24.06.14 P5 || LANDSCHAPSKUNSTEN EN LOCATIETHEATER

OEROL FESTIVAL (NL): TEMPORARY STRUCTURES FOR ART, THEATER, + LIVING

TU DELFT AELab-11 MSc THESIS

FALL 2013 - SPRING 2014

SARAH J. ROBERTS No. **4259769**

TUTORS: IR. TJALLING HOMANS

PROF. MARTIJN STELLINGWERFF

PROF. ENGBERT VAN DER ZAAG

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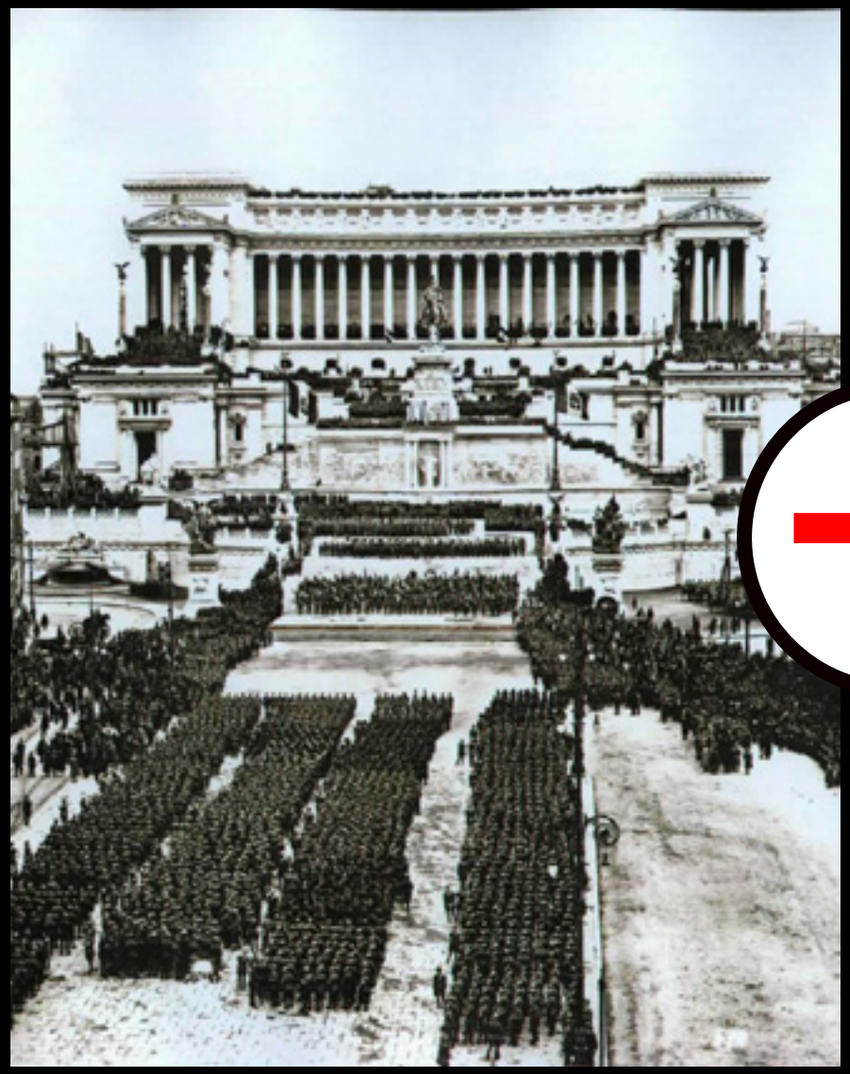
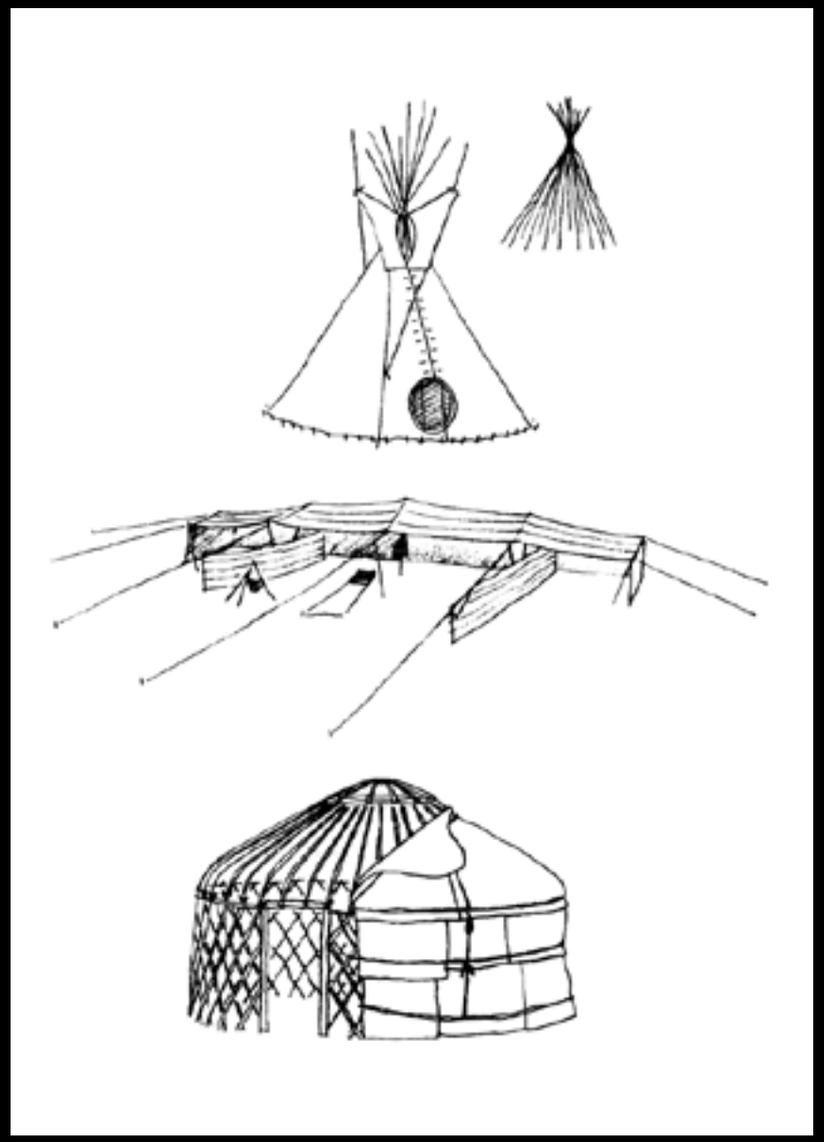
TECHNICAL RESEARCH



Altare della Patria (Giuseppe Sacconi, Rome)

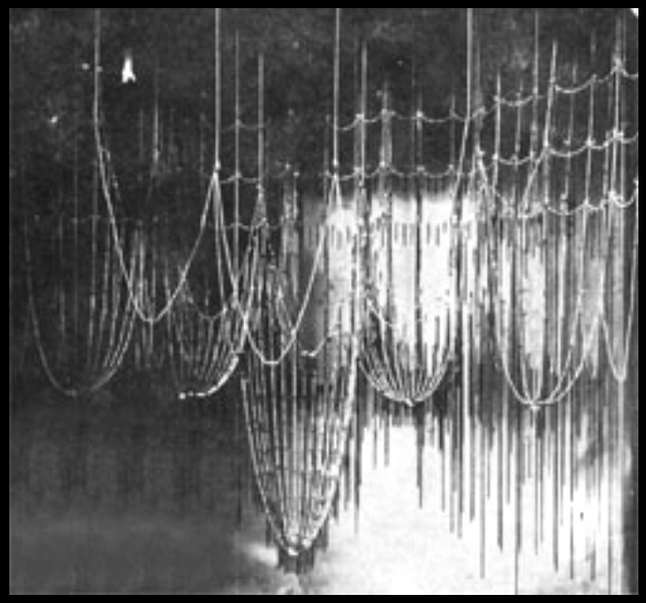
Spacebuster (Raumlabor, New York City)

Temple of Juno (BRC, Burning Man 2012)



Clockwise from Left: Traditional Portable Shelters (Renzo Piano), Mongolian Yurt, Hammock Tent, Emergency Shelter (DRASH).

Left: Stuttgart ICD/ITKE 2010 Research Pavilion. **Right:** Olympiastadion in Munich, Frei Otto.



Clockwise from Left: Nordisk Wind Tunnel Test, Gaudi's Chain Model (J. Tomlow), Rudimentary Load Testing.

Research Questions:

1. How can computational **parametric tools** be used
   for the design and fabrication of small-scale form-active structures?

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2. More specifically, what are the strengths and weaknesses of **Kangaroo** for Grasshopper, a plug-in for Rhinoceros, in the processes of **form-finding**, **selecting materials**, and **generating cutting patterns?**

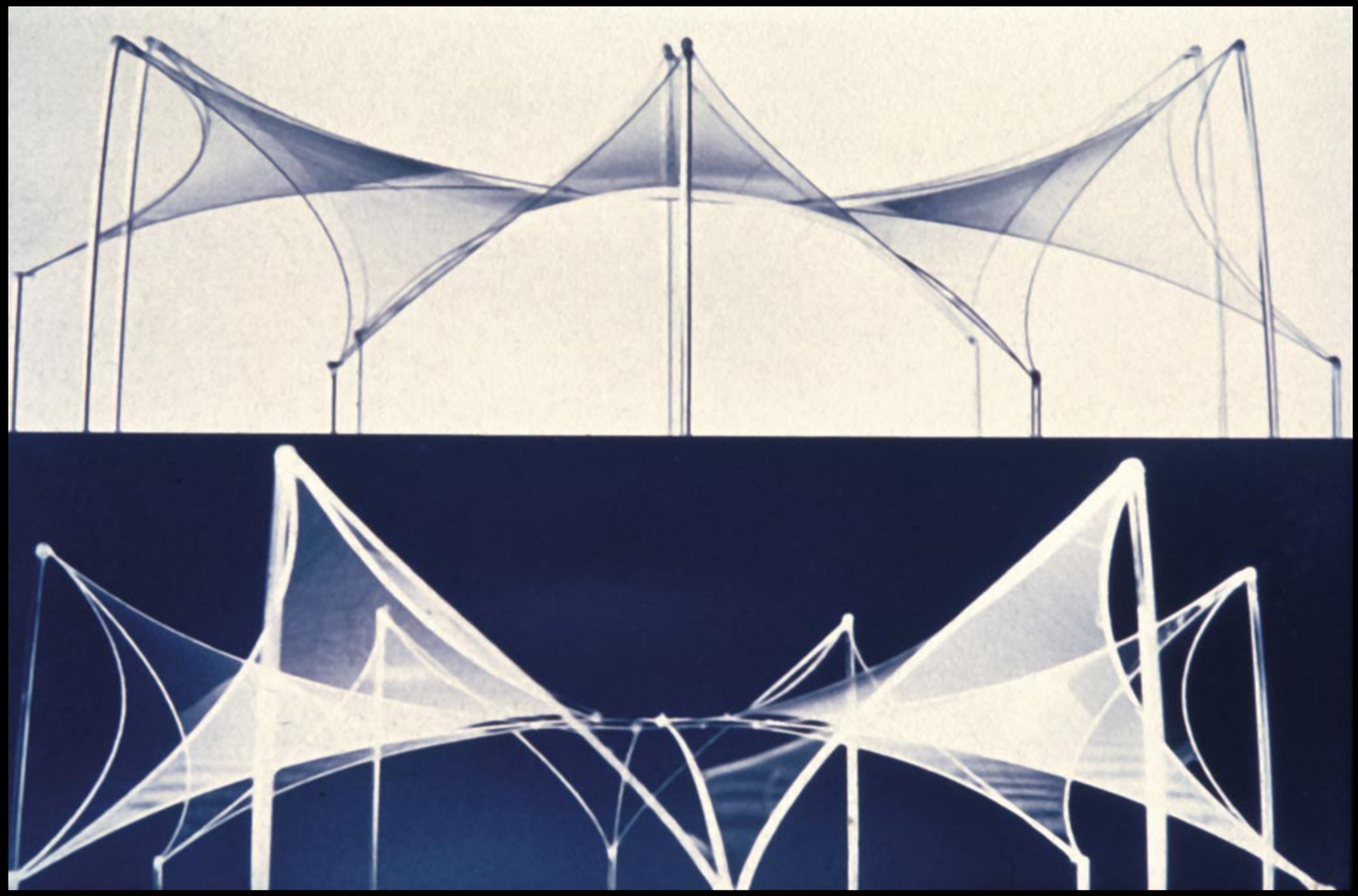
Research Questions:

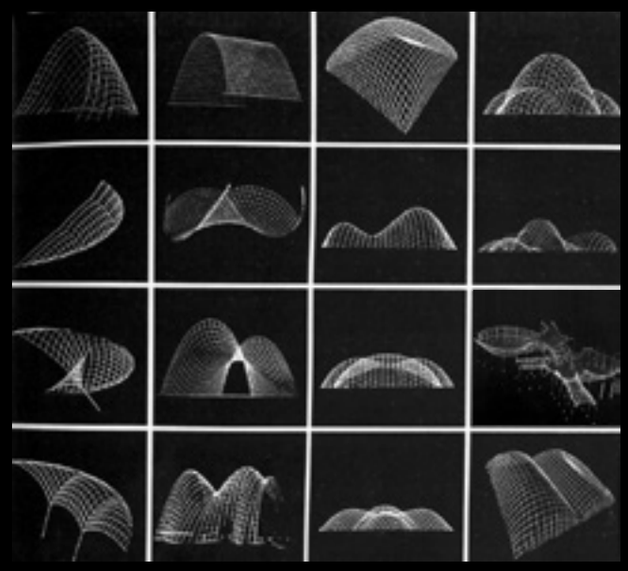
1. How can computational **parametric tools** be used for the design and fabrication of small-scale form-active structures?

2. More specifically, what are the strengths and weaknesses of **Kangaroo** for Grasshopper, a plug-in for Rhinoceros, in the processes of **form-finding**, **selecting materials**, and **generating cutting patterns?**

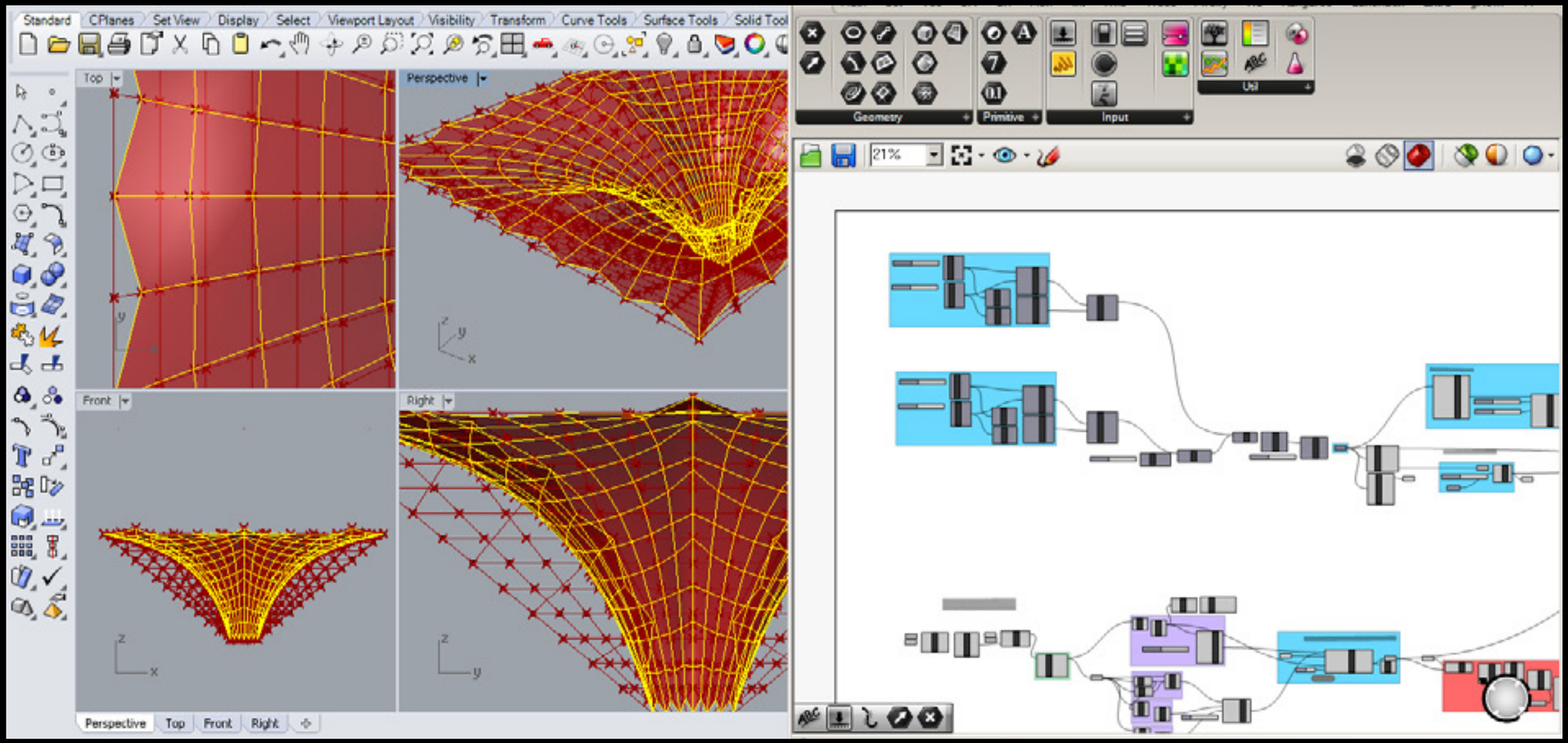
3. Which alternative design methods are recommended?

What is Form-Finding?



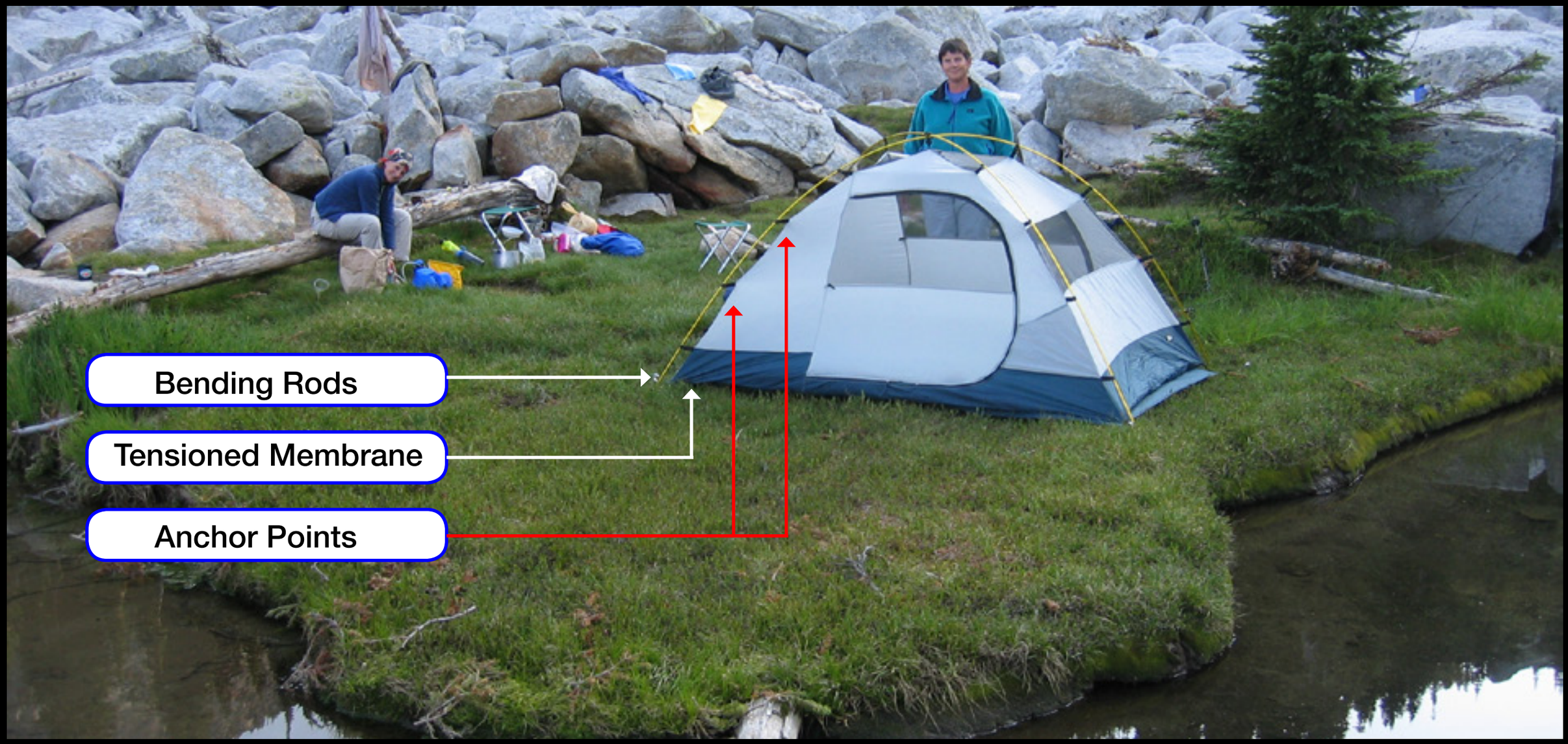


Left: Minimal Surface Soapfilm, SL Rasch GmbH. **Right Top:** Multihalle Mannheim Gridshell, Frei Otto. **Right Bottom:** Form Finding Studies.



Kangaroo Script: Form-Finding a canopy.

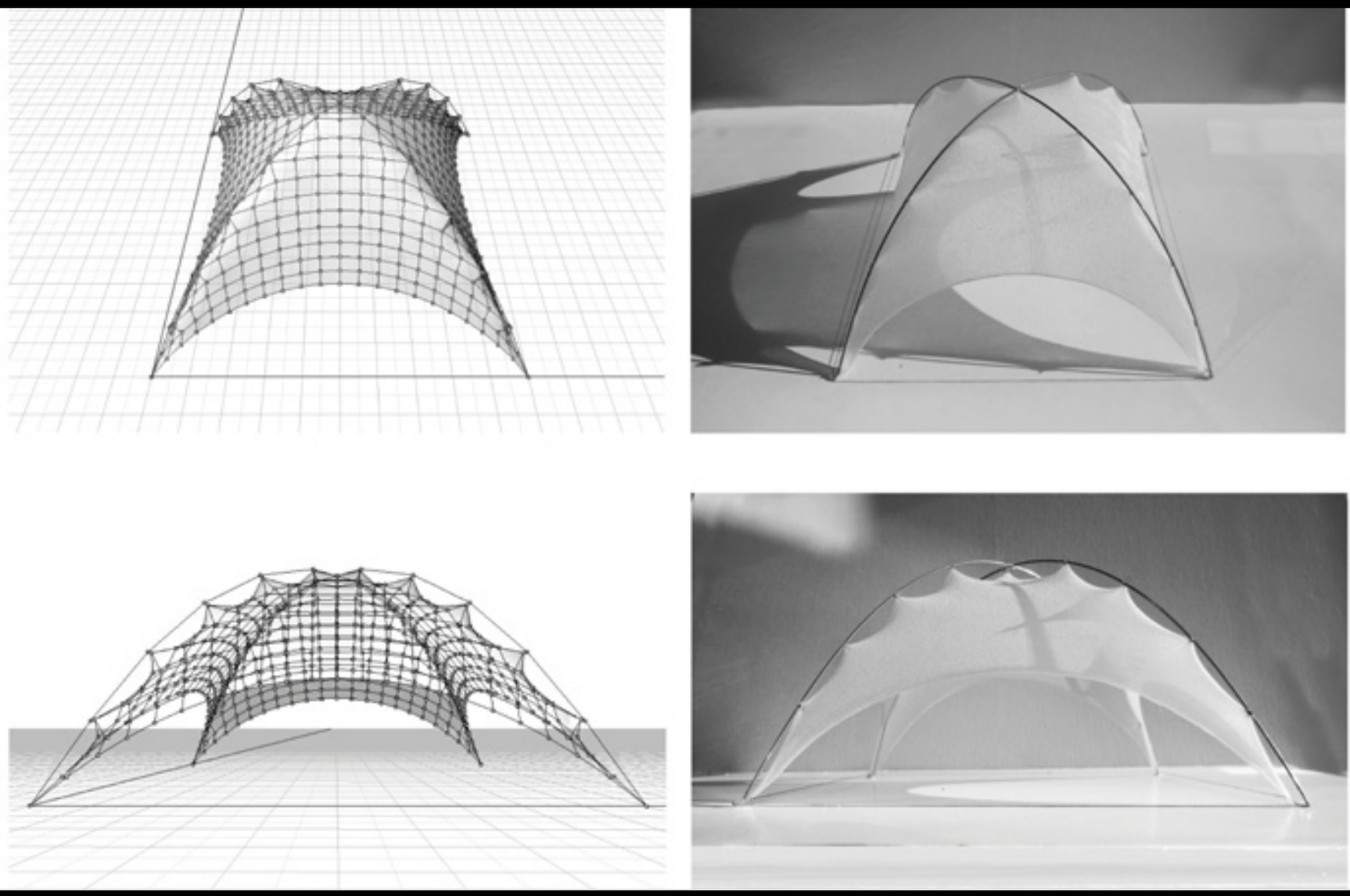
Structural Members



Base Geometries: Key Structural Elements for the Case Study.

Analog Model

Analog Model: Scale 1:10.



Comparison Study. Left: Digital Tent Model **Right:** Analog Tent Model (Scale 1:10)

Research Conclusions:

- Goal: To promote the creation of more structurally efficient, financially and environmentally economical, and aesthetically beautiful shelters.

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- 3 phases explored in the design process for equilibrium structures:
    1. Form-Finding: Kangaroo was an effective tool.
    2. Materiality: Alternative software recommended.
    3. Cutting Patterns: Possible with Grasshopper + Rhinoceros.

Research Conclusions:

- Goal: To promote the creation of more structurally efficient, financially and environmentally economical, and aesthetically beautiful shelters.

- 3 phases explored in the design process for equilibrium structures:
    1. Form-Finding: Kangaroo was an effective tool.
    2. Materiality: Alternative software recommended.
    3. Cutting Patterns: Possible with Grasshopper + Rhinoceros.

- **Next Step**: Use these **techniques** to create portable shelters for different **programs** (functions), environmental **contexts,** and **scales**.

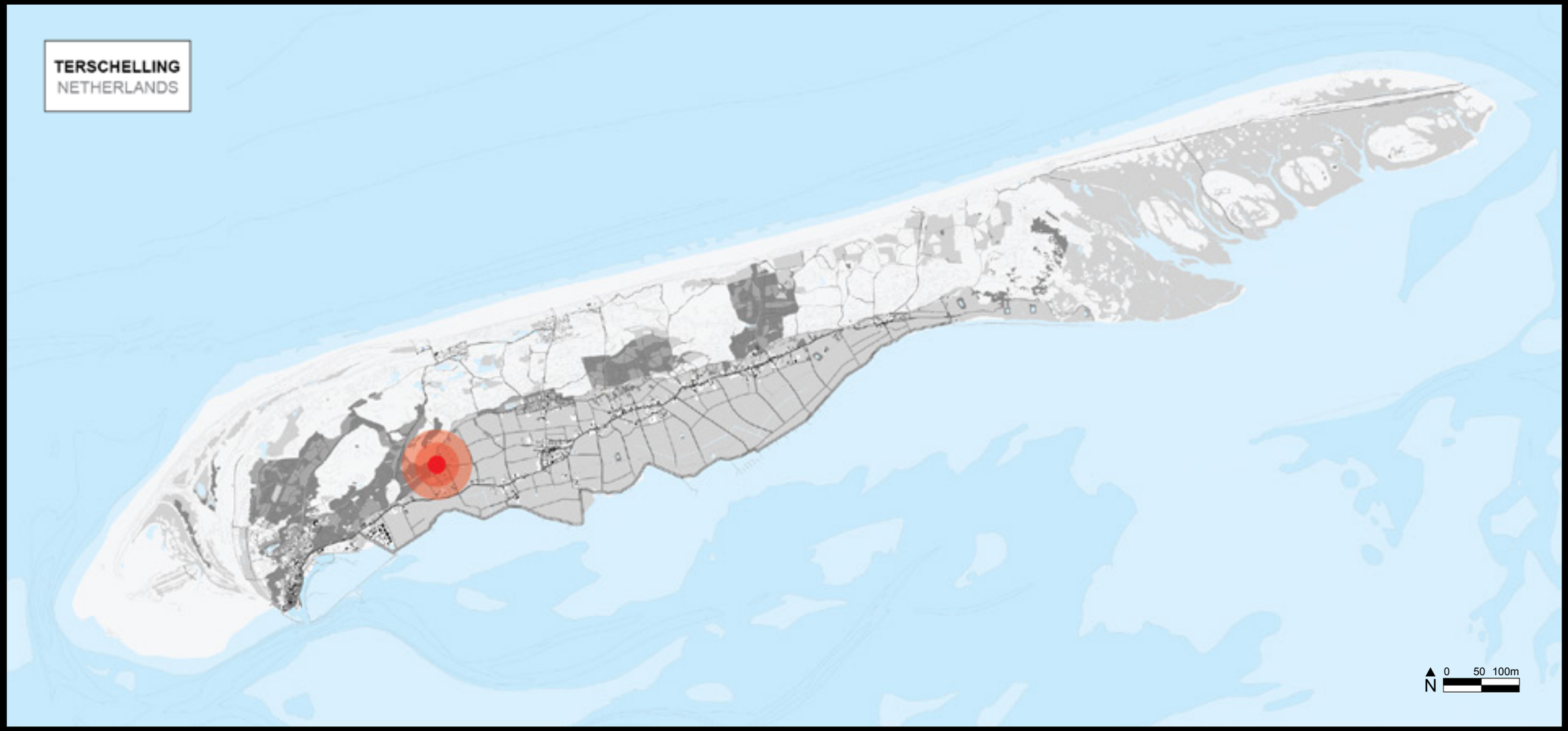
DESIGN PHASE

Design Question:

How can **digital parametric tools** be used to design various form-active structures customized for the **Oerol Festival** on the Dutch island **Terschelling**?

Left: Terschelling, The Netherlands. **Right:** Oerol Festival Promo 2013.

Above: Participatory Performances at Oerol.



Duinmeertje van Hee. Terschelling Island (NL).

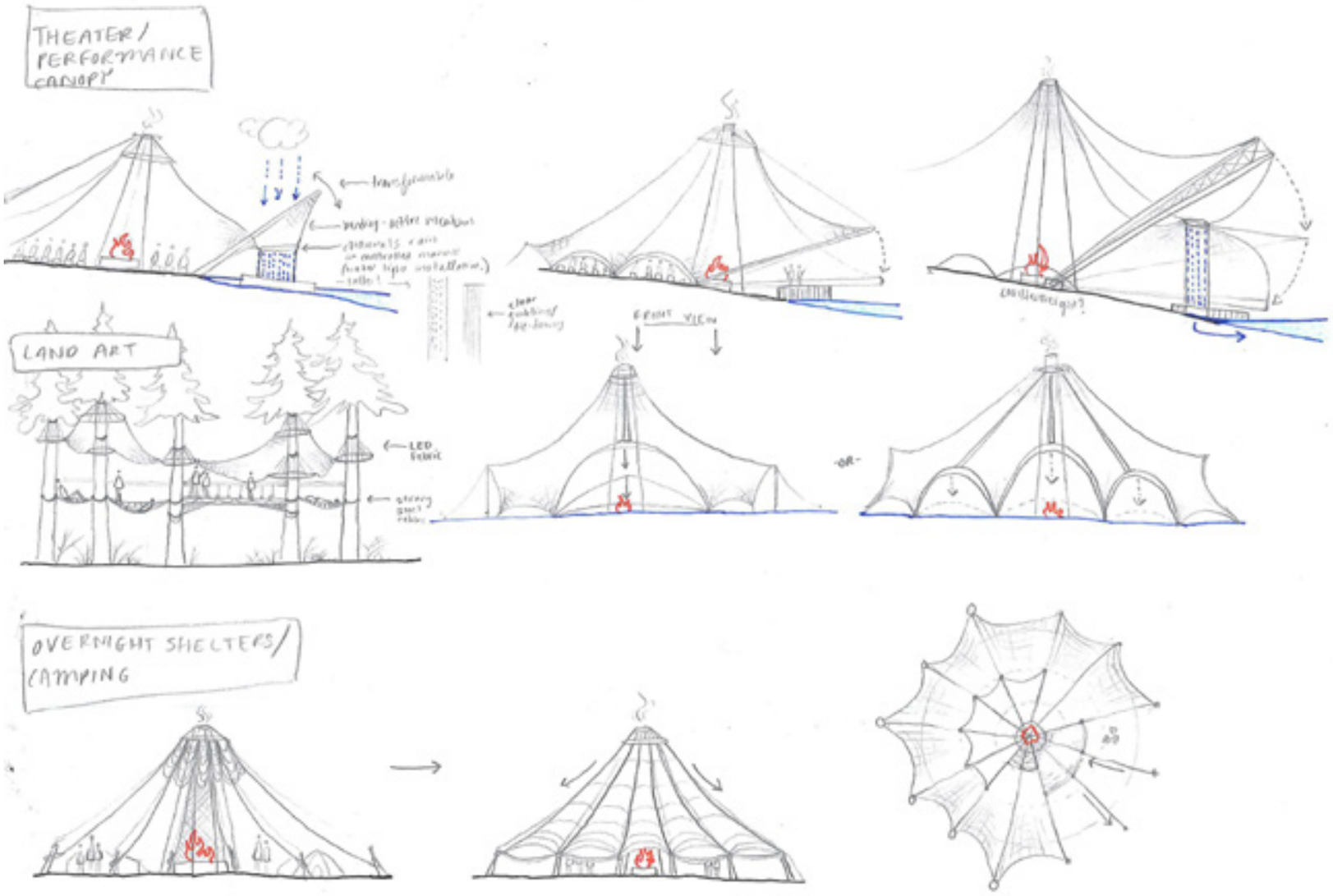
SITE || Duinmeertje van Hee, Terschelling

Left: 5 Land Types. **Right:** Duinmeertje van Hee beach.

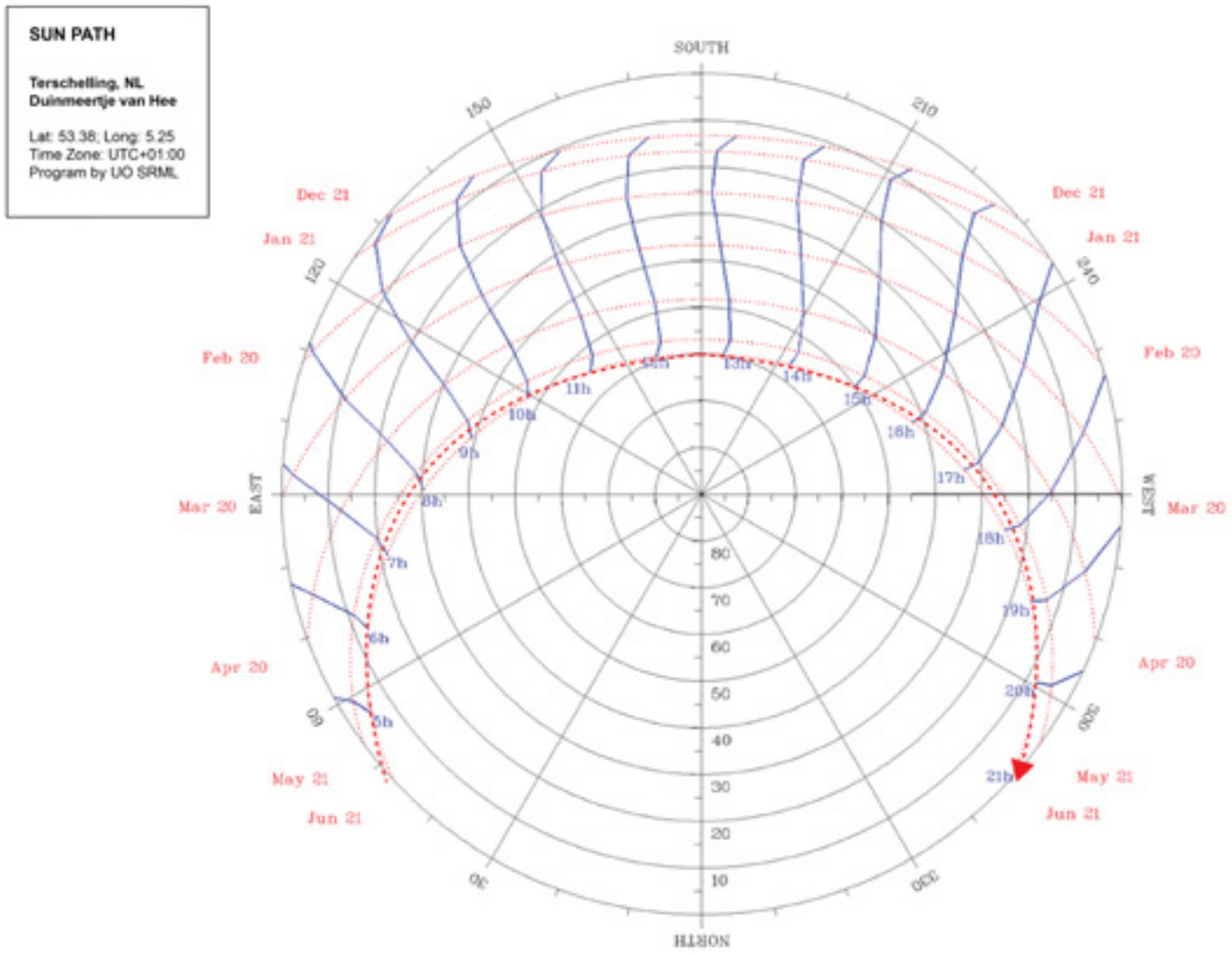
Duinmeertje van Hee, looking North.

Above: Duinmeertje van Hee, beach looking East.

Sketch Model: Early Project Concept.

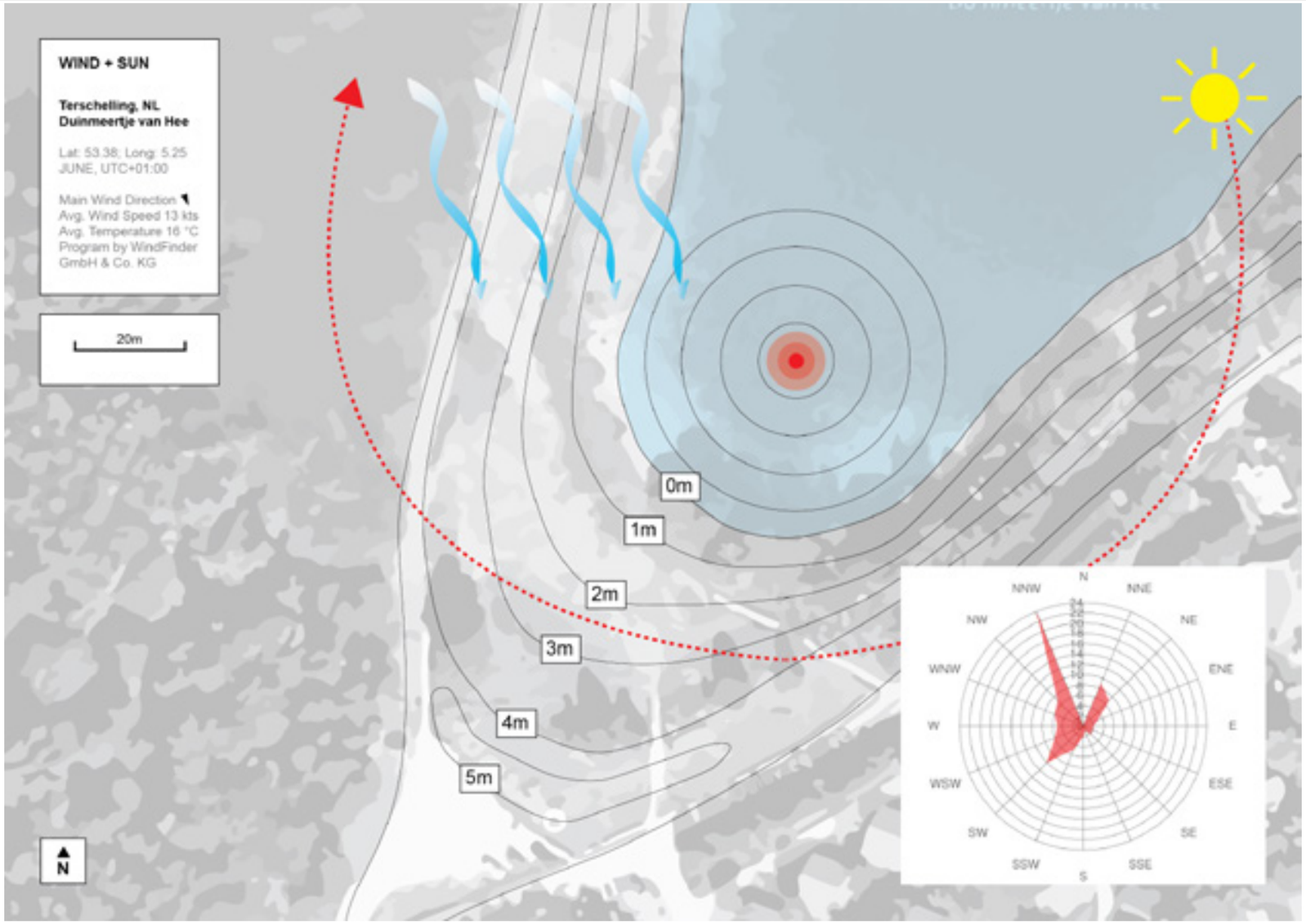


Sketches: Early Project Concept.



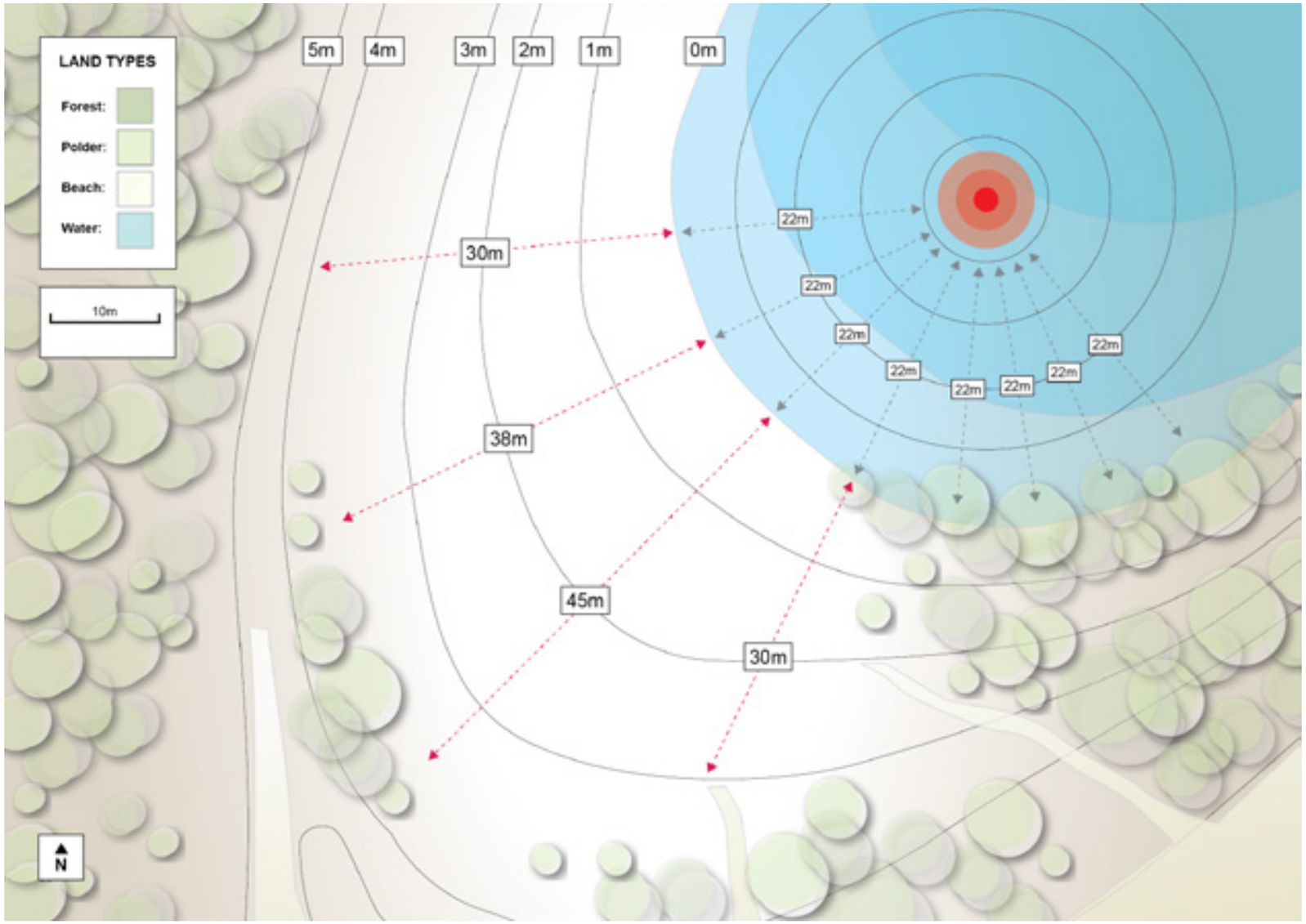
06.2014 Solar Path: Generated with UO's SRML program.

Climate: Wind + Temperature



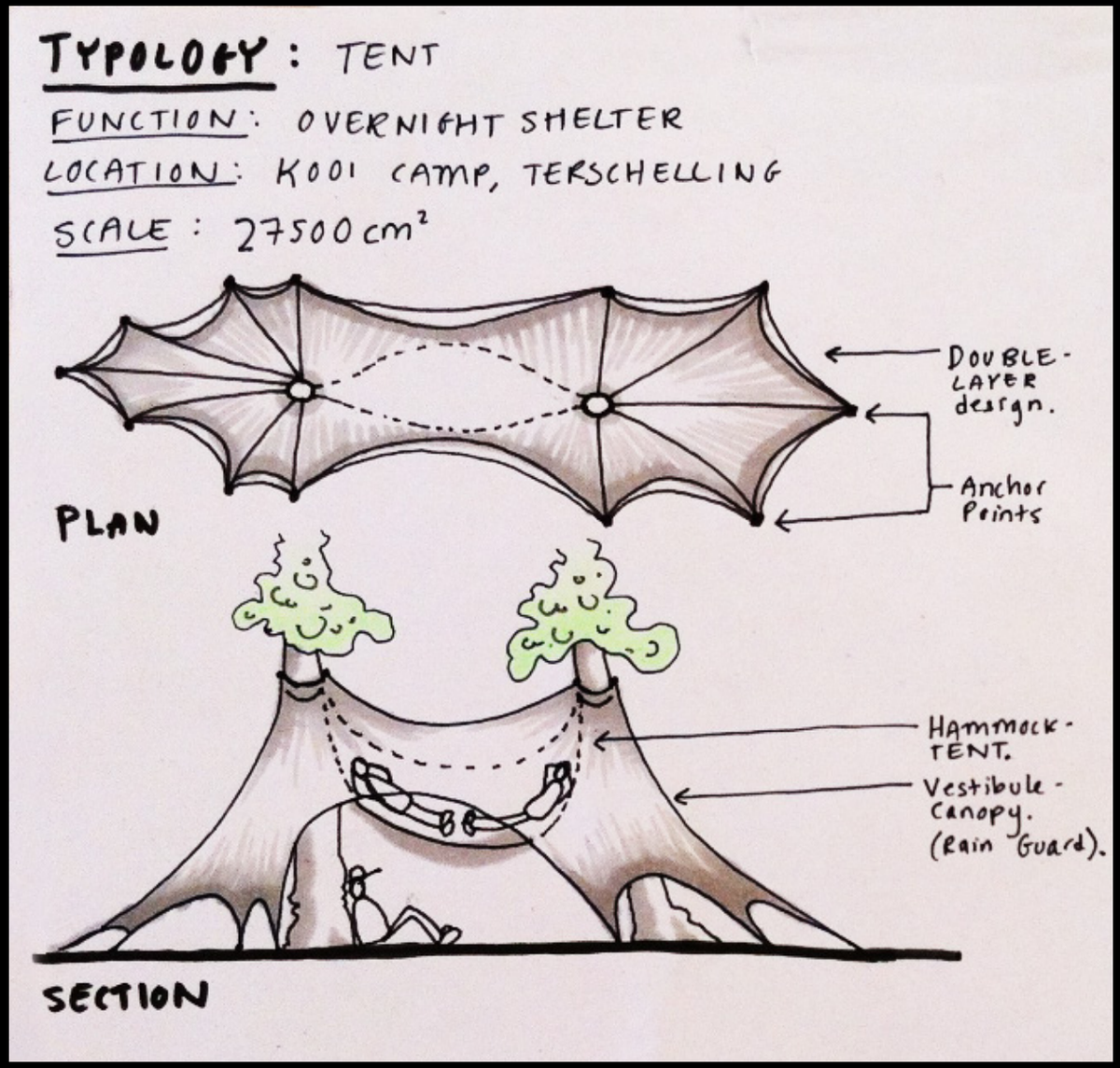
06.2014 Climate: Temperature, wind, and sun conditions.

Radial Focus: Floating Stage

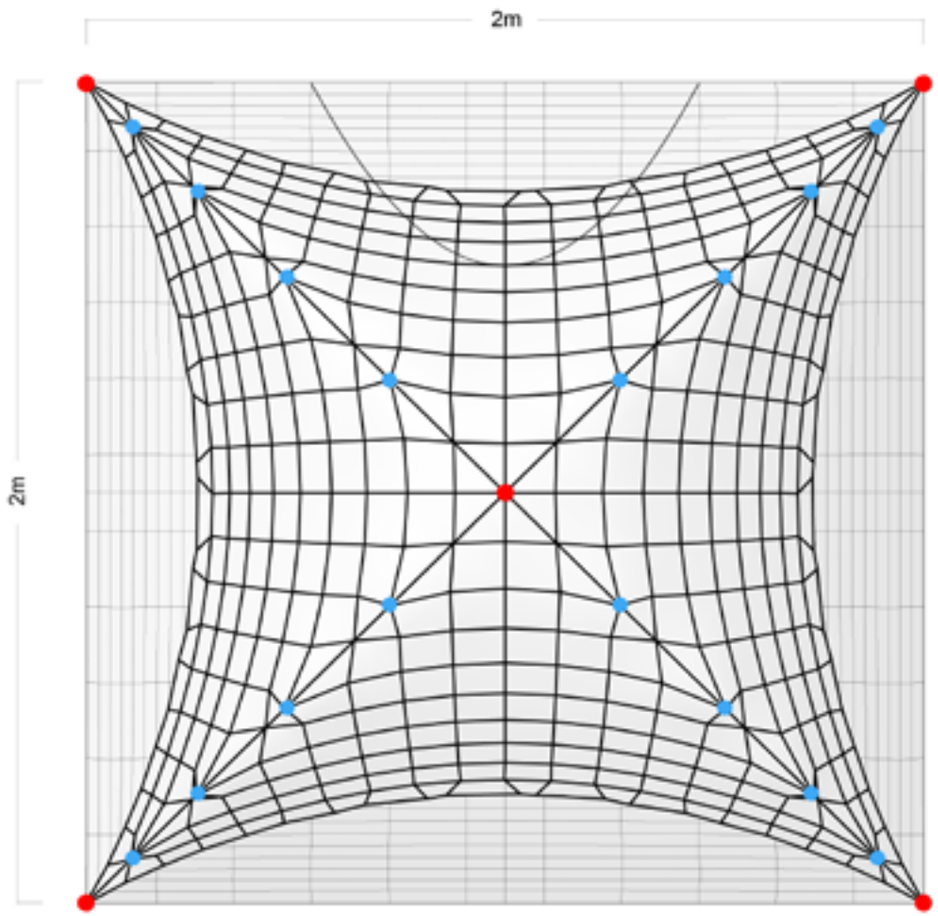


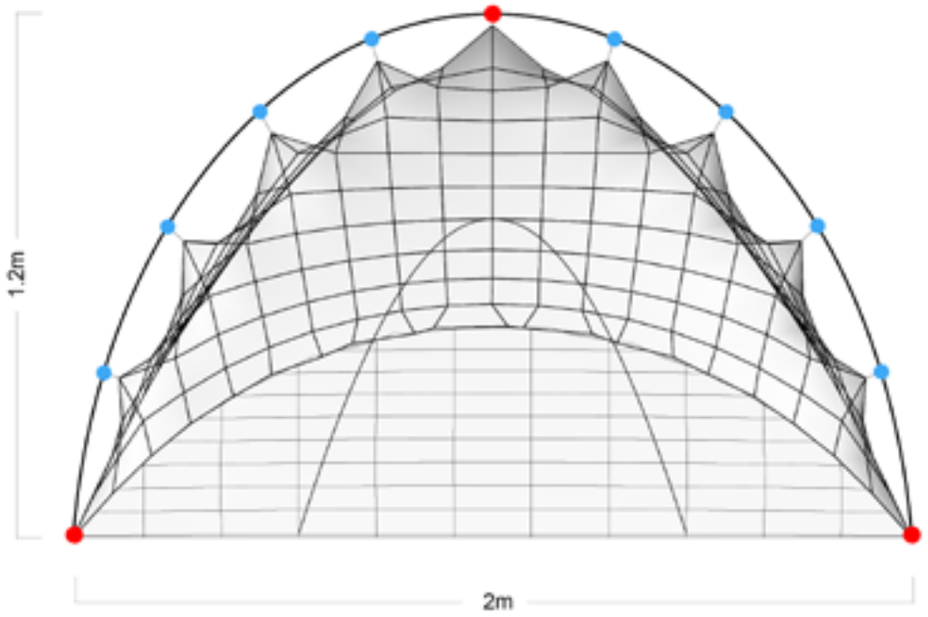
Site Axes: Floating Stage as a Radial Focus.

The Problem

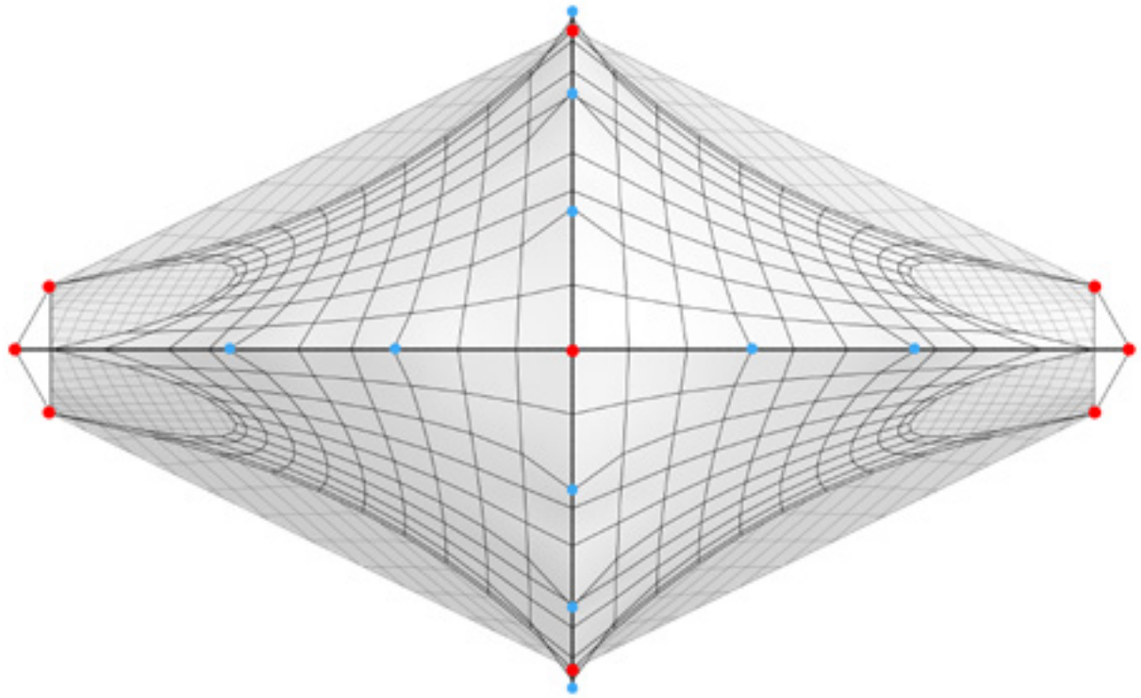


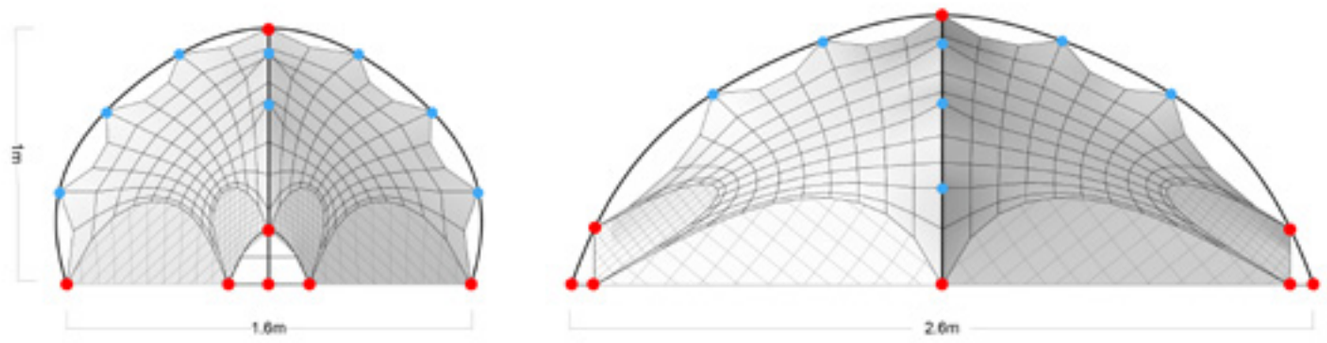
Left: Flooded Festival Tents. **Right:** Tent, Concept Sketch.



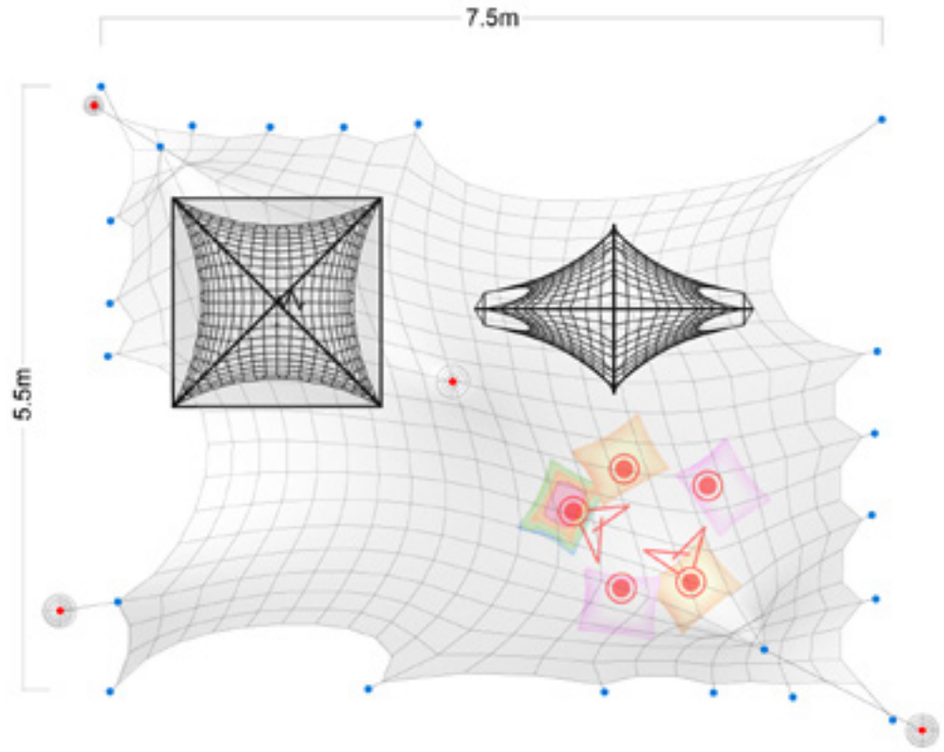


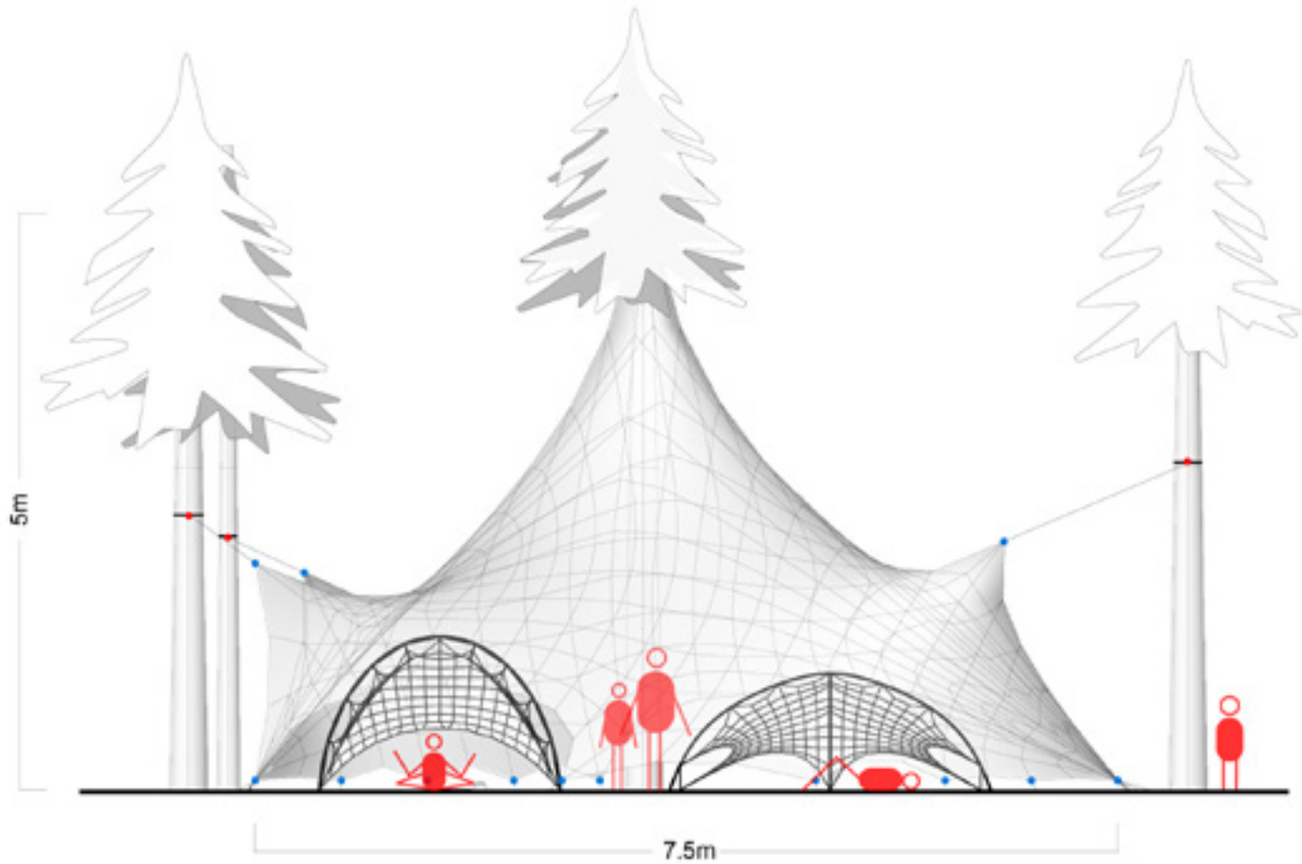
Early designs. Left: Tent Design, Plan View. **Right:** Elevation View.





Top: Tent Design, Plan. **Bottom:** Front + Side Elevations.

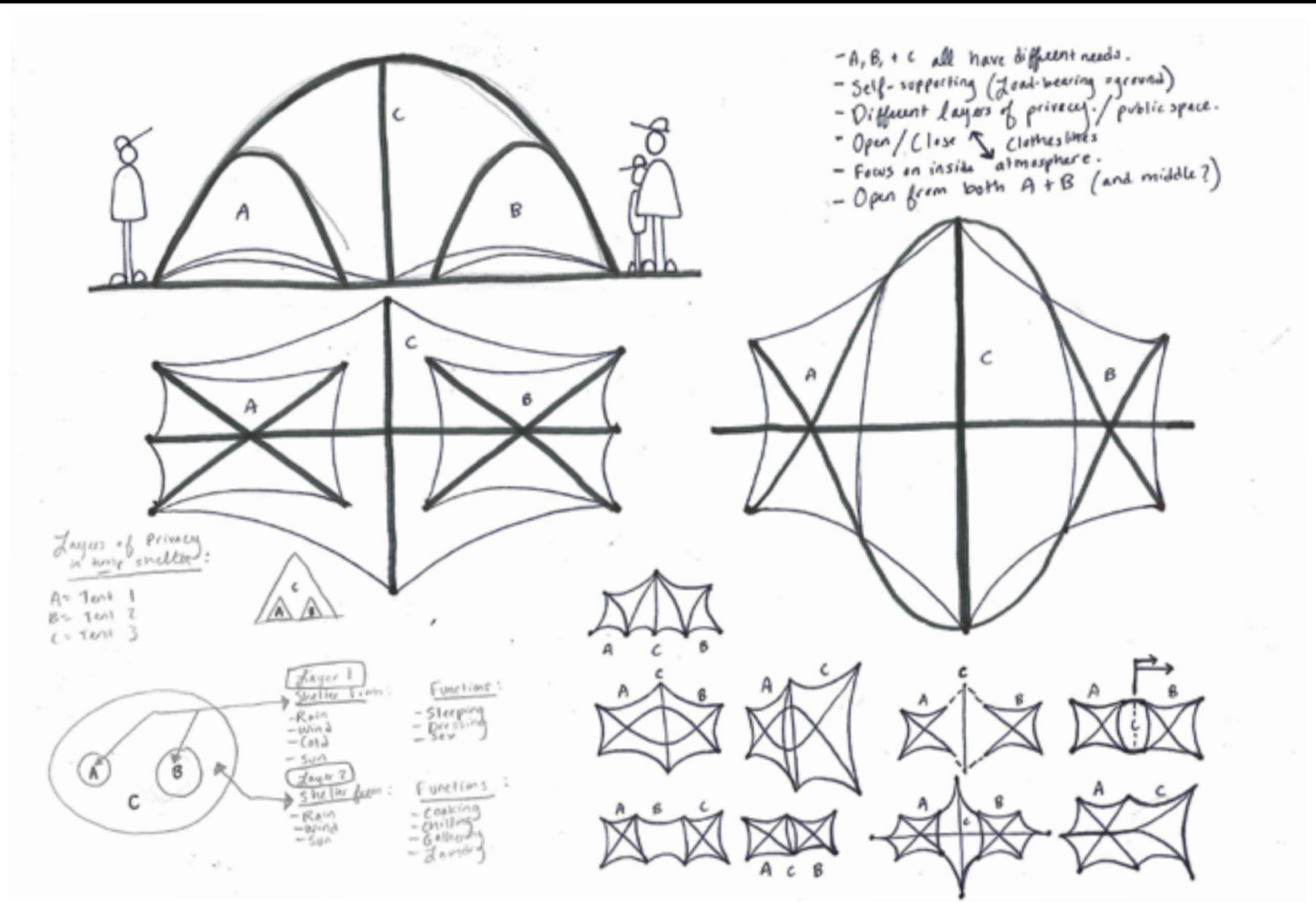




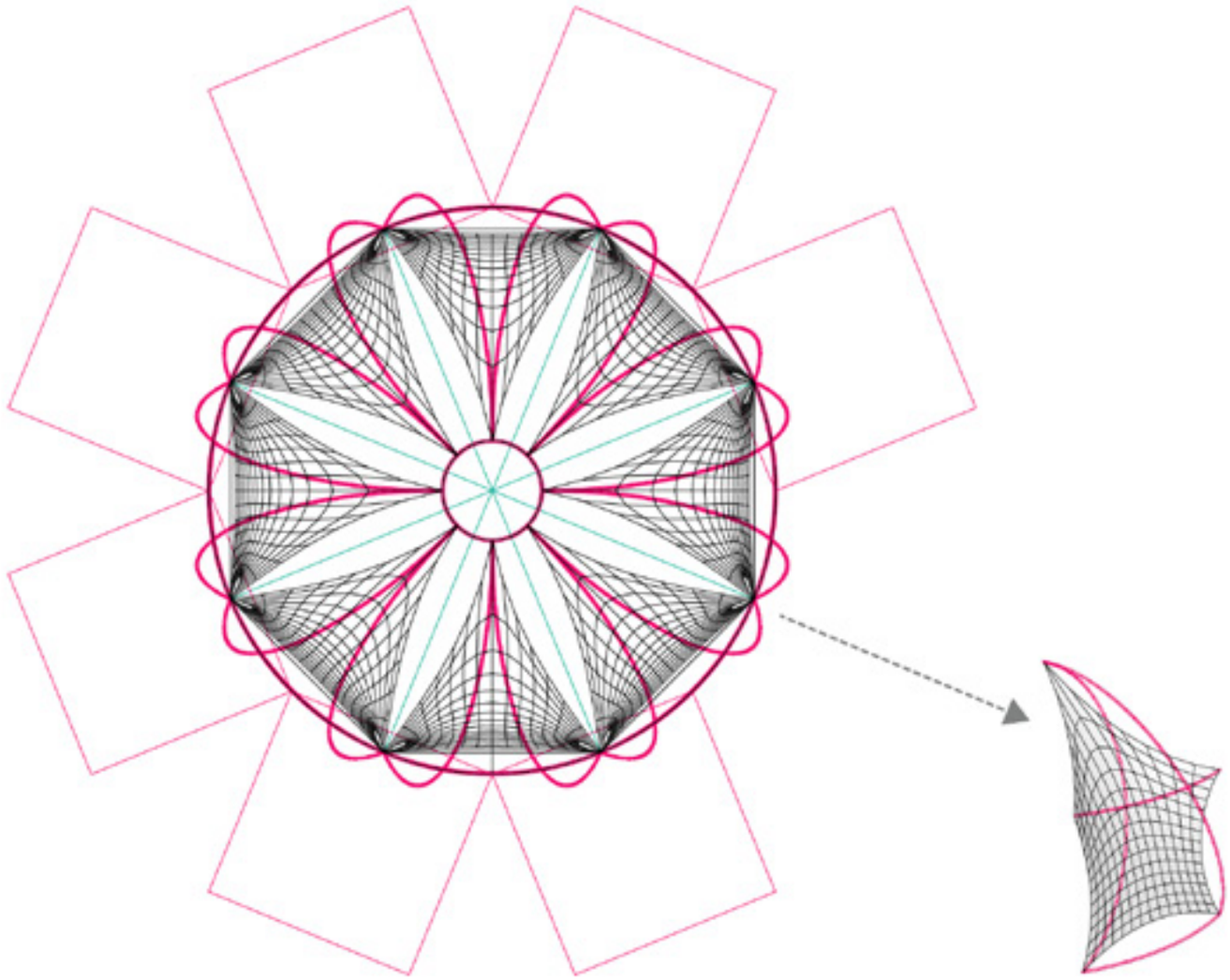
Left: Communal Tent, Plan. **Right:** Elevation.

DESIGN 1 || De Kampeertent

Early Designs



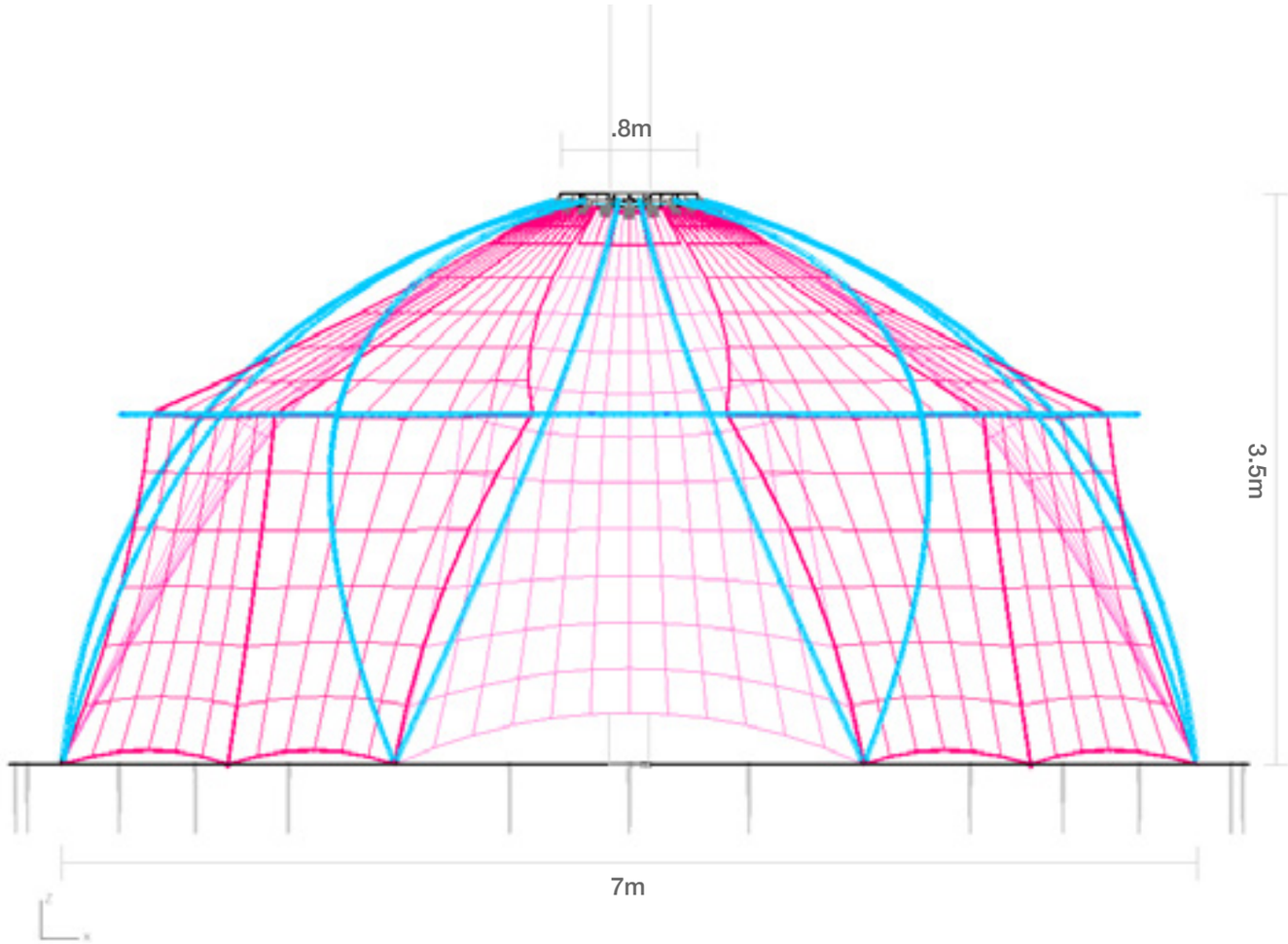
Revised Concept: Private Tents with shared Community Space.

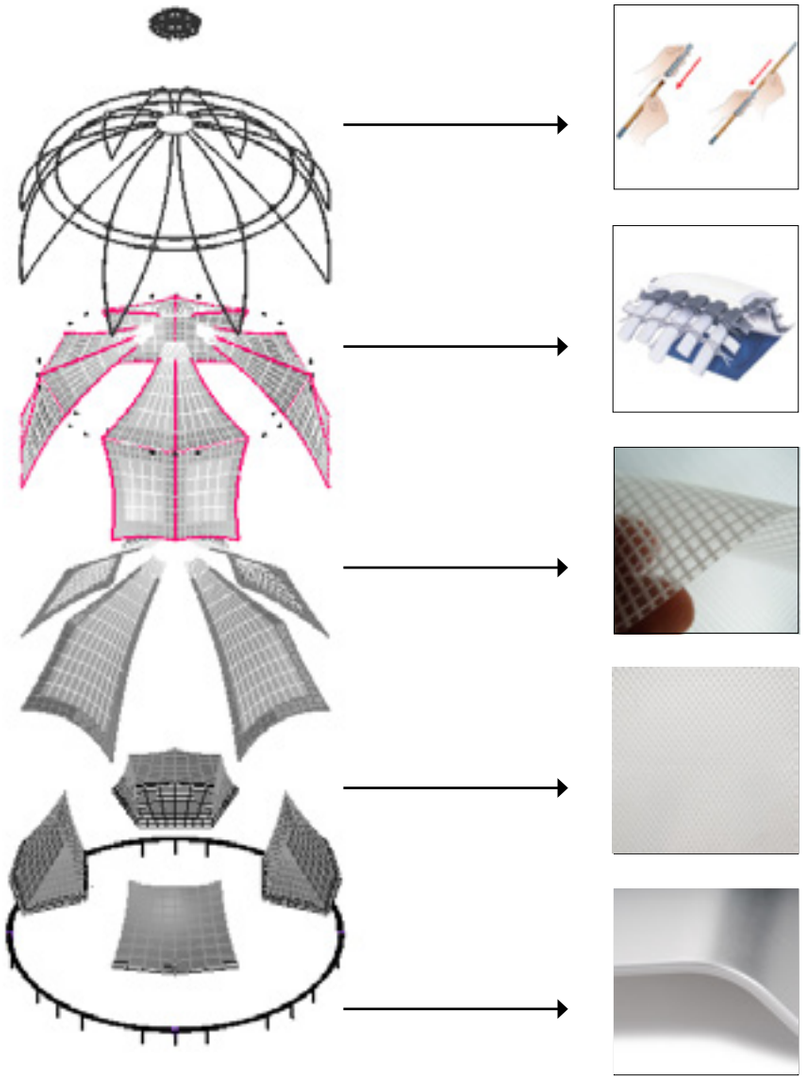


Revised Concept: De Kampeertent, with public + private zones.

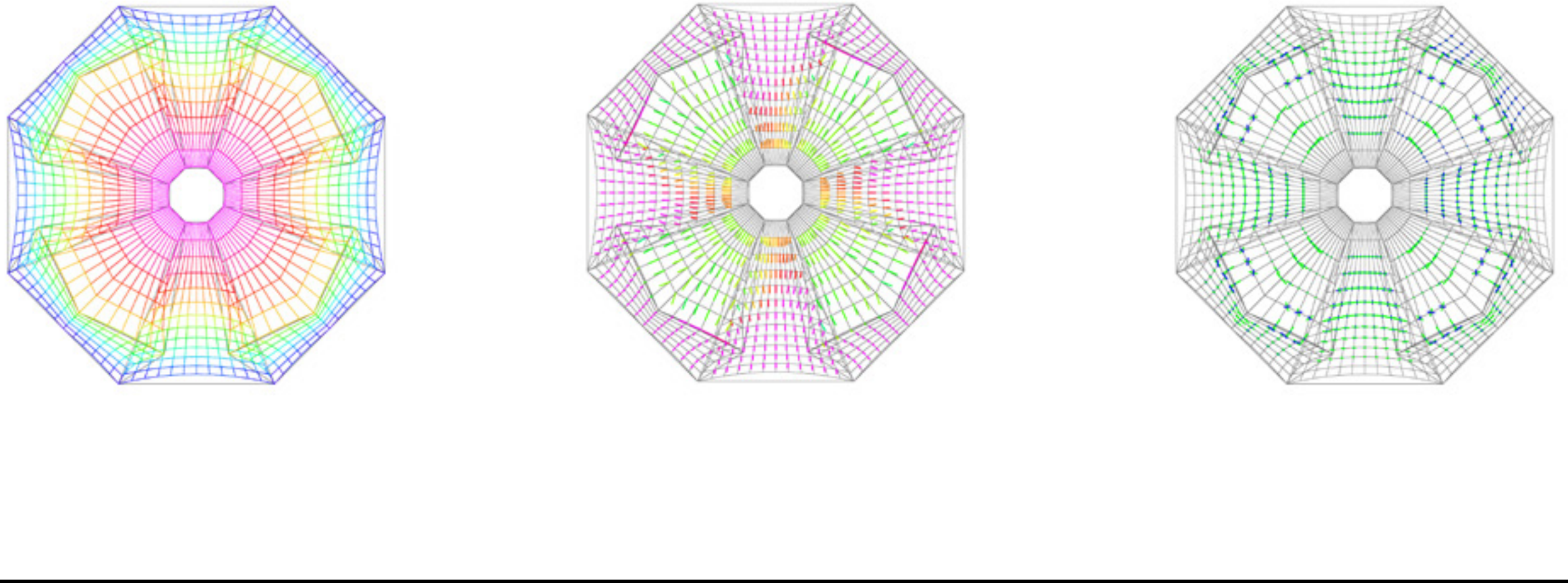
DESIGN 1 || De Kampeertent

Structure + Materials

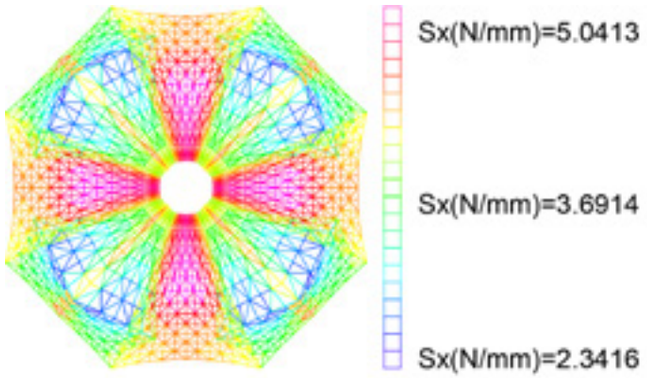


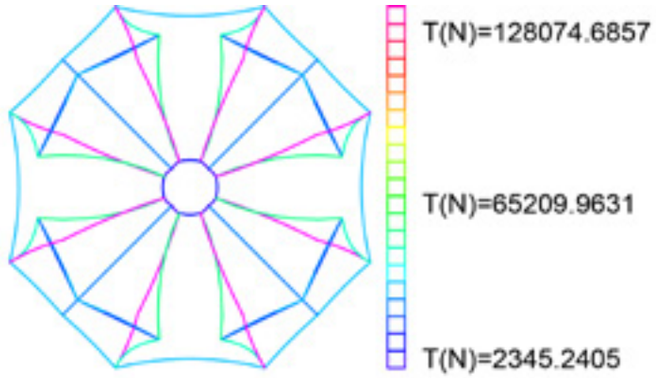


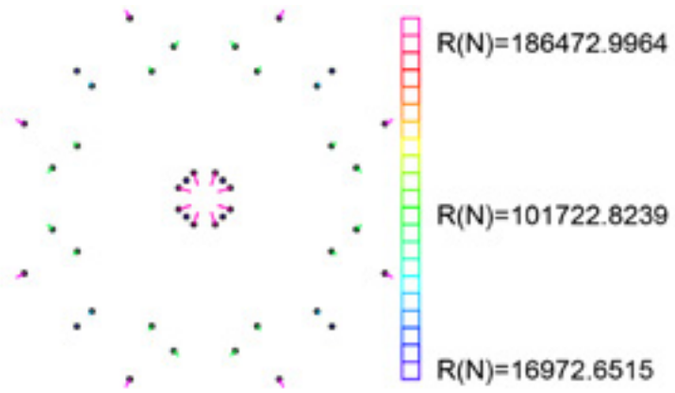
Left: Blue=Bending. Pink=Tension. **Right:** Materials Top-Down: Carbon Fiber Poles, Acrylic Coated Polyester, Ibid, Insular Nylon, Aluminum.

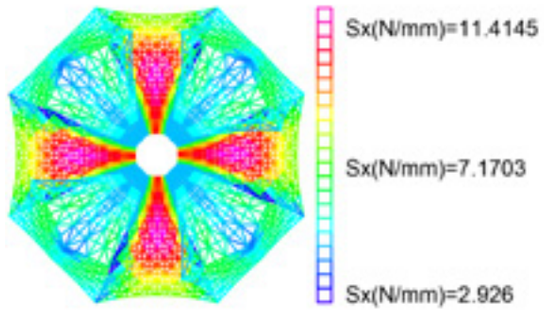


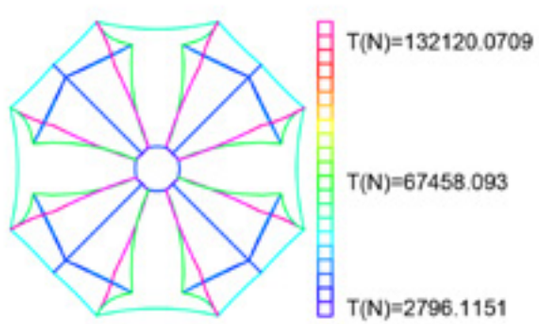
Left: Mesh Height. **Middle:** Mesh Gradient. **Right:** Mesh Curvature.

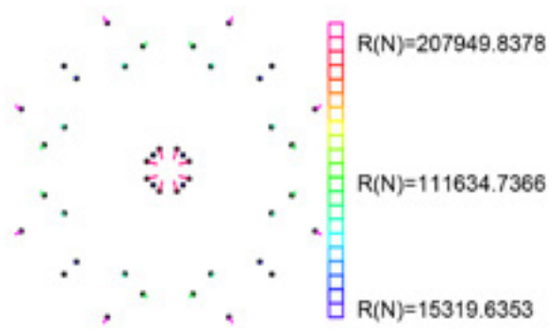


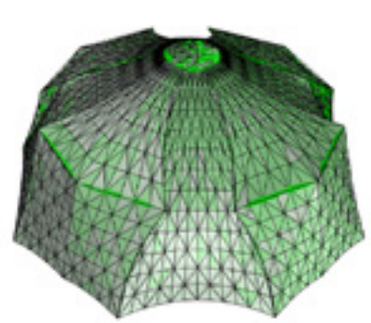




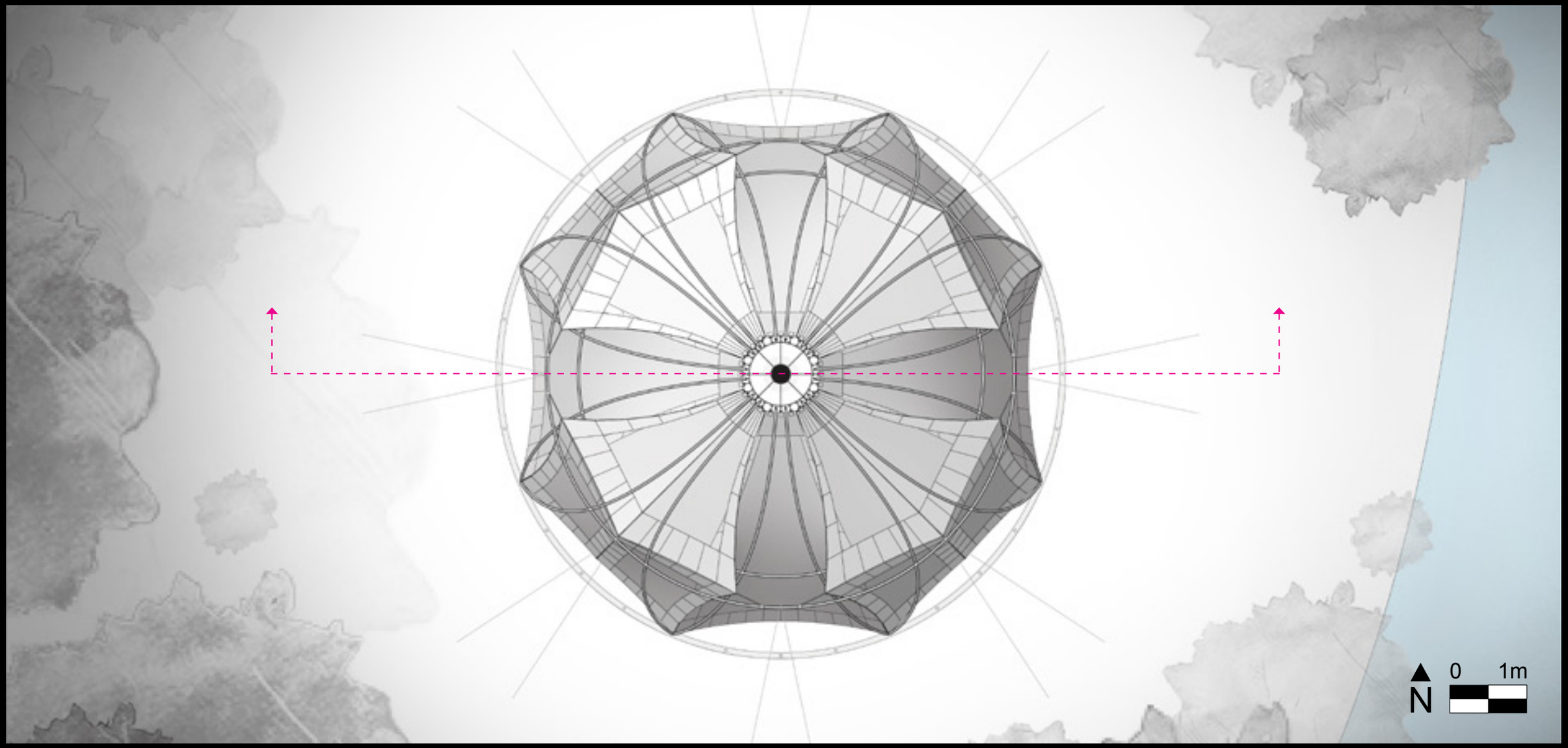




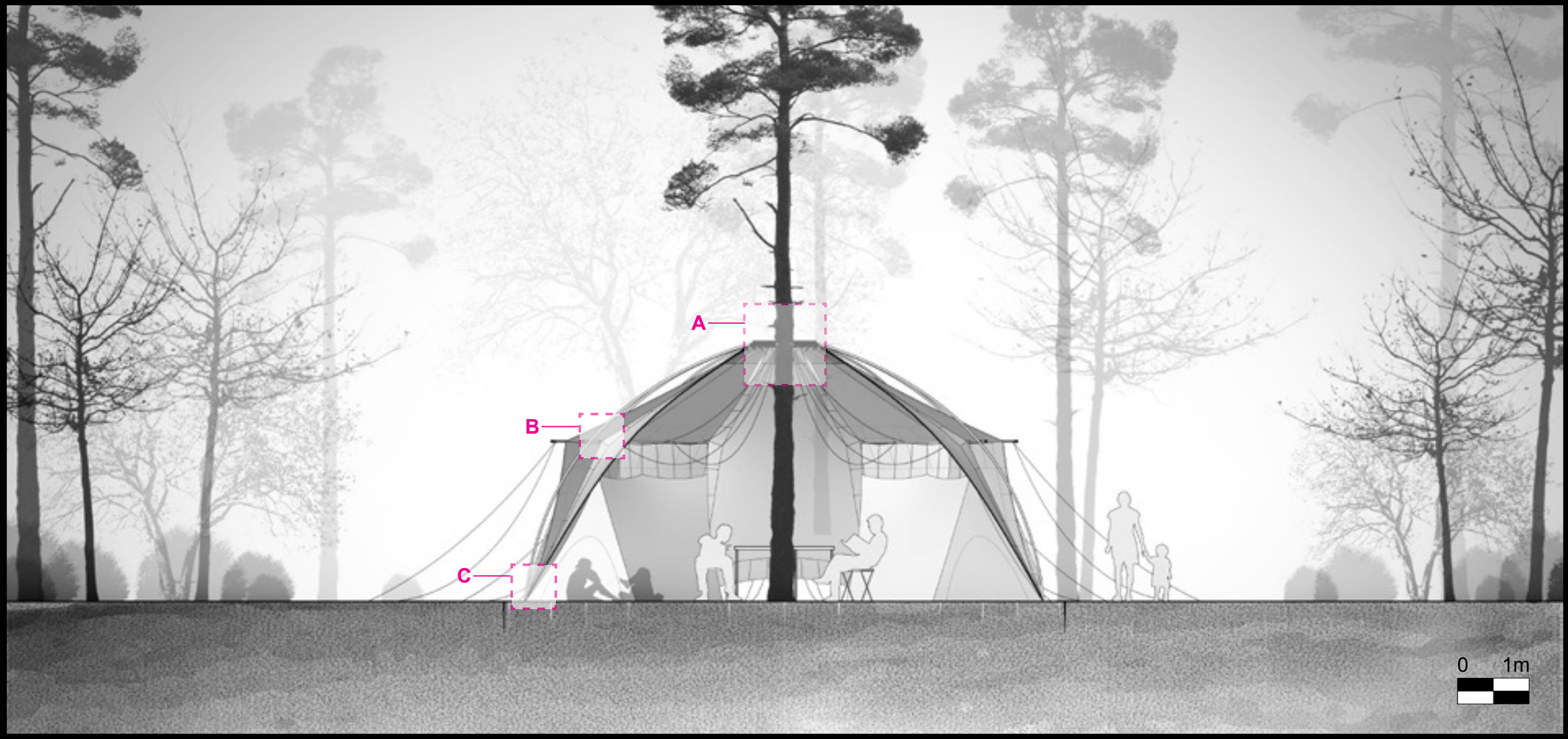




Top Left: Membrane Pre-Stress. **Top Middle:** Cable Tension. **Top Right:** Reactions at Fixed Points.
Bottom: High Wind Simulation. **Bottom Right:** Displaced Shape in High Winds.



Above: De Kampeertent, Plan.



Above: De Kampeertent, Section.

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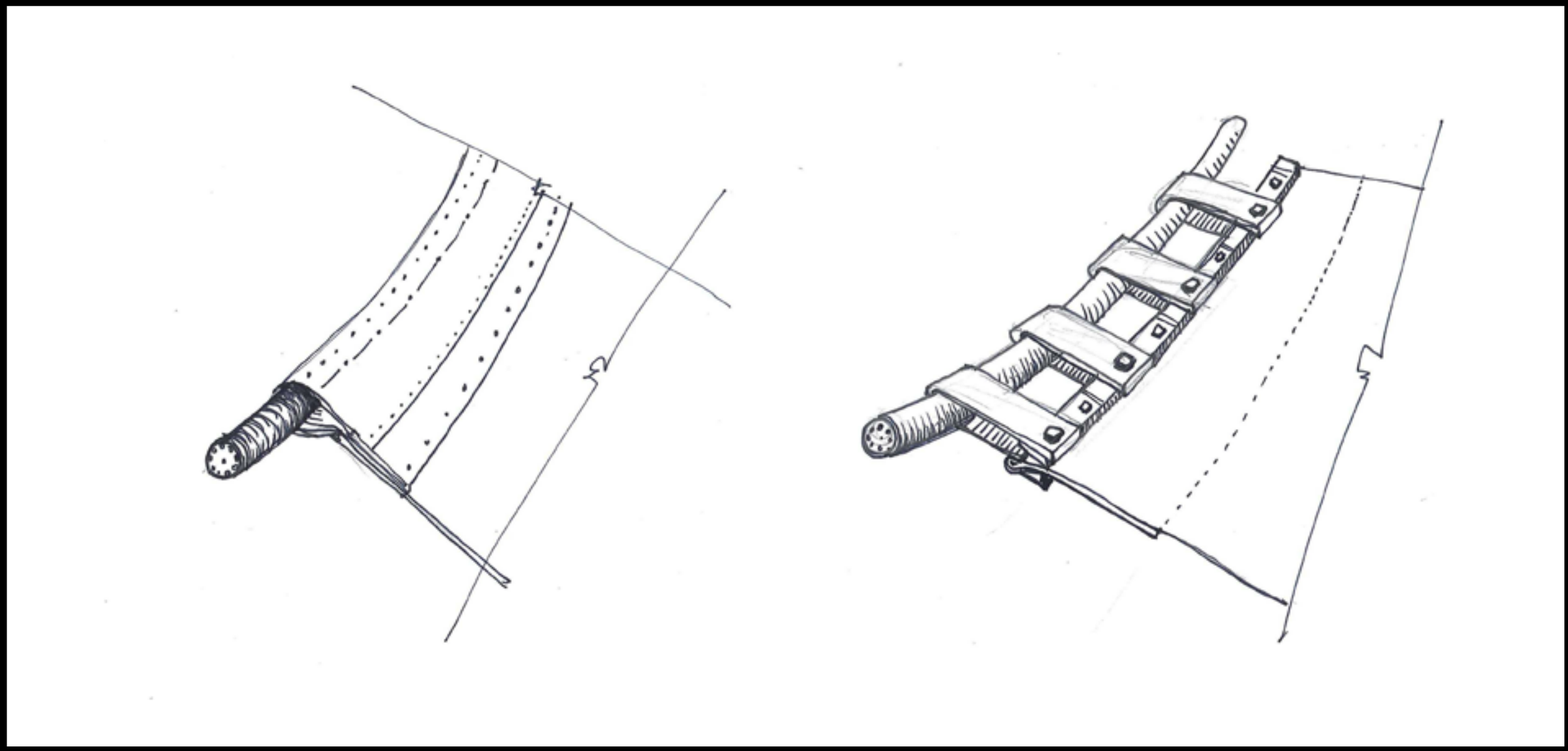
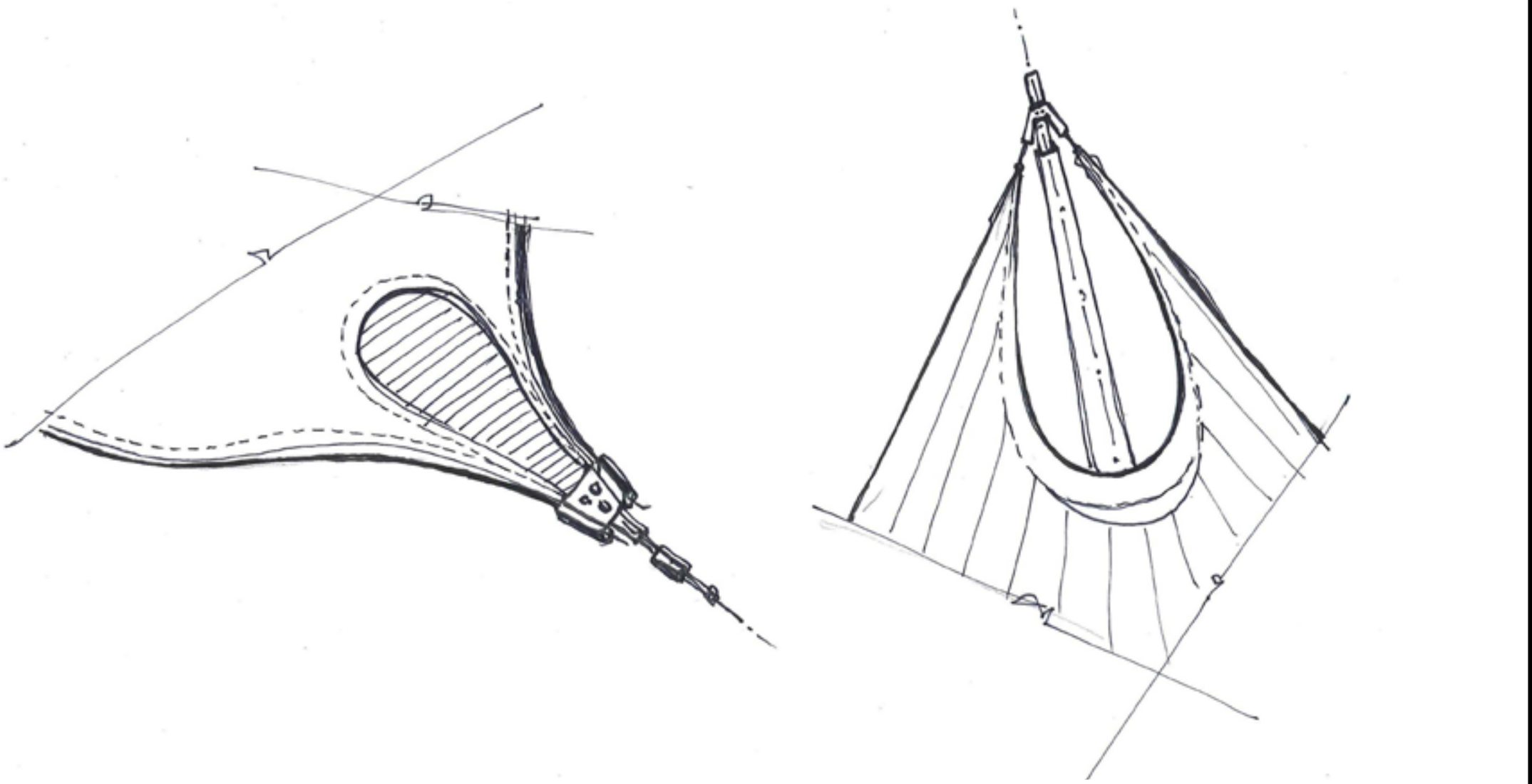
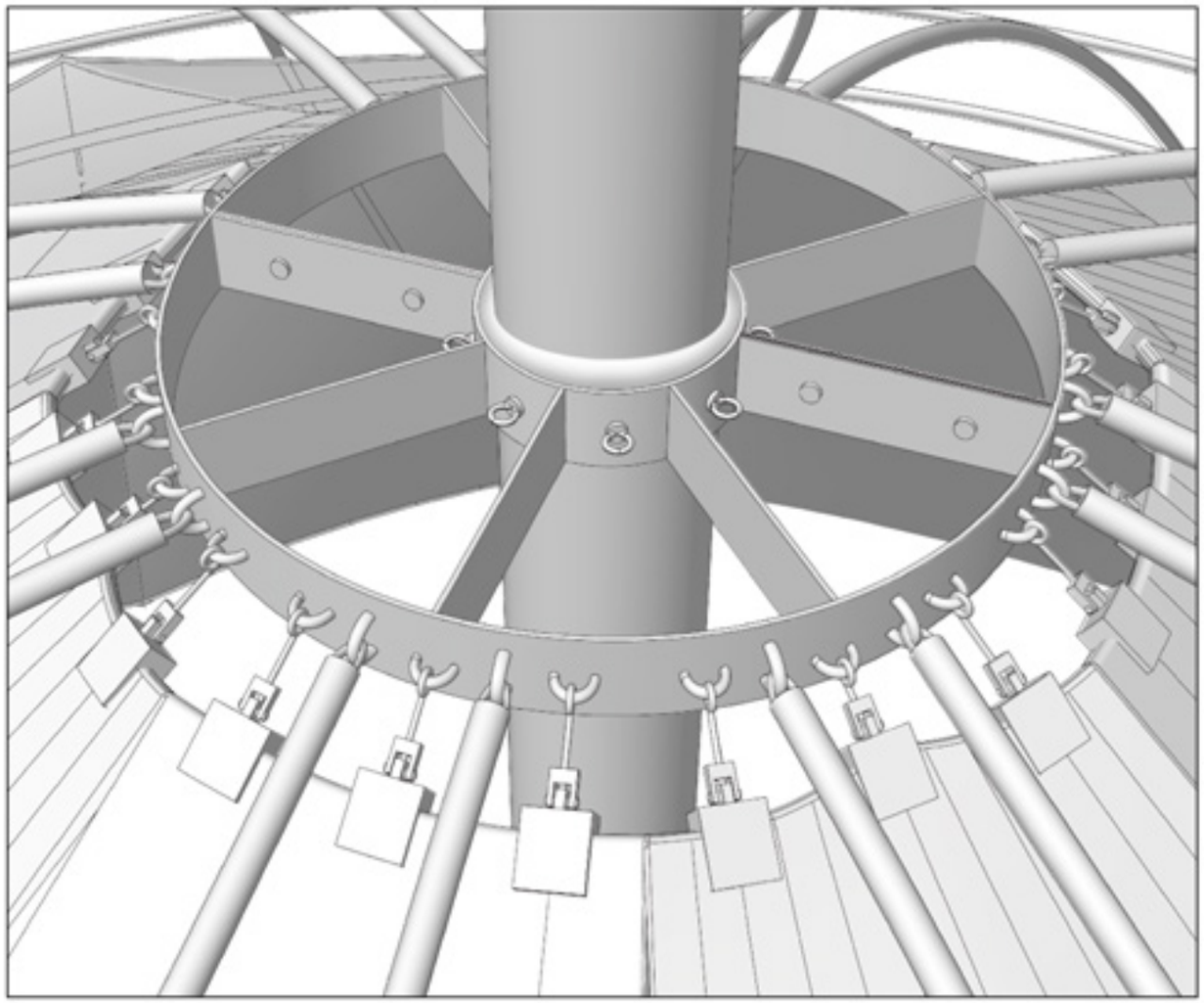
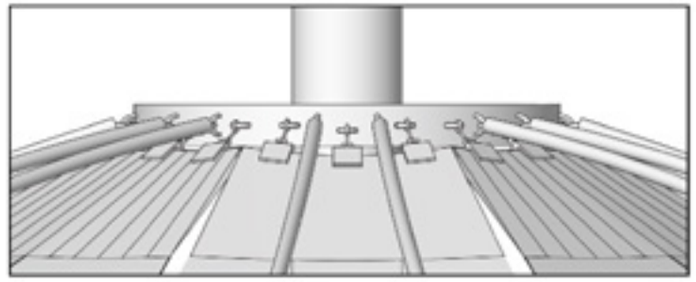


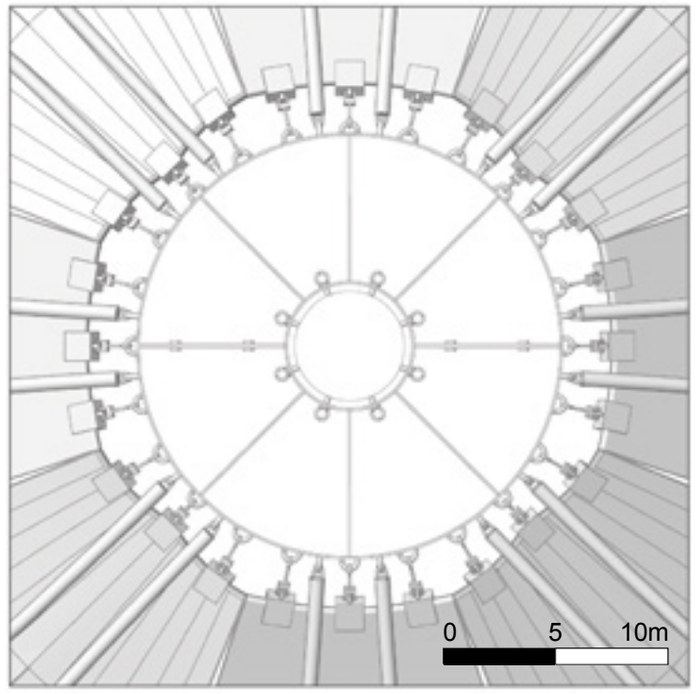
Early Detail Sketches. Left: Fabric Pocket with Cable. **Right:** Edge Cable with Clamps.



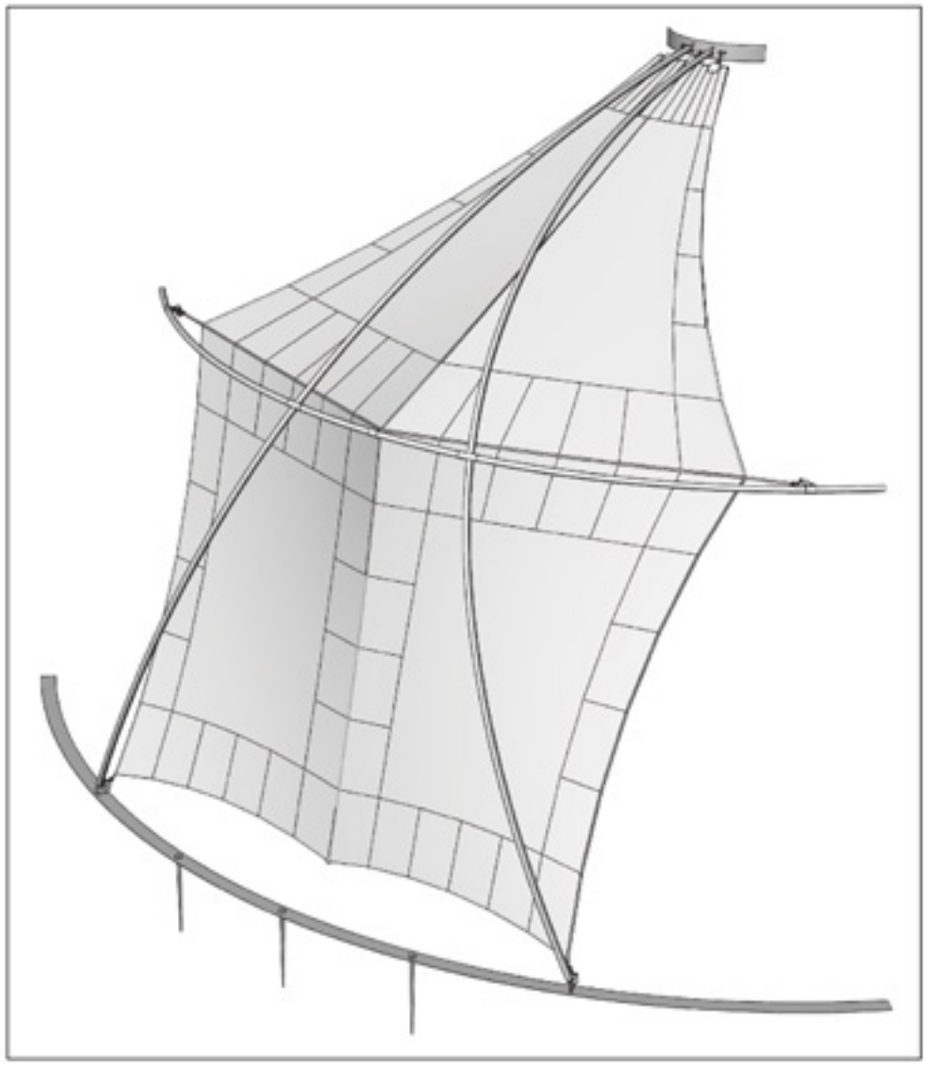
Early Detail Sketches. Left: Eye Cable. **Right:** Cable Loop.

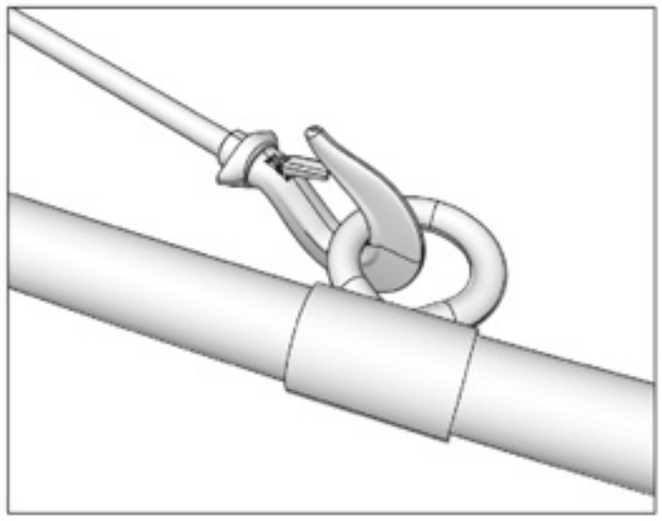


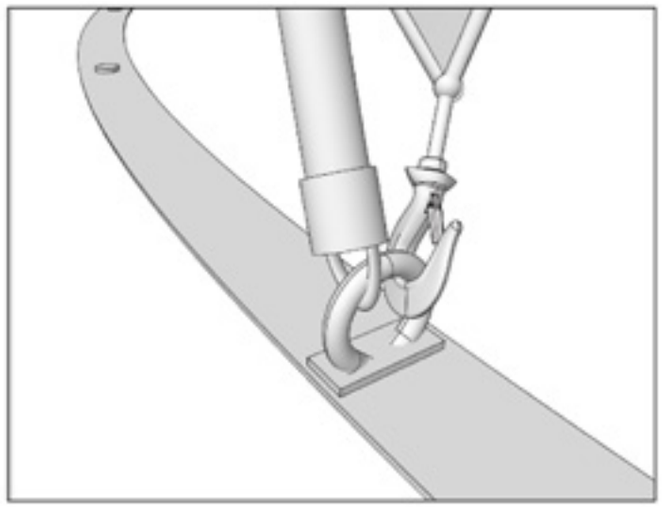




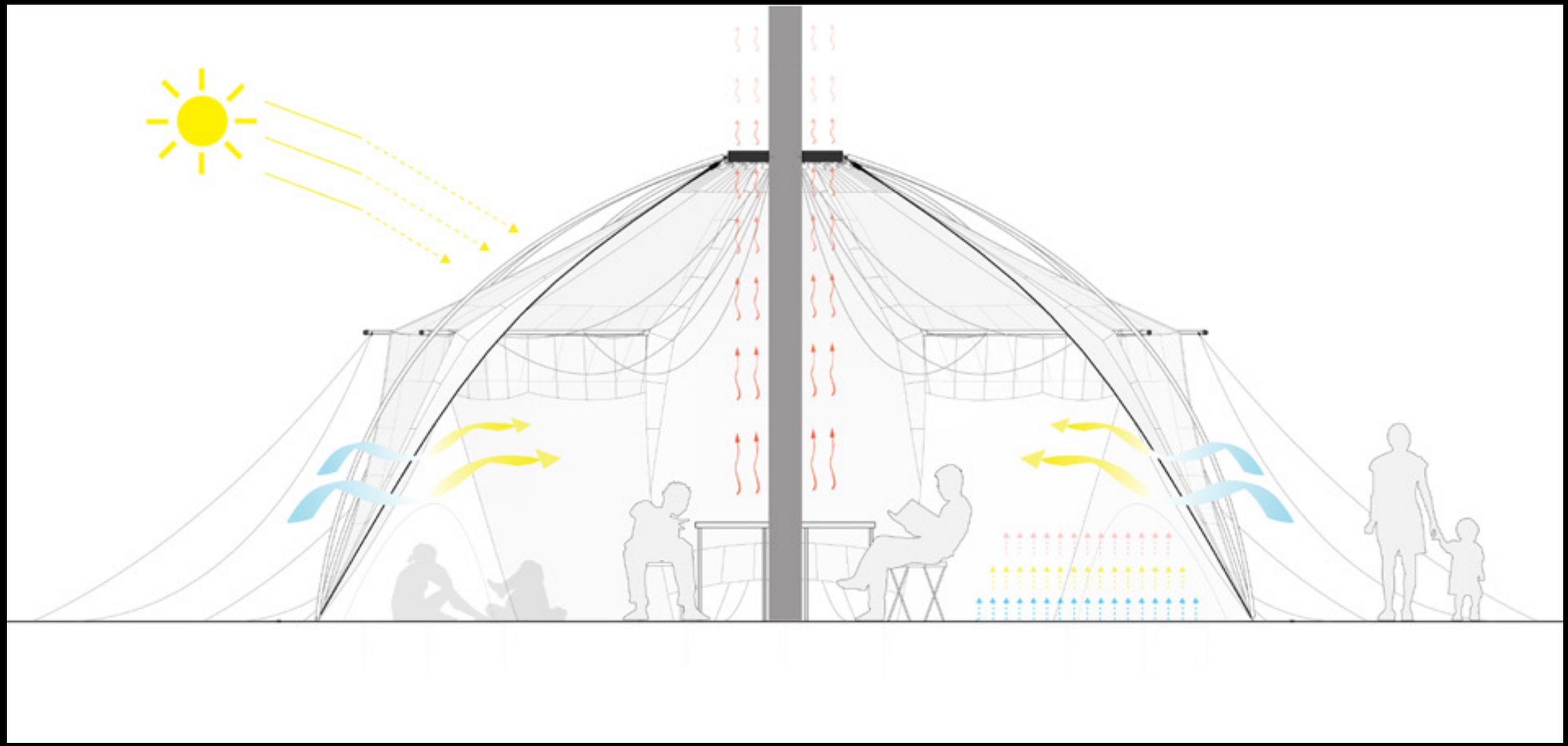
Detail: Tree Compression Ring.



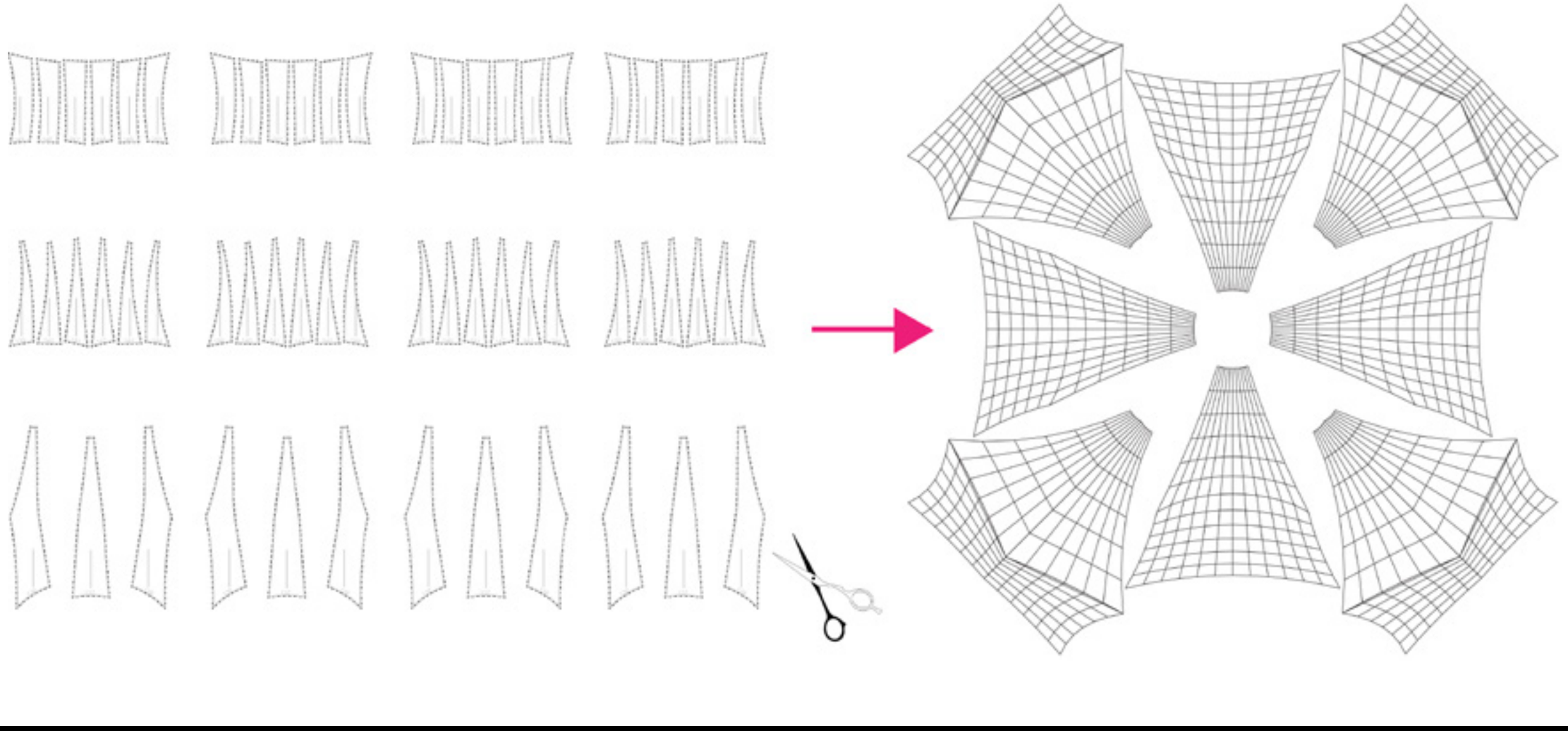




Left: Hypar Sail Unit. **Right:** Cable Hooks and Ground Connection.

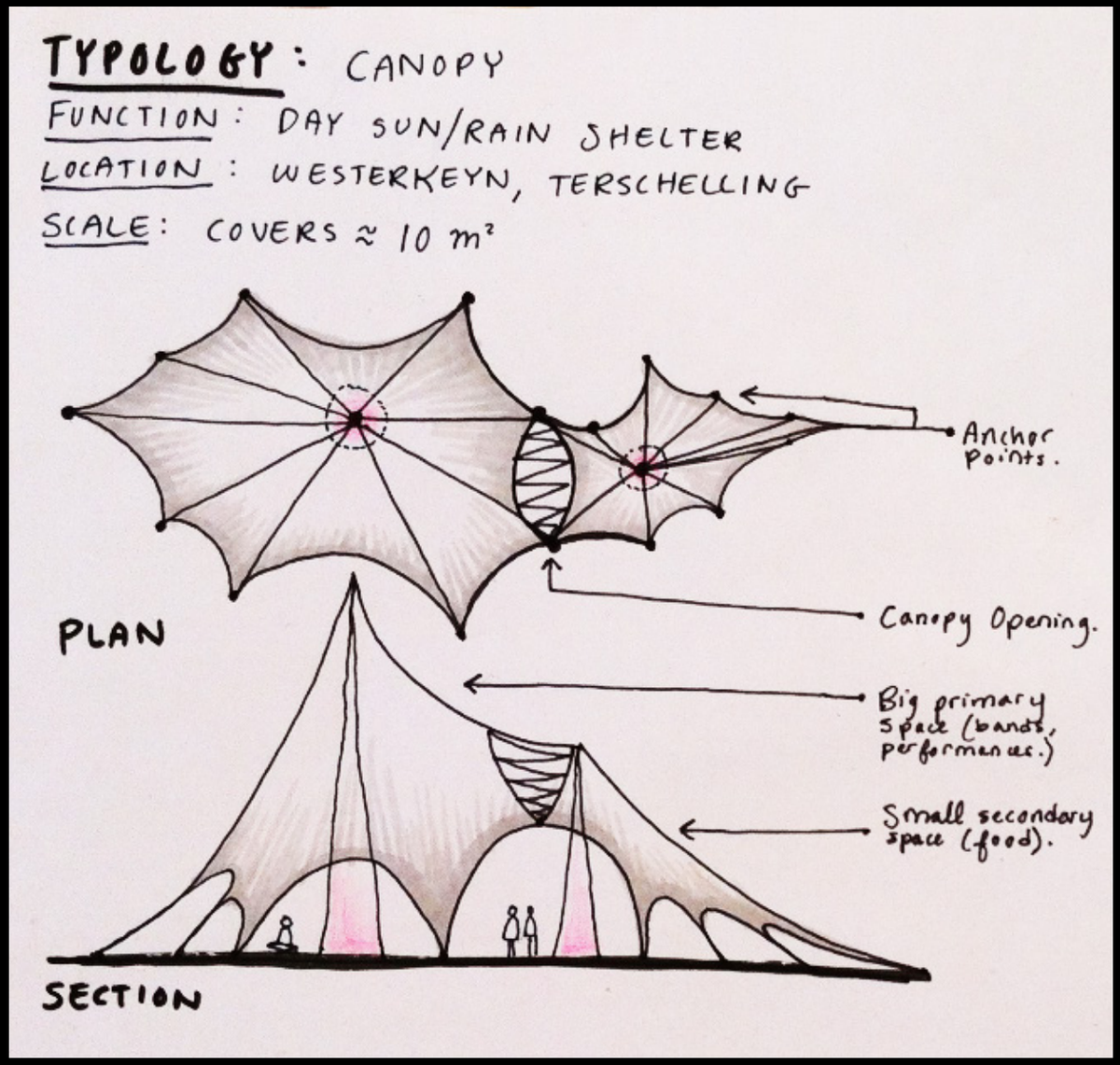


Above: Climate and Air Flows.



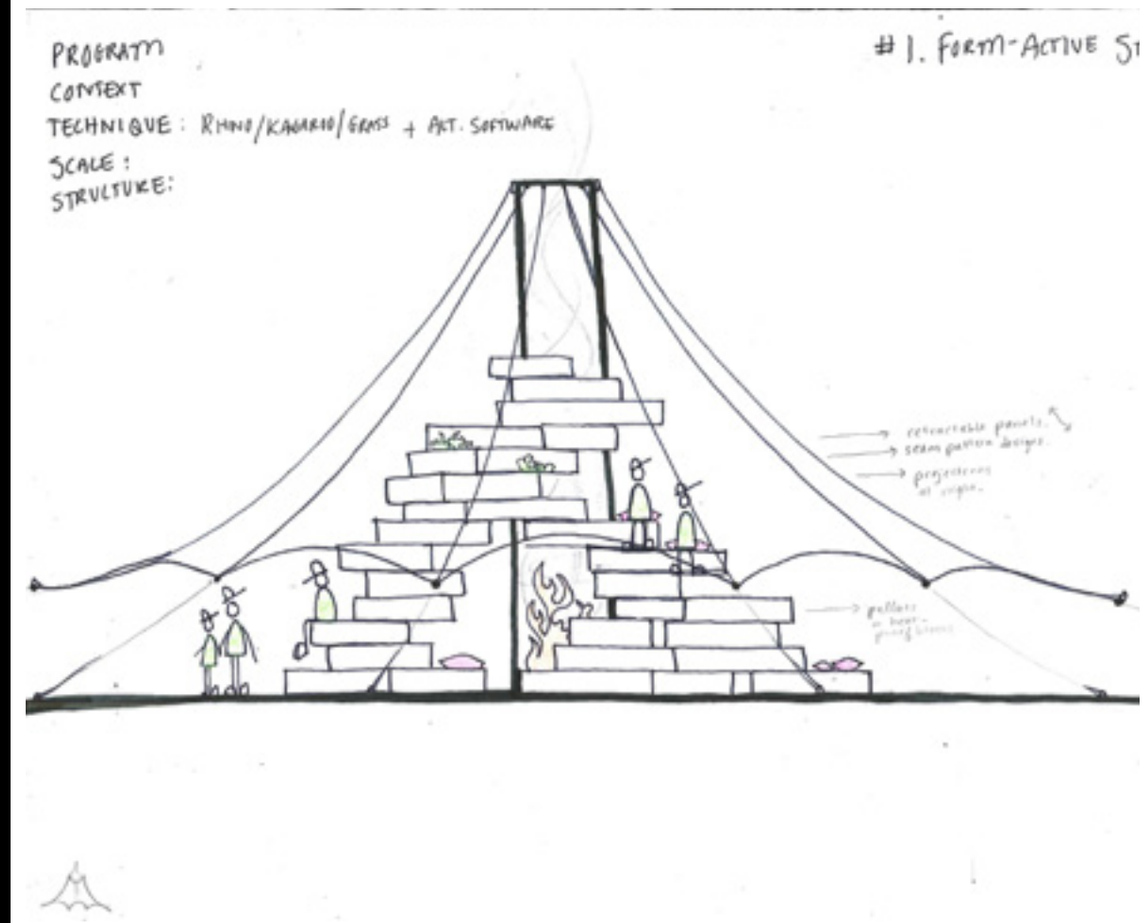
Cutting Patterns: Panels to be cut from flat fabric, pre-nesting.

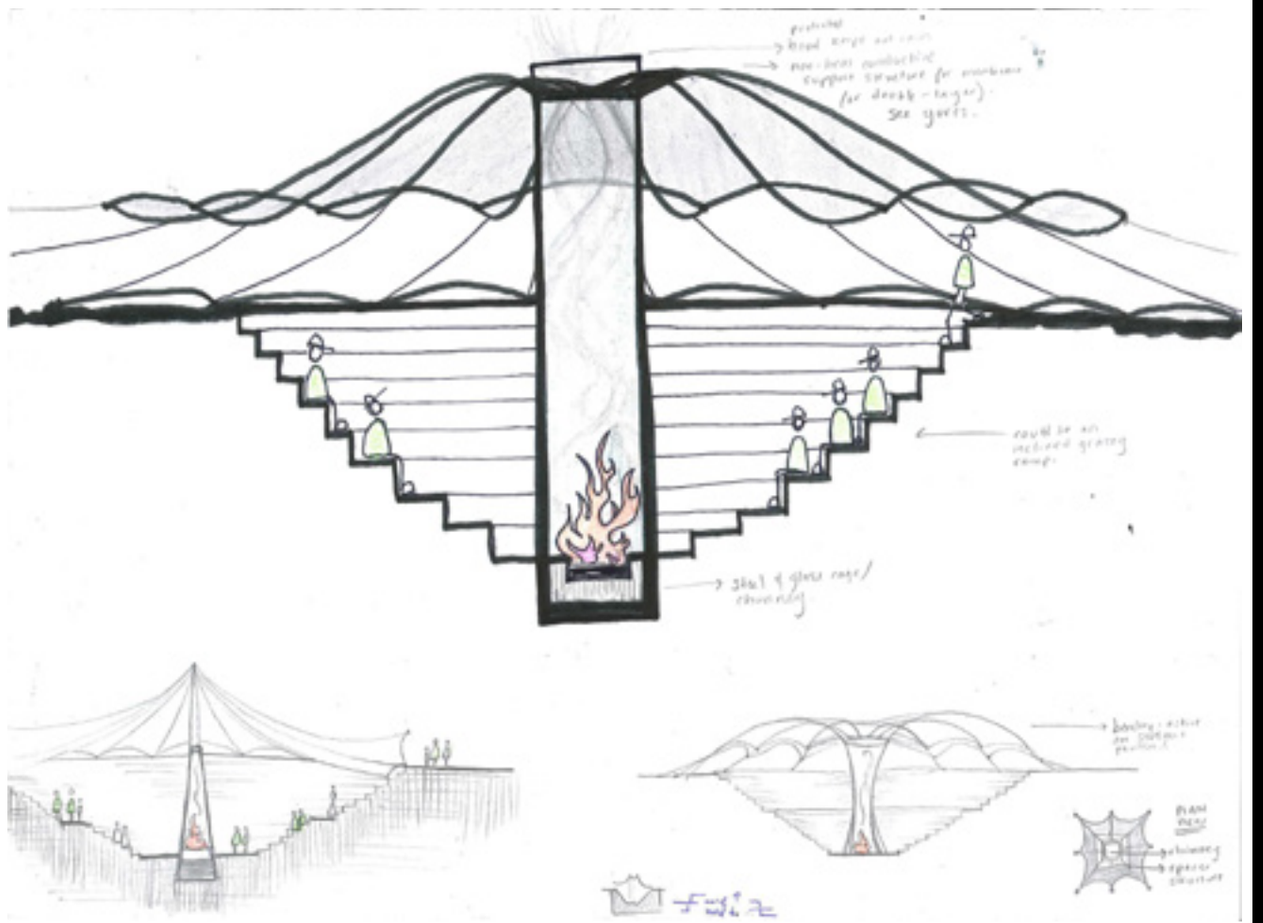
The Problem



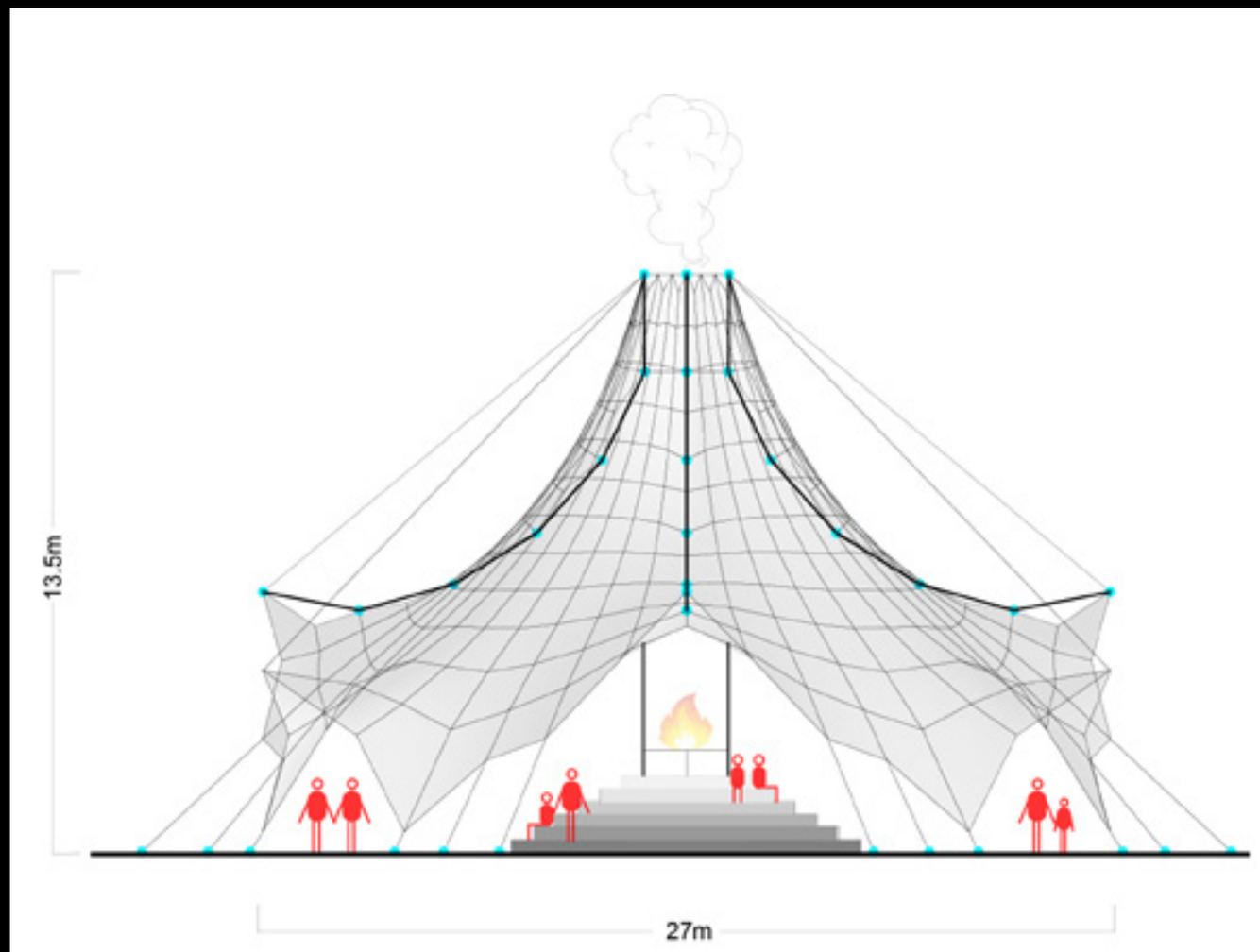
Left: Problem: Cold, Rain, Wind. **Right:** Solution: Sun/Rain Canopy.

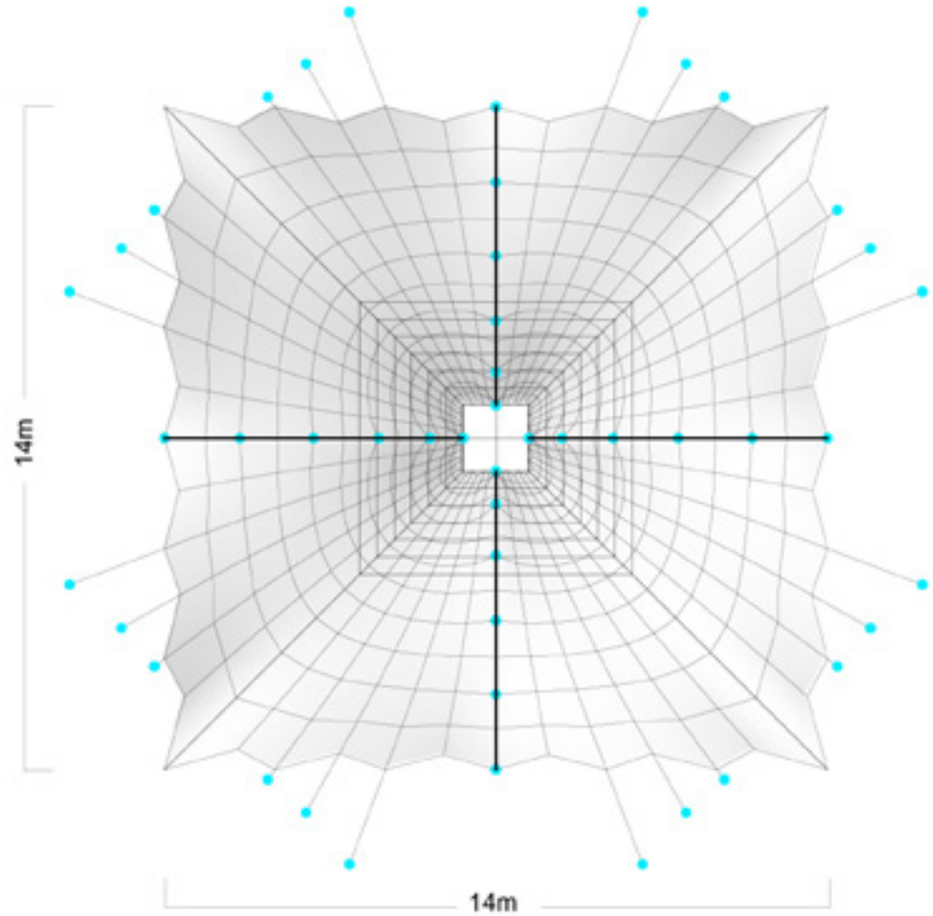
Early Designs



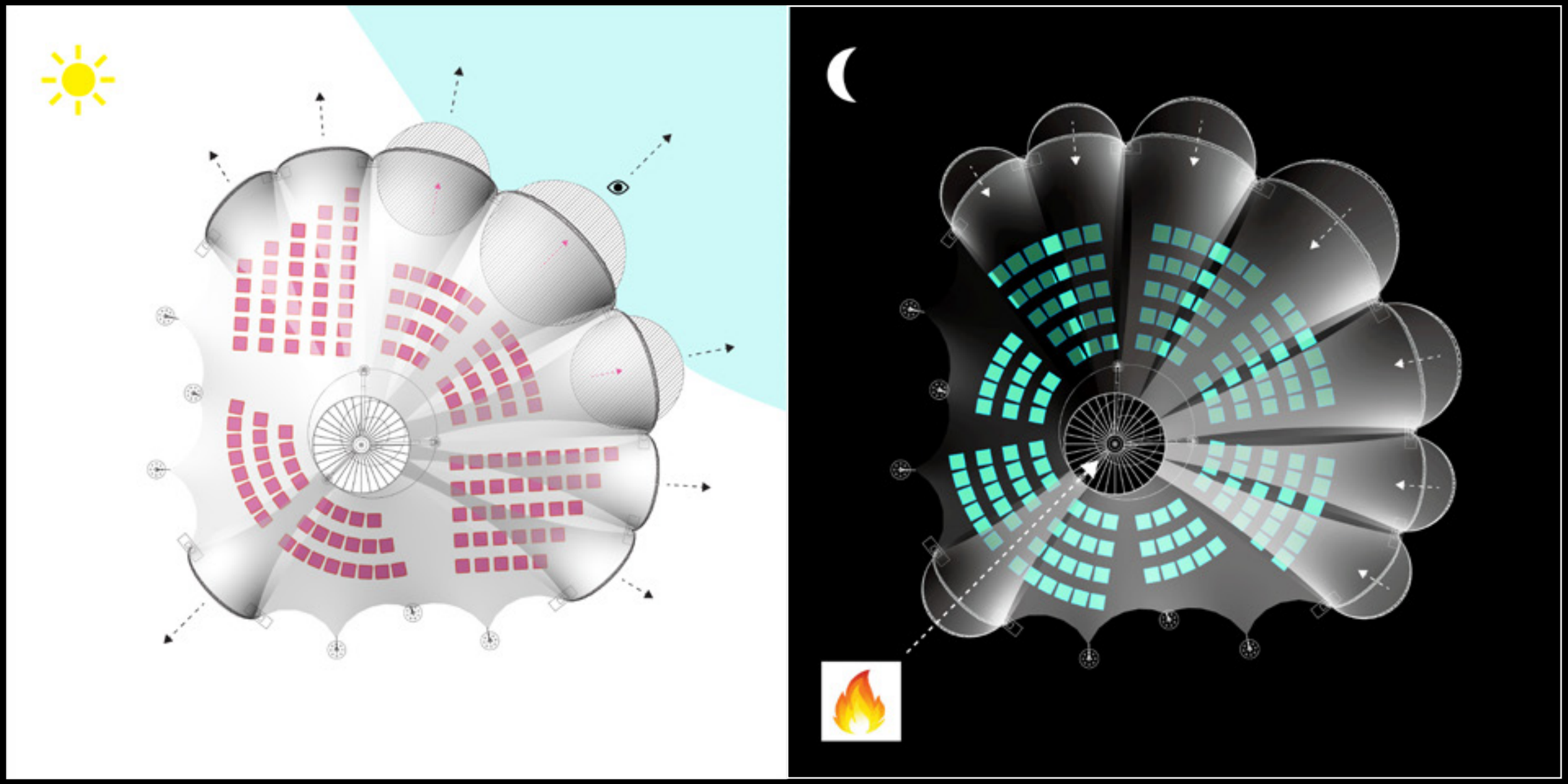


Early Designs. Left: Warming Tower. **Right:** Underground Shelter.

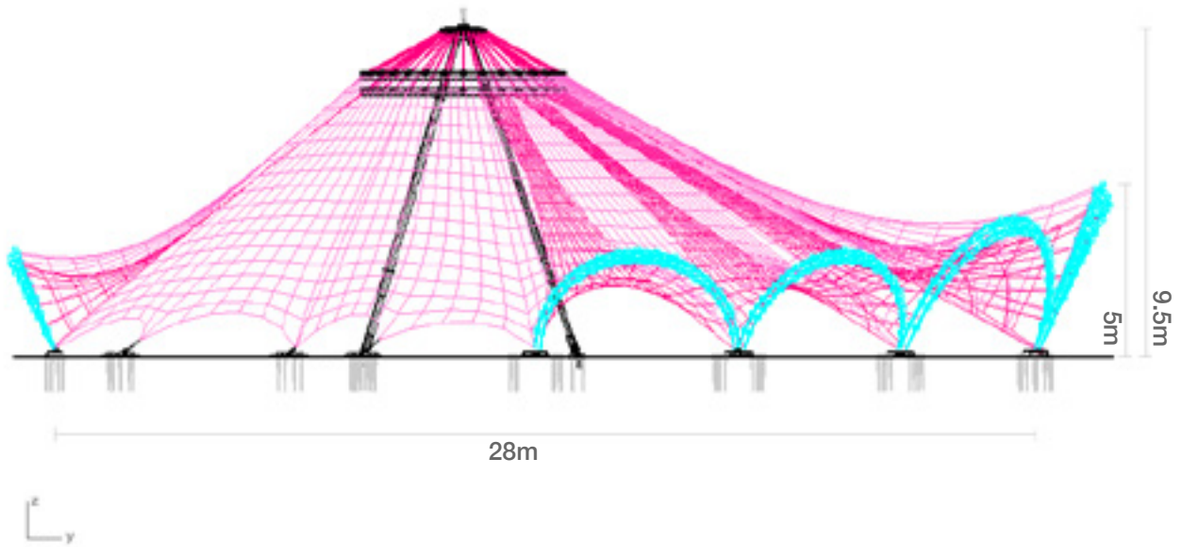


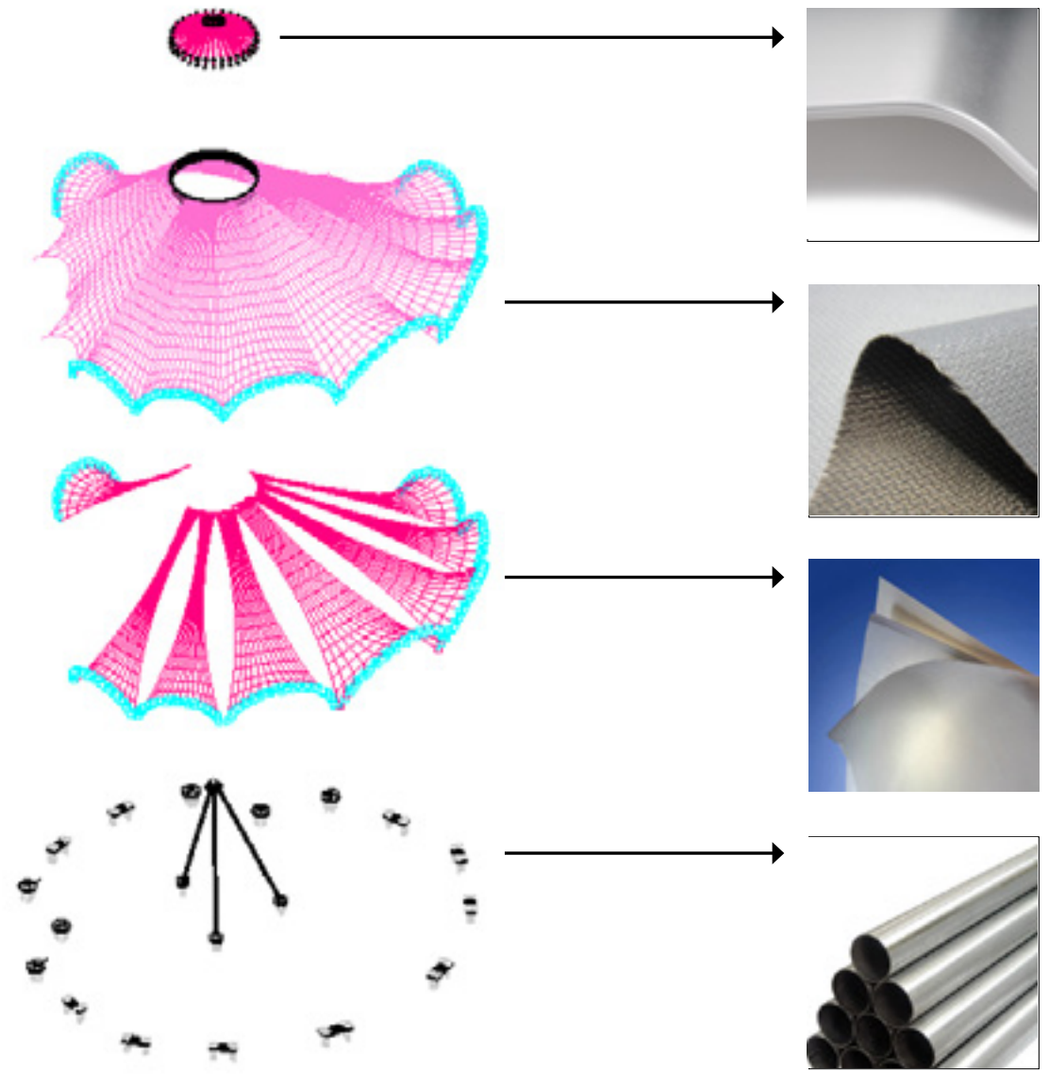


Early Design. Left: Canopy Design, Elevation. **Right:** Plan.

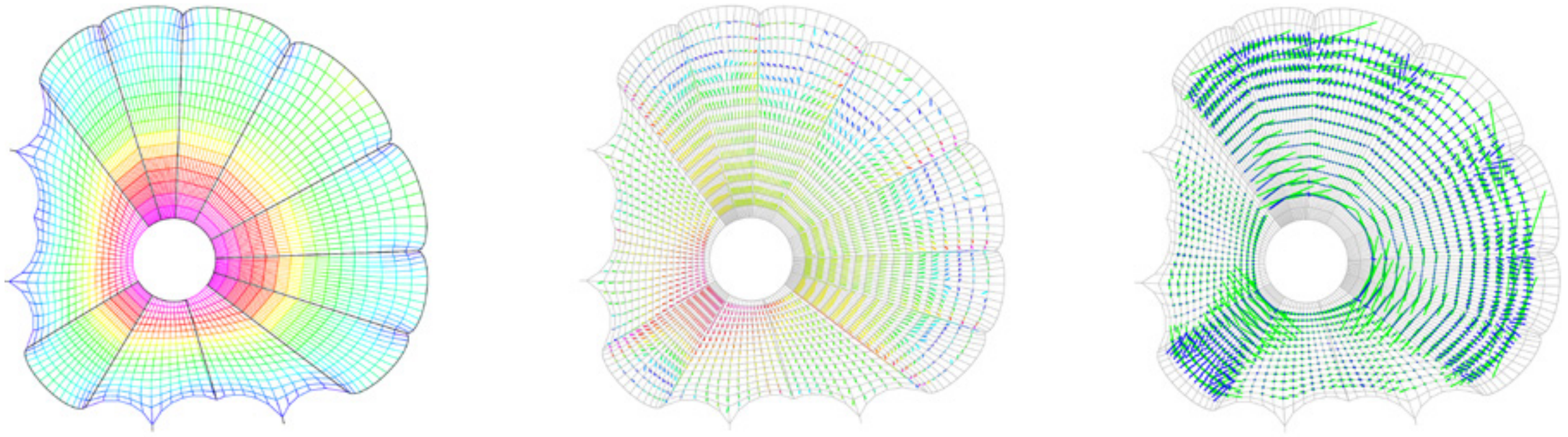


Left: Day Configuration. **Right:** Night Configuration.

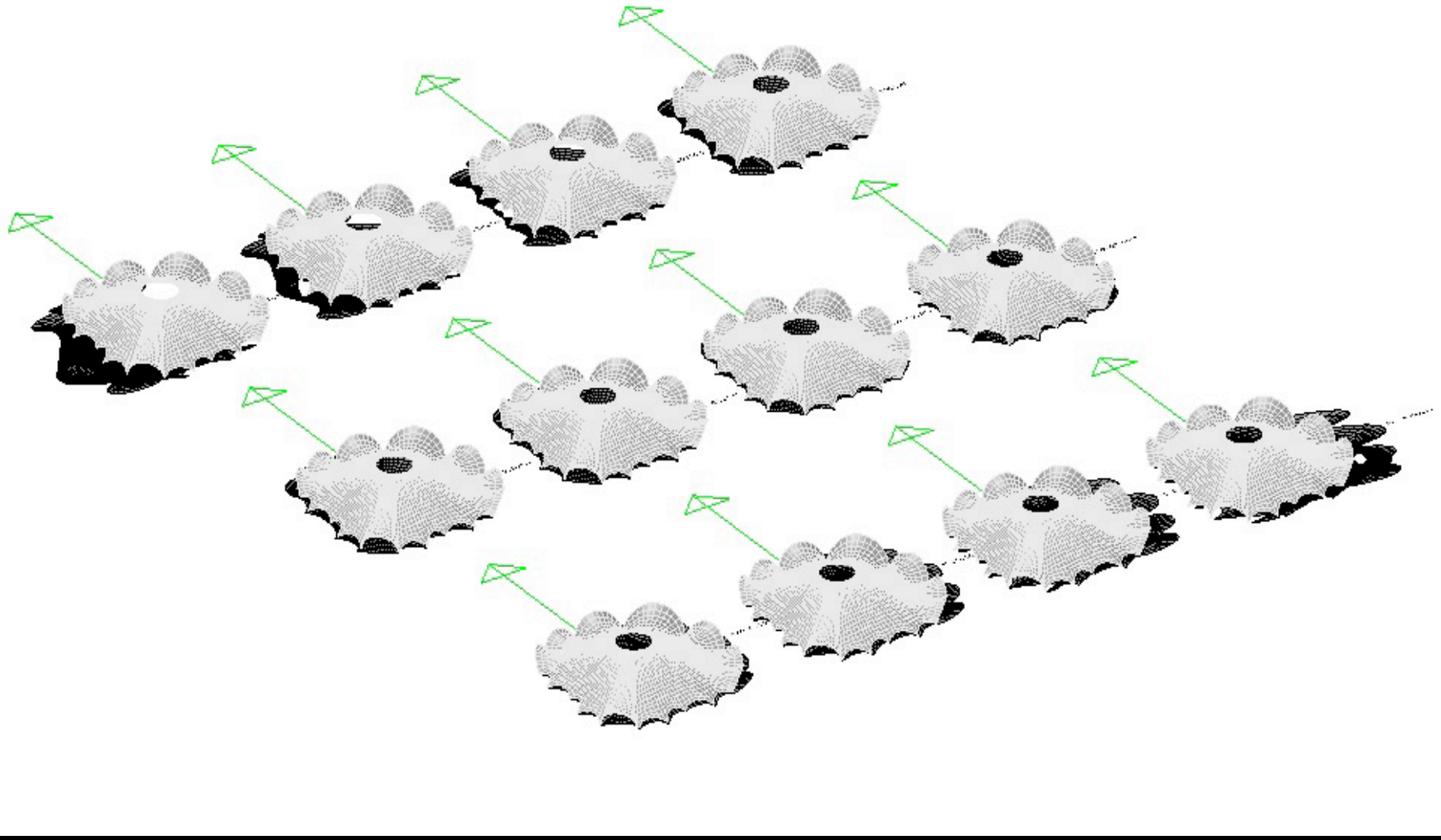




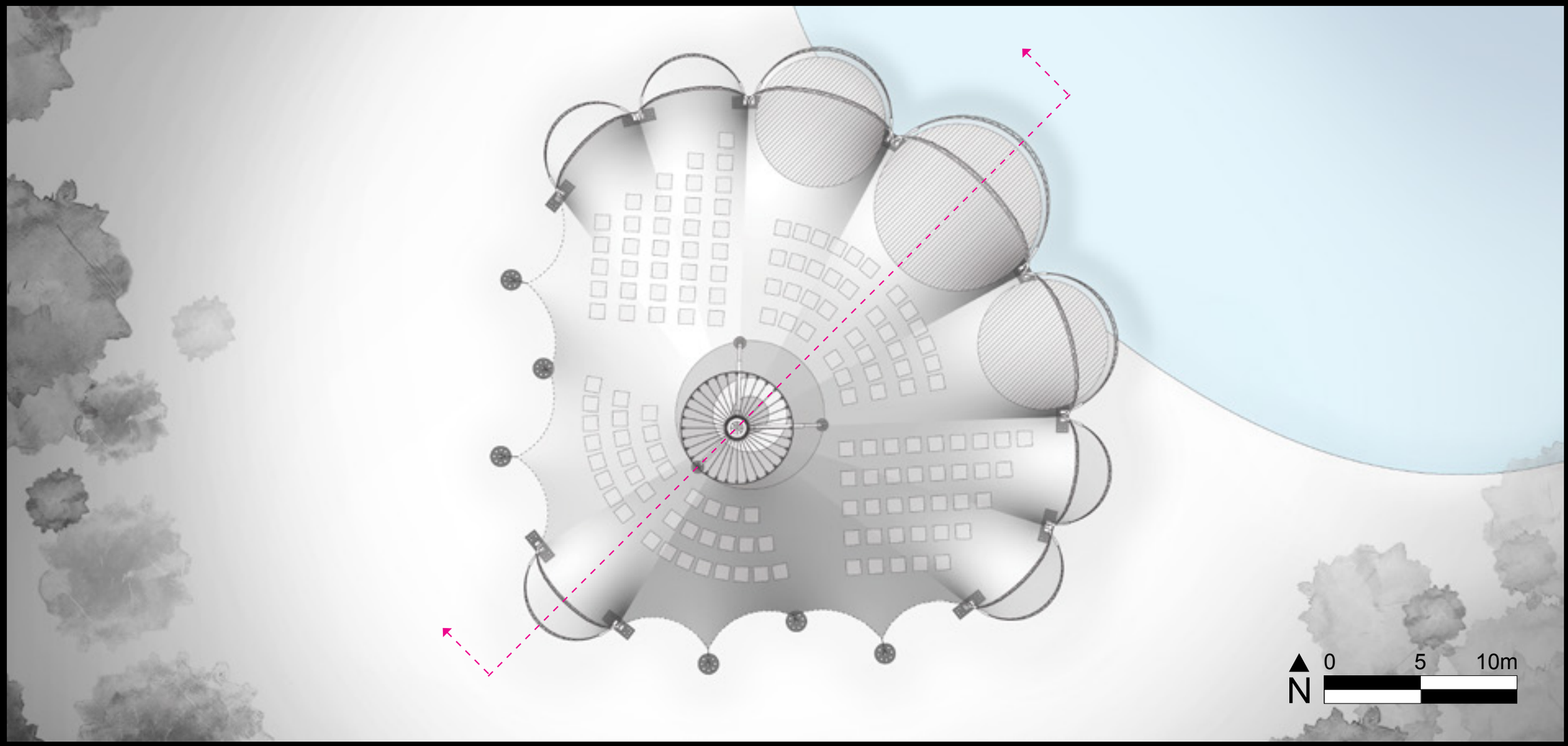
Left: Blue=Bending. Pink=Tension. **Right:** Materials Top-Down: Aluminum, PTFE coated glassfiber, acrylic, hollow steel stakes.



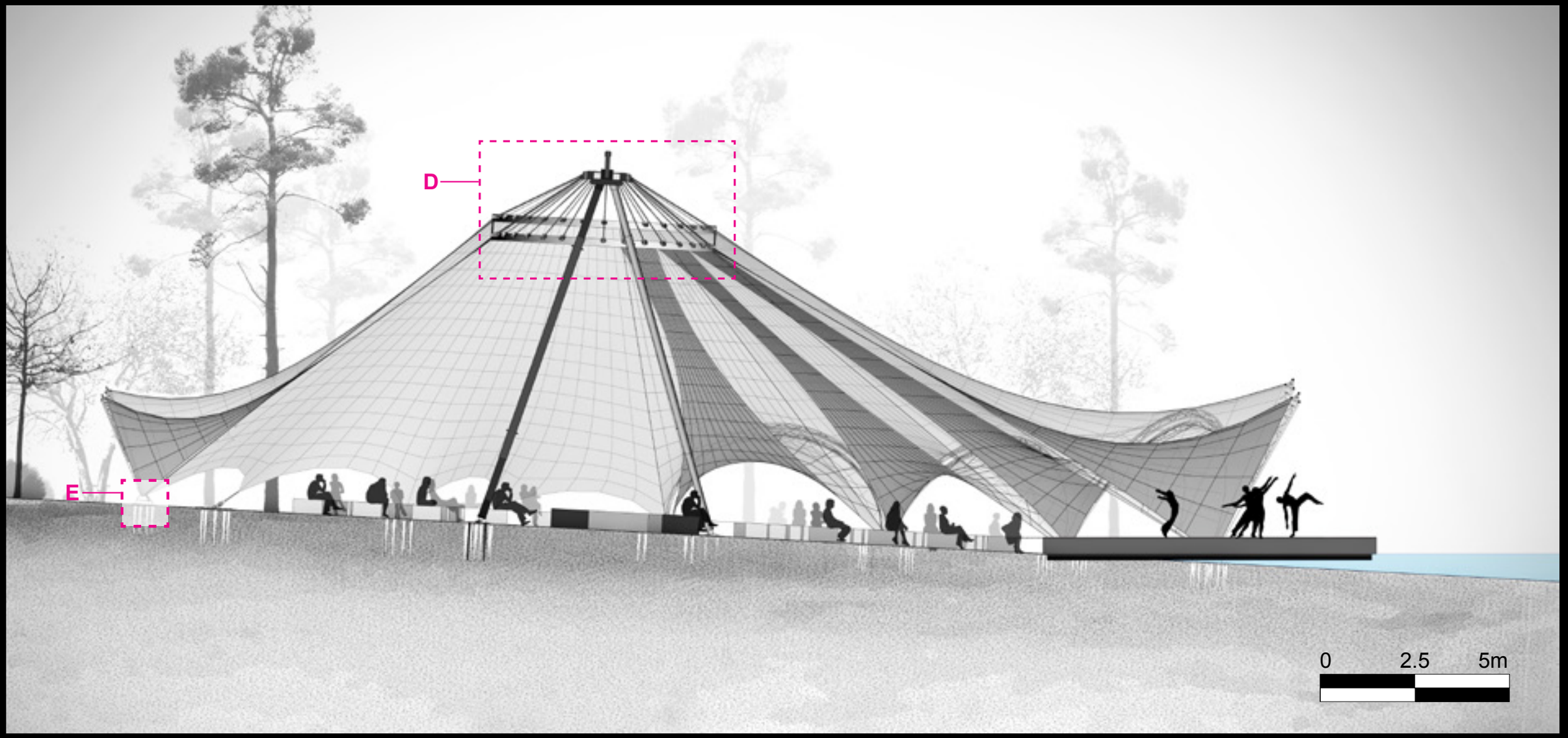
Left: Mesh Height. **Middle:** Mesh Gradient. **Right:** Mesh Curvature.



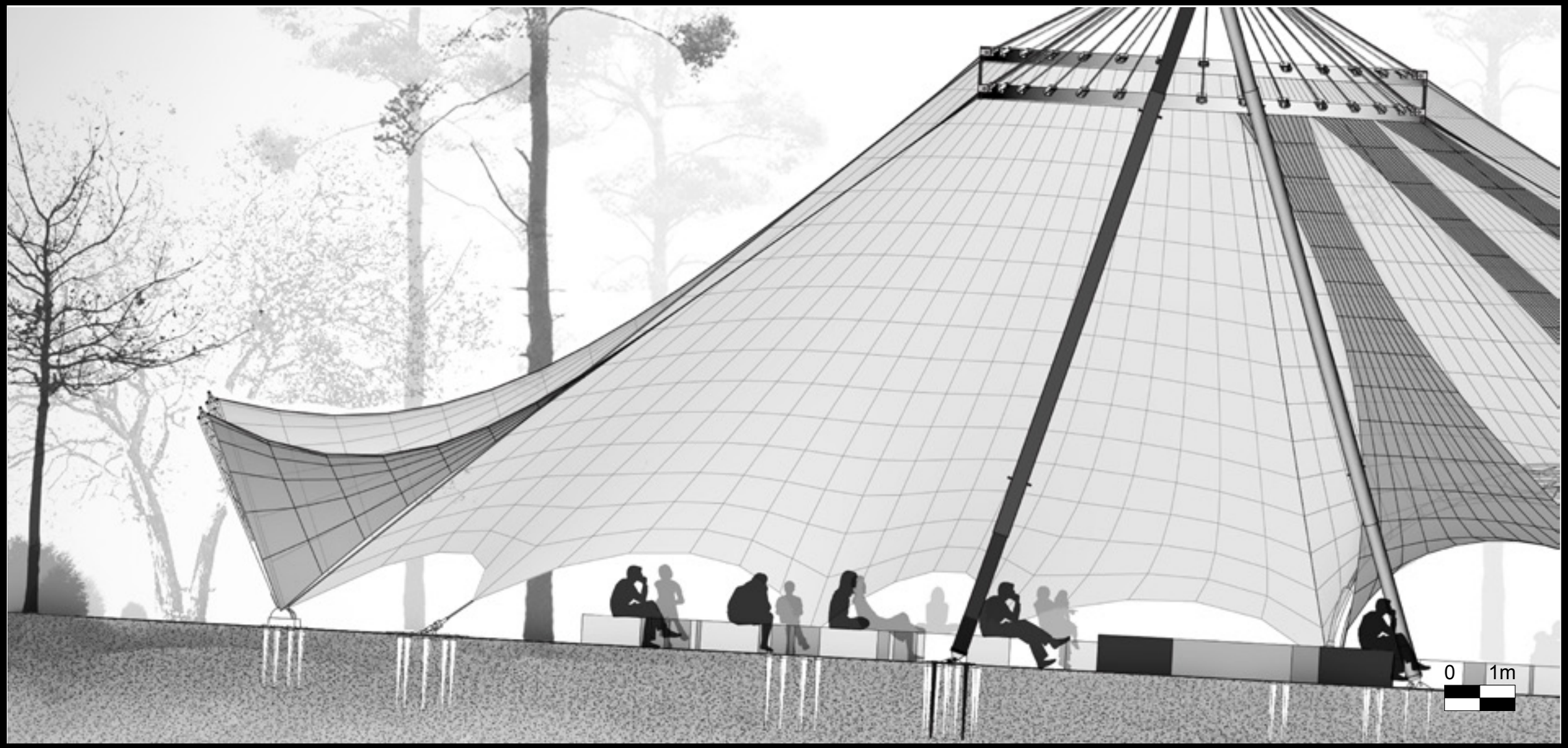
Sun Simulations: Over a 12-hour time period in June.



Above: De Theatertent, Plan.

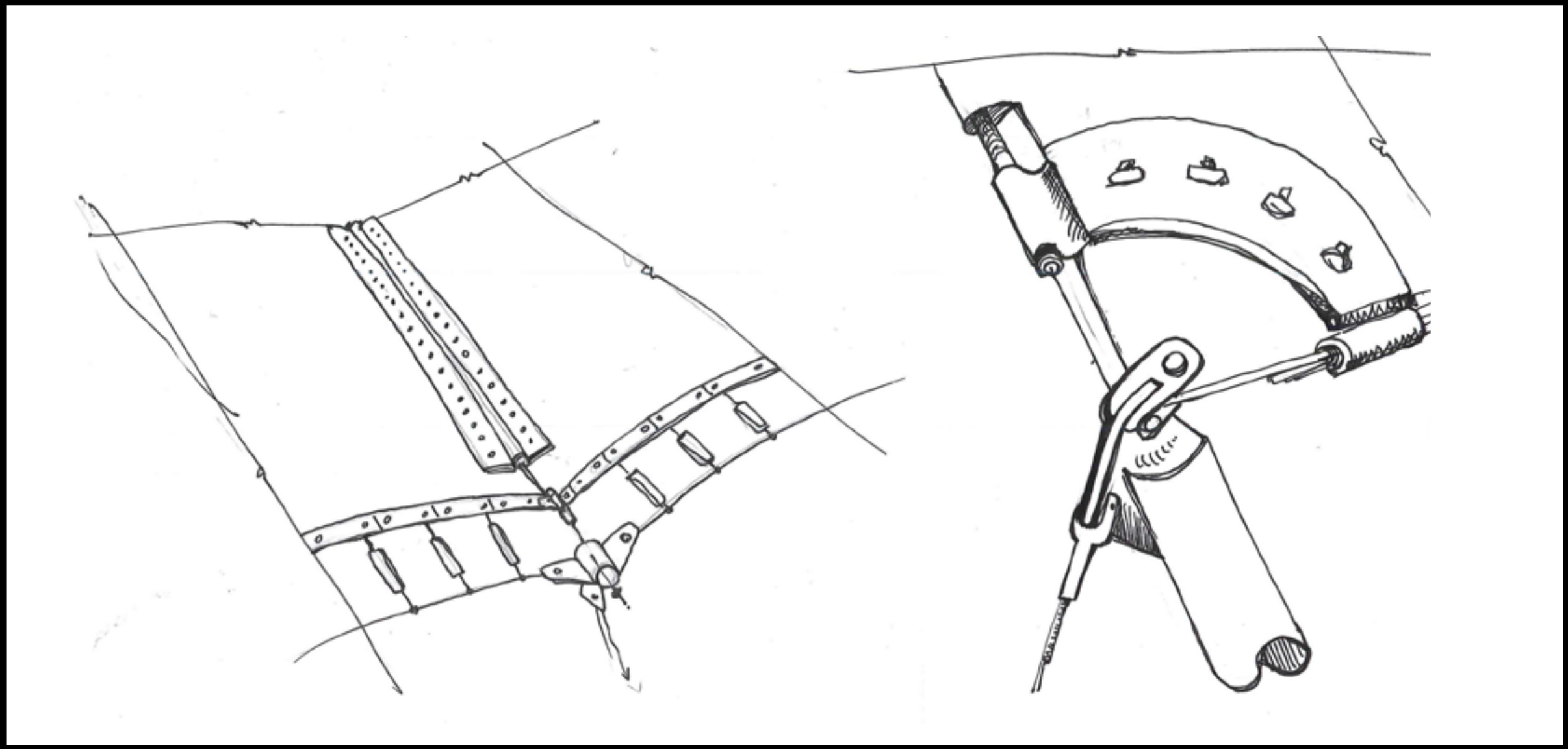


Above: De Theatertent, Section.

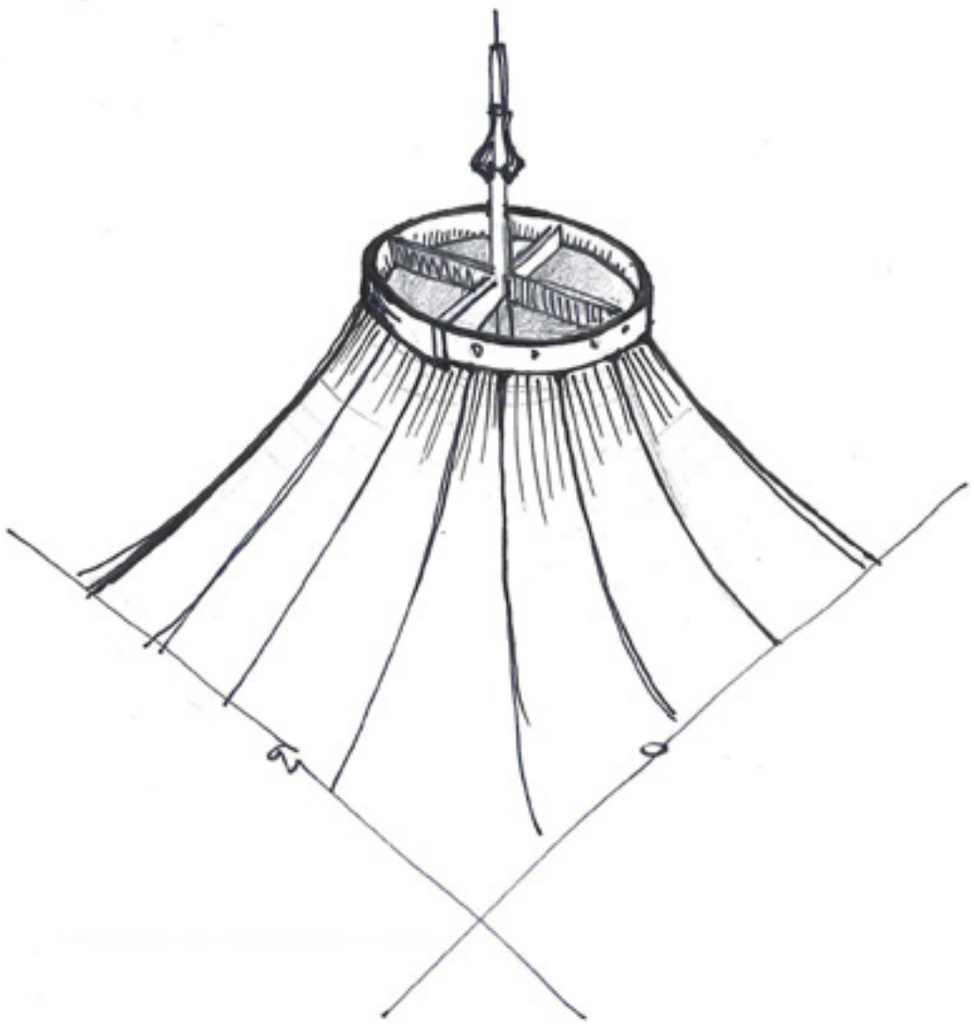


Above: De Theatertent, Section.

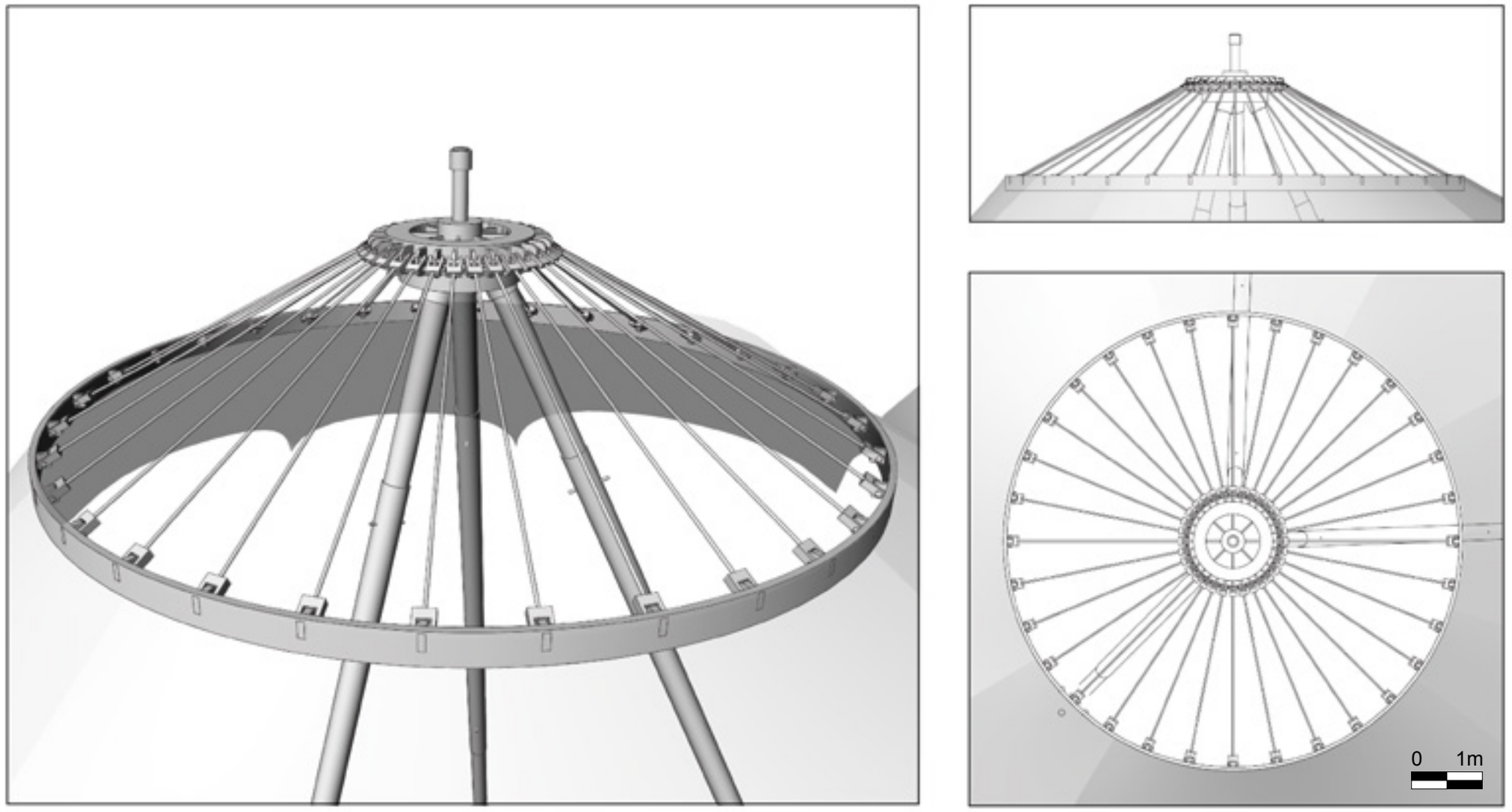
Early Details



Left: Adjustable Valley Cable. **Right:** Clamped Corner Plate with Adjustable Cables.

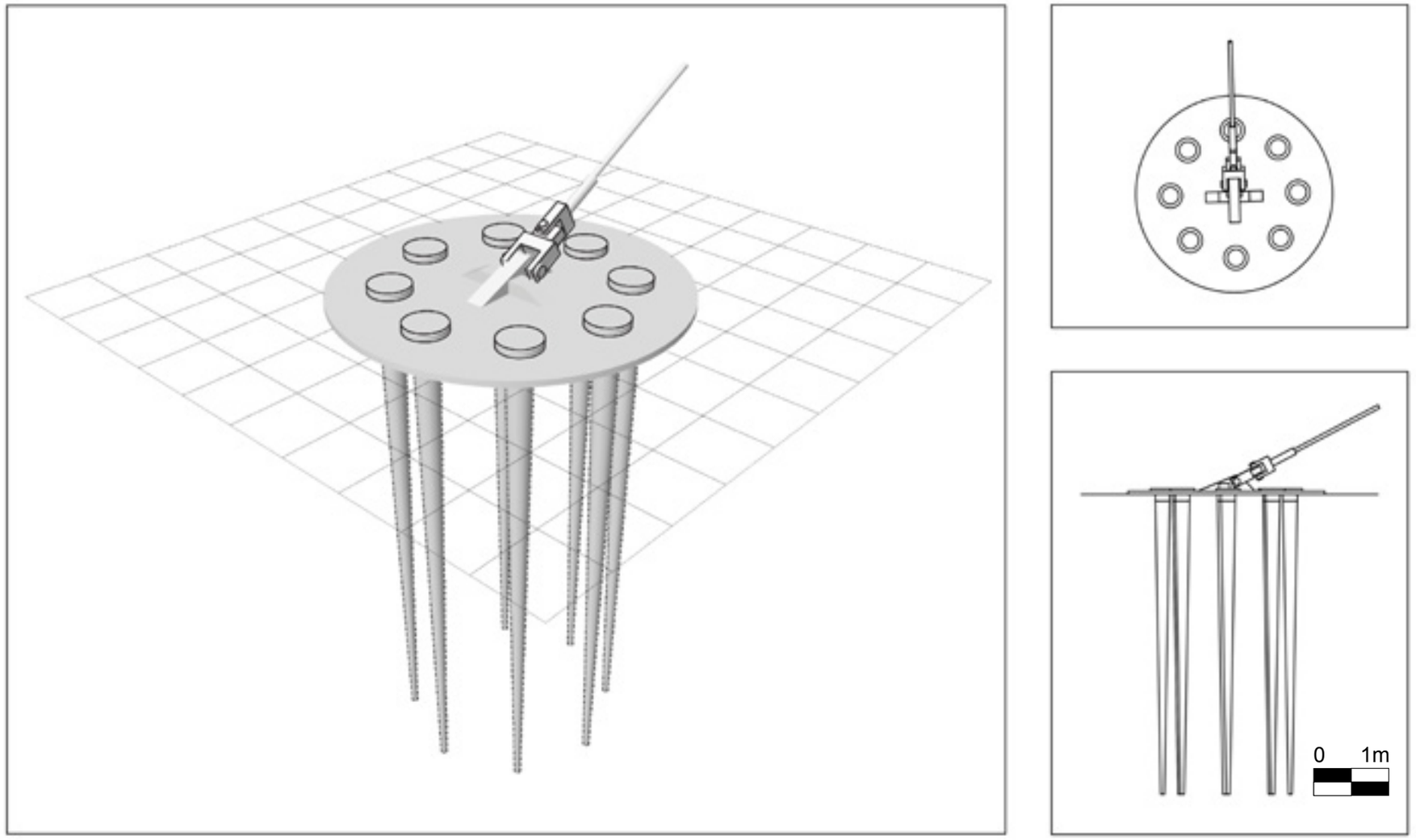


Left: Bale Ring. **Right:** Butterfly Cable Loop.

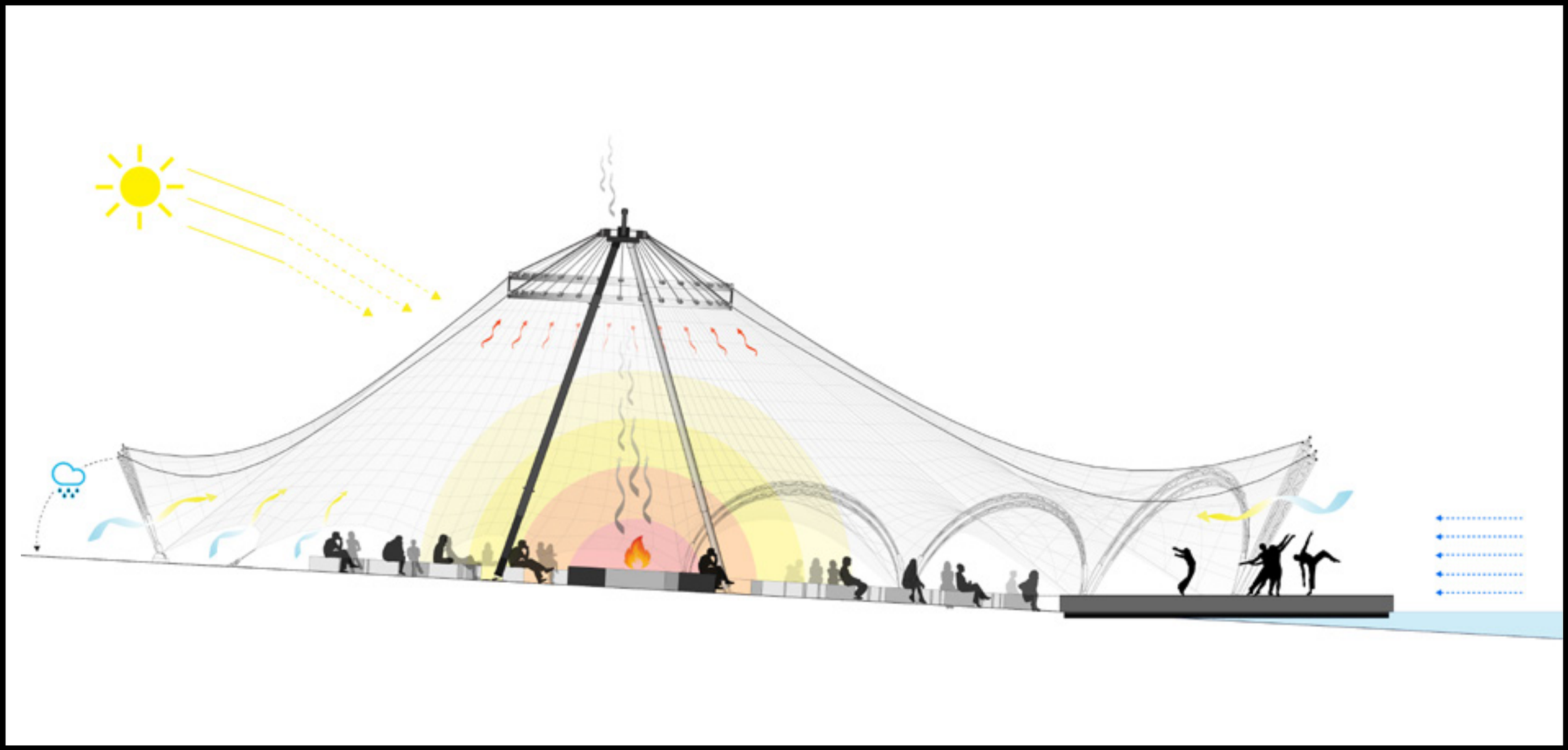


Detail: Top Ring with Tension Cables and Masts.

Detail E

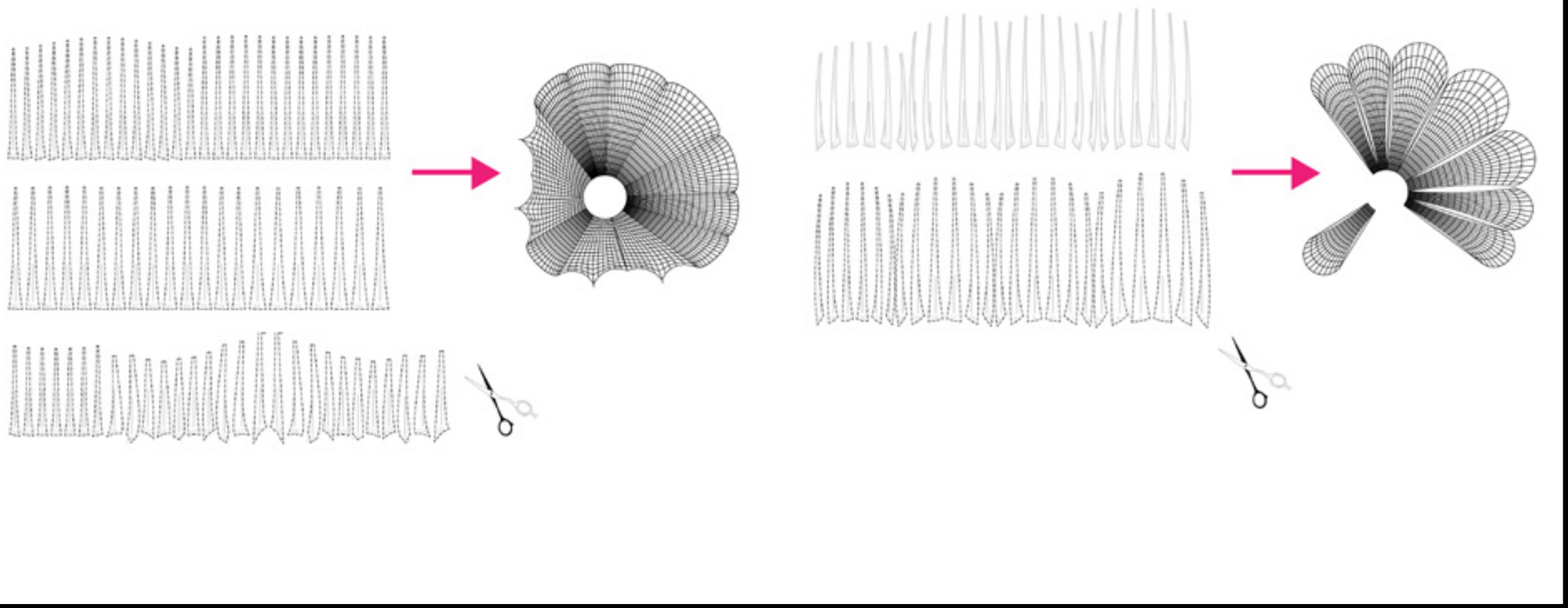


Detail: Ground Plate Anchor with Steel Stakes

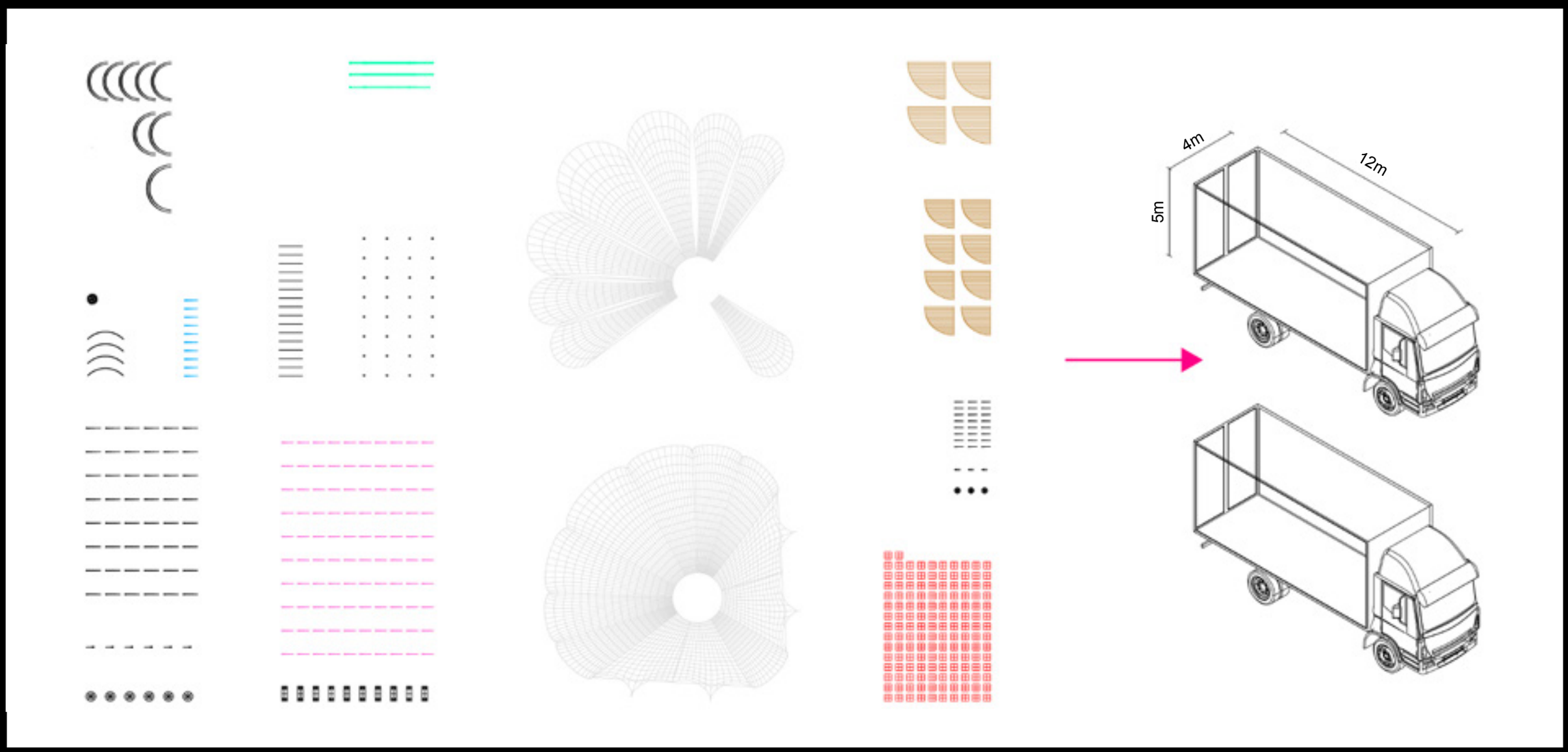


De Theatertent: Climate and Air Flows.

Cutting Patterns

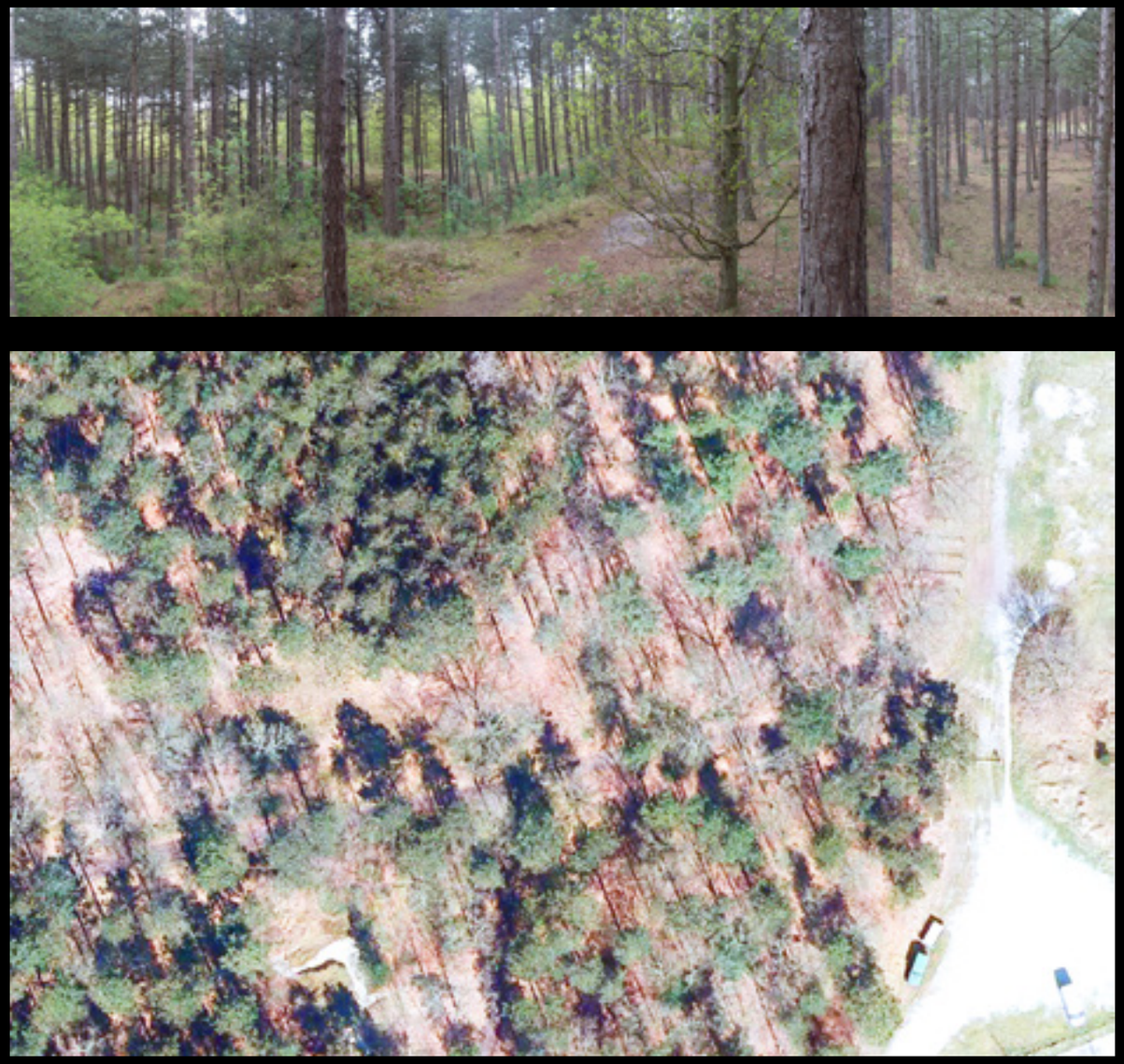


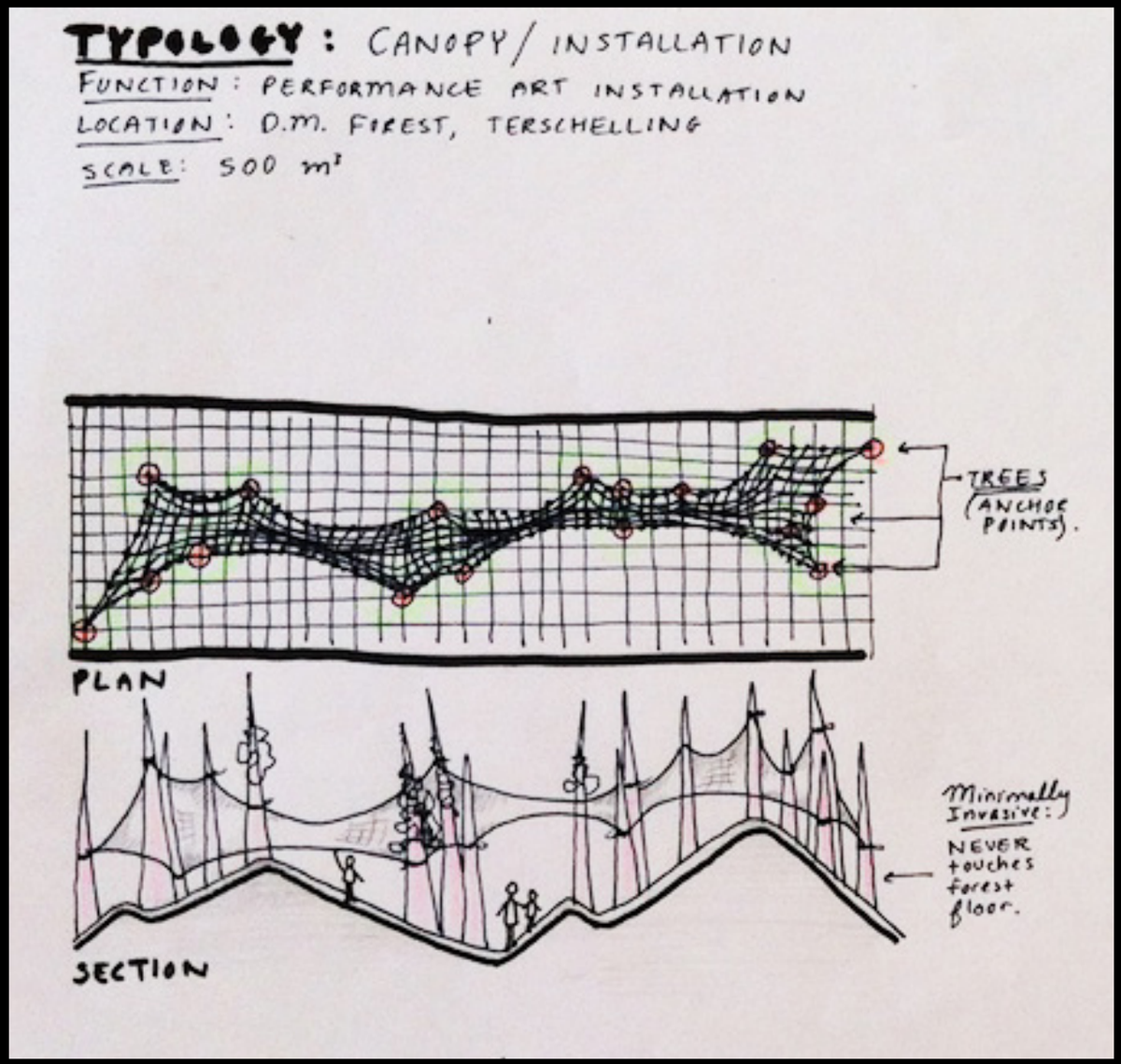
Cutting Patterns: Panels to be cut from flat fabric, pre-nesting.



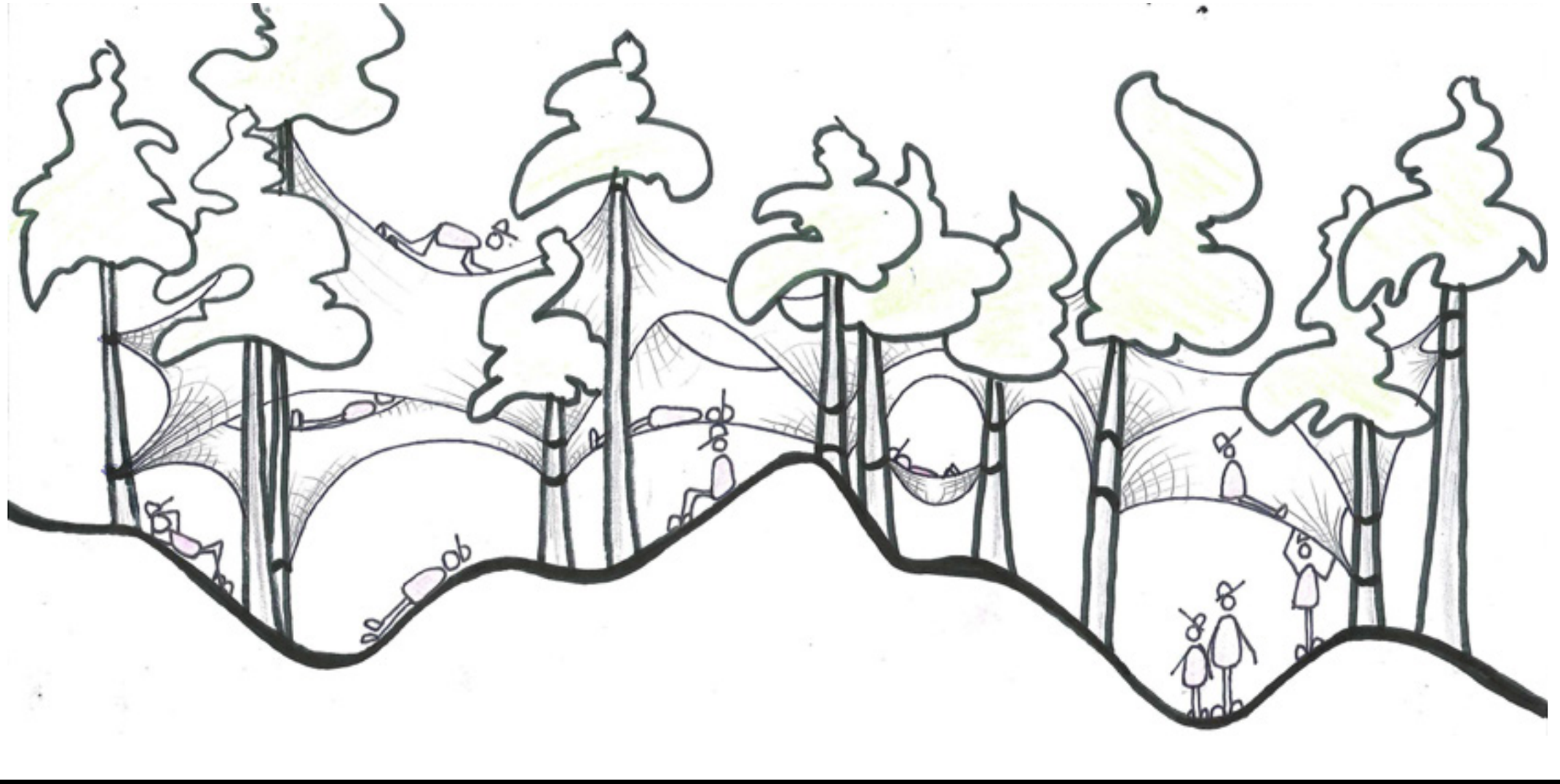
Mobile Design: All structural parts are estimated to fit into 1-2 standard EU trucks.

The Problem

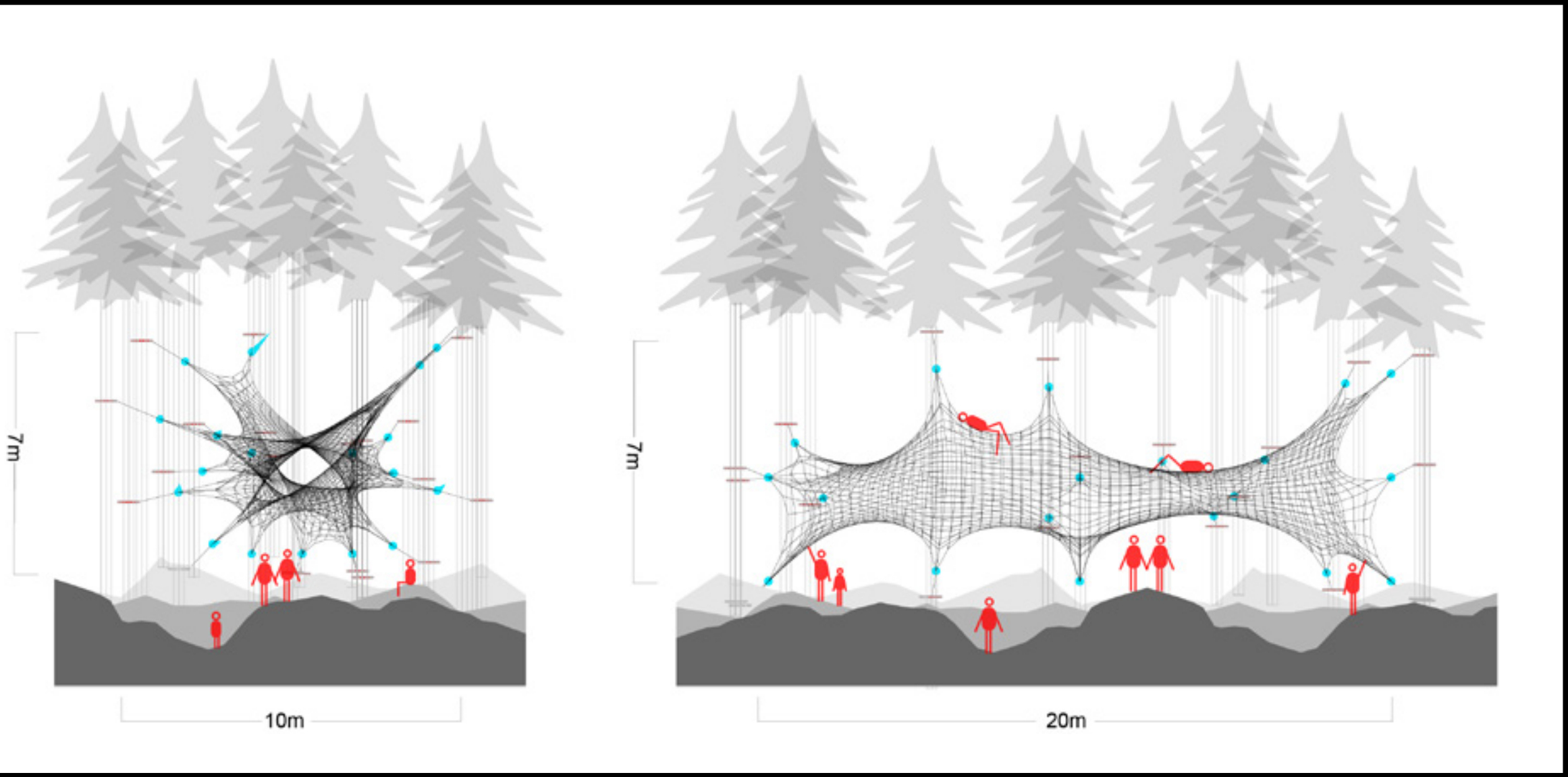




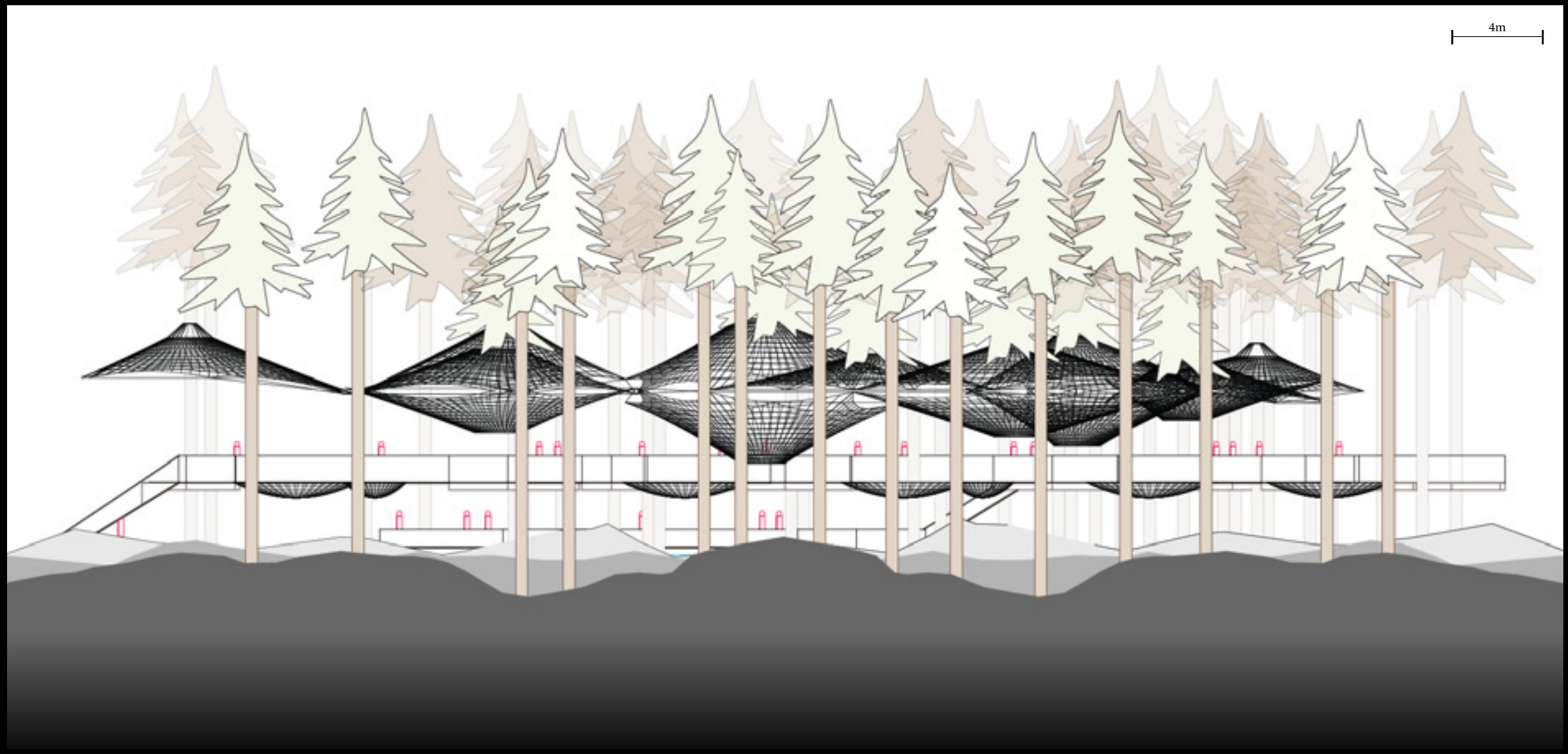
Left: Problem: Protected Duinmeertje Hee Forest. **Right:** Solution: Minimally Invasive Installation.



Early Design: Interactive Installation.

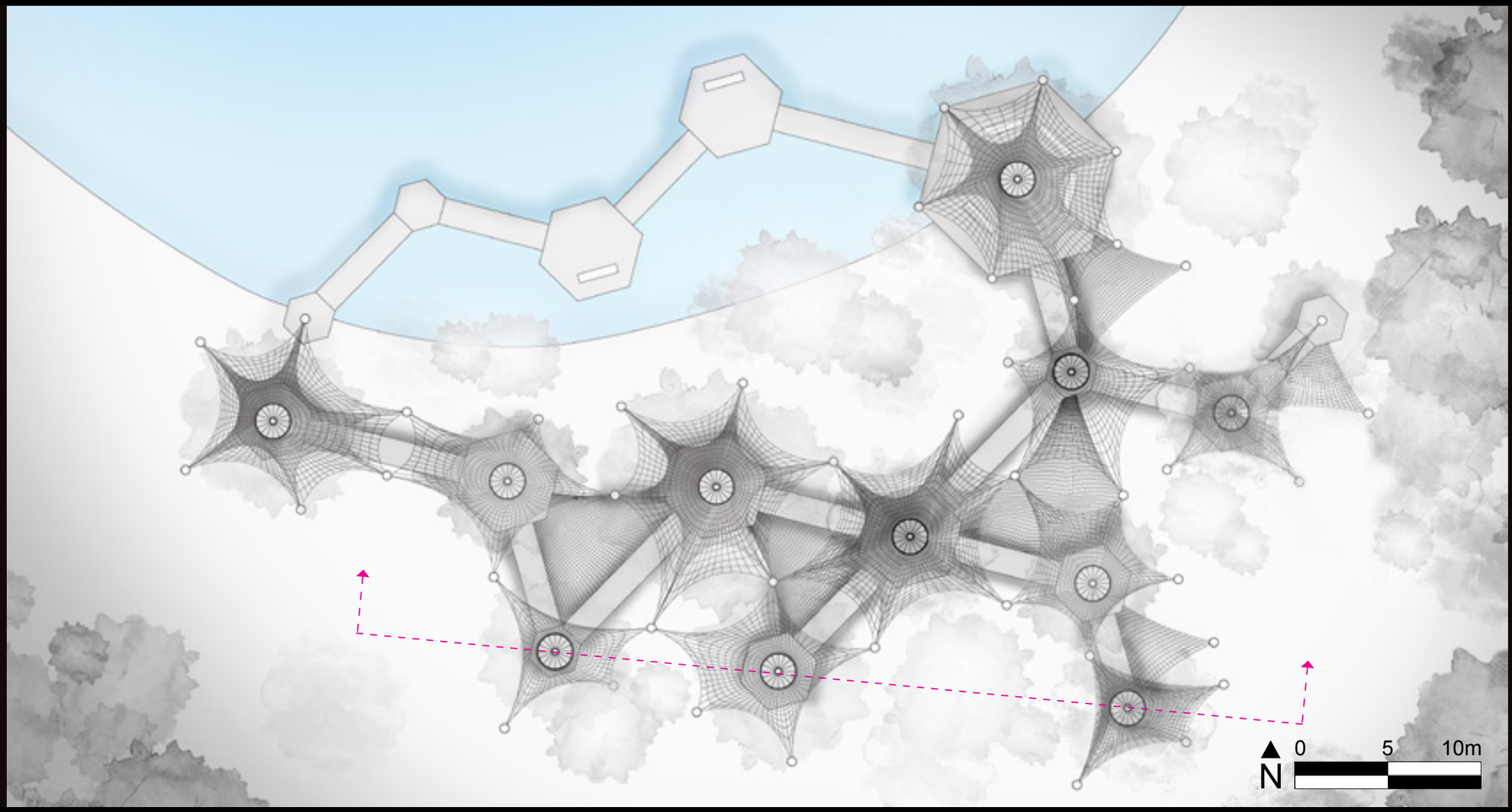


Early Design. Left: Installation, Front Elevation. **Right:** Side Elevation.



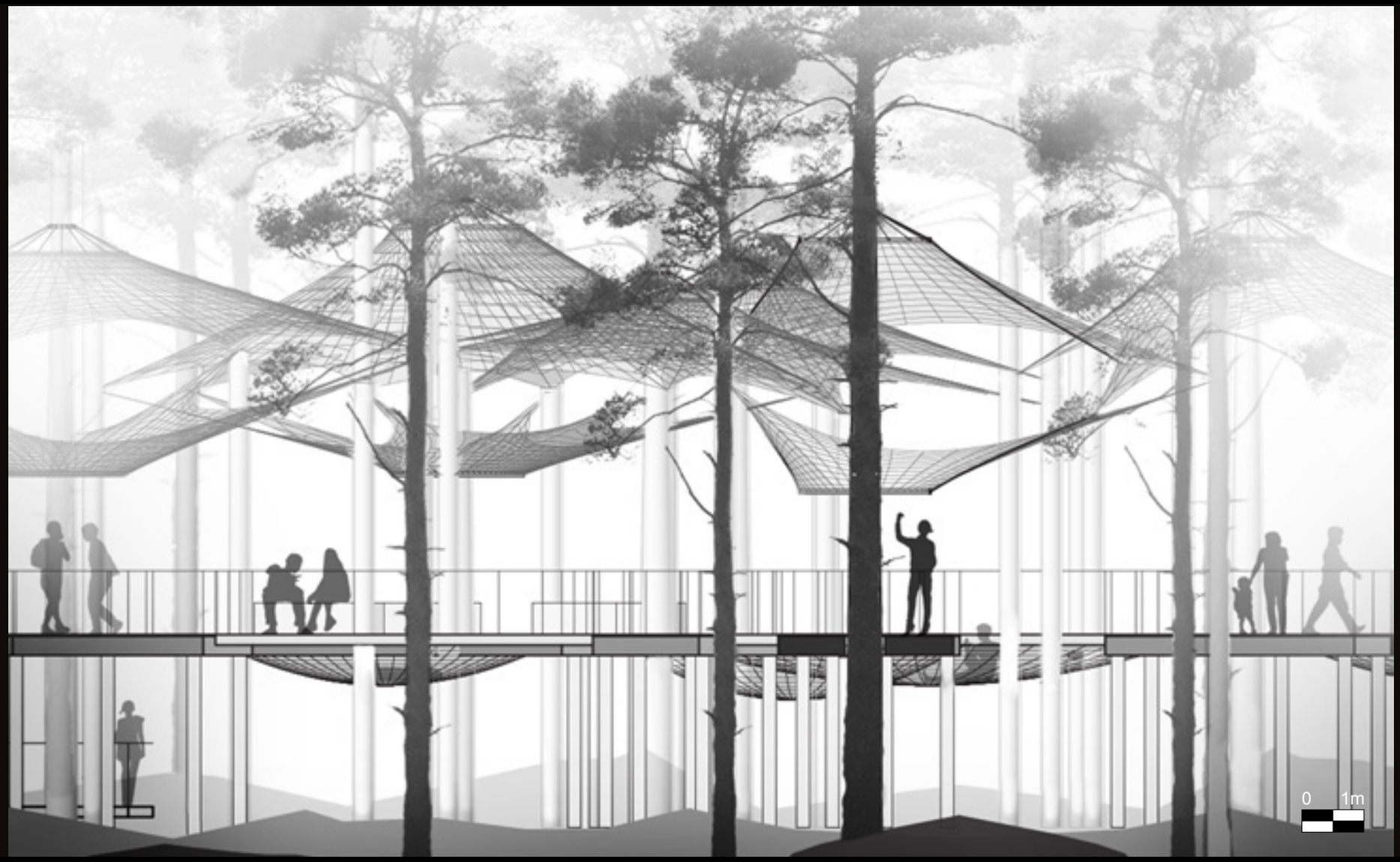
Early Design: Installation, Side Elevation.

Early Design: Interactive Installation.



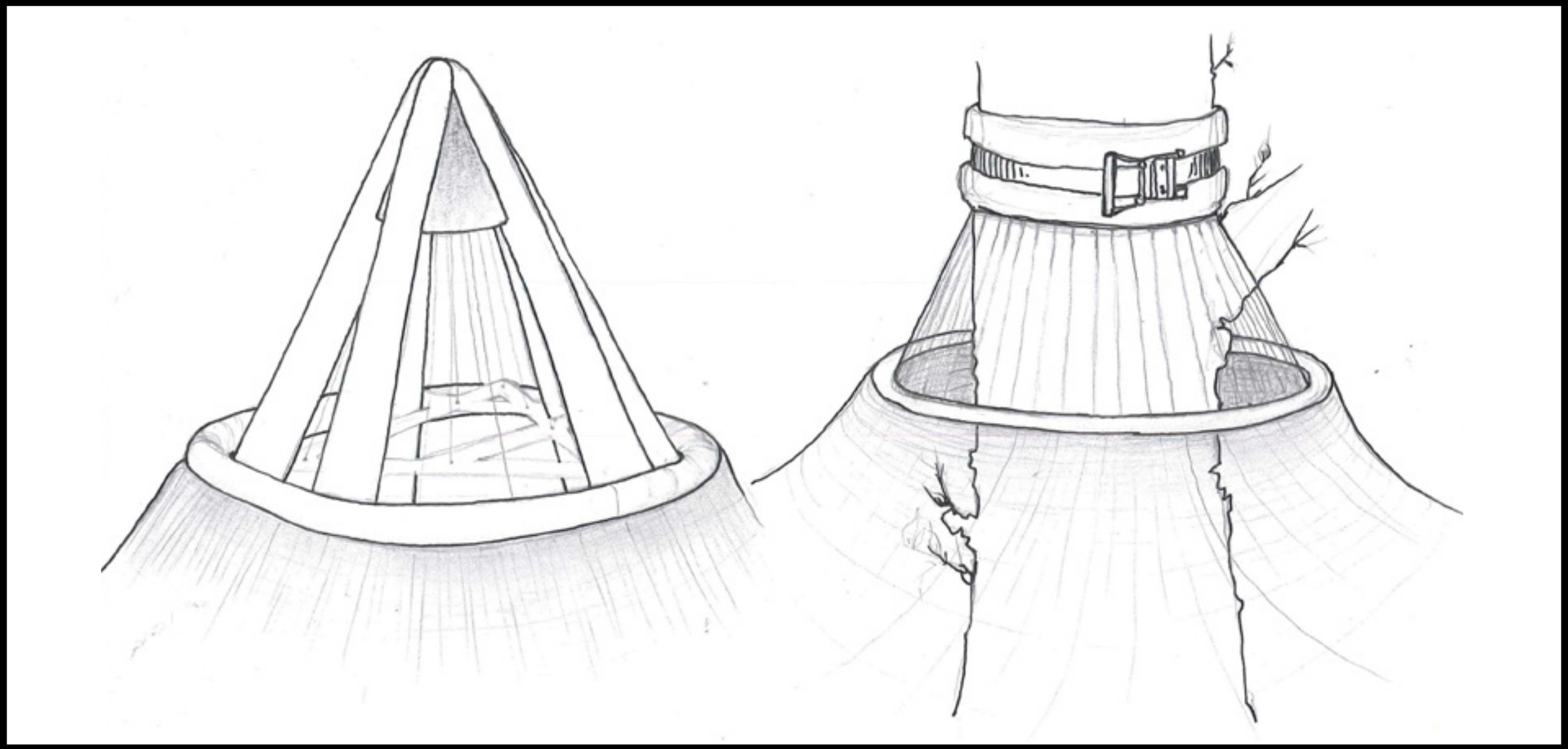
Above: Het Klimbos, Plan.

Above: Het Klimbos, Section.

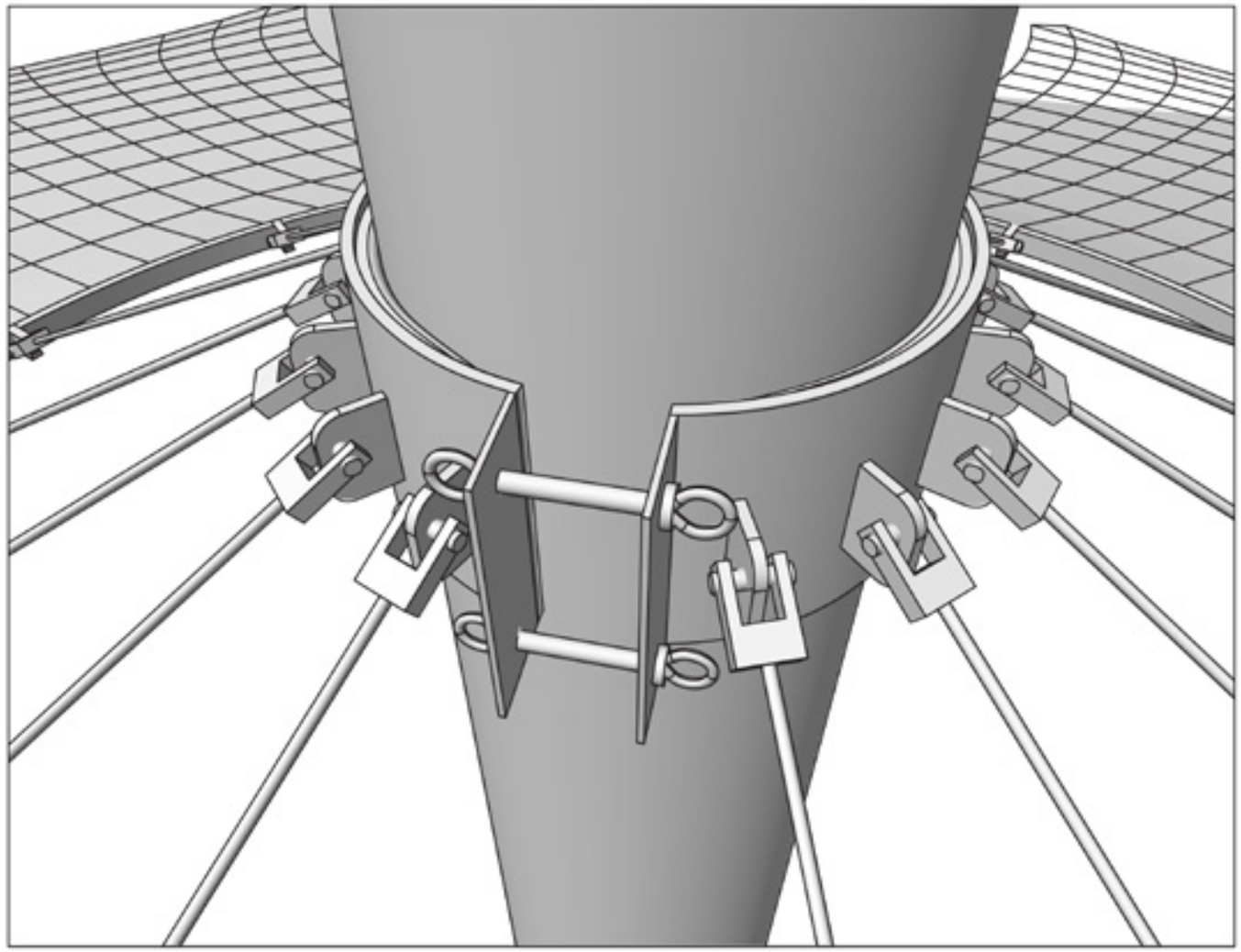


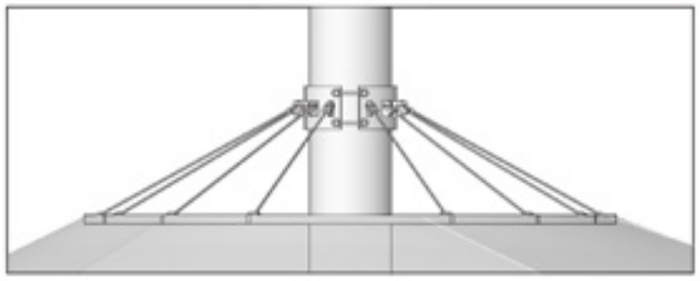
Above: Het Klimbos, Section.

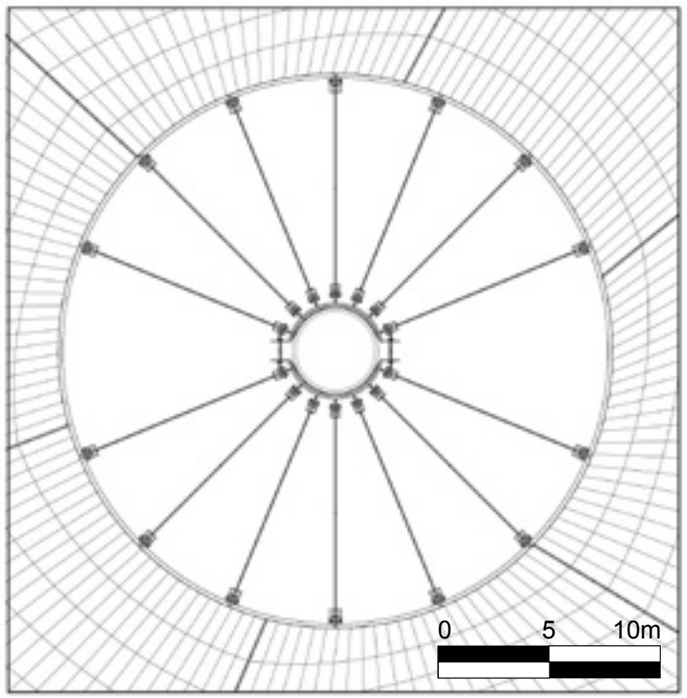
Early Details



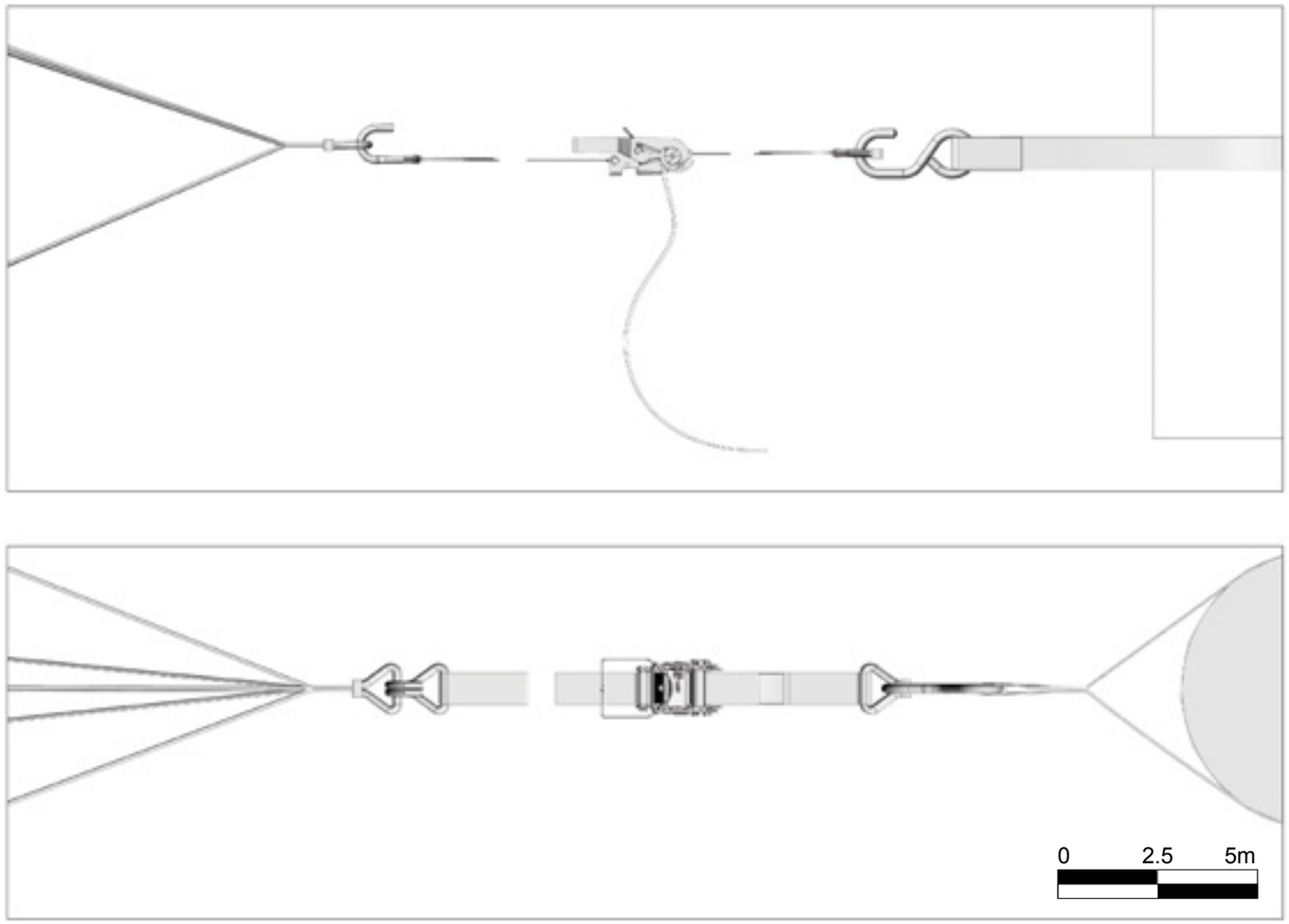
Early Details. Left: Cap Connection. **Right:** Tree Connection.



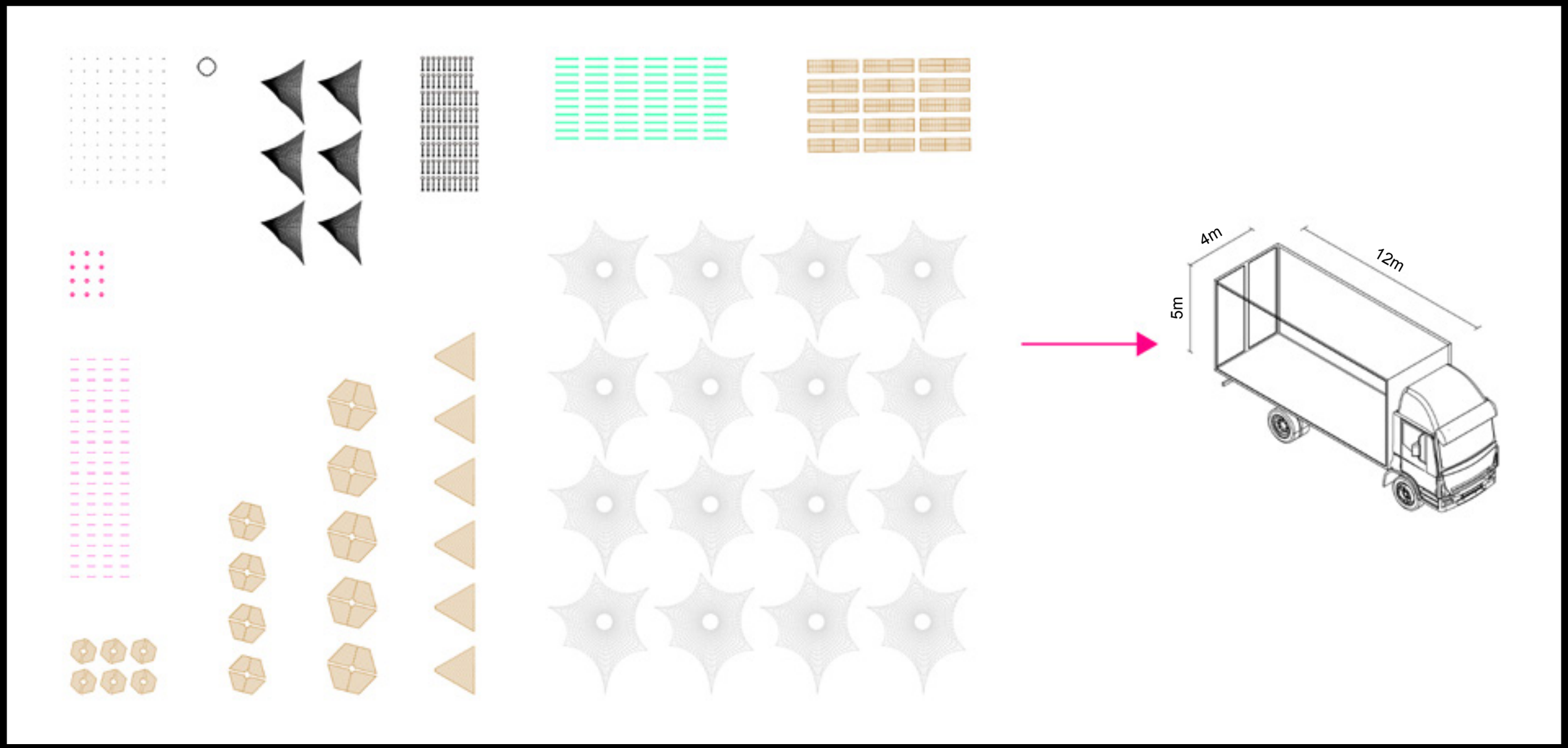




Detail: Tree Connection for Lightweight Catenary.

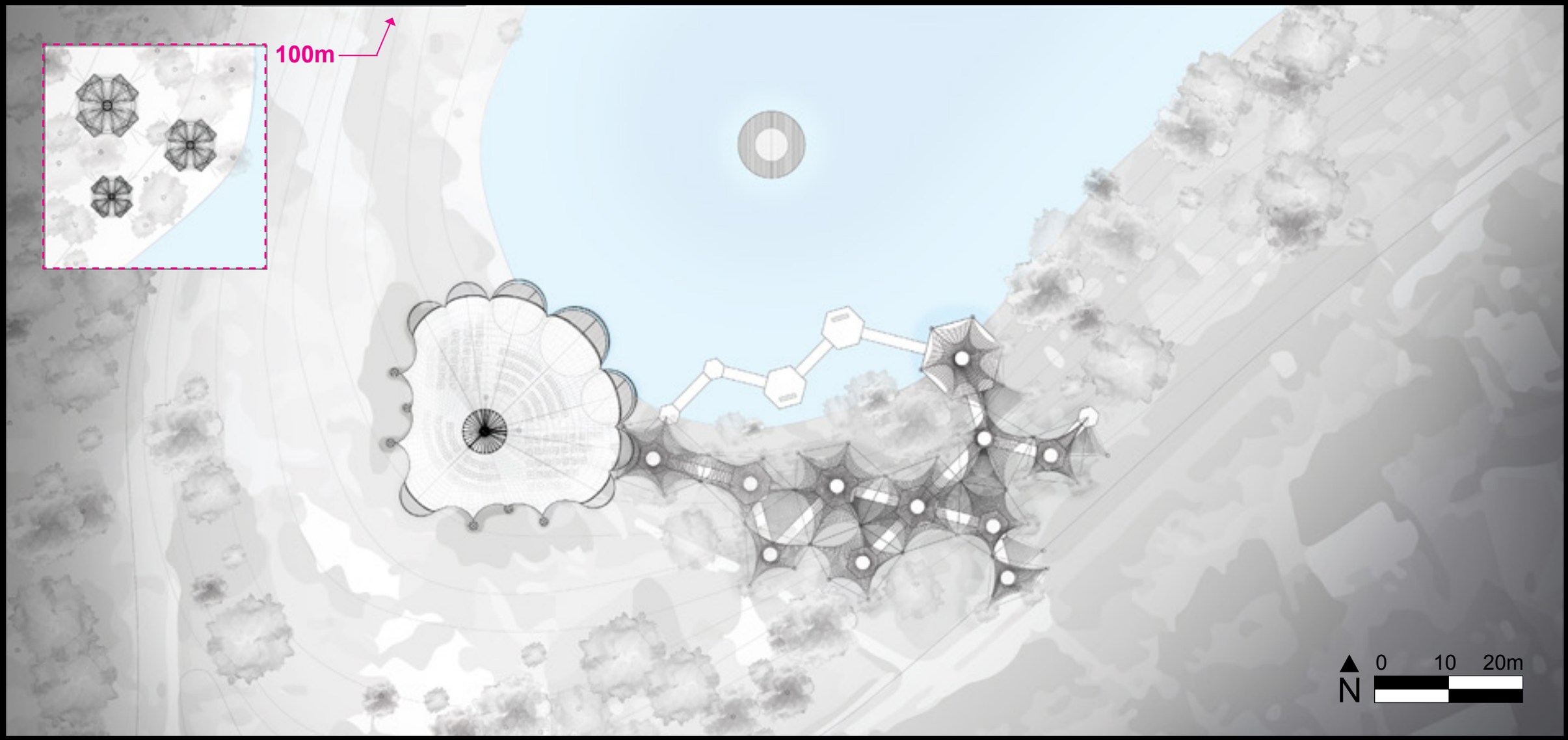


Detail: Adjustable Cable Connection with Tree.



Mobile Design: All structural parts are estimated to fit into 1-2 standard EU trucks.

Landschapskunsten En Locatietheater



Landschapskunsten en Locatietheater: Site Plan.

Landschapskunsten En Locatietheater

Landschapskunsten En Locatietheater

Landschapskunsten En Locatietheater

Landschapskunsten En Locatietheater