DROPNET

Fog Collection and Lightweight Construction

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Abstract

Standard fog collectors can be a great help to provide drinking water in isolated areas or those with a low infrastructure. This is proved by the success of several projects, conducted in different countries around the world.

Different factors influence the efficiency of fog harvesting. To reach a high yield of collected fog water first suitable locations that show a lot of fog accumulation need to be found. As important as the location is the reliability of the collectors that will be used. They have to be adjustable to the wind direction and resistant against strong winds. They need to be in a good condition and their meshes should be tensed well.

The existing systems used for fog harvesting have some weak points. These points have to do with their construction, materials and organizational matters and can lead to a soon ending of a relief project.

Fog collectors of the type “DropNet” could be an alternative.

The aim of the concept is to create a lightweight construction that is in first place resistant against very strong winds and that provides the mesh with the required tension. Other important subjects are the transportation of the devices, the set-up and the dealing with different local conditions, like landscape and soil properties.

Another important subject is the integration of fog collectors in the environment and the increase of acceptance in the population considering design factors.

Keywords

Fog water collection; climatic design

1. Introduction

The problem of drinking water supply is an acute one, so the United Nations are expecting that already until the year 2025 two thirds of the world`s population is suffering from water shortage. Today 1.1 billion people have no access to clean drinking water. Every year 2.5 million people die of thirst or just because of drinking polluted water.

`DropNet` is the title of my bachelor - thesis, supervised by Prof. Ulrich Hirsch, at the Muthesius Design Academy, Kiel, evolved from the subject 'Drinking Water Abstraction World Wide'. About one month I collected information about drinking water shortages, existing solutions, concept ideas and their advantages and disadvantages. Through this research I also heard about the fog collectors in South America installed by the Canadian non-profit organization `FogQuest`.
I have been fascinated by the low-tech idea of water abstraction using natural resources. During my analysis I found out that their construction (looking like volleyball nets) is not very

resistant against wind and, that most of the collectors have been destroyed after a short term.
I thought that there was much more potential in the idea of fog collection and after some email exchange with Prof. Otto Klemm (Prof. for Climatology in Münster, Germany,) I was convinced to engage myself in creating a new fog collector.

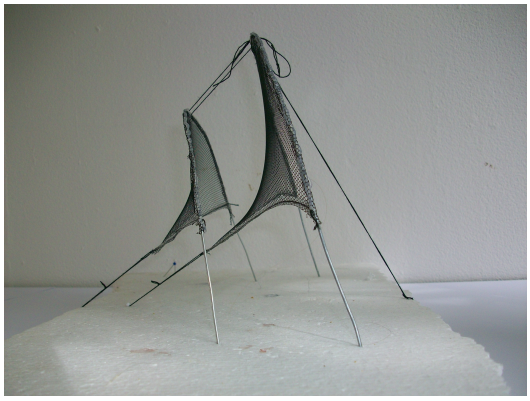
2 What is ´DropNet`?

The 'DropNet' is a fog collector which has the potential to provide drinking water supplies to to isolated areas or areas with low infrastructure. Using natural and local resources, the collector filters tiny water droplets from fog clouds causing the droplets to coalesce. The tent-like construction of the 'dropnet' is easy to assemble, with a total height of 3 metres and width of 4.5 metres, giving it a net surface of ca. 6 metres squared. It is made from an inexpensive mesh of polypropylene, which is a special fabric using horizontal and vertical fibers to create a triangular pattern. The net needs to be tensed, so that it shows curvature in two directions, thus building a saddle surface that creates a stiffness which is durable enough to resist strong winds. Water is collected via drain gutters which are connected to the net by weltings, draining the water into a small tank. an integrated filter within, cleans the water before it is distributed.
The `DropNet` has been designed to be built up on flat and uneven ground in situations with or without hillsides. The best conditions for installing the fog collectors are in especially arid, coastal areas with altitudes between 400 m and 1200 m which exhibit a lot of fog accumulation.
Such locations include Chile, Haiti, Peru, Nepal, Spain etc. depending on the conditions, 'DropNet' can collect 10 to 20 liters of water per m2 a day.
If a number of collectors are installed together and connected to pipelines, they have the capacity to supply a small village with enough drinking water.

3 How did I arrive at this particular form for the DropNet ?

My briefing indicated a construction that is very wind-resistant and can be set-up as easily as a tent and maybe also be stuffed in a bag like a tent, so it won't need too much space during its transportation. The local conditions of the landscape and the soil properties can variate strongly, where a fog collector can be placed. My design needed to be very flexible.

To find a suitable form for the fog collector I created little models from wire and fly-screens to test the forms on their tenseness and water draining capacities. The model that worked the best (seen below) I used as a bases for my design.



During this experimental phase I have also been supervised by Prof. Dieter Zimmer, who has been the project leader of Prof. Frei Otto's project 'Olympic Roofs, Munich 1972'. These examples inspired me and led me to a design basing on a lightweight construction.

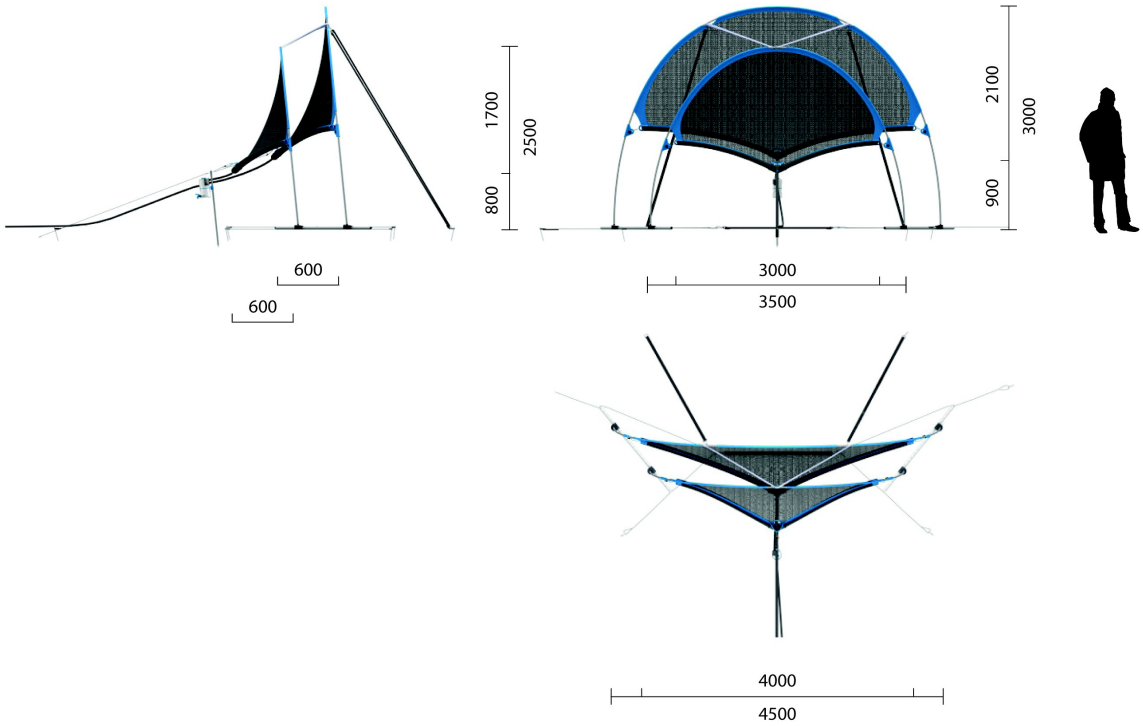
4 The technical process of how the mesh filters the droplets

Locations suited for fog collectors are especially arid, coastal areas with altitudes between 400 and 1200 m, that show a lot of fog accumulation. The fog type 'Advection Fog' is very suitable and can be hundreds of meters thick. Advection fog occurs when moist air passes over a cool surface by advection (wind) and is cooled. Advection fog can easily be accompanied by force 8 winds. The tiny droplets of the fog are blown against the tensed mesh. The wind can pass the mesh, while the droplets remain. if many droplets converge, they form bigger drops and run down the mesh to the drain gutters. from here the drops coalesce and follow the gutters to the little water tank, where the water is cleaned before it is transfered to the pipeline. If the prevalent wind is very strong, it can happen that some droplets are pressed through the mesh and fall down without being caught by the drain gutters. therefore dropnet has got a bigger, second mesh behind the first one. it can catch the droplets which escaped the first mesh. it is important that both nets are tensed very well, because tests (also my tests with my models from wire and fly-screen) have shown that like this the droplets can be collected much more effective.

5 The construction

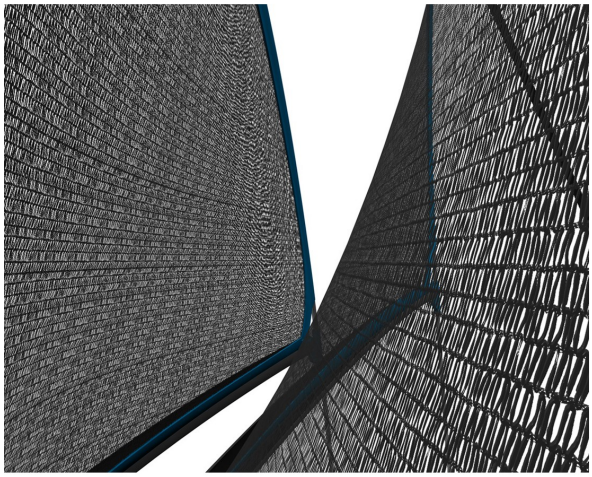
The setup is relatively simple due to a tent-like construction. In the following chapter I want to show how the single components work together.

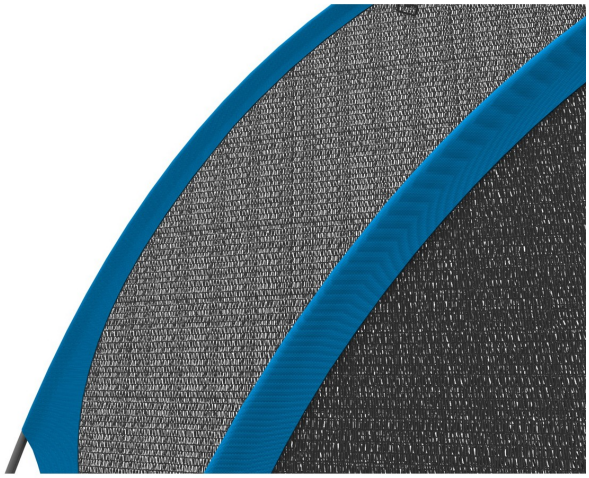
But first of all I want to give an overview about the dimensions, because they give an idea about the size and the proportions of DropNet. In my design the biggest mesh has got a surface of ca 6 m^2 resulting from a width of 4 m and a height of 2,1 m. The smaller mesh has got a size of 3.5 m^2. These dimensions are not fixed, they are just an example. Every location conducts different requirements. Locations with a light wind force will fit a construction with a bigger mesh surface. A second mesh behind the first one does not need to be installed. If it is a location with very strong winds, a construction with two meshes of a smaller size will fit better..



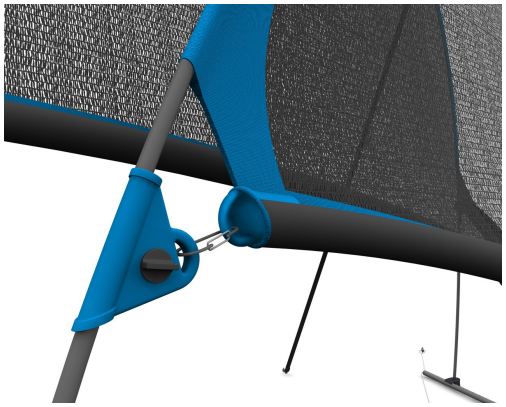
5.1 The (tent) poles and the net

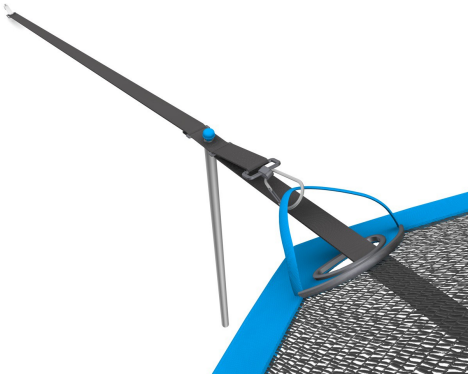
The poles of the fog collector are out of aluminium, the same as the tent poles of big igloo tents. This material is much more steady than the common fibreglass. The poles have a diameter of 22 mm, so that they can resist the stress without problems. The poles are pre-bended and connected through a rope inside. As soon as all segments of the pole stick together, the pole has a gentle tenseness and is ready to use. The curved poles have such a flexibility that they can be bended even more than they are already. That is very important for the setup.The most important element is the net of the type Raschel Mesh. The low-priced mesh from polypropylene is a special fabric using horizontal and vertical fibers to create a triangular pattern. The mesh is UV-resistant and should have a coverage of 60%.





The mesh is bordered with a fabric frame, so that the mesh can be tightened allover. The net has to be tensed, that it shows a curvature into two directions, building a saddle surface,which creates a stiffness, strong enough to resist strong winds. Thanks to the saddle surface even little droplets will drain to the gutters. The tenseness of the net is created by different elements such as the sliders at the sides and the belts at the forefront. The net is connected to the side sliders by carabiners. If the adjusting knob is turned around, the slider can be moved along the pole to tense the net (picture on the left top next page).

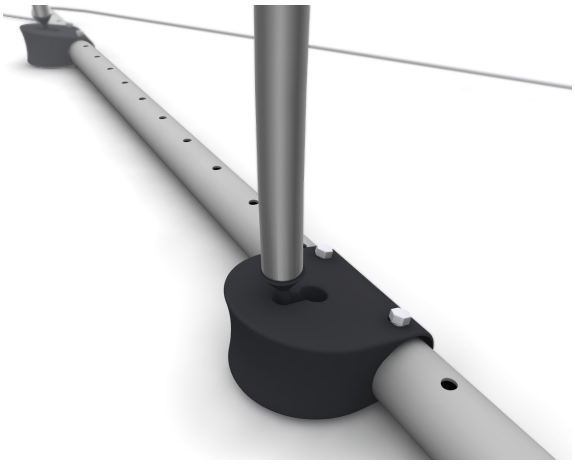




The front of the net is tensed with the help of a tension belt (picture at the right).

5.2 The base construction

The poles are connected to the base construction with the help of massive elements from plastic. These elements have a keyhole locking. (picture on the left). The plug-like end pieces of the poles fit into the keyholes and, because of the tenseness of the curvature, will be pressed to the outside and be blocked.

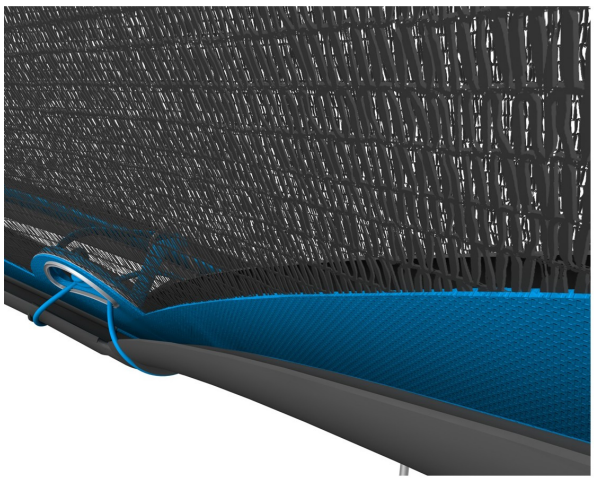


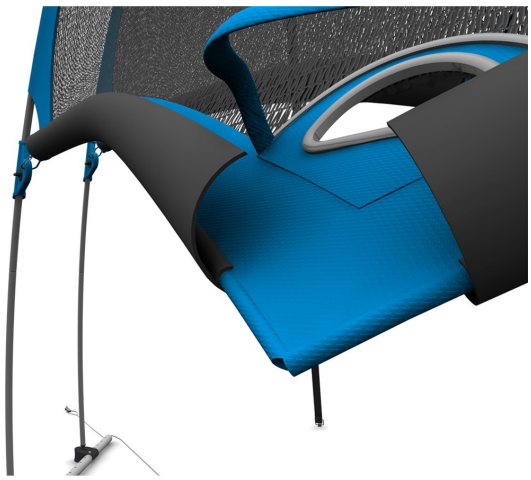
To release the poles from the base construction, the poles first have to be pressed to the opposite direction by muscular strength.

The massive plastic elements of the base construction can be moved on the tubes before they will be fixed by screws. The tubes and the whole base construction are fixed on the ground by ground anchors. According to circumstances and to the nature of the ground can be used pins (for rocks), ground anchors or ,for a permanent installation, a concrete foundation. (picture on the right).

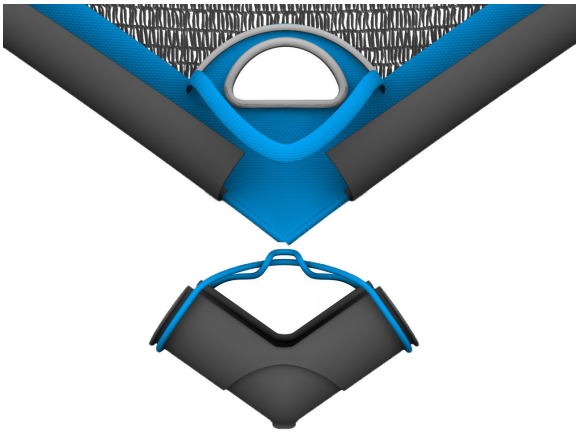
5.3 Gutters and pipes

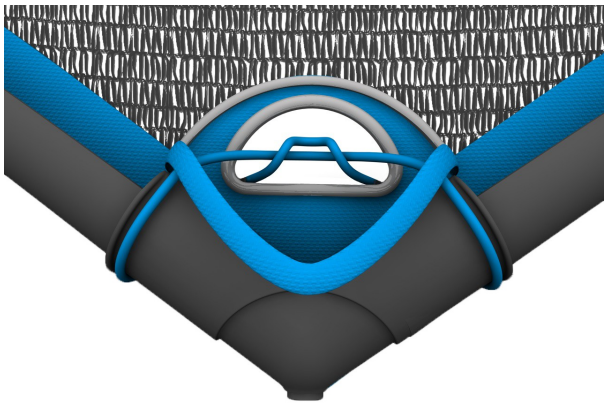
The drain gutters are connected to the net by welting. This connection is especially stable and affords an easy cleaning, because the gutters stay at the upper side completely open (pictures below). The gutters are moved over the welting of the net from the front to the sides. Rubber plugs at the ends prevent a leakage.





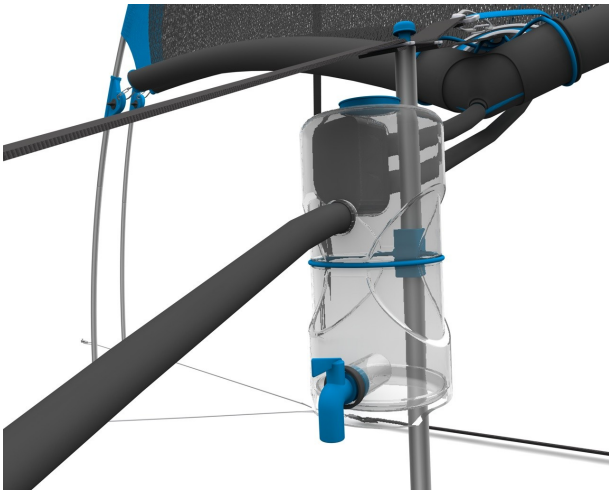
The connect the two gutters with each other a Y-piece is needed. A metal bracket keeps the Y-connection at its place (pictures next page on top). It is important that the drain system is independent from the anchoring. This way, pieces belonging to the drain system can be exchanged or cleaned without interfering with the whole construction.





5.4 Water tanks

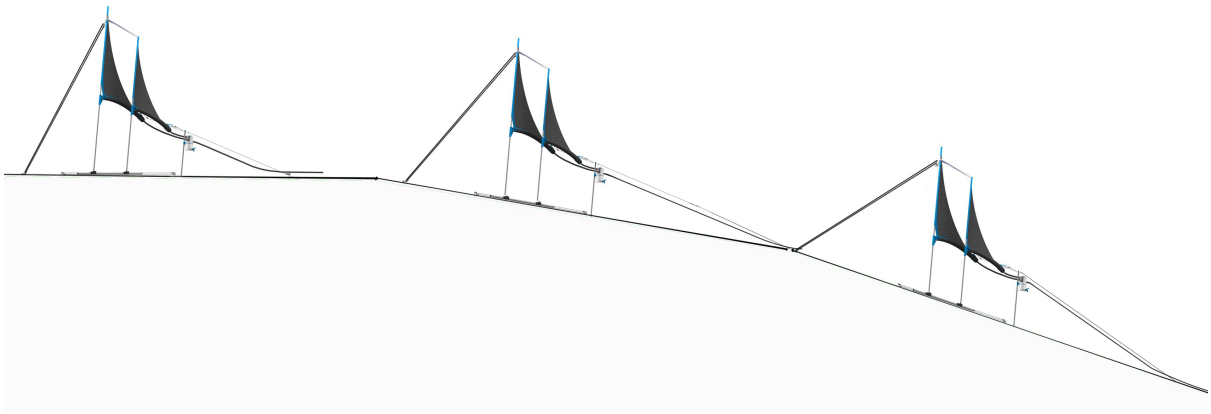
The water flows from the gutters to the Y-connection, then through a tube and finally arrives in a little water tank that is fixed to the front pole (picture below). The water tank has got a volume of 2 litre and has different functions. The tank has got an integrated filter to clean the water before it is distributed.



Further samples of water can be extracted by a tap.

From here pipelines lead the water from the fog collectors to the consumers, whose villages are often situated in isolated areas or regions with low infrastructure. If there does not exist any water conduits in the villages, big water tanks can be used (see pic “big water tank”) as branch or water intake point. The shown water tank has got a height of 1,6 m and a volume of 1000 litre. If needed, also much bigger water tanks can be used. Installed over or under the ground.

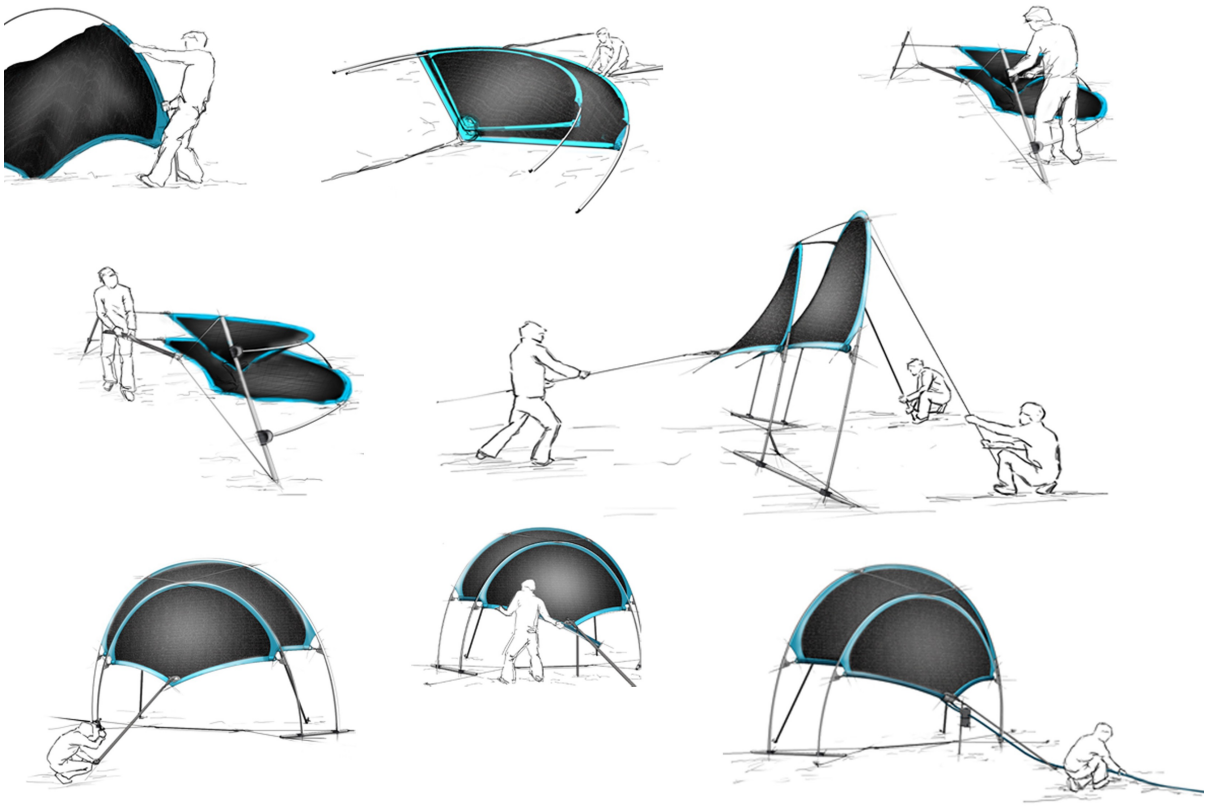
5.5 Hillside adjustment



DropNet is constructed to be built up on flat as well as on uneven ground - with or without hillside situations. This is possible due to the flexible connection between poles and base construction. The end pieces of the poles can still move in the plastic foundation with the keyhole locking. The angle of the whole construction depends on the anchoring of the belts and ropes.

6 The set-up

To make organizational matters easier, the tent-like construction can be assemled by a few non-skilled workers. The inhabitants can help each other to set up the construction, it wont be necessary to employ professionals from other countries.



7 Scenarios

The scenarios show my idea of `DropNet` in use.

Although there is no prototype existing yet, I got positive feedback from people all over the world. Some wanted to order the collector to try it out and others were seeking for information.

The first picture on the next page shows the water supply with the help of `DropNet` in an isolated mountain village in Peru. In villages like this the inhabitants are often dependent on water tank trucks or have to get their water by walking a long hard way. The second picture shows a group of fog collectors set up at a hillside.

8

`DropNet` is still on a concept level, due to the short time (three months) that I could work on it. Nonetheless I hope that in future this project will be elaborated further!

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