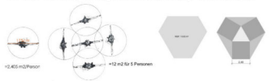
SELF SUFFICIENT DYNAMIC LEVELING

MOBILE FOREST FIELD STATION



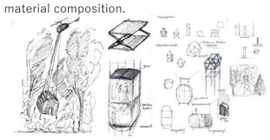

The task of the semester project was the design of a mobile, minimally invasive, and self-sufficient research station for forest studies, developed individually with a focus on energy management and reusable construction systems.

The first step was to determine how much space and which functions were required and had to be accommodated, and what basic equipment and supplies would be necessary for one week off grid. To estimate the required spacial dimensions, measurements of the human body served as key indicators.



Furthermore through research on nomadic tent structures and on-site laboratories, the spatial configuration and overall functional areas were analysed and defined. The limited transportation possibilities such as a bicycle, a helicopter, the human body and drones were evaluated, resulting in a maximum weight indicator for both the structure and the equipment.

For the structural system and overall design, different approaches were considered, for example a suspended framework, a foldable structure, a pre-build module to be placed on site or a free-standing framework. As references, structures and approaches from camping gear, astronautics, tiny houses and art projects provided helpfull input and encouraged an open-minded approach to construction. Based on the same research backround, materials as well as construction details were developed. From all the gathered information, precise calculations could be carried out for the load-bearing structure and material composition.



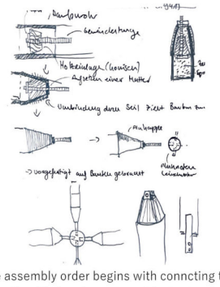
The final design considers a free standing structure due to numerous advantages, including the ability to adapt to different tree species without causing damage, as well as flexibility for various forest environments, user sizes, reusability and ease of assembly and disassembly.

It is based on a triangular structural framework, consisting of bamboo poles in combination with stainless-steel joints, which get prefabricated. Enclosed by a nylon–aerogel membrane on the first level, the station remains habitable throughout the year. The vertical configuration, rising 11 meter in height, enables research along the entire tree profile. Research platforms, formed by a tensile net structure with climbing devices, can be mounted at varying levels, allowing adaptation to different tree morphologies.

The overall structural weight is limited to approx. 500 kg, allowing minimal invasive transport to any location by cargo drones, which are also used as assist for on-site assembly. The design further ensures autonomous basic supply: water bags for rainfall integrated beneath the research nets, photovoltaic nets deployed by drones in the canopy, and thermal curtain systems secure year-round functionality.

Going into the construction and assembly details, the key construction detail is a stainless steel junctiore inspired by the Conbam joining technique.

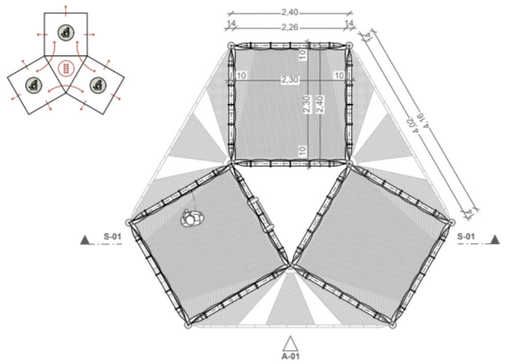
Bamboo of a certain minimal thickness is cut open on the ends and filled with a bearing pin embedded in epoxid plaster and tied to a coan shape at the ends by steel wire, which can be pinned into a connecting ball joint.



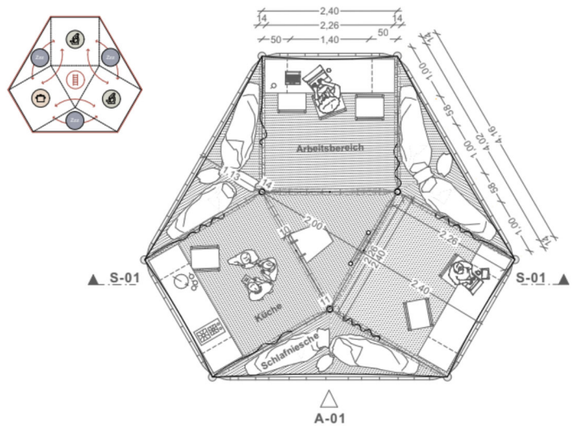
The assembly order begins with conncting the joints level by level, starting with pinning them into base feet, which spread the weight of the structure to preserve the forest ground.

On the first level the tent structure is layed out. From there the level gets build from inside, similar to a tent, stretching out the fabric to create a hollow space. The tent bottom is flattened by three-layered slab.

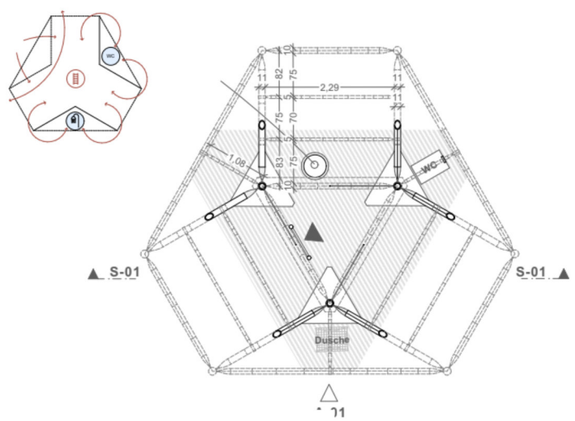
After that, the openings get closed by hatches and the next levels can be build up to the top. When assembled, the structure has to be anchored on three points to tree bases close to the ground as safety anchor. Later, the add ons can be installed.



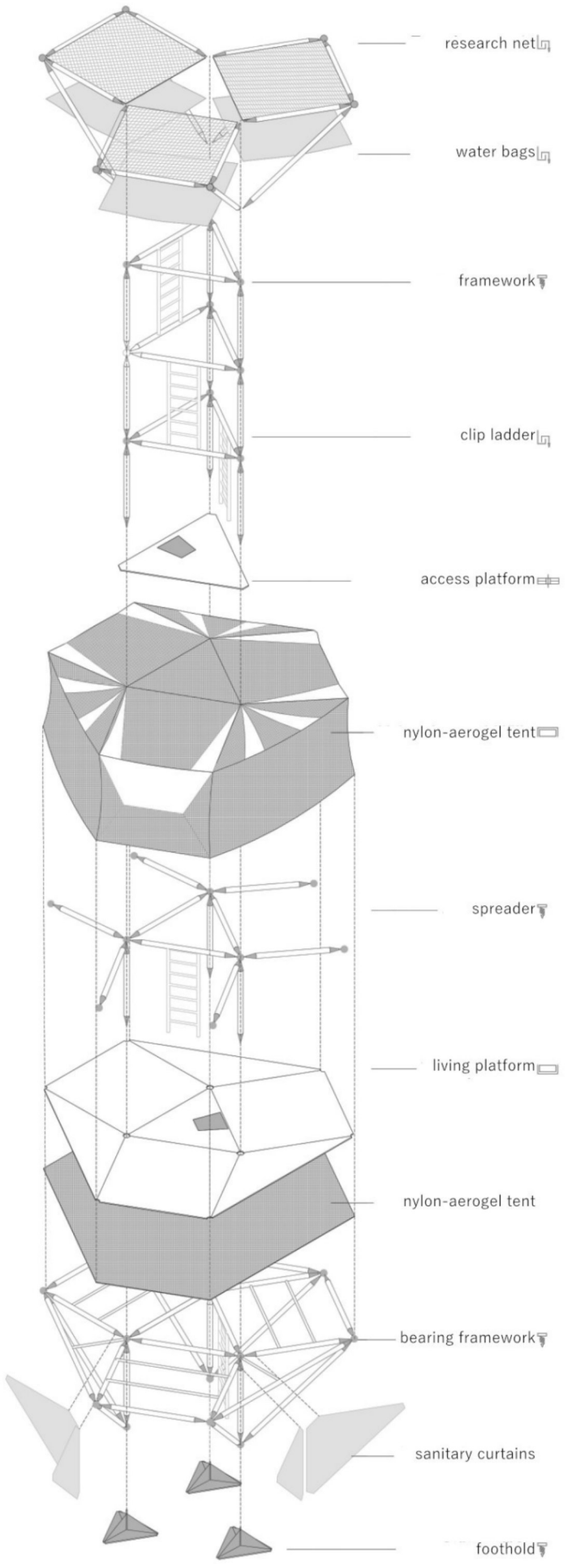
M 1:50 level 5

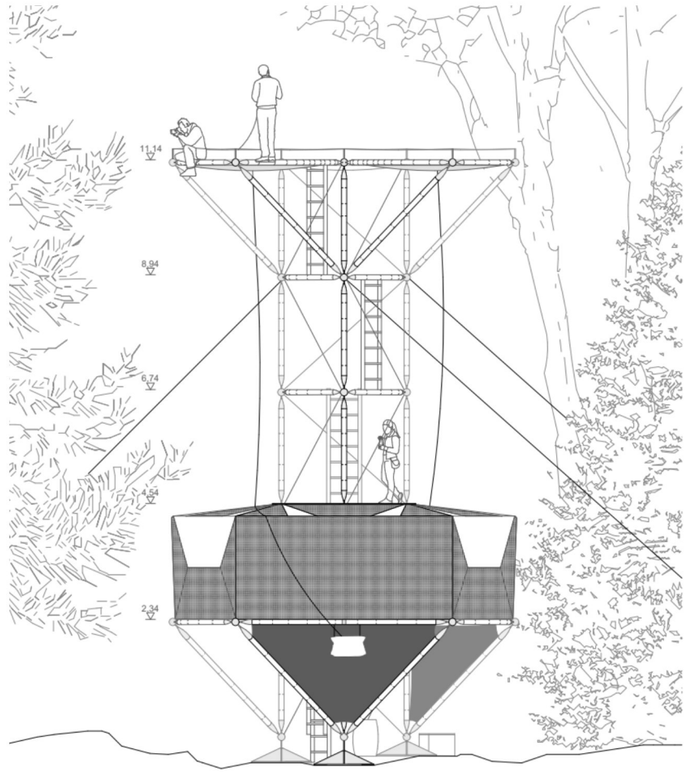


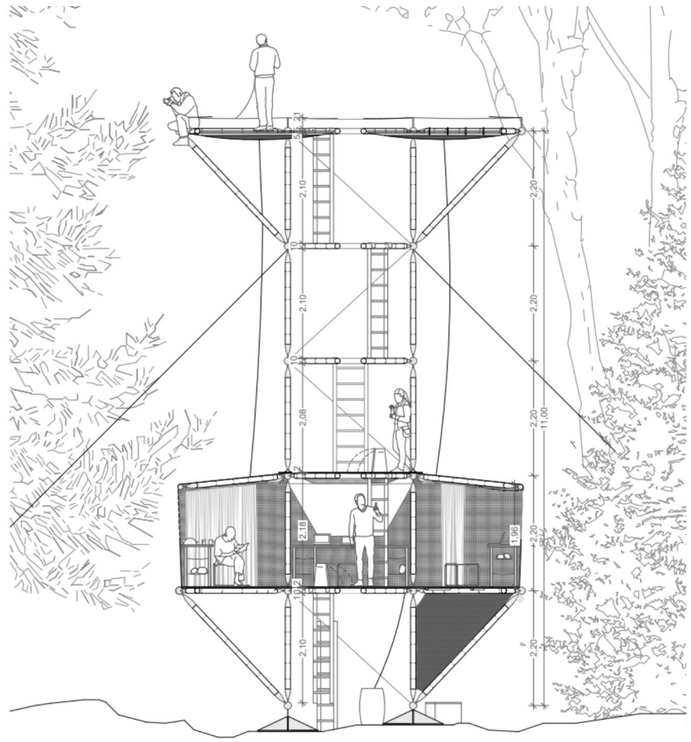
M 1:50 level 1

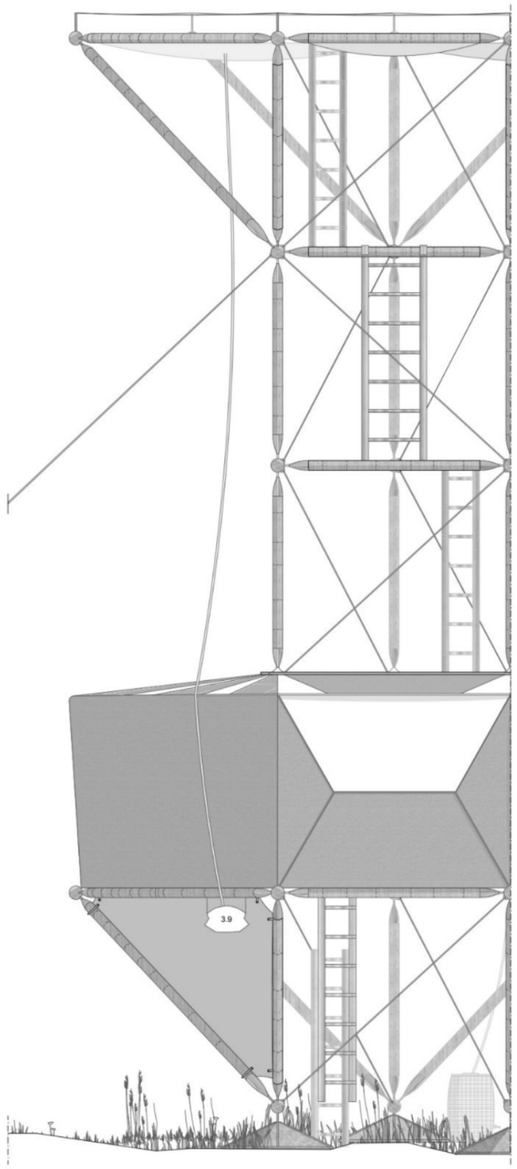


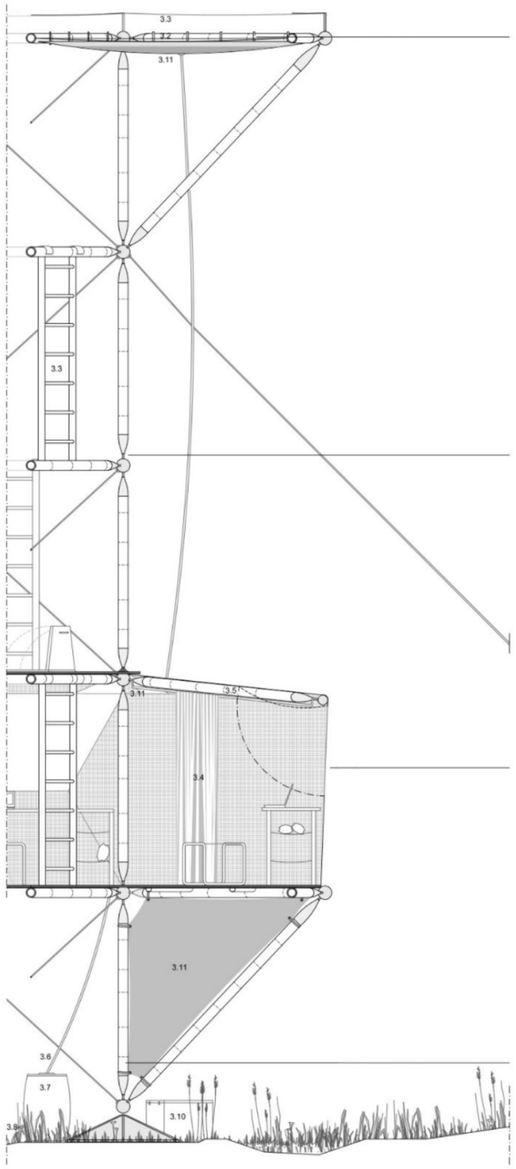
M 1:50 level 0











research platform

-variable height
-allows free movement
-climbing saftey gear
-water bags placed underneath

bamboo framework

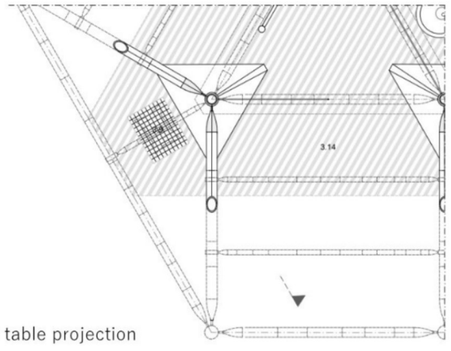
-variable heights for platforms
-access via clip ladder

tent platform

-surrounding tent cover

sanitary level

-compost toilet and shower
-water and energy storage
-privacy prossible through curtains



M 1:20 table projection

1 Tragwerk

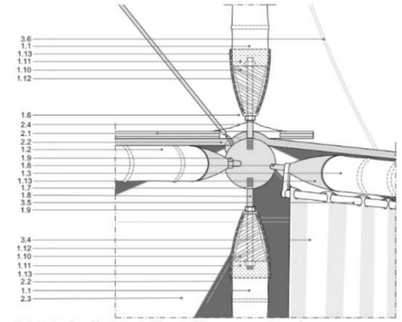
1.1 Stütze, d110, Bambus behandelt
1.2 Träger, d100, Bambus behandelt
1.3 Spreitzstab, d100, Bambus behandelt
1.4 Querträger, Bambus, d110
1.5 Stützenfuß, 1080/1080/1080/400, Stahl verzinkt
1.6 Druckstab, d10, Stahl
1.7 Verbindungsknoten, d140, Edelstahl
1.8 Lagerbolzen, M16, 250mm, Edelstahl
1.9 Mutter, M16, Edelstahl
1.10 Formholz
1.11 Epoxidmörtel
1.12 Stahldraht
1.13 Alukappe

2 Hülle

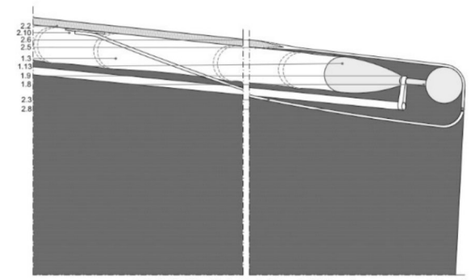
2.1 Drei-Schicht Massivplatte, 20,6mm, Bambus behandelt
2.2 Zelt, 20mm, Nylon-Aerogel
2.3 Fenster, 7mm, PVC
2.4 Abdichtung, 1mm, PE verklebt
2.5 Nylon, 0,5mm
2.6 Nylon, 0,1mm
2.7 Aerogeldämmung, 20mm, weich
2.8 Zeltstange, Aluminium, d7
2.9 Zeltstange, Aluminium, d14
2.10 Klettstreifen

3 Ausstattung

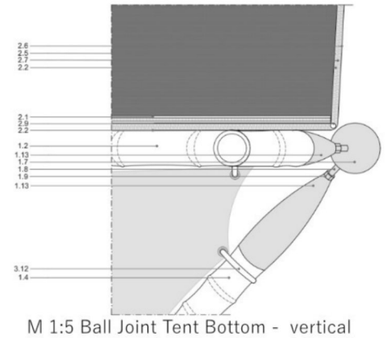
3.1 Einhangleiter, d70/d30, Aluminium
3.2 Bauschutznetz, d5, Polypropylen/Polysteel
3.3 Absturzsicherung, d10
3.4 Heizvorhang
3.5 Vorhanghalterung, d4. Aluminium
3.6 Wasserschlauch, d20
3.7 Wasserfass, 30L
3.8 Filterhahn
3.9 Duschbeutel, 10L
3.10 Trockentoilette
3.11 Plane,PE
3.12 Klettband
3.13 Wassertasche
3.14 Bambusmatte, als Lastverteilung für weiches Gelände



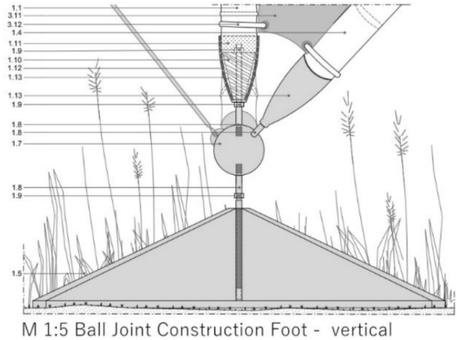
M 1:5 Ball Joint Tent Top - vertical



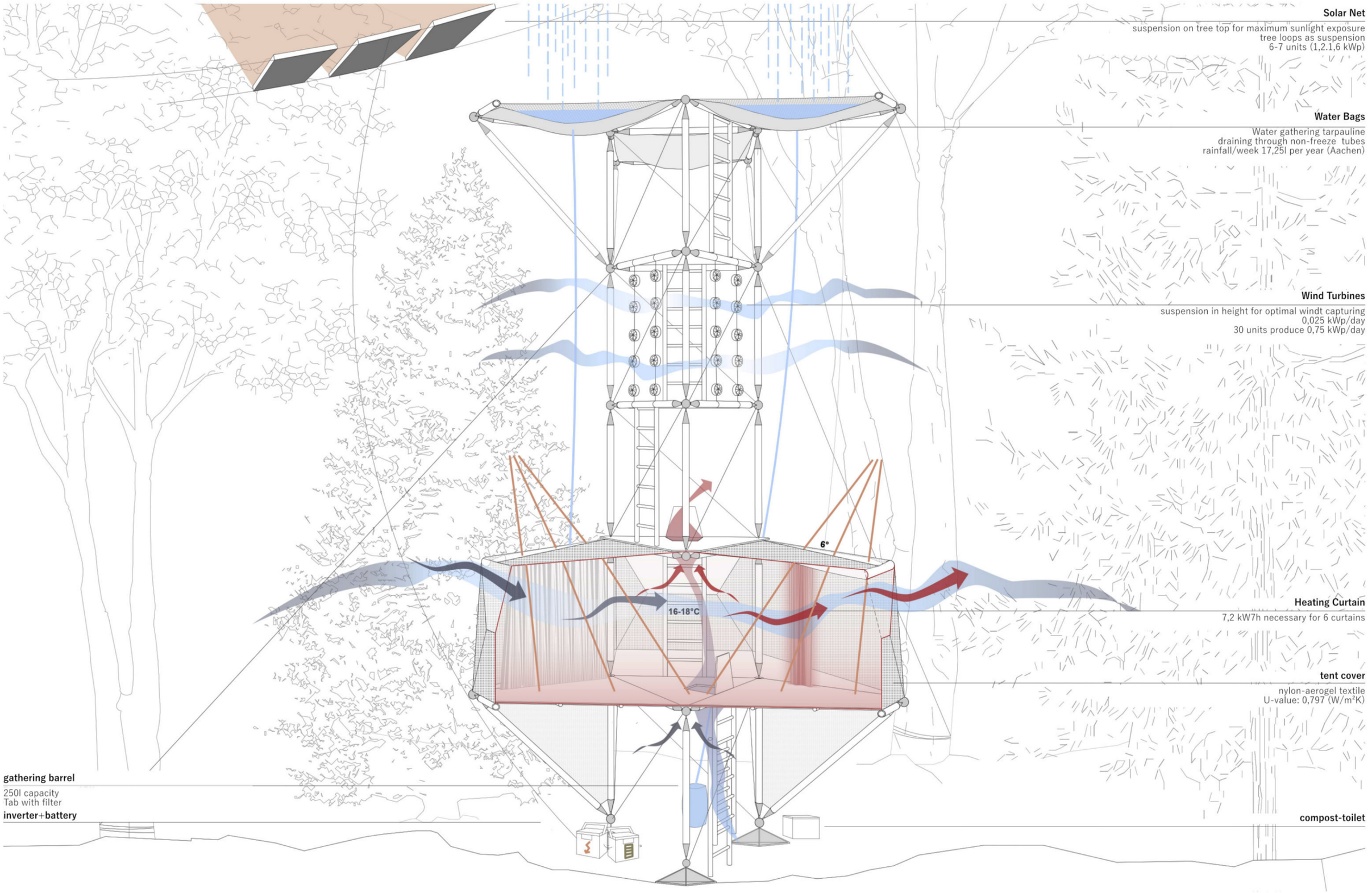
M 1:5 Ball Joint Tent Window - vertical



M 1:5 Ball Joint Tent Bottom - vertical



M 1:5 Ball Joint Construction Foot - vertical


Solar Net
suspension on tree top for maximum sunlight exposure
tree loops as suspension
6-7 units (1,2.1,6 kWp)
Water Bags
Water gathering tarpauline
draining through non-freeze tubes
rainfall/week 17,25l per year (Aachen)
Wind Turbines
suspension in height for optimal windt capturing
0,025 kWp/day
30 units produce 0,75 kWp/day
6°
16-18°C
Heating Curtain
7,2 kW7h necessary for 6 curtains
tent cover
nylon-aerogel textile
U-value: 0,797 (W/m²K)
gathering barrel
250l capacity
Tab with filter
inverter+battery
compost-toilet