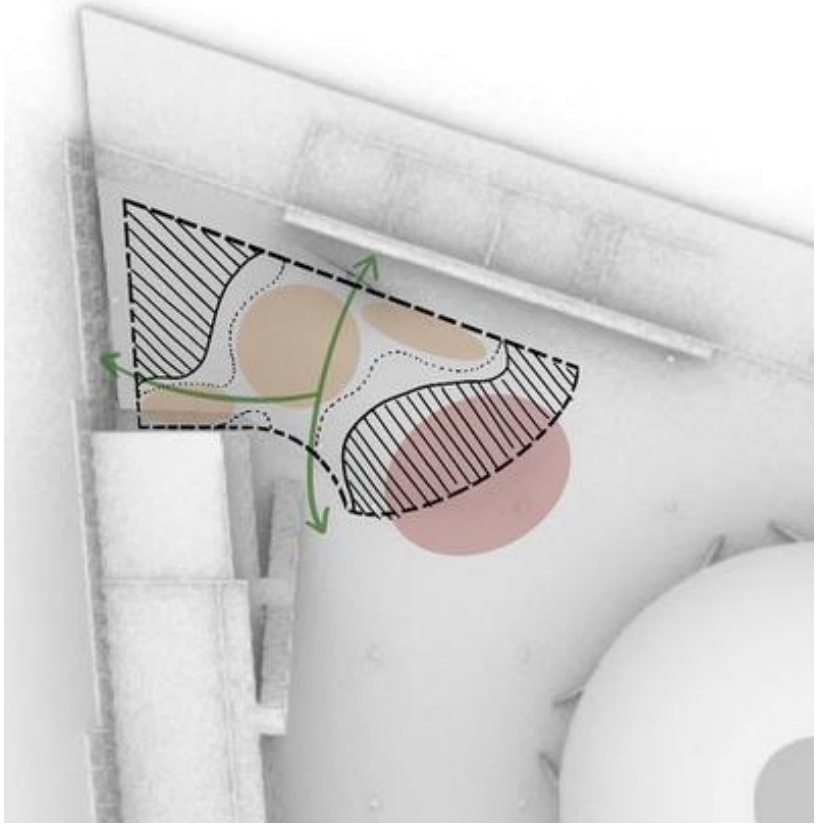


1. Concept

Apart But Together

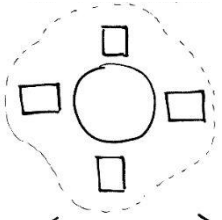
1. Concept

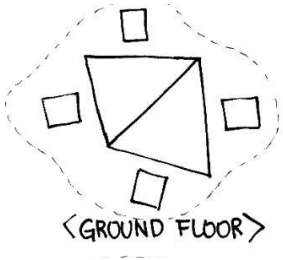
"Apart but Together" is a space organisation concept that encourages the user to make their own decisions in how they occupy the mixed use space. The new landscape, offering room for both rest and study, allows the user to find comfort as well as an environmental diversity.

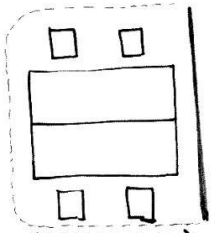


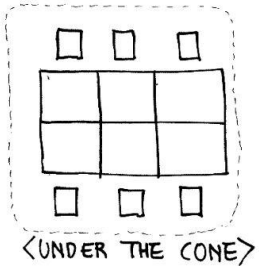
Intimacy in an Open Space

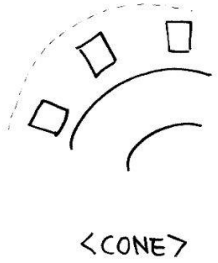
1. Concept

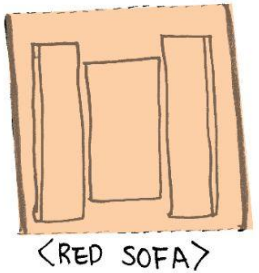






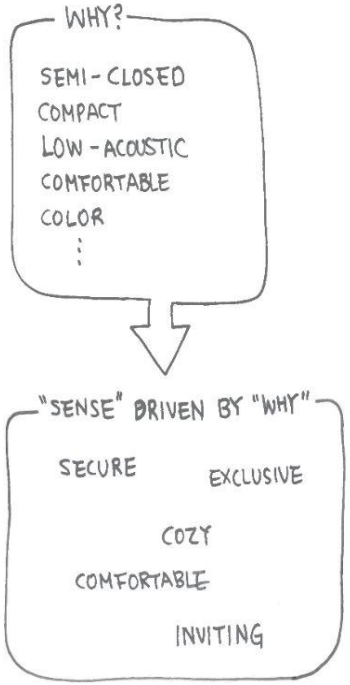






Intimacy in an Open Space

1. Concept

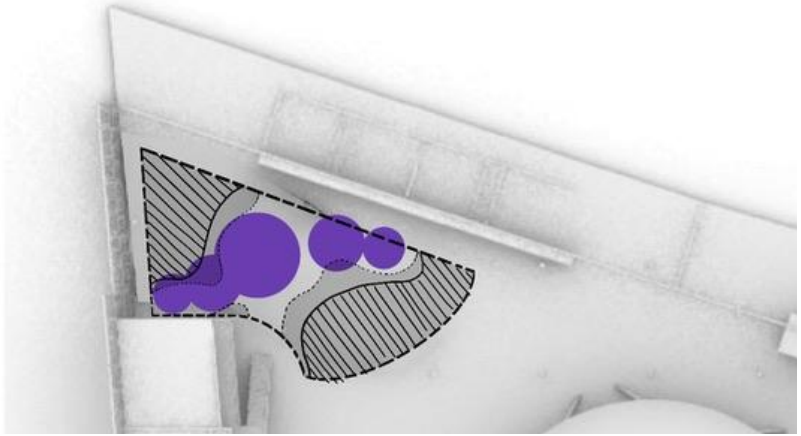


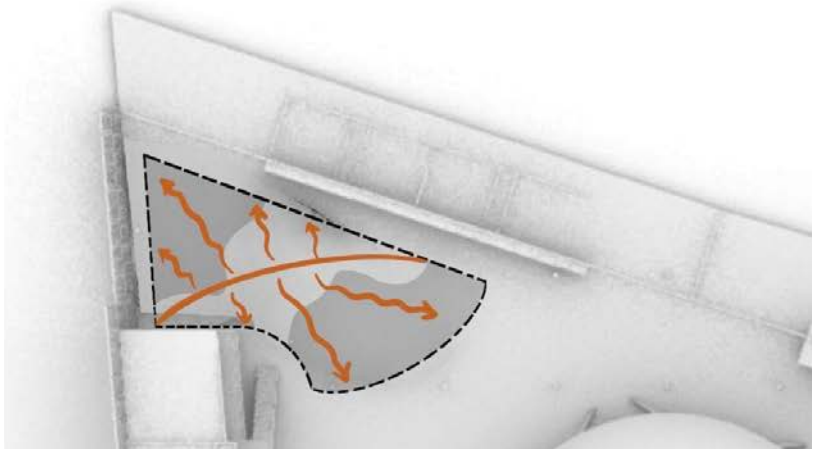
2. System

CaveScape

2. System

The “CaveScape” will provide a new typology to the TU Library Main Hall. Entering a room of fluid ceiling formations, undefined levels and comfort seating, the user is able to escape the continuity of the Main Hall. Such diversity in the environment can stimulate student’s focus and boost their productivity when they return from their break or when they decide to study in the cave.





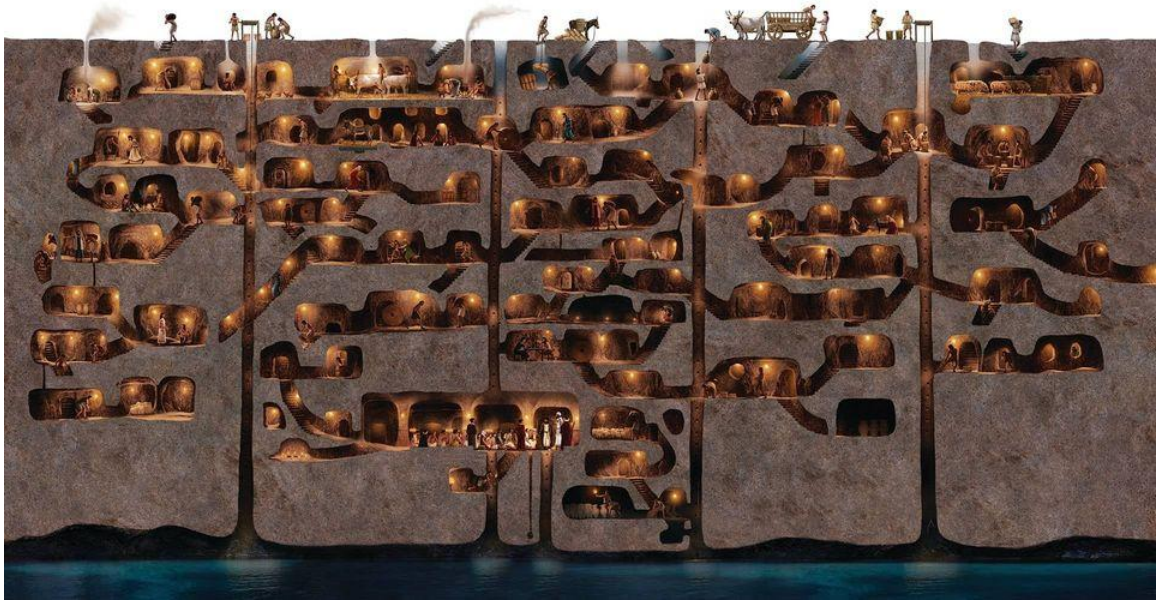
References

2. System

Baitogogo, Henrique Oliveira

References

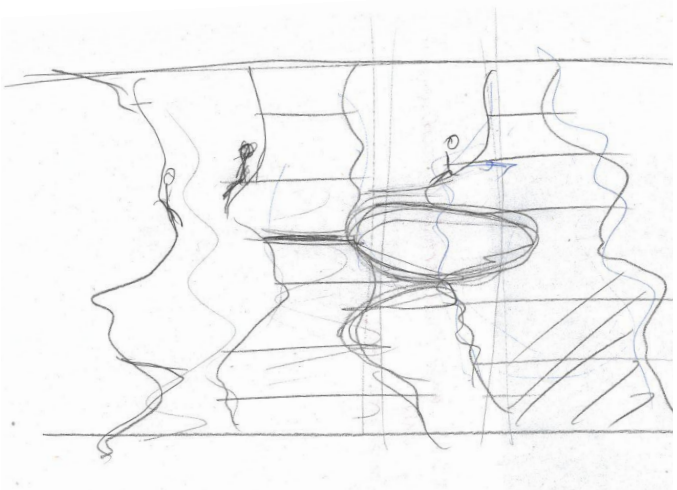
2. System



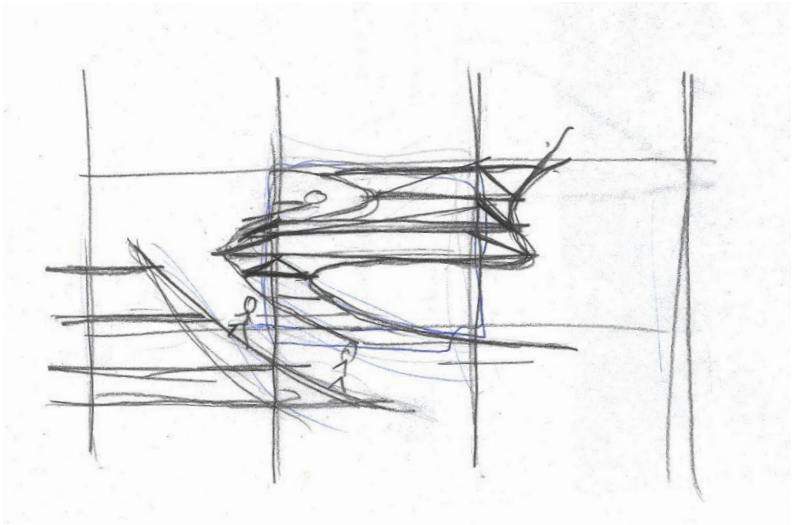
Cappadocia - Turkey’s Secret Underground CIty

Sub-System Components

2. System



The main system's goal is an adjustable enclosement that provides the user with enough and different levels of coziness.



To achieve this, the design allows a great control of the form leading to an overall body comfort.

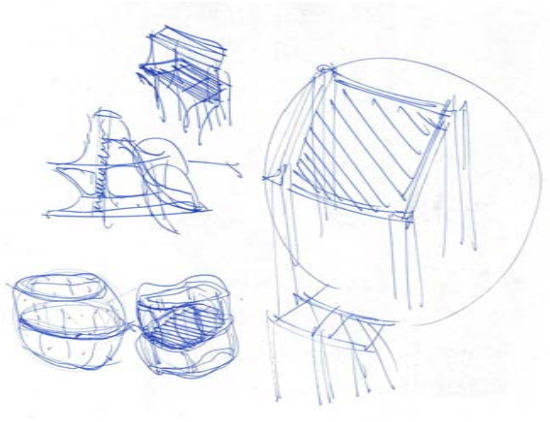
References

2. System

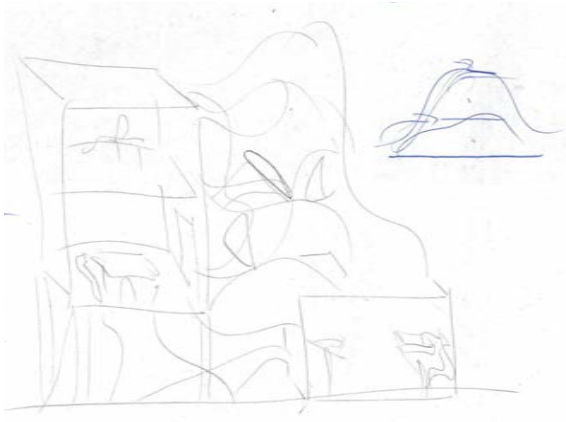
The Little Island Park, Heatherwick

Sub-System Components

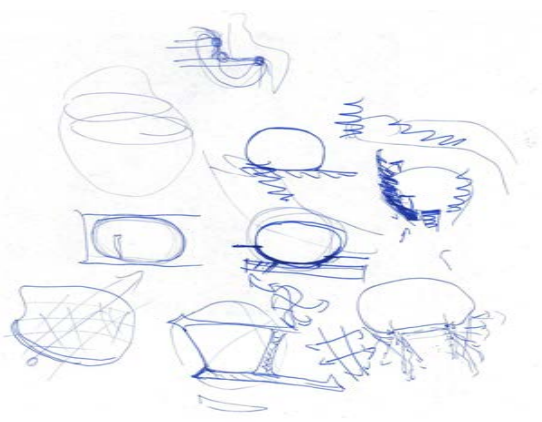
2. System



Seating at several levels



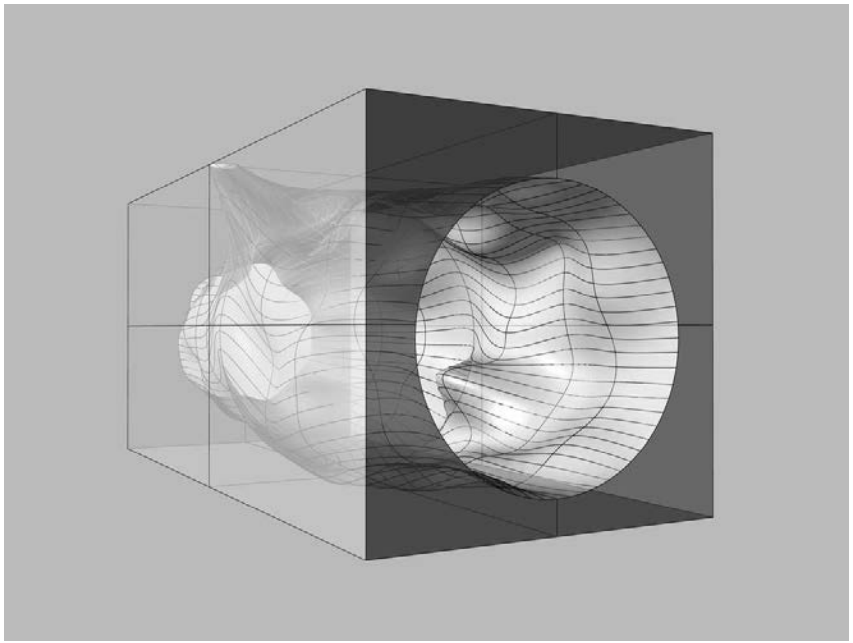
3D grid supporting fluid seating



Growing cocoons

Sub-System Reference

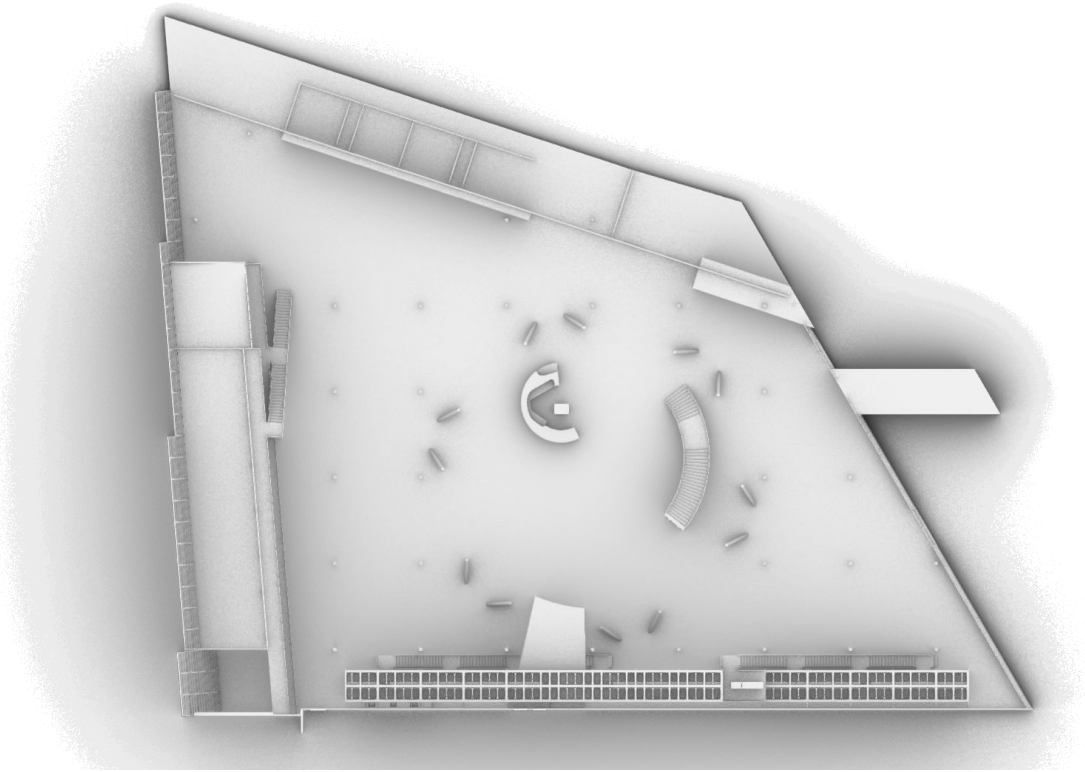
2. System



Artificial Topography, Ryumei Fujiki

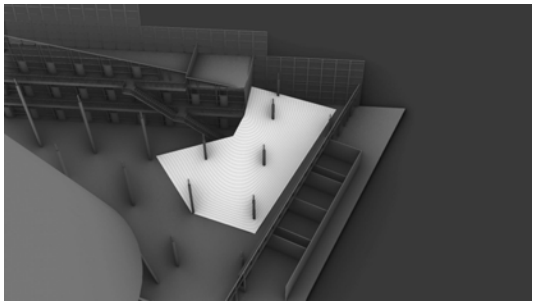
The Main Hall - Multiple Contexts, One System

2. System

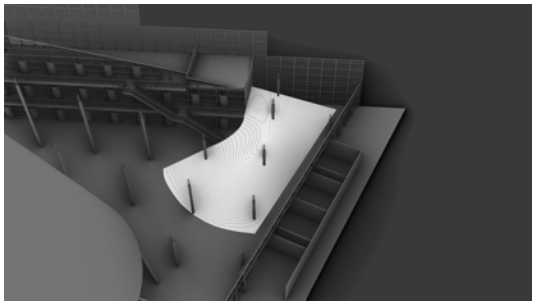


Sub-System Components

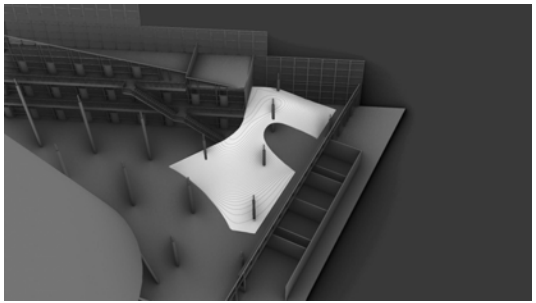
2. System



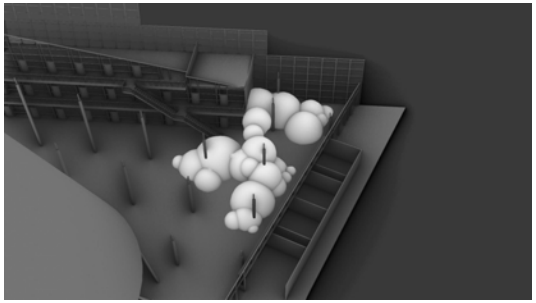
Single canopy



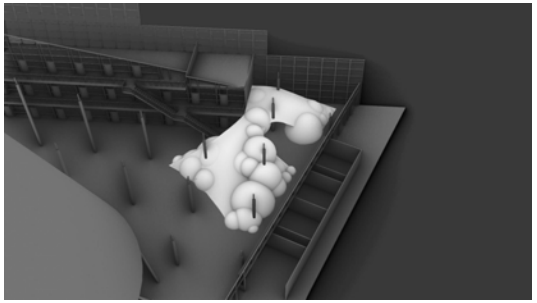
Single canopy, optimised for maximum interior use and head room



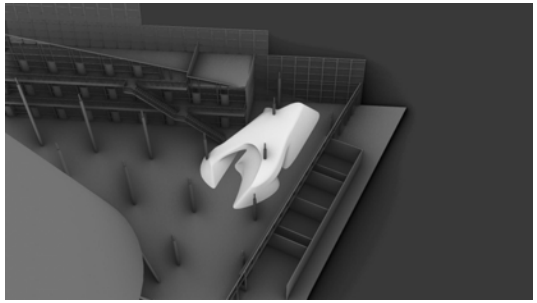
Single canopy appropriated for circulation



Modular landscape



Modular landscape intersected with a single canopy



The landscape in context.

Sub-System Reference

2. System

Google Mountain View HQ, California, United States

Sub-System Components

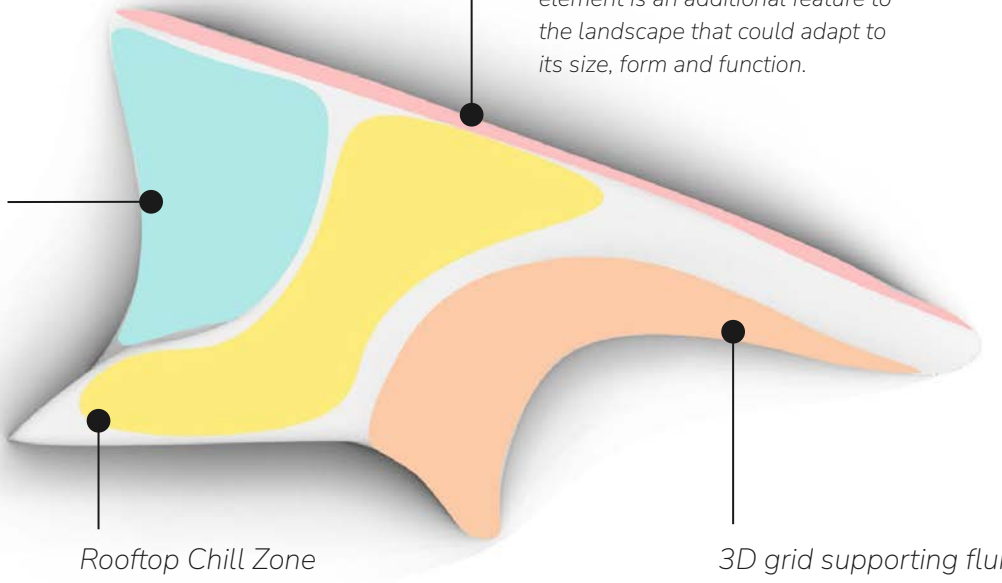
2. System

Growing cocoons

The west facing facade becomes an inhabitable structure. This element is an additional feature to the landscape that could adapt to its size, form and function.

Seating at several levels

Amphitheatrical landscape flow, allowing the user to have a break while enjoying the view out of the window.



Rooftop Chill Zone

The highest area of the landscape is as expanded as possible, This allows maximum chill zone span at higher level as well as optimal interior space.

3D grid supporting fluid seating

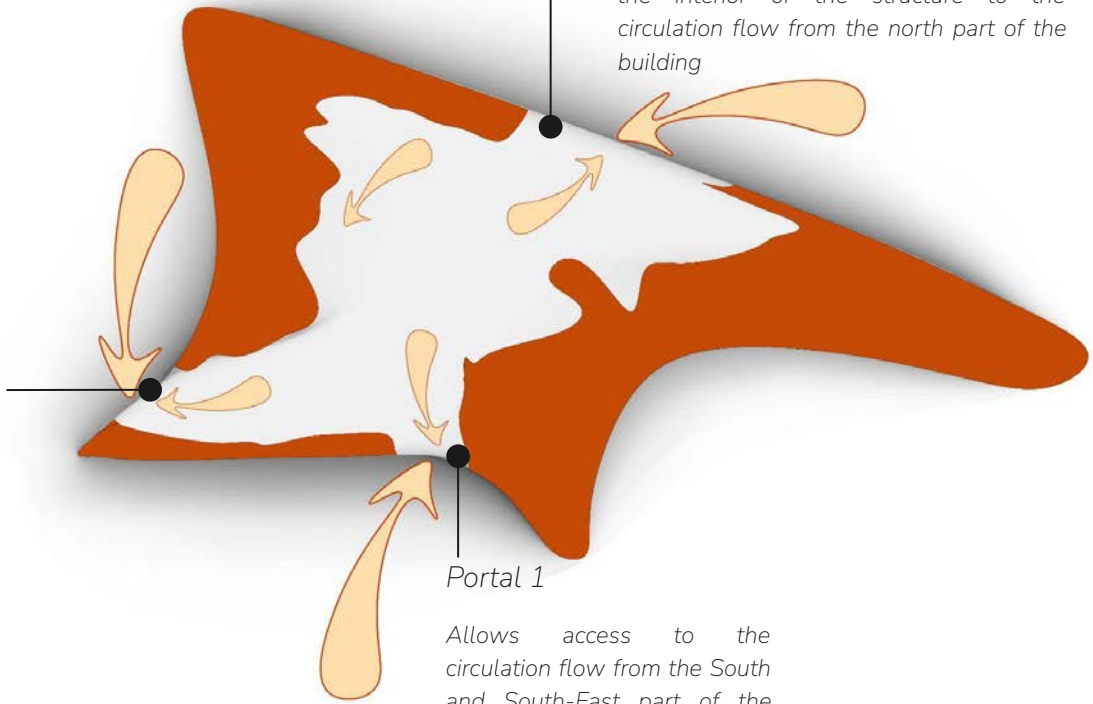
Amphitheatrical landscape flow, allowing the user to have a coffee break, attend a lecture or have a chat with a friend.

Circulation Scheme

2. System

Portal 2

The newly created corridor on the west side of the landscape allows for easier access to both the surrounding rooms and the interior of the structure to the circulation flow from the north part of the building



Portal 3

Allows direct connection with the glass wall and the amphitheatrical landscape area facing South.

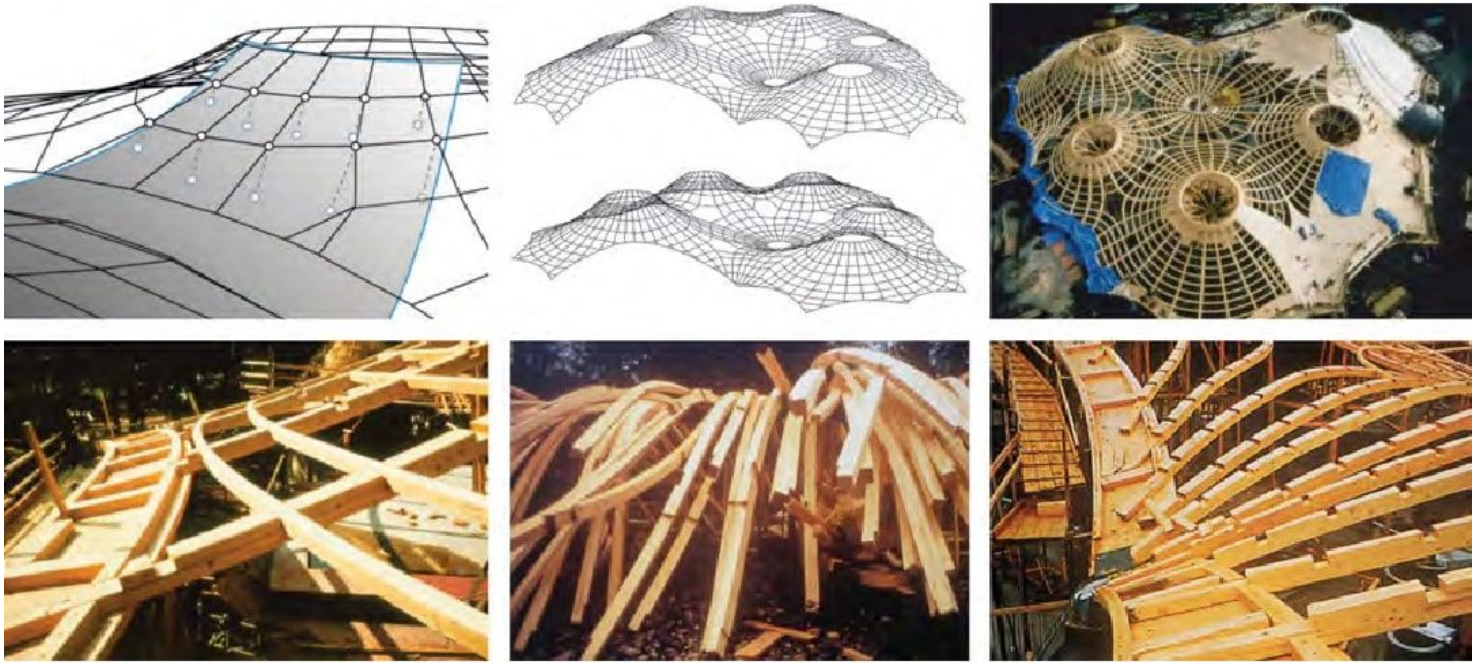
Portal 1

Allows access to the circulation flow from the South and South-East part of the building.

3. Structure

References - Shelter Design

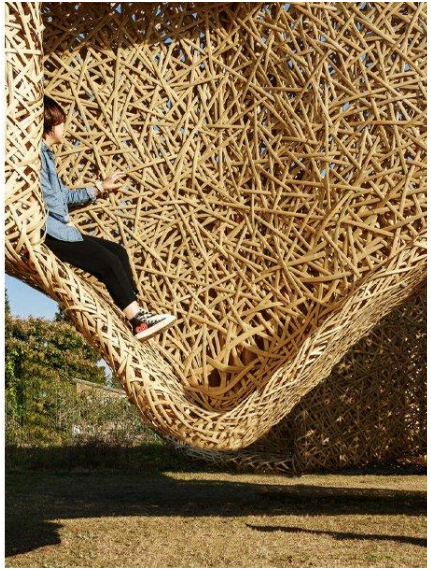
3. Structure



References - Growing Design

3. Structure

First Light Pavilion, Hassell Studion



Bamboo Pavilion, LIN Architecture

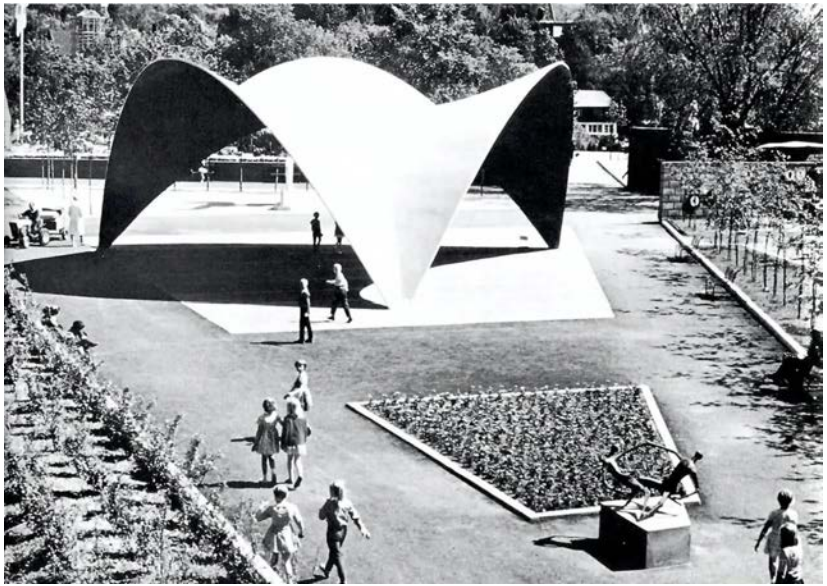
References - Structural Systems

3. Structure

Heydar Aliyev Center - ZHA

References - Structural Systems

3. Structure



Felix Candela - Concrete Shells

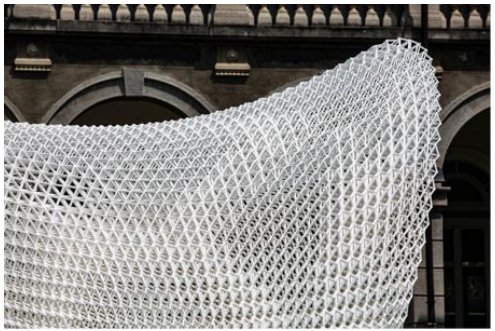
References - Structural Systems

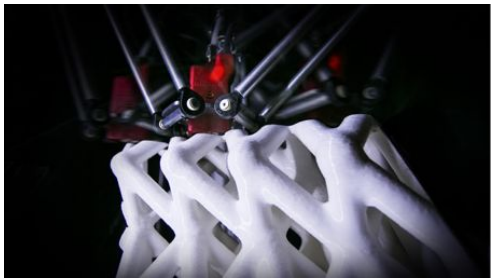
3. Structure

Gallery of flexible landscape, GOA Architects

References - 3D Print

3. Structure





Trabeculae Pavilion, Wasproject

References - 3D Print

3. Structure

Tecla House

References - Structural Systems

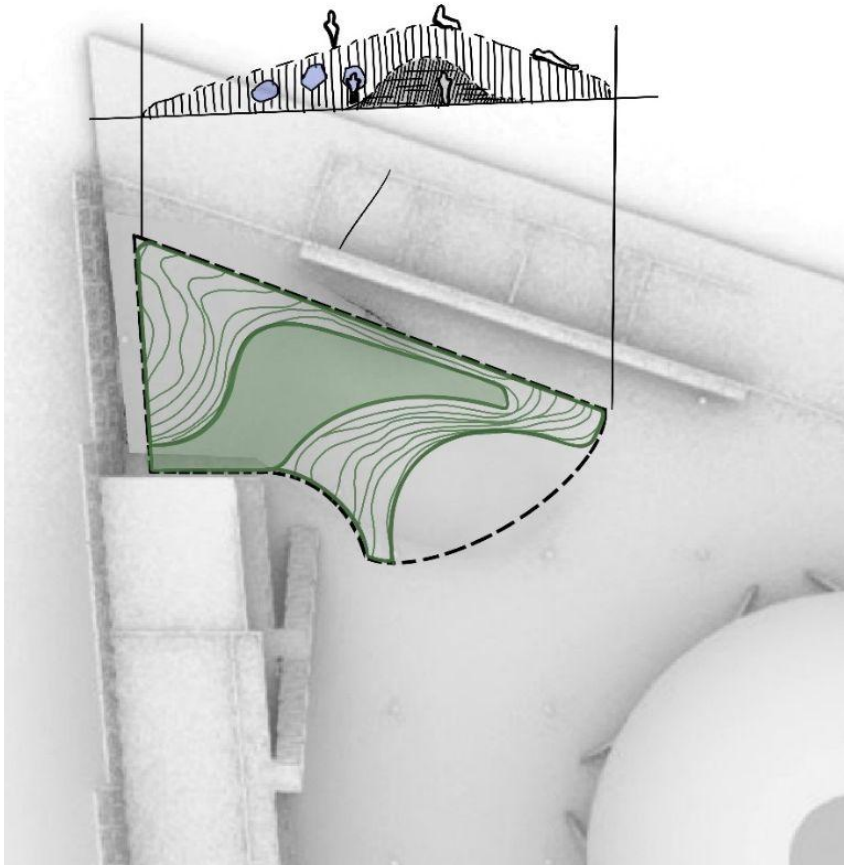
3. Structure

National Museum of Qatar Shop Interiors

Hard Body - Soft Skin

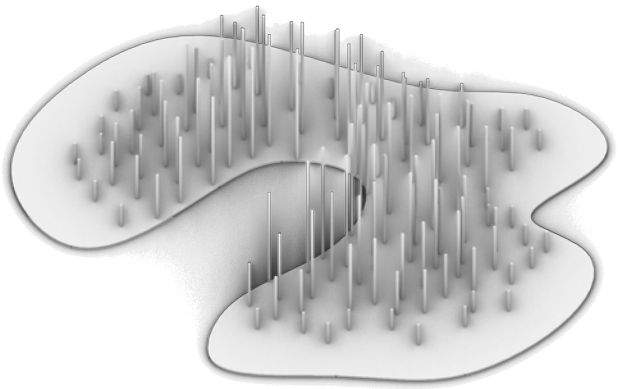
3. Structure

The structure to achieve the proposed spatial design qualities will be column-plate system. This will allow quick modification and readaptation of the design. A grid arrangement could be avoided so that it does not imply any form restrictions. Moreover, the density of the planes could be controlled and can vary depending on the function of the landscape zones. Thanks to that, the form can be controlled to a high-detail achieving ergonomical qualities desired by the users.

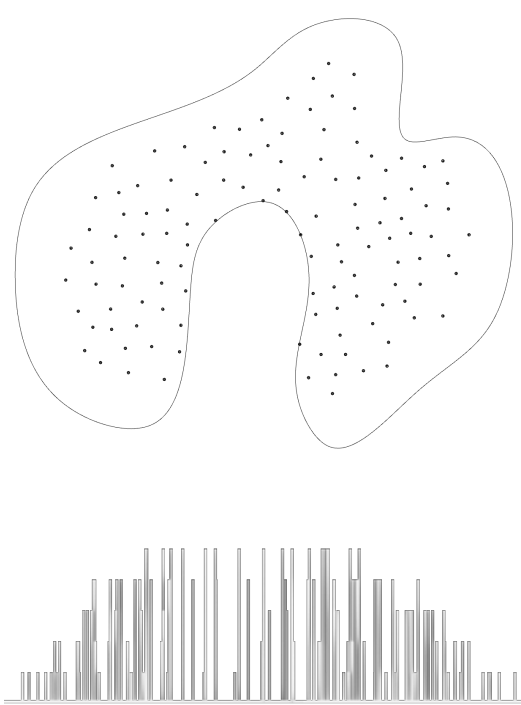


Column-Plate System - Columns

3. Structure

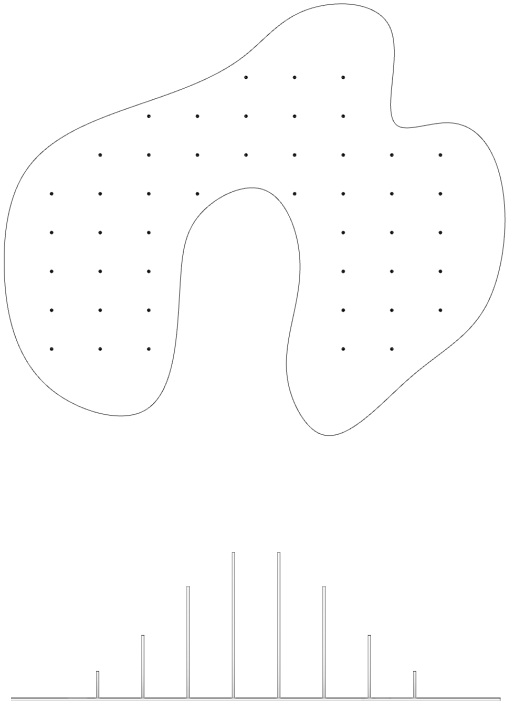


Structural optimization and material reduction allowed by the random column organisation



Optimized Column Organisation

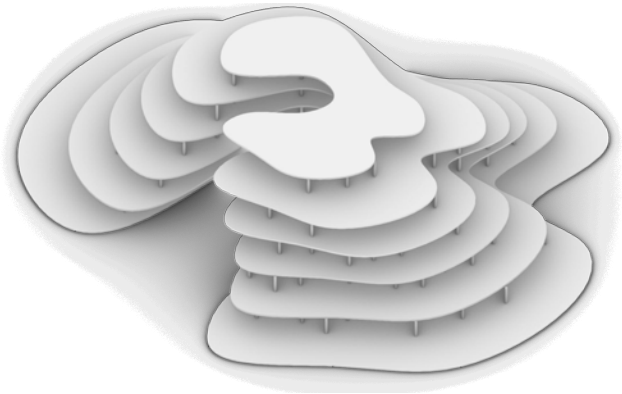
VS



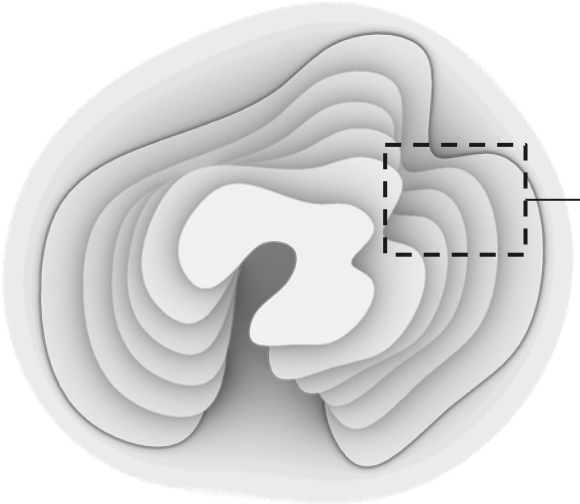
Rigid Grid Organisation

Column-Plate System - Planes

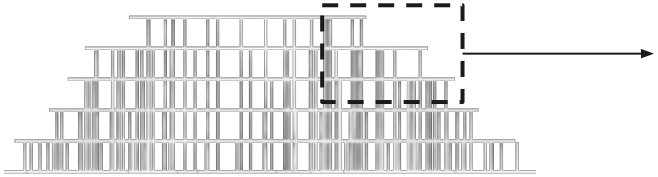
3. Structure



Adaptive spatial qualities allowed by the organic topographical planes



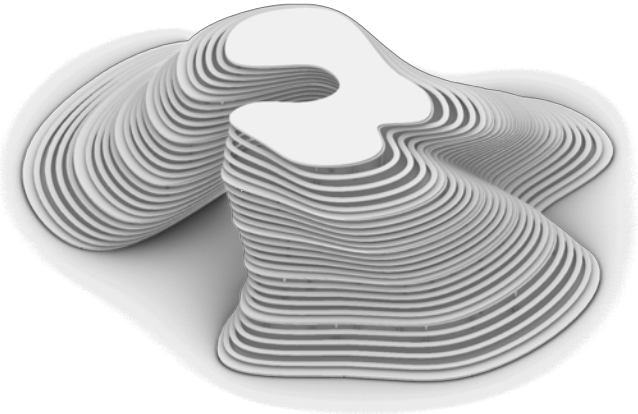
Inhabitable pockets embedded within the landscape of various size and incline.



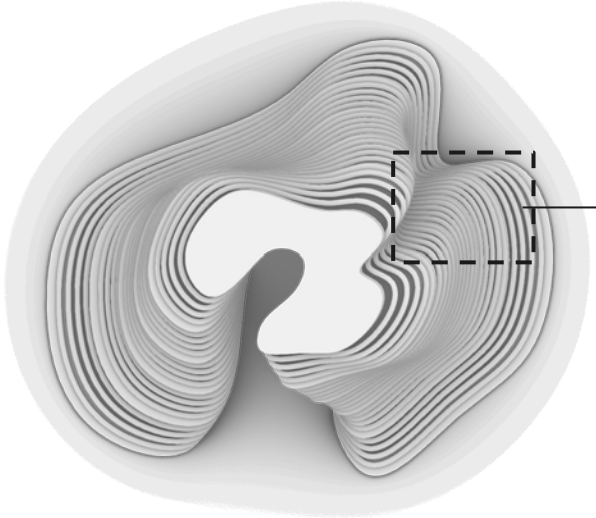
Main topographical planes defining the overall shape

Column-Plate System - Semi-Planes

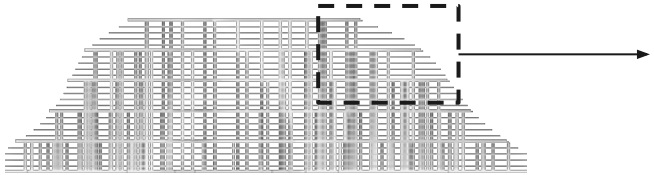
3. Structure



Adaptive Spatial qualities allowed by the random column organisation



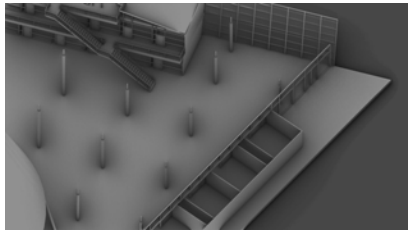
Inhabitable pockets embedded within the landscape of various size and incline.



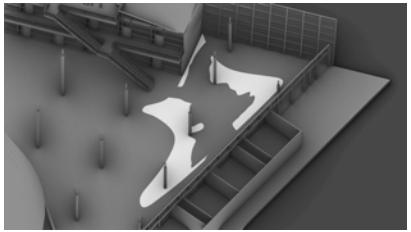
Supporting topographical planes to achieve higher detailing

Construction Sequence

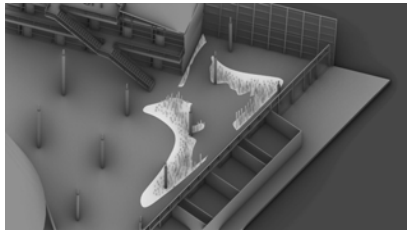
3. Structure



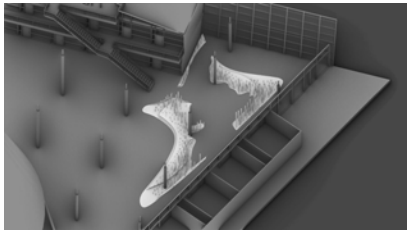
Preparing the floor



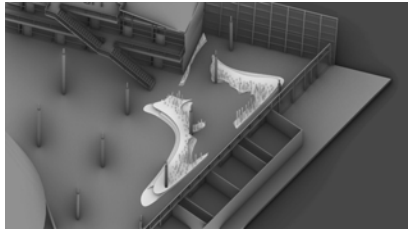
Installing the base



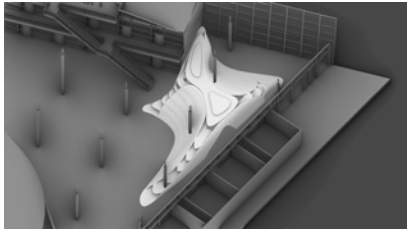
Installing the steel columns



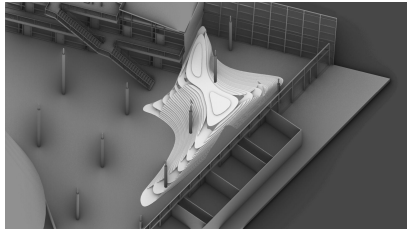
Installing the first group of the sub-planes



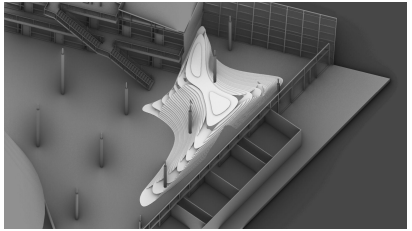
Installing the first main plain



Follow this principle until full structure completion



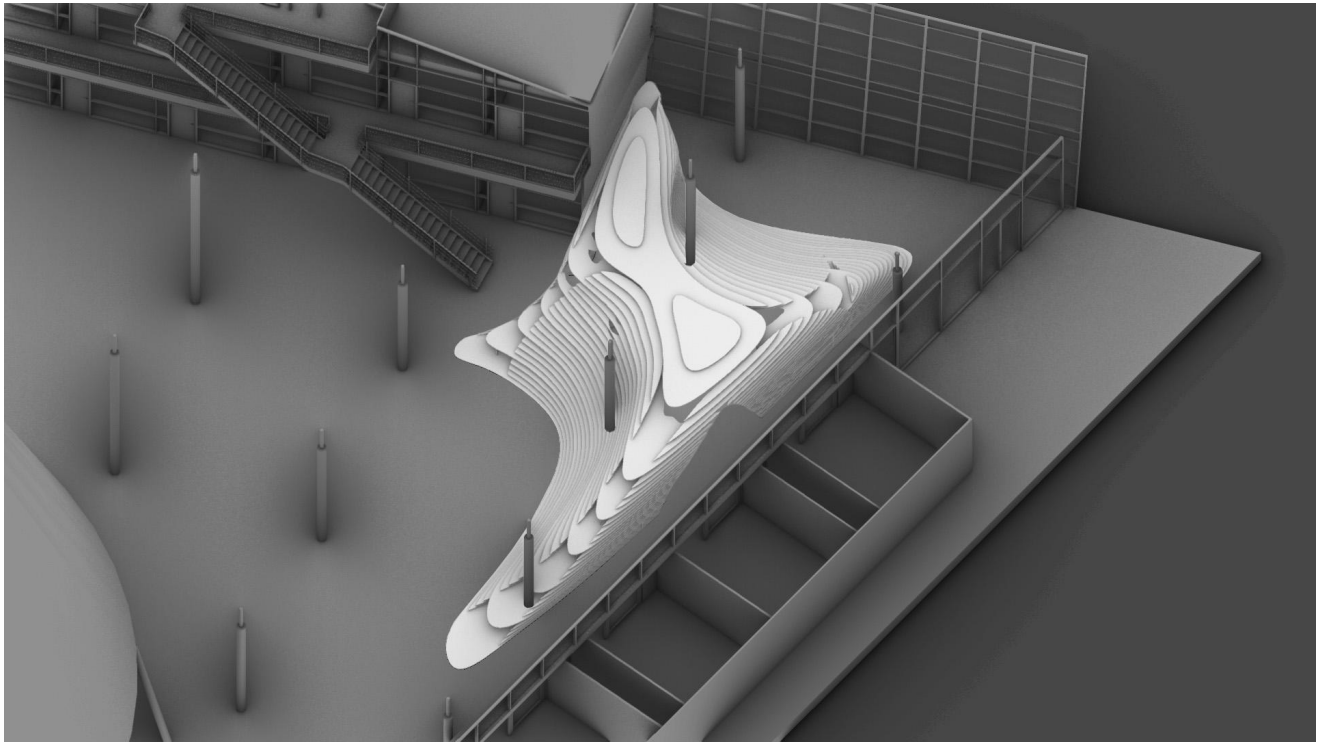
Installing the rubber canopy on the exterior



Installing mycelium on the interior

Construction Sequence

3. Structure



4. Materialisation

Comparative Material Analysis

4. Materialisation

	Rubber	Silicon	Cork	Mycelium	Wood (CLT)	Plastic	Clay	Steel
Strength	+/-	-	-	++	++	+	++	++
Precision	+	+	+/-	++	++	++	++	++
Curing Time	+/-	+	-	-	*N/A*	+	-	*N/A*
Contact with Humans	+	+/-	+	+/-	+/-	+/-	+/-	+/-
Recyclable / Sustainable	+	-	++	++	+/-	-	+	-
Robotic Assemblage	*N/A*	+/-	+/-	+/-	++	++	++	++
Purpose	*Finishing Material on Outer and Inner Shell*	*Translucent Cladding Panels on Outside/Inside*	*Inner Cladding*	*Inner Cladding*	*Structural & Cladding*	*3D Printed Shell*	*3D Printed Shell*	*Load Bearing Structure*

Material Selection

4. Materialisation

	Rubber	Mycelium	Wood (CLT)	Steel
Strength	+/-	++	++	++
Precision	+	++	++	++
Curing Time	+/-	-	*N/A*	*N/A*
Contact with Humans	++	+/-	+/-	+/-
Recyclable / Sustainable	+/-	++	+/-	-
Robotic Assemblage	*N/A*	+/-	++	++
Purpose	*Finishing Material Outside and Inside*	*Inner Cladding*	*Structural & Cladding*	*Load Bearing Structure*

Material Reference

4. Materialisation

Appelle Moi Papa - La Colline

Material Reference

4. Materialisation

Appelle Moi Papa - La Colline

Analysis of Selected Materials

4. Materialisation

	Strength	Precision	Curing Time	Contact with Humans	Recyclable / Sustainable	Robotic Assemblage	Purpose
Rubber	Mulch: Rated to last at least 10 years and does not encounter the same fading issues that as other types of mulch. It allows water to filter through it, with fertilizers, providing a warm, moist environment for plant growth. Approx. tensile strength 25 MPa. Excellent abrasion resistance Translucent Rubber: Excellent compression set. Approx. tensile strength 5 MPa. Poor abrasion resistance.	Molded over the structure, successful overall roughness.	Self adhesive properties, which makes it easier to bind and construct.	Ideal. Climbing, walking, sitting and lying are comfortable. Protective against drops and falls, as similarly applied in children playgrounds. Durable to weather and low maintenance.	Yes, recycling it saves energy, which reduces greenhouse gas emissions. *Recycling four tires (50kg) reduces CO2 by about 323 pounds, equivalent to 18 gallons of gasoline.*	*N/A* *The mold takes smoothened form after handcrafting. In case of outdoor application, also a bitumen layer is applied.*	*Finishing Material on Outer Shell*
Mycelium	Its maximum tensile strength ranges between 5.1 and 9.6 MPa. Depending on the shape, structural capacity can be maximized. A living organism that is the root system of mushrooms. The webbed mycelium acts as a natural binder.	Molded over the frame or 3D printing	3-4 weeks for mycelium to grow over the shape.	During the process of curing time, mushrooms grow and can be picked up and eaten.	Very good. When mixed with fiber + mycelium, wasted fiber or paper cup can be reused. quality of air cleaning.	*N/A*	*Cladding*
Wood (CLT)	Very good. The average characteristic shear strength (fv) of the 3-layer CLT panels is 1.737 MPa with a COV of 7.5%; in contrast, the average fv of the 5-layer CLT panels is 1.803 MPa with a COV of 6.5%.	Fine-cut with high definition.	Mass manufactured pre-constructi on.	Uses bio material chitin mixed with regolith from Mars	Yes, CLT contains biomass and its recyclable, they are sent back to the manufacturer for reuse and recycling.	Closed loop and zero waste solution, can be recycled in more forms.	*Structural & Cladding*
Steel	Extremely flexible and known for its high tensile strength alongside compression.	Default profiled column.	*N/A*	*N/A - Not Accessible*	No, low sustainability.	Easy assembly with CV.	Load Bearing Structure

Impression of Interior

4. Materialisation

Mycelium Panels

Rubber Panels with sensor-actuator

Exposing the CLT Plates

5. Sensor-Actuator Networks

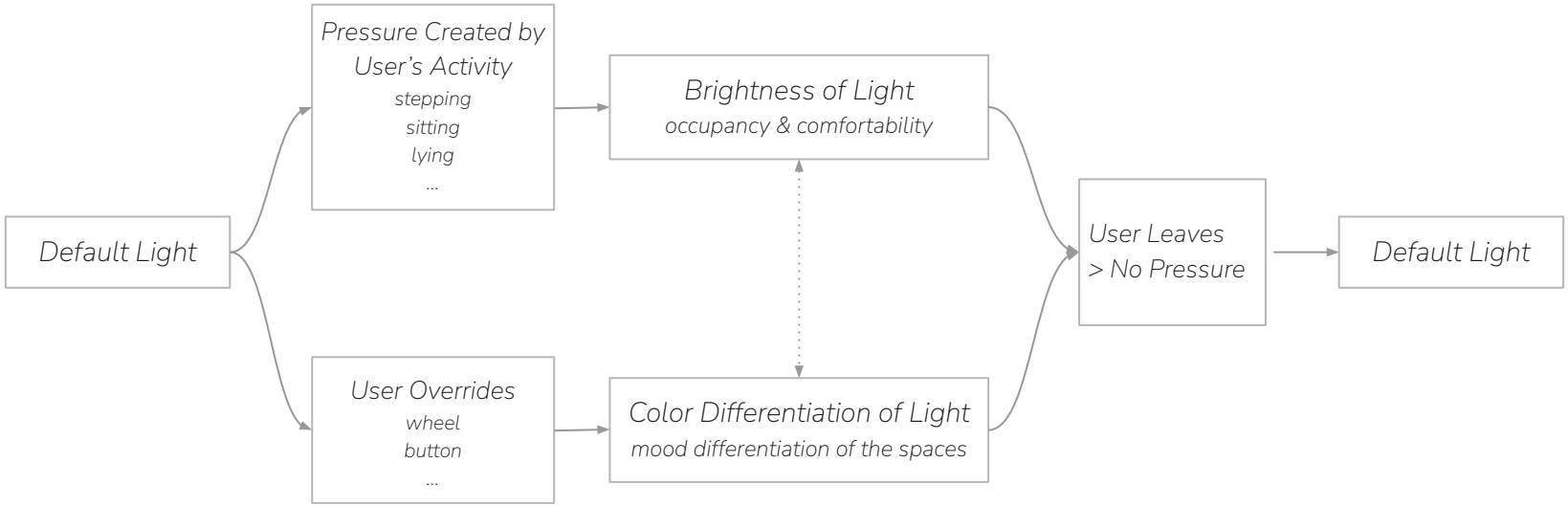
Interactive Environment with Light and Pressure

5. Sensor-Actuator Networks

Pressure, created by the users' posture and activity, triggers LEDs which by interaction can be changed to create different light intensity and colors. When more pressure is applied onto the object, for instance sitting, the rubber platform yields and adapts to the pressure of the users while providing comfortable feeling like a cushion.

Responsive Lighting Control by Pressure

5. Sensor-Actuator Networks



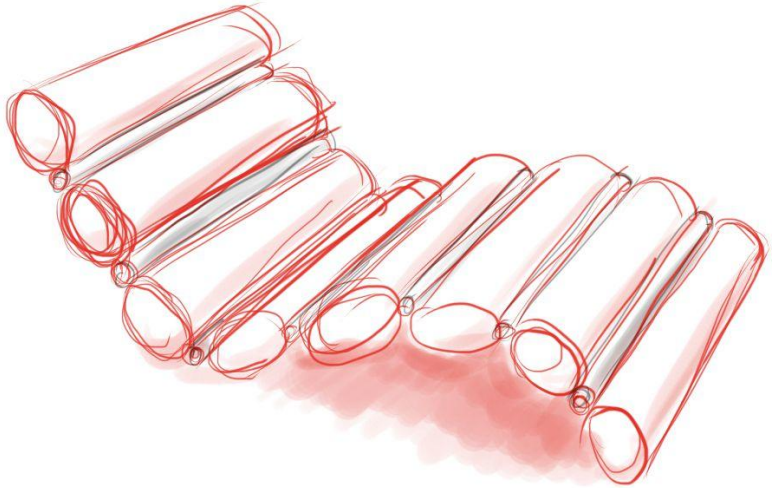
Impression ✨

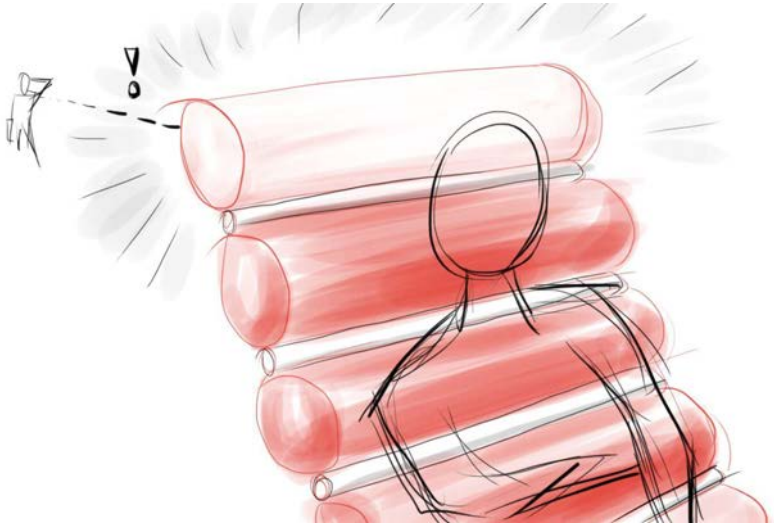
5. Sensor-Actuator Networks

6. Furniture Detail

Adjustable Element

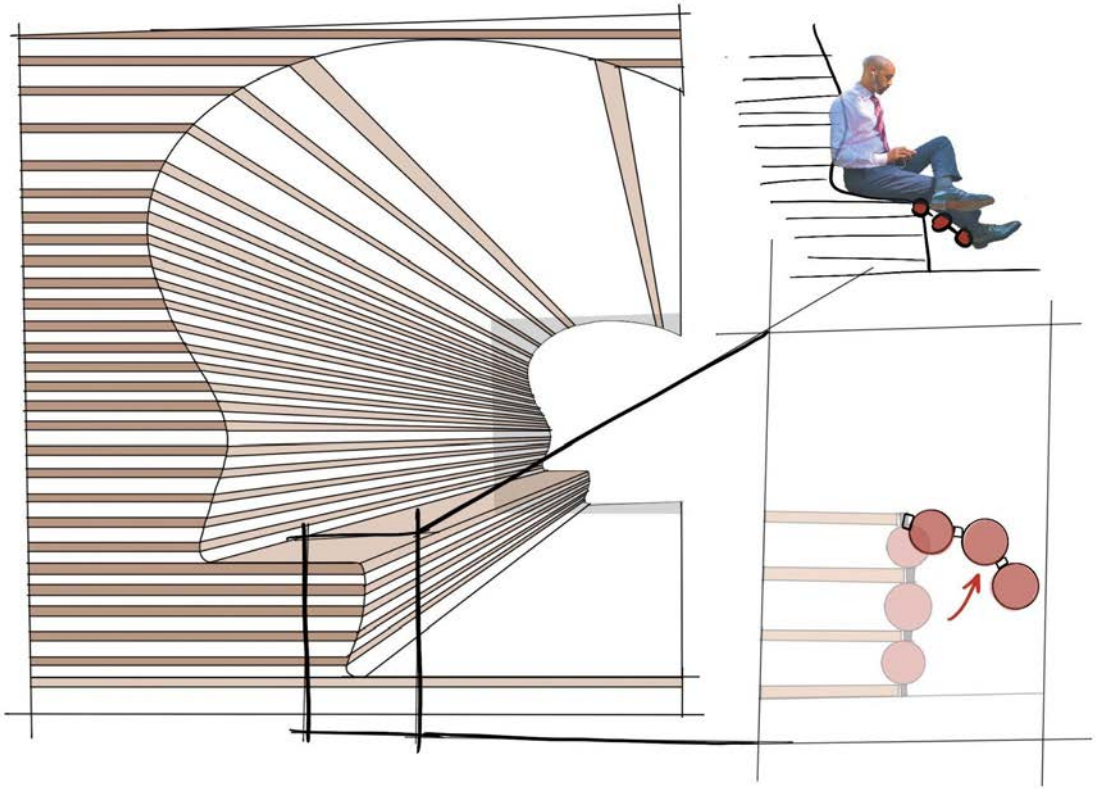
6. Furniture Detail





Adjustable Element

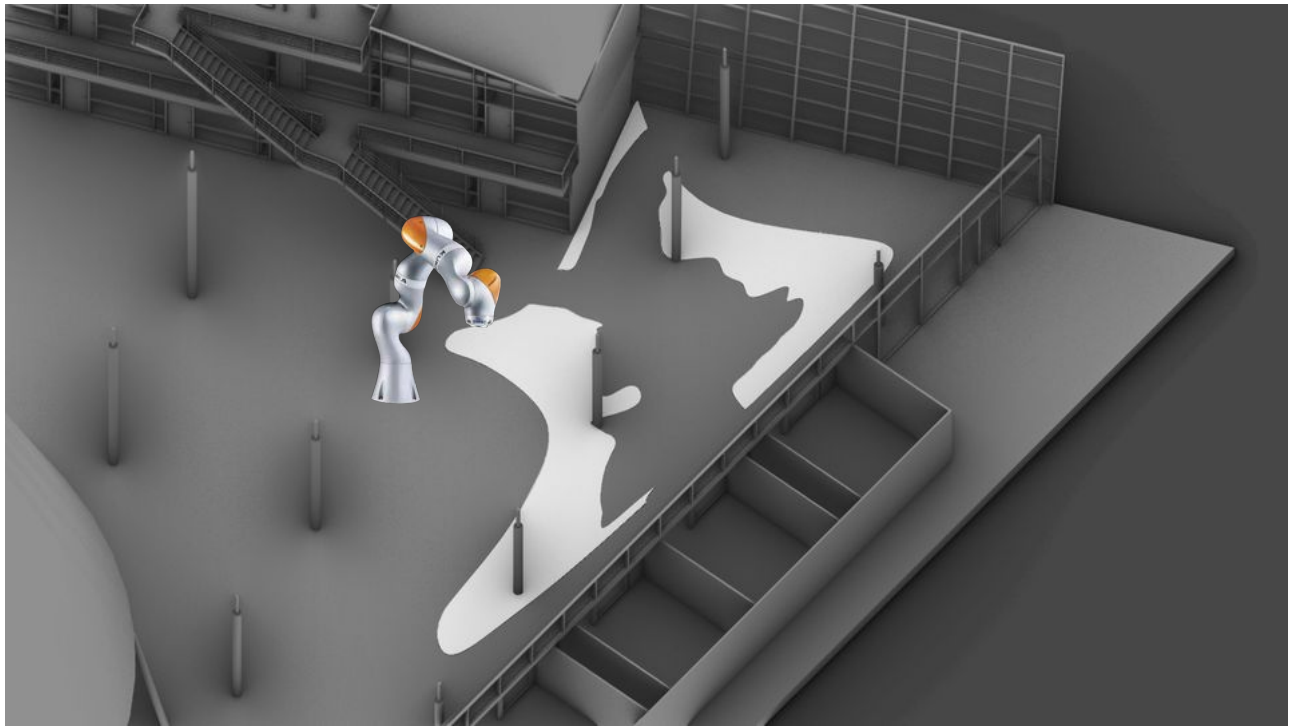
6. Furniture Detail

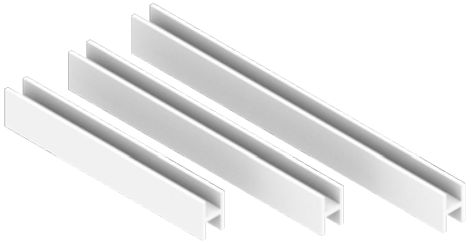


7. Computer Vision

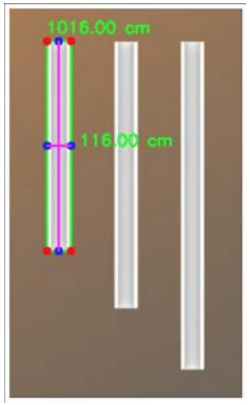
Assembly

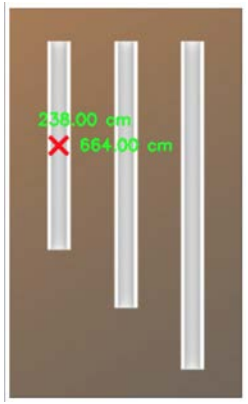
7. Computer Vision





```
#specify to be found element (based on size dimension)
dim = [18, 5]

#find element + create new 'list' with closest point
idx = findelement(dim, bboxs, pixpm)
bboxfound = [bboxs[idx]]

#draw specific bounding box
drawbbox(img_w, bboxfound, pixpm=pixpm)

#get center of mass
cms = getcm(bboxs)

#draw cm
drawcm(img_w, [cms[idx]], pixpm)
```





8. Final Design Proposal

Inhabiting the Cave

8. Final Design Proposal

Inhabiting the Cave

8. Final Design Proposal

Inhabiting the Cave

8. Final Design Proposal