



RAMMED EARTH

BIØN II- Follow-up report

By miga / ACTYVA

Written and edited by Lucile Couvreur, 2021

BIØN
Building Impact Zero Network



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RAMMED EARTH



Rammed earth is a building technique based on an abundant resource located under our feet: soil. Carefully chosen and mixed with the right amount of water, it is compressed with a rammer into a formwork which is then removed in order to let the wall dry and reach its final resistance. Often missed or despised, this ancestral building technique is however a key defining feature of the traditional architecture of south Extremadura (Spain).

Because earth has excellent characteristics as a building material (thermal properties, indoor air regulation, low-environment impact, etc.), it makes sense to bring it up to date here in our region, as it is being done in other places since several decades.

Dehesa Tierra association is a diverse group of people gathered as a non-profit organization with a common goal of spreading and promoting earthen construction and architecture in Extremadura (Spain). The purpose of the workshop "Design&Build with Rammed Earth" organized by Dehesa Tierra in 2018 was to investigate suitable ways of building with rammed earth, creating a small building able to last in time and meet current comfort



Opposite page

1. View on the library from the top, in the park of the municipal swimming pool (2021).

This page

1. North facade of the library and access connecting to the park (2021).

and security standards. At the same time, the idea was to suit the needs of a local community, realizing a small building that would stay after the workshop.

The place chosen to collaborate in this project was a small village of South Extremadura called Valverde de Burguillos, which in spite of its aged and decreasing population (today 273 hab.) has a municipality engaged in fighting depopulation and therefore open to receive inputs from diverse agents to boost the cultural life of the village.

With the participation of 16 trainees coming from of 9 different countries,

a 20m² book storage (small library) was built in the park of the pool of the village in April 2018 and inaugurated in July 2018. The first steps of the building (foundation and basement) were realized before the participants arrived, allowing them to focus on rammed earth technique (construction of the walls) during this the two weeks workshop.

Three years after, the small library is still standing and our organization miga | ACTYVA (whose professionals were actively involved in the project in 2018 as Dehesa Tierra members) went to Valverde to analyze the state of the building and the impact of the project on the village's life.

1. SOCIAL LANDSCAPE AND PLACEMAKING

Coming back to the small library of Valverde, the state of the rammed earth walls testify of the passing of time. More than three years have passed since the construction of the building and as we could predict, the natural erosion process has revealed the gravels and stones contained in the mix used to build the walls.

This evolution shouldn't concern us, because as we will explain after, it is something that is exponential at the beginning and then slows down with the years, until it reaches a stabilized state. But it's true that it makes look the building different and older, as well as the colour of the wooden doors, turning little by little to grey (another natural process that was expected to happen).

Entering in the building we can see that the interior has remained relatively unchanged, as a consequence probably of the few use gave to the building these past years. As predicted, the small library was only used in summer time 2018 and 2019, during the opening period of the swimming pool. In 2020 it was closed due to the sanitary crisis, and is now reopening

for the 2021 season.

The municipal perspective

Speaking with the mayor of Valverde (unchanged since 2018), we can clearly say that the municipality makes a very positive evaluation of the collaboration with Dehesa Tierra. They had a good experience in receiving the group of participants during the two weeks training, and would like to repeat the experience of hosting a BION workshop in the village in the future. In order to make it possible they need to increase their hosting capacity. Until now the village didn't have any hostel, obliging the municipality to rent private houses to accommodate the participants. But they are currently finishing the refurbishment of a building into a municipal shelter and therefore will be able to receive groups in the future.

They also explained us that the experience of collaborating with BION increased their awareness regarding the necessity of implementing sustainable building techniques in their village (which isn't always possible due to economical and administrative constraints), and to intervene to halt the deterioration of the the earth built heritage. One of the most ambitious project they have for the future is to refurbish the "electroharinera", a set of ancient rammed earth building



LO ÚLTIMO QUE VERÁN TUS OJOS
El Picante
DOLORES REDONDO
TODOS ESTO TE DARÉ

Stack of colorful children's books on the lower shelf.

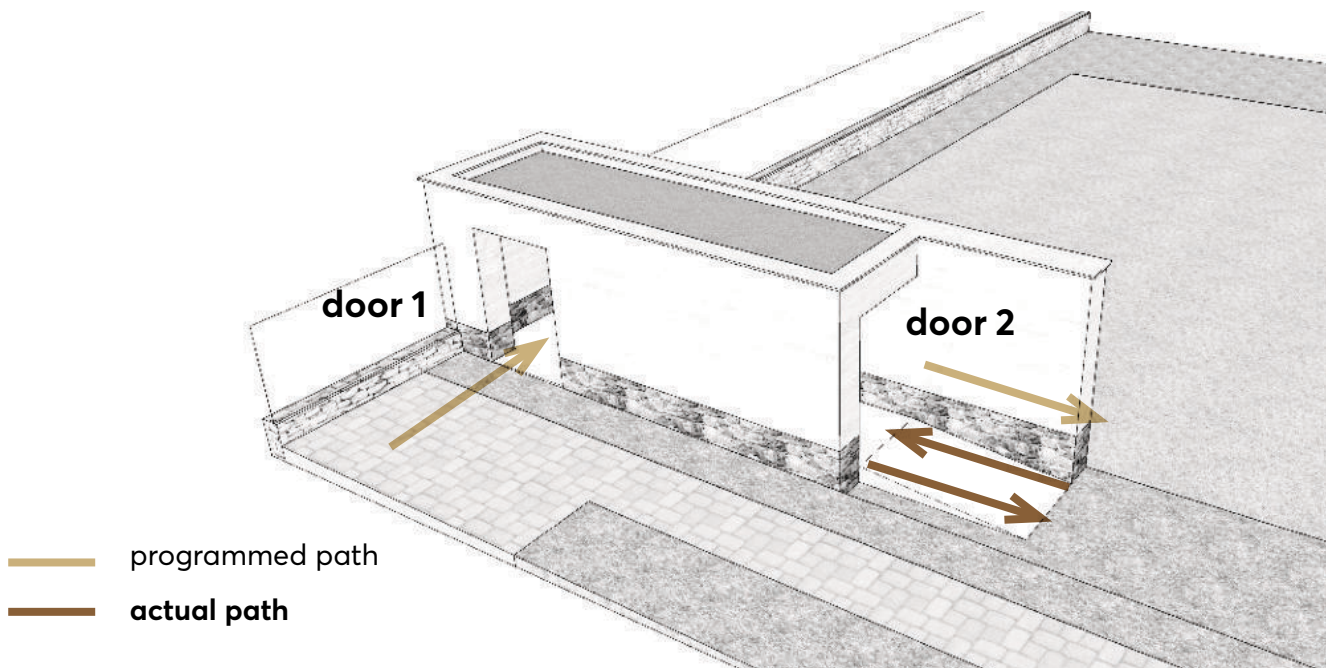


located on the outskirts of the village which the participants had the opportunity to visit during the training.

Regarding their experience the library itself, it seems that the building meets the needs of the municipality. As the mayor told us, people (especially children) like to enter and take some books and go back to the park to read on the grass. The original idea was to have a door to enter (1), and a door to go out (2), considering that the library would be like a "corridor" to enter into the park and pick a book on the way. But with the time they realized one access is enough and take the habit to let the door (1) closed. This is mainly due to the fact that they can finally count on a extra municipal worker to be attending to the users of the library (when the building was designed, they thought they would only have one

municipal employee, and that this person would watch the entrance to the library from the ticket office of the swimming pool).

Regarding the evolution of the state of the building with the years, the municipality is globally satisfied. They are conscious that the library wasn't designed as a totally closed space (there is a gap in between the doors and the walls and floor, to allow the ventilation of the space) and therefore some birds have taken possession of the building making their nests on the top of the walls in the interior. In addition, with the wind some dry leaves tend to deposit on the ground of the space. But on the point of view of the municipality, it isn't a problem, because it takes part of the building life and just requires to make a quick cleaning at the beginning of the season.



Interview with the users

Since the opening of the library, two different municipal employees have been in charge of it. Regarding their time availability, they have been offering or a basic service (opening the library few hours a day, allowing people to pick up some books, and bringing on demand some new titles from the municipal library), or a more complete service (being present all day long and proposing extra activities, mainly for children: story-time in outdoor, colouring books, etc.).

In both cases their experience of the building is that it is a functional and pleasant place. They also told us about the way people visiting the building, from the village and surroundings, are responding. According to what they say, the visitors are unan-

imous: they love the aesthetic of the building and are positively surprised of its strength and durability. They have heard many times people wondering: "How is it possible that it is still standing after so many rains? It's just earth without any render! It's incredible that not a drop of water came in and that it is still impeccable!".

Of course, listening to all these feedbacks is the best award that can receive the team in charge of the project, because it is the proof that all the objectives were reached: the workshop not only allowed to train people to the rammed earth technique, but also provided a building useful for the community, and in addition contributed to demonstrate that traditional techniques implemented with contemporary standards are a valid way to build nowadays.

Where the materials came from ?

FROM SITE ¹ 86%

The earth, gravels and sand of the walls comes from a quarry located at 6km. The stones comes from the village. The cement is made in a factory located at 9km. The soil for the green roof was taken from the park.

LOCALLY ² 10%

Part of the sand and gravels used also come from a quarry located a bit further, as well as the lime used for the slab. The ceramic tiles come from a craft factory located at 75km and the windows and dorrs were also made by local craftsmen.

TRANSPORTED ³ 4%

The wooden beams of the roof are from national production. Some other materials also had to be imported: plastic membranes and specific materials for the roof, nails and screws, etc.

¹ Village and surroundings (in a radius of 10km)

² Province (in a radius of 100km)

³ More than 100km far from the site

Percentages of the total volume of materials.



Type of material

EARTH 44%

Local earth mixed with coarse sand is the only component of the walls. It was compacted layer by layer at a humid state in wooden formworks before being sun-dried.

STONES 27%

Stones are the main component of the basement walls. They were assembled in the traditional way using just a bit of hydraulic lime mortar in the center of the wall.

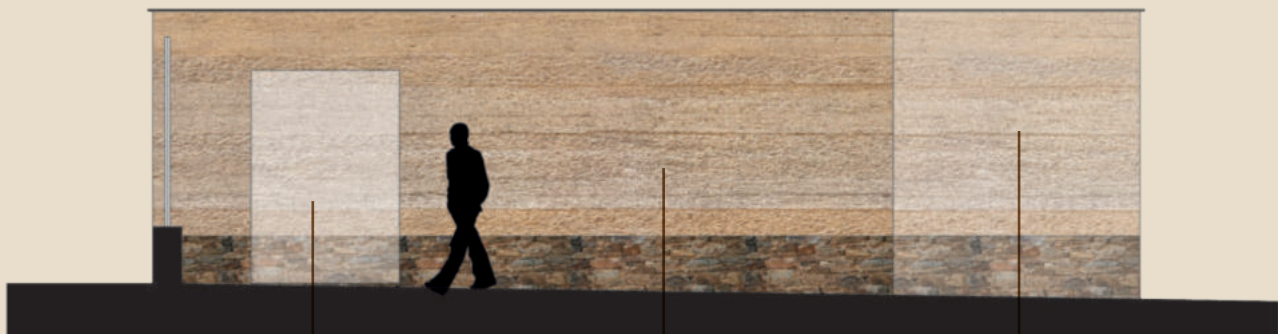
OTHER 29%

The rest of the material is cement mortar (foundations), lime mortar (slab and plasters), wood (roof, ringbeam, windows and door), metal (screws, nails, etc.), plastic (roof membranes) and ceramic (parapet and windows tiles).



Evolution of the construction after 3 years

NORTHERN FACADE



A

Natural ageing of the wooden part of the doors + incomplete air tightness.

B

Natural erosion of the rammed earth walls.

C

Heterogeneous aspect of the lime plaster.

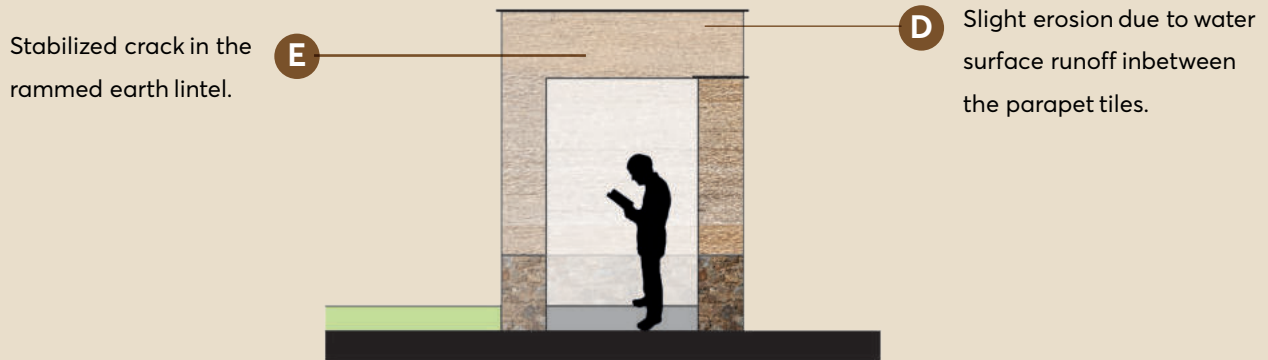
SOUTHERN FACADE

D

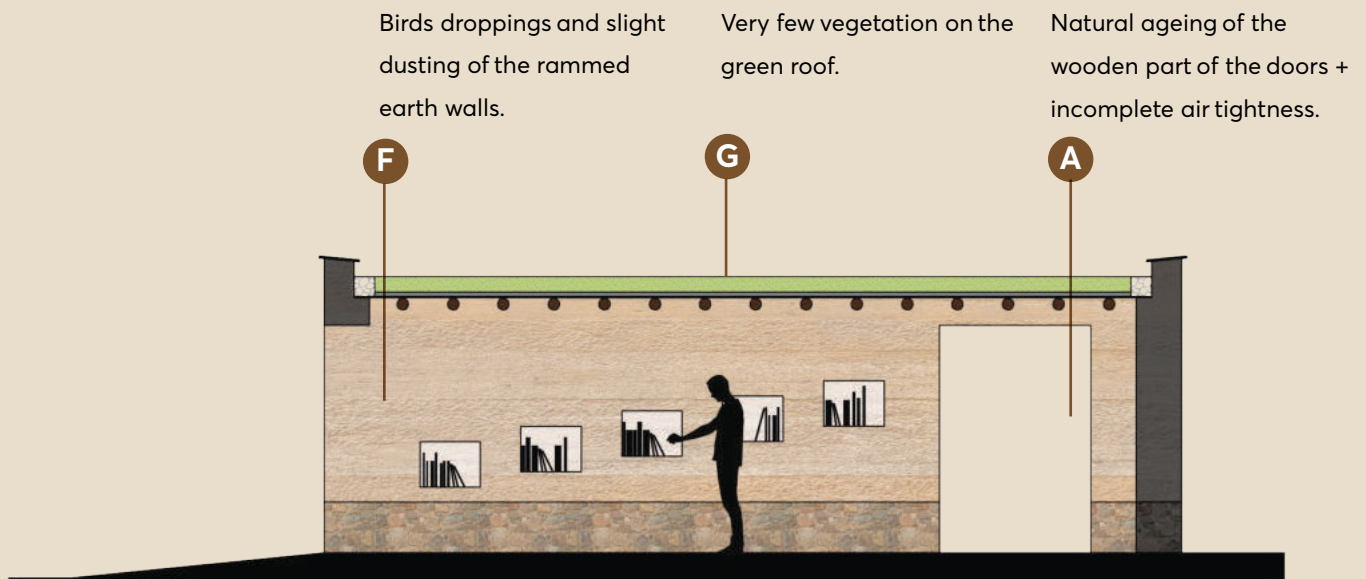
Slight erosion due to water surface runoff inbetween the parapet tiles.



WESTERN ENTRANCE (door 2)



INTERIOR OF THE BUILDING (NORTH SIDE)





2. RAMMED EARTH ARCHITECTURE AND THE TECHNICAL EVALUATION

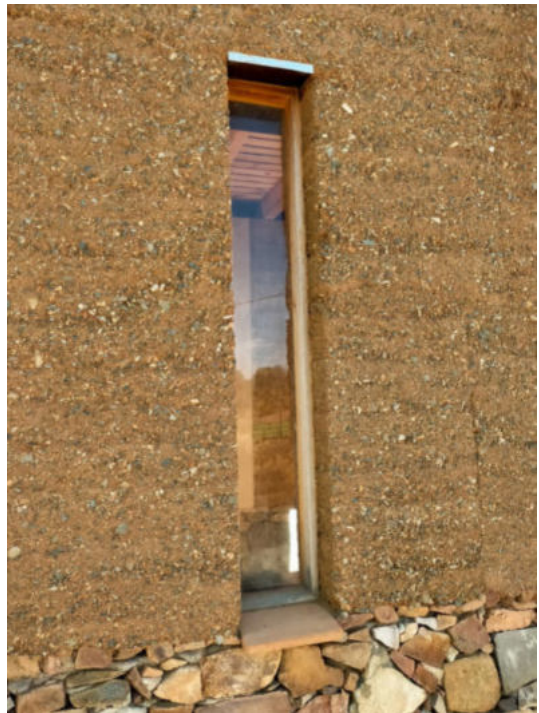
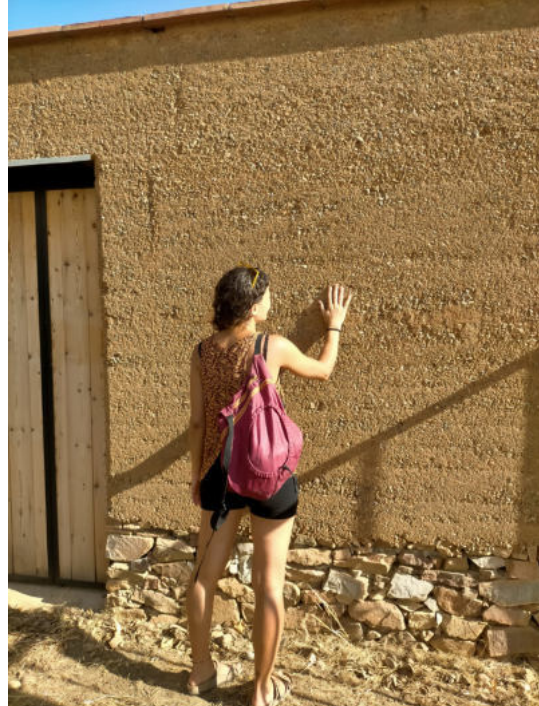
The library has been used few months since its construction, during the summer periods of 2018, 2019 and 2021 (in 2020 it didn't open due to the sanitary crises). As a consequence, the interior of the building is quite intact and no intervention was made by the users more by the municipality. Nevertheless, the exterior of the building was exposed to weathering and some changes predicted during the design phase as "natural ageing of the building" are already visible. A visit onsite at the beginning of summer 2021 allowed us to make an assessment of the building's state.

Exterior rammed earth walls

While inside the building the walls remain unchanged since their construction, the exterior walls clearly suffered an erosion process due to weathering exposition. As it could be predicted, the finest particles composing the mix (fine sands, silts and clay) were "washed", making the biggest particles (coarse sands, gravels and stones) more visible on the surface.

This natural erosion process is also called "controlled erosion process" and must not be perceived as a pathology of a building, but just as an aesthetic variation. In the first years of life of the building, this phenomenon is especially pronounced, and then slowly disappears, when all the small particles have been washed away (this is one of the reasons why it's important to have big particles in the rammed earth mix: they provide a long term surface weather resistance). Therefore, loss of mass resulting from this erosion process is so small compared to the thickness of the wall that it can't affect the structural stability of the building. This phenomenon has been largely studied and documented by Martin Rauch, an Austrian builder who has used for years the unstabilized (no cement) rammed earth technique.

The only way not to have such a big texture change with unstabilized rammed earth would be to have a larger roof overhang or to plaster the walls (this last strategy was the one adopted in the traditional architecture of south Extremadura, plastering or painting with lime the walls, also to have a higher reflection of the solar radiation and maintain a cool indoor climate). But the concept of the building designed by Dehesa Tierra was to keep the rammed earth walls visible in order to highlight the use of earth



Opposite page
South facade in 2021 (bottom).

This page
1. Detail of the northern facade in 2018.

2. Same detail in 2021.

3. Detail of the southern facade in 2018.

4. Same detail in 2021.





Opposite page

Longitudinal section of the building (view from north facade). Zoom on the composition of the roof.



This page

1. Detail of the top part of the door on west facade in 2018. A slight crack appeared in the rammed earth in the drying phase.

2. Same detail in 2021. A small cavity appeared in the rammed earth in the corner due to water flowing inbetween the tiles.

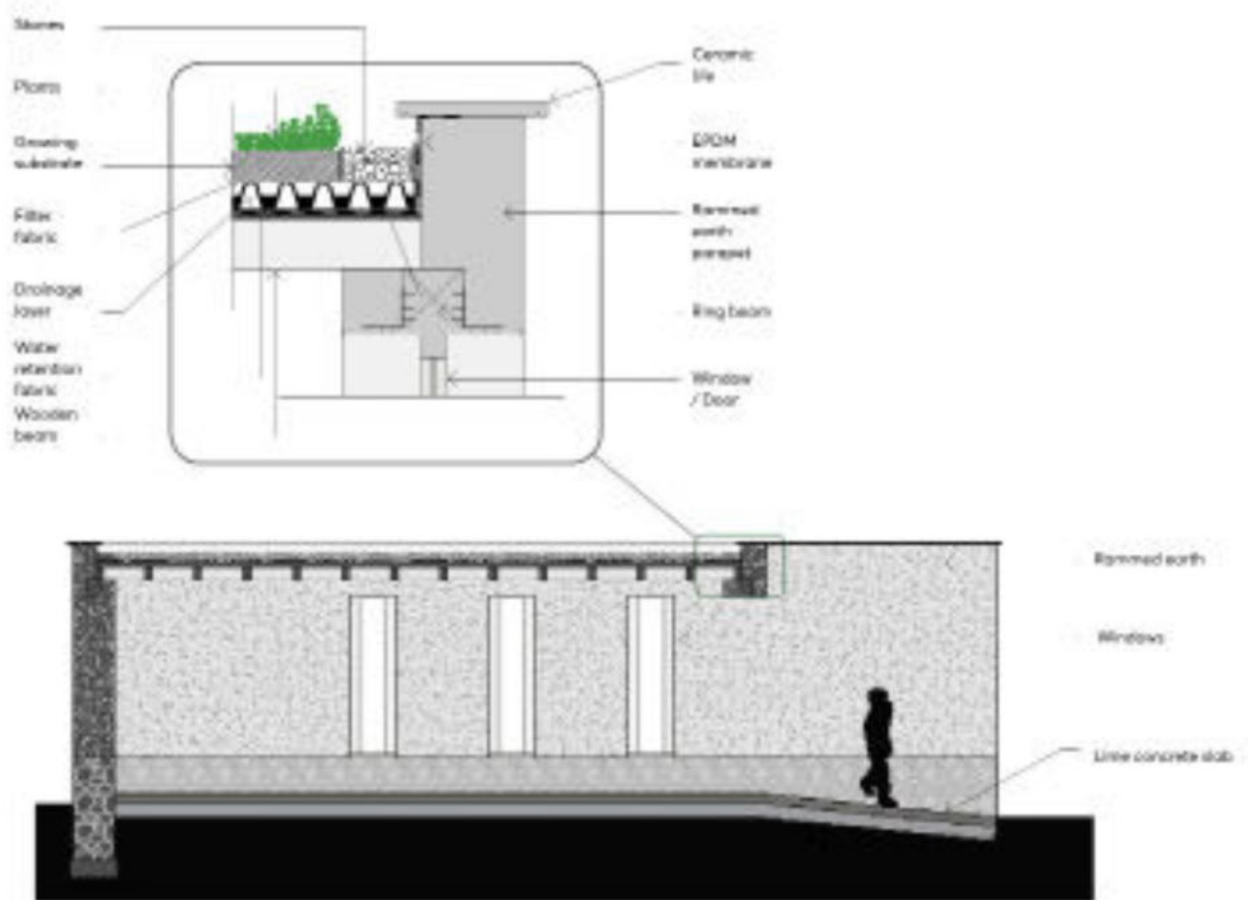
material in the construction and its capacity to last in time, ensured by two key elements known as "good boots and a good hat". Indeed, on one hand the stone basement (the boots) ensures no humidity will reach the rammed earth walls by capillarity. On another hand the ceramic tiles placed on top of the parapet, as well as the drainage system of the green roof (the hat) prevents rains to enter in the walls.

On this last aspect (the roof), there is a slight default on the building that could be corrected which is the small gaps that are starting to appear inbetween the ceramic tiles of the parapet

due to the wear of the cement joints. Therefore, small quantities of water are running inbetween the tiles and causing a slight erosion on the top of the wall. This is a phenomenon quite invisible for now but that could accentuate if no maintenance of the building is made. Actually, on the northern and southern facade is almost imperceptible for the moment, but on the western facade, a small cavity in the rammed earth already appeared.

Rammed earth lintels

The rammed earth lintels were something quite experimental in the design



of the building of the library. In real terms, the rammed earth isn't assuming the function of a lintel on top of the windows and door (as we know rammed earth can't be submitted to flexion) but a wooden beam. The rammed earth is just behaving as a cladding of this wooden lintel, on both side of the wall (see roof detail above). The experiment clearly gave good results. Only one crack can be observed (on the wester door's lintel), but as it appears a few time after the construction, during the wall's drying phase, we can deduct it is retraction crack and not a crack due to an overload on the element.

Exterior lime plasters

The exterior lime plasters were't programmed in the initial design but had to be added at the end of the construction of the building after a small accident occurs (the unexpected starting up of the grass watering system, with a water jet directed to the northern facade that in a few hours created a furrow in the recently finished walls). A few square meters of lime plaster were applied on the affected zone to repair the damage. In order to make an intervention as neutral as possible, red pigments were added to the lime mortar to obtain a surface similar to





Opposite page

Pigmented lime plaster added after the "accident" of the water-jet, in 2018 (top) and in 2021 (bottom).

This page

1. Door on the northern facade in 2018.



2. Same door in 2021. The bottom part of the door is starting to turn grey.

the rammed earth walls. For unknown reasons, few time after the application, the plasters get an heterogeneous aspect with thin surface cracks and whitish stains. Three years after, the aspect of the plaster is still the same, which isn't a problem for the conservation of the wall (the plaster is still hard and stable), but can be disturbing on an aesthetic point of view. There are several hypothesis to explain the pathology observed : presence of unwanted salts in the sand or in the water used for the mortar? pigment overdose? Additional research should be made to know the exact cause.

Wooden doors and windows

The two folding doors located on the northern and western facades were tailor-made for the project by a local artisan with steel and wood. After three years of existence of the building, they are in a perfect state and we can only appreciate a change in the colour of the wood which is turning to grey, something that was actually predicted and assumed in the design of the project as a "normal ageing" of these elements. A linen oil treatment was applied in the moment they were placed but wasn't repeated since this moment. For a good maintenance of the building, this oil should be applied every two or three years.



Opposite page

View from the inside of the library.

This page

1. Gap in between the door and the wall (the building wasn't designed to be a totally closed space).

On the contrary, the windows wooden frame, treated with varnish by the company that made them, are in a perfect state. Eventhough, it is recommended to realize a maintenance every 5-10 years.

What could be improved in the design of the doors is their air tightness. Indeed, the gaps between the door and the floor, and the door and the lintel are big enough to allow dry leaves and animals to enter in the building. As mentioned before, it was intentional in the moment of the design of the building to have this air permeability of the building, because the use it would have (obviously, a library in summer time doesn't requires the

sane indoor climate conditions than a house inhabited all the year). Even if the municipality didn't expressed any inconvenience regarding this point, it's true that this could be solved in order no to have to make a deep cleaning of the library every year before the opening (while sweeping the dry leaves is easy and quick, washing the birds droppings on the walls is a bit more difficult). An easy way to fix this problem would be to place two "combs" or wooden pieces on the bottom part and top part of the doors to fill the gaps.

Interior rammed earth walls

Apart from the problem mentioned before of the birds droppings, the





Opposite page

View of the northern facade in 2018 (top) and 2021 (bottom).

This page

1. Nest on top of the wall in the interior of the library.

interior walls are in good general state. Touching the rammed earth walls, their texture is almost unchanged and stable. Nevertheless, we can observe on the ground and on the ceramic windows sills a small deposition of earth particles, indicating a slight erosion of the walls. Although the walls were impregnated with a stabilizing a lithium silicate solution after the construction, there is still a minor loss of mass that will probably decrease with the time.

Green roof

In three years, in spite of the intense precipitations, no water entered the building, demonstrating the efficiency of the solution proposed for the roof

(a multi-layer green roof system made of several plastic membranes and substrates, see section on p.19). Even in the absence of maintenance, the evacuation pipe located on the eastern facade is still working perfectly. As expected, really few plants have grown on the roof (the appellation of "green roof" should be reviewed!). Indeed, it was intentional not to plant anything on the roof in order not to generate extra maintenance work to the municipality (the intense heat of the local climate would require the installation of a watering system for the roof's plants). It is true that without plants, the "green" roof isn't fulfilling totally its function. The presence of vegetation would be benefic for the local





Opposite page

Inside of the library in 2021.

This page

1. Furnitures made by Ak0 during the workshop.

biodiversity, and also to keep the roof fresh in summer thanks to the natural phenomenon of evapotranspiration of the plants. Regarding this last point as we said before, having a really cool indoor climate wasn't an objective for this building which is only a "passage place" for the readers.

Rammed earth furnitures

Regarding the rammed earth furnitures (reading space) built by the partner Ak0 during the workshop to experiment with the prefabrication techniques, three years after the construction there is no trail of it. Unfortunately, the elements didn't resist to the first rains and had to be removed from

the site few time after the workshop. A higher basement and maybe some more stabilization is required to keep this kind of rammed earth elements exposed to weathering.



3. EDUCATIONAL AND NETWORKING APPROACH

Impact on the participants

An evaluation sent to the participants at the end of the workshop in 2018 revealed the weak and the strong points of the training and allowed the organization team to make a balance of the experience.

Now that more than three years have passed since the construction of the library, the contacts with the international group of participants are increasingly rare, but still existing.

Recently we asked again to some of them to look backward to the experience they had in Valverde in 2018, and through their answers we can appreciate how the workshop impacted them:

These are the three important things I learned from my experience in Valverde: build together, build with the earth and build by learning. When these three things come together with a single goal, the energy that is created on site is incredibly powerful.

– Participant in workshop 2018

It is clear that the "learning by doing" methodology has proven its worth, at least for the type of profile of participants that are mainly attending BION workshops (architecture students, young architects or building engi-

neers), who are definitely in demand to have a closer contact to the materials and the building site.

Building on a real scale allows you to directly understand what the design choices were, the construction details, and the hard work and sweat required to build it. Practice has been an important and essential part of my training.

– Participant in workshop 2018

In this learning process, as it has been highlighted in previous BION publications, the social and political dimensions are key factors for the trainees to get involved.

Knowing the use that the space we were building was going to have in the future was very inspiring. The technique itself and the purpose of the building were making us feel connected to the place.

– Participant in workshop 2018

We know that for some of them the workshop has been the starting point of a professional career in the earth (or sustainable) construction field, by creating their own company, by entering existing organizations or by continuing their learning process in other contexts.

I was interested since a long time to learn



how to build with rammed earth but it wasn't so easy to find a workshop like this one to practice at an advanced level.

– Participant in workshop 2018

Of course it is a great satisfaction for the trainers and organizers of the workshop to see that some participants have been impacted in their lives much beyond the experience of the workshop itself.

An increased visibility

The dissemination work realized after the workshop clearly contributed to increase the visibility of Dehesa Tierra association, and in general, of the issues linked to rammed earth construction at a regional, national and even international level, for the general public, but also in the academic field. The following events, medias and pub-

lications might be highlighted :

- An exhibition in the Colegio de Arquitectos de Extremadura (CO-ADE) in Cáceres, provincial capital (November 2018).
- A 6min report in "El Lince von Botas", a program of the regional channel "Canal Extremadura" (November 2018)
- A 4 pages article in "Ecohabitar", main magazine about eco-building in Spain (Spring 2019).
- An 8 pages article in the Proceedings of 7th International Conference on Heritage and Sustainable Development, HERITAGE 2020. (November 2020).
- A 13 poges paper in Construction and Building Materials (September 2021).
- Several final degrees of students of Sevilla University in the Architecture and Engineering fields.



4. REFLECTIONS

Local vs global impact

As mentioned in the previous section, the workshop had a great impact on participants and also some repercussion at diverse scales (public in general and academic world). But what about the impact on the local community?

Before and during the workshop, the organizing team tried, in collaboration with the municipality, to catch the attention of the inhabitants of Valverde and surroundings through multiple strategies: public presentation of the project, digital and physical communication campaign, discount on registration fees for locals, recourse to local craftsmen for some parts of the buildings, celebration day and inauguration day, etc.

Nevertheless, the local community remained in the background in all this process, giving the feeling that the purpose of the workshop was more to build *for* than *with* the local community. As this tendency was also observed in other workshops of the first edition of LearnBION project, the partners decided to engage a reflection on this topic for the second edition, by asking AES partner to do some staff training on its approach of placemaking.

Building for training or building for building?

We may ask ourselves how the fact that this building has been realized in the framework of a "learning by doing" process can have affected the way it was designed and built and the final result obtained.

In other words. Would it have been the same to build the library with a team of 3 or 4 professional builders? Of course, the answer is no.

Building with a team of 15 unexperienced trainees makes the construction site much different and challenging: you have to think smaller (it has to be possible to finish on time) but you have to think big enough (it has to be possible for everybody to work at the same time without disturbing the others). For example in this case, the the "excess" of manpower compared to the size of the building didn't justified the use of machines to compact the earth. In a professional building site, some pneumatic rammers would probably have been used. Even if it was a sound decision, it can give a false representation of "what is building with rammed earth nowadays" to the local community. Compacting

with machines would probably have communicated on a more direct way a certain idea of modernity. In the case of Valverde we can say this objective was achieved by the aesthetic of the building, intentionally ground-breaking in regard to the traditional local rammed earth architecture.

Design & Build workshops, a model to be developed ?

The experience of the first edition of LearnBION, not only the workshop in Valverde, demonstrated that there is a great interest of different publics (young architects and engineers, but also selfbuilders and a wide range of profiles) to learn about low impact building techniques through "Design & Build" workshops. A quick overview on the european contexts makes us realize that there is clearly more demand than offer for this kind of training experience, and that this demand is increasing.

On this base we could easily conclude that the Design & Build workshop is a model to develop, but nevertheless, this raises some issues, basically because from an organisationnal point of view, this is a really time consuming process. Each workshop is tailor-made for a new intervention context, trying to answer as much as possible to the needs of the local community, with technical solutions inspired on vernacular architecture and based on local material and human resources, etc. Thus the concept of this type of workshop itself is anything but efficient and rentable.

In view of these observations, how to

guarantee the long-term sustainability of the organizations carrying this type of initiatives ? This is the reflexion the network proposed to conduct in the second edition of LearnBION project, and this is the reason that motivated the integration of a new partner in the consortium, the Institut d'Etudes Politiques de Grenoble (Science Po Grenoble), which through its ChairESS is promoting and supporting the agents of Social Economy through the territorial approach methodology.

The challenge in the future will definitely be to be able to increase our training offer without altering the initial concept and values of our workshops.





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 and 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 architec-

ture 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

ERASMUS +

Erasmus+ is the European Union programme for education, training, youth and sport. It runs for seven years, from 2014 to 2020, with organisations invited to apply for funding each year to undertake creative and worthwhile activities. Erasmus+ aims to modernise education, training and youth work across Europe.

Written and edited by Lucile Couvreur, 2021. Photos by **Dehesa Tierra** and **Miga/ACTYVA**. Drawings and illustrations by Dehesa Tierra. **Graphic layout TIP**

ISBN 978-989-33-4401-9



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Contact contacto@eco-miga.es

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