CANE STRUCTURES AND THEIR COVERING TECHNIQUES

BIØN II- Follow-up report

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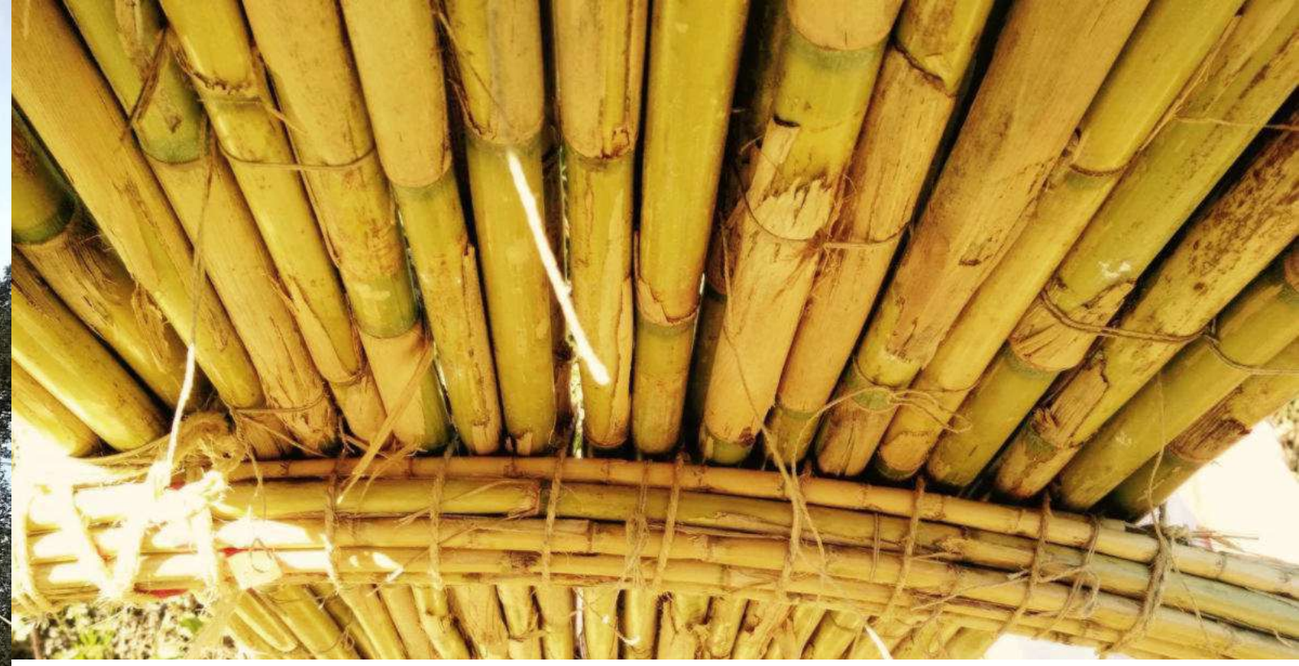
INTRODUCTION



Opposite page
Mounting of the structure for the cane workshop held in March 2018 in Valldaura, Barcelona

This page
Same structure being covered by cane

The structure built for the cane workshop organized for the first LearnBi0n project 2015 - 2018 was executed in March 2018 in Valldaura, Barcelona.

One of the biggest challenges facing this workshop was the lack of participants, only eight participants of the needed 16 came to the workshop, meaning that during the one month period only the structure was completed, without time for the covering, which was meant to be a thatch roof.

Due to other projects immediately after, it was not possible to continue covering the structure, and as a result the canes were not protected in a way that their durability would be ensured over the following months.

The use of the structure was to be a classroom space for future cane construction courses, but since it was not a viable space for running courses, both due to its accessibility as well as the impossibility of offering accommodation to students at a reasonable cost, the space was not then continued to be used beyond the Bi0n workshop.

As a result the arches were dismounted, in order to not continue degrading over time, and were never mounted again.

Although thatch is an otherwise ideal material for covering cane structures, it is somewhat limited in terms of design capabilities, since the inclination of the roof needs to be around 45 degrees, and certainly no less than 35 degrees. This makes dome-like structures impossible to cover with thatch, and cane structures are typically dome-like, and very often with the curve of the roof reaching horizontal at the top.

1. MATERIALS PART 1: MOR-

Surface of layer of earth, hydraulic lime and

First layer: gypsum being applied with hessian cloth

EARTH AND LIME

In the past several structures have been covered with various layers of earth mixed with cane, straw or hemp fiber, and rendered with different layers of hydraulic or air lime mixed with sand and/or marble dust.

In almost all cases the structures resulted in suffering cracks and water infiltration, and since it had been suggested to use gypsum, not only because of its lightness and adhesive qualities, but also because of its relative flexibility compared to cane, in 2019 it was experimented with as a covering material in Tavira.

YESO

Using hessian cloth in the application of the first layer serves two functions:

1. prevents the gypsum from falling through the gaps between the canes by providing a closed surface the gypsum can stick to

2. provides the gypsum with a tensile mesh giving both stability and some flexibility to the first layer

Layer of gypsum with shredded cane on the entire structure

Second layer: gypsum and shredded cane

Similarly to the hessian cloth in the first layer, the shredded cane serves to add structural fiber with tensile properties that help to prevent the gypsum from cracking, but also to provide
a rough surface for the next layer to adhere to.

Third layer: Yeso with fine shredded cane

Third layer: gypsum and fine shredded cane

As with the second layer, the finer shredded cane gives structural integrity whilst fitting into the gaps of the previous layer and providing a slightly smoother surface for the next layer

Fourth layer: Gypsum only

Fifth layer: Elastic paint

Fourth layer: gypsum only

A fine layer of gypsum without fiber is used to close the gaps between the fibers of the previous layer and leave a smooth surface for applying the elastic paint.

Fifth layer: Elastic paint

Because of the absorbing nature of the gypsum painting with a waterproof elastic paint is necessary in order to keep out all moisture from surface water as well as humidity from the air.

Between layers a synthetic fiber mesh is used to prevent the paint from cracking and ensure that the entire surface remains waterproof.

Opposite page
Corner or finished foundations showing extruding re-bar for fixing the bases of the arches to the concrete wall

This page
Reinforced concrete wall going up.
In this image you can see the rebar connecting the entire perimeter

HYDRAULIC LIME

Concrete Foundations

For the second structure it was decided to use more solid foundations in order to prevent movement and eventual cracking

A reinforced concrete ring gave a solid base that would connect all the arches together and remove all movement from their bases. This would withstand the weight of several layers of earth and lime, resulting in little to no cracking at all.

Because of the more solid foundations we could use heavier materials, so instead of using gypsum in all the layers, we only used it in the first layer in order to have a good adherence with the canes. We then continued to use different layers of earth, shredded cane and hydraulic lime, followed by finishing layers of waterproof lime (air lime

Opposite page
First layer of gypsum with hessian cloth

This page above
Structure being built on reinforced concrete wall

This page below
Second layer of earth, hydraulic lime and shredded cane

This page above
Third layer: Earth, hydraulic lime and fine shredded cane

Opposite page and next double page
Fifth layer: Water repellent lime, sand, hessian cloth

This page below
Fourth layer: Hydraulic lime and sand

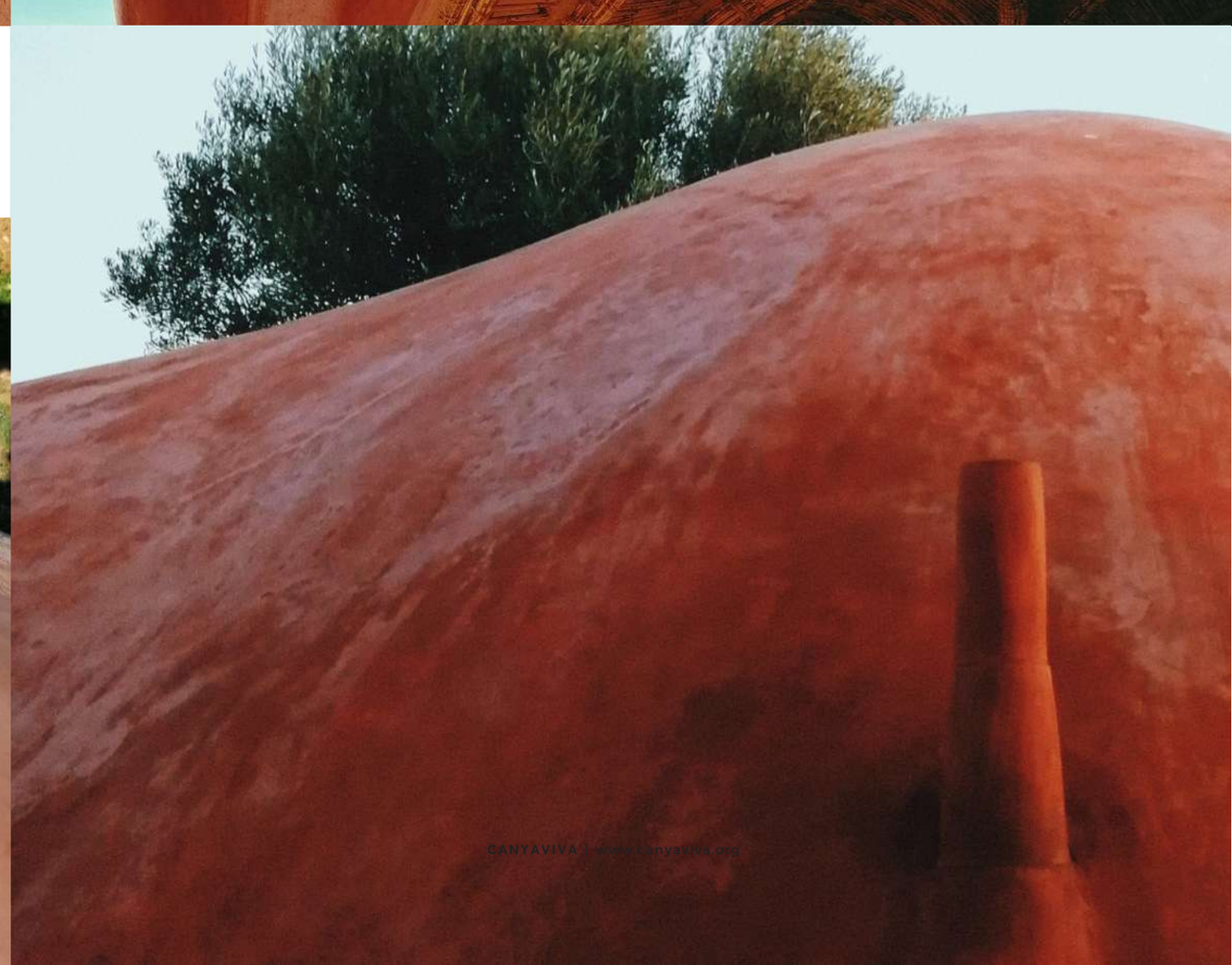
WATER REPELLENT LIME

This page above
Sixth layer: Water repellent lime, marble dust and pigment

This page below

Polishing with a trowel
Opposite page
Finished result

Next page



2. REPARATION TECHNIQUES

This page

Soap and oil being applied to a dry damaged

Reparing with water repellent

Problems with the gypsum used in Tavira 1 and the results of Tavira 2 (in which it was discovered that water repellent lime (quick lime slaked with 1 part linseed oil to 4 parts water) was both extremely sticky, very water resistant and slightly flexible) led to choosing water repellent lime for all layers including the very first layer, which needs to be most adhesive to the cane and most flexible.

The mixture of water repellent lime with marble dust and hessian cloth was not adhering to the cane surface and, because of the lack of cane, straw was chosen as the organic fiber for the first layer instead of hessian cloth.

This was not sticking either until earth was mixed with the lime in a ratio of 1:1, this made the mix both more adhesive as well as much stronger, and as a result the same mix was used for the following 3 layers with varying lengths of straw followed by hessian cloth to finish the fiber before continuing with the fiberless renders.

This page above
First layer tests:
Water repellent lime with marble dust and hessian cloth
Water repellent lime with marble dust and straw
Water repellent lime with marble dust, straw and earth

Opposite page
Second layer:
Water repellent lime with marble dust, straw and earth

Following two pages

This page
Fourth layer:
Water repellent lime, marble dust and pigment

Opposite page
Finished result except for the borders

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SOAP AND OIL

This page
Applying soap and oil to a patch in need of repair

Opposite page above
Final layer before soap and oil

Opposite page below
Final layer after soap and oil

In some places, especially when working on hotter days, the final layer of lime and marble dust would crack and lift off the surface below, creating a gap between the final two layers.

A mixture of linseed oil and liquid (blue) soap (1:1) was then used to soften the outer layer again.

Interestingly enough it would adhere again to the layer below, demonstrating that the soap, serving as a bonding agent, would allow the oil to be better absorbed by the lime, and thus protecting the lime from becoming too dry and maintaining its resistance to water.

CORK GRANULES AND CORK

Opposite page
Applying a mixture of hydraulic lime and cork granules to a patch in need of repair

This page above
Final result before soap and oil

This page below
Final result after soap and oil

There were then places where the structure was just too flexible and a lighter more flexible material was needed in order to avoid cracking.

This was when cork granules and cork dust was used instead of sand and marble dust due to it being much lighter and more flexible

3. MATERIALS PART 2:

This page

View from the outside of the thatched roof

Opposite page

View from the inside showing the internal structure

YOGA DECK, ALCANTARILHA, PORTUGAL, 2023

For larger structures, such as the yoga deck we built in Alcantarilha for the second LearnBi0n project, we chose thatch as the covering technique, mainly due to the need for wooden post foundations as opposed to concrete foundations.

Although thatch is an otherwise ideal material for covering cane structures, it is somewhat limited in terms of design capabilities, since the inclination of the roof needs to be around 45 degrees, and certainly no less than 35 degrees. This makes dome-like structures impossible to cover with thatch, and cane structures are typically dome-like, and very often with the curve of the roof reaching horizontal at the top.

However, with the right design, due to its light weight, flexibility and application method it is an ideal material for

4. REFLECTIONS

Having spent months covering, repairing and repairing again the same structures but using various covering techniques, materials and application methods, the past three years, especially those two years in Tavira, have been extremely useful for arriving to at least two possible and viable covering methods, after many years in which the idea of permanence in cane structures was still a complete mystery.

It is also interesting to note that the two options, that are 'hard' or 'soft' covers, have their differing qualities, both aesthetically and structurally, and serve for different purposes according to the size of the structure and legalities as far as foundations are concerned.

Whilst mortars provide solid and long lasting solutions to smaller, denser structures such as tiny houses or dormitories, thatch comes into its own when dealing with larger structures or laws not allowing for concrete foundations required for heavier, mortar based, covering techniques such as earth and lime.

Overall it has been a hard but very worthwhile period for cane construction and we look forward to developing both techniques further in the near future.

Many thanks to the LearnBi0n network and everyone who has been involved in these last three projects.

BIØN - Building Impact Zero Network
A network of partners active in low impact building techniques. Our aim is to share knowledge, practices and experiences, in order to contribute to the built environment and to our communities.

BIØN – Building Impact Zero Network is a group of partners, created in 2015, active in low environmental impact building techniques with positive social impact. Our aim is to share knowledge, practices and experiences, in order to contribute to the built environment and engage our communities.

Our objectives are:
– Improve the access to quality information about low impact building techniques through our platform, and through actively participating in our local communities. We will document our work an provide open access documents through our website and multinational network.
– Increase the skills for construction workers, NEET, migrants, refugees, students, professionals and other adults interested in the topics about low impact building techniques through workshops.
– Increase awareness about low impact techniques on an environmental-, economical-, social- and cultural level.
– Develop strategies to maximise participation and generate inclusive communities, by the use of architecture as a tool. Improve the connection between formal and informal learning systems, developing or using existing accreditation systems.
– Improve standards of natural and recycled materials use in building, by integrating the building legislation of each country and discuss possibilities with stakeholders, councils and communities.

More info at: www.bi0n.eu

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