CHAAC HA´

Wather system collector

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ABSTRACT

In the water management problem arises our challenge, which was to develop a model that could capture and store water; after an extensive literature review, we take the decision of bromeliads as the winner organism, particularly those that are epiphytes, since they possess structures known as trichomes, which allows them to capture water according to the environment in which they live; and the air resistance mechanism that produces the spiderweb, as an important part for fastening the model.

Regarding the design of the model, it started by brainstorming, which took into account the structure of the spiderweb and the trichome; also the dew gathering ability of the latter. Added to this were analyzed other factors such as population that would be adressed the product and the potential material to use. We create different prototypes which, the main challenge was to get a material that would meet our demands.

As a result of these analyzes was created the Chaac Ha´, which is a device that consists of three parts: a bamboo frame, a collector and a water tank, both made from Teflon with an insulating coating. This design is capable of collecting a minimum of 2.5 liters of dew per night.

CHALLENGE

For human use in all forms; water becomes an increasingly scarce natural resource (Lira, 2005).

Causes

- social conflicts
- Slows socioeconomic development
- Various diseases.

Lack of water

In Mexico

A growing number of regions and populations suffer water shortages, and is exacerbated by population growth and aspirations for better living (Lira, 2005)

In Yucatan

There are rural areas with no access to water but due to the wet weather we can find large quantities in its gaseous state.

Problem: No water in rural communities

Problematic: How to get water for human use?

DESIGN A DEVICE CAPABLE OF COLLECTING WATER FROM THE ENVIROMENT SUCH AS RAINWATER AND DEW

OTHER BIOLOGICAL ORGANISMS AND STRATEGIES INVESTIGATED

Ascidians

- They are also known as tunicates
Most live attached to a substrate (Rocha, 2006).
- They are feeding invertebrates, which can become dominant in certain seabed.
- The adult ascidians have two basic models of organization: colonial and solitary(Díaz, 2007).
- They have an oral siphon (where water enters) and atrial siphon (where water is ejected)
(Salhi, 2005).

Cactaceous

- Retain water longer.
Main method is the root uptake.
- The major function of the spines is evaporation
They can perform photosynthesis overnight.
- They are able to colonize warm and dry.

(García y Méndez, 2011).

BEST CHOICE AS WATER SCAVENGER

The epiphytes Bromeliads

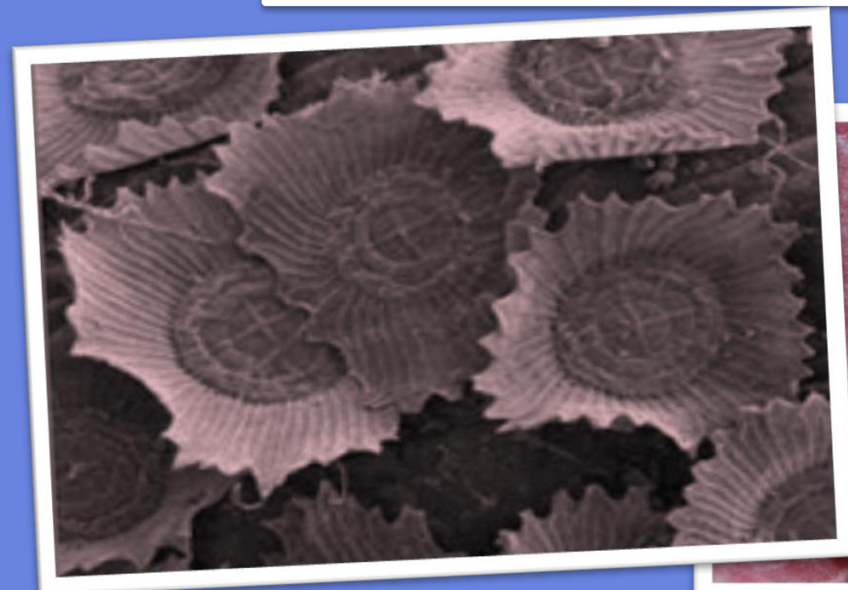
Plants that are most directly dependent on rainfall for water and the nutrients transported by this means (Granados- Sánchez *et al*, 2003).

Its leaves are slightly bent and arrange in a rosette form to retain and collect water (Zotz t Andrade, 2002)

Have:

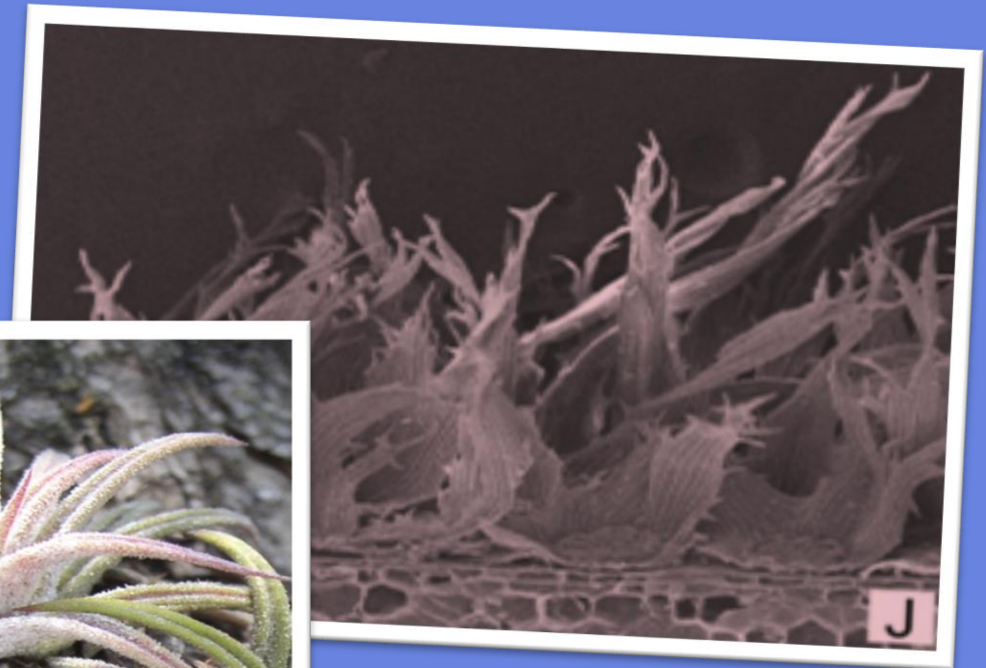
- Shape of tank formed by the bases of the leaves.
-They have better water efficiency
-They have succulent leaves and stems
- They have trichomes(Mondragón et al, 2011).

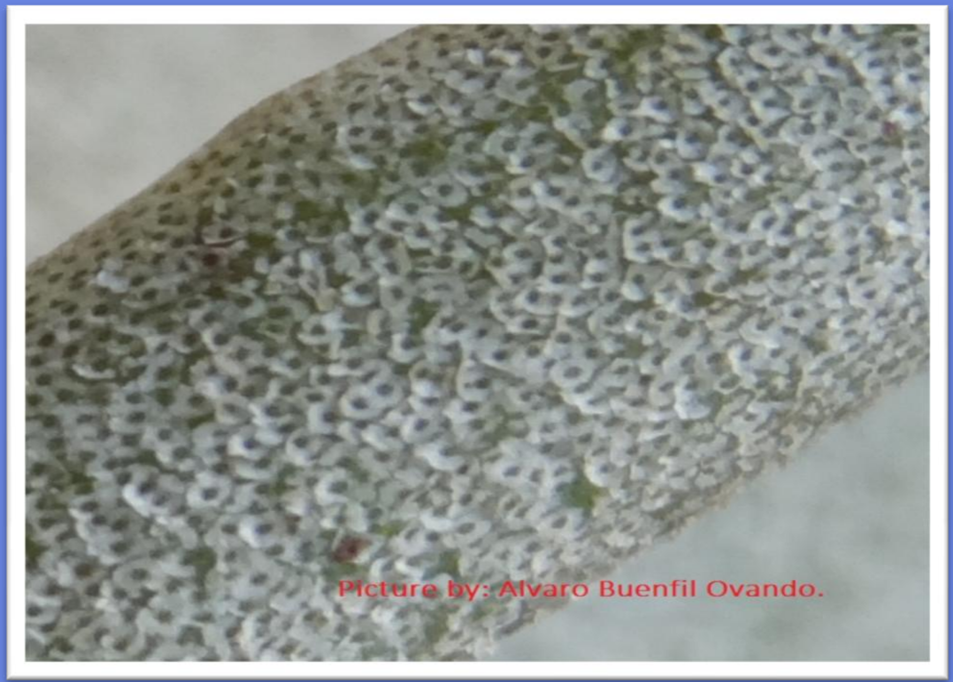
The trichomes with peltate scales shape, condense and collect dew water and absorb it with the entire surface of the blade (Granados- Sánchez *et al*, 2003).



BIOLOGYCAL STRATEGY EMULATED: TRICHOMES

Trichome: Is a Structure that specializes in capturing water and nutrients from rain, dew or runoff trough the branches of their guests, carrying water to their internal tissues to execute its vital functions (Granados- Sánchez *et al*, 2003).





Scales (epidermal trichomes) of bromeliads serve to atmospheric nutrition. They belong to the specialized structures of the plants formed for absorption of nutrients and water(Granados- Sánchez *et al*, 2003).

ESTRUCTURAL BEST OPTION: THE SPIDERWEB

- Is used as a rest area for the spider.
- Oviposition deposit.
- Capture excess deposit.

(Martínez y Baz, 2010).

-Super Shrink capacity.
- Decreases its length when it gets wet because their molecular structures become misaligned.(Regio et al, 2004)

- The web is structurally constituted by different kinds of threads: a bridge, which is the initial structure; the frame structure which serve as basis for the following threads that clamps to an object. the radius wire go toward the center of the frame wires and afterwards the spider make the threads for the spirals. Ata (Hoffmann, 1993).

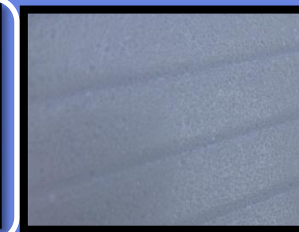
- Due to its thermal stability, it can resist temperatures up to 225 ° C (Yepes et al, 2006).

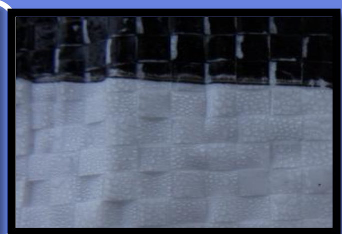
PROTOTYPES MADE

The purpose of our prototypes was to determine what material would be more suitable. A material that could catch and direct water to be stored. The prototypes were placed in the open from 10:00 pm. And were reviewed at 6:00 am. The degree of success is shown below:



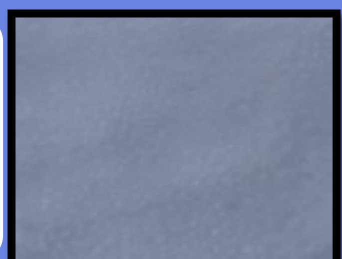


All prototypes comply in order to capture water, some less than others. But, the reason why we chose the Teflon fabric, is because it was the only material capable of capturing and conducting water.

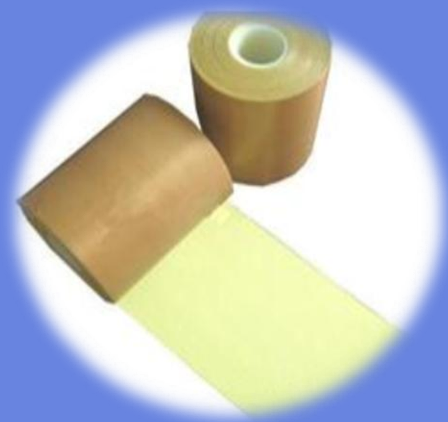


Spider web structure prototype


TEFLON CHARACTERISTICS

- Is impermeable.
- Easy to clean.
- In most cases are self-cleaning surfaces.
- It can withstand temperatures up to 316 ° C.
- It can be used at temperatures as low as -270 ° C.
- Normally it is not affected by chemical environments
- It is nonstick, ie very few solid substances will stick.
- It is completely non-flammable.



BAMBOO CHARACTERISTICS

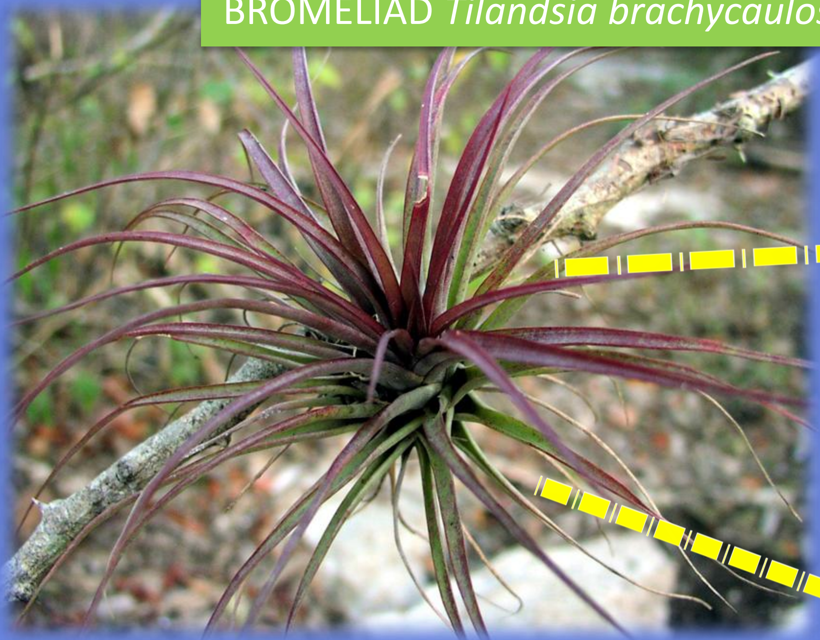
It will be used bamboo waste from fishing in the region, because it is a highly resistant material, meets the requirements for the form and structure of the prototype is a way to use a material that is considered waste at certain times of the year.

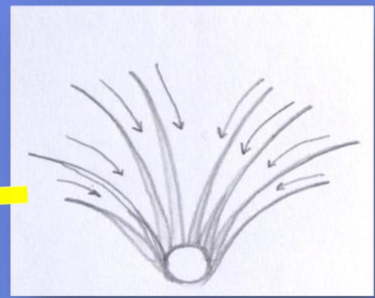
- Special Properties: Light, flexible, wide range of constructions
- Economics: Low cost
- Stability: Low to medium
- Training required: Labor traditional bamboo constructions
- Equipment required: cutting tools and bamboo
- Climatic suitability: Hot, humid climates
- Level of expertise: Traditional

(Castillo, 2011)

BIOLOGICAL STRATEGY

BROMELIAD *Tilandsia brachycaulos*



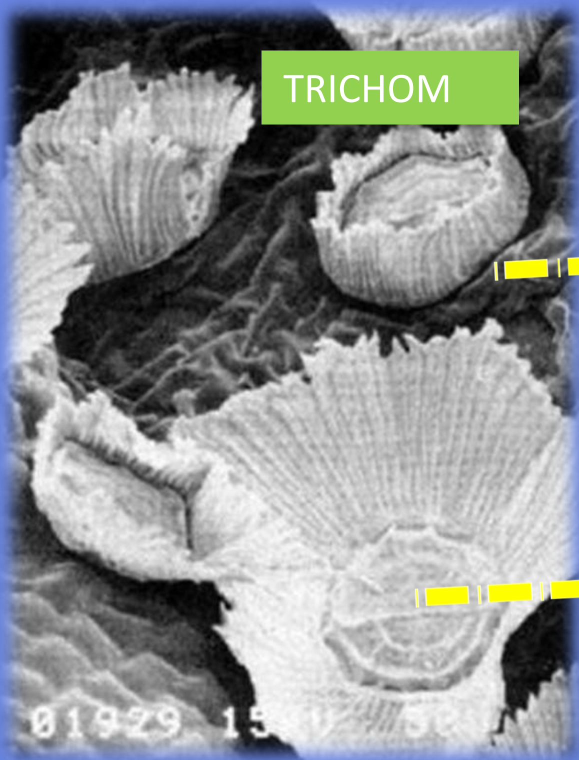


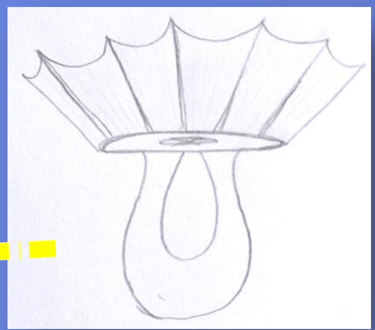
Directed toward the center leaves for water harvesting.

-Bromeliad leaves moisture recolectors

-Concave form for water slide.

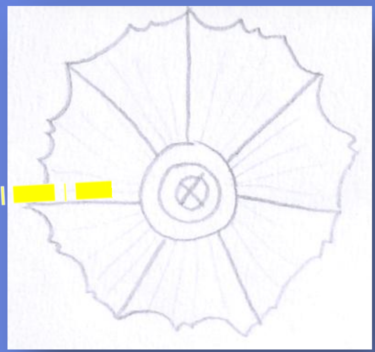
TRICHOM





- Concave shape to direct water and sections that provides greater catchment area.

-Hidrophobic material that allows water slide.

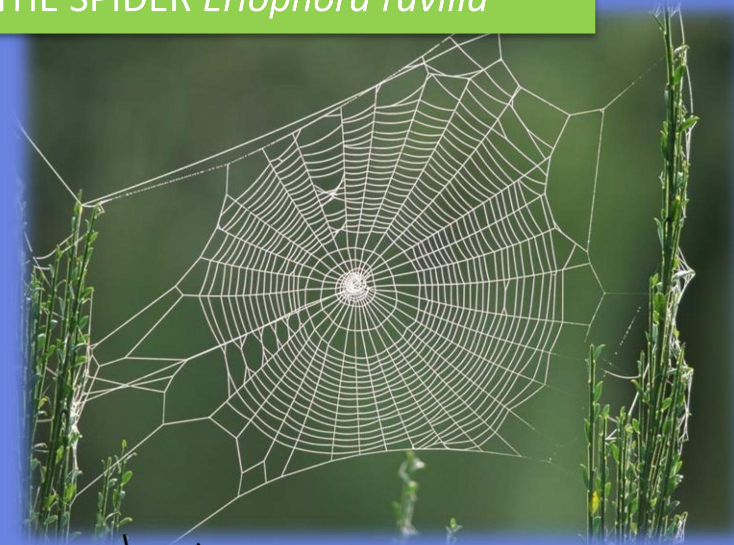


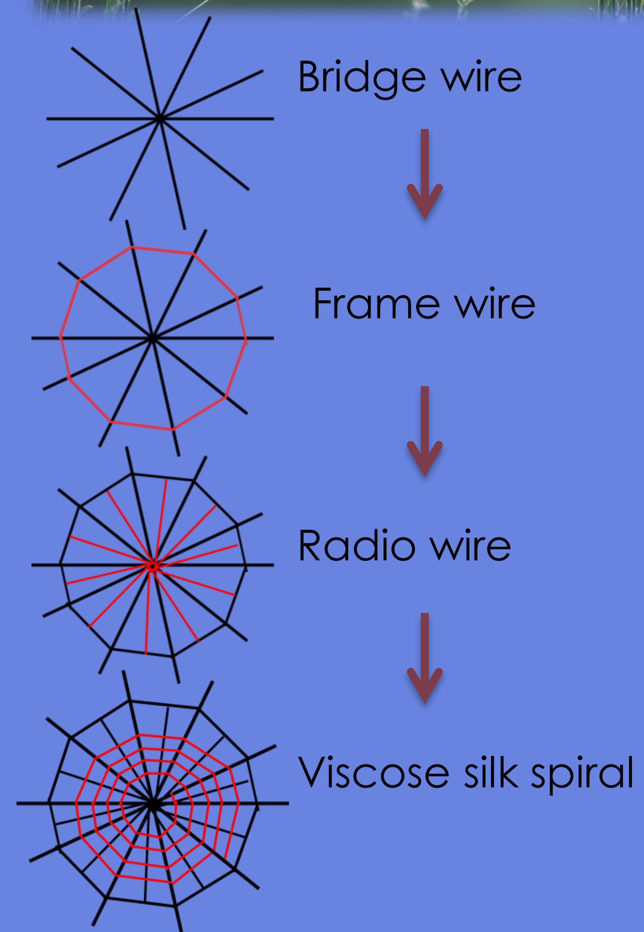
-Trichomes have a water tank below.

- Gate that prevent water loss from evaporation.

-Irregular edges for collecting dew

SPIDER WEB OF THE SPIDER *Eriophora ravilla*





BIOLOGICAL STRATEGY TO DESIGN

30° Inclination:

Is the ideal angle for the water slide and head towards the receptacle with just gravity.

Bamboo structure:

This material is highly resistant which gives us a structural safety of the cobwebs emulated besides being biodegradable. For this device will be reused the bamboo disused by fishermen of the region.

Spider web spiral:

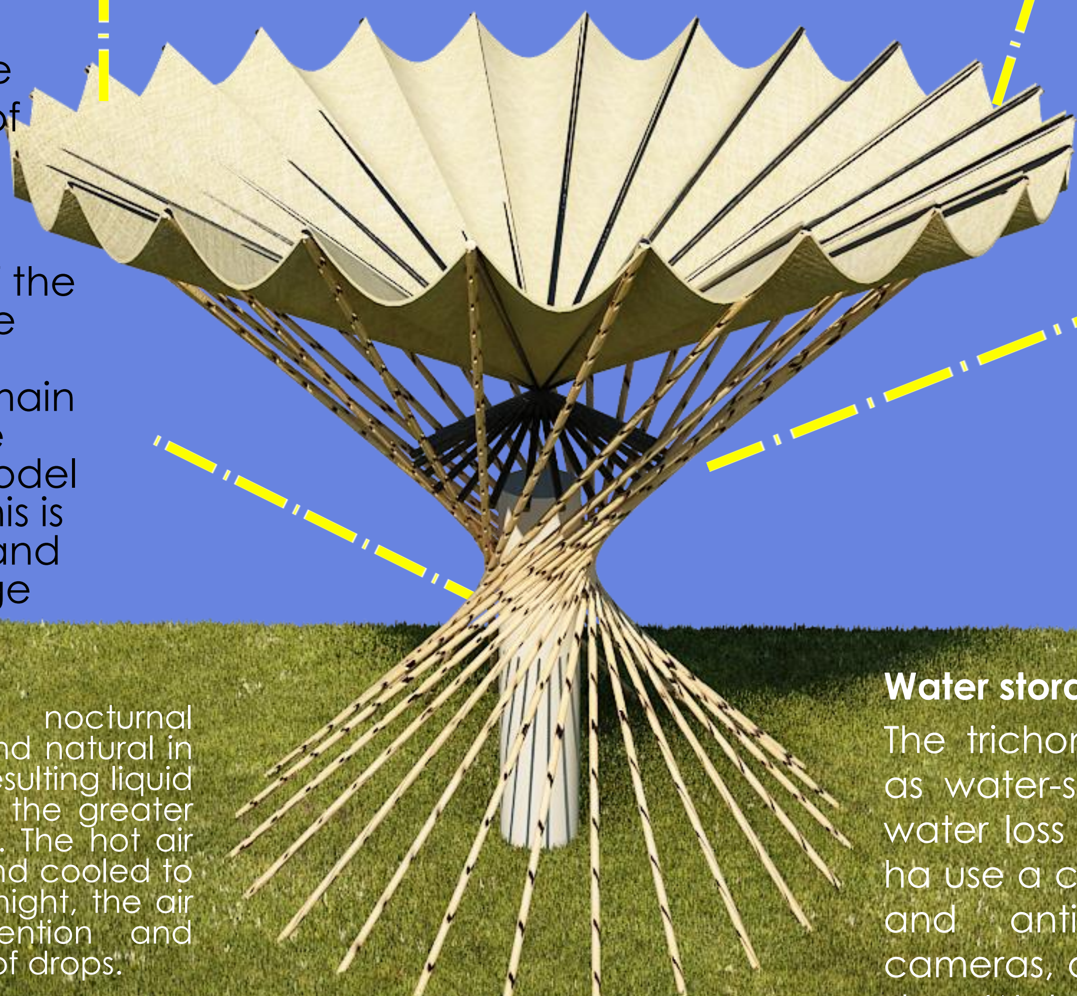
The order and the distribution of the elements forming the coils of the radial web system and the distribution of forces, were the main characteristics emulated for the model base. The center hole model resembles that of the web, as this is where the elements are linked and where the water goes for storage and later use.

Teflon fabric:

This material has hydrophobic properties which allows us to simulate the process of harvesting water of the trichome. Once reaching the dew temperature, the created water droplets slide, reach the central part and they are deposited in the container

Concave shape:

Leaves of bromeliads have concave shape which makes it easier to collect water to be stored inside. In the prototype is used for both; the directionality of water and to have a bigger capture surface. Peaks also allows air resistance and more water capture



Cord tensioners:

The web has tension radiating from the center to the main structural yarns. The device uses this strategy to anchor and keep the teflon fabric tilted at 30 ° and ensure the bamboo structure.

Dew collection:

Dew formation is defined as a nocturnal atmospheric phenomenon, common and natural in that moist air condenses on a surface resulting liquid water. The higher the air temperature, the greater the amount of water in vapor form on. The hot air may be about 17g of water at 20 ° C and cooled to 10 ° only about 9g. Upon entering the night, the air cools and reduces its water detention and condenses on cool surfaces in the form of drops.

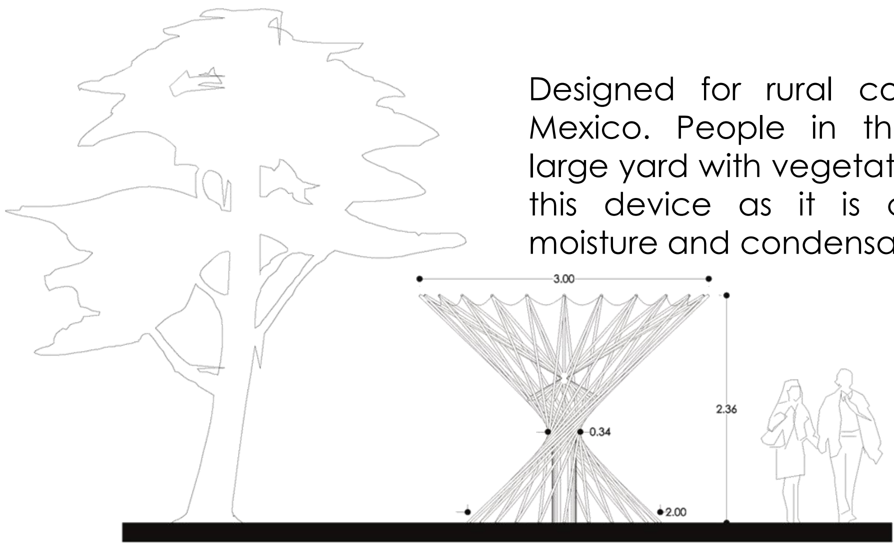
Water storage:

The trichomes of bromeliads also functions as water-storage, with a valve to prevent water loss through evaporation. The Chaak ha use a container of a waterproof material and antibacterial with two different cameras, one for rainwater and another for dew. Water is recovered by valves.

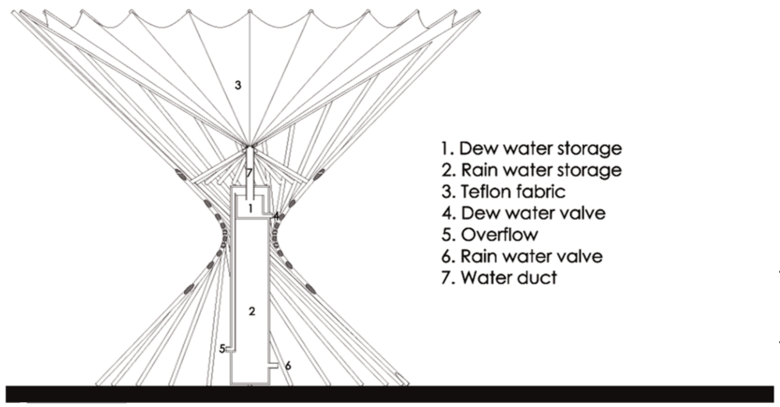
CHAAC HA´

The "Chaack Ha '" (god of rain and water in Maya) is a device that collects water from dew at night and rain. It is a chimera emulated by the water catchment system of bromeliads and the structure of the web.

Designed for rural communities in Yucatan, Mexico. People in these communities have large yard with vegetation, making great use of this device as it is concentrated a lot of moisture and condensation.

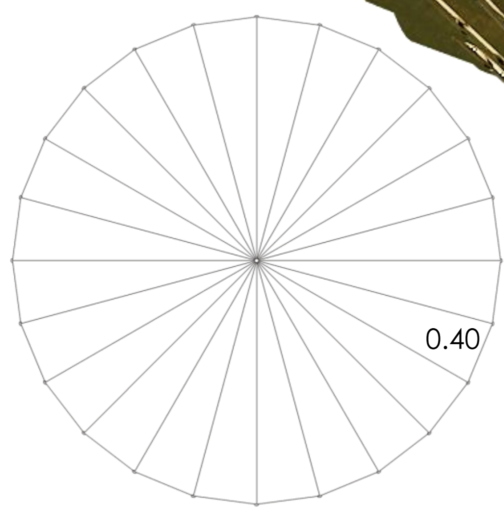


ELEVATION

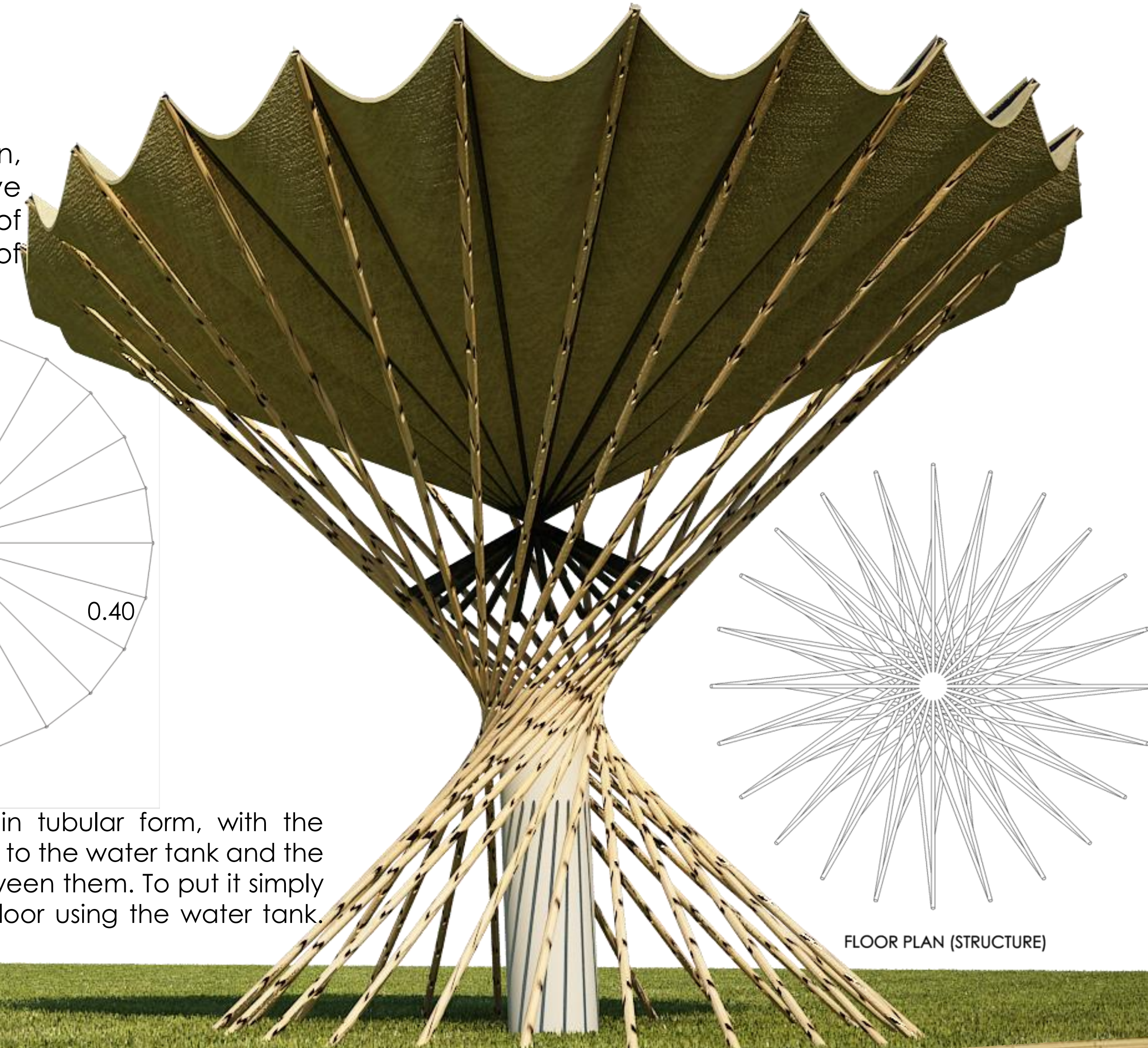


1. Dew water storage
2. Rain water storage
3. Teflon fabric
4. Dew water valve
5. Overflow
6. Rain water valve
7. Water duct

SECTION



FLOOR PLAN



FLOOR PLAN (STRUCTURE)

The device will come in tubular form, with the bamboo stirrups parallel to the water tank and the Teflon cloth folded between them. To put it simply deploy it on the base floor using the water tank. Thus it is portable.

Based on bibliographic information the device would collect 2.5 liters of dew water per night, increasing this measure according the weather of the day. With a rain it will collect 50 liters and if the water tank is full, it can continue collecting through the relief valve.

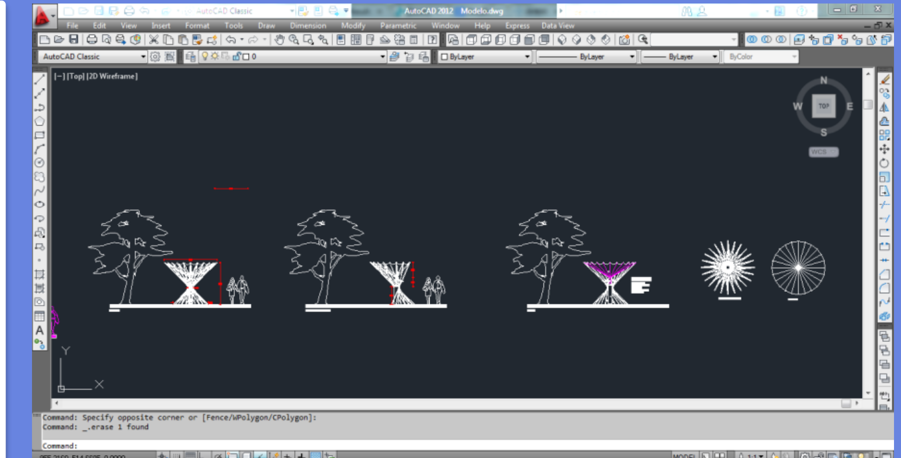
AUTODESK SUSTAINABILITY AWARD

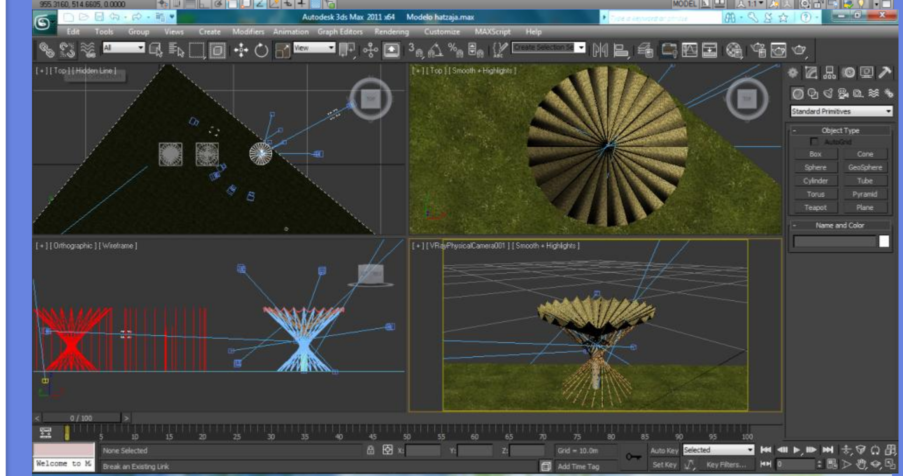
AUTOCAD 2012 AND AUTODESK 3DS MAX

We used the autocad to draw our project in 2d and it helps us to realize the exact measures of it. Autocad makes possible to communicate our ideas exactly as we imagine them. After drawing, we create a 3D model using autocad and autodesk 3ds max . With this second program we render our 3d model into JPG images. Then we edit them and then we have a realistic view of what or device is going to be like. We also generate some animation using 3ds max . This animations are very useful because with them is possible to see our project from more angles than in one image

The best way to express our ideas and explain our project is through realistic pictures. Because it makes it easier for people to understand what we are offering to them

With Autodesk programs we create accurate schemes, 3d models, realistic pictures and helpful animations. Thanks to all that it is possible that more people around the world know and understand our project





EVALUATION ACCORDING TO LIFE'S PRINCIPLES

Evolve to Survive

Work on this project was a continuous evolution. We investigate, propose and correct our mistakes. We were always learning and changing until got to the final product.

Adapt to Changing Conditions

Because of its affordable materials in case of damage or wear it can be easily repaired. Even with some damage will continue working.
Includes multiple ways to meet their functional needs.

Be Locally Attuned and Responsive

The materials use are locally accessible. We reused bamboo from the fishermen of the region and the Teflon fabric is affordable. We take advantage of the water cycle to capture rainwater and dew and that way we guarantee that we will always have some water.

Be Resource (Material and Energy) Efficient

The model satisfies multiple needs, including capture and store rainwater and dew with almost zero energy requirements.

Integrate Development with Growth

It has modular components .
The bamboo poles with Teflon fabric work together to capture water and to create a stable structure to support itself and to has wind resistance.

Use Life-friendly Chemistry

The model consists of three parts of easy assembly, it has an elegant form and it works with natural processes of the water cycle.

LIMITATIONS OF THE DESIGN

- Scarcity of experimenting with prototypes and materials.
- The need to see specialist as a chemical engineer and physicist for asistance.
- The materials are a limitation, we need to investigate materials with the following characteristics:

1. Hold their properties or to cool fast.
2. Border irregularity to provide more surface.
3. Non accumulating bacteria.
4. Perfect combination of hydrophobic and hydrophilic materials.
5. Affordable

REFERENCIAS:

- Brunssen de Occidente. 2005. Propiedades de PTFE Teflón Brunssen. Dupont Licensed Industrial Applicator of Teflon.
- Castillo A. 2011. el Bambú como material de contrucción.En: Ecohabitat :http://www.ecohabitar.org/el-bambu-como-material-de-construccion/. Fecha de visita 5-12-2012
- Ceja J., Espejo A., López A., Garcia J., Mendoza A. Y Pérez B. 2008.. Las plantas epífitas, su diversidad e importancia. Ciencias 91. pp. 35-41.
- Díaz M. 2007. Contribución al conocimiento de las ascidias coloniales (Chordata: tunicata) de la Antártida Occidental y Región Magallánica. Universidad de Alicante. Facultad de Ciencias Departamento de Ciencias del Mar y Biología Aplicada.
- García R. y Méndez M. 2011. Cactáceas. Biodiversidad y Desarrollo Humano En Yucatán. Centro de Investigación Científica de Yucatán.
- Granados- Sánchez D., López-Ríos G., Hernández- García M., Sánchez-GonzáleszA. 2003. Ecología de las plantas epífitas. Revista Chapingo. Vol. 9, Núm. 2. Universidad Autónoma de Chapingo. México. Pp. 101-111.
- Hoffman A. 1993. El maravillosos mundo de los arácnidos. Fondo de Cultura Económica. México. Pp 72-74.
- Lira C. 2005. Agua. La Jornada. México. Universidad Autónoma del Estado de México. Pp. 106-107.
- Martínez F. y Baz A. 2010. Arañas del campus. Cuaderno del Campus Naturaleza y Medio Ambiente. Universidad de Alcalá. Pp. 51.
- Mondragón D., Ramírez I., Cruz M. y García J. 2011. La familia Bromeliaceae en México. Universidad Autónoma de Chapingo. México. Pp. 100.
- Naab O.2006. Vacuolas y sustancias ergásticas. Facultad de Agronomía. Pp. 8.
- Regio J., Eices M., Martínez M., Camero D. y Guinea G.2004. Resistencia mecánica de la Seda Viscida de araña. Departamento de ciencias material. Madrid pp. 5.
- Rocha R. 2006. Tunicados. Estación de Investigación de Bocas del Toro.
- Salhi M. 2005. Biología animal: Origen de los cordados. Facultad de ciencias.
- Yepes H, Pineda P. y Rosales-Rivera A.2006. Análisis térmico de fibra de seda de araña del género *Micherecantha,* familia Araneidae. Revista Colombiana de Física. Volumen 38, N° 2. Pp 950-053.
- García de Peraza, Lorenzo. 1977. Hojas divulgadoras. Publicaciones de extensión agraria.
- Martos, David Simón. 2007-2009. Estudio sobre la captación pasiva de agua de niebla y su aplicabilidad.
- Gandhidasan, P. Abualhamayel, H.I. 2004. Modeling and testing of a dew collection system.

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