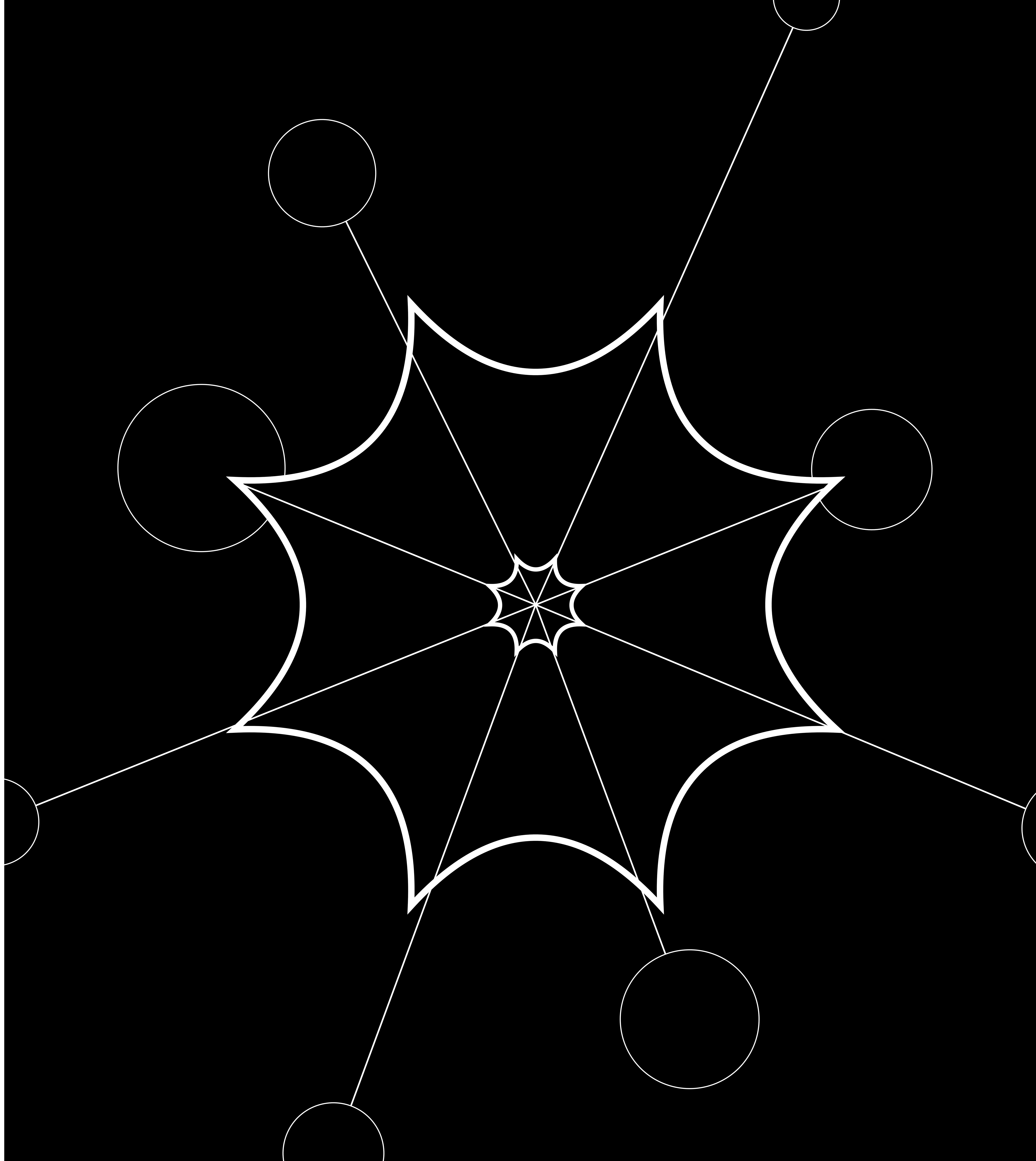
the Octagon



The Bartlett School of Architecture
MEng Engineering & Architectural Design
BARC0131 Design Practice 1 Project 1
Isaac Wang

Manifesto & Narrative

The design process began with an analysis of a character that interests me the most from a book. The character I have chosen is Fagin from Oliver Twist, a rich, multifaceted character, who played an important role. The first appearance of him in the story, was a thin old jewish man with a mess of dishevelled red hair holding a baking fork, makes the readers immediately know that this is not a kind-hearted man but a typical villain.

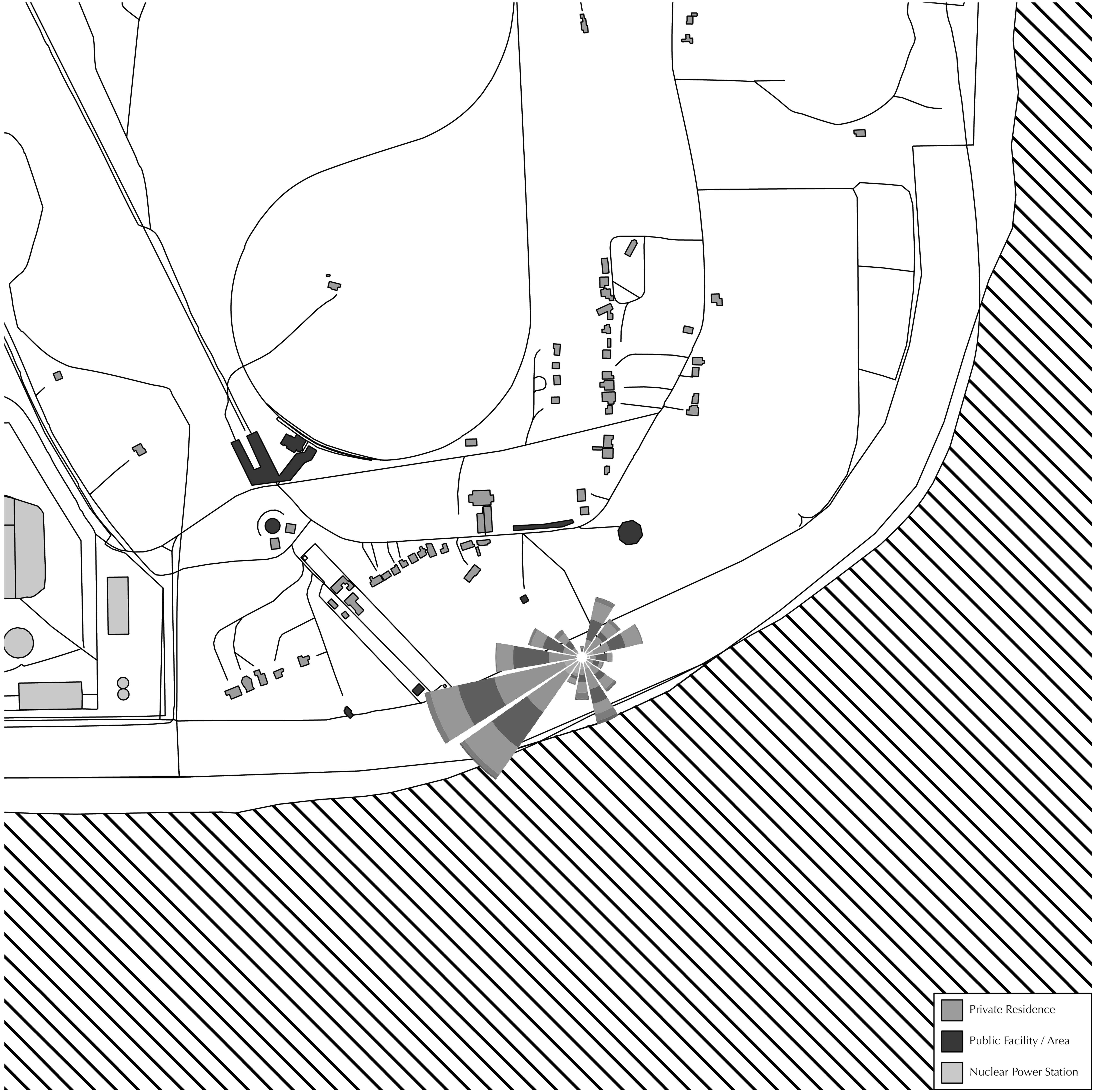
Fagin taught Oliver stealing skills, tried to cultivate him into a thief like the other kids, who were instigated to steal for him. In order to 'brainwash' Oliver, Fagin locked him away to edify with loneliness and melancholy. And when Oliver was arrested, Fagin was furious, aggressive and even fisted. Even at the end of the story where himself was eventually arrested and to be hanged, he still fantasised that Oliver could help him out, but with no repentance. Fagin can be said to be the dirtiest and the most hateful as the representative of the villains in the novel.

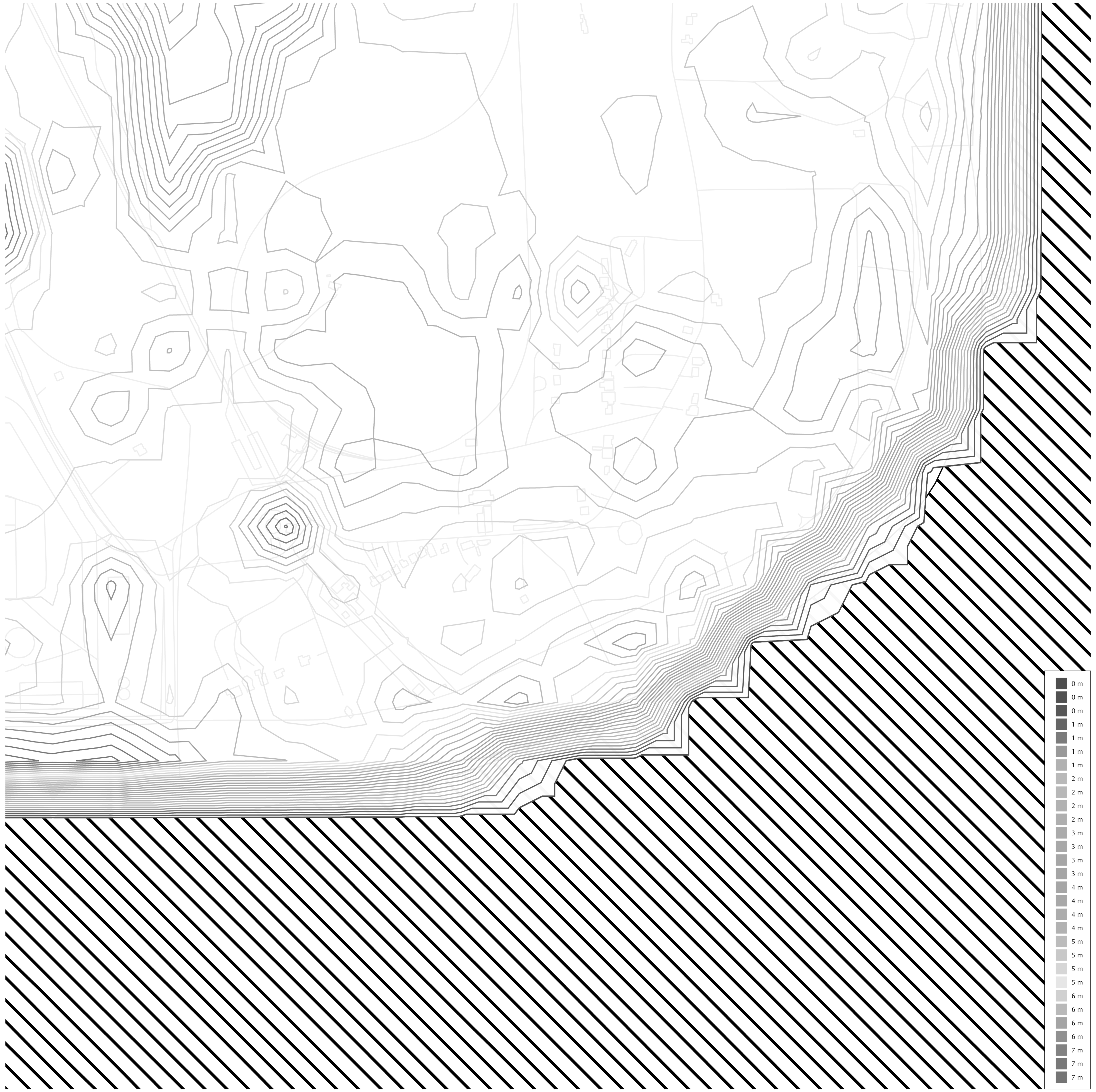
However, on the contrary, Fagin was also a warm old man in the den of thieves. Although behind his smiling eyes lurks the evil, it was undeniable that he was the one who took care of those homeless children, and the den of thieves was even full of laughter. This little tender kindness makes Fagin richer and vivid, becoming the most interesting character in the novel. What this enlightens me with my designing ideas, was that I could design a device that also has a contrary, which is beneficial but meanwhile being harmful, or having shortcoming, or causing loss.

Interactions and motions could enhance this expression, so the design could be made in a way which enables pedestrians to interact or play with. Also 'contrary' could make the design vivid and more interesting, such as putting contrasting or very different elements together and make this difference to be highlighted. The design and the purpose of the design has been shifted and changed times before forming the final design.

Site Selection

Dungeness, a headland located on the coast of Kent, had been chosen to be the site. The device was set to be next to Christines Bench Boardwalk. The site is largely formed by shingle beach. The site is consisted with residential buildings, Dungeness railway station and a nuclear power station. The idea was to build a shelter-like structure upon this 'protectless' area of beach, which collects data of rain and wind as a device considering the fact that the site is seaside.





Site Analysis

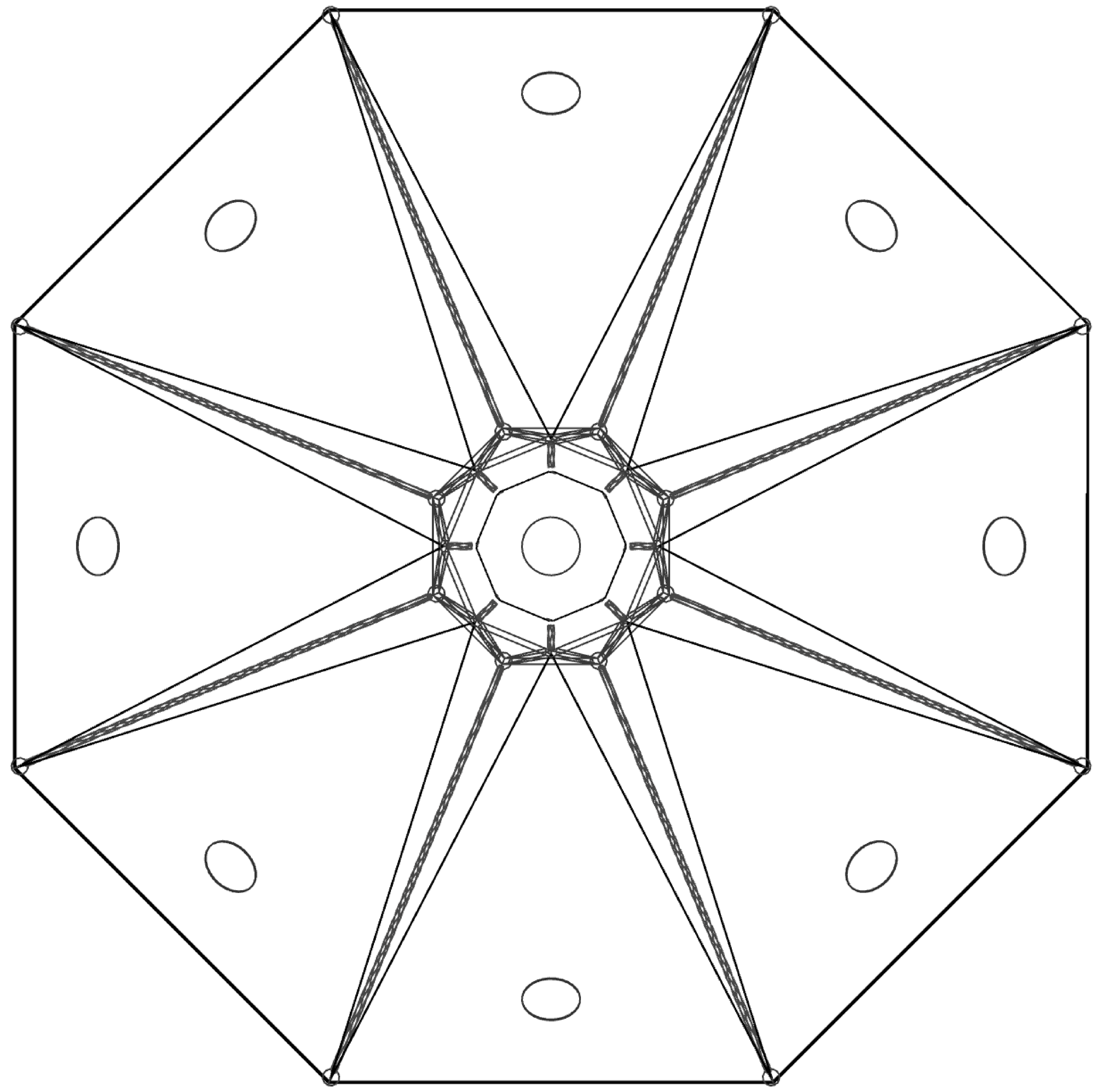
By conducting analysis for terrain and usage of the surrounding buildings combined with wind rose diagram, I was able to conclude the fact that majority of the time the wind direction is south west, which is from the sea. Therefore, potential air pollution from the nuclear power station will not become a major issue and there is no other surrounding buildings tall or near enough to be able to block the wind or rain or causing other issues that shall be brought into concern in terms of the design of the structure.

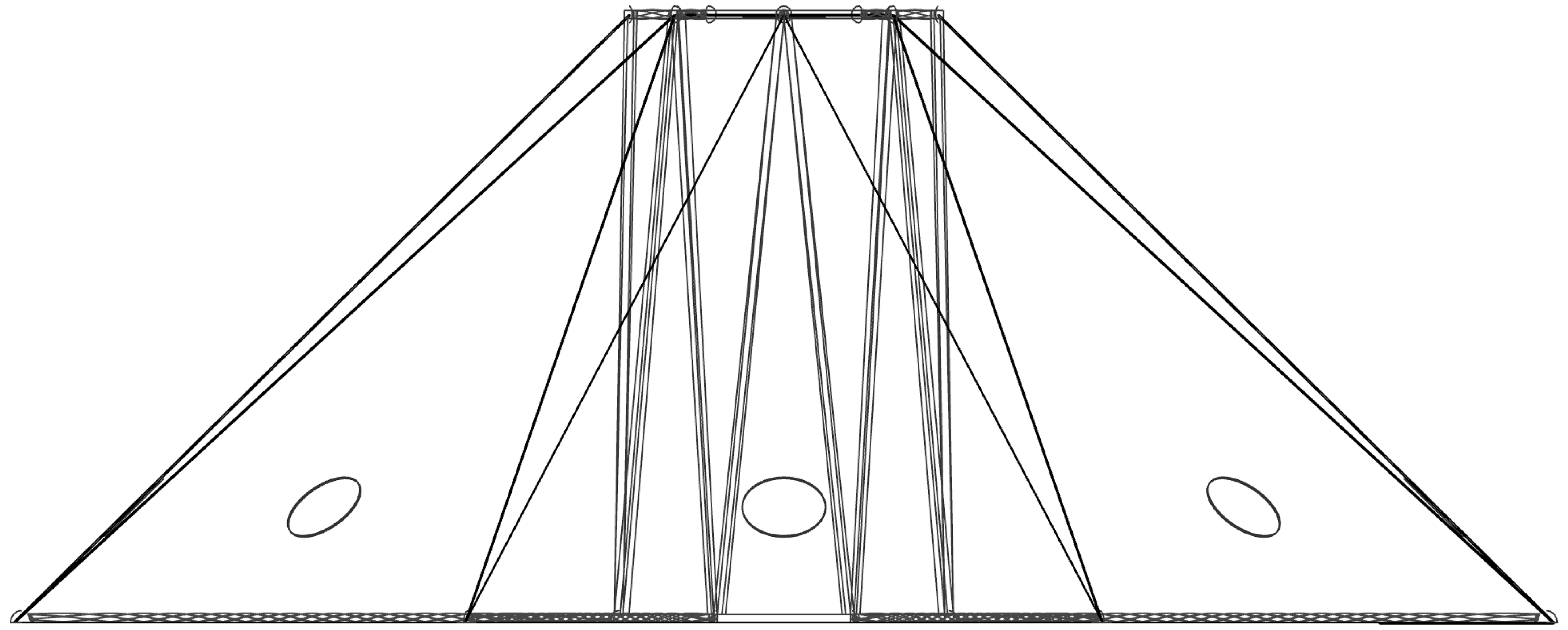
A terrain analysis allowed me to understand the beach where the selected site is located at. The beach is a shingle beach with descending terrain towards the sea, which indicated the fact that the ground conditions would not be ideal and the structure had to be designed to be able to fit into complex terrain.


Iteration I

Initially, the purpose of this device was decided to be collecting data of the rain and the wind. The amount of rain and the direction of rain coming from are vital for the exterior design, as the shape of the outer wall of the structure should be able to cover the pedestrians inside and block the rain. Dungeness is coast side, the wind could blow the rain from other directions other than directly above. Similar to wind, which shall also be blocked as the rain.

On each corner, a small steel ball was used to fix the film and the structure. The data collected by the sensors were to be transferred to a computer for further analysis and generation of further beneficial things such as weather forecasting.





This device is 3-metre-tall. It is formed by 9 polyester films, 9 vibration sensors, and a steel core located at the centre. The polyester films are expanded fully and fixed with the steel core at the centre. They act as drums. There is 1 film fixed at the top. The rest 8 films are distributed with equal angular displacements, and each inclining towards the centre by 45 degrees. They surround the core evenly, and each film has a vibration sensor attached. Its huge size ensures the precision and accuracy of data collected, increased the probability of having random errors occurring.

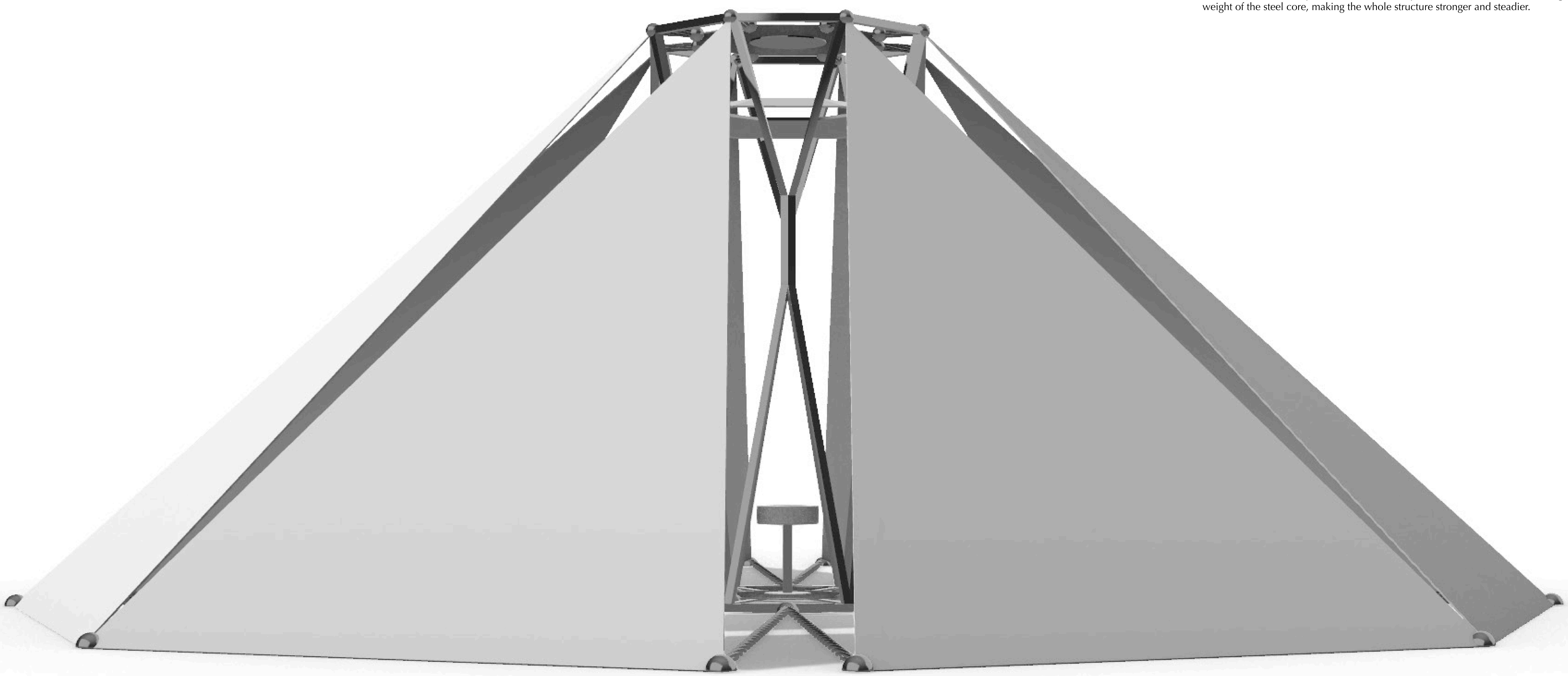
Each time a raindrop hits the film, it causes a vibration, which will be recorded by the vibration sensor. By doing so, both the data of the rate of rain and the direction of wind can be obtained and analysed by simply counting the number of hit by raindrops. The data can be compared to determine which direction the wind blows and the rain hits the most. Also the raining pattern, the average amount of rain, the average raining period during a day, and much more data can be gained, used and considered during the design phase of the final project. Moreover, this could also be used to contribute to weather forecast service.

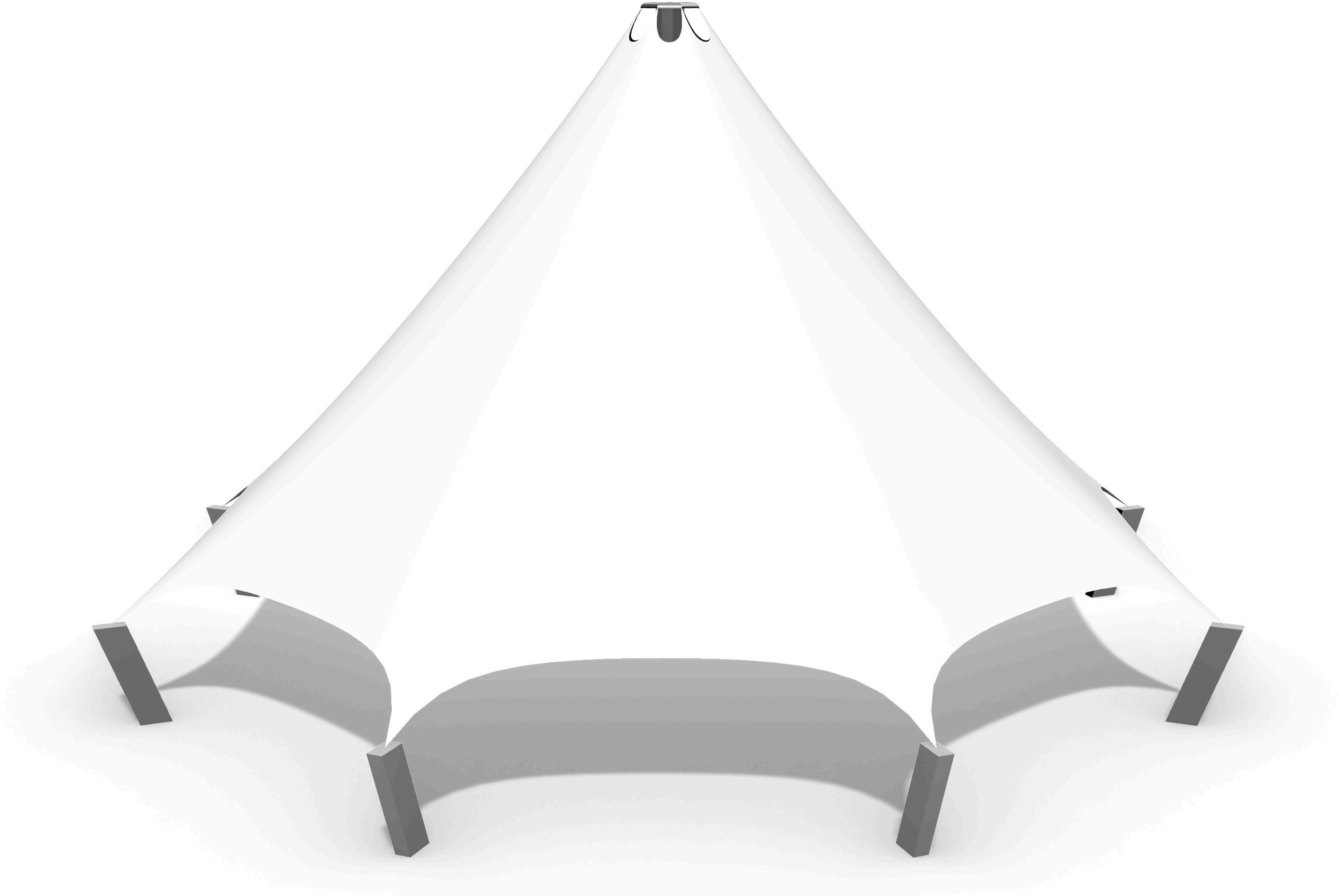
This device has a shelter-like shape that fits the idea of Fagin protecting the children. Also a contrary formed by bringing benefits such as weather data analysis but while blocking the view. The steel core is a giant complex. It has a top roof with an individual film and a base. It has 16 pillars supporting the top roof and the tension from the films. Both the top roof and the base are octagon shaped, with each corner with a cable that fixes the corners of the films to attach the films.

Iteration II

After the initial design proposal, I wanted this device to be used for pedestrian as a shelter, as well as a charming private space to be occupied, where pedestrian can be sitting in the middle with the sound of raindrop coming from all directions. Despite the fact that the data is entirely computer-aided, which is collected by the vibration sensors and sent to computers for comparison and analysis, this new, unique experience is also worth to be developed.

Four gaps among the eight gaps in between the side films are opened further out by reducing the length of the film from both sides to allow pedestrian to walk in while keeping every film with the same size to ensure the fairness of the comparison of the number of hits from raindrops. The pillars have also been completely redesigned to ensure a large enough gaps for the pedestrians to be able to enter and exit while keeping the structure artistic and strong. At the centre of the steel core, a rotatable stool with leather seating pad is fixed on the wooden floor built above the steel bottom. A roof is also added to protect the central area from rain coming from the gap of the top film. All these provide a charming, secure, and relaxing space to enjoy this unique experience. Not only does this match with the general idea of shelter further, it also matches with Fagin's behaviour of which he locked Oliver away to use loneliness and melancholy to 'brainwash' Oliver, as this small central area is designed for one pedestrian at a time and it is fairly closed to 'melancholy'. Moreover, this central area significantly increases the weight of the steel core, making the whole structure stronger and steadier.



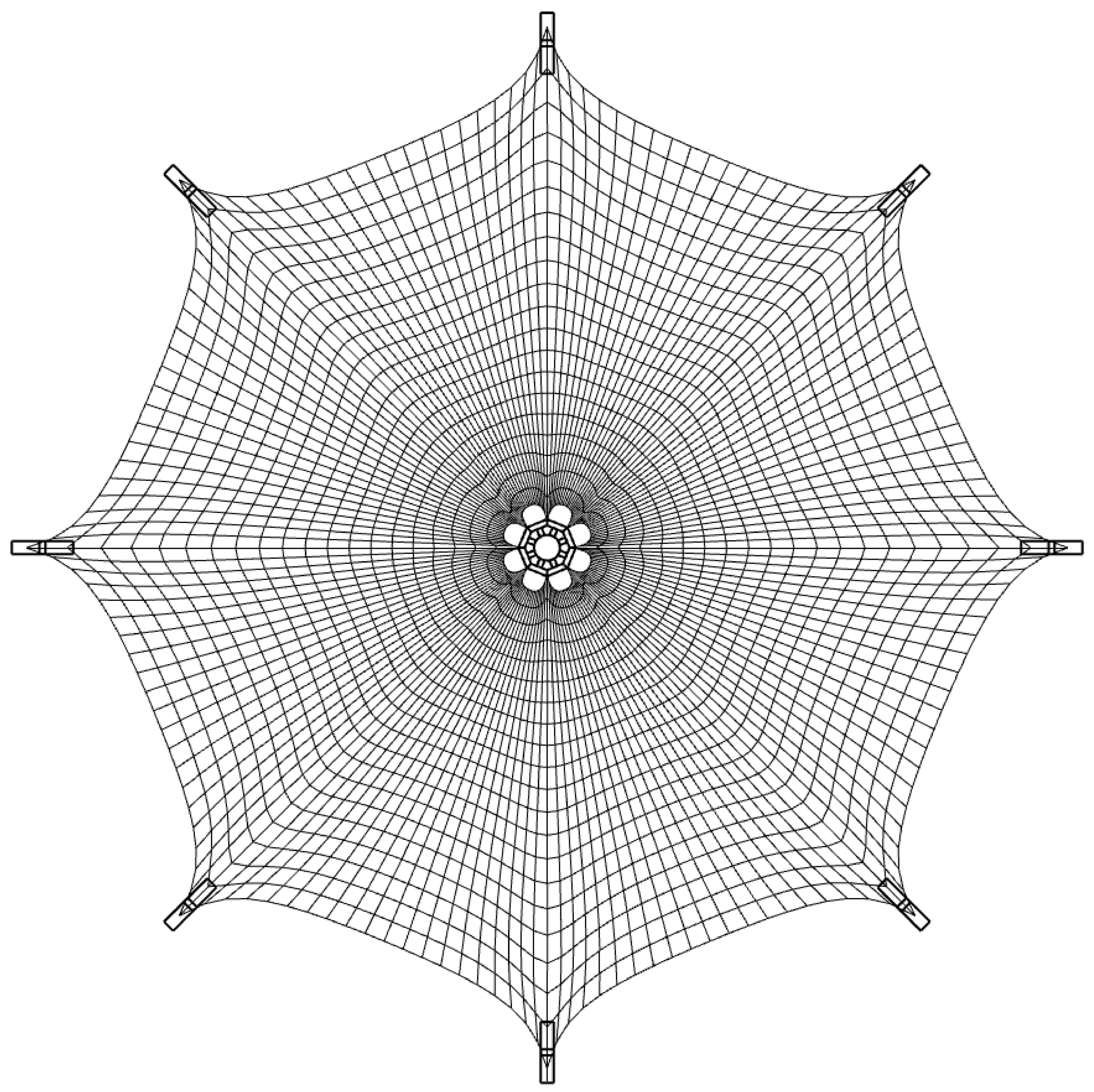


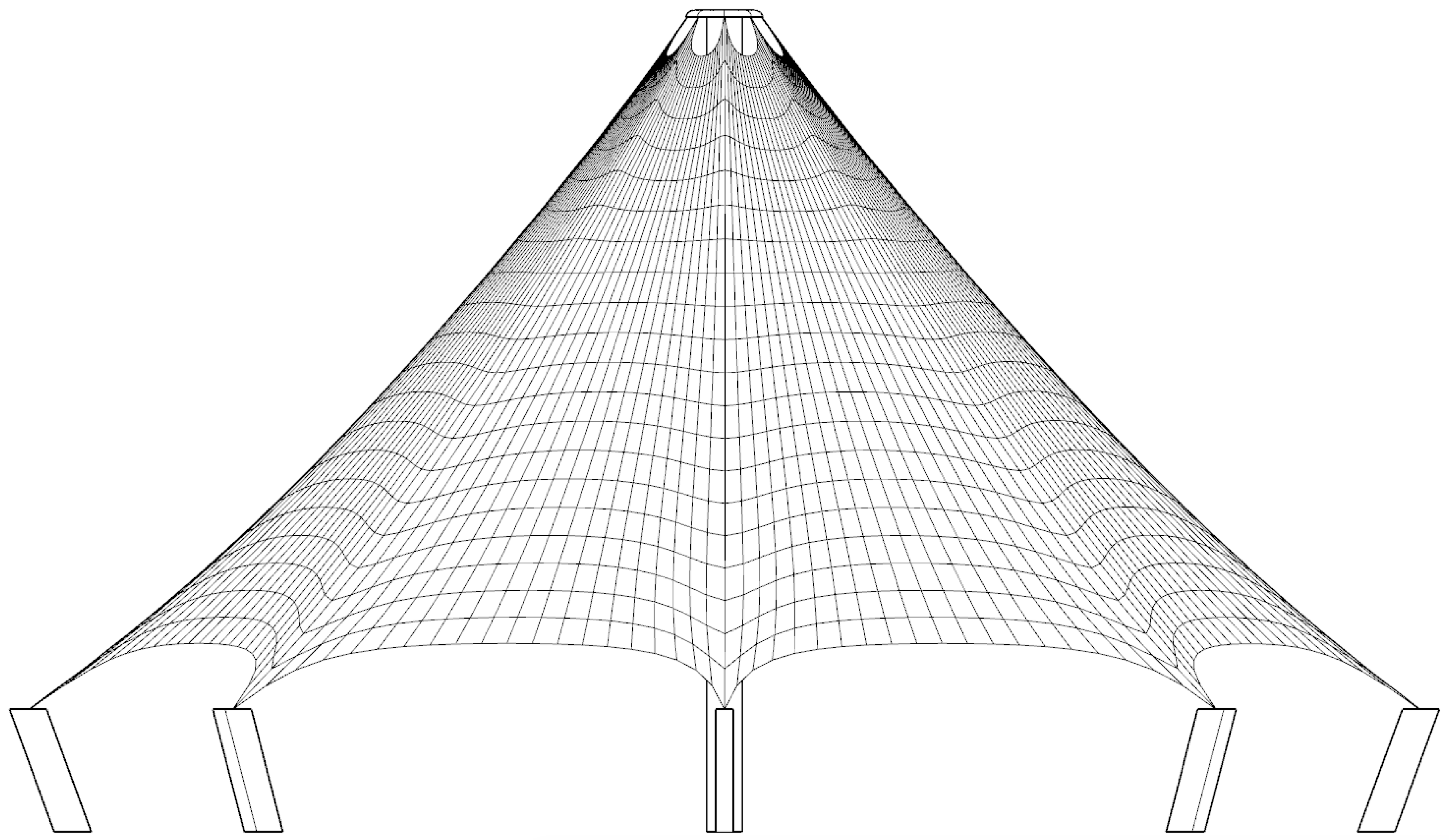
Iteration III

While keeping the general shape, the entire structure had been redesigned to reduce the size of the device and to increase its buildability. Because the previous iterations required very high standard for manufacturing of the parts, especially the central steel core, which is a 3-metre-tall, one-piece giant steel complex. Also it was determined that such structure at that size could not have possibly be steady and strong enough on the beach of Dungeness where wind is strong.

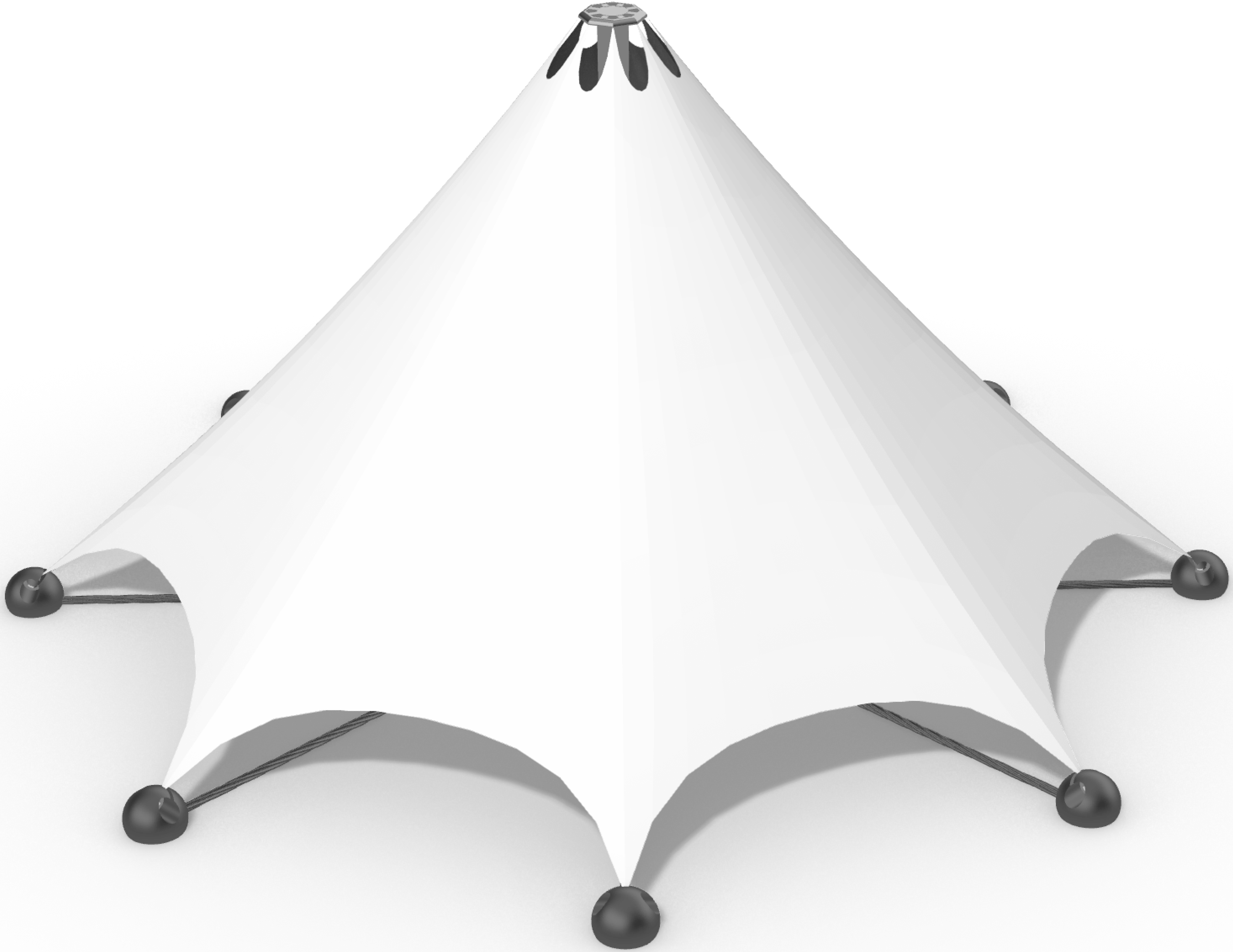
All films are merged into one single piece with tensile fabric used as the material. There are eight anchors set on each the bottom and the top of the structure. This divides the film into eight sections without having a solid barrier in-between each side. Due to the fact that by having a single piece could affect the data collected by sensors since the vibration from adjacent sections could be conducted to the sections where the raindrop did not actually hit. Therefore instead of counting numbers of vibration caused by the raindrop hits, they record the sum of the amplitude of all the vibrations. The total number of the raindrop is also times more than tripled. The data will be processed by a computer as well as the previous designs. By setting up a sensor system like this, rather than having discrete result from different section, the data collected by different sensors are interrelated and the pattern drawn from this joint data set could show the direction of rain much more accurately and precisely than the individual sensor set.

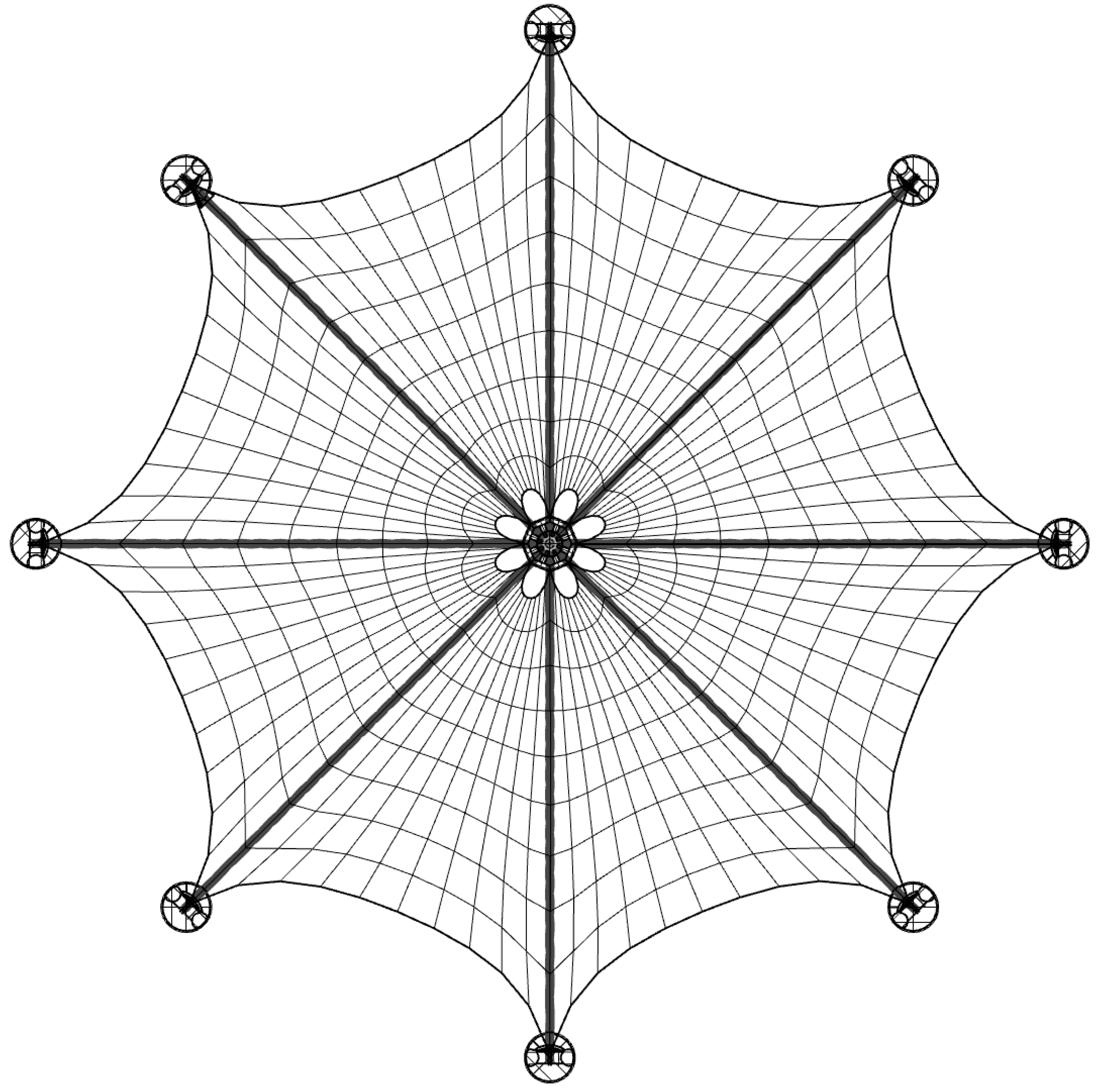
There is a circular central pillar supporting and withstanding the tension and the weight of the film. The horizontal forces are balanced since the plan shape is an octagon. At the very top, there is an outer octagon ring connected to the central pillar with eight anchors, corresponding to the anchors on the side pillars set on the ground to fix the film. The overall height is 1.2 metres, joint by the 1 metre from the structure and the 0.2 metres from the side pillars. The diameter of the plan octagon shape is 2 metres. All pillars are thought to be in aluminium alloy, which is light but strong enough to support the structure.





Iteration IV

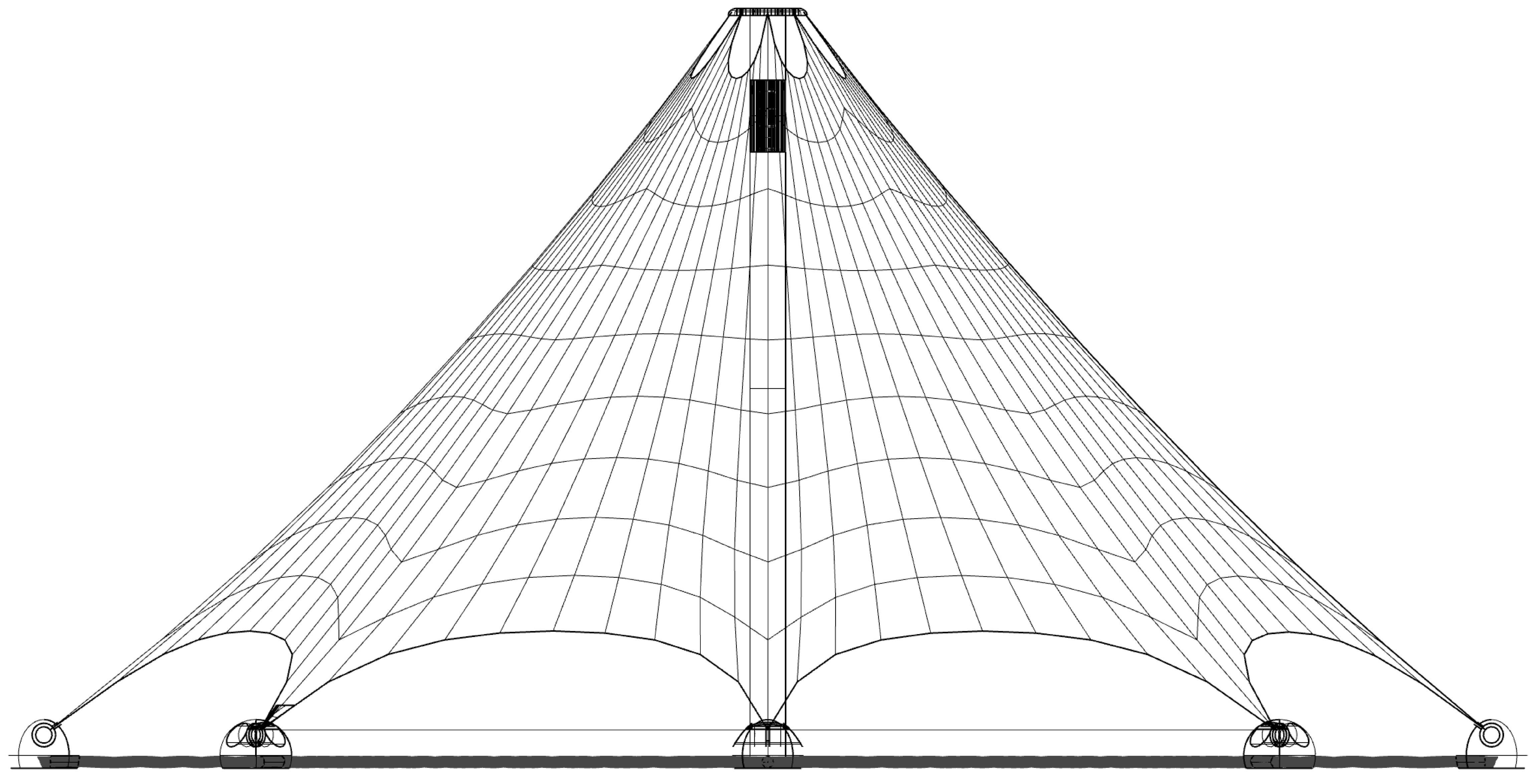


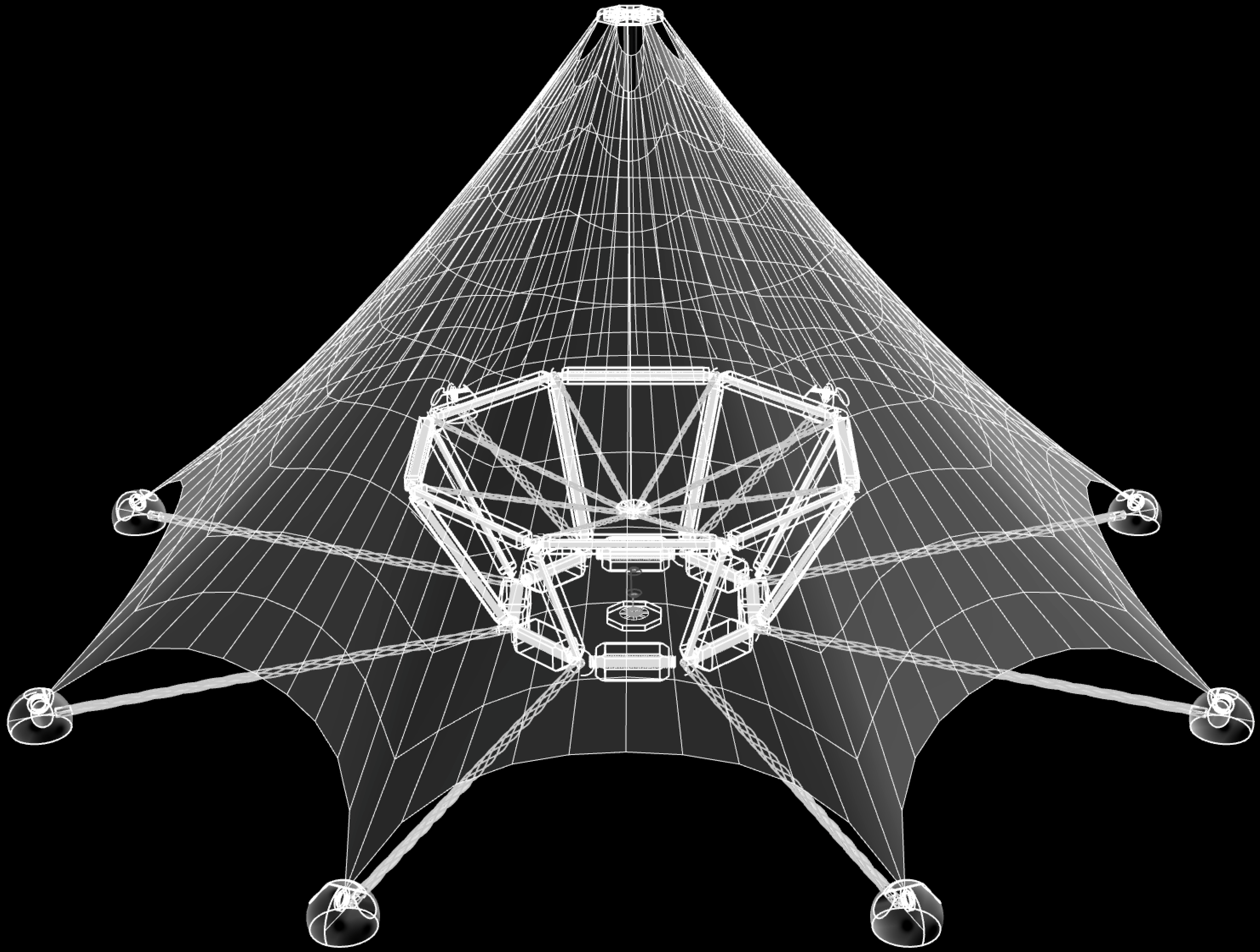


In order to fit into uneven terrains since it is very rare to have a perfectly flat site in Dungeness, rather than having fixed side pillars, they were replaced with movable sphere-shaped individual anchors, allowing free movements to fit into nearly any rough lands. I also brought the chain back from earlier design to establish connection between the central pillar with the anchors. The fabric was added with a ring fixed at each vertex. By chaining the anchors, the distance between the central pillar and each anchor is fixed and also the device is kept as one piece.

To easily place the anchor without having to worry about being interrupted by the film when setting up on site, each anchor can still be disconnected from the film and reconnected by simply sliding the ring out and in. The process of setting up on an uneven site would be: disconnect the anchors, place the anchors in places freely, pull the film to the anchor and slide the rings into the anchors to fix it, all done without any tools needed.

The method of data collection has completely changed into collecting the sound of raindrop. By applying different loads onto different sections of the fabric, bubble sound with different frequency could be obtained, which is used to identify which section the sound comes from and therefore obtain the direction where the rain comes from and therefore the direction of wind. The central pillar has been modified to fit in a microphone.





Iteration V

Iteration V is the final iteration before the final design. The appearance had not changed much, while the structure had been completely redesigned.

Research related to the structure of Cutty Sark Pavilion was conducted, which enhanced my understanding of the supporting structure of a tensile fabric based pavilion. Its brilliant design allows the central pillar to support the fabric without making direct contact with the supporting medium, which is the ground in Project 1. The top of the structure is supported a single central pillar, which is then supported by a sphere held by cables connected to the fixed frames, distributing the force exerted downwards due to the tension of the fabric evenly through out the fixed frame.

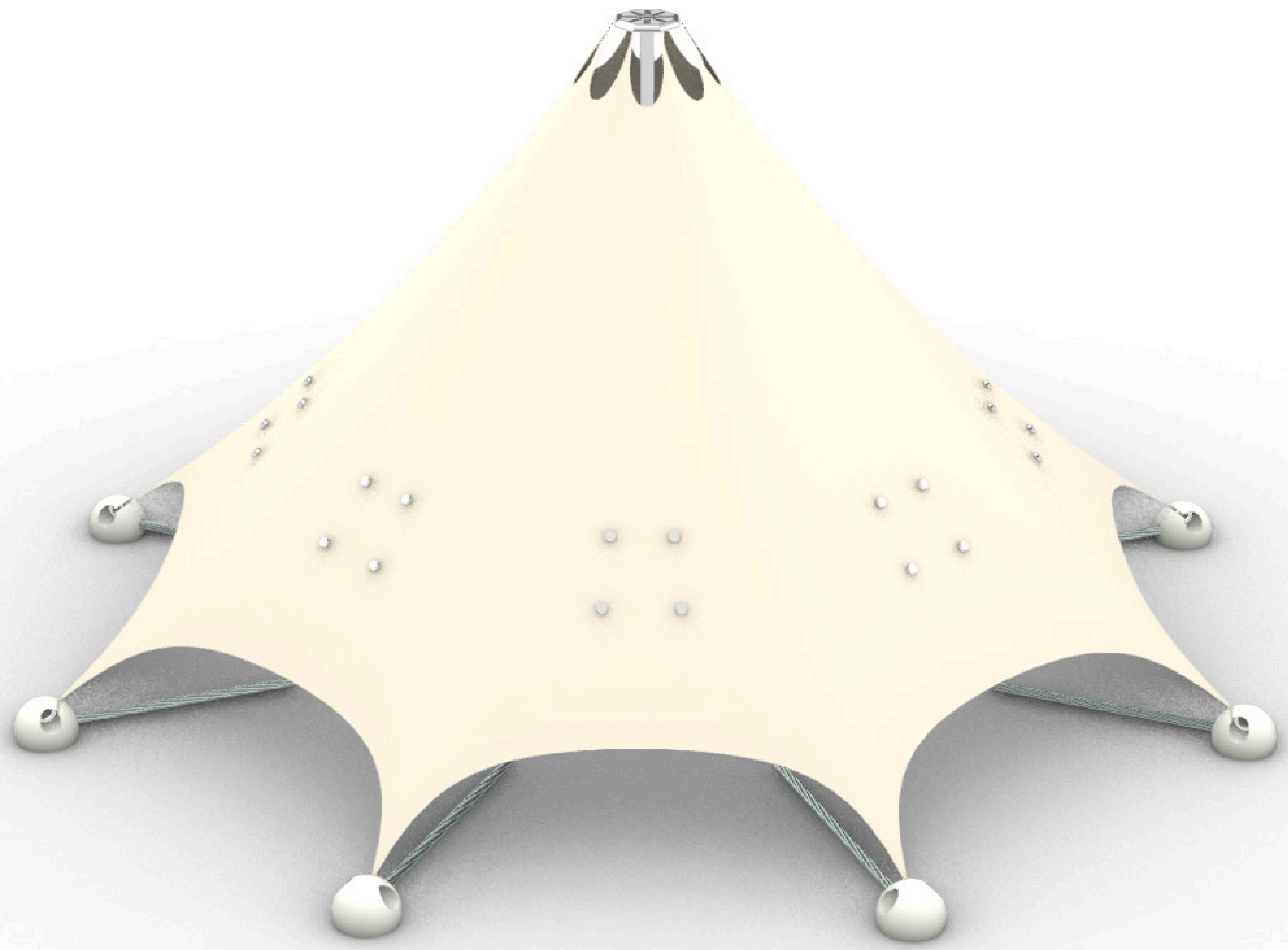
Due to the fact that this device has been designed to be able to fit in any terrain, structure that enables less contact with the ground is preferred. I could not have applied a fixed structure directly onto the fabric as this contradicts with the purpose of the design, which is to enable the shape of the fabric to be changed freely depending on the positioning of the anchors. However, I was able to apply this onto the central pillar solely.

The structure is divided into a upper frame and a bottom frame, each formed by eight timber beams with steel bolts built in and eight spheres as the joints, where the beams of the bottom frame are thicker than the upper frame both frames form octagon shape and they are connected by eight side pillars made out of timber, which also each has a steel bolt built in. Spheres are to join forces acting in different directions at single points, and are made with different materials. The spheres of the upper frame are made with aluminium alloy, the spheres of the bottom frame are made out of PMMC and lead, same as the anchors, as they shall weigh more to keep the centre of mass as low as possible, and also to prevent corrosion from seawater and rain.

The upper frame supports the central pillar via eight steel wires connected from the upper frame spheres to the centre. The bottom frame transfers the forces acting downwards due to weight and tension of the fabric to the ground and holds the anchors and the entire structure. Such structure could prevent a direct contact with the ground from the central pillar to ensure that the central pillar will not be affected by the complex terrain that could potentially lead to tilting and failing, and the force acting downwards is evenly distributed to prevent excess tension at the same single point that could lead to yielding.

Such small bottom frame as the basement could be fit into majority of uneven terrain given that there is also a huge void in the middle to give prominent ground space. The microphone had been moved to the bottom located at the centre, where all sound wave tends to travel to firstly (not reflected) the most. It is held by an individual plate for more flexibility.

The puropse of the device had been shifted from collecting rain and wind data to streaming the sound of rain as multichannel audio as ASMR to provide an immersion experience of the surrounding enviornment of the site without having to step out of the house. The device is easily redeployable and can fit into majority of ground, enabling the device to be used at multiple sites.



Final Proposal

Integrated Technical Drawings

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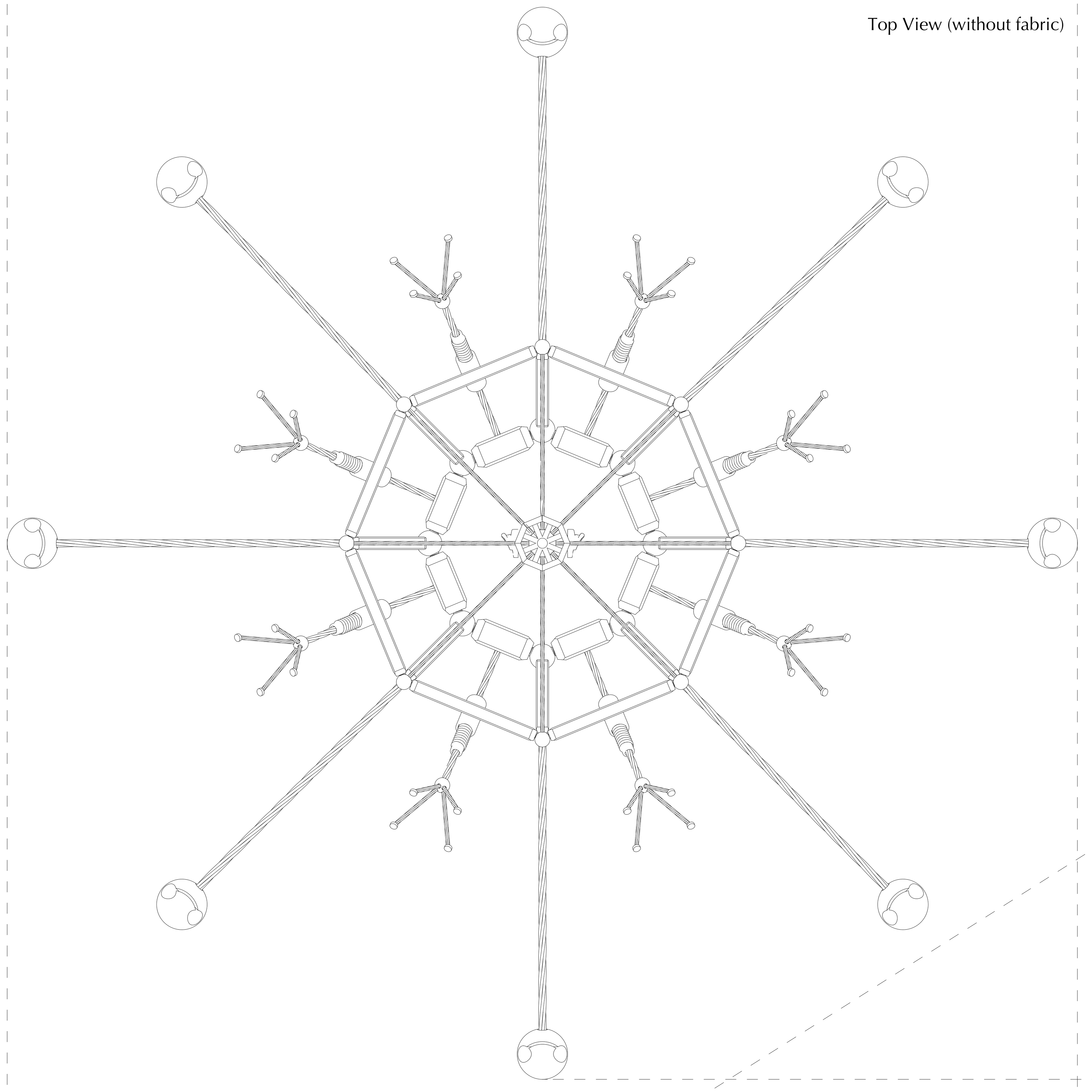
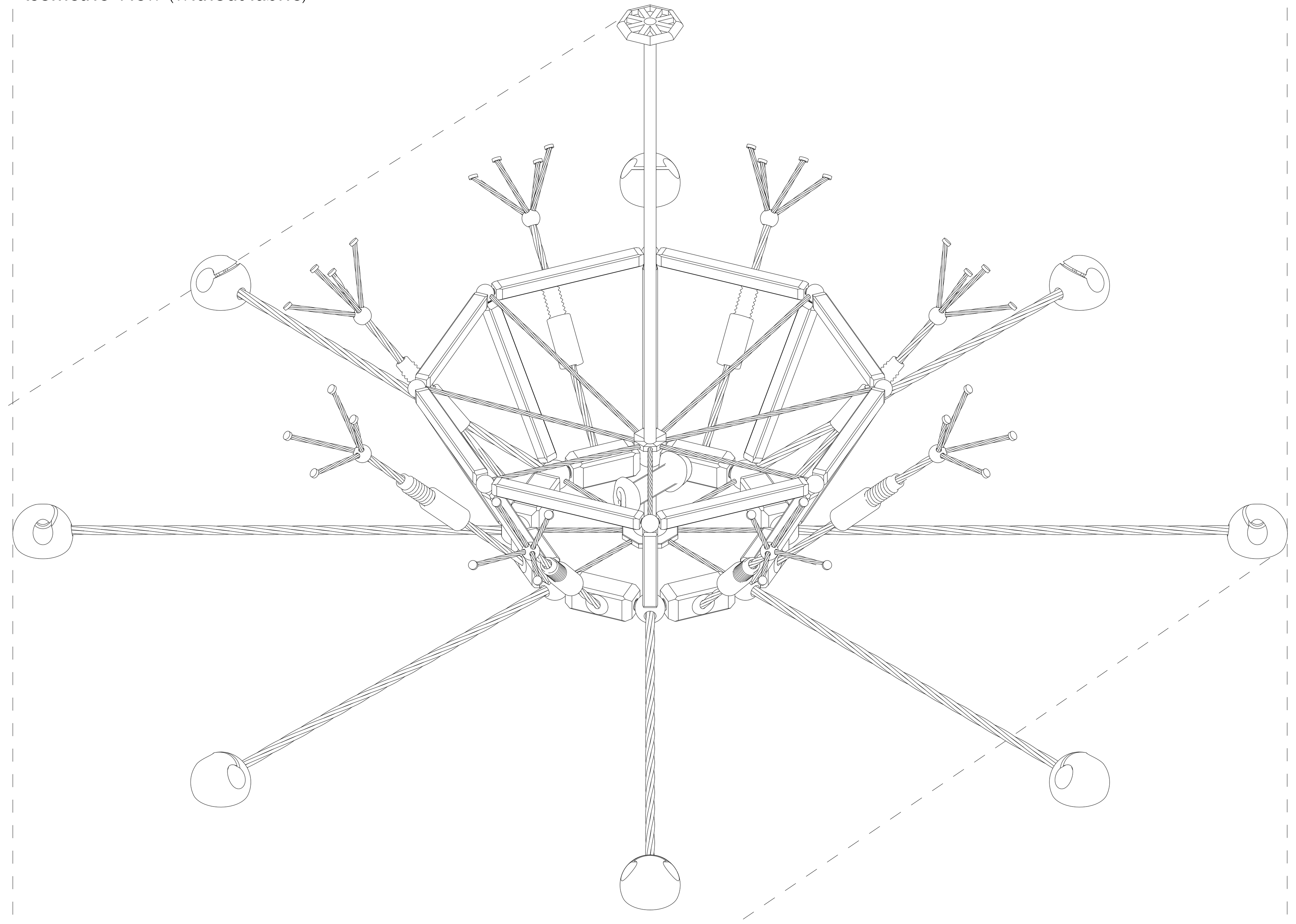


Top View (without fabric)



Isometric View (without fabric)

Integrated Technical Drawings

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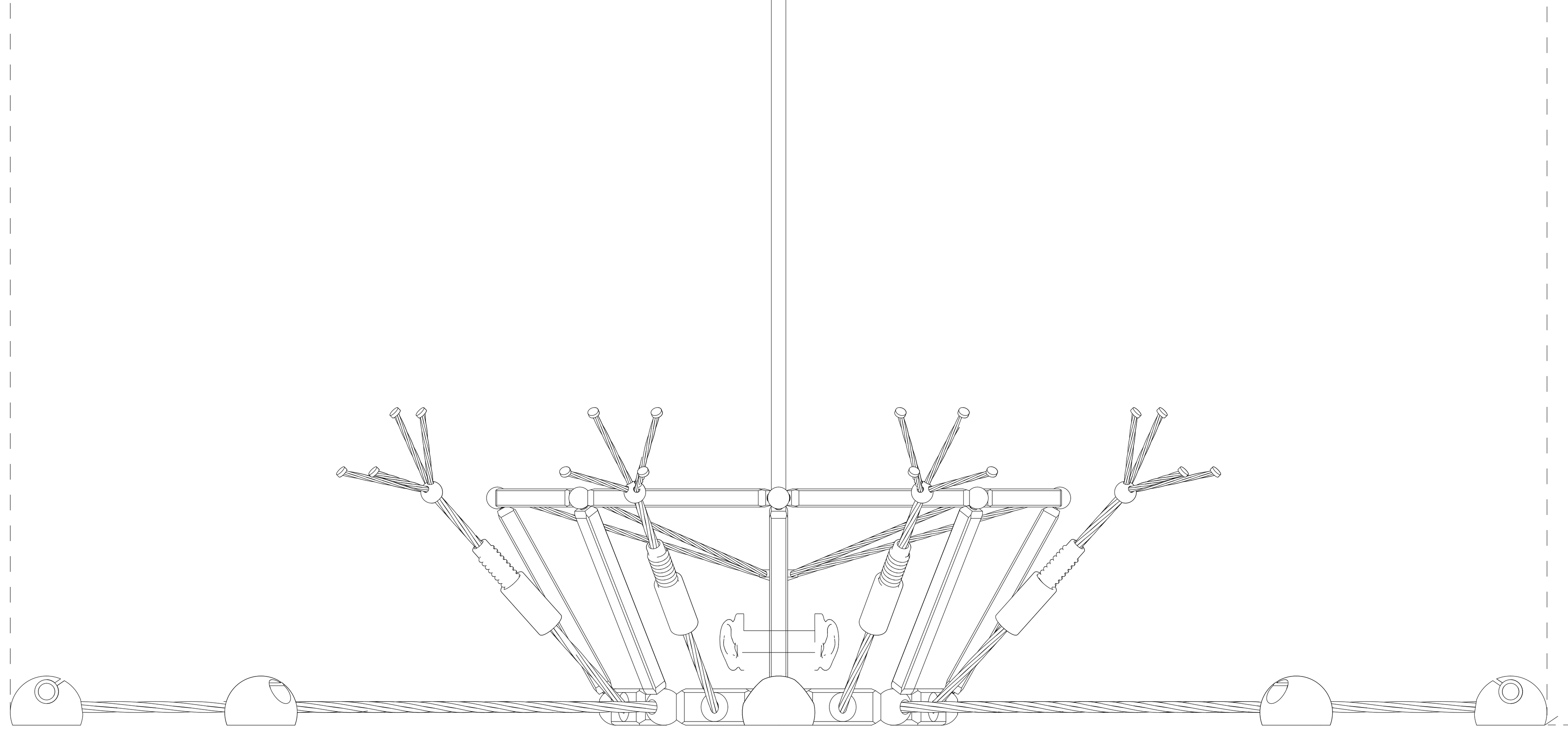
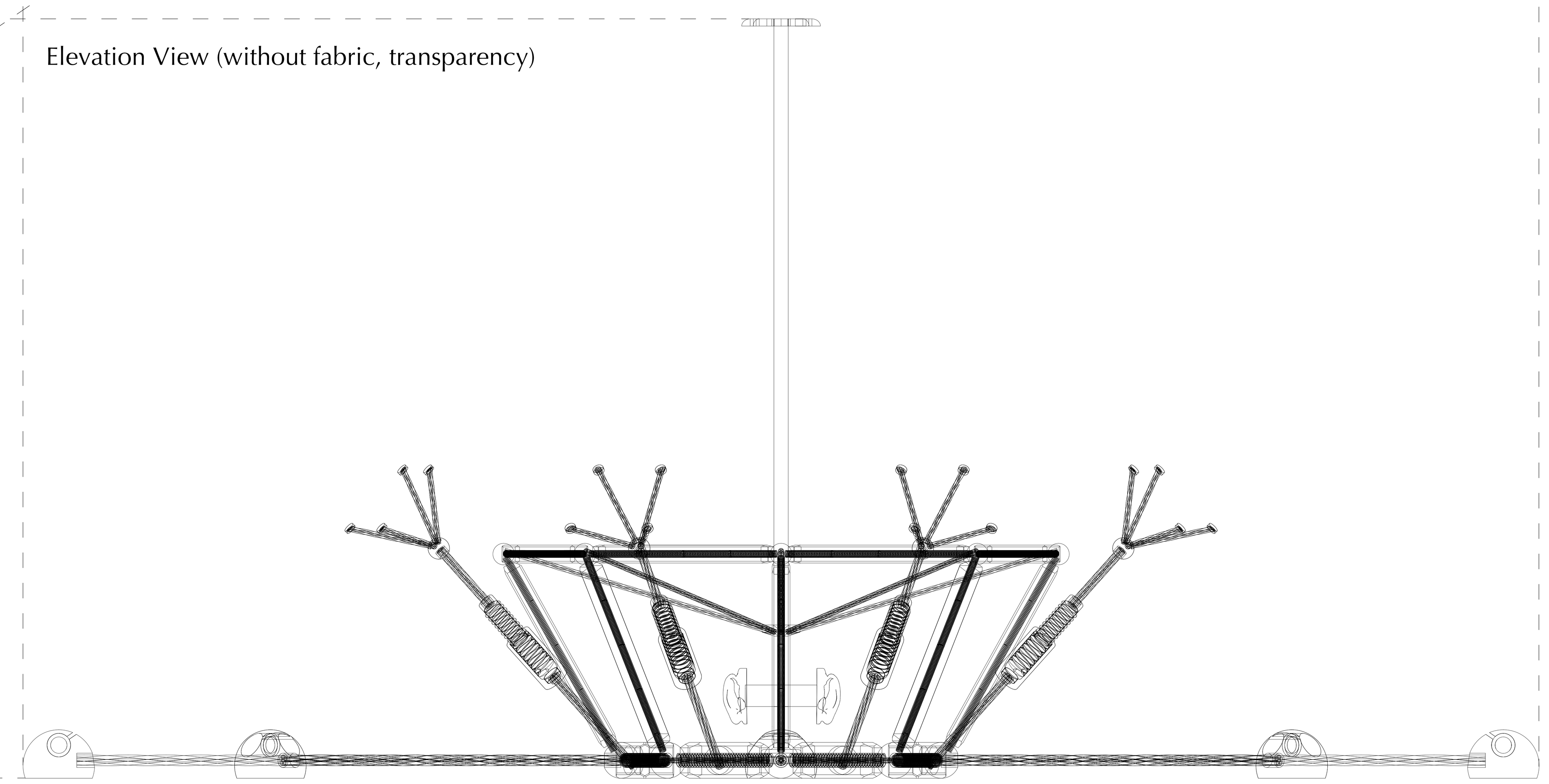
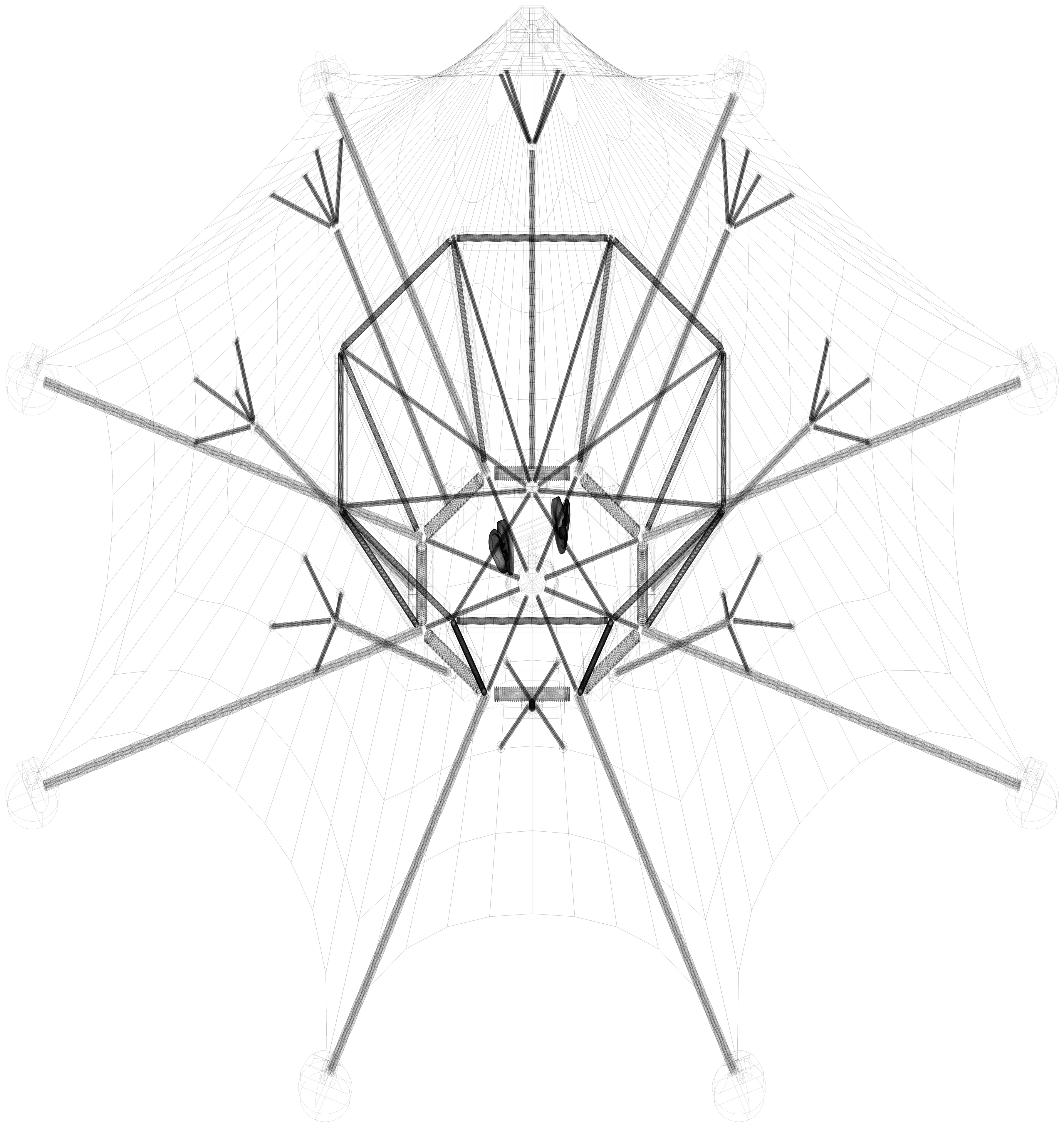


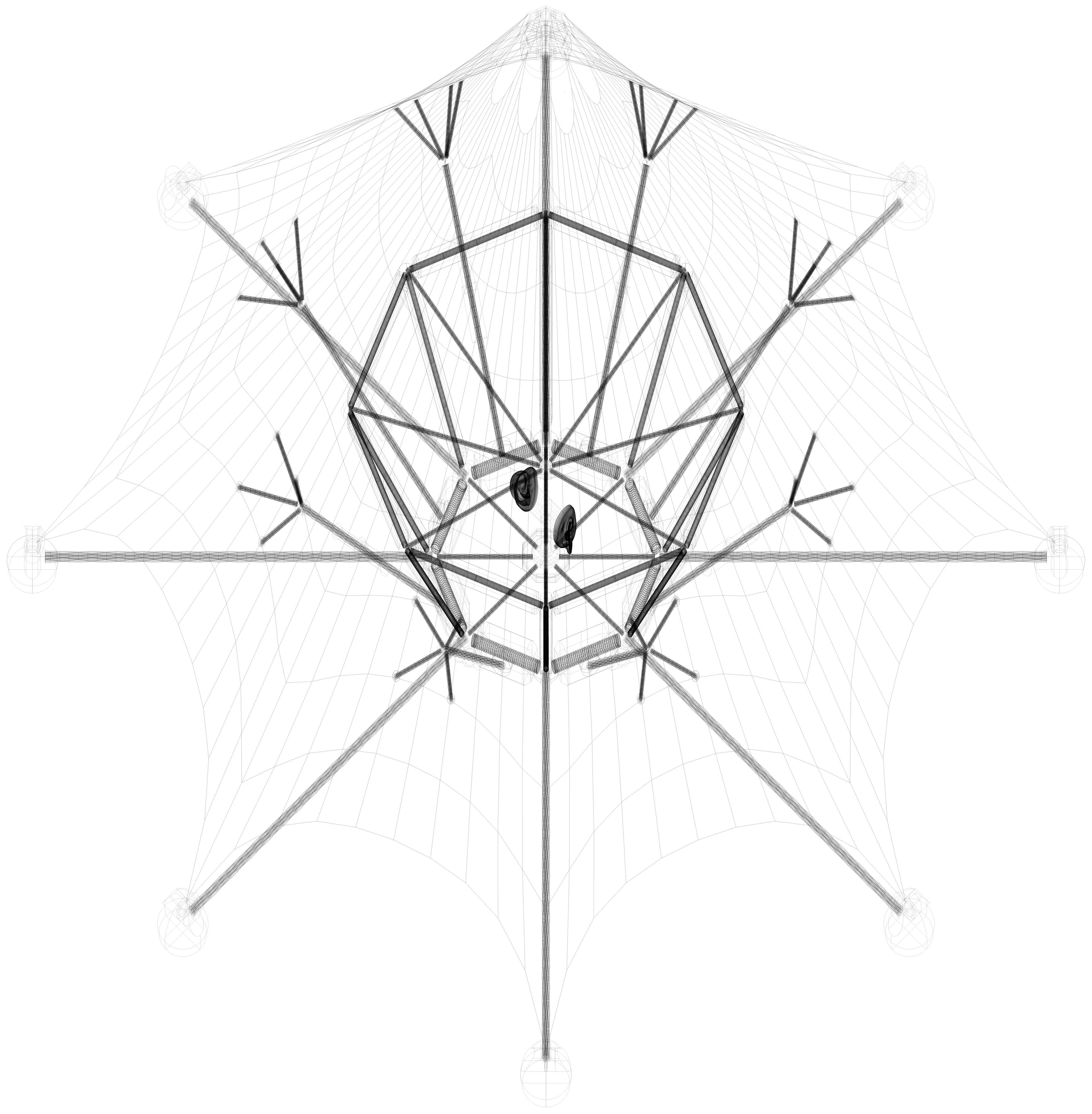
Elevation View (without fabric)



Elevation View (without fabric, transparency)

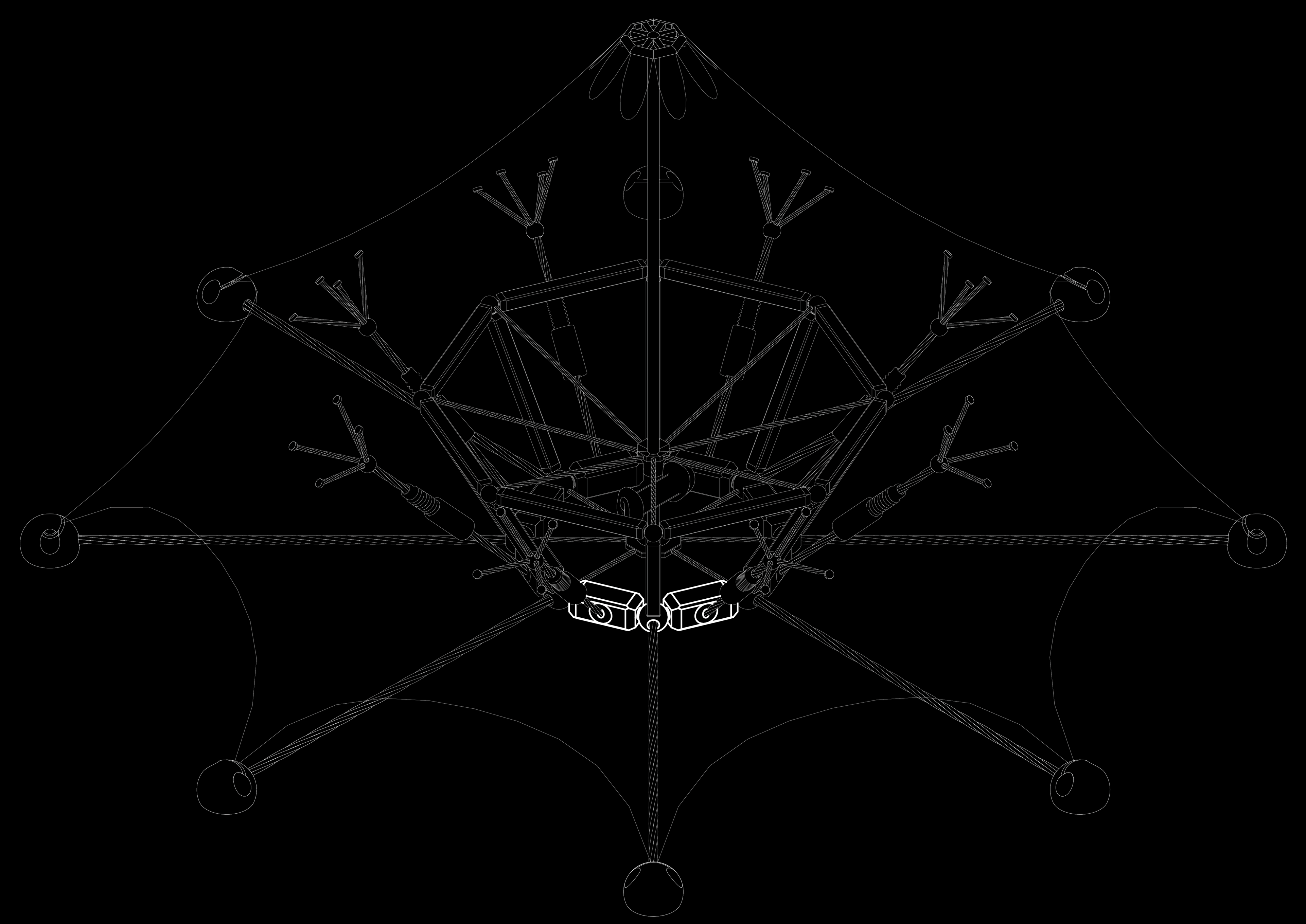


Axonometric View (transparency)



Axonometric View (rotated, transparency)

Bottom Frame



Detailed Technical Drawings

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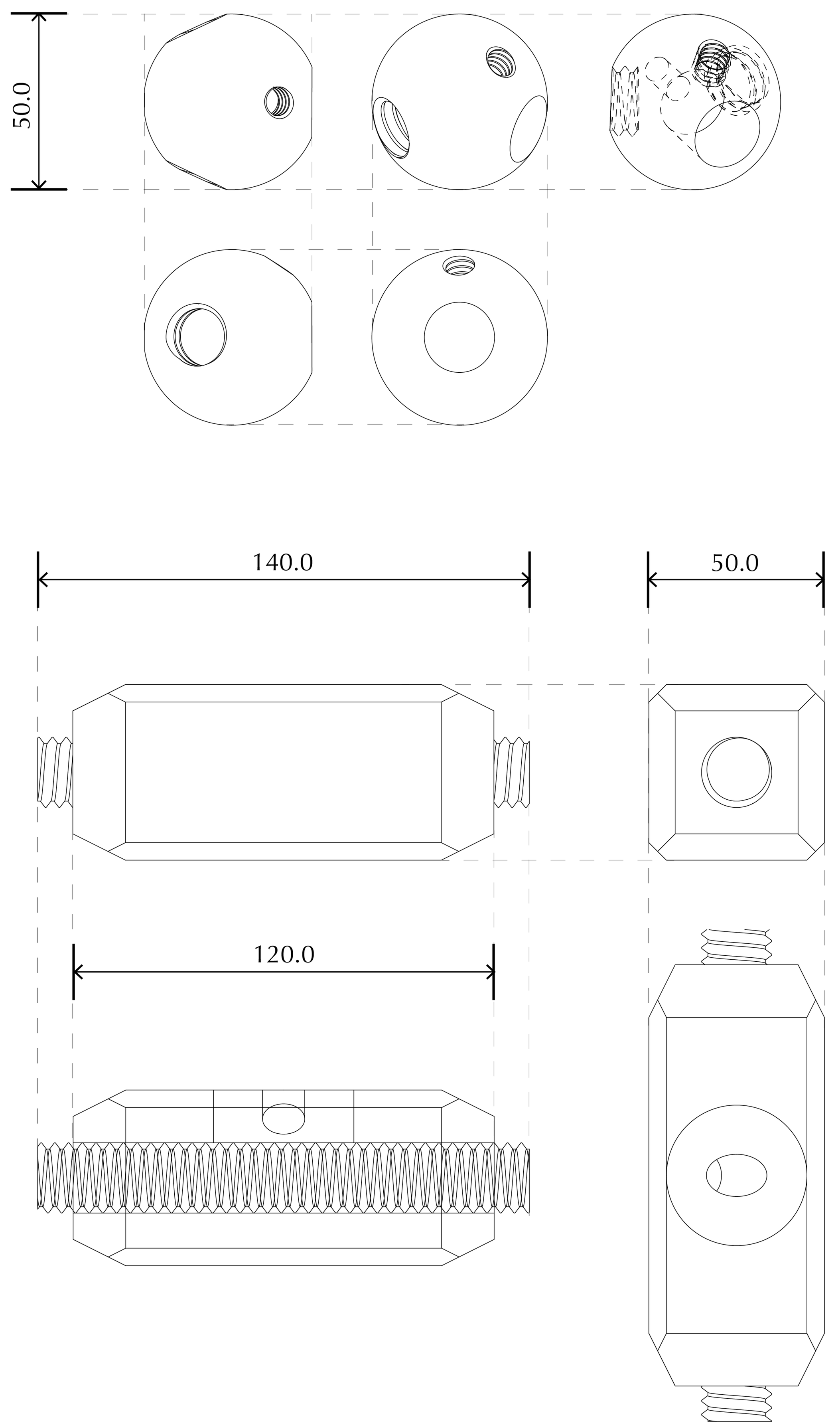
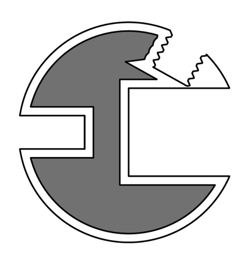
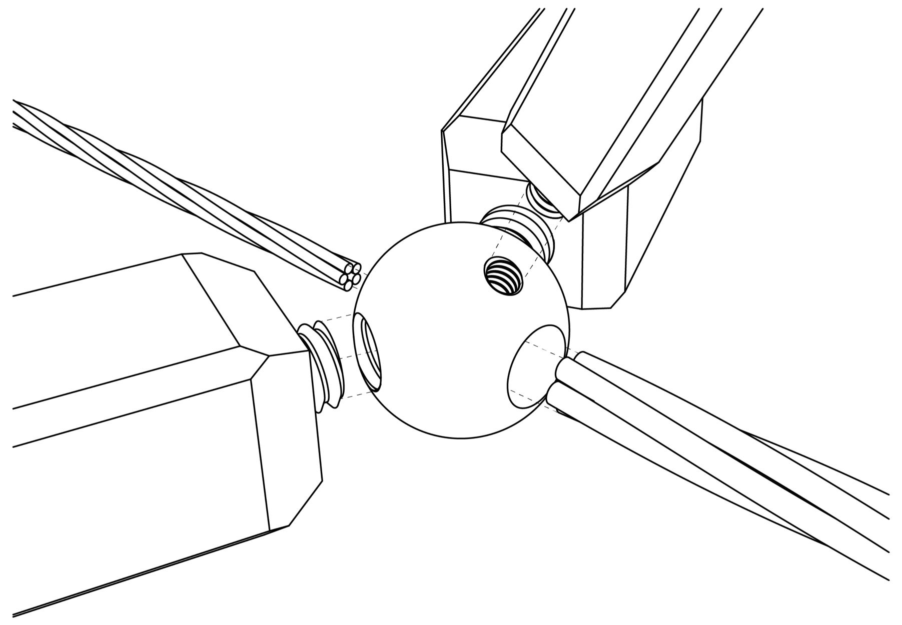




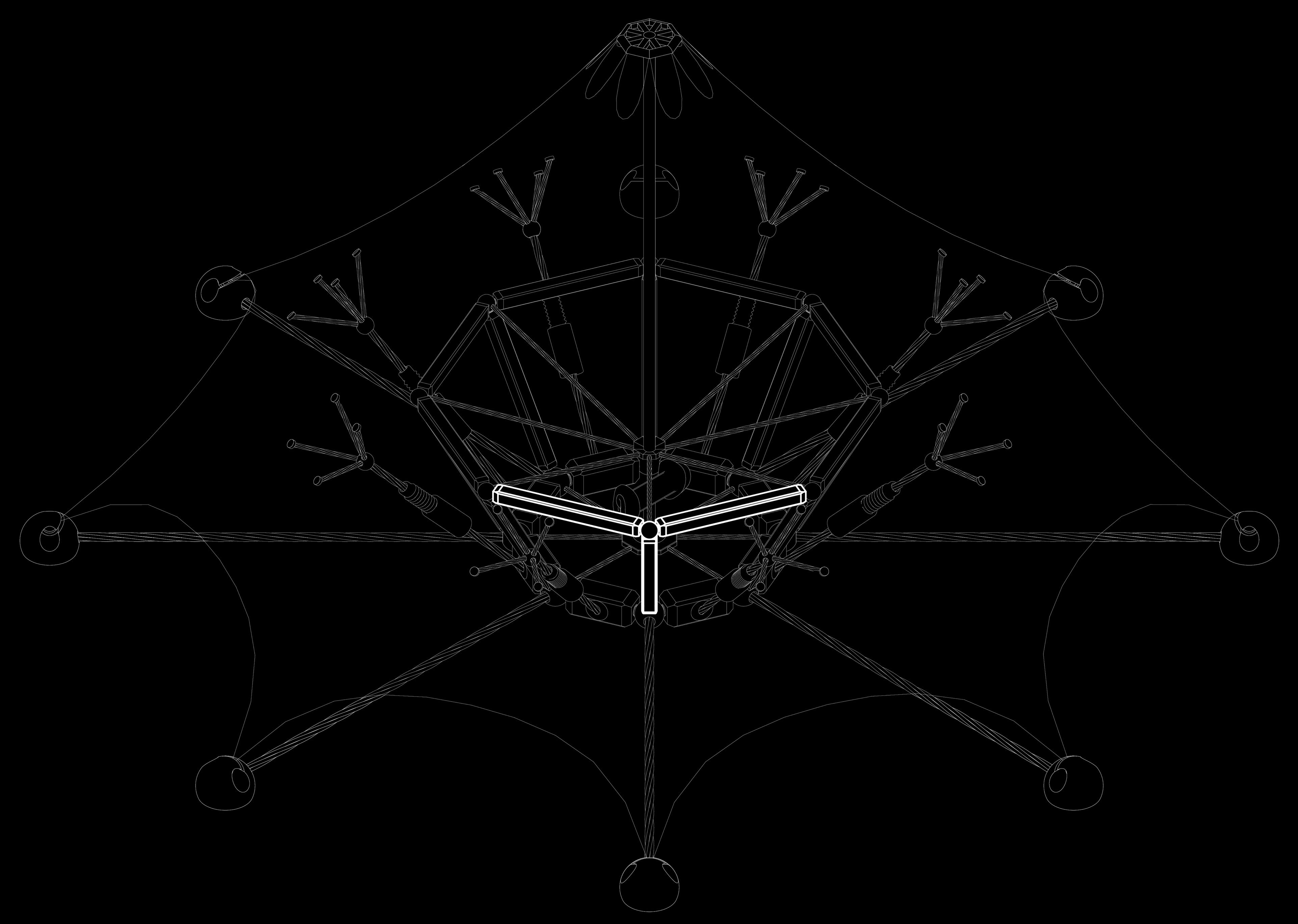
Spheres made with lead core and PMMA are used to join and combine all the forces and joints at each single point of vertices and the octagon.

Lead core with a volume of 45 cm³ has a weight of 0.5 kg, ensuring sufficient weight on the bottom to fix the entire structure with weight of bottom frame timber combined.

PMMA, Arcylic is used to contain the lead core to protect it from rain/seawater, prevent potential pollusion, and provide allealing appearance.



Upper Frame & Side Pillar



Detailed
Technical Drawings

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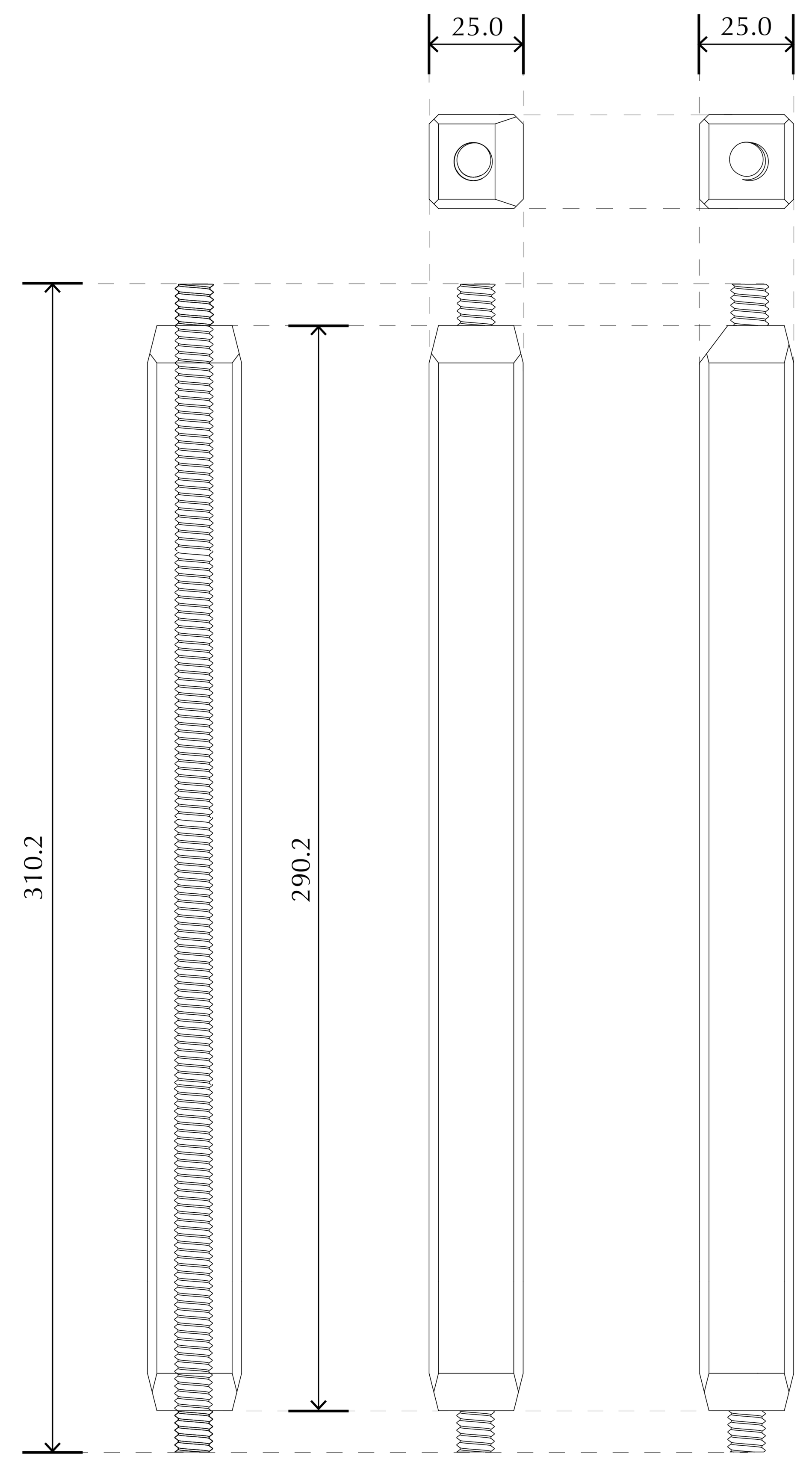
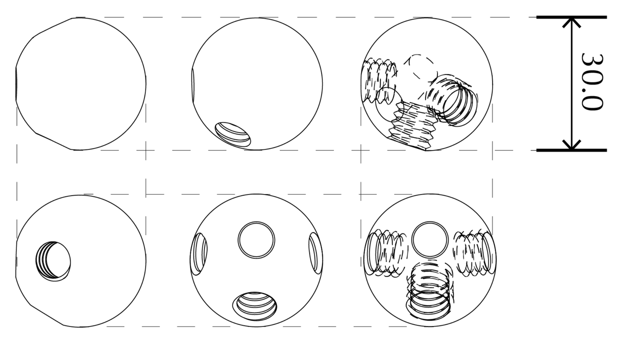
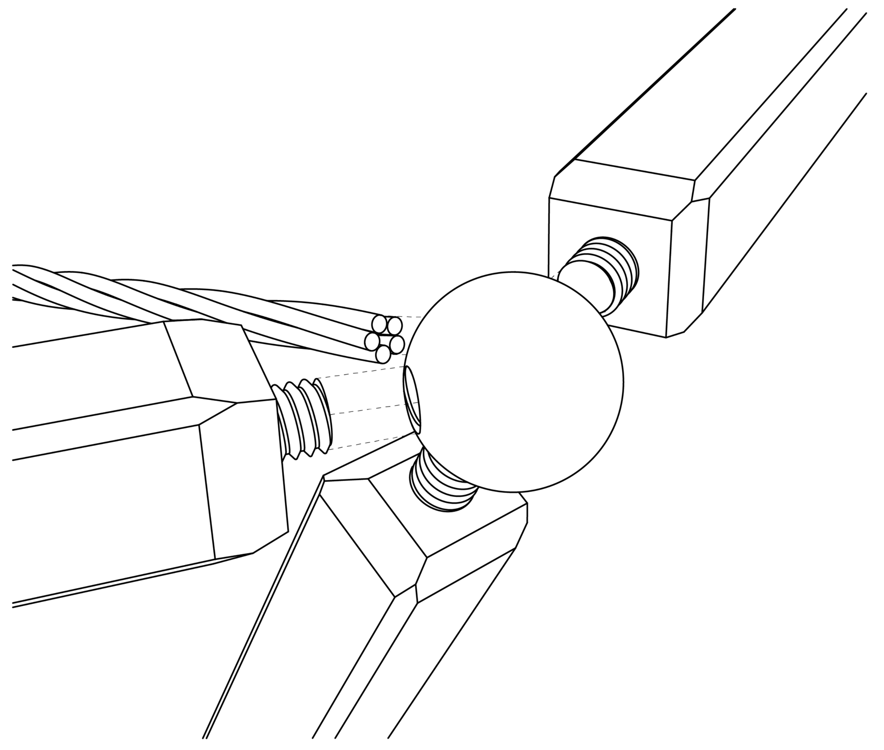


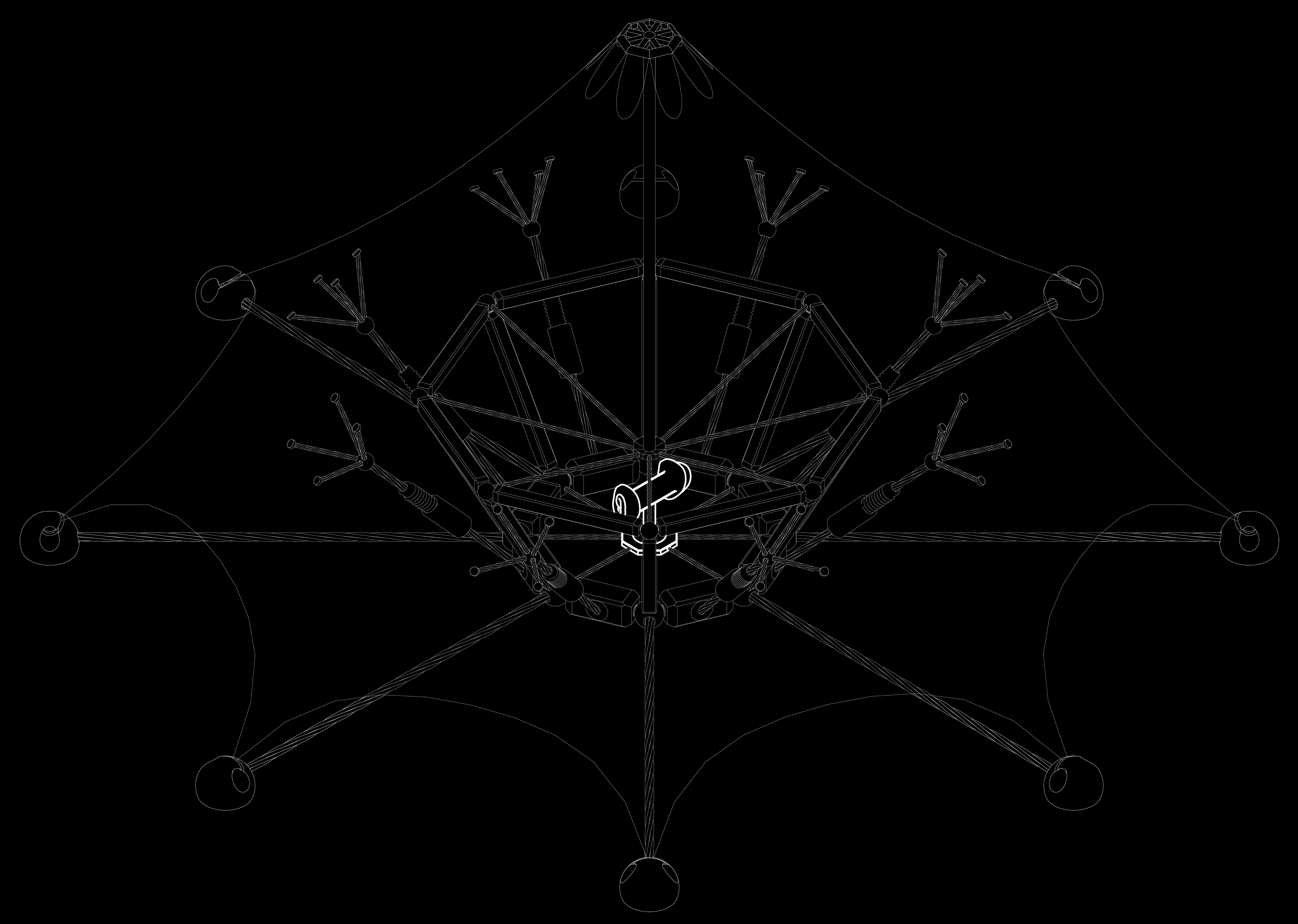


Spheres made out of Alumium alloy with smaller sizes in comparison to the spheres used for the bottom frame are used to firmly hold the joints of the upper frame.

Through these spheres, a connection between the wires holding the central pillar with the upper frame and the side pillars connected to the bottom frame is constructed, while keeping a light weight .to minimise the load of the upper frame.



Bottom Central Plate & Mircophone



Detailed
Technical Drawings

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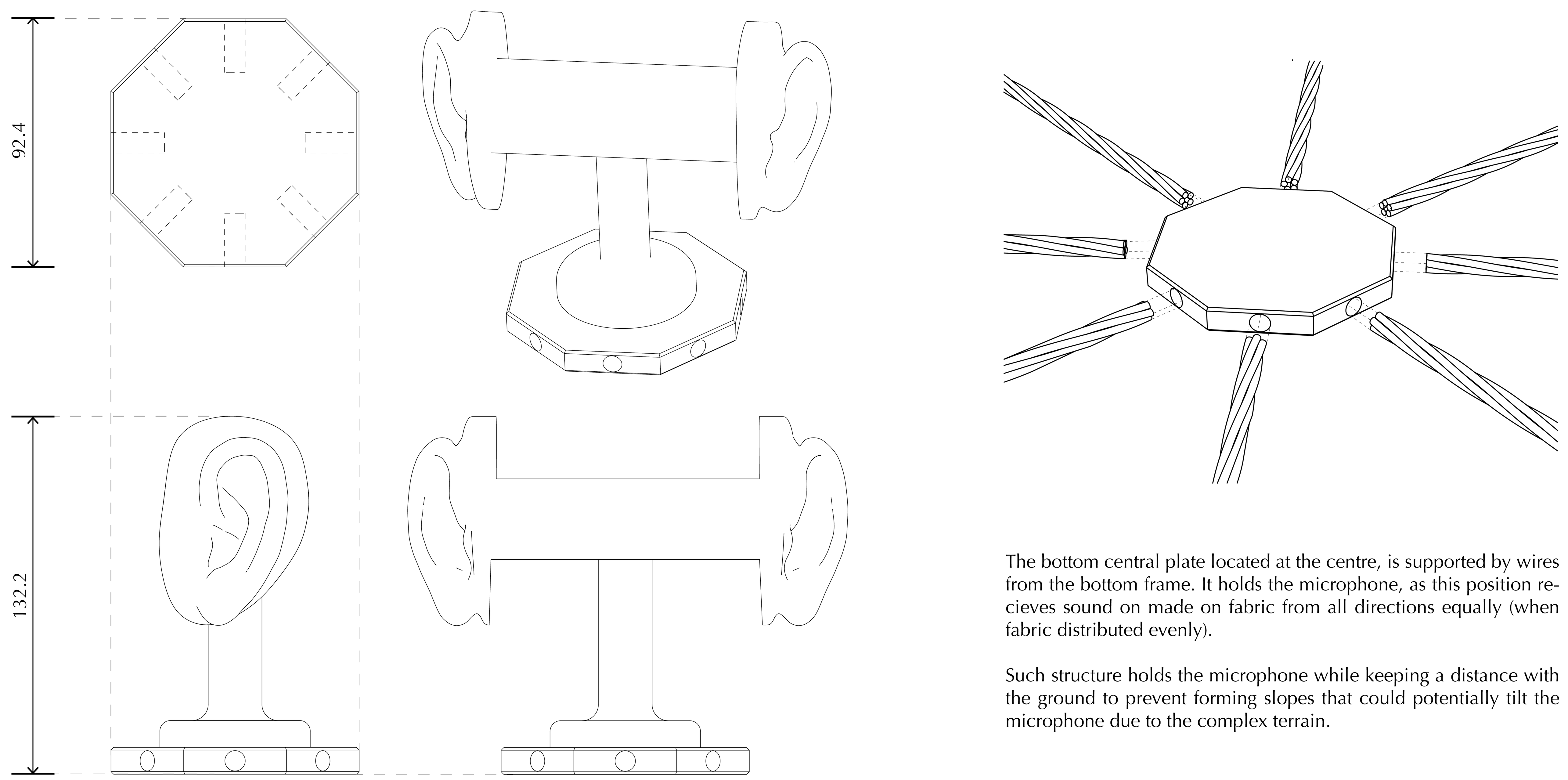

The bottom central plate located at the centre, is supported by wires from the bottom frame. It holds the microphone, as this position recieves sound on made on fabric from all directions equally (when fabric distributed evenly).

Such structure holds the microphone while keeping a distance with the ground to prevent forming slopes that could potentially tilt the microphone due to the complex terrain.

Central Pillar

Detailed
Technical Drawings
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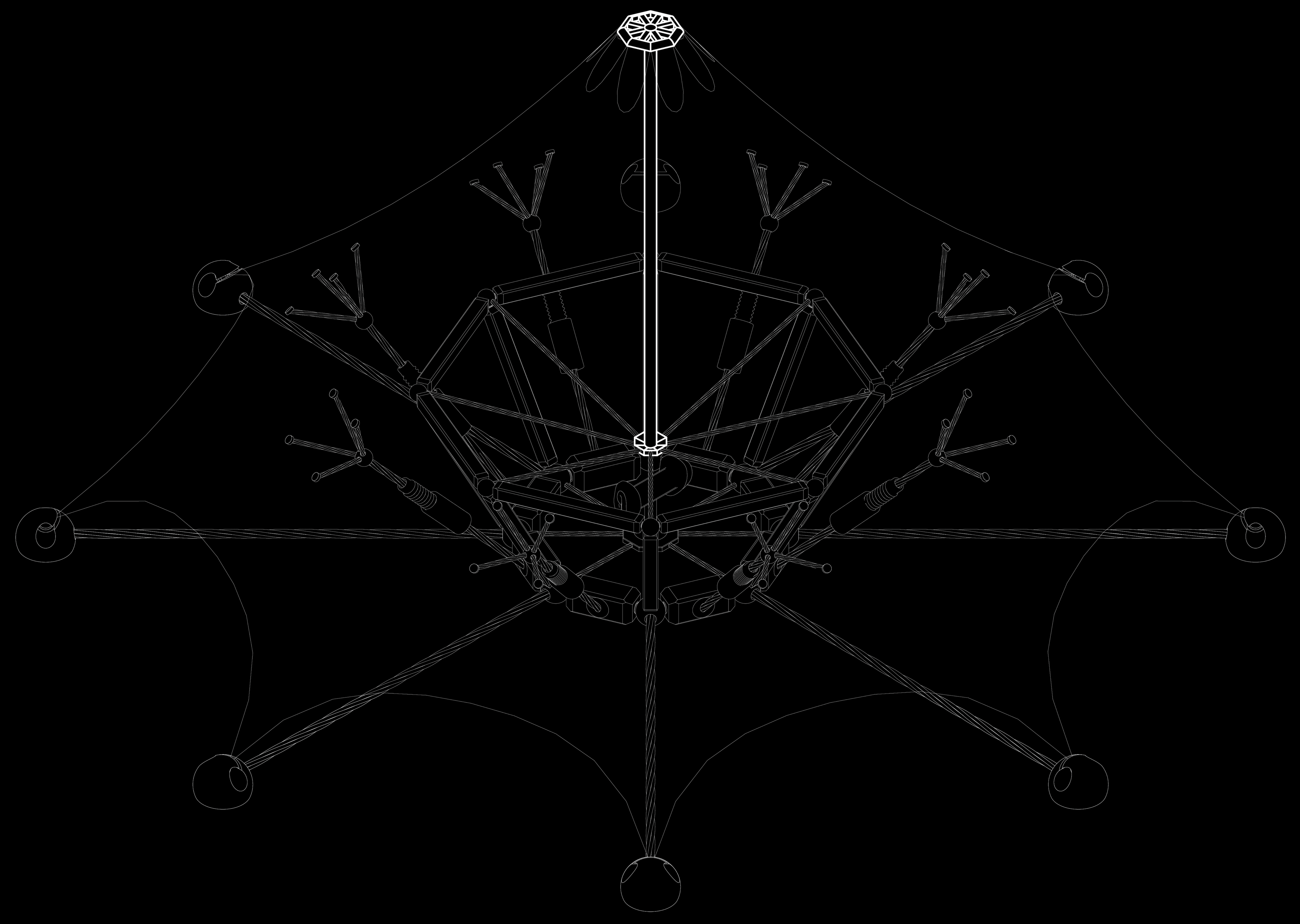
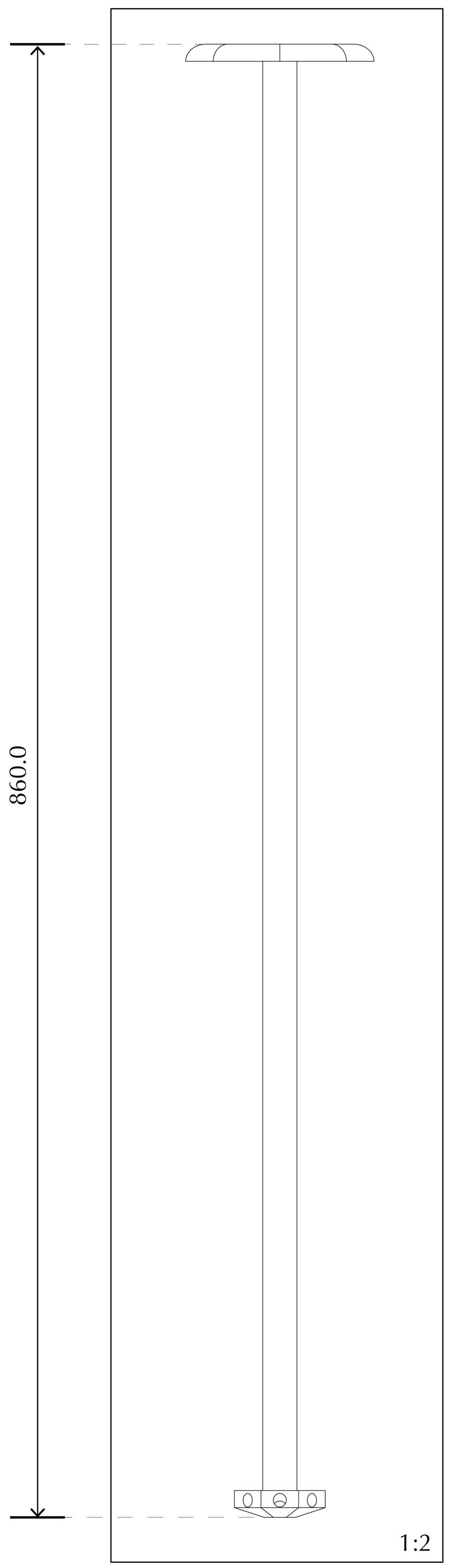
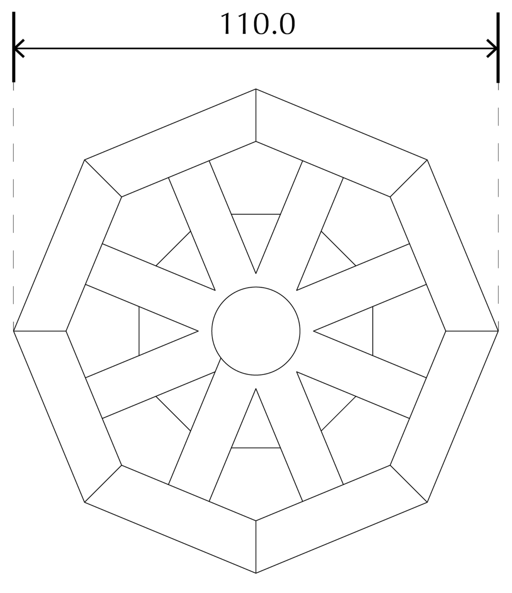
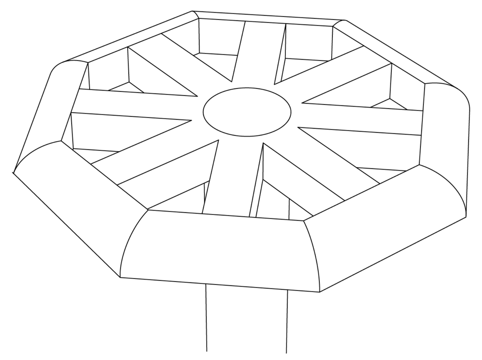
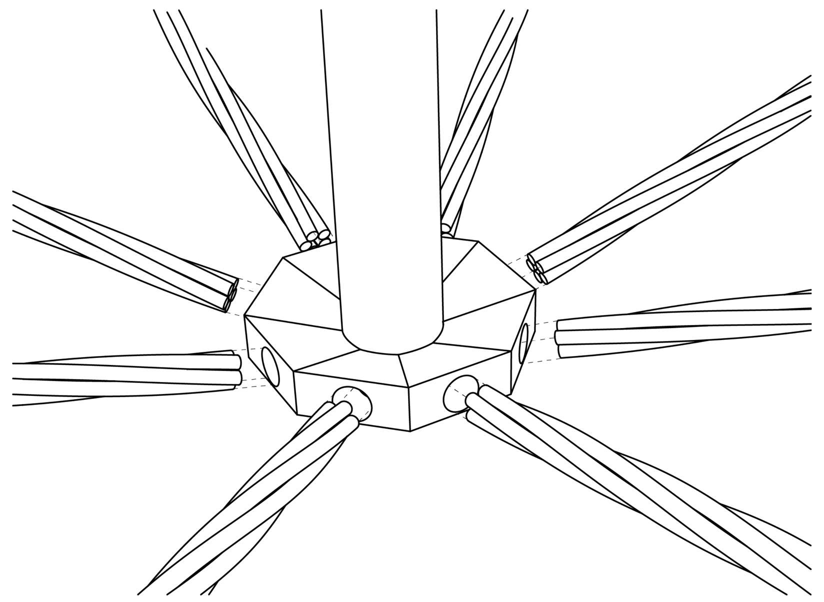




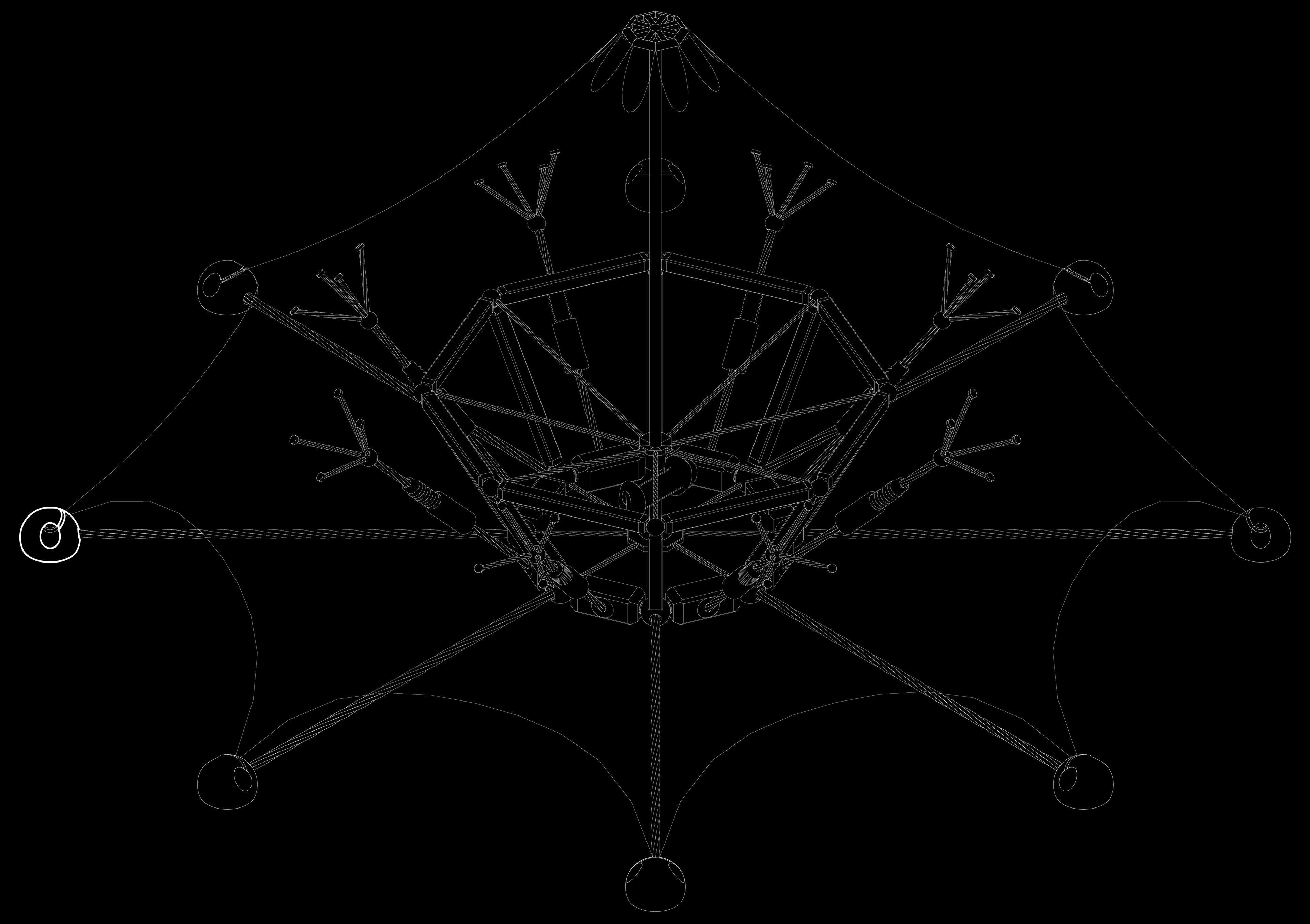






Bottom of the central pillar is supported by the wires connected to the upper frame which transfer the force exerted downwards from the central pillar due to the tension of the fabric to the frame via the wires and therefore to the ground.

Anchor



Detailed Technical Drawings

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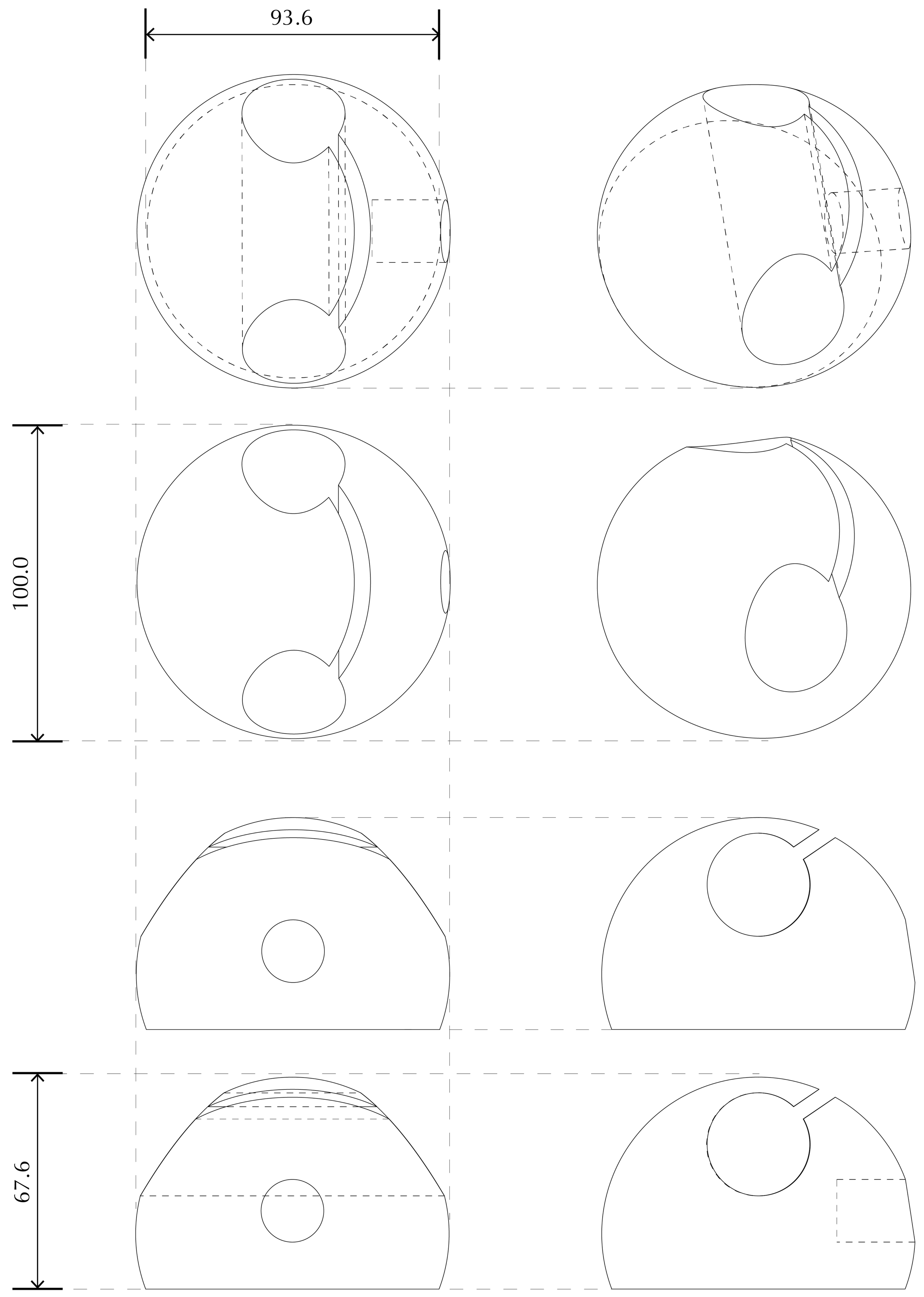
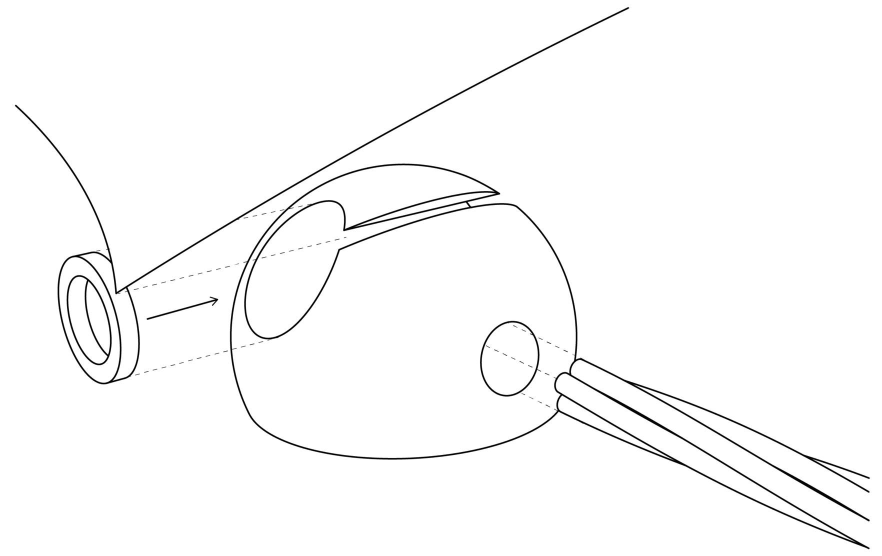
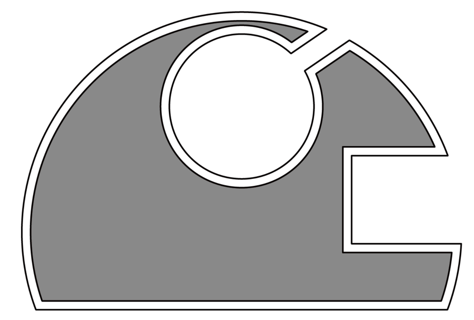




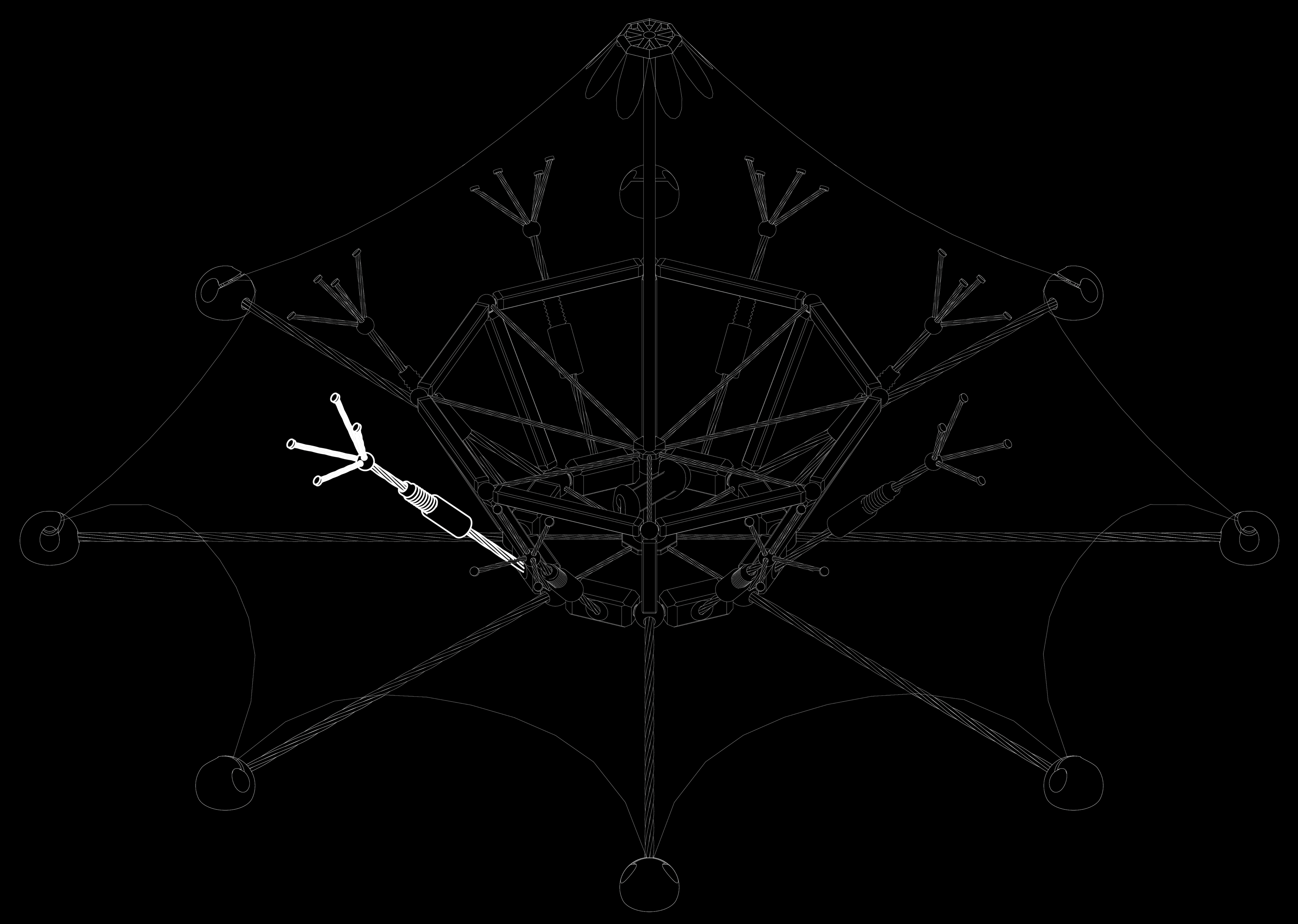
Slide the attached ring on the vertex of the fabric into the gap to fix fabric with the anchor. Ensuring the device to have the ability to perform a toolless modification in terms of the shape of the fabric and the positions of the anchors to fit into complex terrain or variable wind directions.



Lead core with a volume of 300 cm³ has a weight of 3.6 kg, ensuring sufficient force to fix the structure with such small size.

PMMA, Arcylic is used to contain the lead core to protect it from rain/seawater, prevent potential pollution, and provide allealing appearance.

Fabric Adjustment Mechanism



Detailed Technical Drawings

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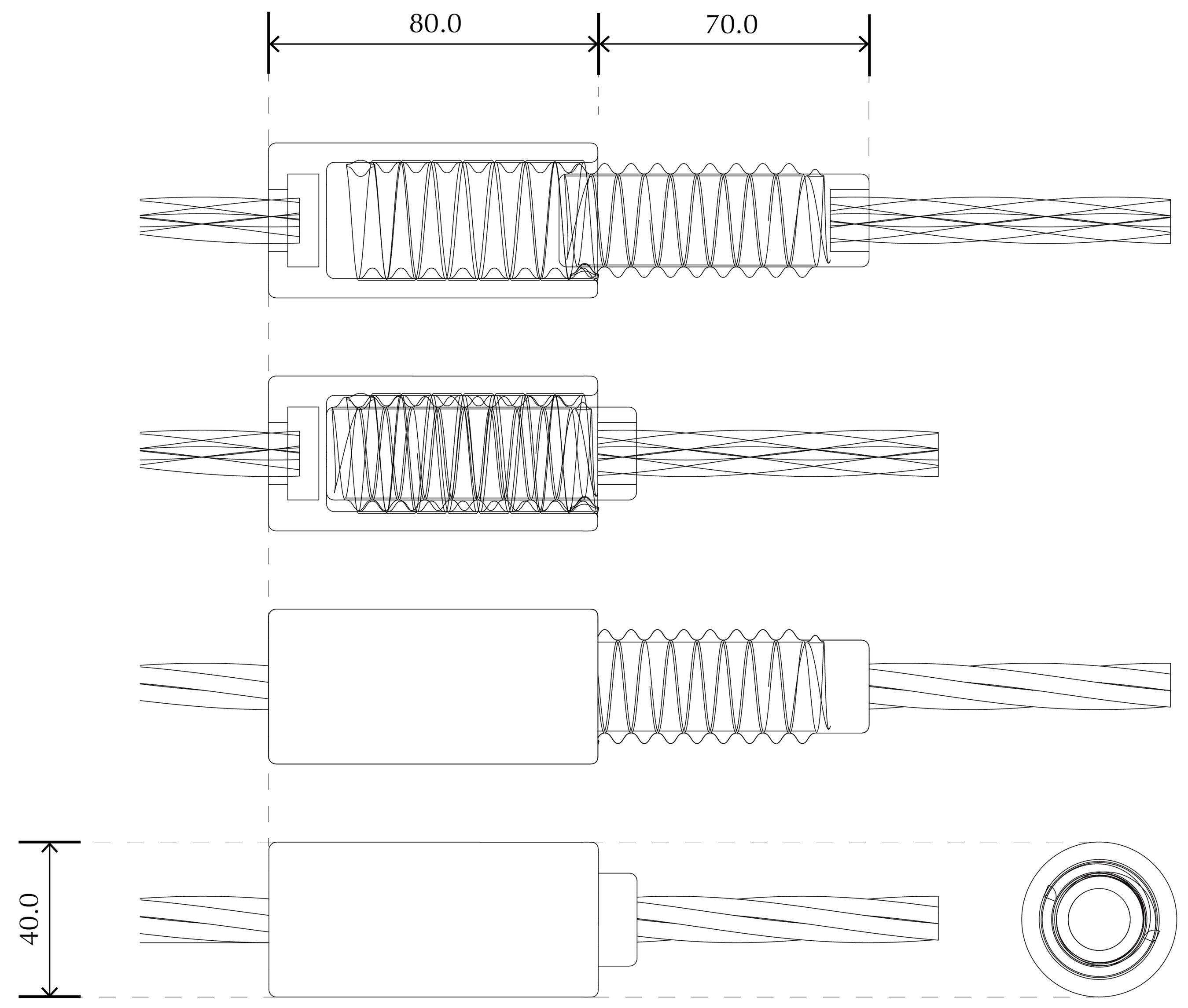
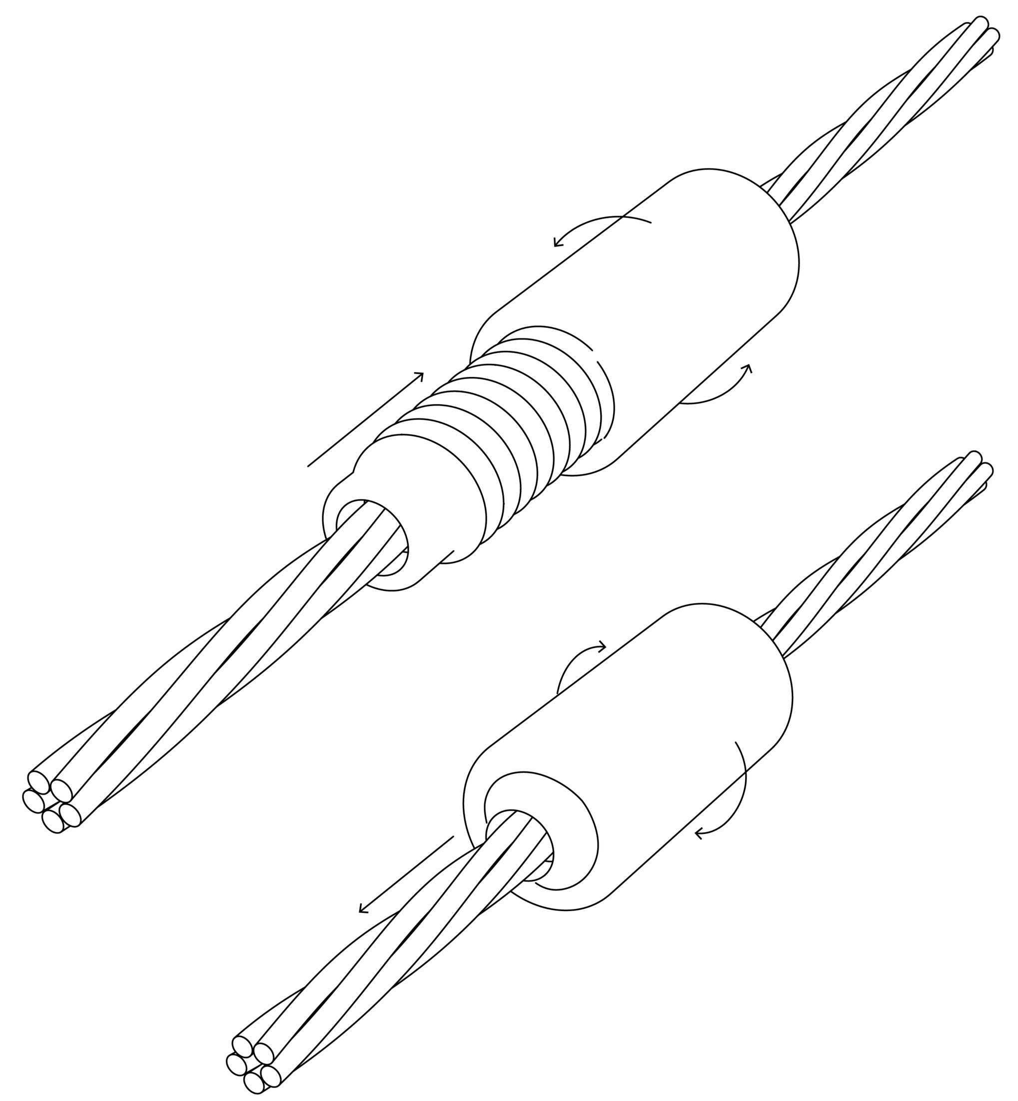
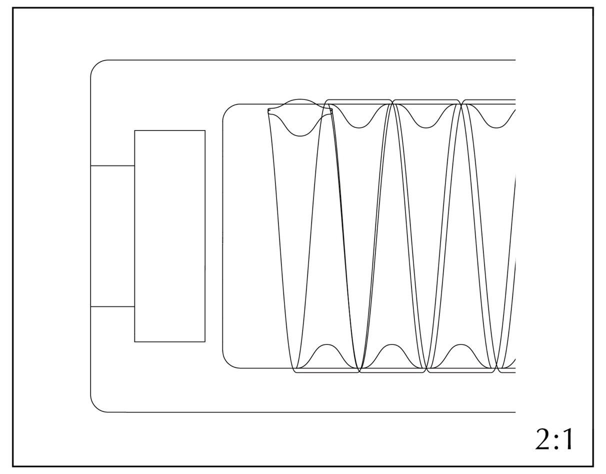
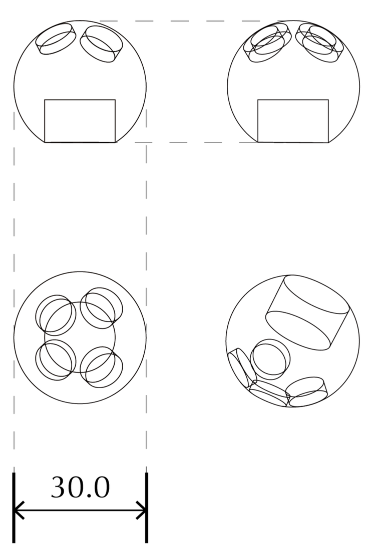




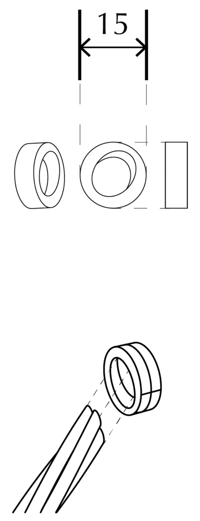


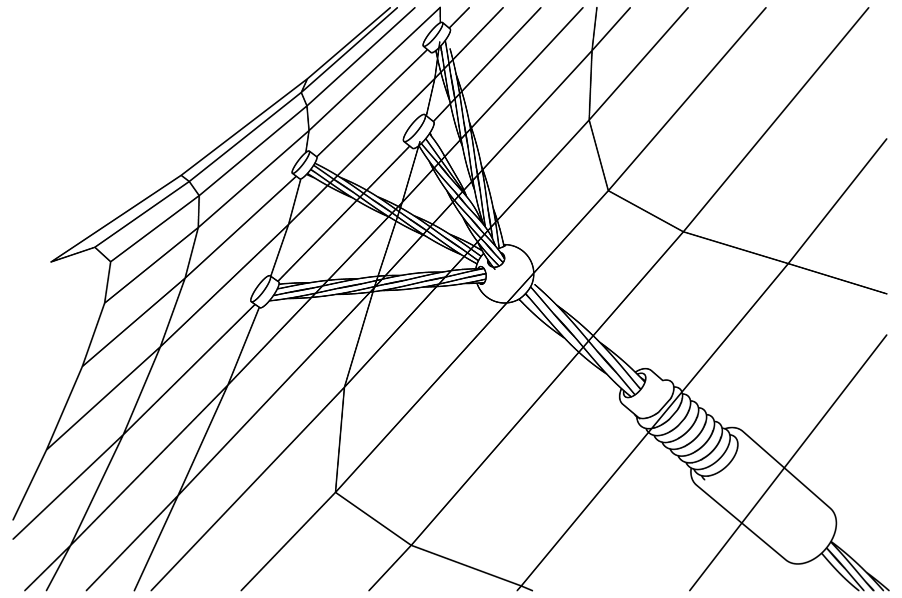
The wire is connected to a rotatable plate within the adjustment mechanism, ensuring the wire not to rotate with the mechanism when twisted.



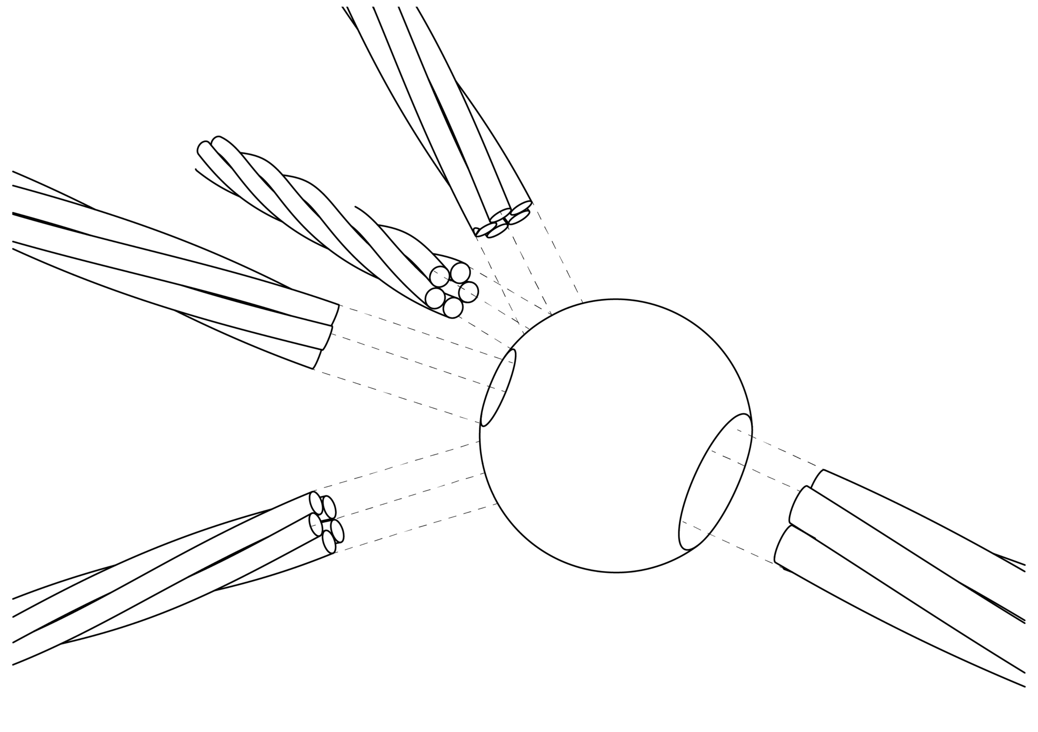
The adjustment mechanism allow the length of the connting wire between the fabric and the bottom frame to be varied by simply twisting. Twist clockwisely to lengthen, vise versa. The maximum variable length of each mechanism is 60mm.

Raindrops hitting fabric with different magnitude of tension cause different sound. The pulling force exerted onto the frabric causes extra tension, which is variable. Therefore the sound of raindrop made on each section of fabric becomes variable as well.





Aluminium clips are used to fix the wires with the fabric.



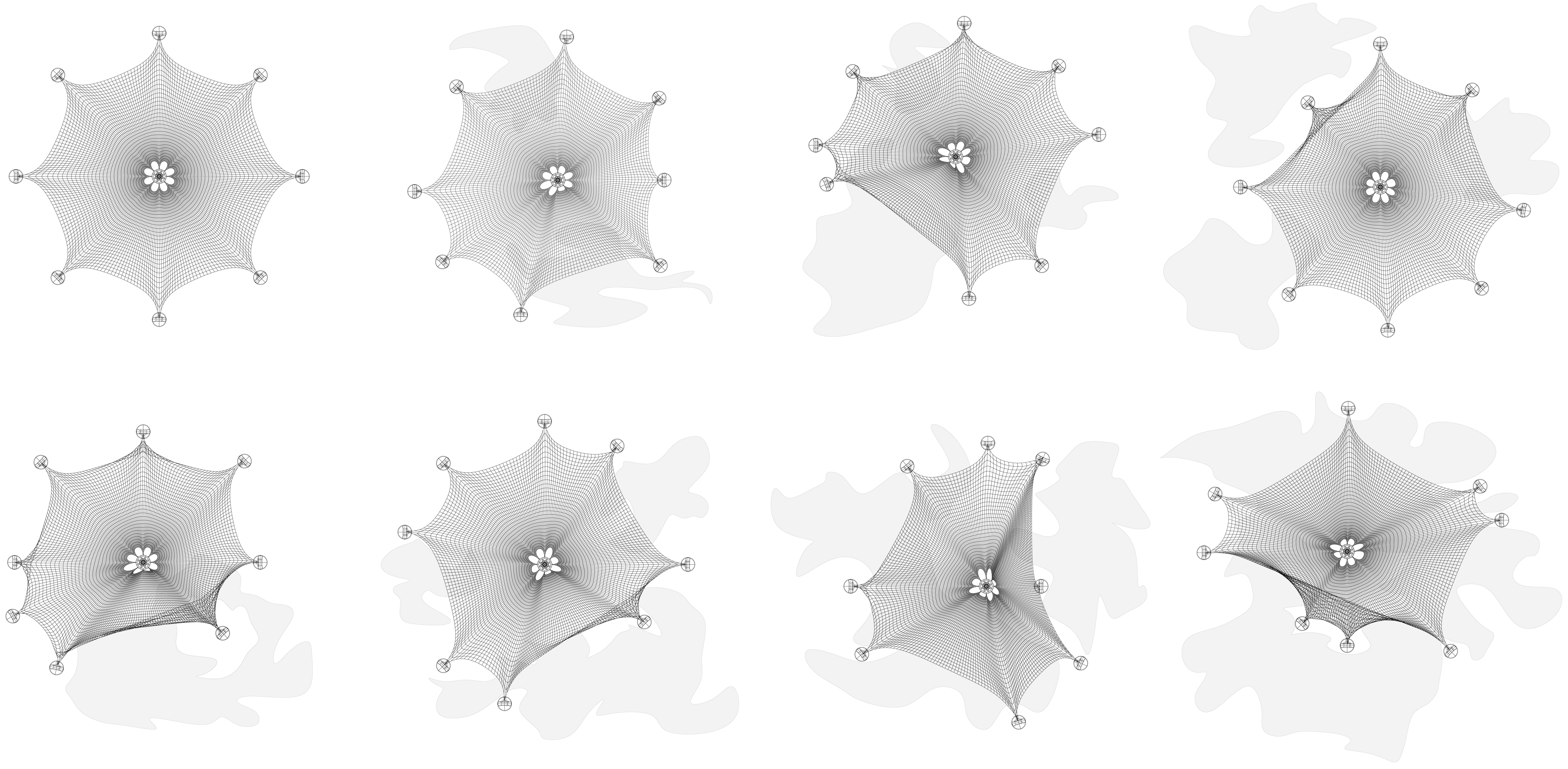
Aluminium spheres are used to distribute the force into four wires to prevent from damaging the fabric by applying too much force onto a single point.

Force Analysis

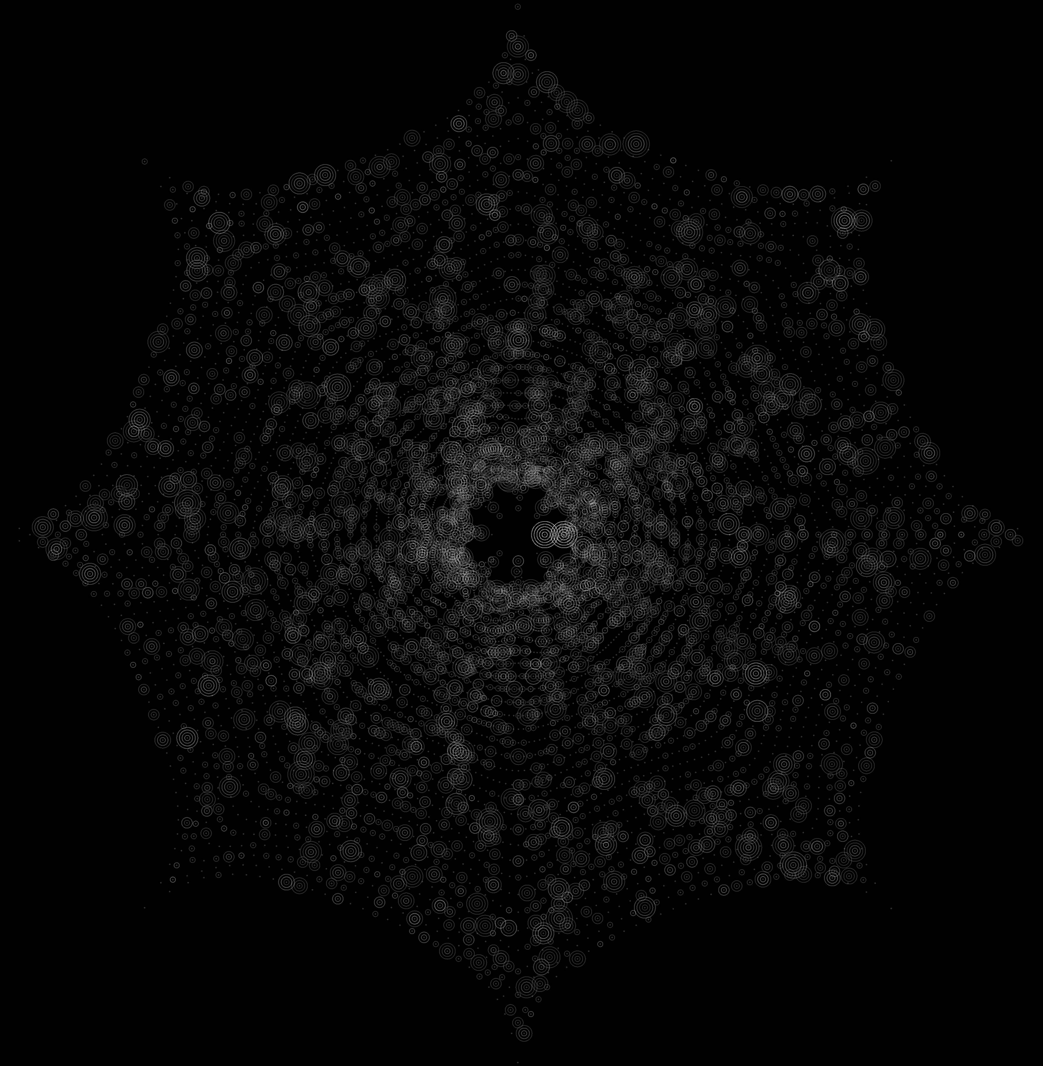
1:2 A2

- Weight
- Frictional Force
- Reaction Force
- Tension in Fabric & Force Caused
- Compressional Force
- Tension in Wires

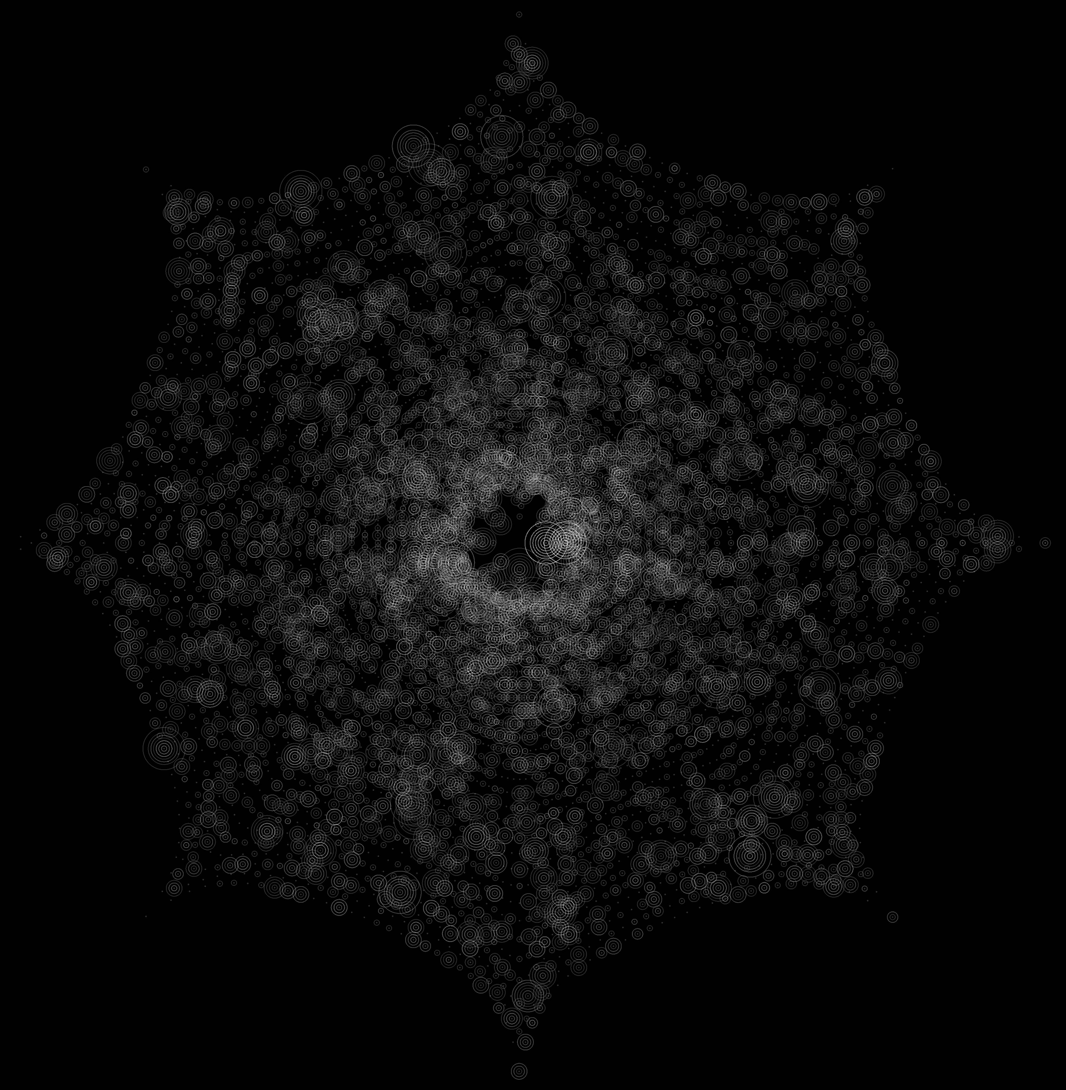
Thickness of arrow ∝ Magnitude of force



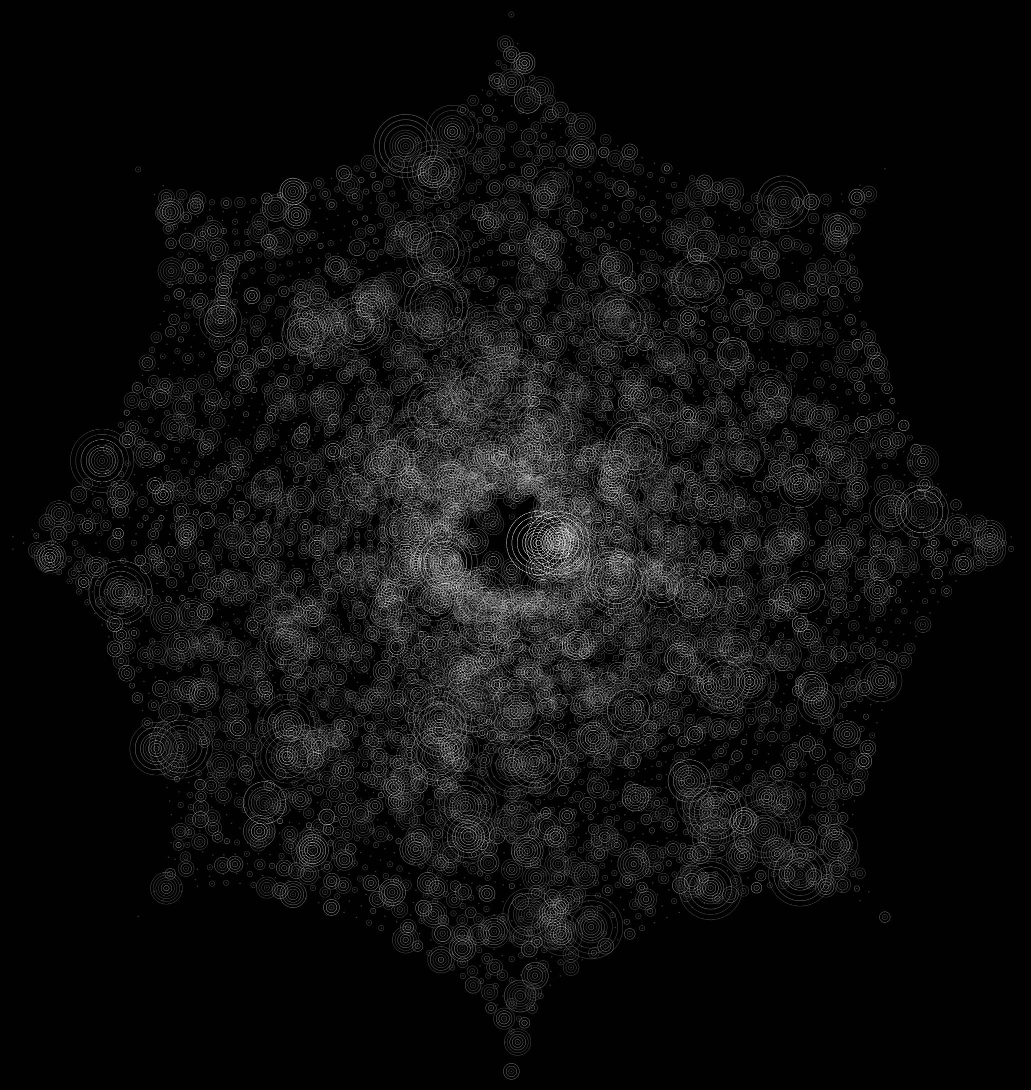
Adaptation Examples



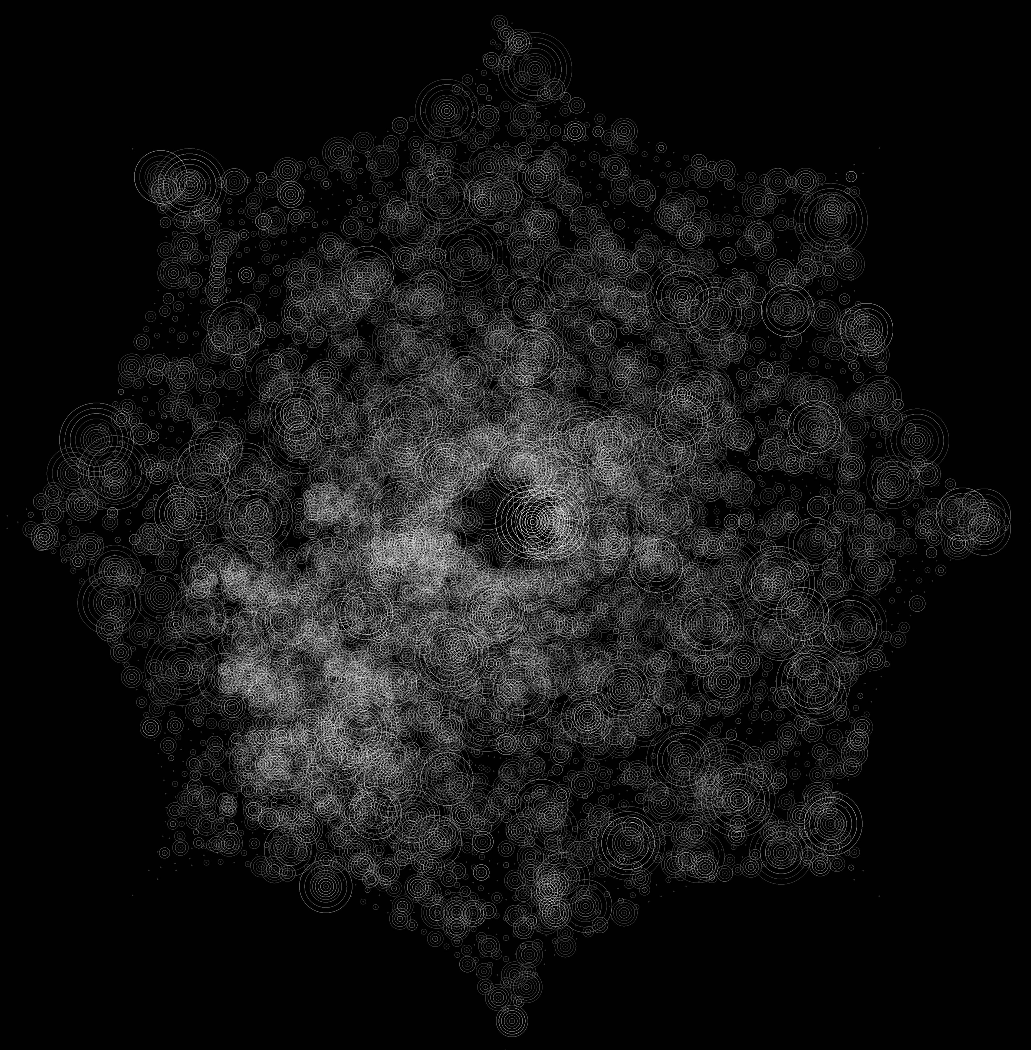
Slight Rain Level / Average Wind Direction



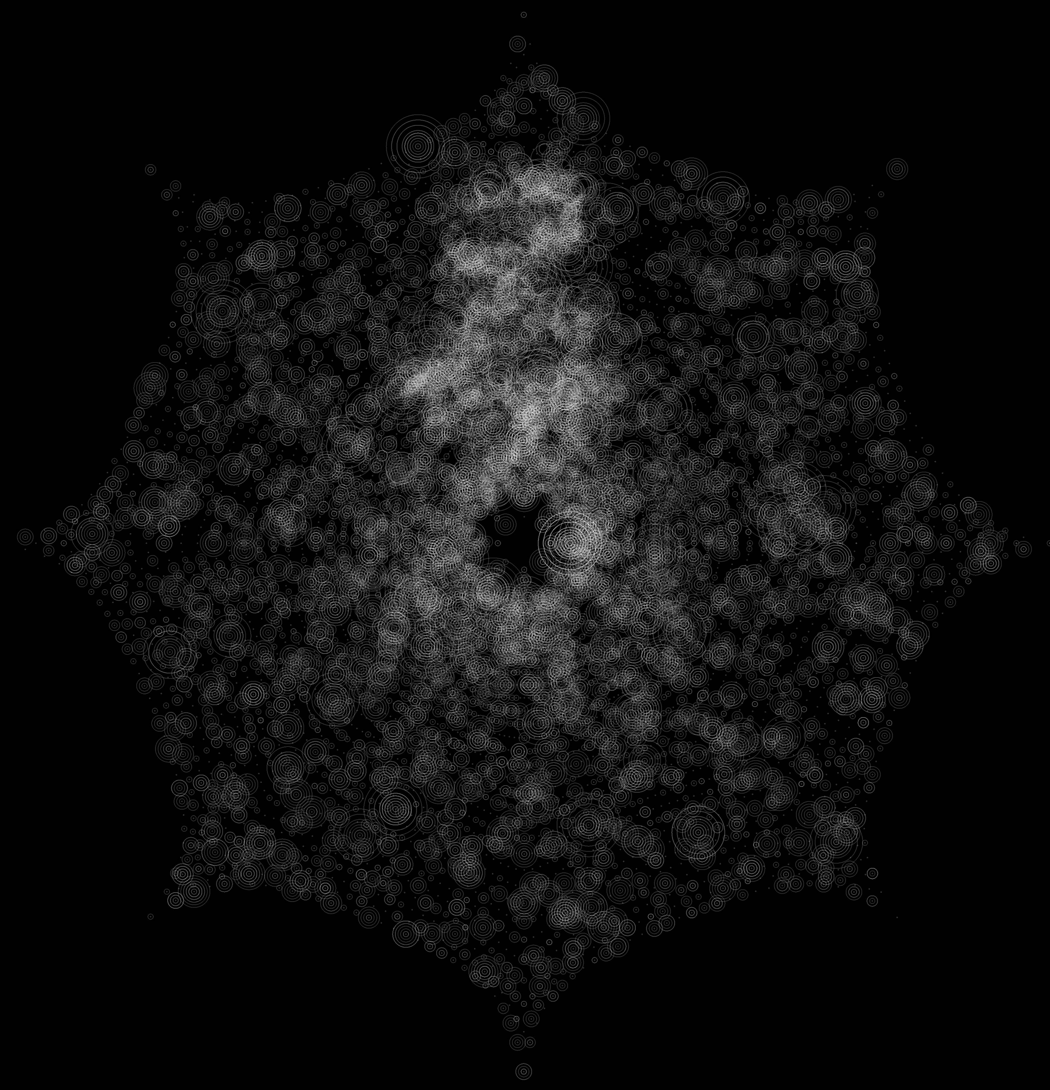
Light Rain Level / Average Wind Direction



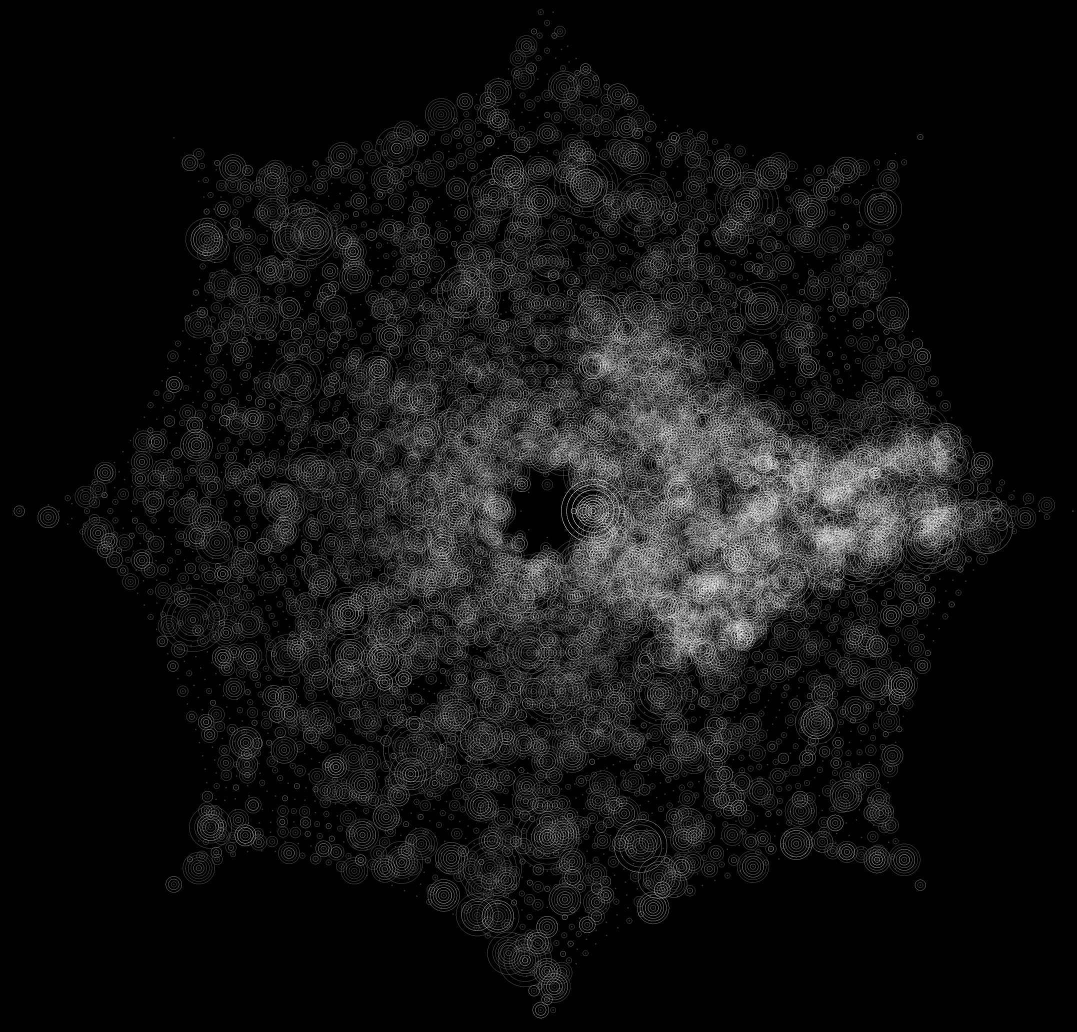
Moderate Rain Level / Average Wind Direction



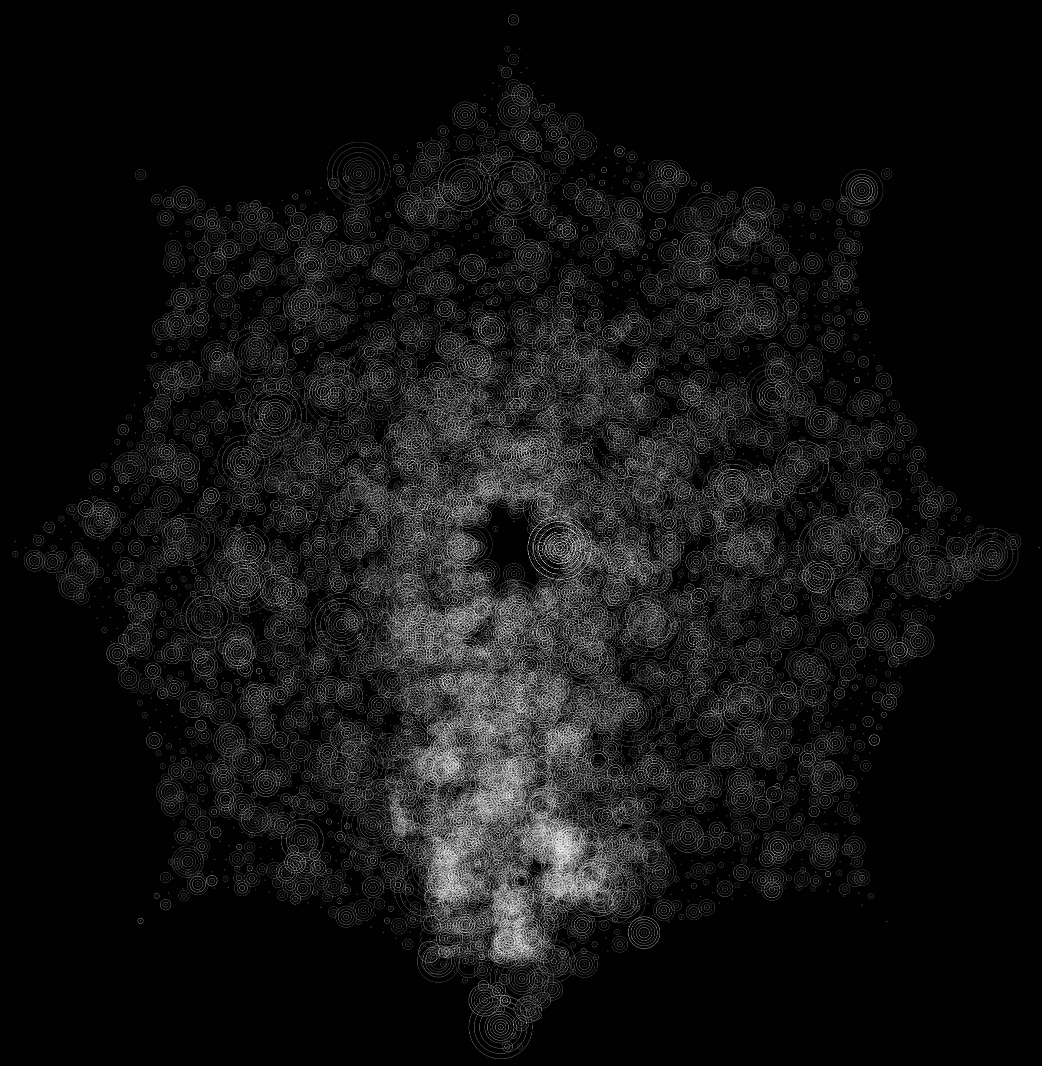
Heavy Rain Level / Average Wind Direction



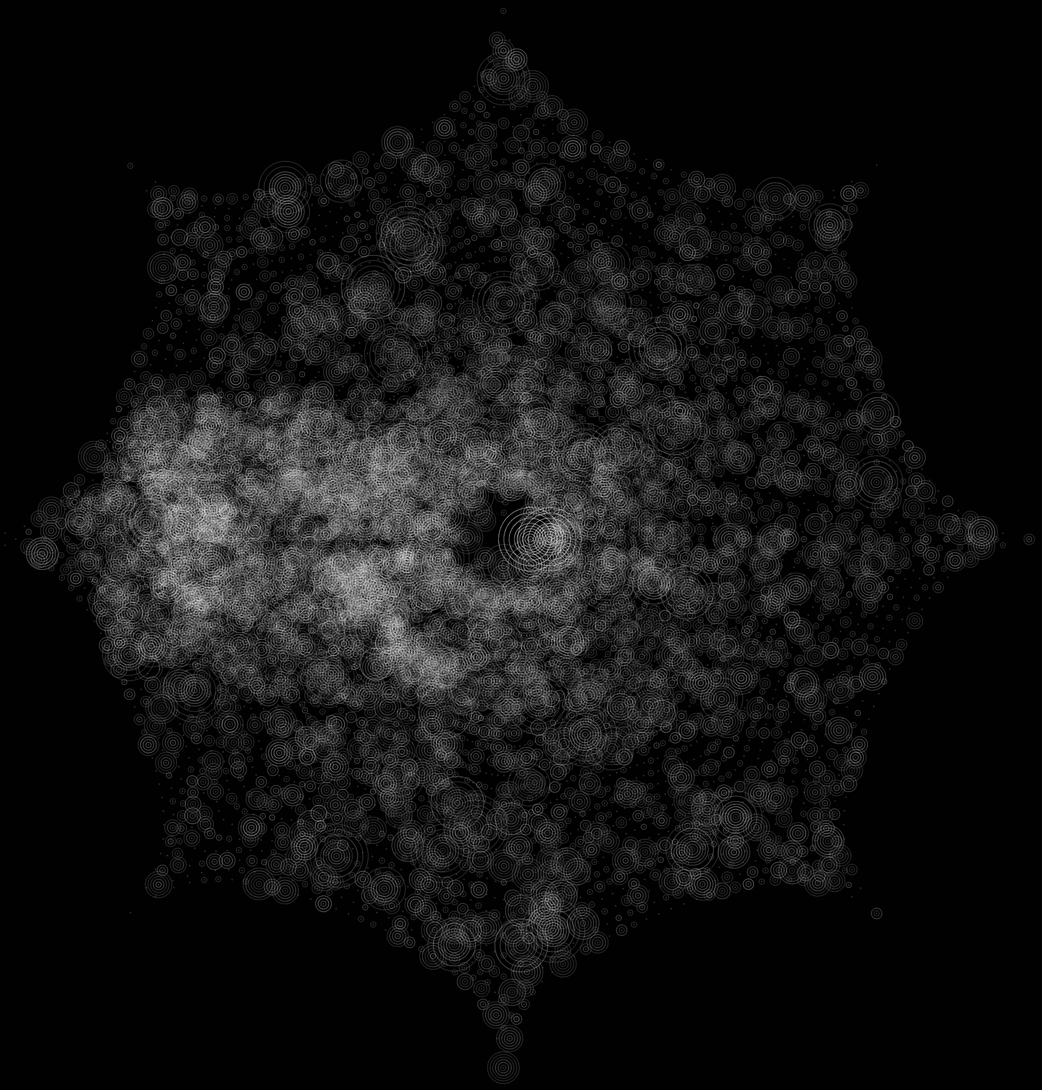
Moderate Rain Level / Northerly Wind



Moderate Rain Level / Easterly Wind

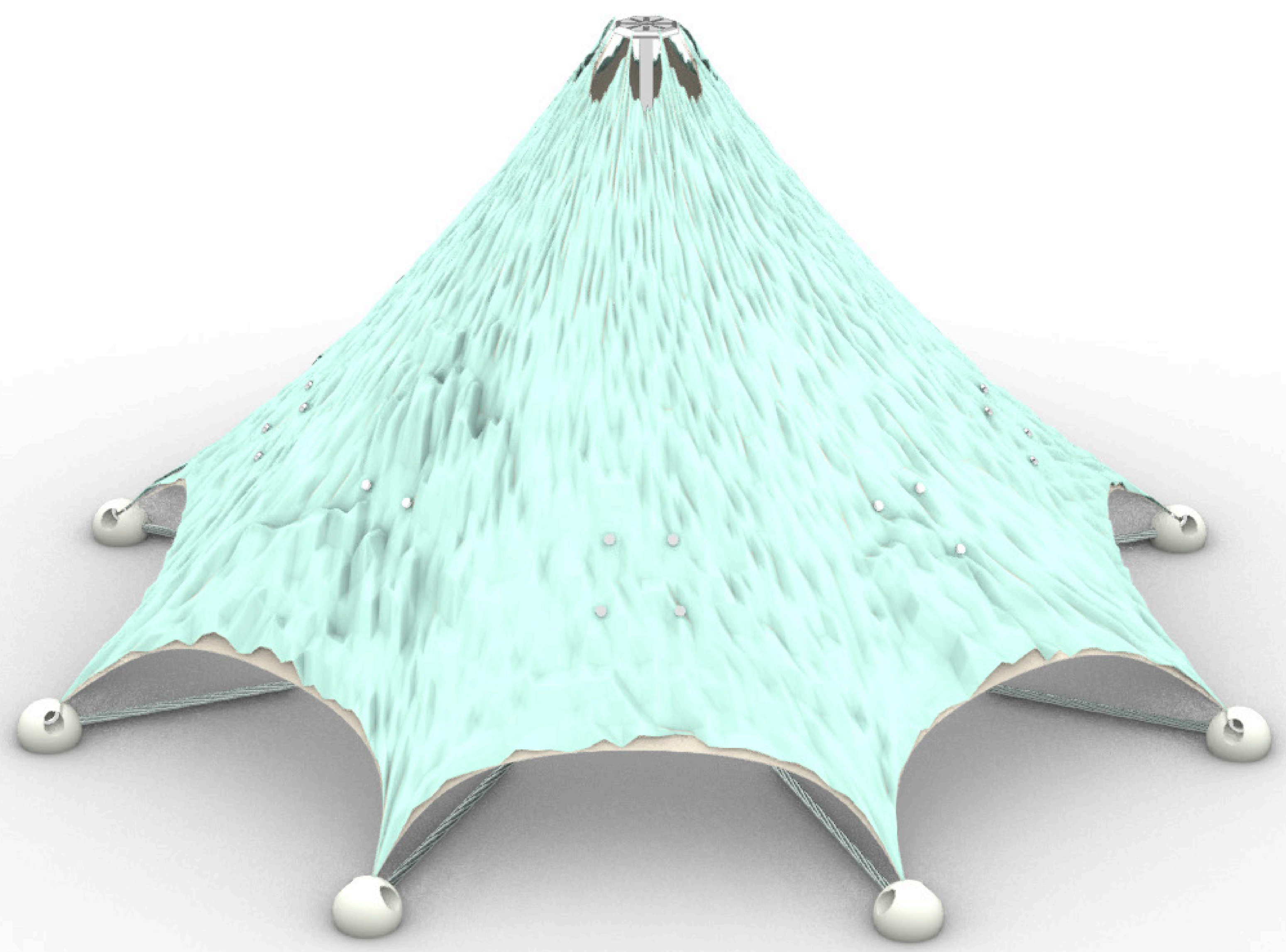


Moderate Rain Level / Southerly Wind

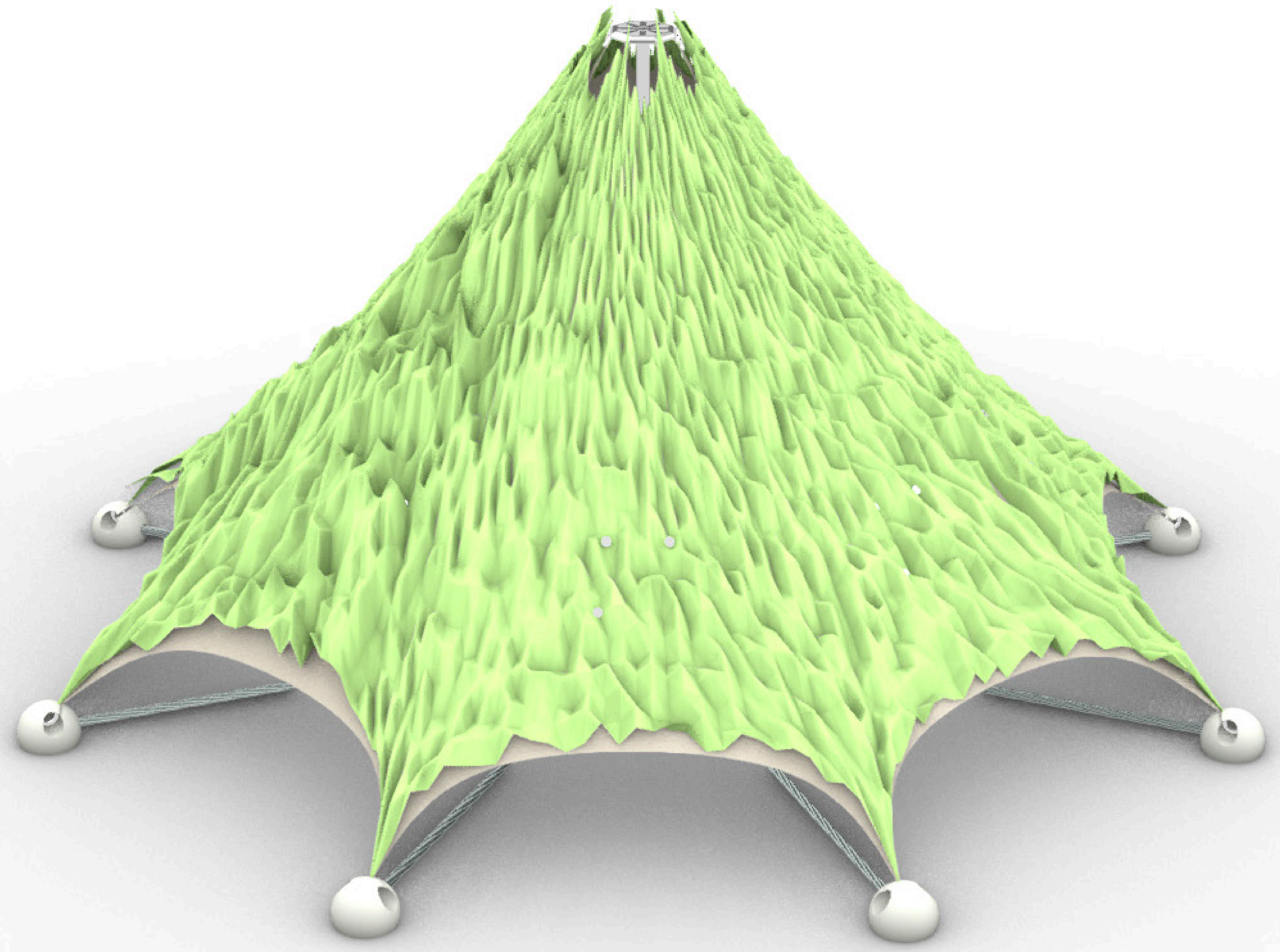


Moderate Rain Level / Westerly Wind

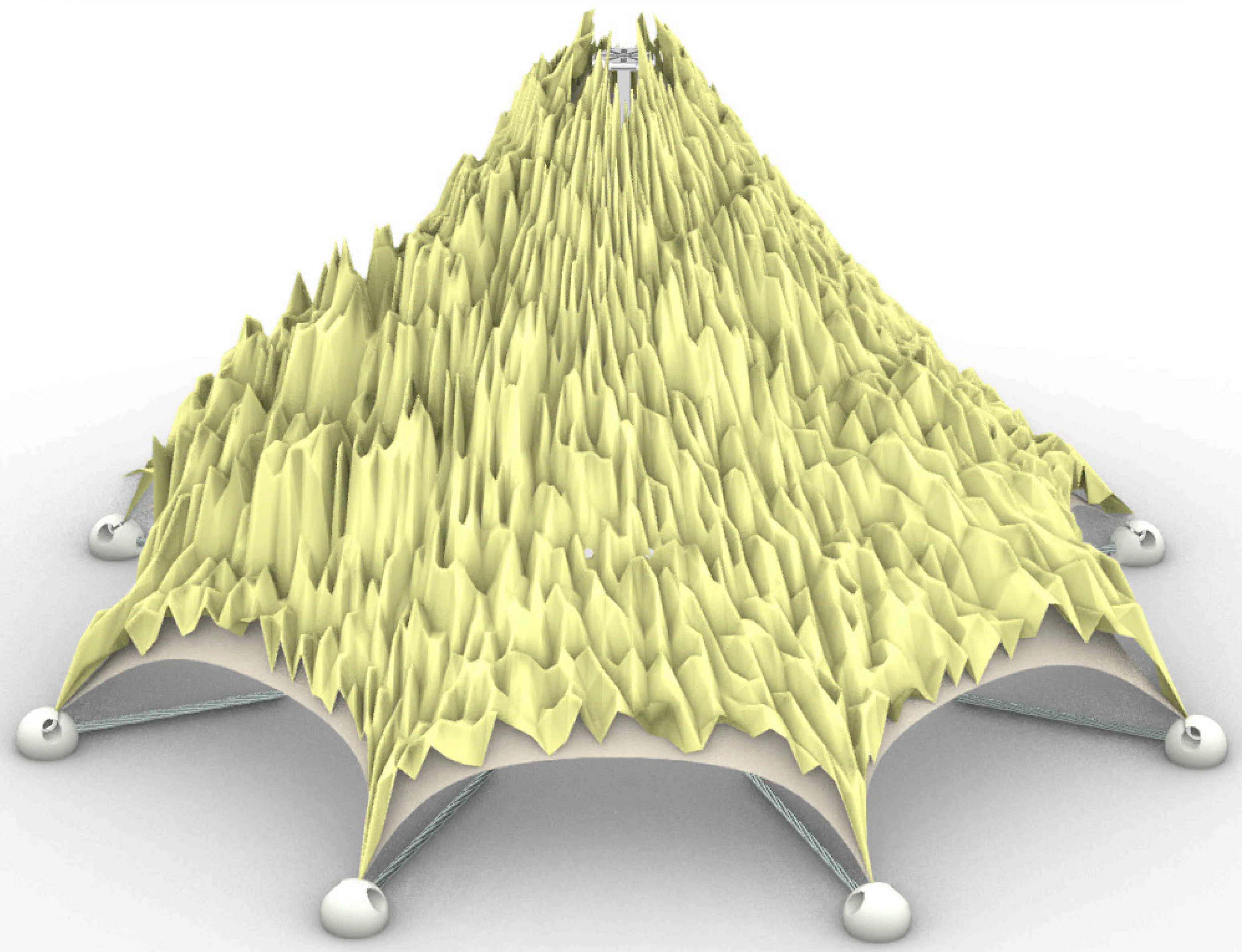
Sound Visuallisation



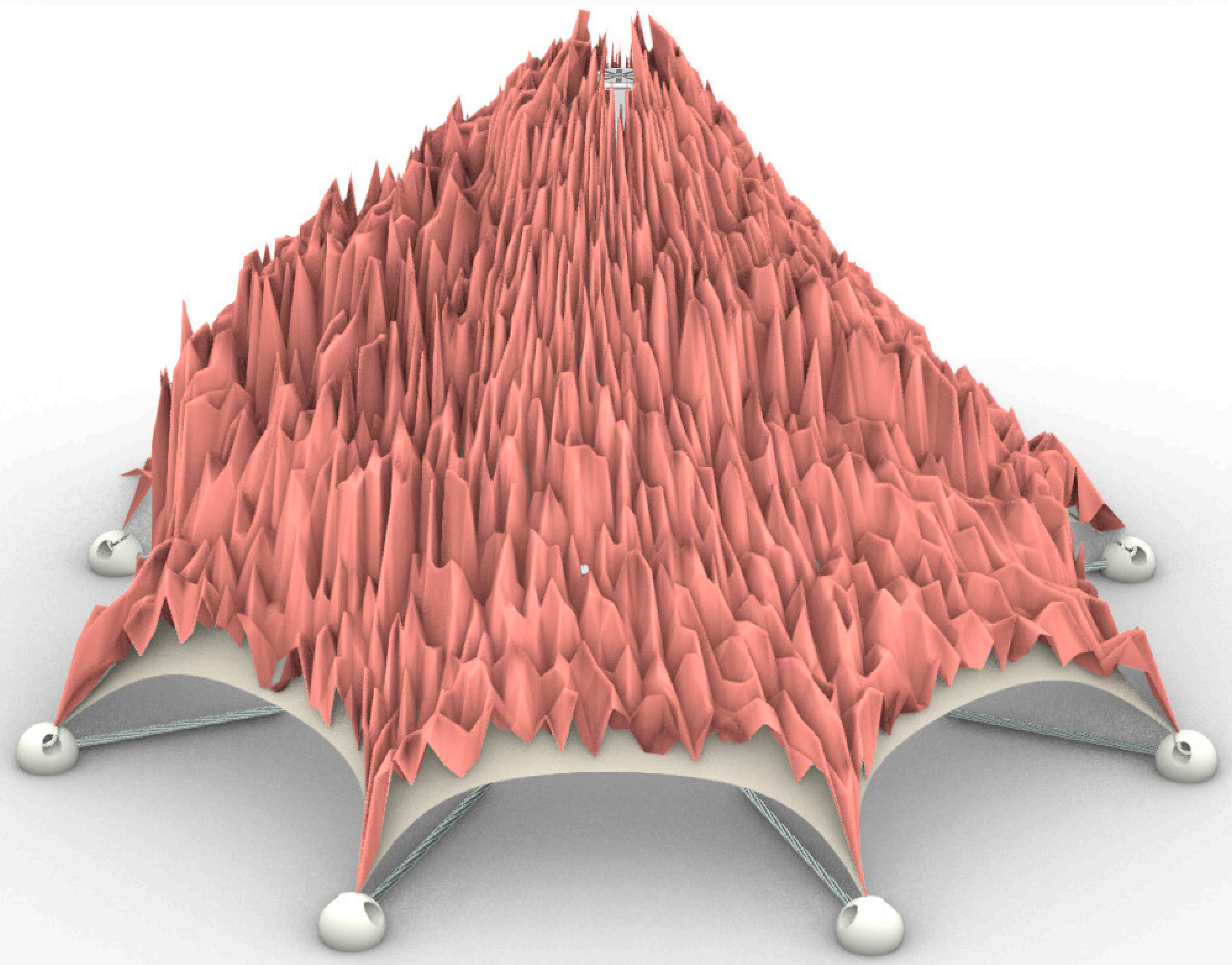
Slight Rain Level



Light Rain Level



Moderate Rain Level



Heavy Rain Level

Sound Illustration