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Alessandro Peinetti, Giorgia Aprile, Kati Caruso, Claudia Speciale

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# PLAYING WITH THE TIME. EXPERIMENTAL ARCHAEOLOGY AND THE STUDY OF THE PAST

**Editors:** Rodrigo Alonso, Javier Baena & David Canales





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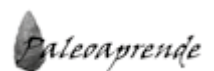
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## LOOKING FOR A SCIENTIFIC PROTOCOL IN PREHISTORIC DAUB EXPERIMENTAL PROJECT Buscando un protocolo científico para un proyecto internacional de barro prehistórico

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### Abstract

Earthen materials are deeply present in the building traditions. Their study typifies a key analysis, not only for the history of architecture and technology but also for the investigation of social and economic dynamics. There is no experimental reference system for the technological and morphological variability in wattle and daub. It is possible to identify four main categories of experimental variables related to: raw materials, frame technology, daub technology and firing/decay processes. These variables are verifiable and can be documented by a settled protocol. In order to obtain a large amount of information, we opted for a prototype made of portions of full-scale walls.

**Keywords:** wattle and daub, earthen architecture, fire, prehistoric technology, experimental protocol.

### Resumen

La tierra es un material muy presente en las tradiciones constructivas. Su estudio supone un análisis clave, no sólo para la historia de la arquitectura y la tecnología, sino también para la investigación de la dinámica social y económica. Se puede señalar la ausencia de un sistema de referencia experimental para la variabilidad tecnológica y morfológica de los rebocos y muros. Es posible identificar cuatro categorías principales de variables experimentales relacionadas con este tipo de edificación: las materias primas, la tecnología de muros, la tecnología del barro o lodo y los procesos de quemado / desintegración. Estas variables son verificables y pueden ser documentadas mediante protocolos establecidos. Con el fin de obtener una gran cantidad de información, optamos por un modelo de prototipo hecho por partes de paredes a una escala completa.

**Palabras clave:** bahareque, construcción de tierra, tecnología prehistórica, fuego, protocolo experimental.

## **INTRODUCTION**

Burned daub fragments are frequently found in archaeological contexts. The partial conservation and the different shape of these remains, as well as the various use that earth materials had for ancient communities, complicate their interpretation. Daub, especially when the fragments show the frame imprints, is often related to the wattle and daub technique. To obtain this material, sediments are mixed with water, sometimes also adding vegetal or mineral tempers. Rammed earth, cob, mudbrick and other hybrid techniques are part of the technological choice since prehistoric times (De Chazelles, Klein 2003). Earthen materials are deeply present in the building traditions from Prehistory until nowadays and therefore in the archaeological record. So their study typifies a key analysis, not only for the history of architecture and technology but also for the investigation of social and economic dynamics.

This paper focuses on daub and wattle and daub technique. It represents a topic of primary relevance for the study and interpretation of building techniques in ancient times and one of the main archaeological proxies for the interpretation of single dwellings.

Experimental archeology on architecture often concerns woodworking and general structural problems (i.e. Drury, 1982; Petrequin, 1991), firing dynamics (Shaffer, 1993; Apel et al. 1997; Gheorghiu, 2005; Rasmussen, 2007; Tipper 2012) or the amount of daub preserved after a firing event (Bankoff, Winter, 1979; Cavulli, Gheorghiu, 2008). An experimental reference system for the technological and morphological variability in wattle and daub and other earth building technologies is so far absent. The aim of this project is to test this variability and to provide more elements for its identification in the archaeological record. For the first stage of the research, we want to focus the experimentation mainly on burned daub fragments.

## **QUESTIONS**

Several questions are raised during the analyses of archaeological daub, first of all about the nature and provenance of earthen raw materials and their selection or preparation. Investigations on the processing strategies relate to the identification of intentional or random inclusions (vegetal and mineral tempers, anthropogenic features intentionally added or different kinds of random inclusions), daub moisture (water *ratio*) and the accuracy of the mixture. The estimation of volume of the different components represents a relevant issue for the lines of research.

In terms of wattle and timber framework technologies, the identification of the materials and their assembly strategies are mainly based on the morphological analysis of burned fragments, especially their imprints. Is it possible, through the print analysis, to recognize different classes and species of timber or other organic materials employed for the structure? What about their processing (i.e. debarking) and their assembling strategies? How can we find the correct orientation of the prints and the original position of the imprinted elements in the dwelling? Why did researchers find a low number of fragments with cross-prints in prehistoric contexts? These are just a few questions about the morphology of dwellings and frames.

It is also difficult to identify the daub installation techniques, especially to recognize the movements used setting the earthen materials on the wall surfaces and the finishing processes. This technological study could be helpful for the correct orientation of fragments as well.

	Variables	Recorded features	Guidelines for description
RAW MATERIALS	Sediment(s)	Excavation site and land use	Description, cartography
		Texture, structure and porosity, moisture, anthropogenic inclusions	Field description, visual esteem
		Colour	Munsell Soil Colour Charts
		Content of carbonates	HCl test (FAO 2006, p. 38)
	Mineral and/or vegetal additives (*)	Nature, size, shape	Description (before processing)
		Amount	Volume esteem / count
	Water	Amount and source	Volume esteem, provenance of water
	Wood, reeds or other organic raw materials for the frame building (before processing)(*)	Species and ecological provenance	Identification, description
		Procurement practice	Description of technique (**)(***)
		Morphology of raw materials	Direct measurement and description
Amount of raw materials		Volume esteem / count	
Processing of wooden and other organic raw materials(*)	Processing practice	Description of practice and tools (**)(***)	
	Morphology of elements (shape, size, features)	Accurate description, direct measurements	
	Frame elements installation	Description of technique and gestures, pictures, videos (**)	
Installation technology	Binding, joints, mortises	Description, direct measurements, drawing drafts, pictures	
	Frame morphology	Final shape and size of the frame	
DAUB TECHNOLOGY	Sediments processing	Processing practice and final results (shape, size and features of the elements)	Description of techniques and employed tools (**)(***)
		Additives processing	Description of gestures, tools and structures (i.e. mixing hole) (**)
	Mixing process	Mixing technique	Volume esteem for each constituent element
		Mixing ratio (sediments/additives/water)	Visual esteem of the mixture homogeneity
		Degree of mixing	Moisture esteem (Houben, Gillaud 2006, p. 33)
		Daub moisture	Tactile esteem (Houben, Gillaud 2006, p. 57)
		Plasticity	Identification, description
	Installation technology	Installation process	Description of gestures and of used tools - if any -, videos, pictures (**)
		Daub surface finishing	Description of gestures and tools, videos, pictures, description of final result (**)(***)
	Daub final morphology	Placement of daub on the frame	Description, draft drawings
		Daub thickness	Measurements
	Drying process	Drying time	Visual esteem/time
		Drying ratio	Alcock test (Houben, Gillaud 2006, p. 57)
		Drying effects	Description of effects on different parts of the structure

(\*) All the entries are to be repeated for each material  
 (\*\*) Suitable recording of time and manpower  
 (\*\*\*) Specify if modern tools are used

Figure 1. Variables and guidelines for description, concerning raw materials and building technology.

	Variables	Recorded features	Guidelines for description
LIFETIME	Damages or alterations	Building responses to environmental stress	Record events and mechanisms
	Maintenance	Maintenance process	Record all the maintenance process (following the protocol, fig. 1)
FIRE DYNAMICS	Fire event	Fire spreading	Description, videos, pictures
		Fire development	
		Time	Thermocouple in different control points (if possible)
	Temperature		
Environmental conditions	Season, weather, wind, humidity, biological features around the building	Description, recording, measurements	
Fire effect	Fire effects on the walls, possible collapse dynamics	Description, videos, pictures	
DECAY		Daub hardening or decay	Description, sampling, recurring pictures
		Different decay patterns of the structure / time	
		Weathering	
		Biocorrosions	
	Resulting deposit		

Figure 2. Variables and guidelines for description, especially concerning fire dynamics and decay.

Finally, the identification and recognition of firing, decay and taphonomic processes is essential for the correct reconstruction of archeological structures.

### PROTOCOL

Our experimental protocol is only a first suggestion and a starting point for all the scholars who study daub technology. It is possible to identify four main categories of variables related to:

1. Raw materials (employed for daub and for the frame).
2. Frame technology (processing and assembling of materials; final structure of the frame).
3. Daub technology (processing and installation of daub; final appearance of the wall).
4. Firing and decay processes (building and daub).

Each category is composed by several different specific variables, which can be documented during the experimentation (Figures 1 and 2).

But how is it possible to test the variety of building techniques? The experimentation on new real scale buildings can give very complete and accurate data, but it takes a lot of time and resources. Moreover, dwellings in Archaeological Open Air Museums or other real scale buildings are rarely constructed to be burned, except in exceptional cases of accidental burning or experimental projects focused on burned buildings (i.e. Apel et al. 1997; Bankoff, Winter 1979; Cavulli, Gheorghiu 2008; Gheorghiu 2005; Rasmussen 2007; Shaffer 1993; Tipper 2012). In order to obtain a large amount of information, for our set of



Figure 3. Experimental model exposed to a final fire event.



**Figure 4.** Different steps of the experimental protocol, according to the aim of the project.

the other hand, issues regarding the lifespan of the dwelling and the decay processes require long experimental procedures (in terms of time, at least months or years) and are extremely variable. Furthermore, firing dynamics for the models can be too different from the full-scale ones, so at this moment it is hard to find answers for this topic. Experiments with models can be complete in term of technological and morphological analyses of the structure, but data on fire dynamics and conservation of remains are just approximate.

Each experimental model, based on archaeological data, is composed by two parallel walls, that are 2 metres long and 1,5 metres high, and a light-weight roof to protect them (Figure 5). Two of the three main variables are constant for both walls. Just one of the variables changes and this allows the comparison between two different sets of raw materials, two specific frames or two techniques of the daub installation. Measurements and records have to be done before and after the firing event. Particular care must be paid to the technical process (Figure 6). All the morphometrical and morphological data about the frame and the earthen construction are recorded. After the fire event and a short period of abandonment, the experimental model can be analyzed by archaeological methods and all the burned daub fragments are collected. They are studied from a macroscopic point of view, with the same protocol generally reserved to archaeological materials, in particular: quantification and size recording; description and measurements on surfaces and prints; recording of the shape of the fragments by correlating imprints and surfaces; cross-section of fragments to observe the composition, the granulometry and the pattern of the constituent features; colour recording; esteem of hardening rate of fragments; further analyses (i.e. paleoethnobotany or soil micromorphology) can be realized to answer specific questions. Then the experimental materials can be compared with archaeological ones. In a second phase, it is necessary to relate every experiment to each other. Thus we hope to identify specific markers that explain technological behaviors and contribute to a better understanding of the archaeological record.

experiments we opted for a prototype made by portions of full-scale walls. Each model is exposed to a final and unique firing event (Figure 3). It represents the only way to obtain reliable data and testing very different hypothesis in controlled conditions without building a whole dwelling. The approach we adopted can give a considerable quantity of data, but less complete and more general observations. Our experiments are not an alternative but a complementary study to the experiments on the full-scale buildings.

Question marks are extremely complex. The first points to be evaluated concern raw materials and building technology. These variables are verifiable and can be documented by the settled protocol at the first step of the experimental process (Figure 4). On



**Figure 5.** Experimental model after its realization, waiting for the fire event.



**Figure 6.** Recording the hand movements during the placing of the daub.

## CONCLUSIONS

It is as yet too early to answer the initial questions and to compare the data between the different models, as we need to proceed at least to collect the data on the fragments.

There are several prospects to strengthen the experimental research on different scales; the main aim is to estimate the reliability of the models. In the meanwhile, we want to test and verify the reliability of the protocol. The first steps are to obtain and process the data of every single model compared to its own archaeological context and to create an experimental collection. All the results of the experiments will be compared to identify analogies and differences that can help the archaeologist to recognize architectural technologies and behaviors through daub analysis. The second step is to cross the data to have answers from different models, in order to obtain a reference system for daub analysis and earthen structures (Figure 3).

The seeds we want to sow in experimental dwelling makers' minds are to evaluate and record all the possible information about daub, in the archaeological openair museums or in any other kind of rebuilding projects. The protocol here proposed is effectively adaptable to every kind of experimental project on earthen architecture (on both real scale dwellings and scale models). The final purpose is to create an international network of experimental daub researches, collecting more and more data to compare and to share and regulate the vocabulary and the protocol for daub analyses in archaeology.

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