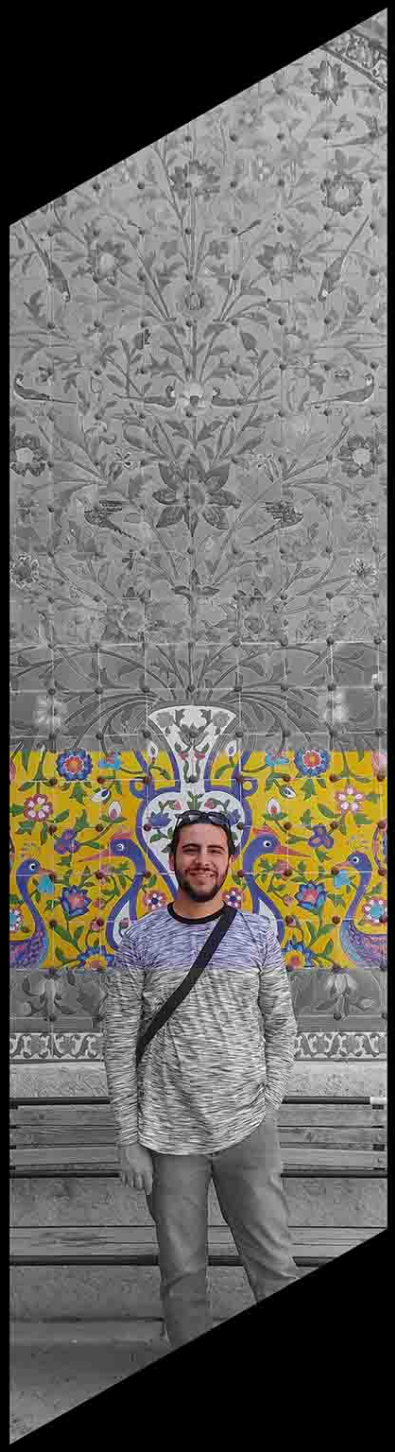
PORTFOLIO

Mohammad Sajjad Amrallahi Biouki



Personal Information

Top-ranked graduate of Architecture, well-versed and enthusiastic in Architectural Technologies Computer Aided Design, Digital Fabrication and Structural Engineering;

Education

B.Sc. in Architectural Engineering 09/2016 - 08/2021
Department of Architectural Engineering, University of Tehran (Ranked 1st in Iran)

Diploma in Mathematics and Physics 09/2012 - 07/2016
Shahid Sadooghi High School - NODET

Achievements

- Ranked 7th in Architectural Engineering in Iran's National Master's Entry Exam
- Received Full Scholarship from "Iran University of Science and Technology"
- Computational Design: NEXT 1.0 Workshop Attendanded June. 2020
- Encoded Stereotomy Workshop Attendanded June. 2019

Experiences

Exchange Student Intern 06/2022 - 08/2022
Sultan Qaboos University (IAESTE Exchange Program)

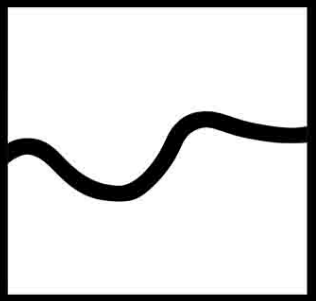
Head Designer & Co-Founder 05/2018 - Present
SHIMO Design Studio

Research Interests

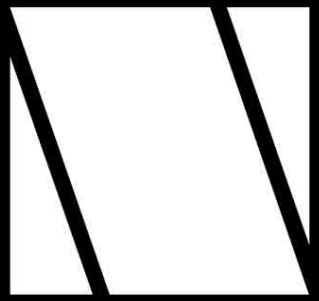
- Funicular Structures with Classical Mud Bricks
- Sustainable approach to Replace Concrete Blocks
- Easy to Build Shelters in Deprived areas
- Tessellation and Self-Stability of Shells during Construction

Technical Skills

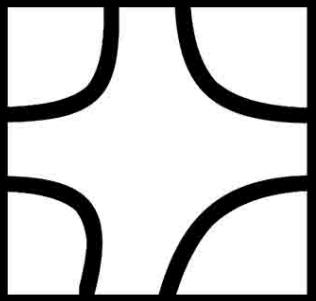
AUTOCAD 2D		SKETCH UP	
REVIT		3D MAX	
GRASSHOPPER		RHINO 3D	
V-RAY RENDER		C# FOR GH	
CORONA RENDER		PHOTOSHOP	
TWINMOTION		POWER DIRECTOR	
CATIA & FEM		MICROSOFT EXCEL	



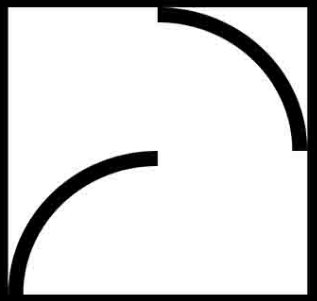
Karakal Desert's Adobe Vault
Spring 2021
Pages: 1 to 5



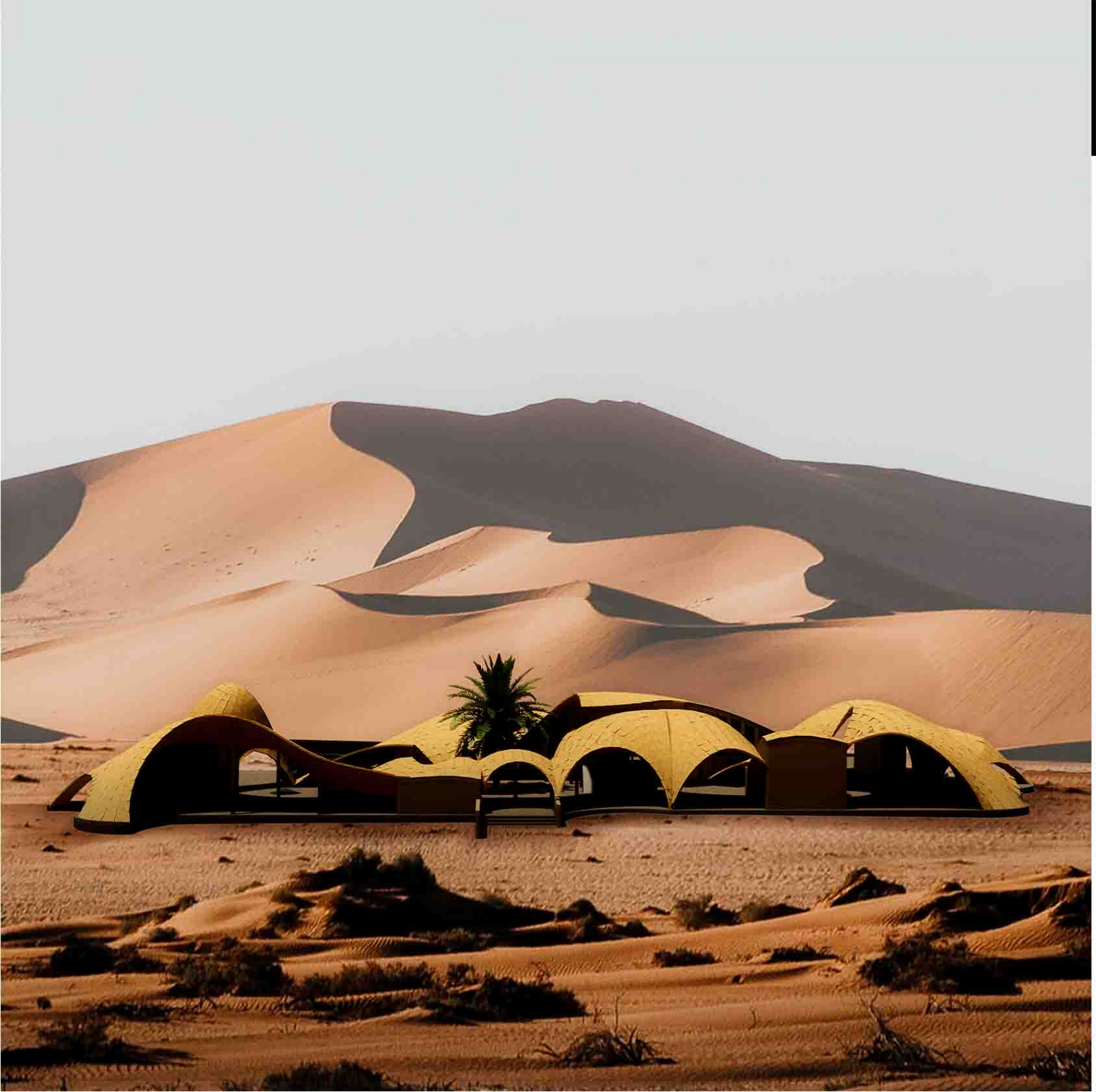
TSETMC Double Skin Facade
Summer 2022
Pages: 6 to 10



Minimal-Surface jointed Structure
Winter 2019
Pages: 11 to 13



Printerra (3D Printing Earth)
Summer 2023
Pages: 14 to 16



Karakal Desert's Adobe Vault

Type: University Final Bachlor's Project
Date: Spring 2021
Lecturer: Dr. Hamed Mazaherian
Location: Bagfh, Yazd, Iran

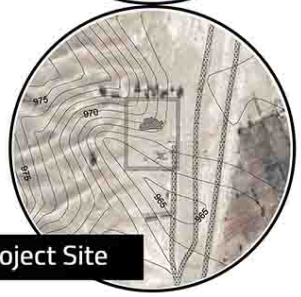
The main purpose was to design a touristic camp point and hostel intended to welcome Karakal desert visitors, provide them with basic shelter and maybe have the option to rent out some rooms, for the ones who desire a longer stay and want to see the stars.
After analyzing the environment, the approach was to divide the required areas into two separate sections. First the shelter and rest section and then the more sensitive parts, that are hostel, café, management and maintenance.
The biggest concern was, however, not to disrupt the viewer's eyeline with blatant figure and to respect the unprecedented landscape of the desert; therefore, the decision was to create a form, seemingly related to the dunes.
A set of vaults that act as sunshades. But the challenge was to find a method of construction that would result in an approximately funicular shape which is self-standing and avoid non-necessary structural care to withstand the vaults load. for that purpose, RhinoVAULT ™ plugin was chosen, to calculate the compressional arcs using the basis of graphic statics.

Iran

Yazd State

Bafgh City

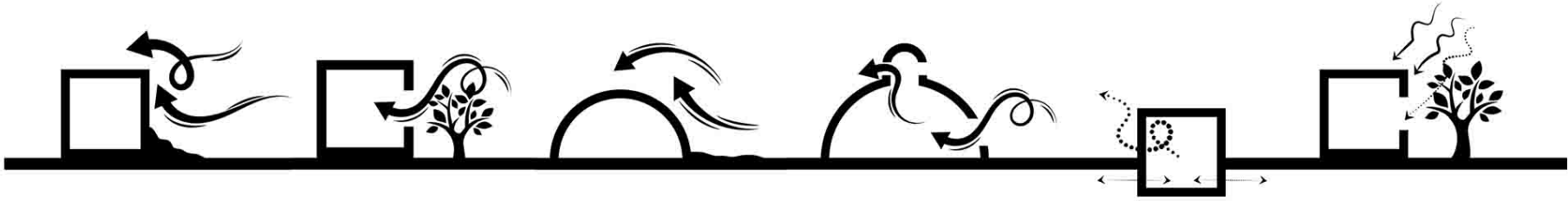
Karakal



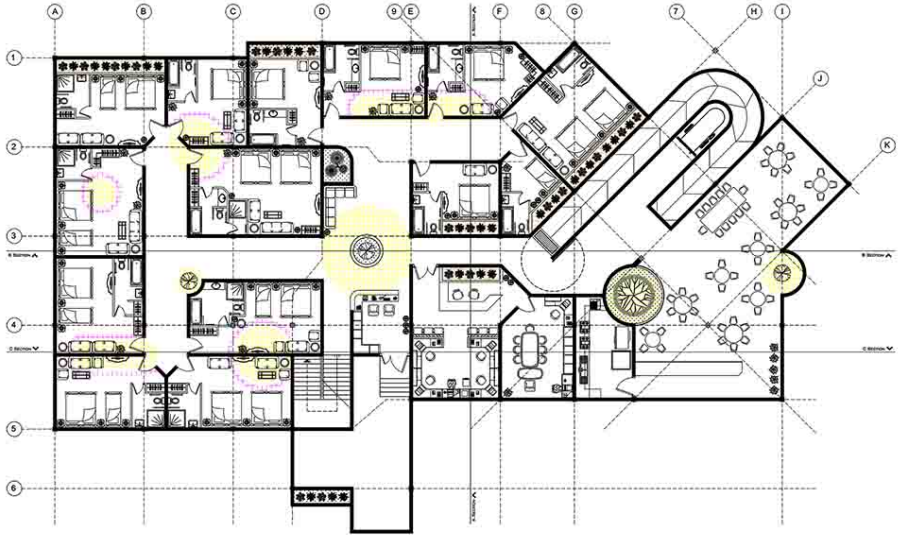
Project Site

Karakal desert is a phenomenal sand dune valley, adjusting the village of Sadegh Abad, created unexpectedly by the special wind torrents of the area trapped between mountains near the area. Designing in such climates need some expedient arrangements to overcome problems like the sand sediment, dry wind, burning sun rays or high difference between day and night temperature.

The main idea became to use arch domes to both let the air flow smoothly and for the landscape view to match the background. Some alternatives were made but to reach a clearer vision of the upcoming design, a collage of pictures was created that could represent the atmosphere of the idea and the environment, and then by envisioning the different parts and combinations of it, a brighter picture emerges.



Basement Plan

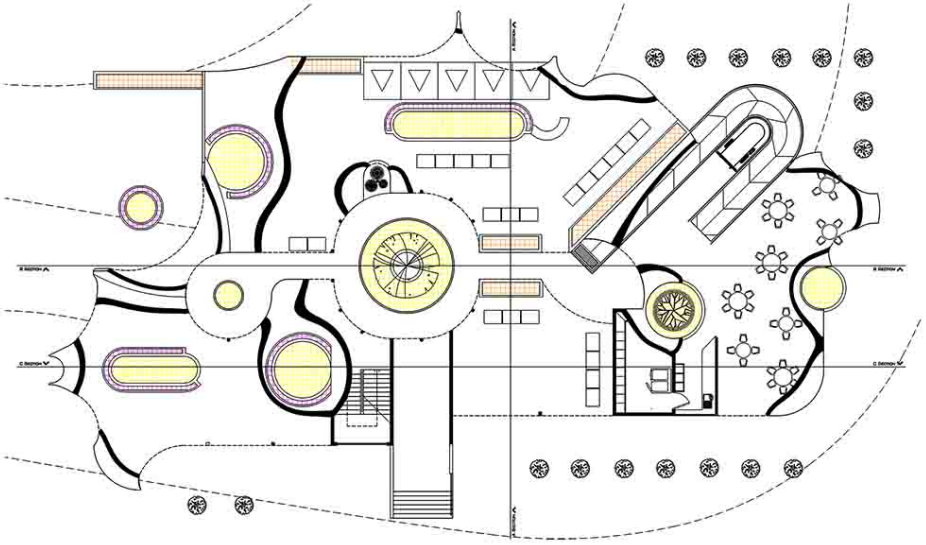


Ceiling Light

Shaft Aperture

Ceiling Vent

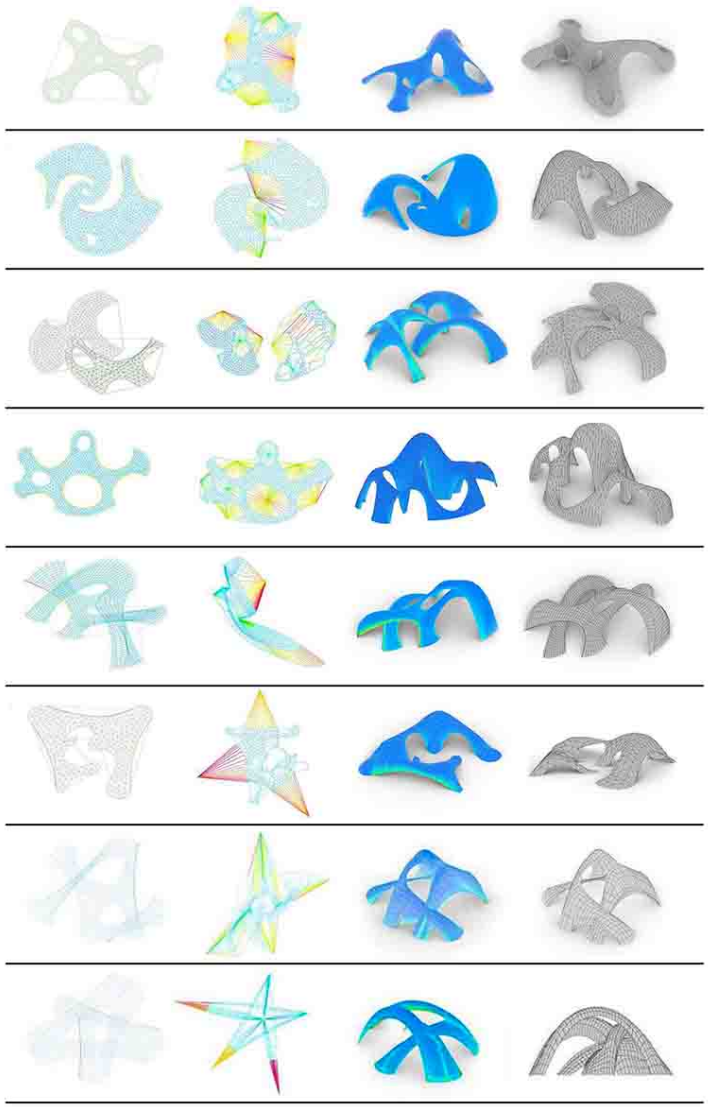
Floor Plan

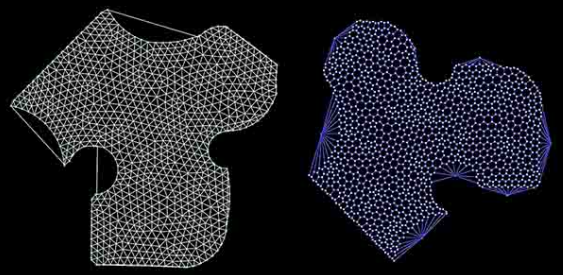


Using RhinoVAULT ™ platform some different variations were made inside the sketched boundaries of plan; after adding some supports, the ones that best fitted with each other based on openings and height were selected and underwent the final stages of equilibrium.

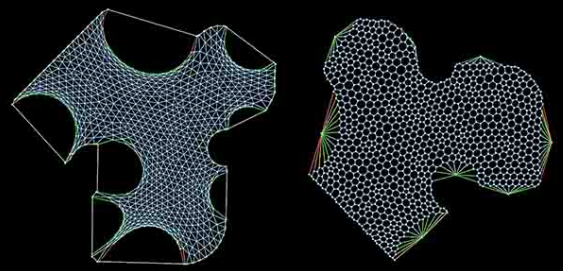
Created Alternatives

Form	Force	Thrust Net.	Mesh

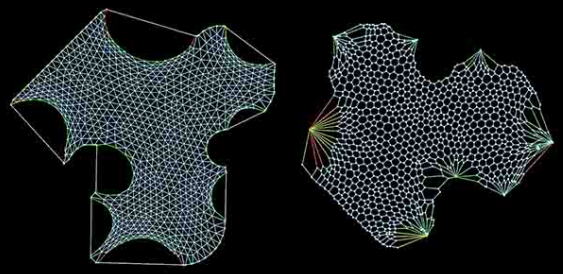




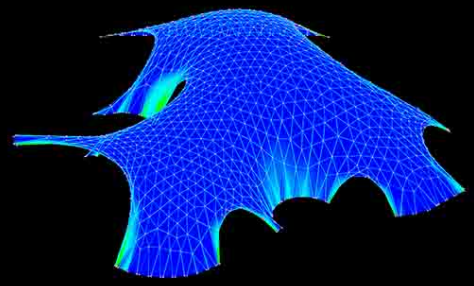
▪ Generated Diagrams before Equilibrium



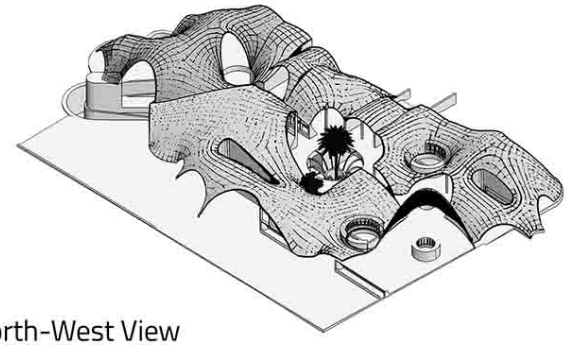
▪ Form Diagram after Vertical Relaxation



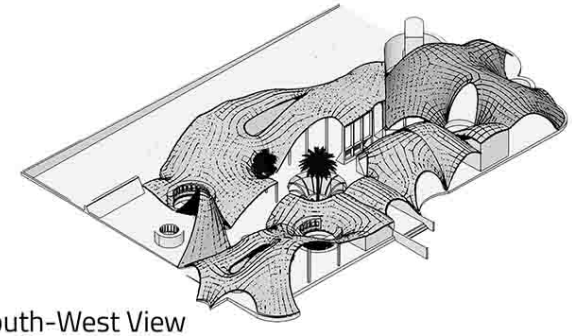
▪ Force Diagram with Horizontal Equilibrium



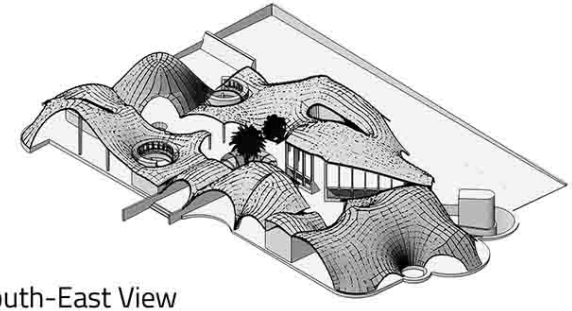
▪ Final Thrust Network and Mesh analysis



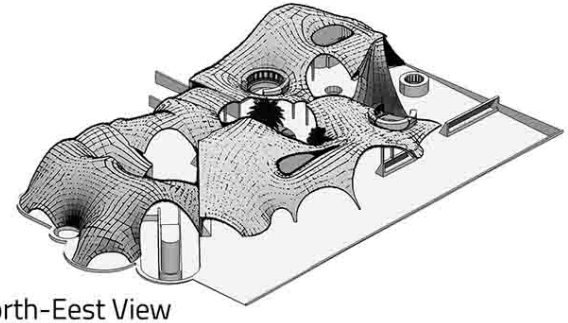
▪ North-West View



▪ South-West View

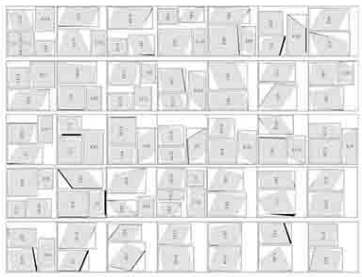


▪ South-East View

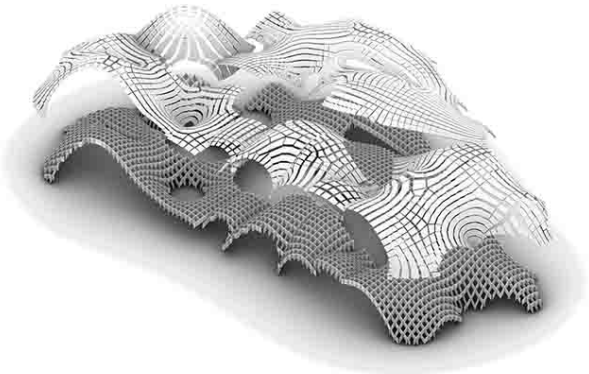


▪ North-Eest View

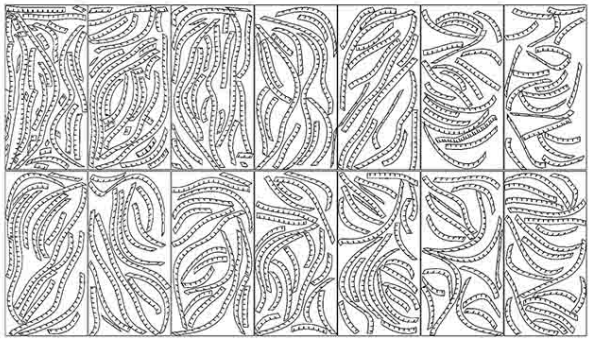
- For the construction stage a temporary support was needed, like a waffle plywood structure. Also, a digital manufacturing method was chosen for the adobe bricks. A mold cutout from polyester by a 4D wire-cutting machine for the mortar to be poured inside.



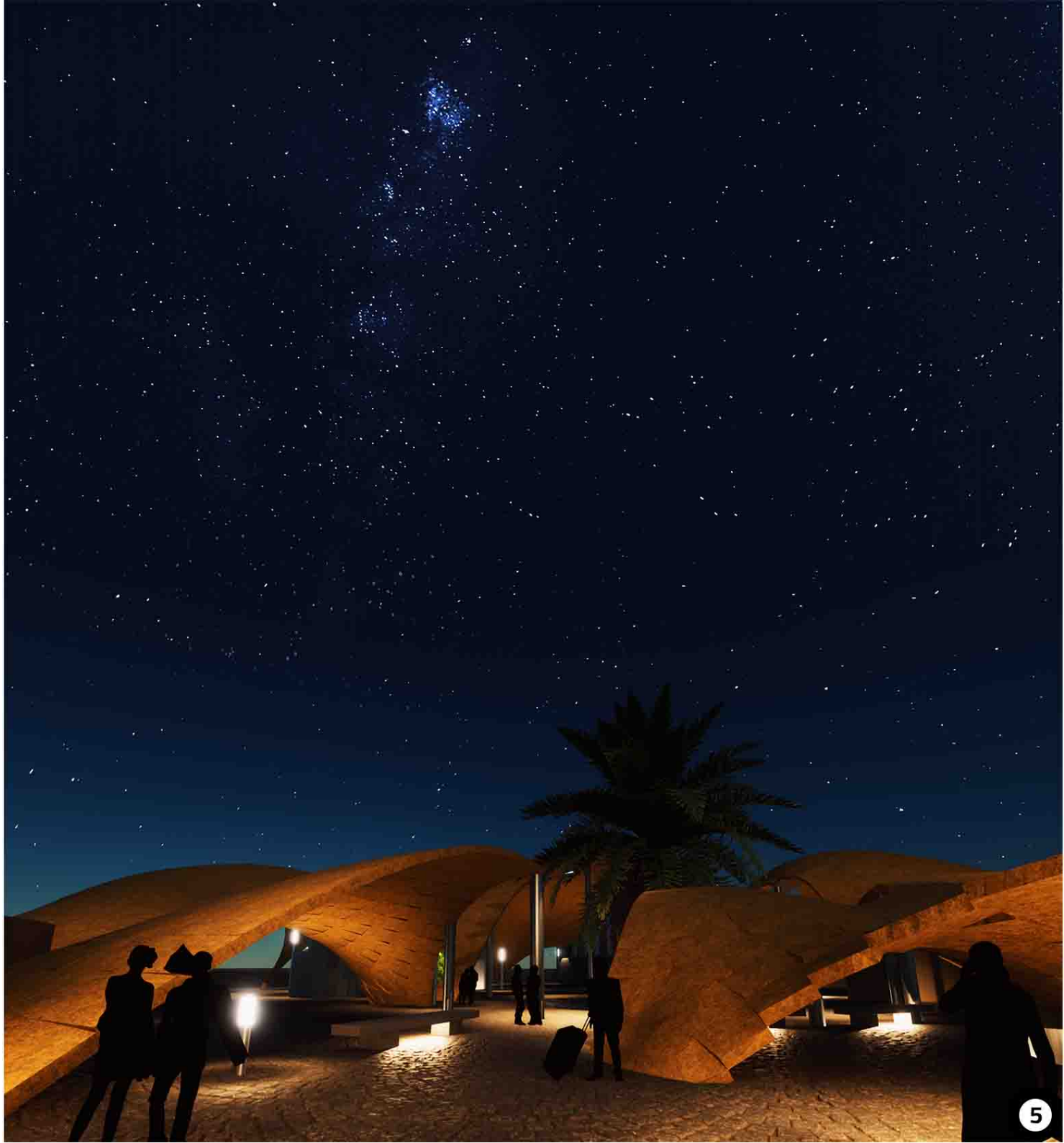
- Wire cutted mold for adobe bricks



- Installation onto the waffle supports



- Supports laser cutting sheet

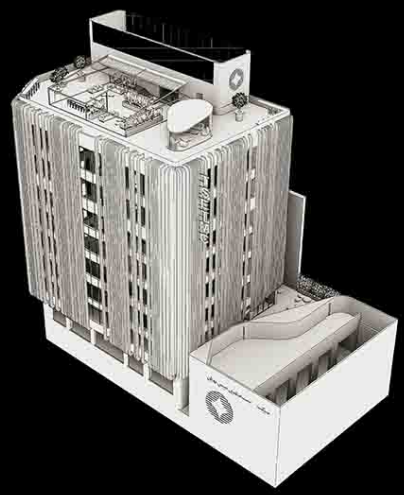


TSETMC Double Skin Facade

Type: Freelance Design Project
Date: Autumn 2021 - Summer 2022
Employer: 210|6 Architectural Firm
Location: Tehran, Iran

The contract that was handed out from "6|210 Architects" stated that their new project needed a parametric second façade covering the newly renovated "Tehran Stock Exchange" Building. Again, the approach was obvious, to test multiple alternatives and consult each, regarding multiple attributes of each.
Although at the end the simple idea of simple aluminum stripes was picked, because of the difference in price and development schedule, the other ideas are worth mentioning too.
First idea was to use a set of lightweight brick veneer made from porous adobe, griped between two horizontal tubes, tilted more in the middle to let light in. use of the special material was both about reducing the weight and on the other hand, giving the potential of passive evaporative cooling to the second skin façade by spraying water onto them.
And then there was the favored alternative of stretch metal panels, spread and installed on diagonal profiles that was fully covering the façade, but the translucency made a pleasant view from the office and a sense of privacy from outside.

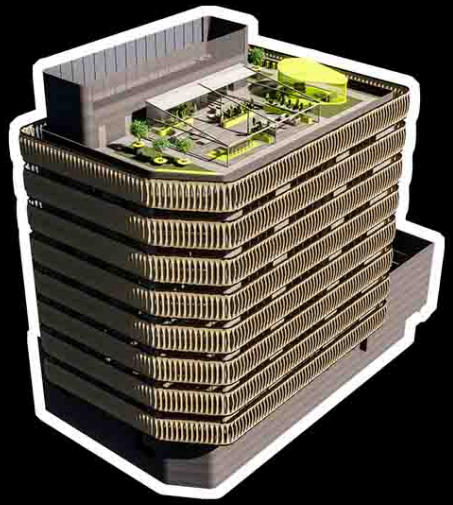
1st Alternative



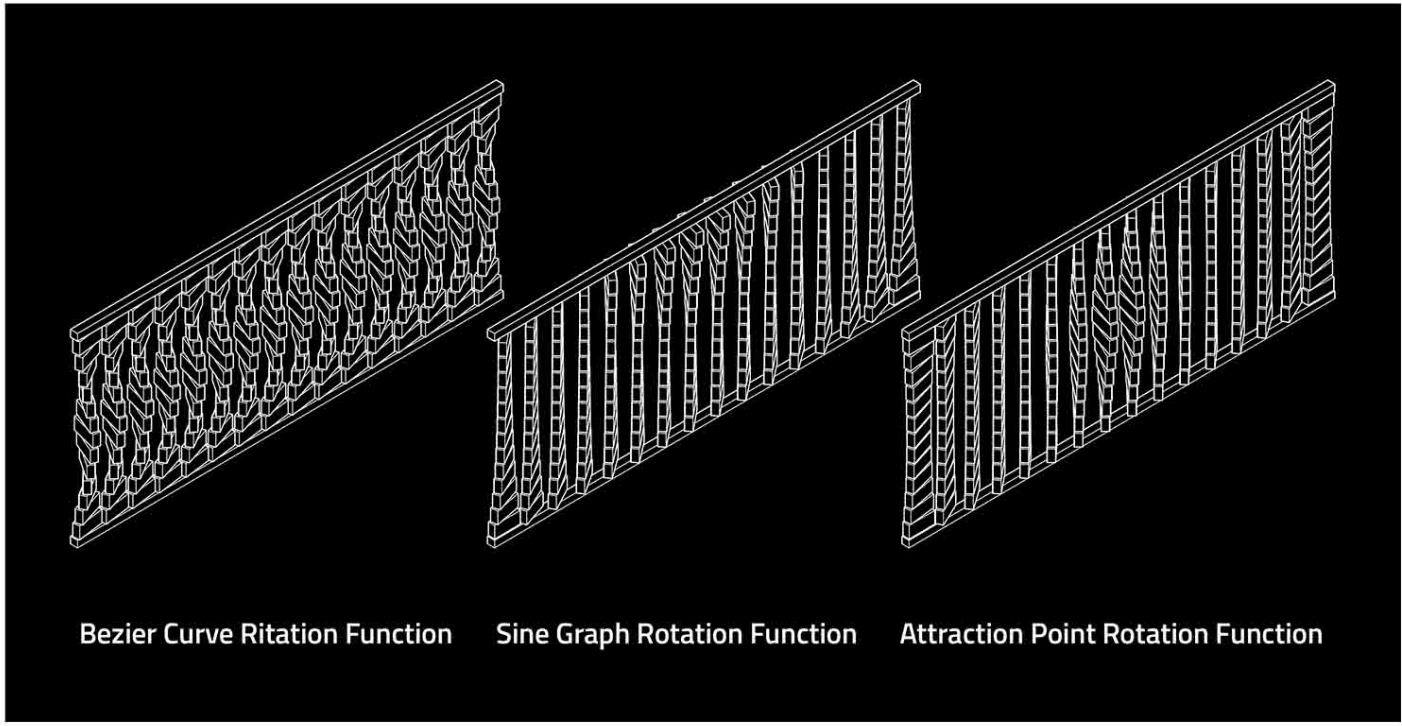
The approved design is the one shown, containing vertical narrow columns of steel brushed tubes, lengthening from the roof to the ground floor's ceiling. They acted as shades blocking eastern and western sunlight and to provide privacy for the building. The distance was calculated linked to the floor plan; whether there was a window, distance widen and were it reached walls, the gap would shrink.

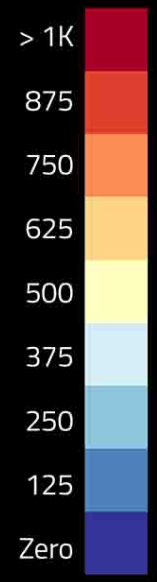
2nd Alternative

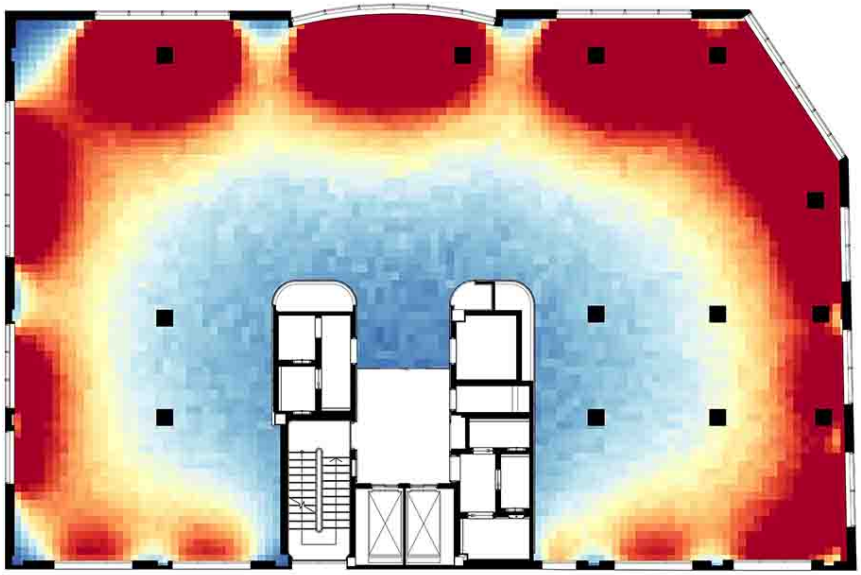
The second alternative focused more on the material part of the design, as a lightweight porous was needed to pull it off. it surrounded an idea to have a passive evaporative cooling facade and to also control the incoming daylight. tough it may seem difficult, after searching the market, a manufacturer, "AzarakhshBrick" let us to modify a veneer brick production line. a method to bake the thin brick by high amounts of aluminum dioxide (according to Tuna Aydin, 2017), and bake it with less amount of compression, then, let it rest in a fire chamber to become a clay like brick. However, after the test stage it was realized that the cost of this operation would surpass project's limit and so it was disapproved at the end as a valid alternative.



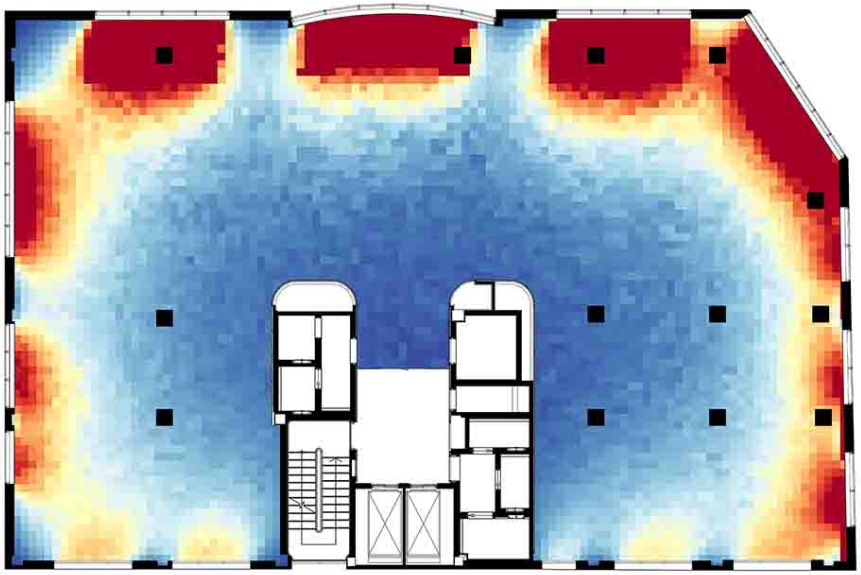
The illuminance amount in office buildings such exceed 500 lux; but as it is shown in the diagram on the left, without shading, the situation doesn't reach the required limits. The second diagram on the other hand, shows the office in a state that catches the proper amount of sunlight. By test and analyzing different attributes of the design, like the rotation principle, calculation and limit, the brick modules' dimensions and the distance between each module, the best possible stage was reached that contained the highest possible percentage of useable space in each floor plan.







Daylight Simulation Analysis Without Shading



Analysis With Presented Shading System

3rd Alternative

The 3rd design idea was the most favored; consisting of transparent cells covering the whole façade, improving privacy efficiently and with the color gradient shading the cells, it rendered an astonishing view from outside. The best material that could work in this situation was Stretch Metal Sheets, expanded and held between different forms of steel profile. The profiles fabrication was managed by equalizing the bending curvature of the diagonal ones and cutting them by waterjet machine. But the process faced a problem when it was known that the manufacturer of such metal sheets had stopped working in Iran and the material was to be imported, which increased the cost significantly.

Minimal-Surface jointed Structure

Type: University Bachlor's Course
Date: Winter 2019
Lecturer: Dr. Ramtin Haghnazar
Location: Tehran University, Tehran, Iran

Computer Aided Design and Fabrication (CADF97) was a course submitted on the first semester of 19/2018 academic year. It was an optional computational design and fabrication course for bachelor students, consist of only 12 students. But through our course we convinced our lecturer to construct an actual structure, as a unique way to end the course. Alternatives were submitted but at the end, an idea to fabricate a simple column, consisted of struts and Minimal-Surface joints was chosen.

Different approaches were tested. First using re-mesh or mesh smoothing methods like Catmull-Clark or Loop Subdivision or curve charging, using Cocoon plugin; however, at the end the best results came from only two options: KangarooPhysics or T-Spline.

Due to T-Spline's incompatibility to newer versions of Grasshopper, the longer pass of computing each joint as tensile surface by Kangaroo was finally picked as a result. The outcome was a combination 274 Steel rods, manually cut based on data and 3 165D printed joints, each optimized to exert the least amount of material necessary.

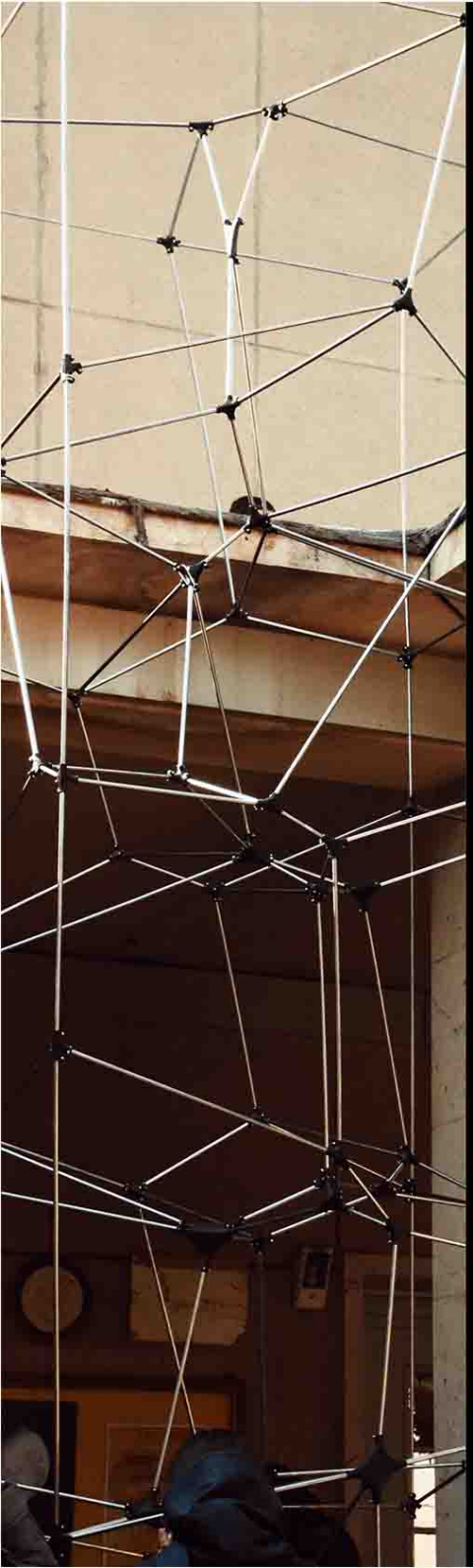
T-Spline

Re-Mesh

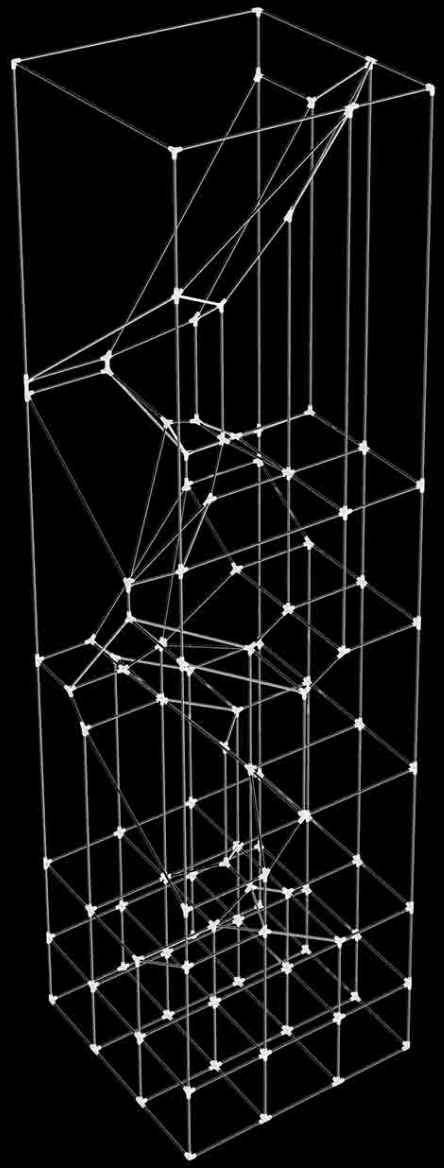
Tensile Strech

The biggest challenge of the design was to come up with an idea for the joints. The purpose was to finish the structure with the least amount of expenses possible. So the best approach was to optimize them using a method of minimal surface computing to spend the minimum amount of materials on each. Different possible ways, firstly the fastest method was to use T-Spline algorithm, but it was incompatible with the new versions of the Rhinoceros application or the grasshopper plugin. Remeshing, using Catmull-Clark algorithm was the fastest method to be reached, but the process was too buggy and the results were inconsistent. However, the slow algorithm of KangrooPhysics plugin was chosen to analyze and compute each joint as a tensile surface.

The number of the rings indicates the order of slots in joints, to be able to recall for assembly.



The 3D Model



The joints were 3D printed using ABS filaments, but due to high expenses the printing accuracy was lowered. The steel struts were cut manually and marked, though the measure list was optimized to have the least amount of waste in 6m long rods. In the next phase the structure was assembled in 3 separate parts inside the studio to grant easier mobility. They were then moved to the located site, joined together and then were erected cautiously.

Printtera (3D Printing Earth)

Type: Architecture & Robotics Research Collabration and Course
Date: Summer 2023
Organizer: Iran University of Science & Technology, School of Architecture
Location: Tehran, Iran
Instructor: Dr. Morteza Rahbar

Robots have become widely recognized tools, that offer a dual purpose: they assist in easing human labor, while also serving as replacements in situations requiring high precision or when harsh conditions make human involvement impractical. Robots employ various established methods such as modular assembly, subtractive manufacturing, or partial human-robot collaboration to reduce human interaction and labor costs.

However, for our proposed project, additive manufacturing or 3D printing stands out as the most prominent and efficient construction method globally.

Our design presents an advanced moving Cartesian 3D printer, uniquely adaptable to challenging landscapes. This innovative robot draws building materials directly from the earth and prints modules, cell by cell, until the entire camp or village is fully constructed. This approach minimizes human involvement and maximizes both construction speed and sustainability.

Spatial Daylight Autonomy

100.0 %
sDA

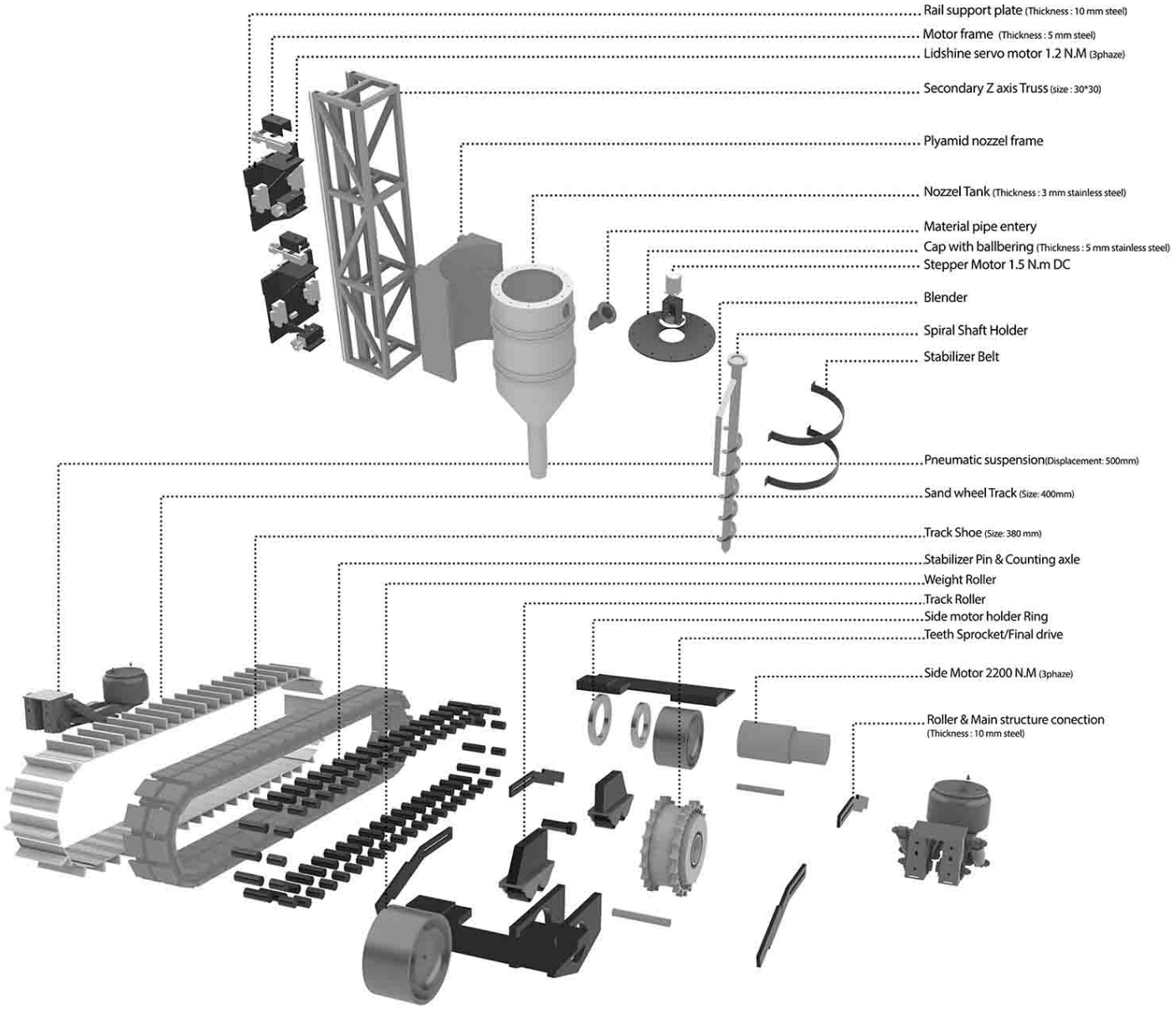
Annual Sun Exposure

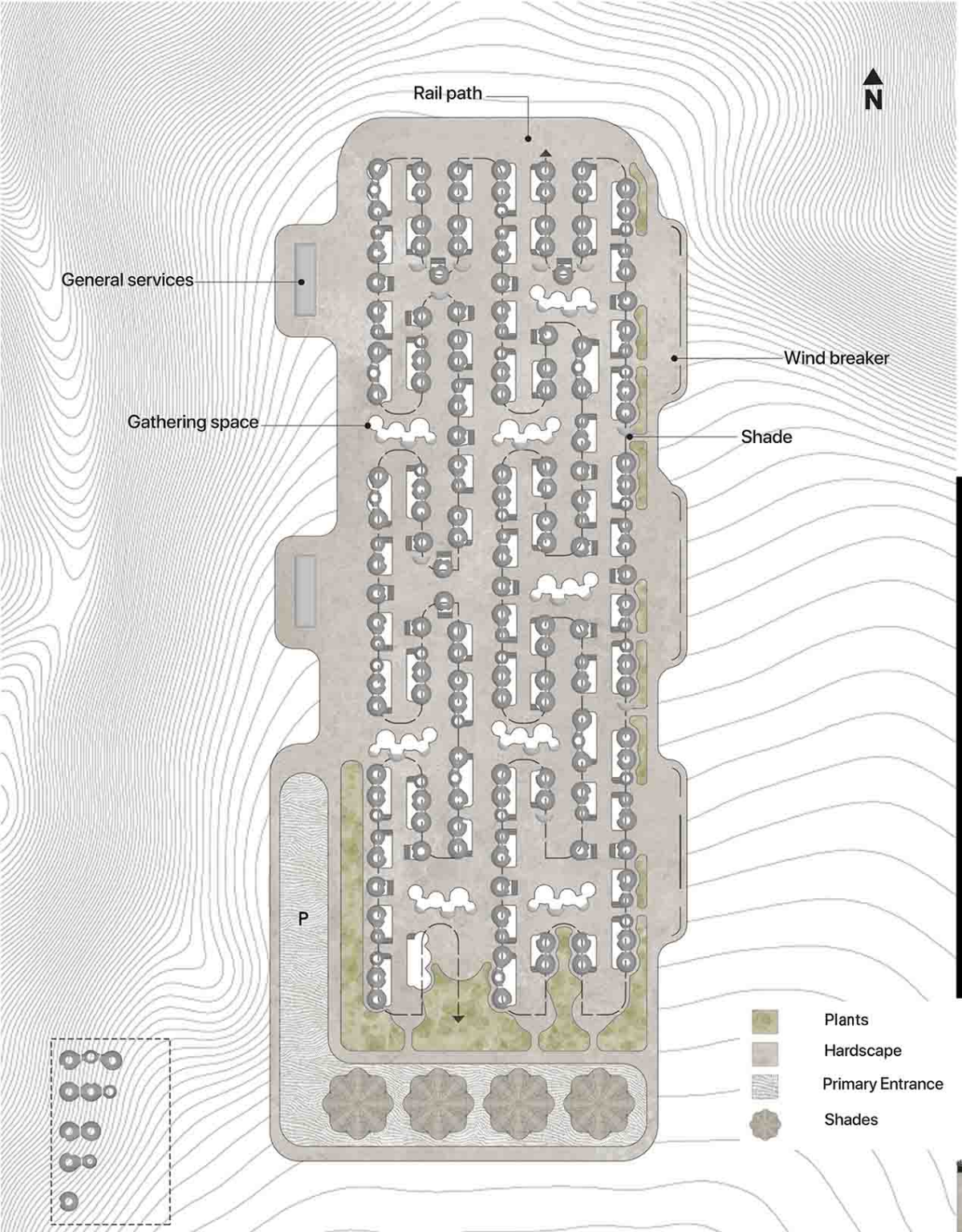
38.5 %*
ASE

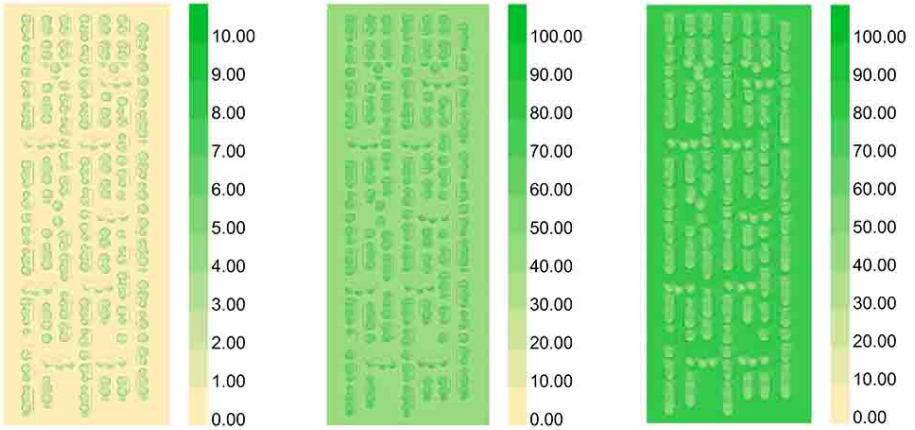
Mean illuminance

5170
avg lux

Details of Printer and Light Analysis : sDA, ASE, Mean illuminance







Outdoor comfort : The outdoor comfort is evaluated in the winter for 3 months, the summer for 3 months, and the moderates. As could be predicted, in the summer this climate is too harsh, and using these strategies could improve the situation. So staying in units or designated semi-open spaces could improve outdoor thermal comfort.
In the winter, these semi-open spaces could conserve heat during the day and give it back to the environment at night. So these ideas also work in the winter. In the moderates (spring and autumn), the UTCI is provided and no critical issues exist in these times.

The Landscape and it's section are present in view.

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THANK YOU!