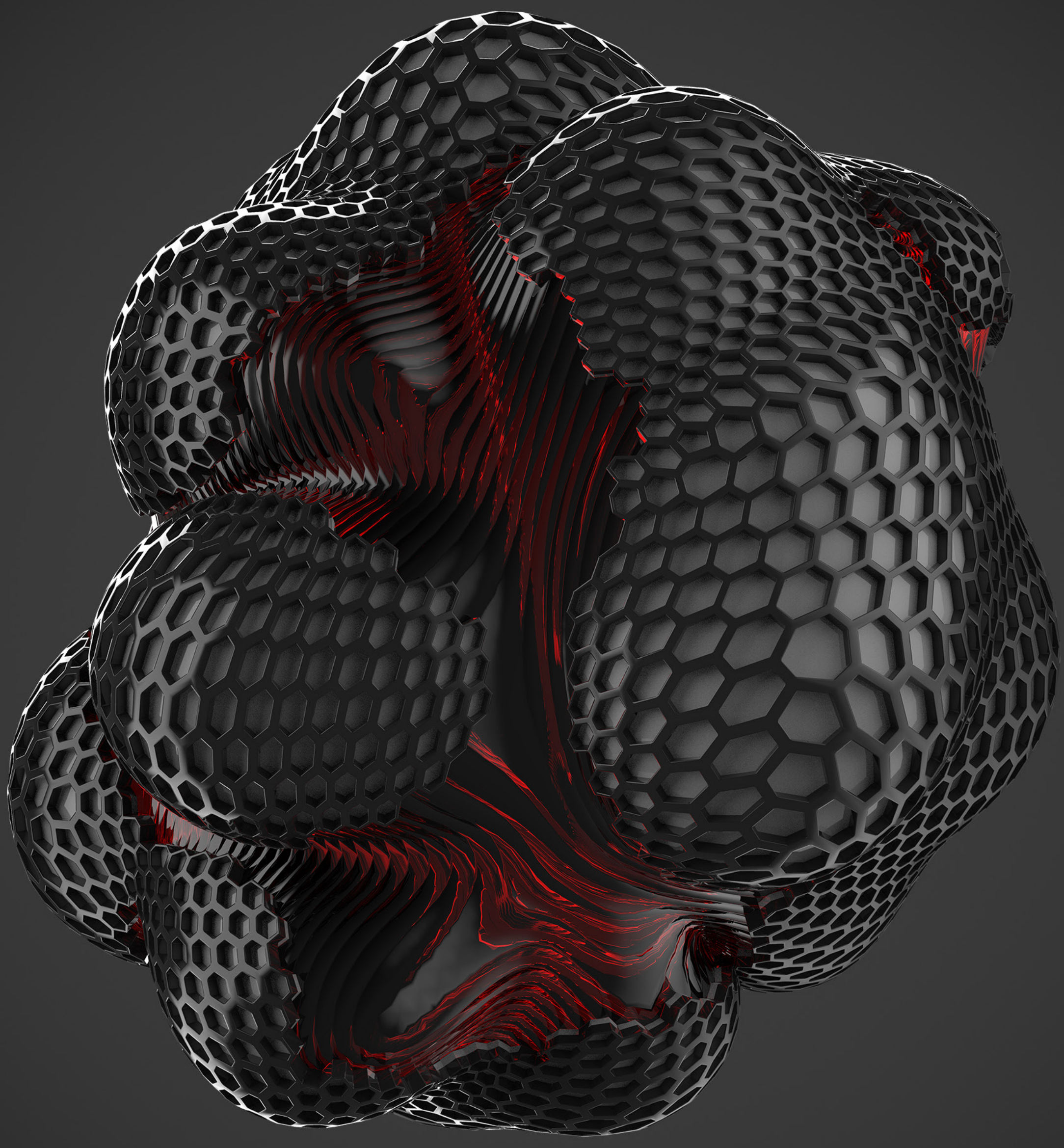

مَحْمُودُ عَبْدِ الْمُحْسِنُ

Mahmoud Abdel Mohsen

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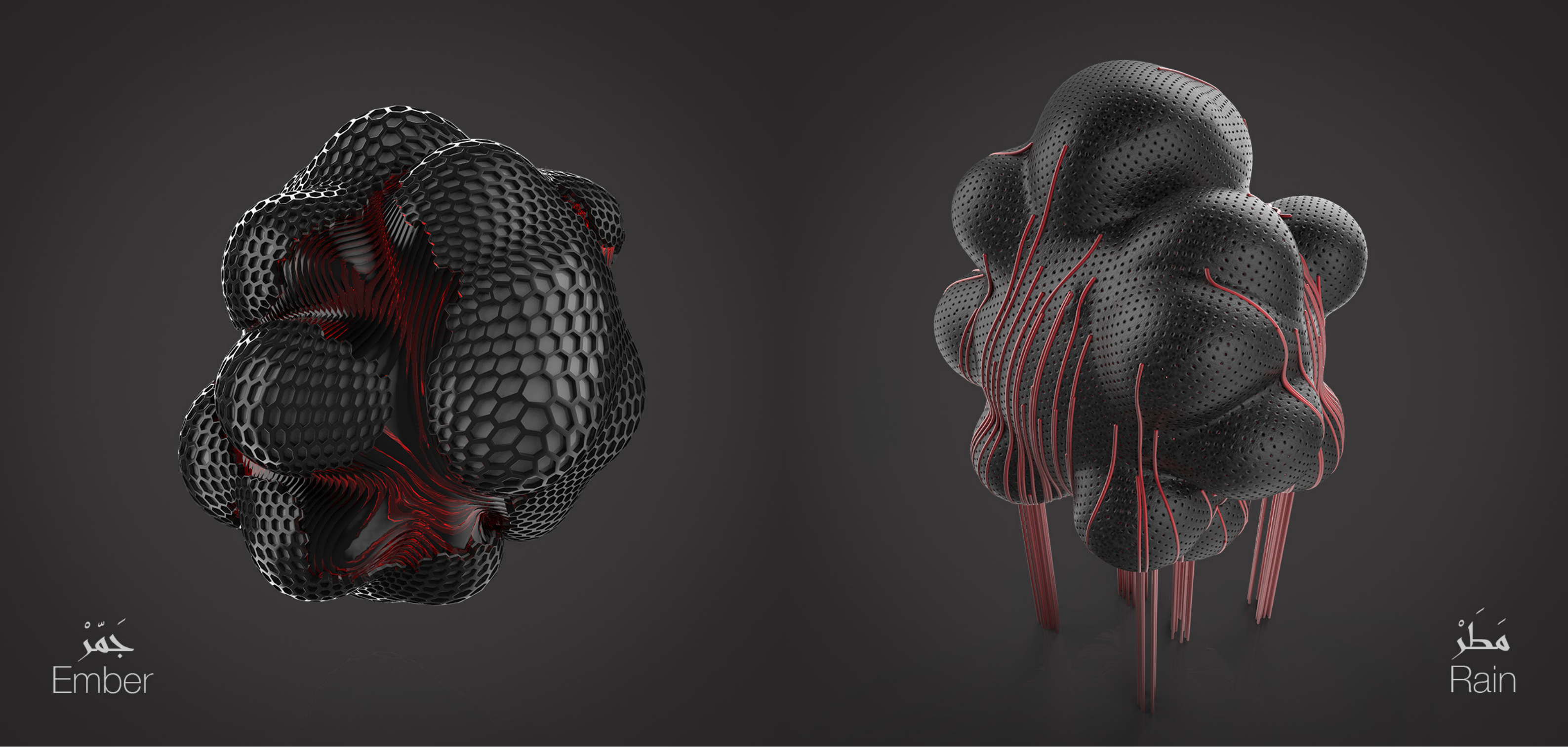
Disclaimer:
All projects shown in this portfolio are completely designed, drawn, modeled and rendered by me. I am the original author of all images but some of them was created/distributed whilst employed at a previous company. The image's ownership is that of whom contracted the creation of the drawings.



01 B-127// Speculative Architecture

Study on the bio-aesthetics of behavioural models

Year: 2020 3rd master semester. **Function:** Structural system **Client:** Academic project. **Status:** Concept Design. **Digital tools:** Rhino, Grasshopper, Kangaroo 2.0, Weaverbird, Python and Keyshot.

The project is to use agent based modeling to study the bio-aesthetics of behavioural models. My design objective was to create a structure system which could support any elevated form.

I started to design the behavioural model of the structure itself, until I realised that I would need to design a form in parallel so the structure can wrap around it.

On the other hand, I decided to have a reciprocal interaction between the form and structure. In other words the structure should form the form and the form should form the structure.

Since the available fabrication technology was able only to bend 2d plane wires, I started with the design with random planes, which confines structural members, and at the same time intersects with a sphere the initial state of the form. Then I inflated the sphere, which was restricted by the intersecting planes, to have the first form “Ember” (Figure 1).

Afterwards, I used a mesh analysis algorithm by Anders Deleuran, to simulate rain drops behaviour on a surface, which led to the second form “Rain”. Finally, to build a prototype I used 2 different types of wires, which were bended with help of D.I.Wire v1 machine from Pensa Labs (Figure 2).

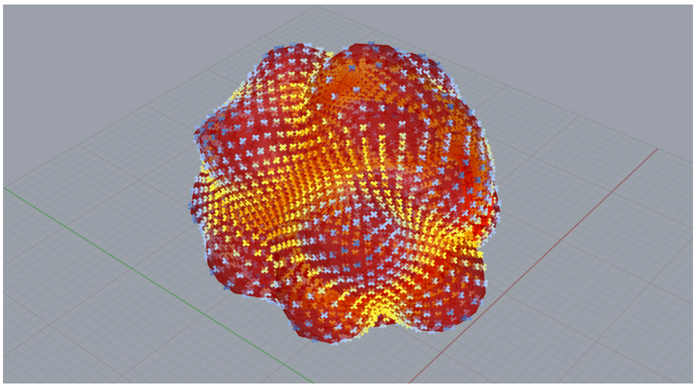


Figure 1: restricted mesh inflation.

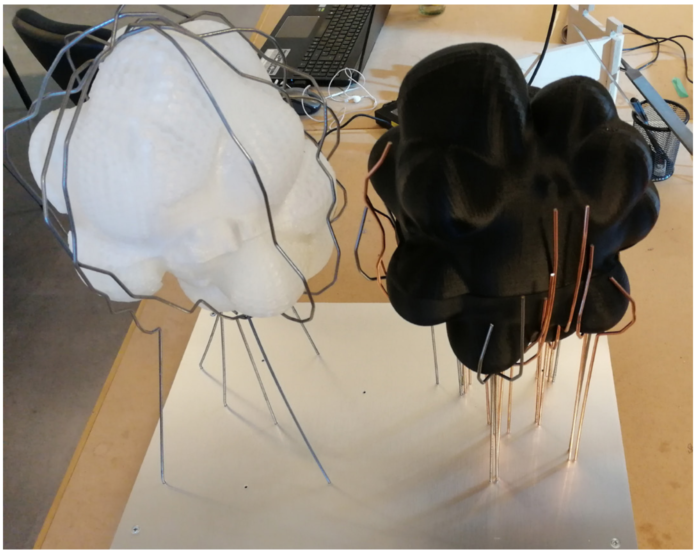
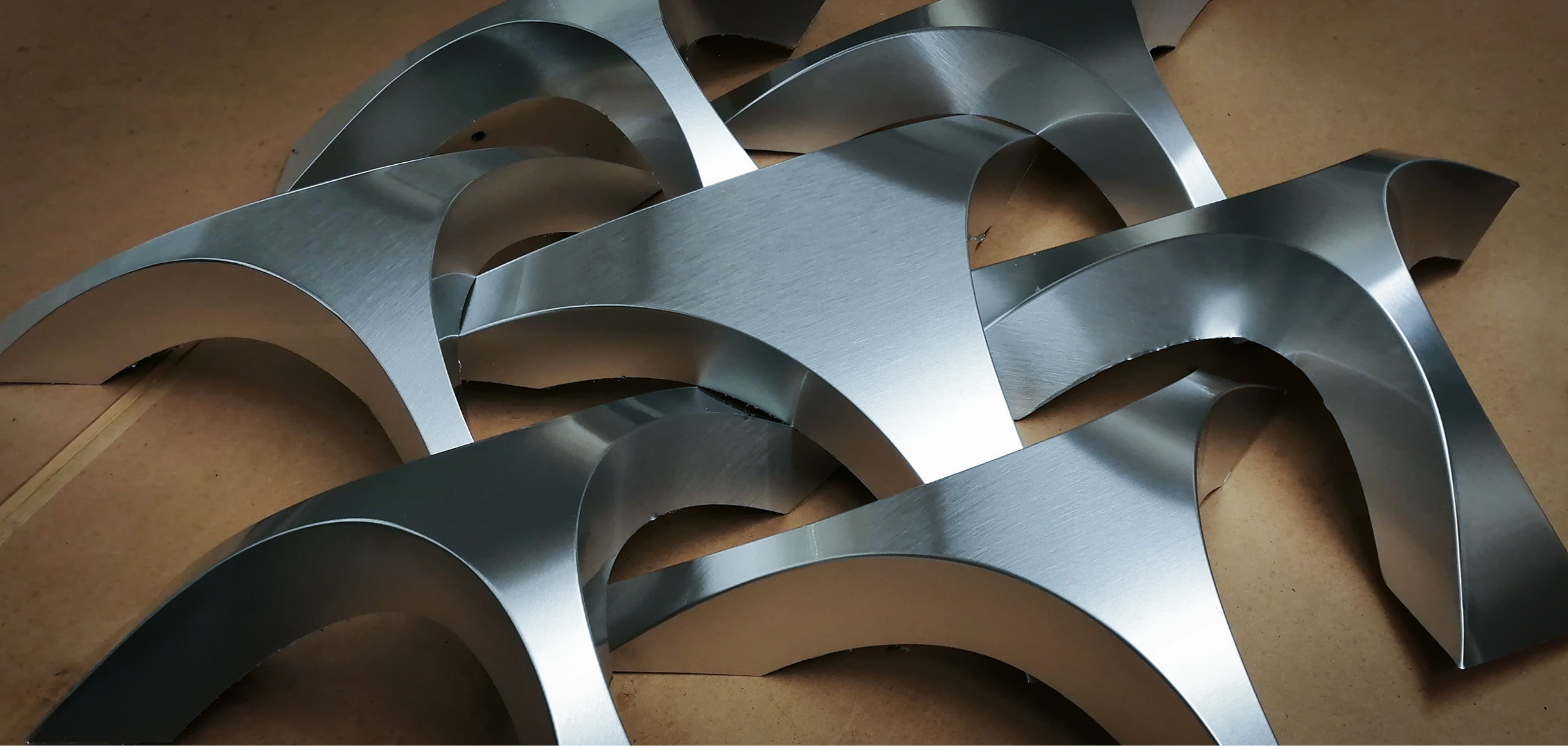


Figure 2: Final Prototype



02 Robo_Composite_Fold
Robotic folding of Aluminum composite panels

Year: 2019 2nd master semester. **Function:** Structural system / Cladding pattern. **Client:** Academic project. **Status:** Prototype. **Digital tools:** Rhino, Grasshopper, Kangaroo 1.0 and KUKAprc plug-in.

The main objective of this project was to curve fold aluminum composite sheets with the help of an industrial robotic arm from KUKA (Figuer 2).
The initial form finding process started by using an origami component by Daniel Piker, which was used to simulate curve folding behaviour in thin materials. However, the material has a 3.5 mm LDPE core which not only increased bending stiffness of the material but also added structural stability to the folded module.
I used 3 different modules to generate 2 slightly different patterns (Figure 1). Crease lines were milled, with a "V" shaped mill tip, all the way through the back layer and core. A finite element analysis was carried out to later to verify if the maximum required bending force is lower than maximum payload capacity of the robotic arm (Figure 3).

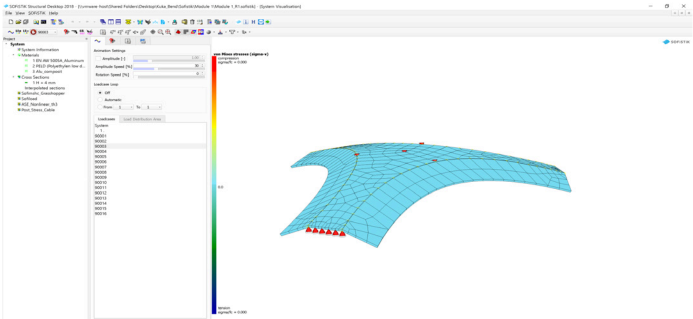


Figure 3: F.E.A. Model in SOFiSTiK

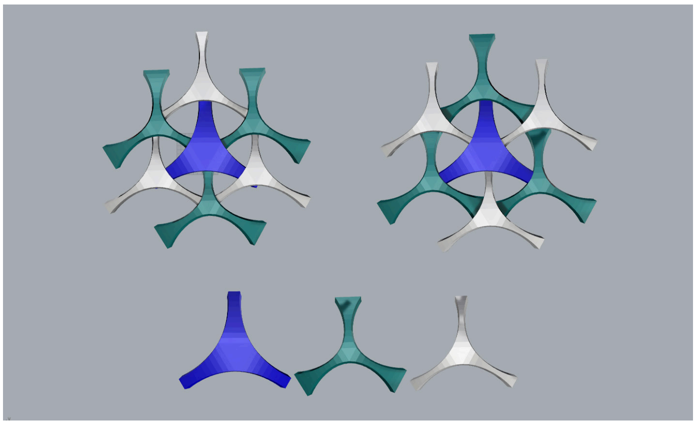


Figure 1: Form finding process with Kangaroo 1.0

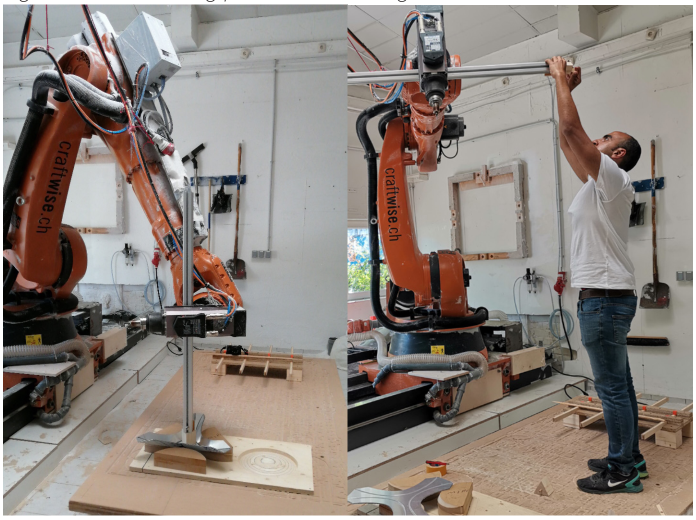
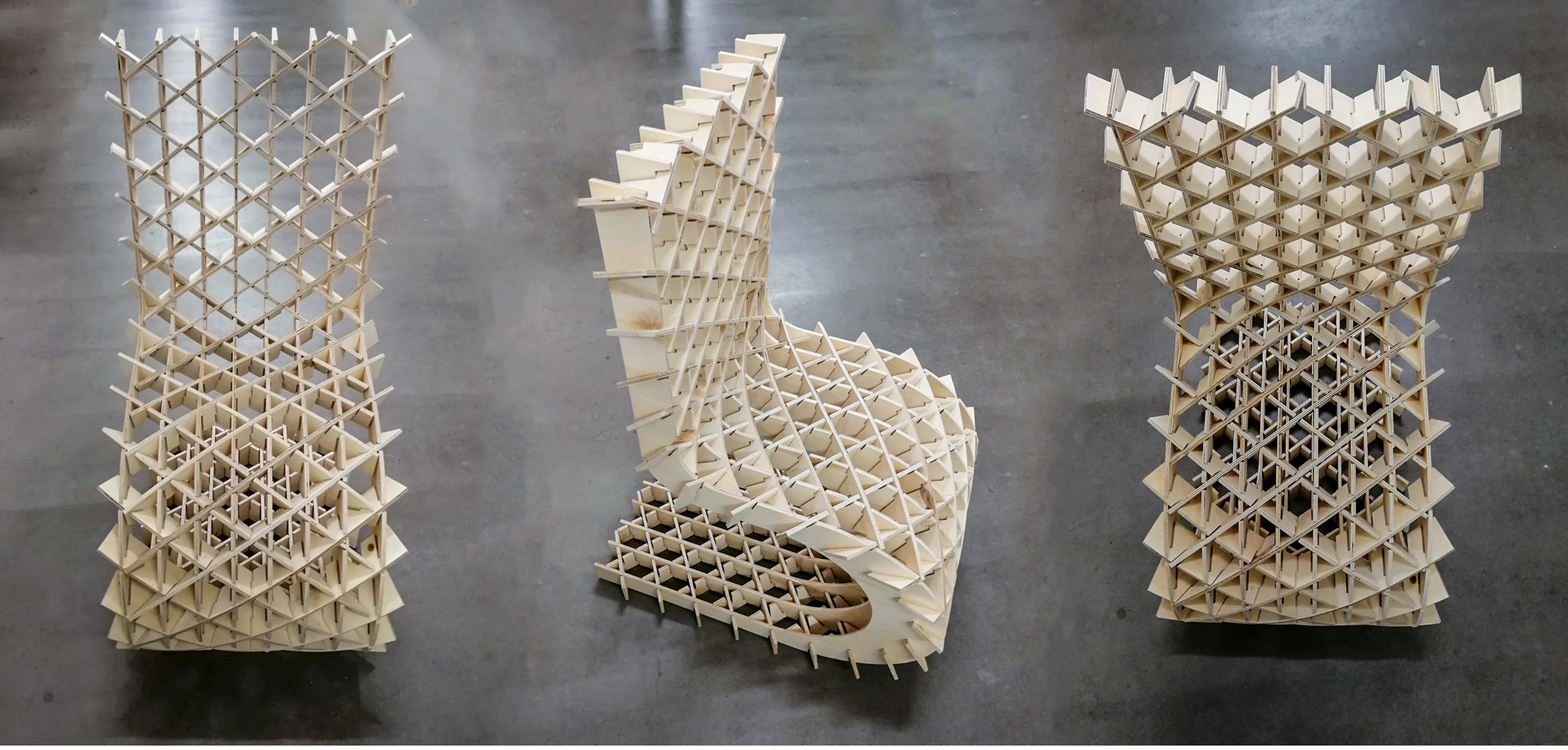


Figure 2: KUKA robotic arm setup and adaptive mold below



03 Talata Chair // Open desk proposal

A 3 layers waffle structured chair

Year: 2019 1st master semester. **Function:** Furniture. **Client:** Open Desk. **Status:** Prototype. **Digital tools:** Rhino and Grasshopper.

The initial design goal was to realize wooden double curved furniture with low tech fabrication techniques (Figure 1), while maintaining the requirements of Open Desk furniture.

At the beginning I started prototyping with cardboard material, which was able to handle the torsion of the non-planer parts in the system. However, 2 layers waffle structure was not stable enough for a chair. Next, I simplified the initial double curved surface to an extrude reverse curve, added a third layer of waffle structure to the system and planarized all parts to be able to use plywood in prototyping. However, the modified system showed outstanding performance in an empirical load test on a cardboard mock-up (Figure 2).

Finally, I used a 6mm plywood for the final prototype. All parts were CNC milled by a 2.5 milling machine (Figure 4). At the end I was able to assemble the chair with zero tolerance and without any adhesive materials or screws (Figure 3).

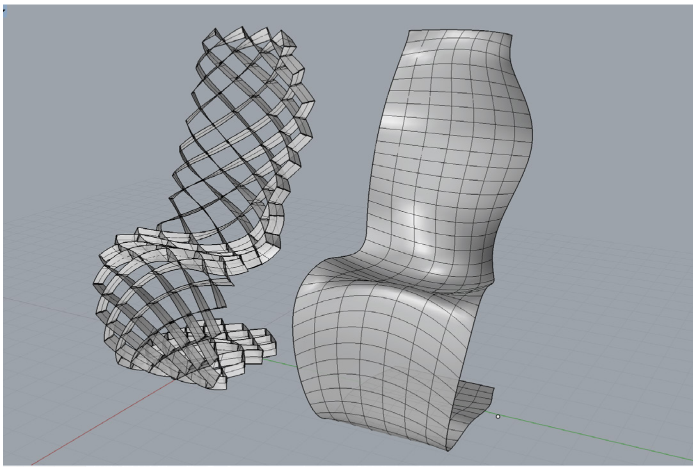


Figure 1: Initial design with doubled curved surface

Figure 2: mock-up load test

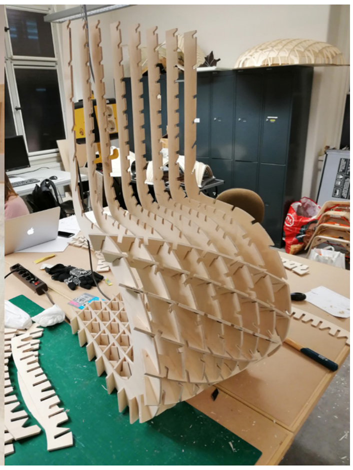


Figure 3: zero tolerance installation

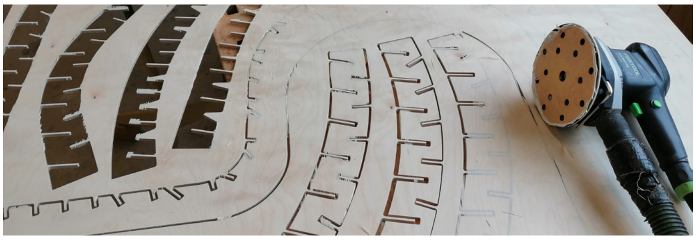
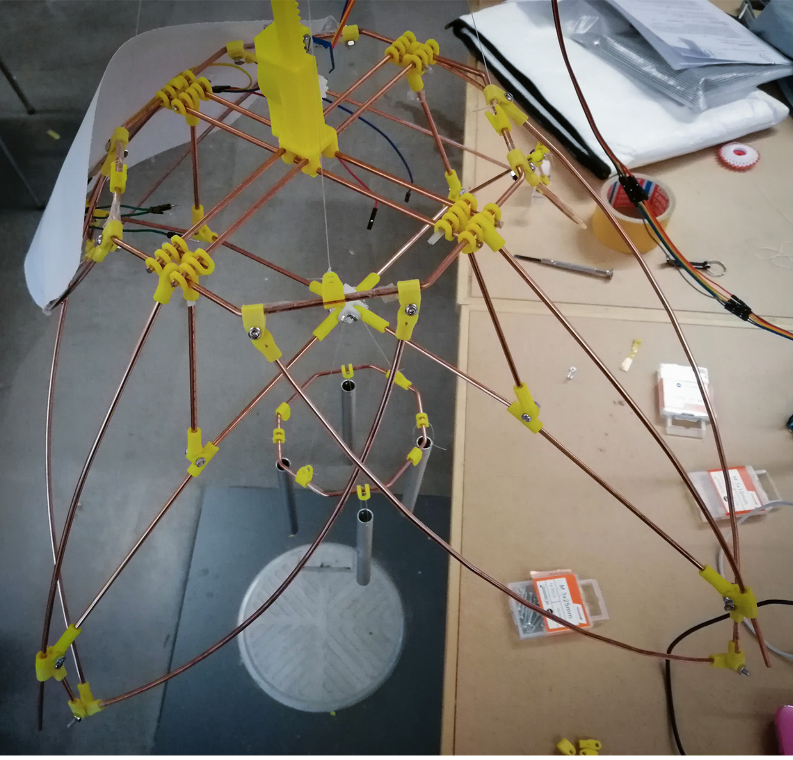
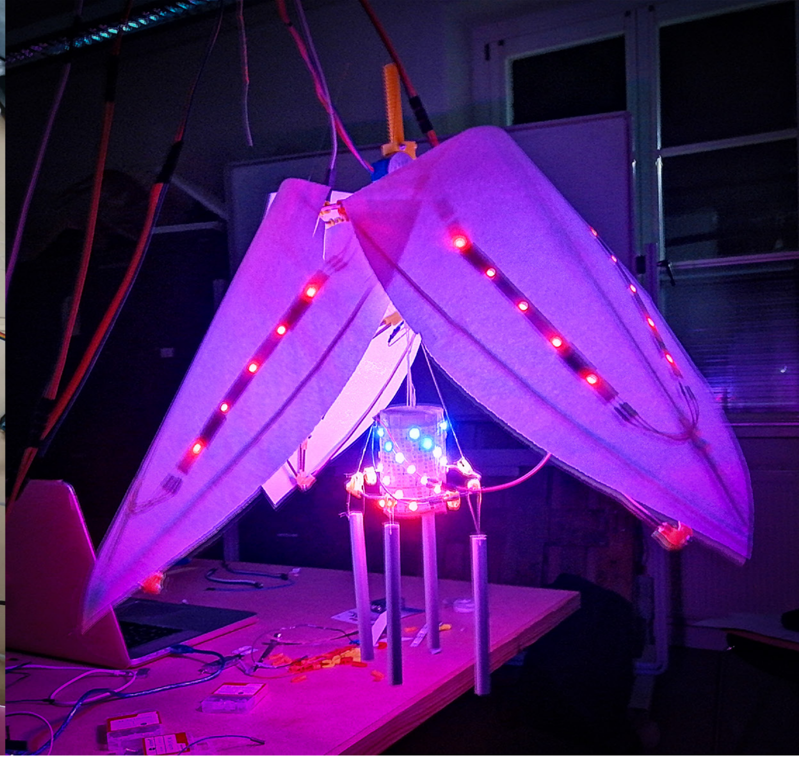


Figure 4: CNC milling without bridges





04 Robo_Flower // Burning man proposal

An interactive lighting fixture

Year: 2019 1st master semester. **Function:** Interactive light. **Client:** Academic project. **Status:** Prototype. **Digital tools:** Fusion 360, Arduino IDE and AutoCAD.

The Robo-Flowers are basically a smart wind chimes which could be actuated by wind, human or motorized, and also could be programmed for interactive live music shows or can even recognize famous musical pieces by its self and interact with them.

They are equipped with motion sensors, so they open like a flower when they got approached by a human. However sometimes they stay closed based on noise levels and wind intensity (Figure 2).

To minimize power consumption, the design was developed maintaining balance between moving parts; the middle part acts as a counter weight for outer parts (Figure 1).

Meanwhile, to reduce overall mass and maintain stiffness, the whole system was constructed from bended wires and 9 multi-functional 3d printed parts, which were designed specifically to cover all complex joints (Figure 3).

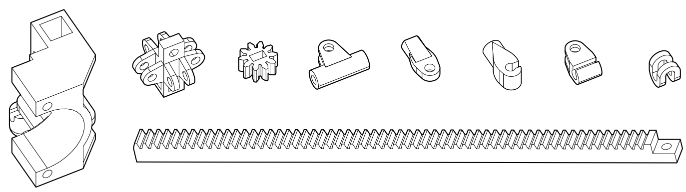


Figure 3: 3d printed parts

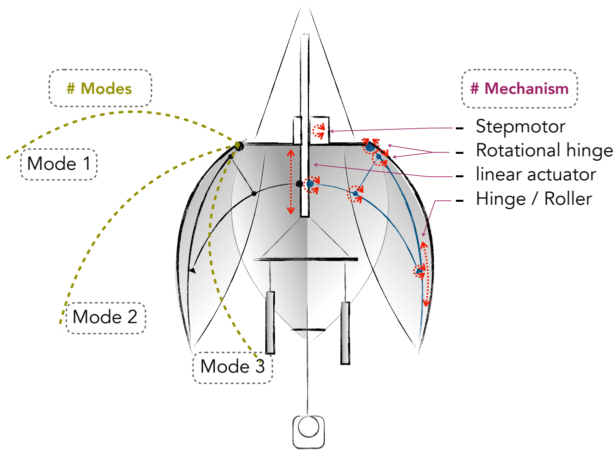


Figure 1: System mechanism

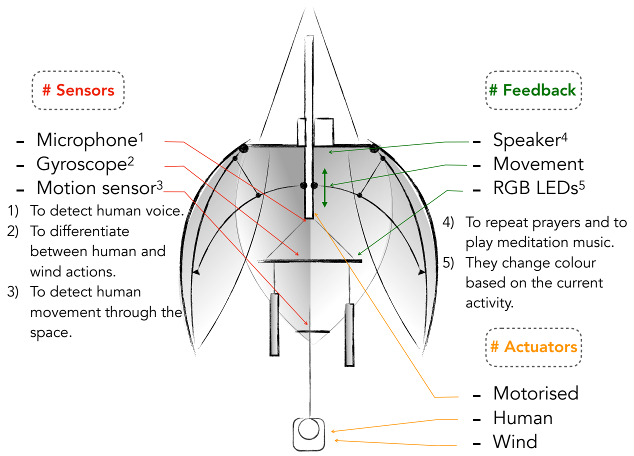


Figure 2: Sensors diagram

05 Graduation Project // Partially Revamped
Permanent Submerged Research Facility

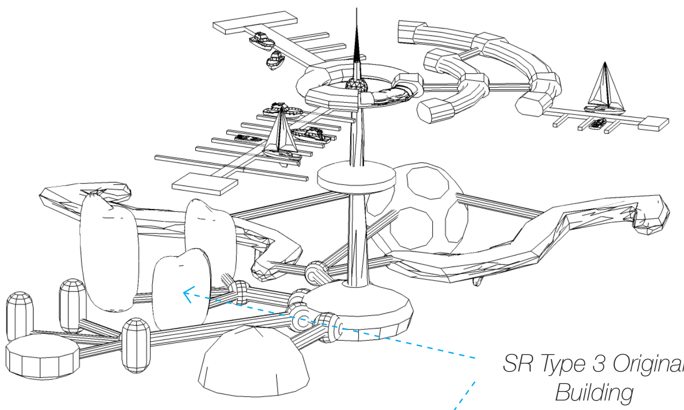
Year: 2006 (4th Academic year). **Use:** Residential+research facility **Area:** 8,200 m2. **Client:** Academic project. **Status:** Concept Design. **Location:** Red Sea (submerged), Lowest point is 100 m below sea level, Sharm el Shaikh, Egypt.

The project is a self sustaining submerged research station which can accommodated scientists and researchers permanently.

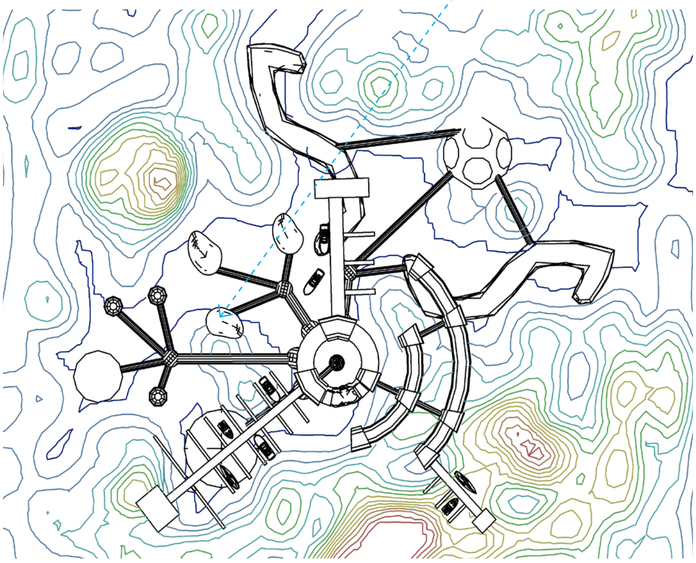
One of the buildings (SR type 3) was redesigned recently to enhance its water pressure resistance which could exceed 160 psi at 100m below surface.
The proposed solution was to increase panels curvature, add an Exoskeleton and to reinforce glass panels with hexagonal structure.

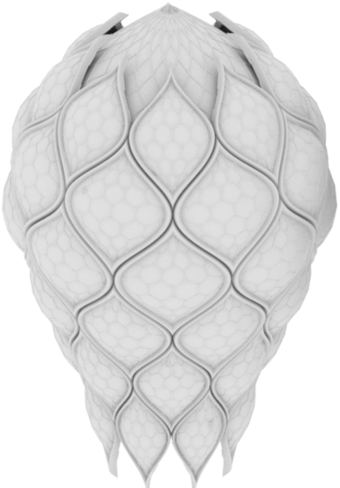
Panels were designed as a 180 degree revolved sine curve, arranged into 2D linear array and then morphed to building surface. Panels which attached Exoskeleton shares the exact sine curve boundary.

The new proposal consist mainly of two parts: The first part is the base which is 10m high 6m in Diameter, piled to seabed and connected with other building through tunnels.The second part is the main building which is almost 30m high and 20m in diameter. It contains 5 residential levels and a mechanical level witch is connected to main ballast tanks. The building is designed to be buoyant and in case of emergencies, it can disconnect itself from the base and reach the surface by discharging all the water from main ballast tanks.



SR Type 3 Original Building

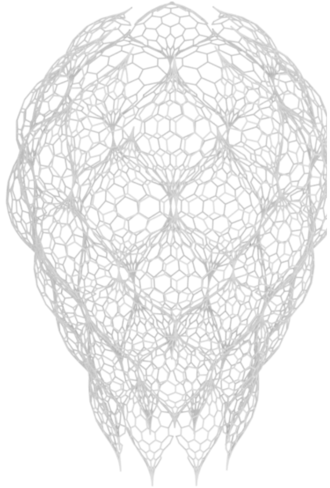




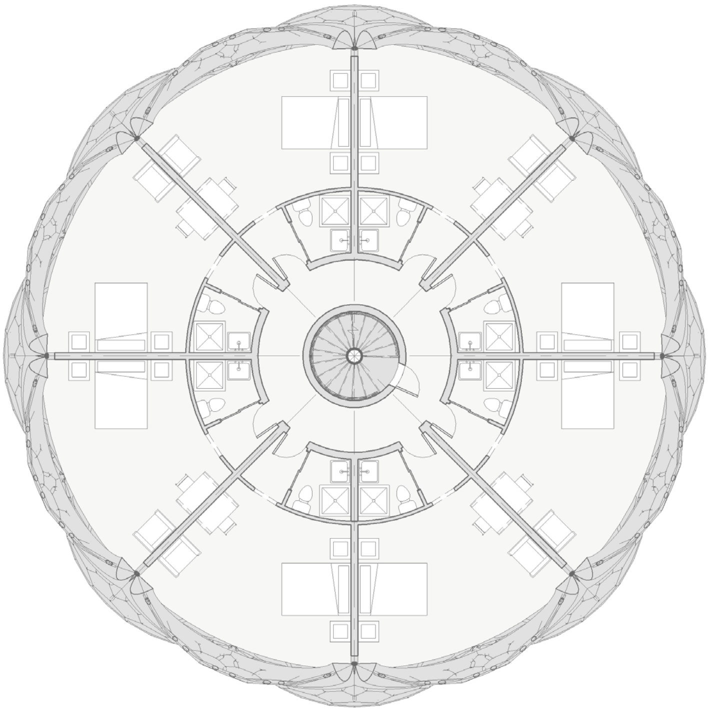
SR Type 3 alternative design

Main paneling system

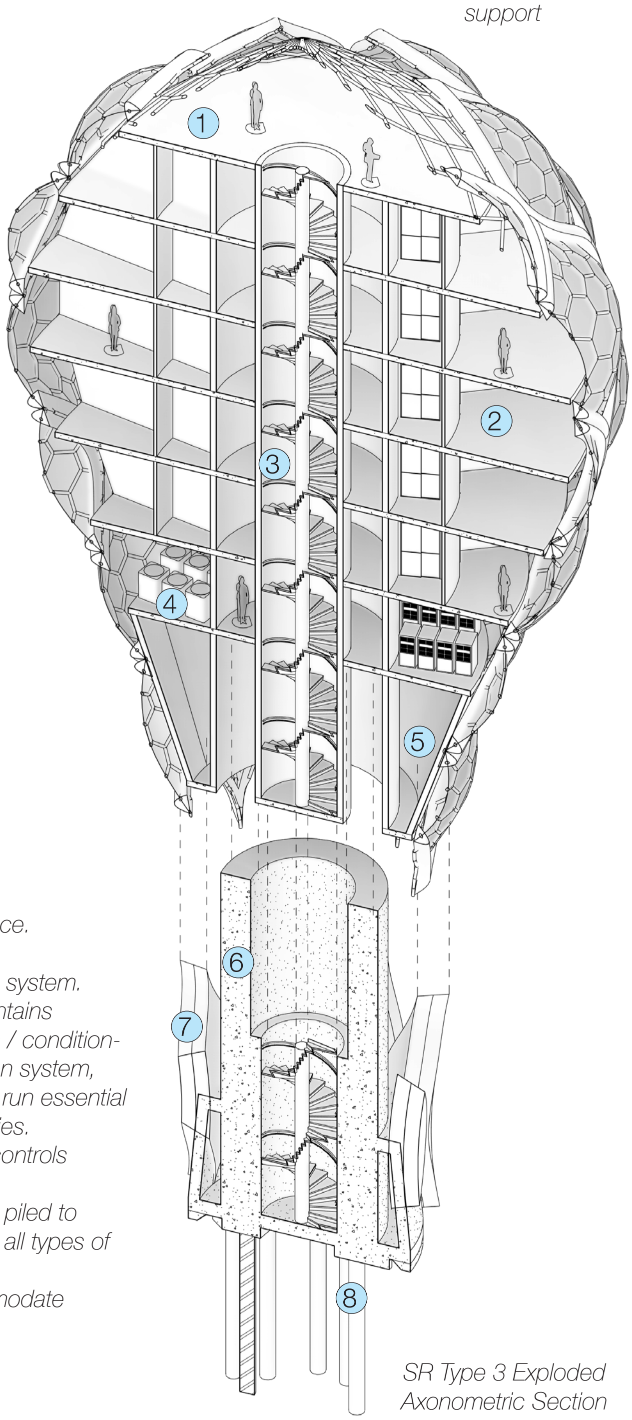
Exoskeleton



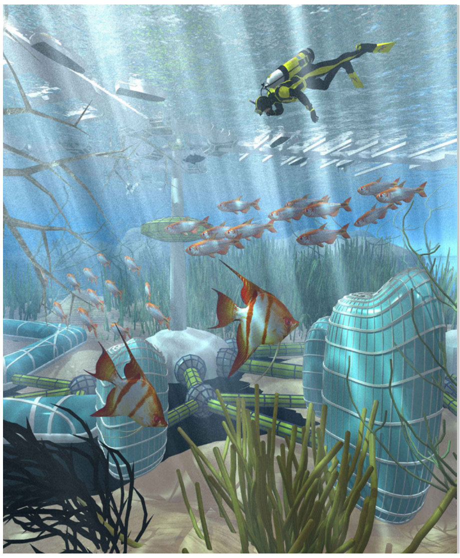
Hexagonal paneling support



SR Type 3 Level 8 Plan



SR Type 3 Exploded Axonometric Section



1- Common / Evacuation space.
2- Standard residential unit.
3- Main vertical transportation system.
4- Mechanical level which contains nuclear reactor, air purification / conditioning systems, water desalination system, water pumps and batteries to run essential systems in case of emergencies.
5- Main ballast tanks, which controls building buoyancy.
6- SR Building base, which is piled to seabed and designed to host all types of SR buildings.
7- Locking system to accommodate rotational forces.
8- Piles.

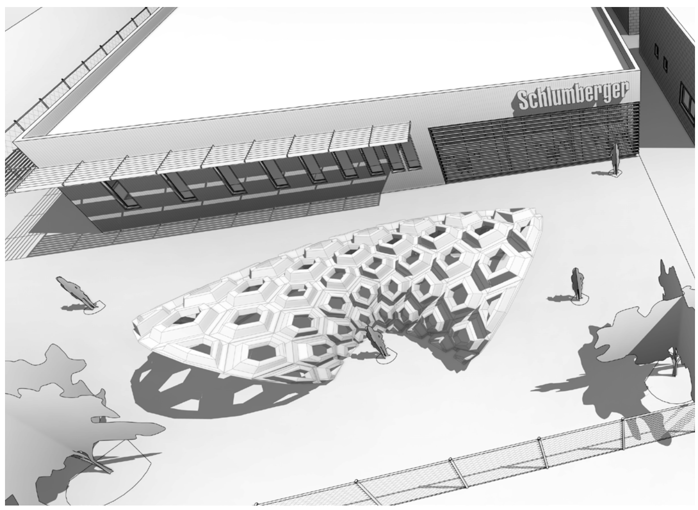
06 MI SWACO Chemical Laboratory + Outdoor Canopy
Laboratory and Offices Facility

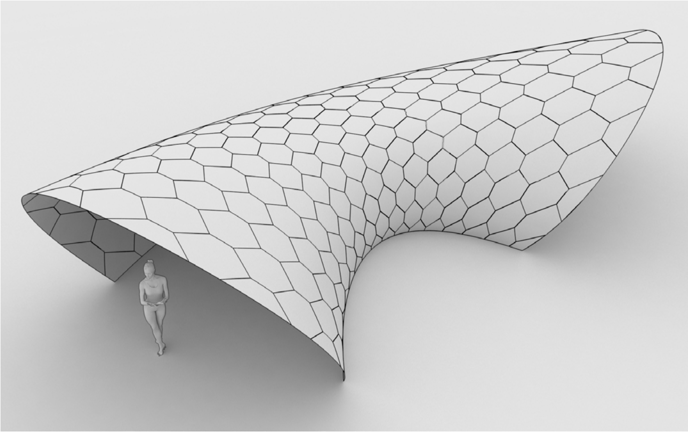
Year: 2014 (Main building) / 2018 (Outdoor canopy). **Use:** Offices and laboratory facility. **Area:** 600 m2. **Client:** Sclumberger Limited. **Status:** Concept design. **Location:** Jabel Ali industrial zone, Dubai, United Arab Emirates.

MI SWACO is an innovative R&D department in Schlumberger Oilfield Services, which is responsible for developing drilling chemicals.
This project had a tight budget constrain, but on the other side the client wanted a dynamic facade system, to control daylight and sunlight especially in Lab spaces. One of the solutions was to control daylight by varying the distance between windows statically. Fibonacci series was chosen as a parametric constrain, to define the distance between windows, and that was my first experiment with parametric design.

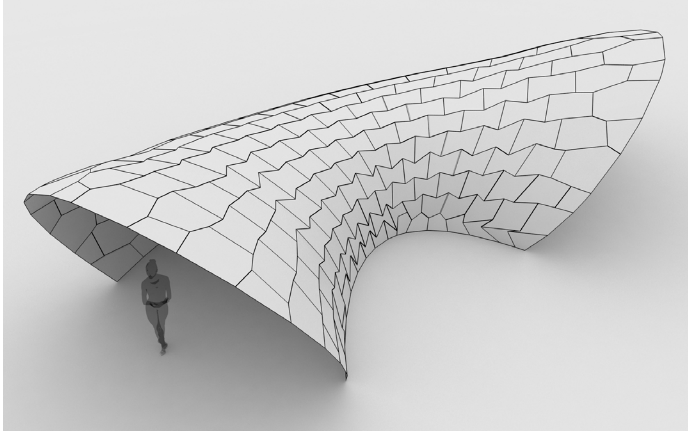
Recently an outdoor multipurpose canopy was added to serve as a shed for outdoor smoking/break area. The main concept was to design a low budget light structure. So I proposed a double curvature form with hexagonal paneling system, which ended up with a non planner panels. So to simplify manufacturing process, I came up with two solutions: The first one is to planarize all panels using kangaroo physical simulation engine, but unfortunately most of the panels got distorted. The second was to convert all none planer surfaces to meshes, which turned out to be much easier solution than the first one. Another aspect of the design was to optimize canopy structure, by minimizing both maximum displacement and Structure's mass. That was achieved by using evolutionary optimization Plug-in, which uses particle swarm optimization algorithm.

(Above) Laboratory facades, (Below) Outdoor canopy

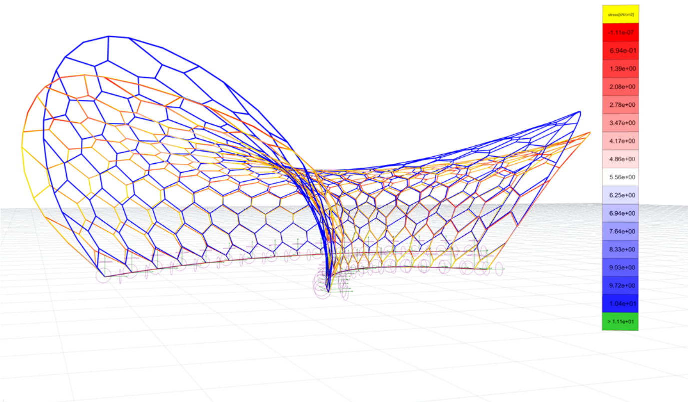




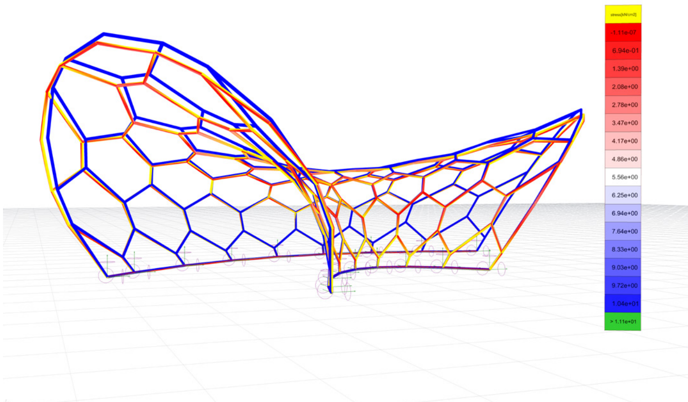
Initial design



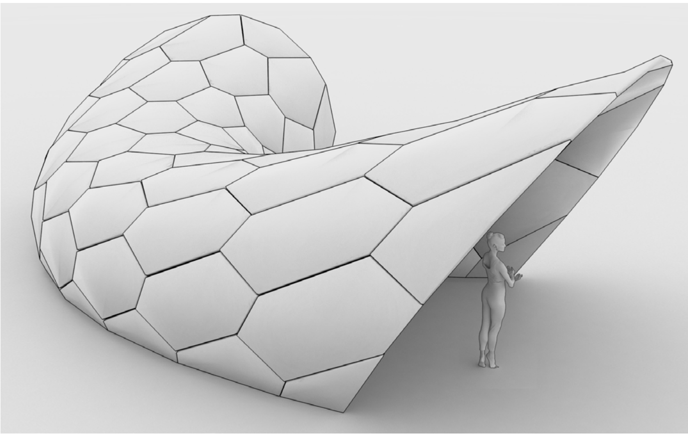
Planerizing experiment with Kangaroo (Failed)



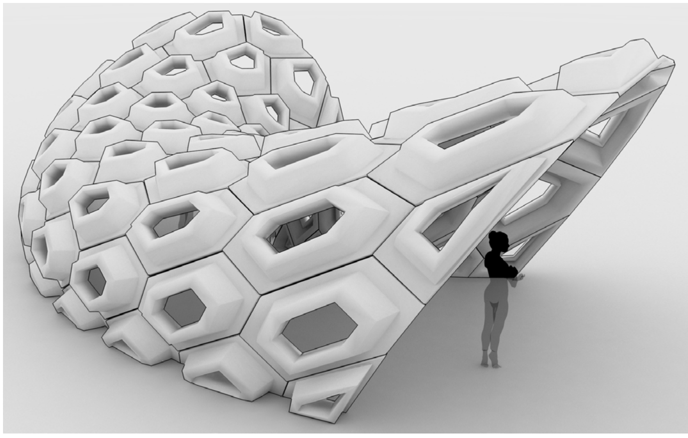
Axial stress diagram (Initial structure)



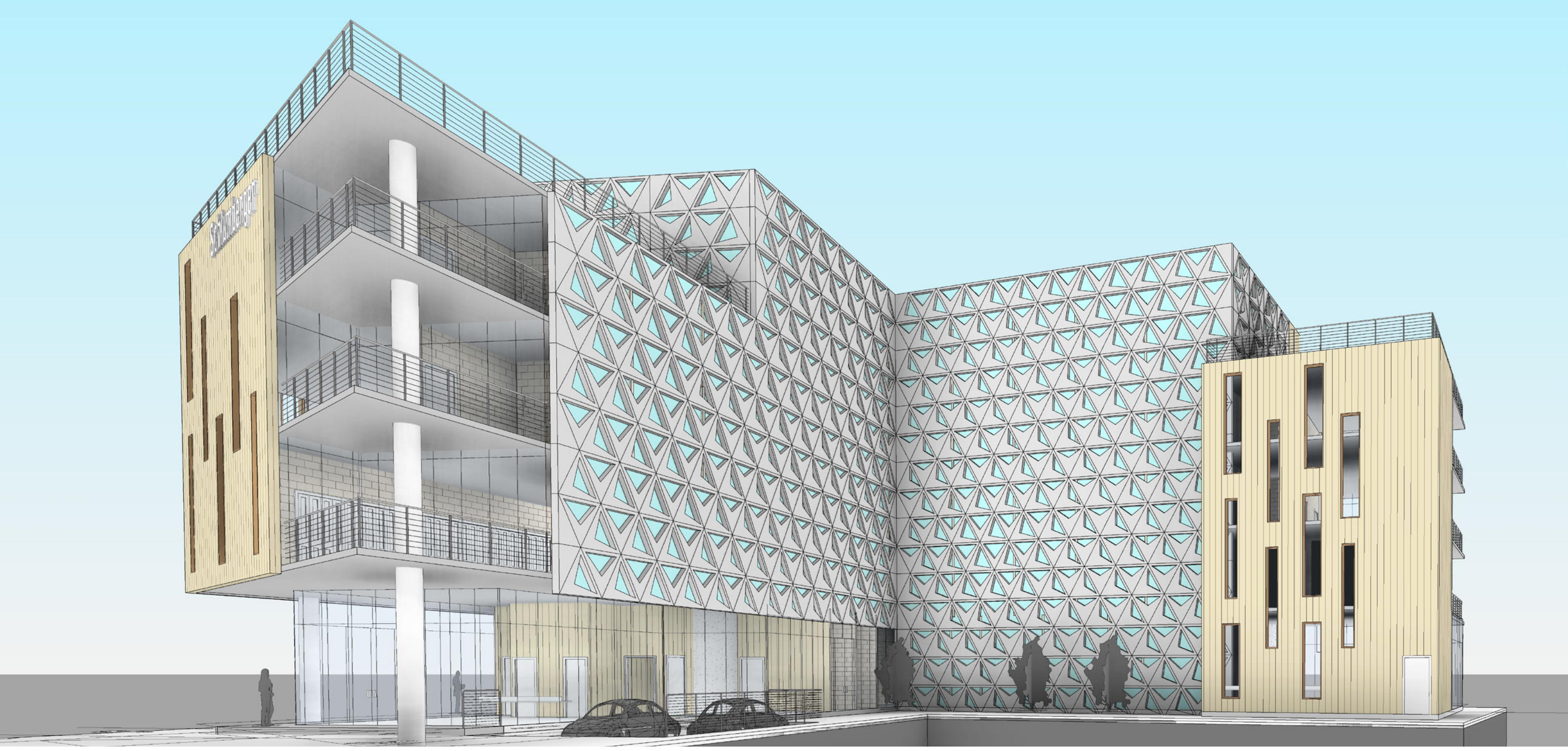
Axial stress diagram (Optimized structure)



None-planer honeycomb panels



Final morphed panels

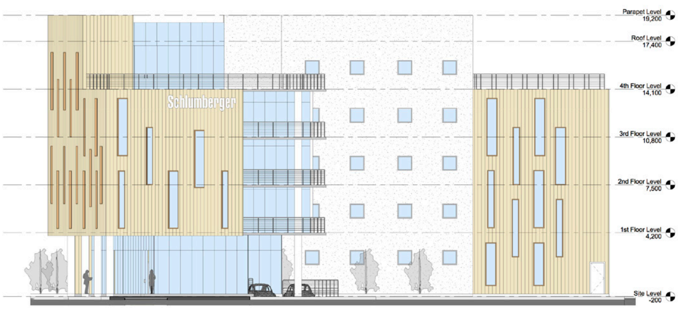


07 NAG HQ Offices // New Southern Facade

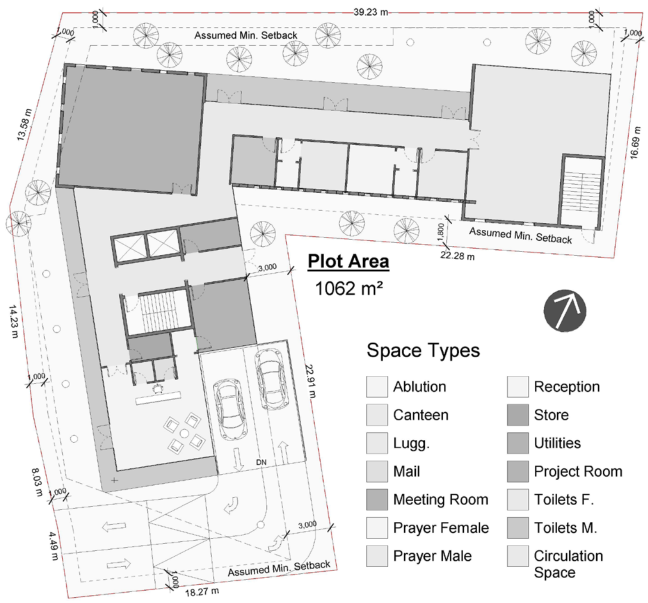
G+4 Offices Facility

Year: 2015. **Use:** Office building. **Area:** 2,600 m2. **Client:** Schlumberger Limited. **Status:** Concept design . **Location:** Algiers, Algeria.

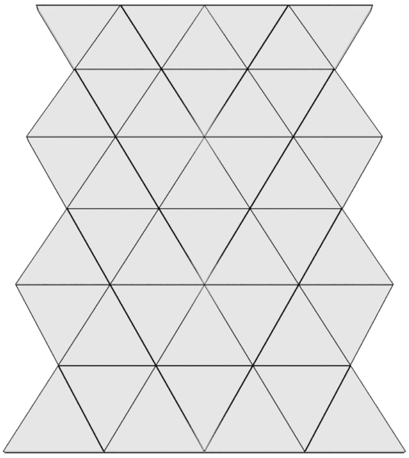
The building is designed as a headquarter for Schlumberger North Africa group of companies to represent the new sustainable energy direction which was adopted lately by Schlumberger after a recent oil crisis. It was designed to target LEED gold rating. Hence, some passive green building design strategies was applied at early stages. One of them was to minimize direct sunlight which penetrates the southern facade, by reducing the size of openings.
The first facade proposal was a simple grid of square openings. The second proposal was made recently based on triangular grid, which leaded to a couple of challenges : First was to draw adjacent triangles at both sides of the grid, to complete the rectangular shape of a wall, and they turnout to be symmetrical in case of odd number of columns. The second challenge was in case even number of columns, adjacent triangles become asymmetrical and must be drawn in a different order. However the first part was easy enough, but the second part took me almost 90 component to build a universal grasshopper definition, which is able to draw the adjacent triangles at any given number of rows and columns. To achieve this, I mainly used Modulus component to identify even number inputs, then Stream Filter component to trigger the second draw order solution.
Later, two parameters were assigned to control window offset from the panel and window height. Later, a point attractor was applied to both parameters. Finally, Perlin noise was Introduced to express the sense of systematic randomness.



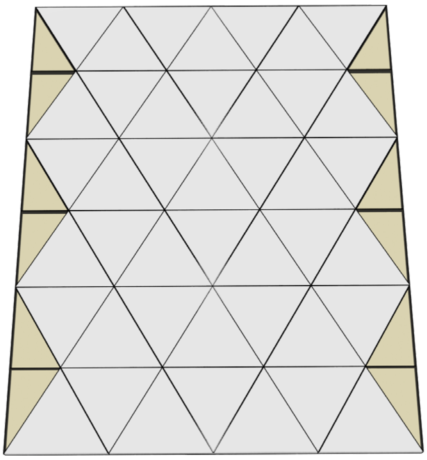
Original southern facade



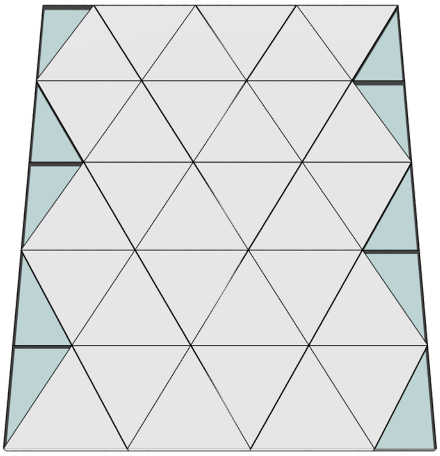
Ground floor layout



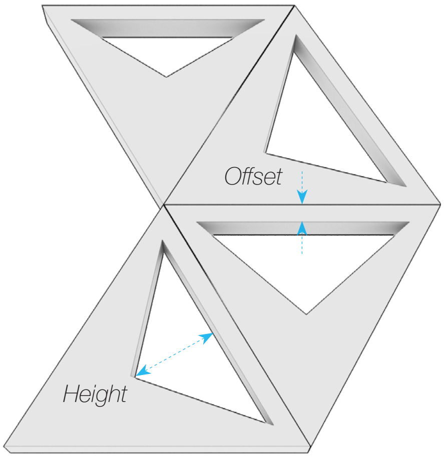
Triangular grid system



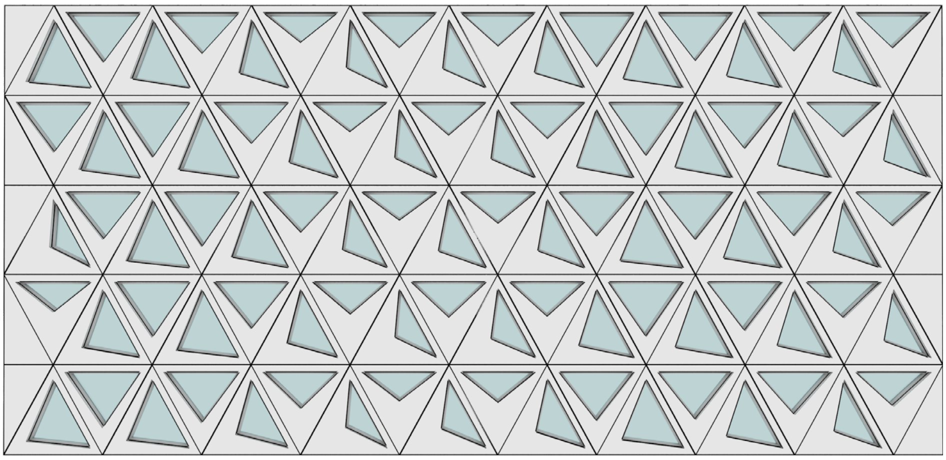
Adjacent triangles (Odd columns)



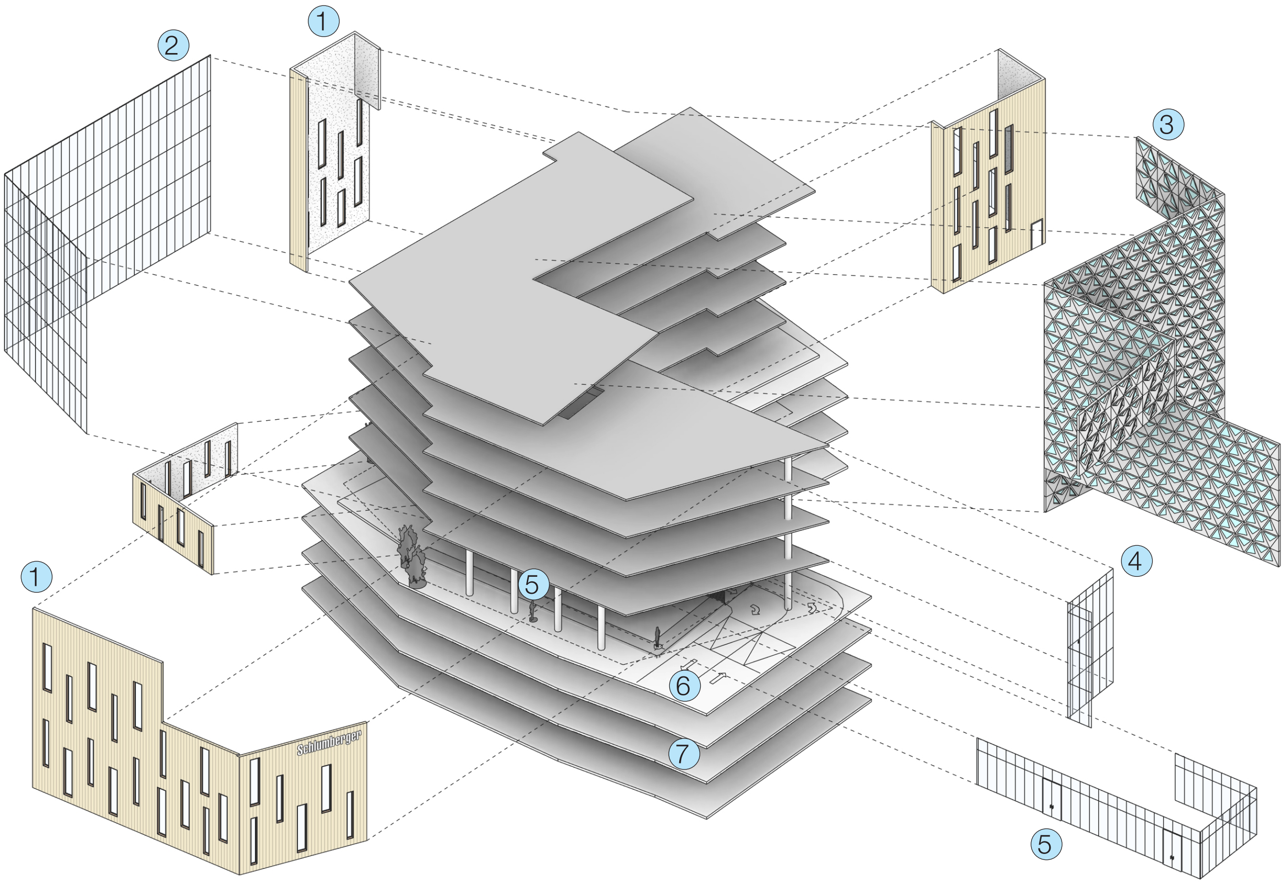
Adjacent triangles (Even columns)



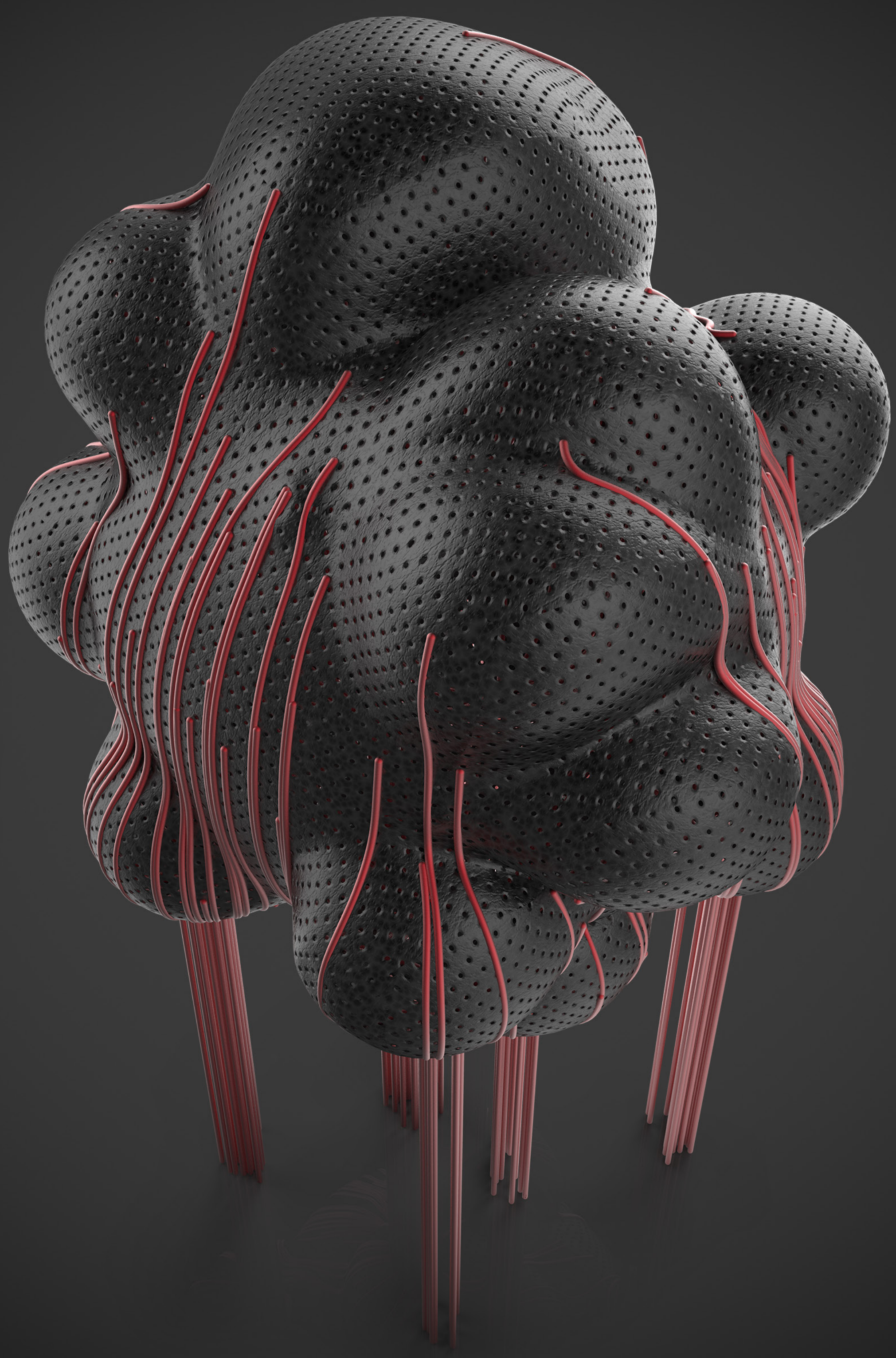
Main Parameters



Perlin noise was Introduced to express the sense of systematic randomness



1-FSC certified wood cladding. 2-Glass curtain wall at northern facade to maximize the use of natural lighting. 3-Parametric southern facade cladded with regional natural stone cladding, which is produced within 160 km of the project site. 5-Recessed southern glass curtain wall shaded by terrace slabs. 5-Main building Entrance. 6-Car parking entrance/exit. 7-Basment parking.



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