PORTFOLIO

DECEMBER 2024

KAMYAB HOSSEIN

CONTENT

BIO

Hossein is a computational designer with a keen interest in structural design. He studied architecture for both his bachelor's and master's degrees. In his master's, he showed a great interest in the application of structural design in architecture. He is interested in pure compression-tension structures, as can be seen in his most recent design projects. As a registered teacher in the Ministry of Education of Iran, Hossein used to share his passion for such structures with his vocational high school students in some workshops. Hossein participated in a few workshops on computational design, which helped him find his field of interest in research. For his master's thesis project, Hossein conducted deep research on structuralizing muqarnas, an ornamental element in Islamic architecture, under the supervision of Dr. Damon Bolhassani from the City College of New York. The result of this project was partially presented at the IASS 2022 conference. Besides his structural design projects, Hossein worked on several architectural design projects during his master's and bachelor's studies, where he was focused on different aspects of architecture, including the relation of a building with its environment, the functionality of the building, and the compatibility of the architecture with the structure. Hossein has good sketching skills, which aid him in being able to freely think about his design projects in different aspects.

01

Structural Muqarnas

Master's thesis project

published paper in IASS 2022

What?

Structural muqarnas

Structural reconstruction of an ornamental element in Islamic architecture called muqarnas

Why?

Bridging Traditional and Modern Architecture

Having access to the computational tools, to generate complex geometries

The possibility of making complex geometries that are structural efficient

How?

1 Finding the pattern of selected muqarnas

2 Modifying the muqrnas pattern according to the Graphic statics principles

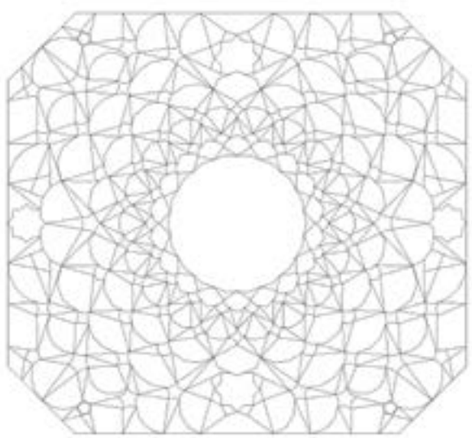
3 Finding the 2D form and Force diagrams (horizontal equilibrium)

4 Finding the vertical equilibrium

5 Specify a profile to the generated form

6 Fabrication

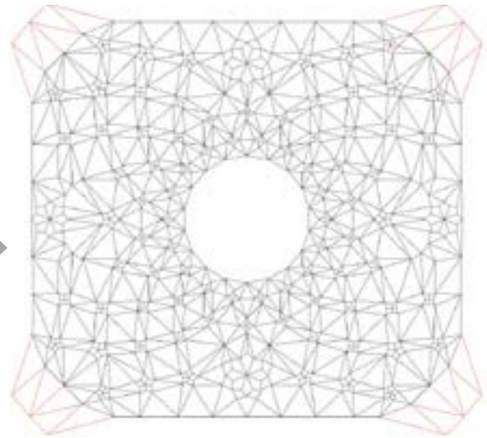
Process of generating Structural Muqarnas



ORIGINAL PATTERN

I

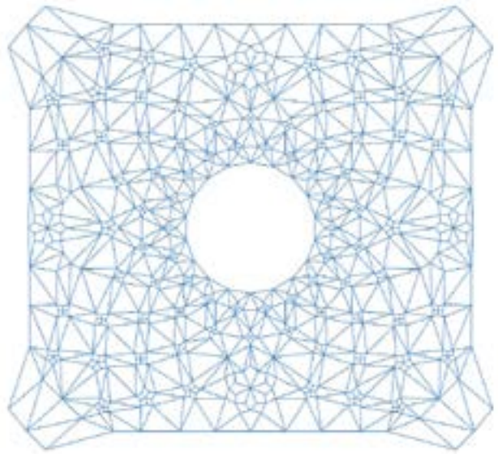
Modification



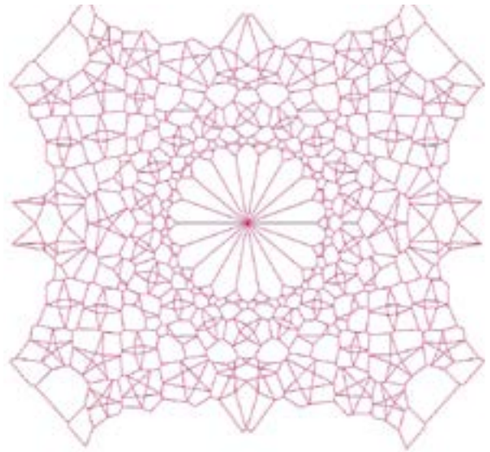
MODIFIED PATTERN

II

Horizontal Equilibrium



FORM DIAGRAM



FORCE DIAGRAM

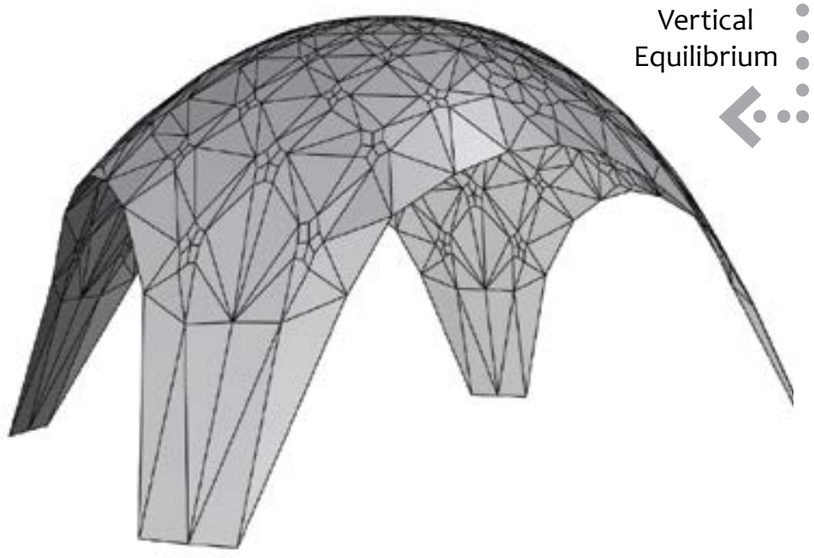
STRUCTURAL MUQARNAS

IV

Materialization

III

Vertical Equilibrium



THRUST LINES

I
MODIFICATION

Following graphic statics principles is essential for generating form and force diagrams, which means not including curved lines or concave geometries in the initial pattern. Pedestals were also added in the very first pattern to make sure they also followed the load path.

II
HORIZONTAL EQUILIBRIUM

Generating the 2D equilibrium by finding the reciprocal force diagram for the existing form diagram using the RhinoVAULT tool.

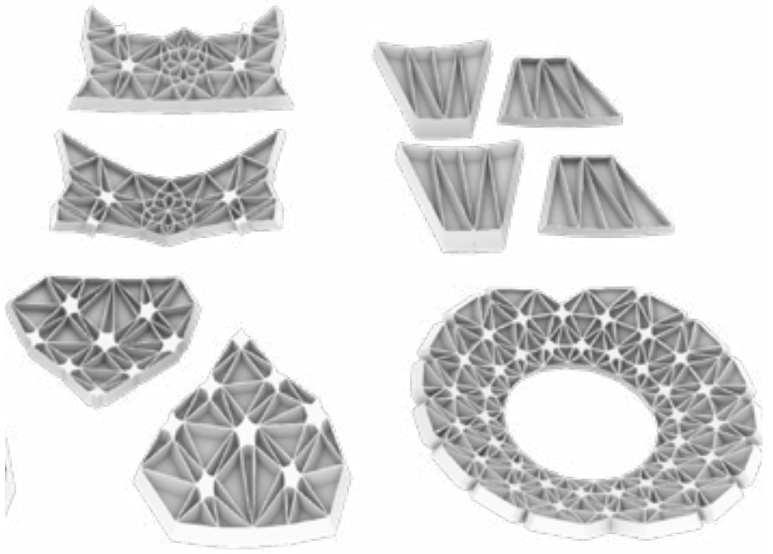
III
VERTICAL EQUILIBRIUM

Finding the 3D thrust line based on form and force diagrams by providing the final height as well as supporting points.

IV
MATERIALIZATION

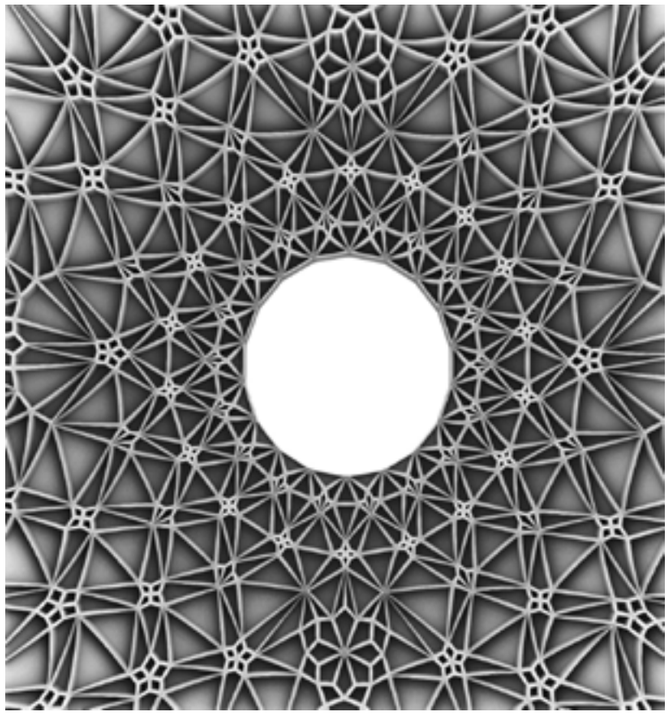
Selecting a curved profile to reduce the usage of material while having a more similar look to the original muqarnas.

Structural muqarnas of hasht behesht palace

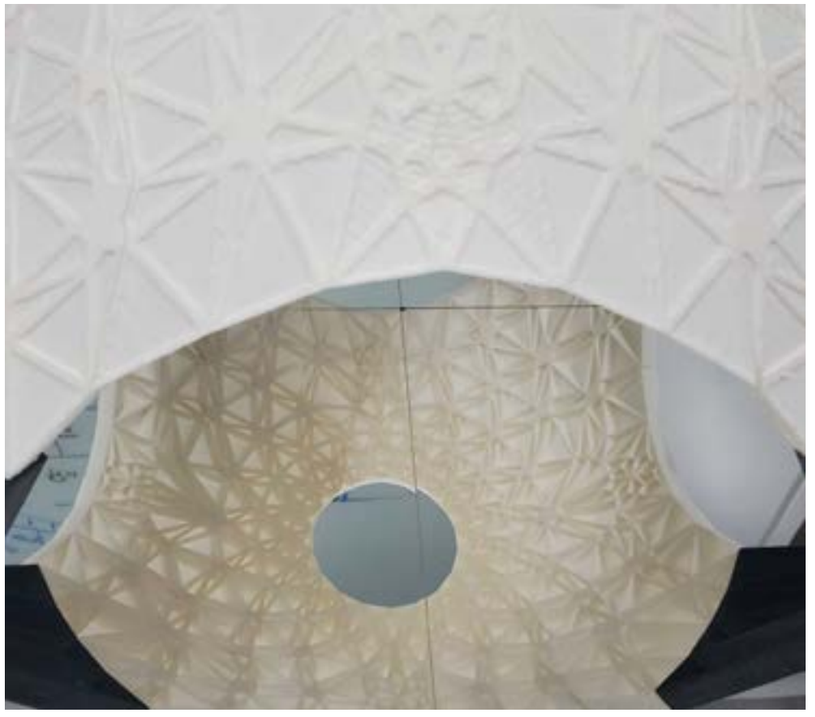


Modeled elements for 3d printing

original muqarnas of hasht behesht palace



structural muqarnas of hasht behesht palace



3d printed structural muqarnas of hasht behesht palace

02 *KINETIC + TENSEGRITY*

STUDIO DESIGN 3- MASTER'S

WHAT?

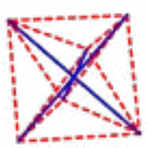
Structure	Kinetic	Tensegrity

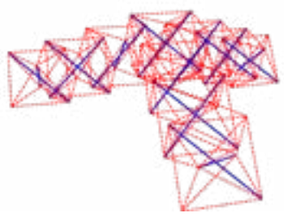
WHY?

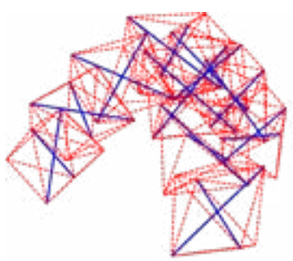
modularity	Compression and tension only	
Easy installation	Flexibility	Affordability
Complexity in simplicity		

How?

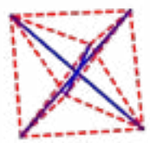
Three compression and three tension elements form a module	The module extends in three directions in several layers	Taking different positions Due to the flexibility of tension elements



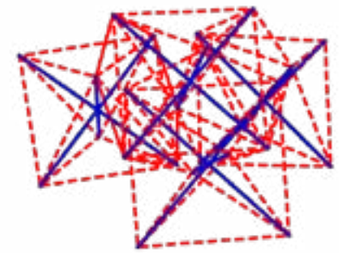




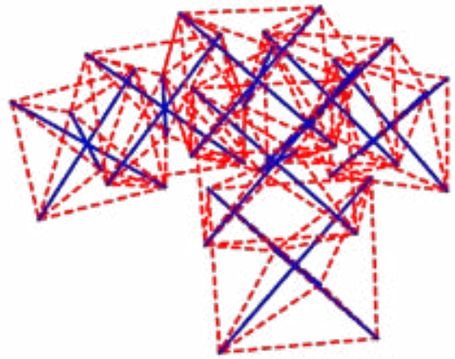
Process of assembling the structure



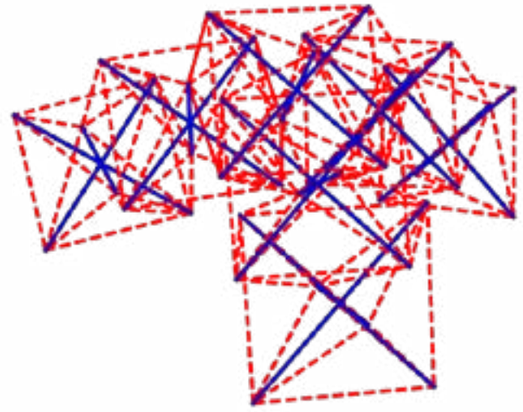
An octagon as
the First module



Addition of
Second layer

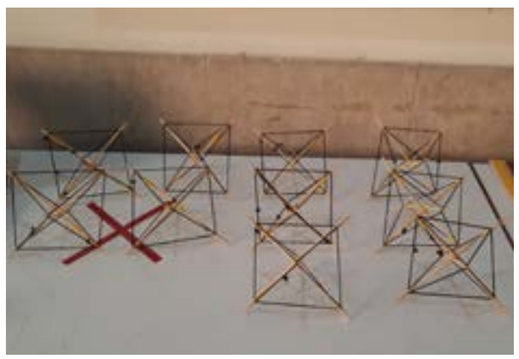


Addition of
Third layer



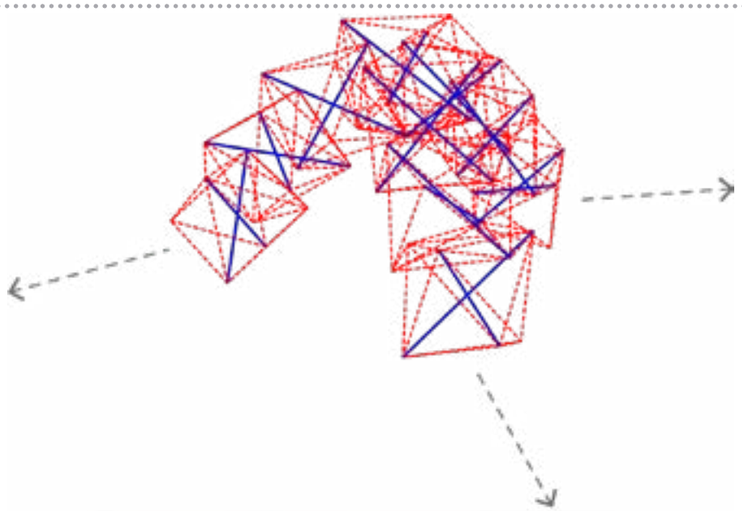
Addition of
Forth layer

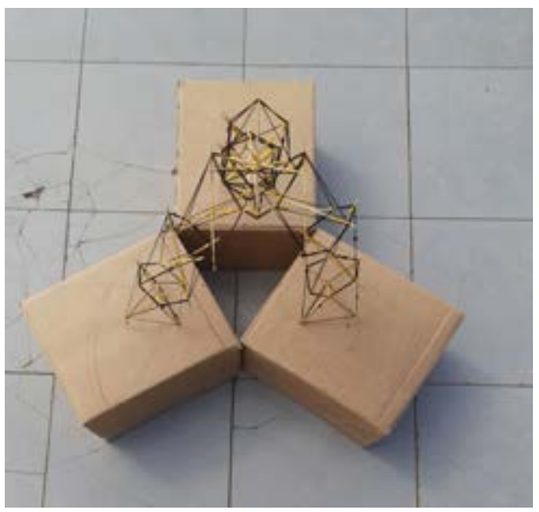
An octagon as the First module



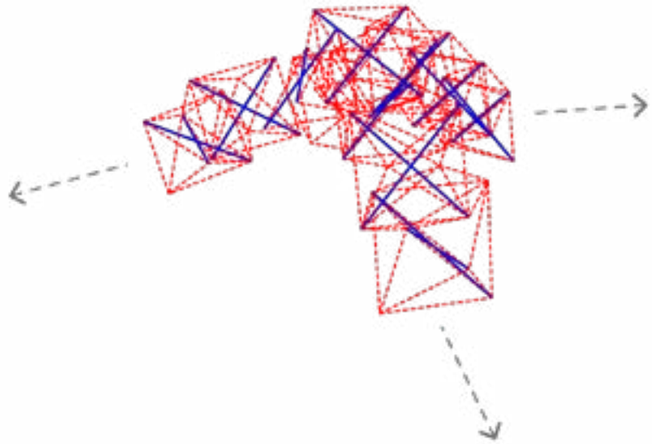
Combination of modules in several layers to generate the final structure

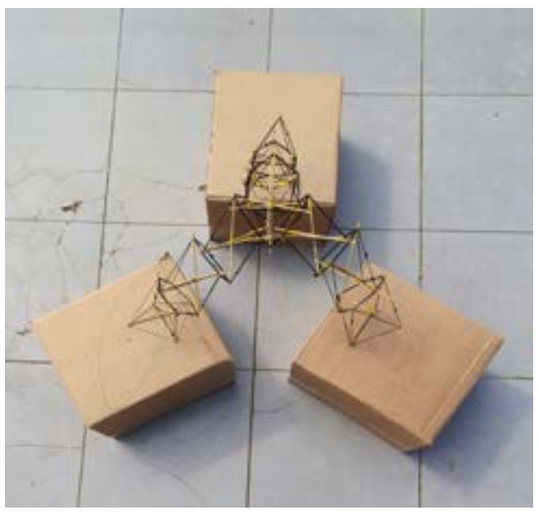
PROCESS OF OPENING THE STRUCTURE



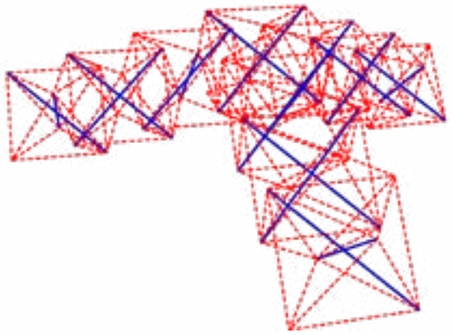


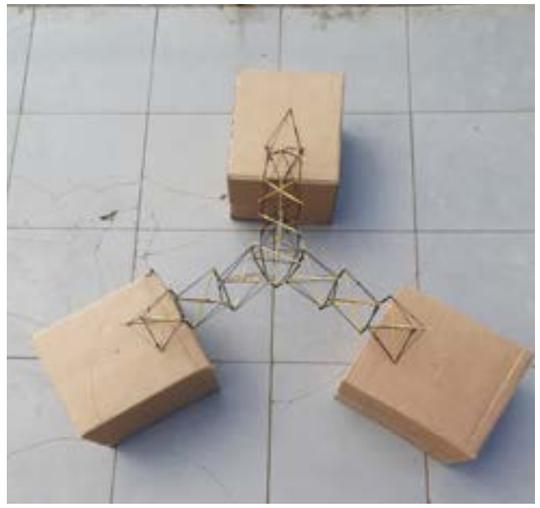
First phase
Height: 50 cm





Second phase
Height : 30 cm





Third phase
Height: 10 cm

03 TENSEGRITY WORKSHOP

FARAHBAKHSG VOCATIONAL HIGH SCHOOL

WHAT?

Tensegrity ball	a Pentagon based structure which consists of pure tension and compression elements

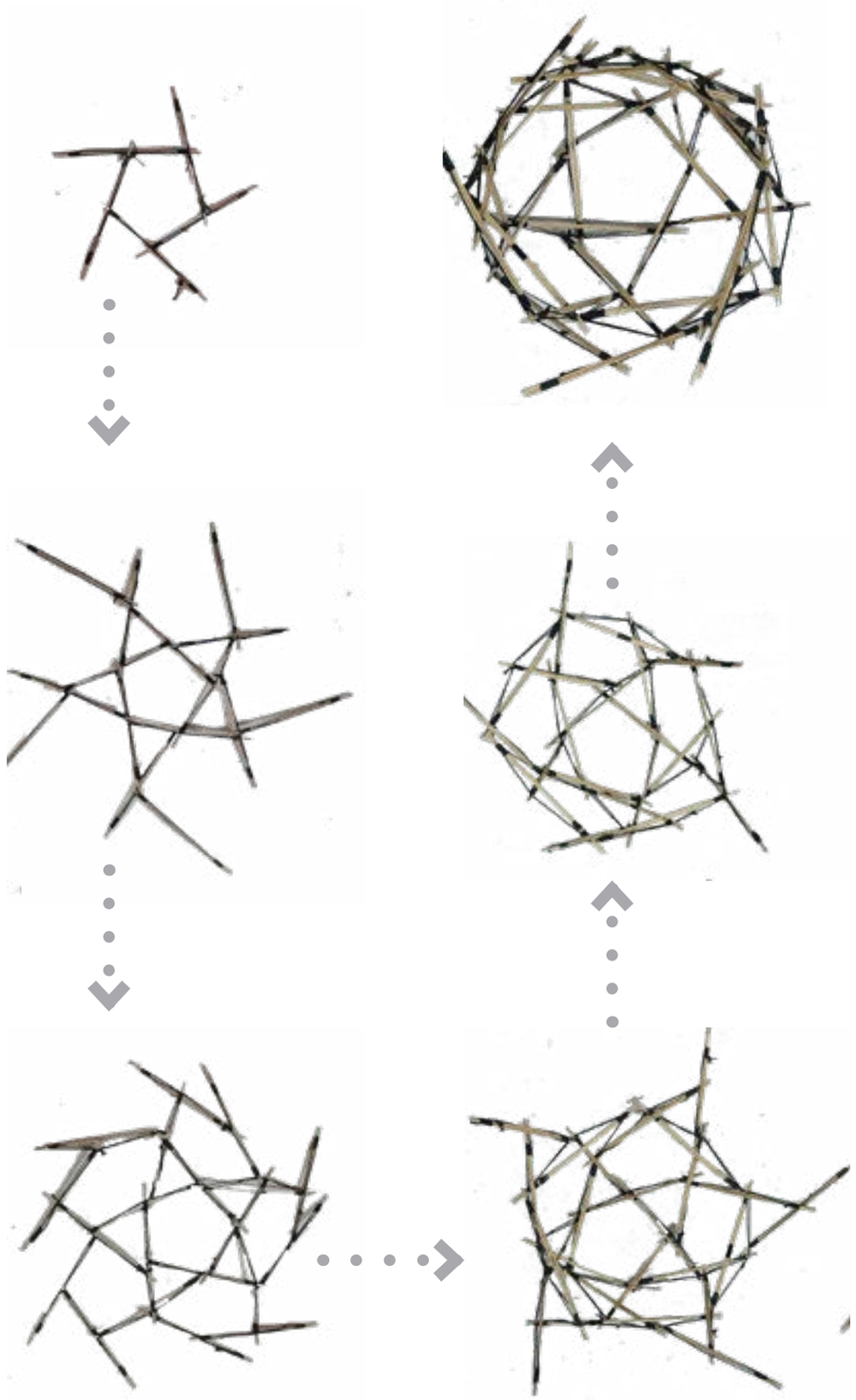
WHY?

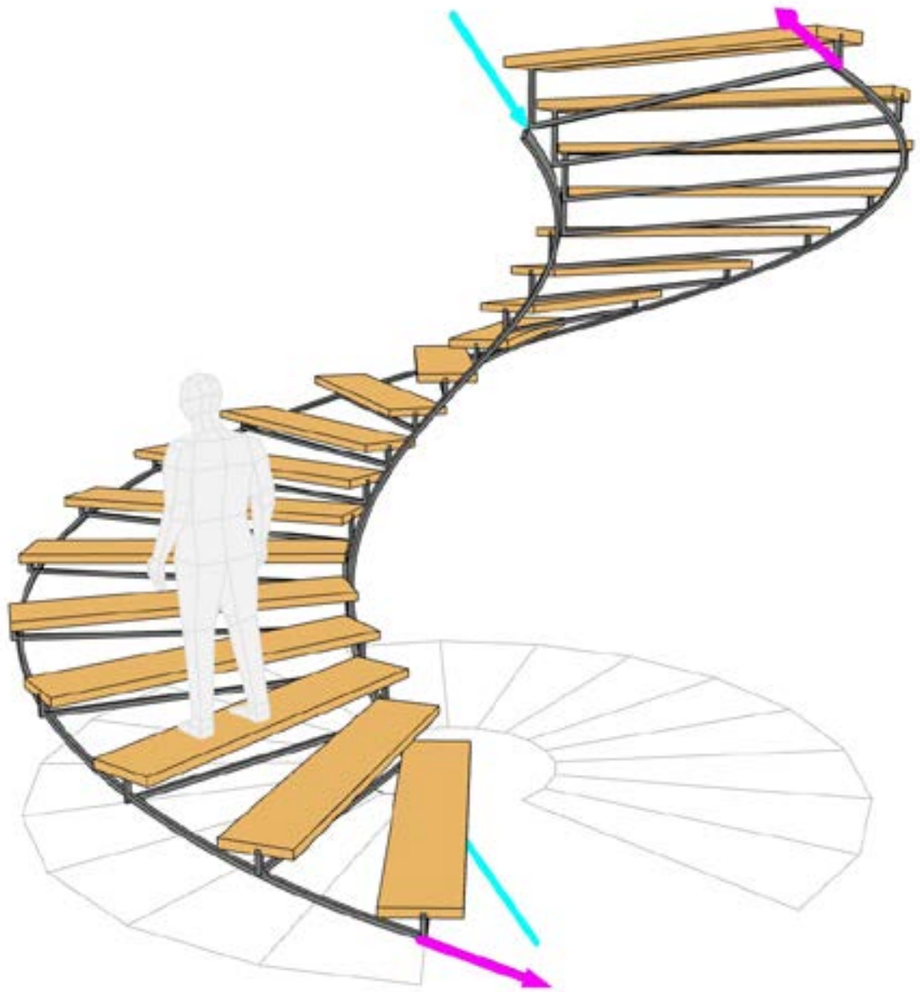
Complexity	working with complex geometries and gather skills to deal with them
Pedagogical	A better understanding of compression and tension elements
Group working	Practicing group working and collaboration
Affordability	Using inexpensive materials which are affordable for the students

How?

Making a pentagon by putting each stick in the middle of the adjacent one	Making five pentagons each shares a side with the primitive pentagon	Continuing making pentagons until reaching a closing pentagon on the top
		

PROCESS OF GENERATING THE TENSEGRETY BALL





04 SPACIAL STAIRACASE

ACADIA 2021

SUPERVISORS: RAFAEL PASTRANA, ISABEL OLIVEIRAPATRICK OLE OHLBROCK, PIERLUIGI D'ACUNTO

WHAT?

Form-finding Staircase	Application of Combinatorial Equilibrium Modeling (CEM) in form finding a staircase
Combinatorial Equilibrium Modeling (CEM)	A form-finding method based on vector-based graphic statics

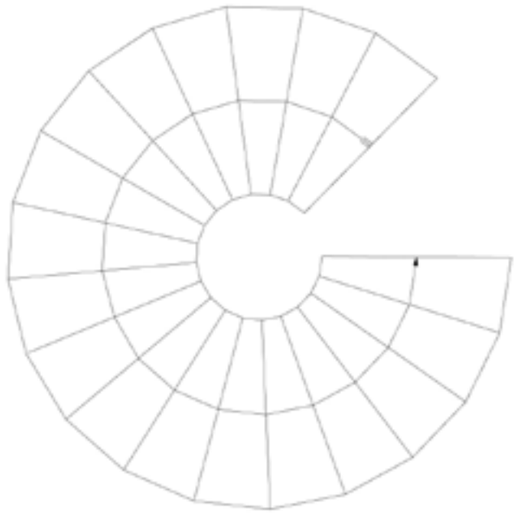
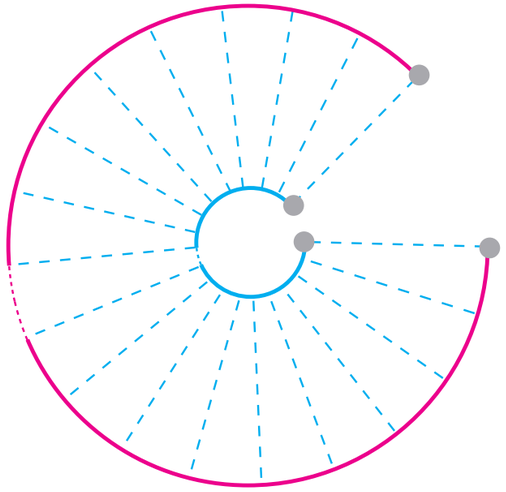
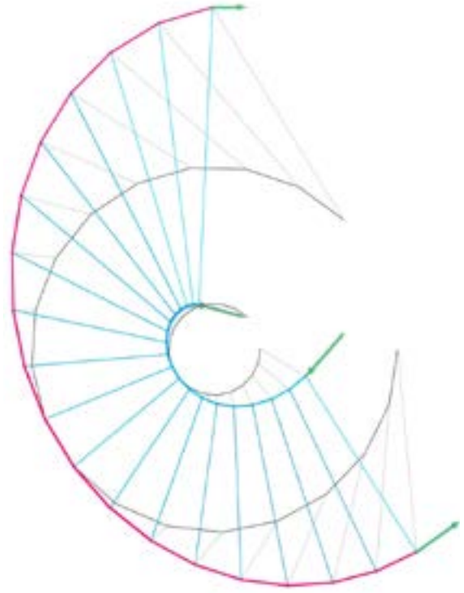
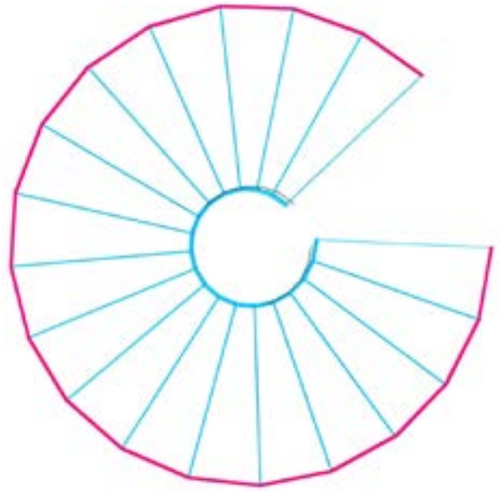
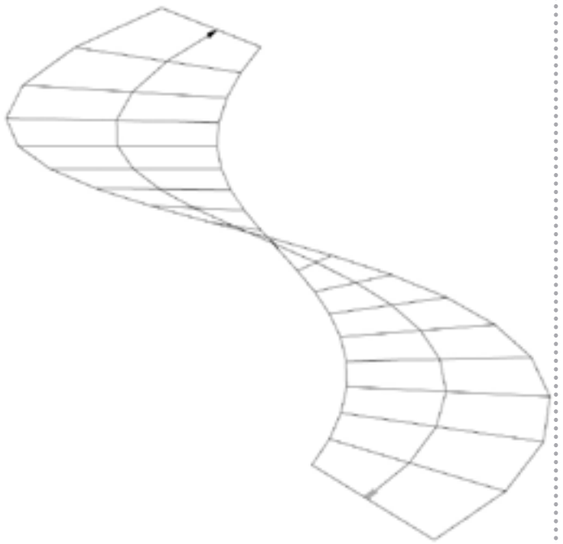
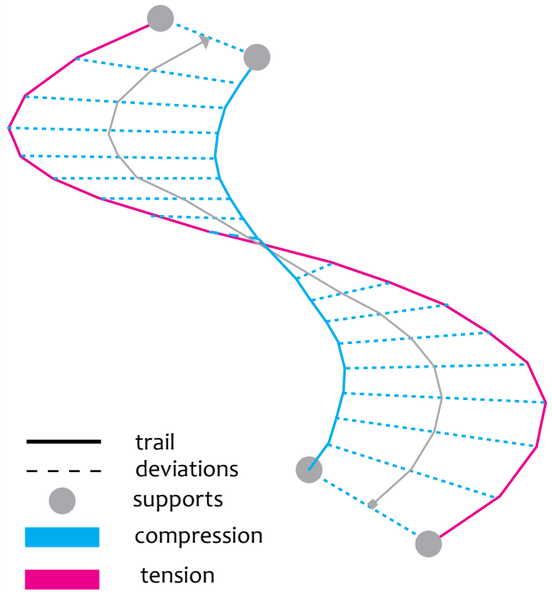
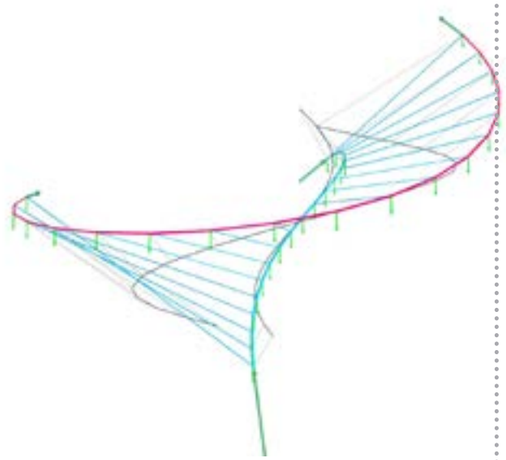
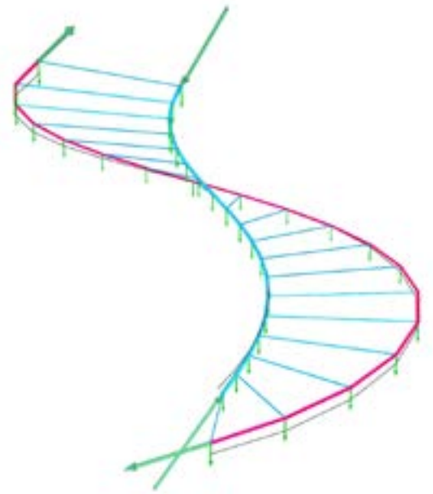
WHY?

Material-efficiency	Due to the pure tension and compression loads applied in these structures they will need the minimum amount of material to carry loads
Elegance	Using this method, makes it possible to design very elegant structures based on applied loads
Stability	Structures that are be build using this structural design method, will be very stable because of that there geometry is based on the loads applied to them

How?

1. Determining the main topology of the structure
2. Determining supports and applied loads
3. Determining the compression or tension function of each element
4. Form finding without any constrain points
5. Form finding with constrain points

Process of form finding of a staircase using CEM method

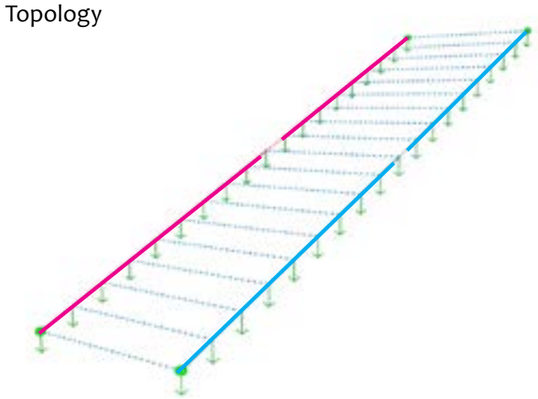
Step 1: staircase Topology	Step 2: Elements Function determination	Step 3: Form finding	Step 4: constrained Form finding
			
			
General topography of staircase including 2D shape, Width, Each step height, Total height	determining support points and each element compresstion and tention functions	Form finding based given topology and applied forces	Form finding by considering theconstrained points

Exploring other staircase alternatives

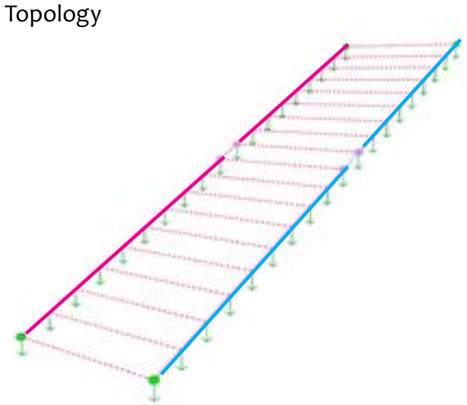
Structure with Tension and Compression elements

Tension only or Compression only structure

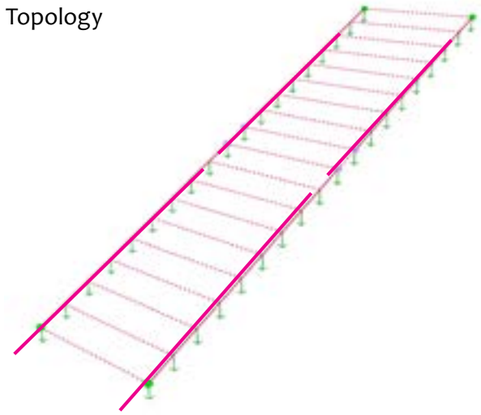
Topology



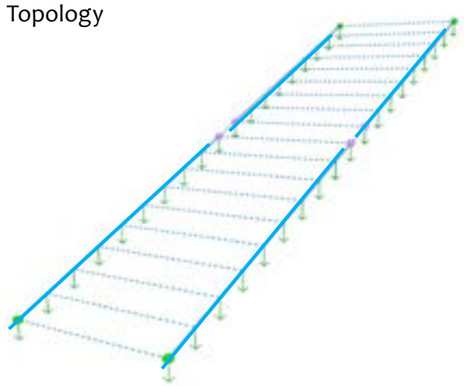
Topology



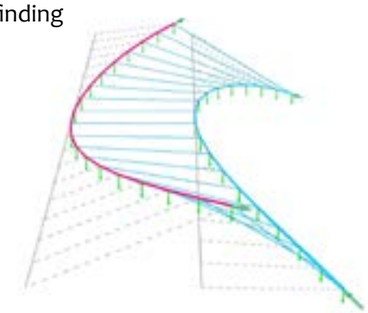
Topology



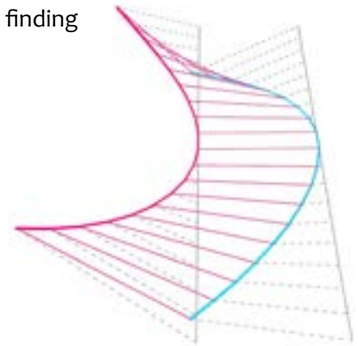
Topology



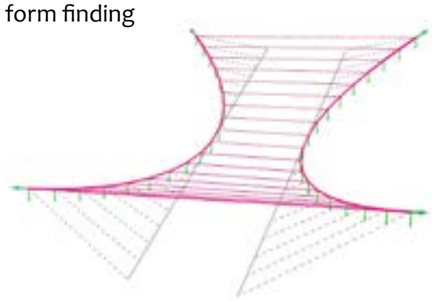
form finding



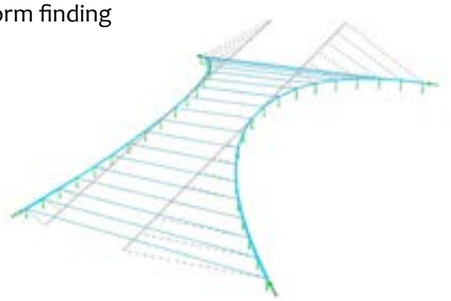
form finding



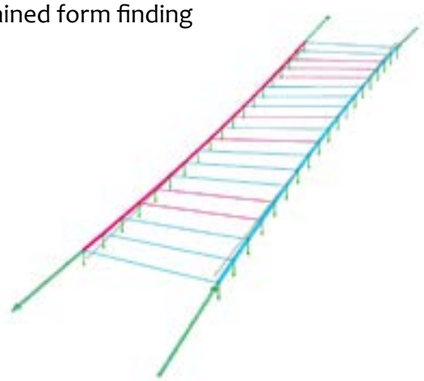
form finding



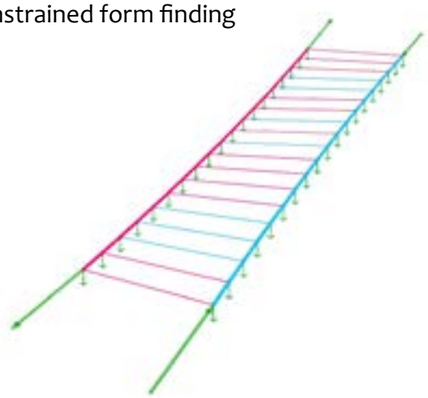
form finding



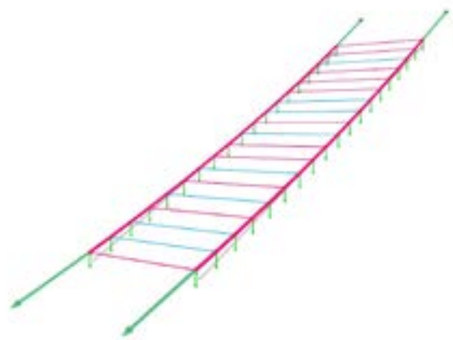
Constrained form finding



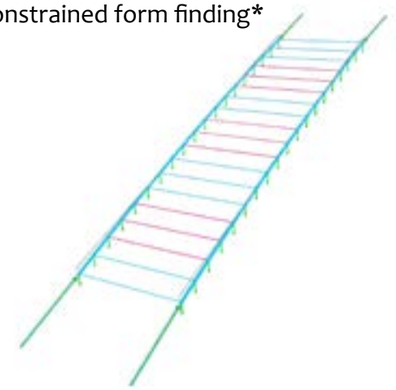
Constrained form finding



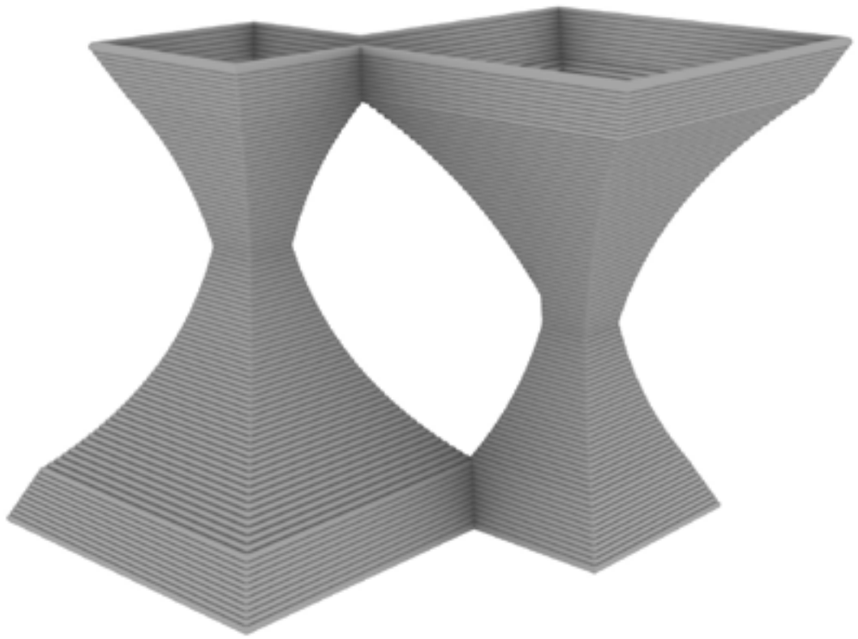
Constrained form finding*



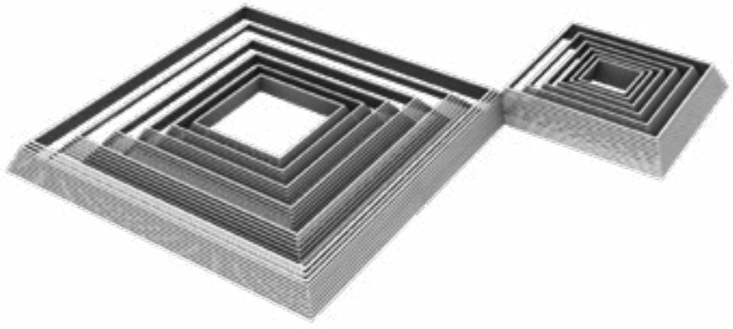
Constrained form finding*



* when we insist on having constrained points, even in the structures that were designed to be compression or tension only there would be some element that does not follow the same tensions



The final structure



Printing the element together

05 Print in Print Workshop

Digital future 2021

SUPERVISIERS:

NEGAR KALANTAR, ALI BAHRANI, MEHDI FARAHBAKHSH

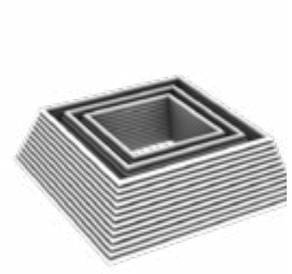
WHAT?

Print in Print	A novel method in 3D printing

WHY?

Affordability	Printing big structures using a small robotic arm
Space limitation	Printing in a limited work place
Time consideration	Splitting the printing task into few smaller ones

HOW?

Printing the first piece	Separating the pieces	Putting the pieces on top of each other
		

Each piece should have a angel more than 90 degrees

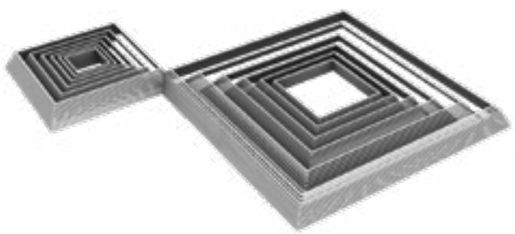
Printing with an offset from the previous piece

With the help of a support structure in the core

Application of the method on the designed project

Simulating the printing process of a robotic arm

Printing the structure in two sets



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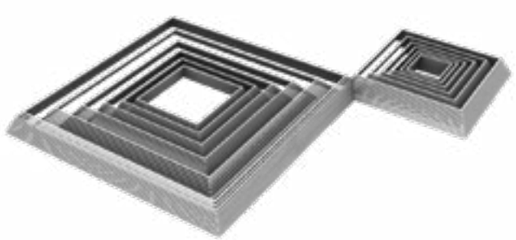
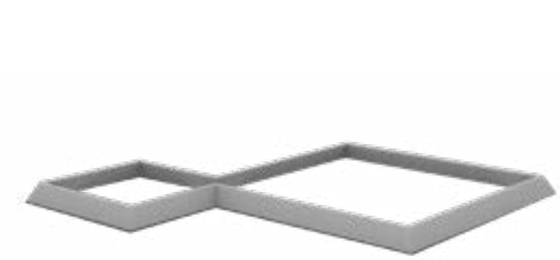


layer 1



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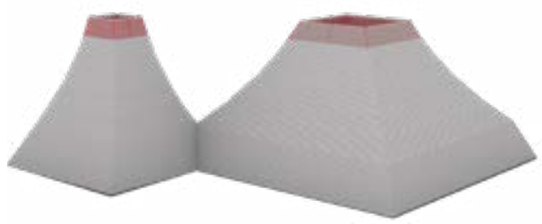


layer 15

layer 17

layer 19

06 INDUSTRIAL HERITAGE

STUDIO DESIGN 1- MASTER

WHAT?

Industrial Heritage	Re-utilizing an old factory as a cultural center

WHY?

Preservation	Preventing the damaging process of this building
Heritage	This building is one of the first concrete structures in Iran
Touristic Attractiveness	Located in a touristic zone of city, and can attract a lot of visitors
Pedagogical	Introducing of the concept of silo to people

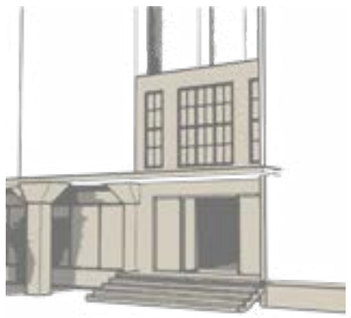
HOW?

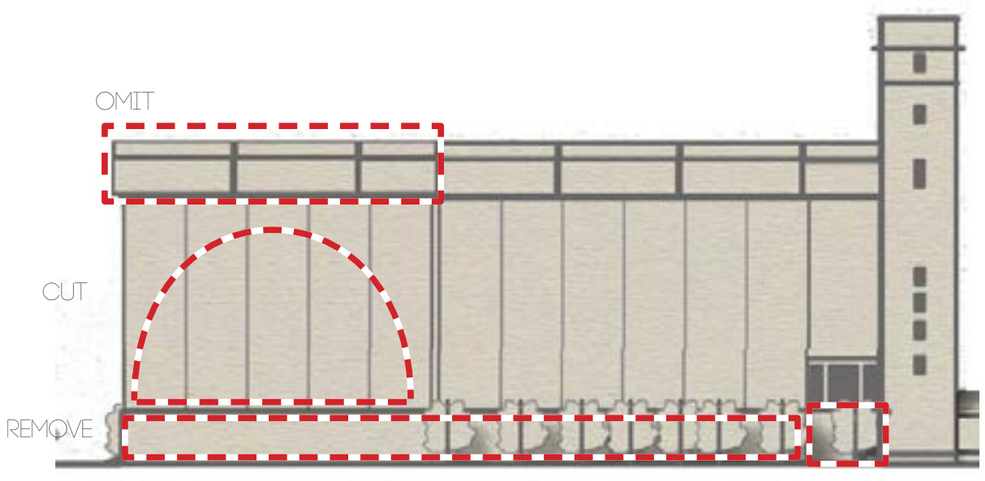
Modifications	A welcoming entrance	Exposing the structure of the silo	Elimination of a part of silo head
Re-purposing : A new usage for spaces	Storage ↓ Library	Top of the silo ↓ restaurant	Grand floor ↓ Exhibition hall

MODIFICATIONS OF THE ORIGINAL BUILDING

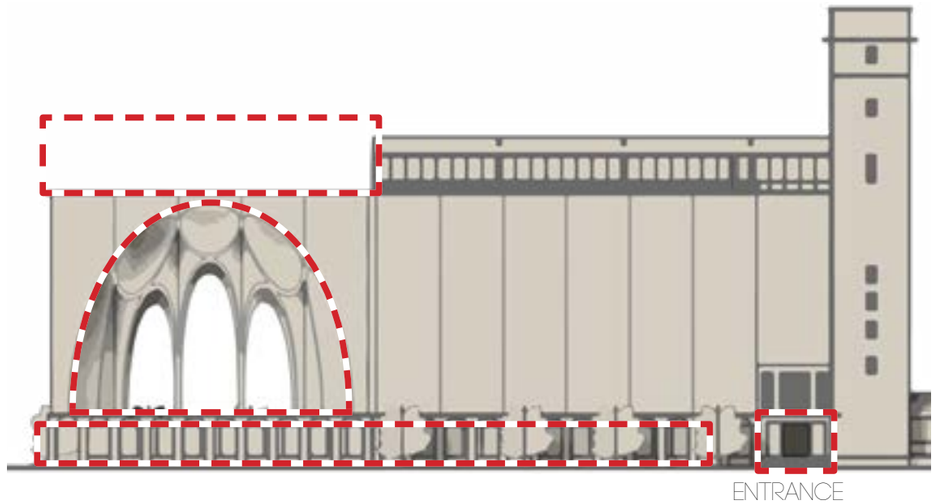
CUTTING THE
GRAIN SILO AND
MAKING IT VISIBLE

ALLOCATING A
WELCOMING
ENTRANCE FOR
THE BUIDLING

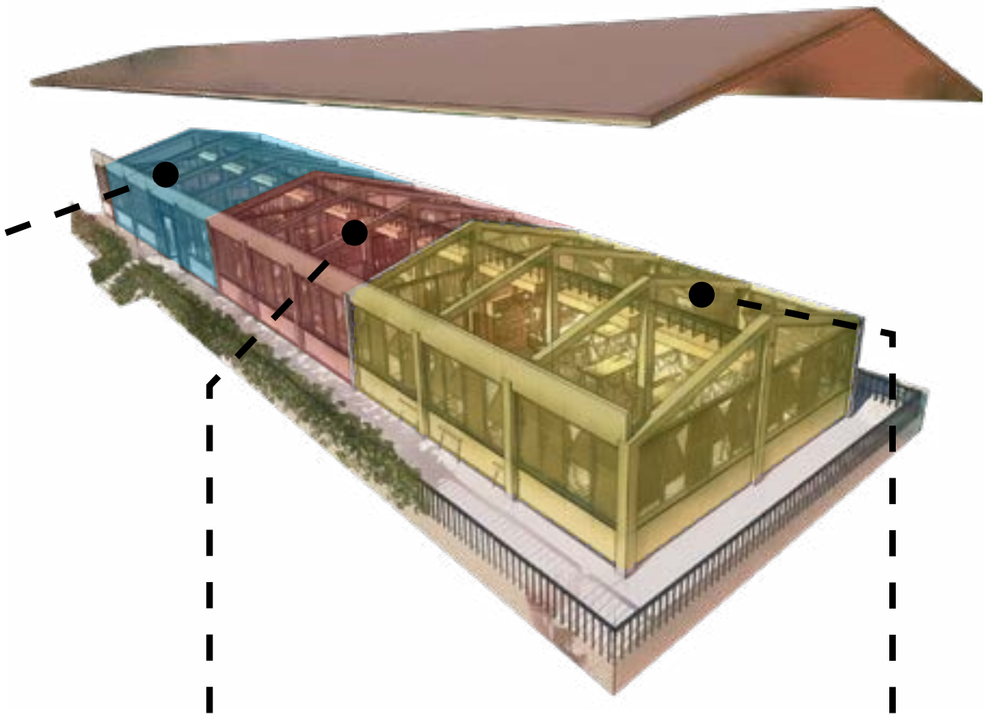




CHANGES DONE
ON THE EXTERNAL
BUILDING



RE-PURPOSING : FROM **STORAGE** TO **BOOK CAFE**



ENTRANCE

BOOK CAFE

PUBLIC LIBRARY

PRIVATE LIBRARY

RE-PURPOSING : FROM **SILO HEAD HOUSE** TO **RESTAURANT**

NON LOAD BEARING WALL

UNIQUE PERSPECTIVE OF THE CITY

GOOD SPACE FOR TABLES

KEEPING PROMINENT ELEMENTS OF THE PREVIOUS USE OF THE BUILDING

PROVIDING SHADOW

WIDE AND TALL WINDOW

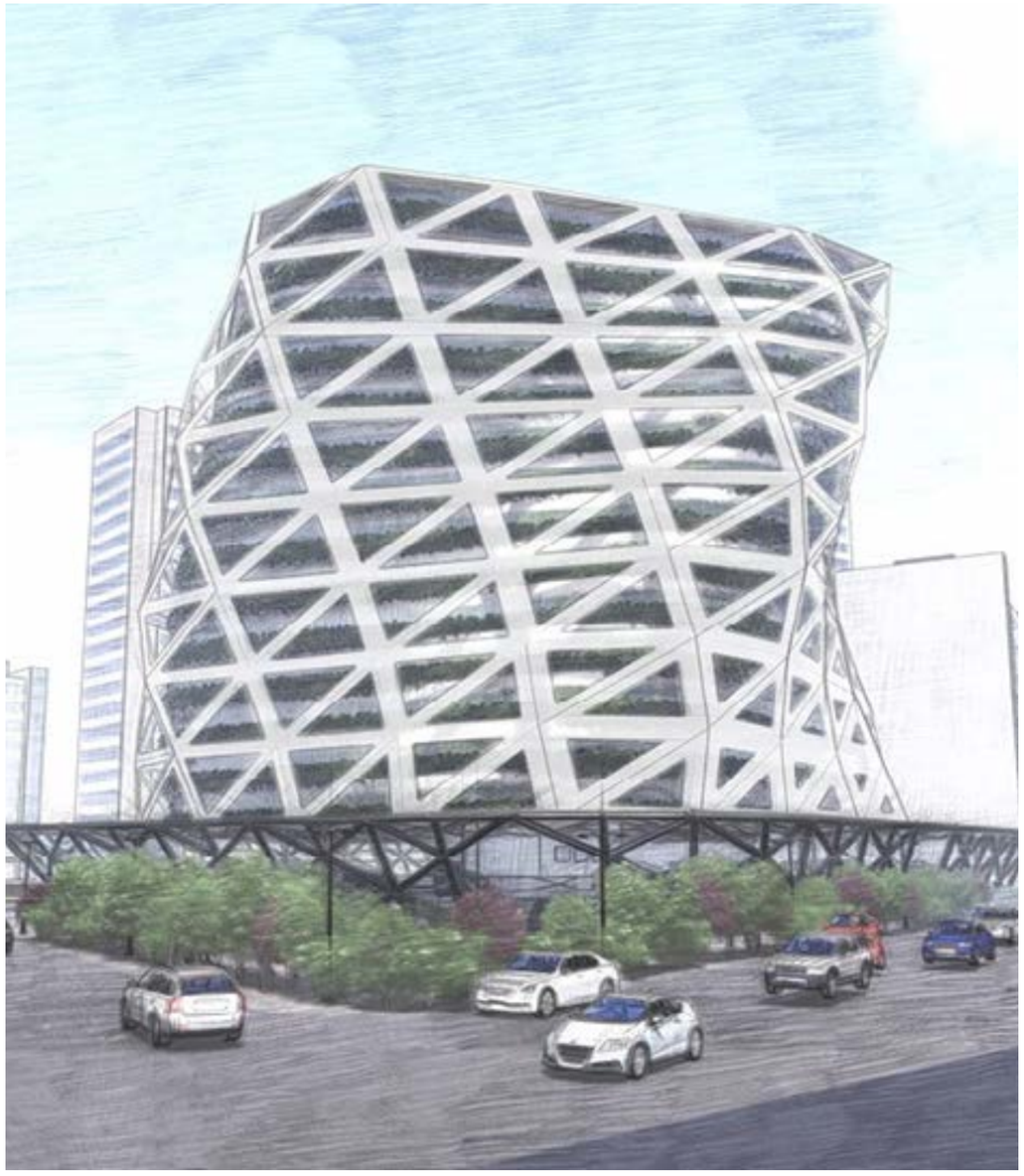
MAIN STRUCTURE

NON LOAD BEARING WALL

MAIN STRUCTURE

PARTITION: PROVIDING PRIVATE SPACE

WIDE AND TALL WINDOW: UNIQUE PERSPECTIVE TO THE CITY



07 07 Turning Tower

Studio design 2- master's

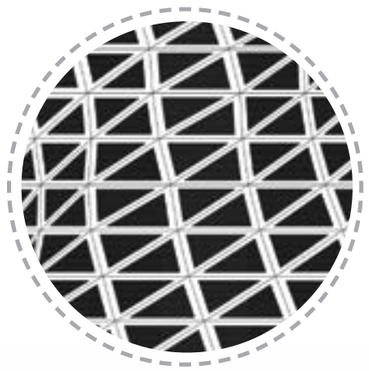
What?

Turning Tower	A residential building in north west of Tehran, with a turing form

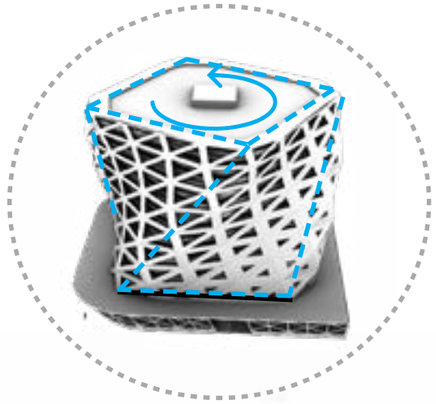
Why? How?

Urban perspective diversity	While all other buildings look similar, this building provides a different view to the street by having turning form
Having diverse views	Having turning view provide a unique perspective in each unit
Not blocking the airflow	The turning form of the building makes it possible for the air flow to pass the building without being blocked
A better usage of space	Using central core helped the building to save a lot of space , which can be used for other usages
Having well integrated living space	Connection between different spaces of each unit and units together and floors together was tried to be productive
Sharing a lot of units in each floor but prevent a lot of interactions	Allocating 4 different sets of elevation and stair cases in each floor to prevent unnecessary interactions

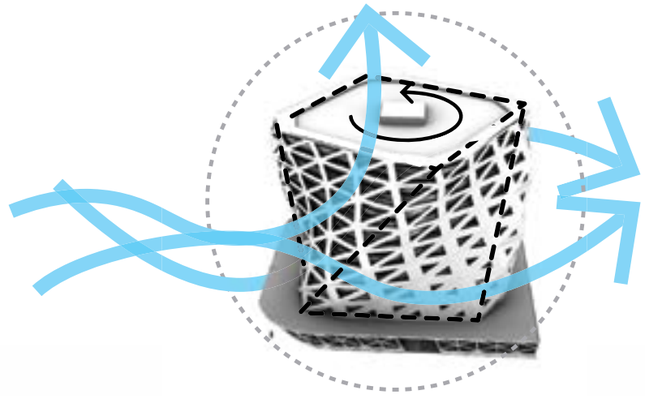
Environmental design of the turning tower



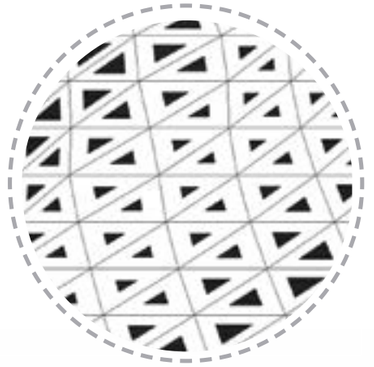
BIG OPENINGS



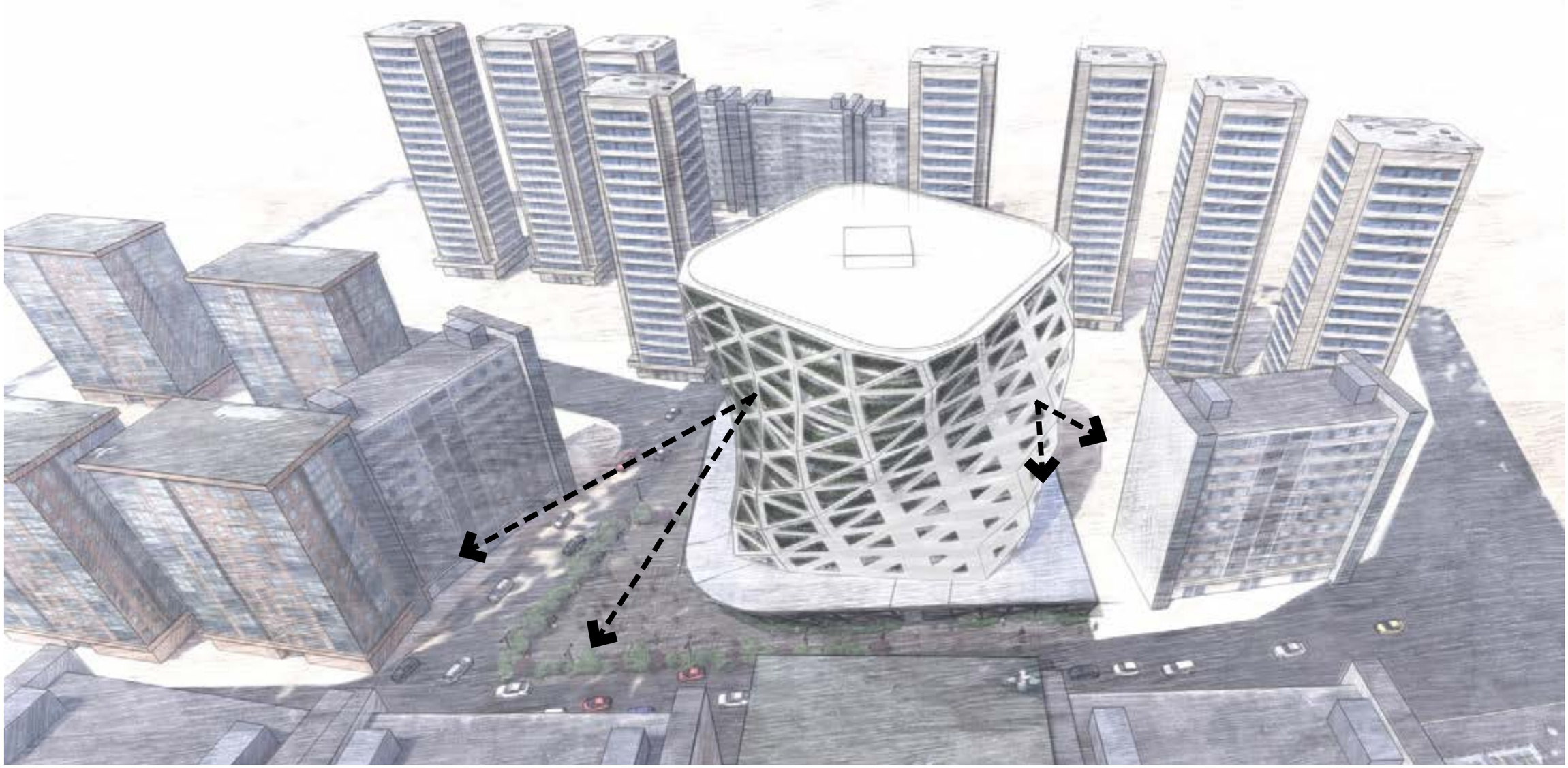
ROTATING OF THE BUILDING



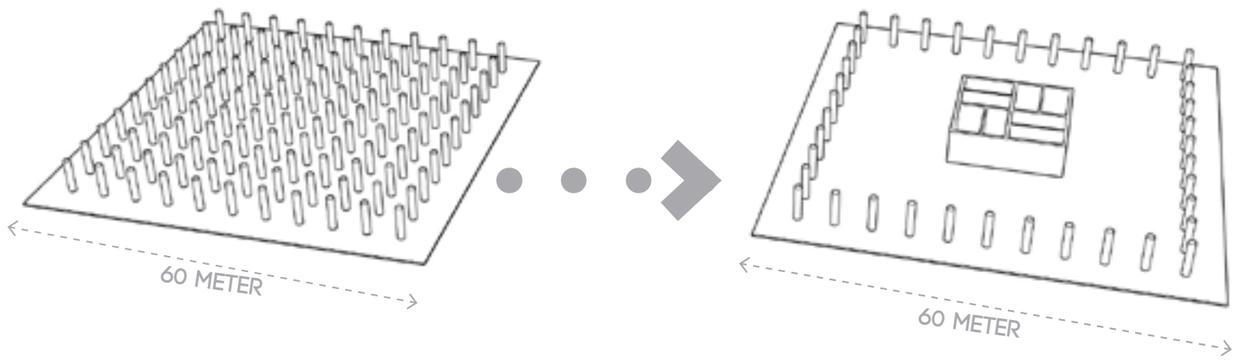
NOT BLOCKING THE AIRFLOW



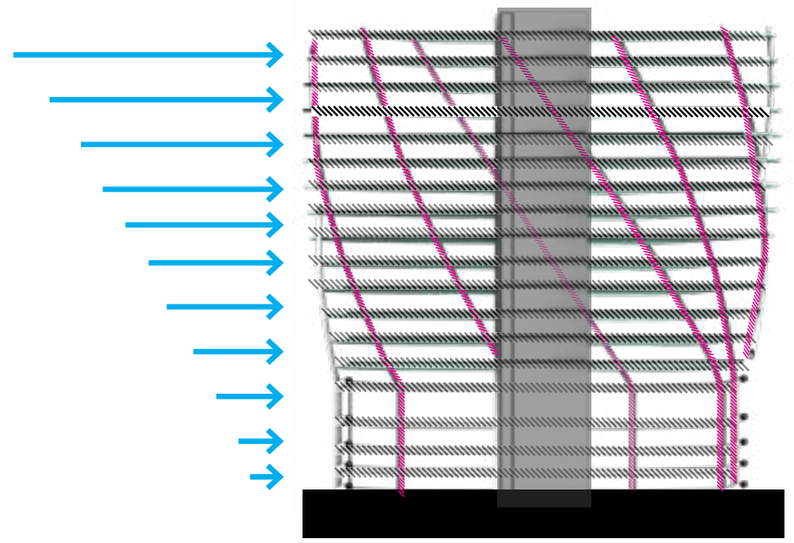
SMALL OPENINGS



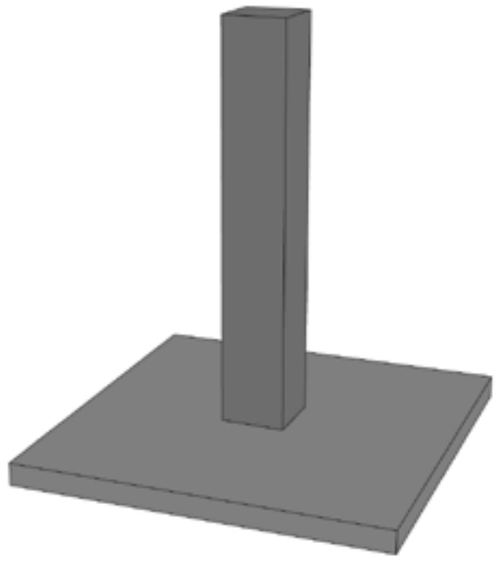
Structural design of the turning tower



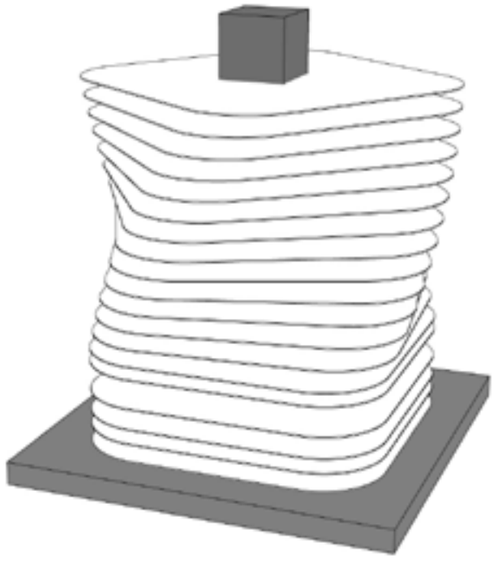
Omitting columns to make more free space



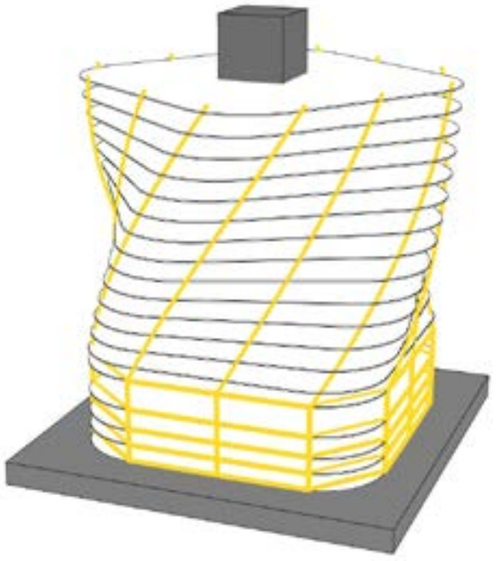
Staibilty of the building against wind force



Central Core

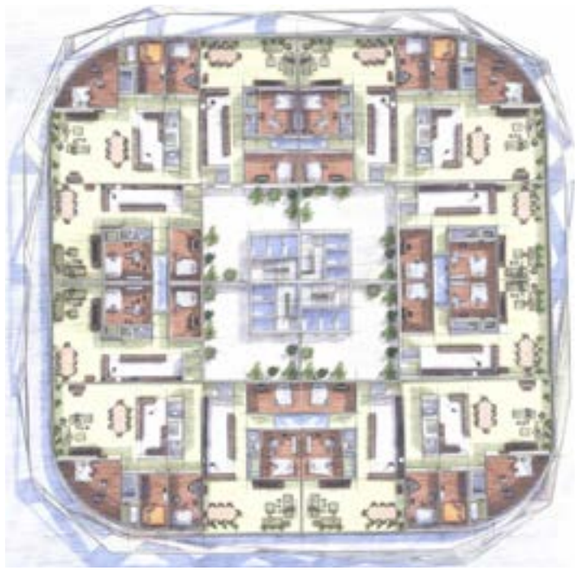


Central Core + Plates

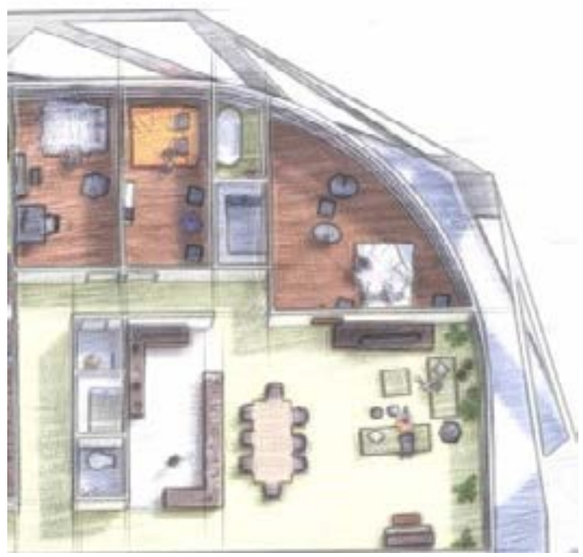


Central Core + Plates + Space Frame

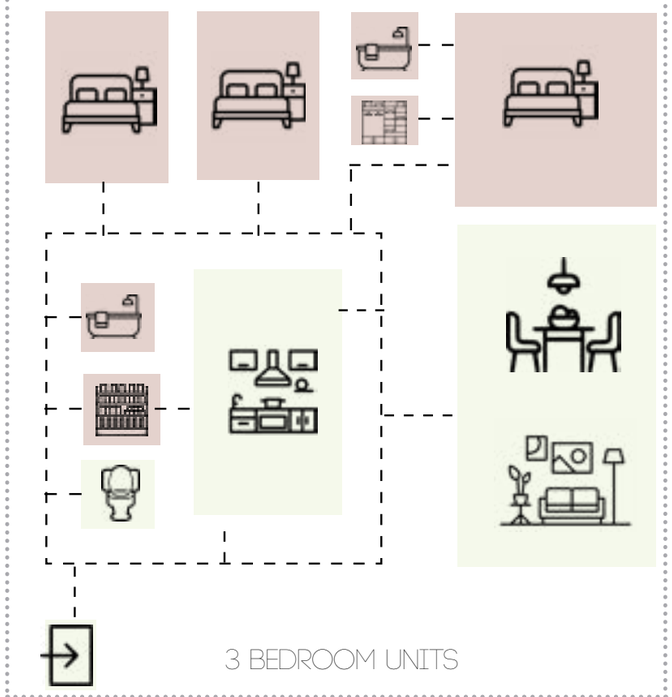
ARCHITECTURAL DESIGN OF THE TURNING TOWER



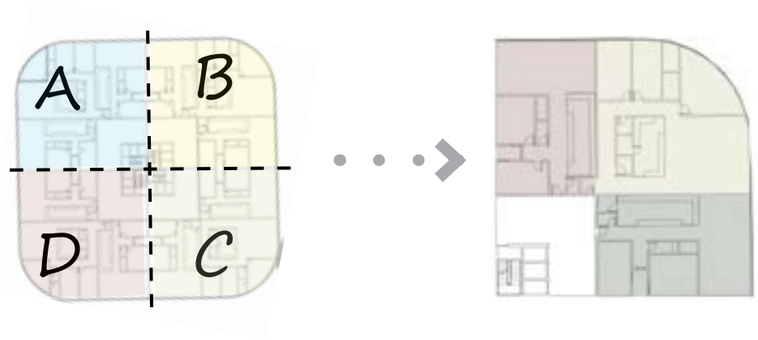
TYPICAL FLOOR PLAN



3 BEDROOM UNITS

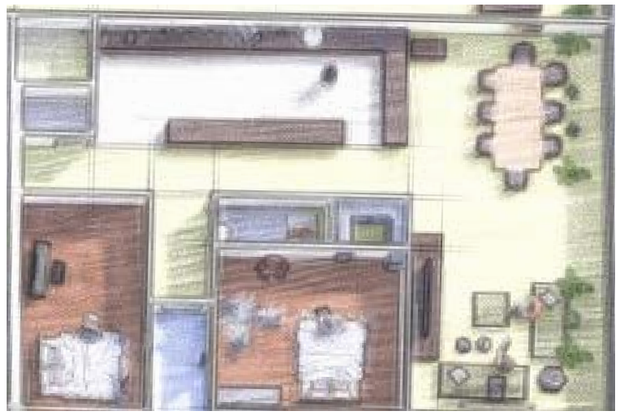


3 BEDROOM UNITS

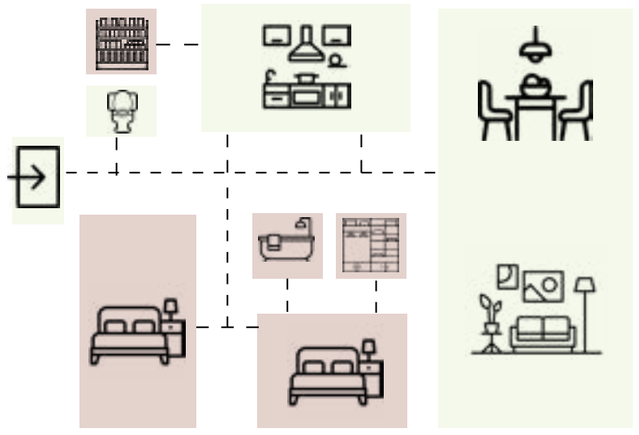


FOUR SEPARATED NEIGHBORHOODS

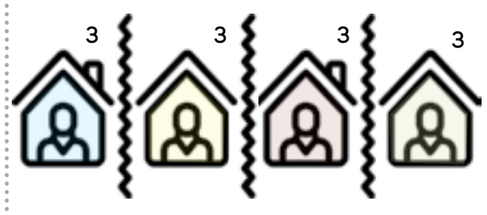
THREE UNITS IN EACH NEIGHBORHOODS



2 BEDROOM UNITS

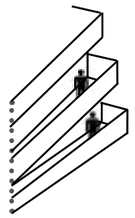


2 BEDROOM UNITS



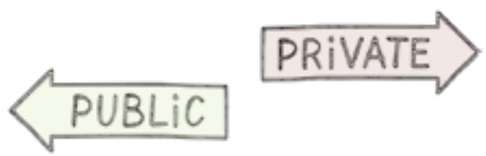
12 UNITS IN EACH FLOOR

SEPARATED STAIRCASE AND ELEVATION

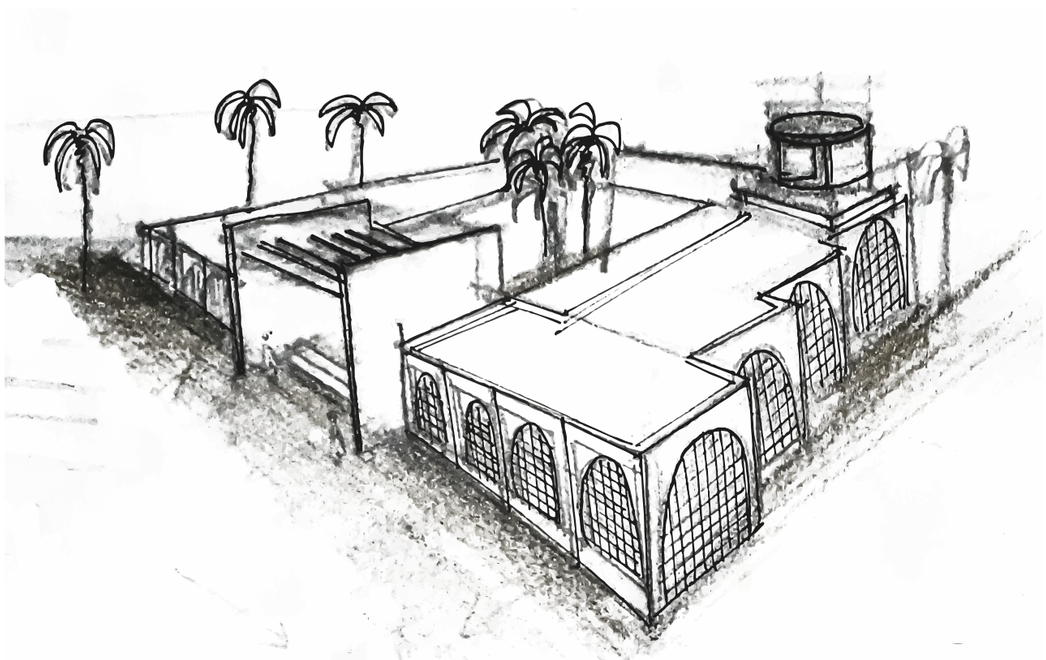


USING SPACE GENERATED BY ROTATION AS BALCONY

LANDSCAPE VIEW



SEPARATION OF PUBLIC AND PRIVATE SPACES



عمارت بادگیر

08 WINDCATHER COMPLEX

SKETCH- BACHOLER'S

WHAT?

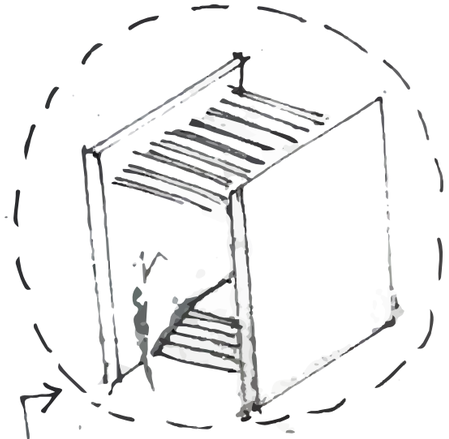
windcather complex	an old building with some energy sustainability features in a desert region

WHY?

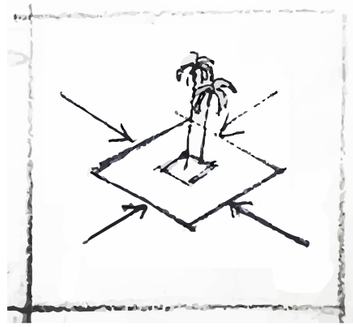
Regional	to follow the main concept of a desert region building
Energy sustainability	to be energy efficient
Smart usage of elements	Trying to solve problems with building elements themselves, rather than energy consuming technologies

HOW?

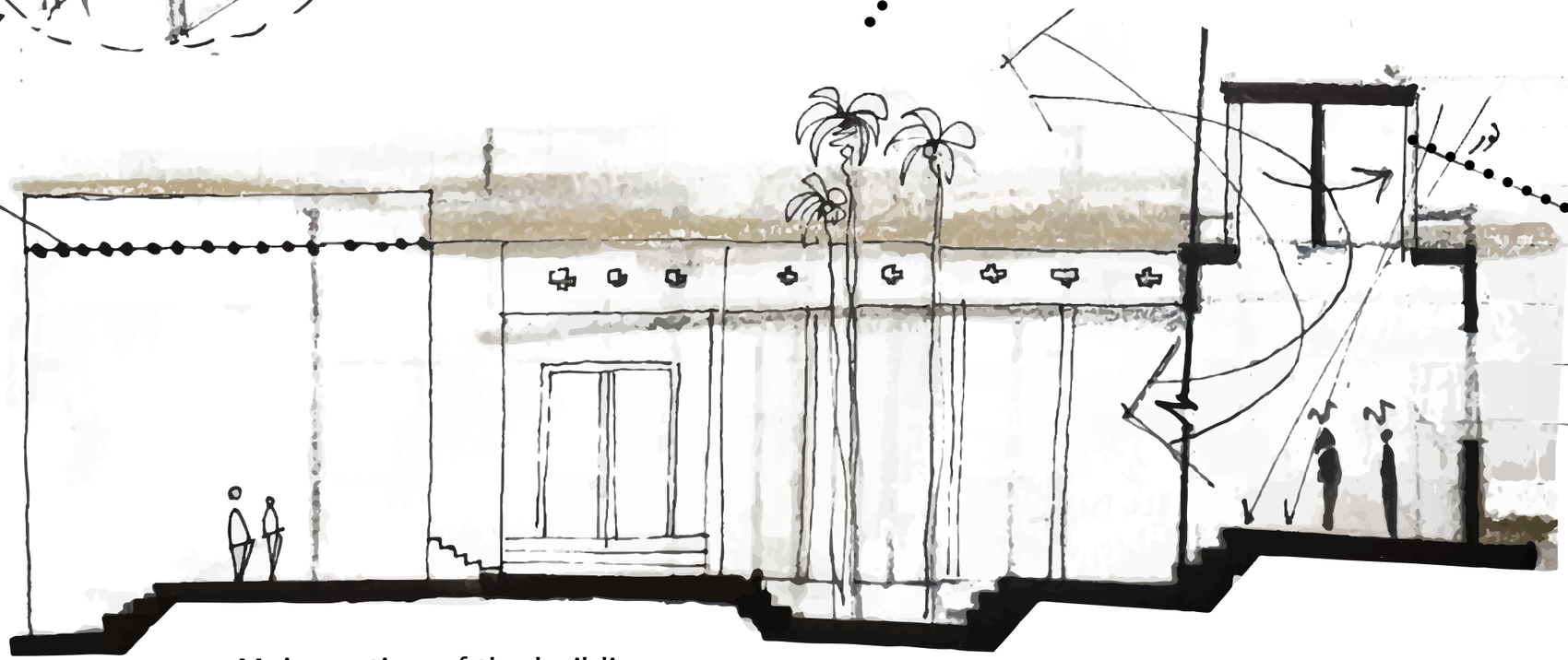
Interplay of light and shadow.	Provide a welcoming enterance	Provide cooler area
Tall Palm tree in the middle of the yard	Shadowing	Prominent element of the building
Modernized windcather	Air conditioning	Lightning
		Generating electricity



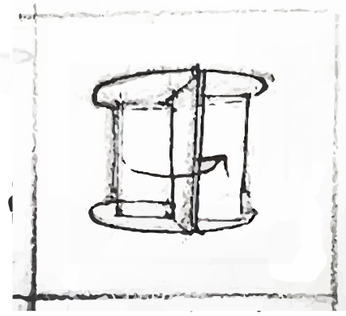
-Inviting entrance
-Interplay of Light andshadow



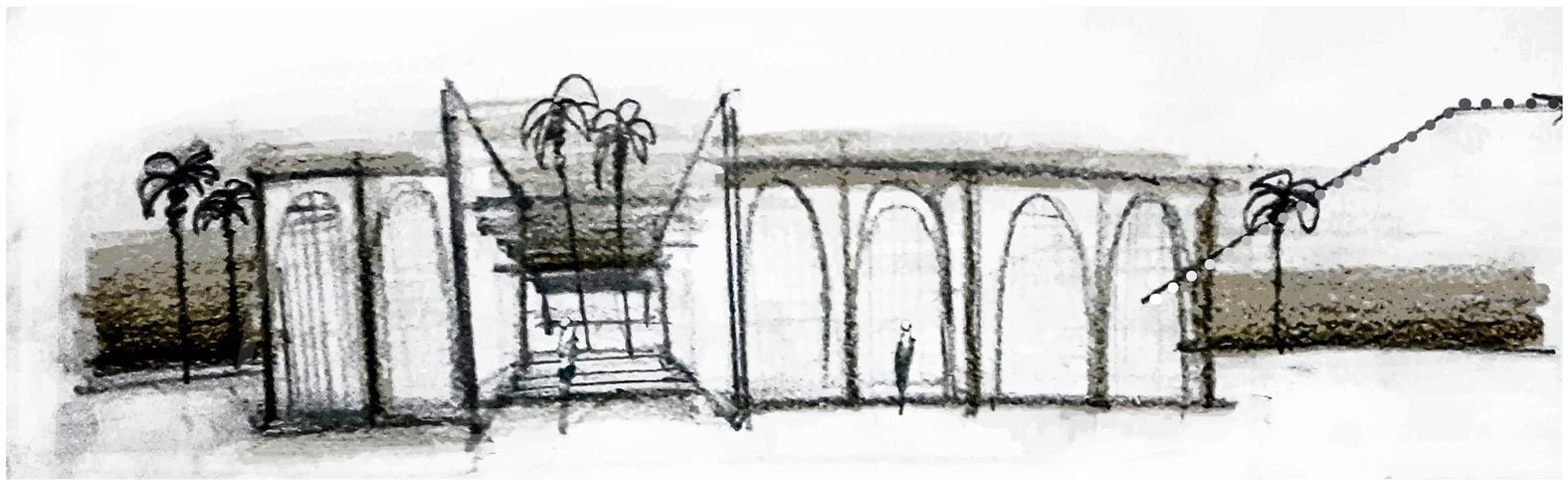
-Prominent element of the building
-Shadowing



Main section of the building



-Air conditioning
-Lightning
-Electricity



Front perspective of the complex

- Air conditioning
-Lightning

THANKS