REEDCOB - An eco-efficient building technology for monolithic walls based on earth and reeds

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CONCEPT

- Development of a new monolithic wall building technology, with low embodied energy, easy to build and, therefore, environmentally friendly and technically efficient
- Use of local materials: mainly earth and reeds (canes and fibers)

METHODOLOGY

- Production and preliminary characterization of small samples of the wall materials for choosing the mix
- Production of a real scale cellule, assessment of the building technology, building conditions and needed craftsmen skills
- Continuous monitoring of the cellule to assess efficiency and durability

MONOLITHIC WALL TECHNOLOGY

Lime-stone concrete foundation

Wood vertical bracing elements, inside the wall

Wood vertical formwork elements (to reuse)

Sucessive layers of earth-reed fibers mortar and reeds

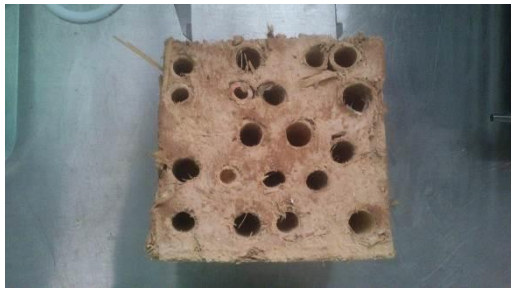
Lightweight wall, with a big percentage of reed cane fibers and air voids inside the reed canes

MATERIALS, MORTAR AND SAMPLES

Mortar materials	Local excavated earth	Lime putty	Artificial pozzolan	Reed fibres
Volumetric composition	1	0,09	0,06	1

MATERIALS, MORTAR AND SAMPLES

Giant reed canes
(Arundo Donax)



Samples 4 x 4 x 16 cm – mortar without reed fibers

Samples 10 x 10 x 20 cm (for flexural) – mortar with reed fibers and layers

Samples 15 x 15 x 15 cm (for compression) – mortar with reed lfibers and ayers

Samples 15 x 15 x 2 cm (for hygroscopicity) – mortar without reeds

……..

TESTS ON SMALL SAMPLES

Bulk density

Flexural and compressive strength

Dynamic modulus of elasticity

TESTS ON SMALL SAMPLES

Water vapor permeability

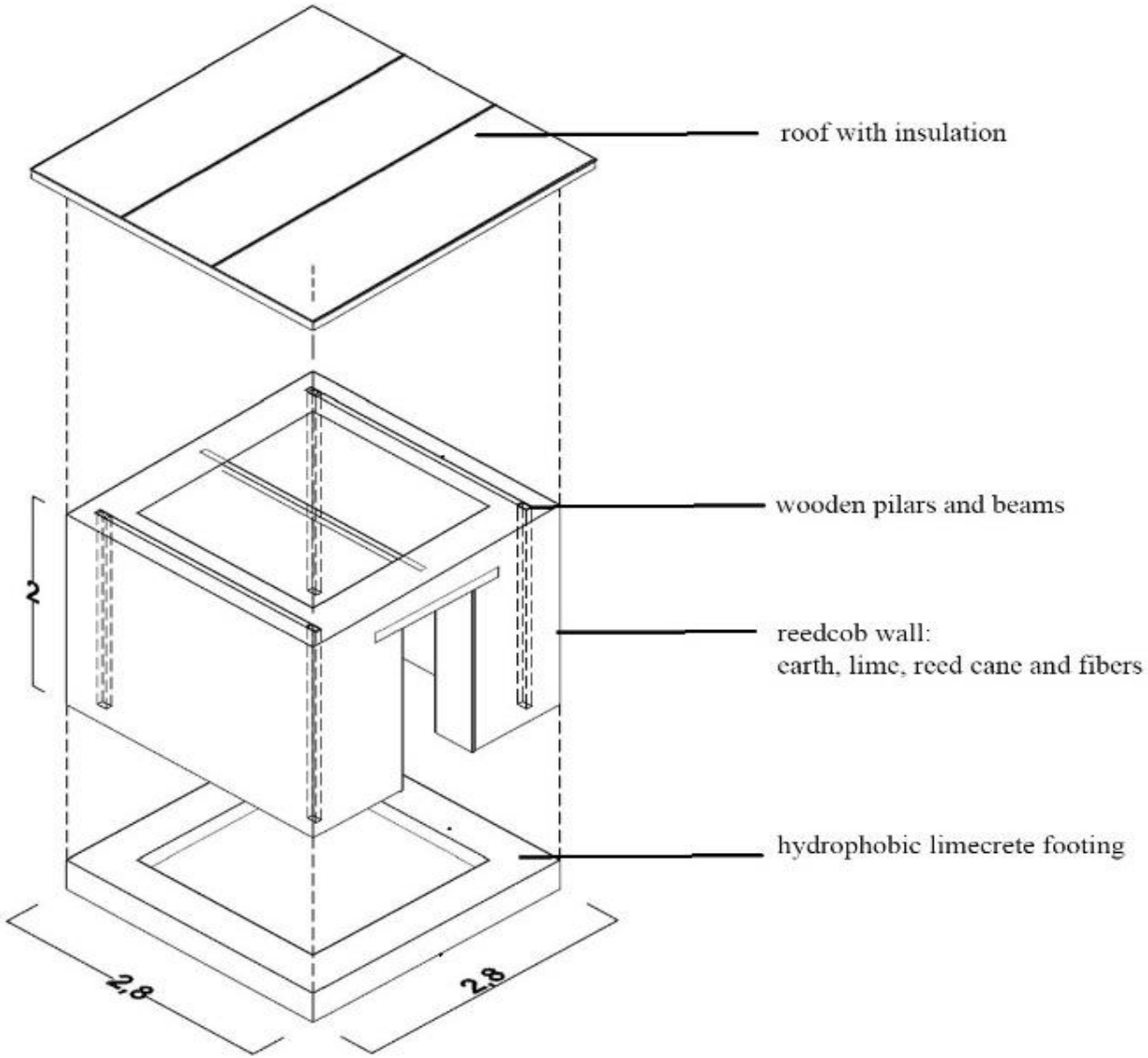
Thermal conductivity

Drying capacity

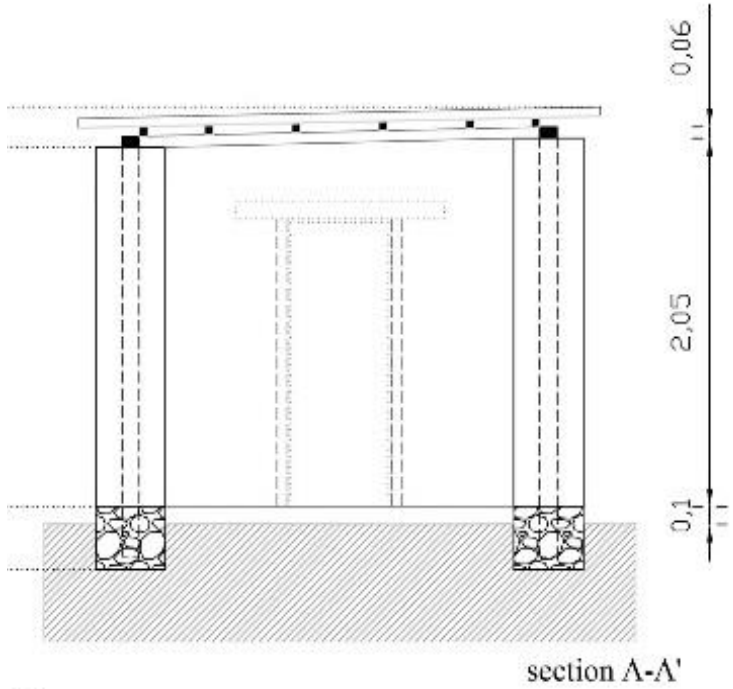
Hygroscopicity test

And others…

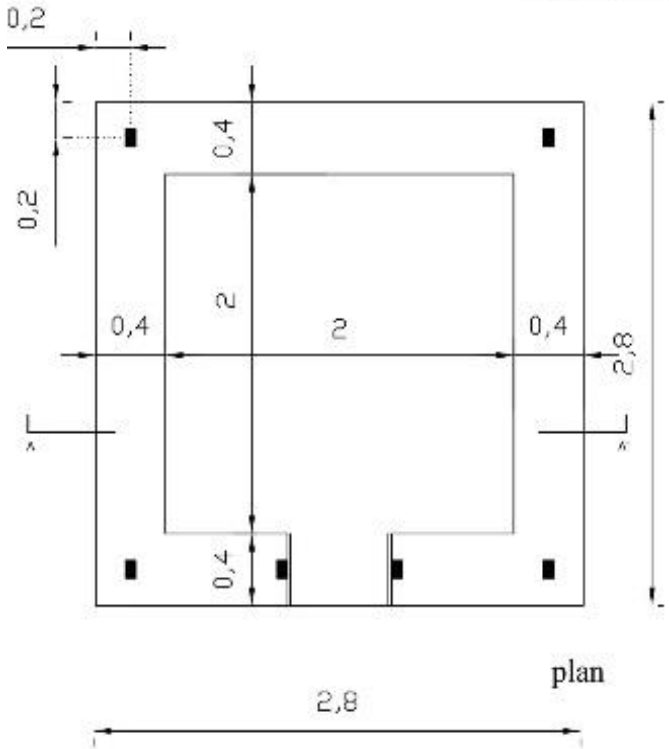
THE CELLULE



[Carneiro et al. 2016]



section A-A'



plan

BUILDING THE CELLULE

Hydrophobic lime-stone concrete foundation

Wood vertical bracing elements, to be included in the wall

BUILDING THE CELLULE

Wood vertical formwork elements, lateral to the foundation, defining the wall thickness during the building of the wall (to be reused)

BUILDING THE CELLULE

Sucessive layers of earth-reed fiber mortar and layers of reeds

BUILDING THE CELLULE

Simple scafold

BUILDING THE CELLULE

The mortar can be made by hand but mechanical help is very positive!!!

BUILDING THE CELLULE

Top of the door opening, top of the wall and roof structure

A group of 2 architects and 3 civil engineering students built the cellule walls in 4 days (July 2014)

BUILDING THE CELLULE AND ASSESSMENT

A thermal insulated roof was applied

DURABILITY ASSESSMENT

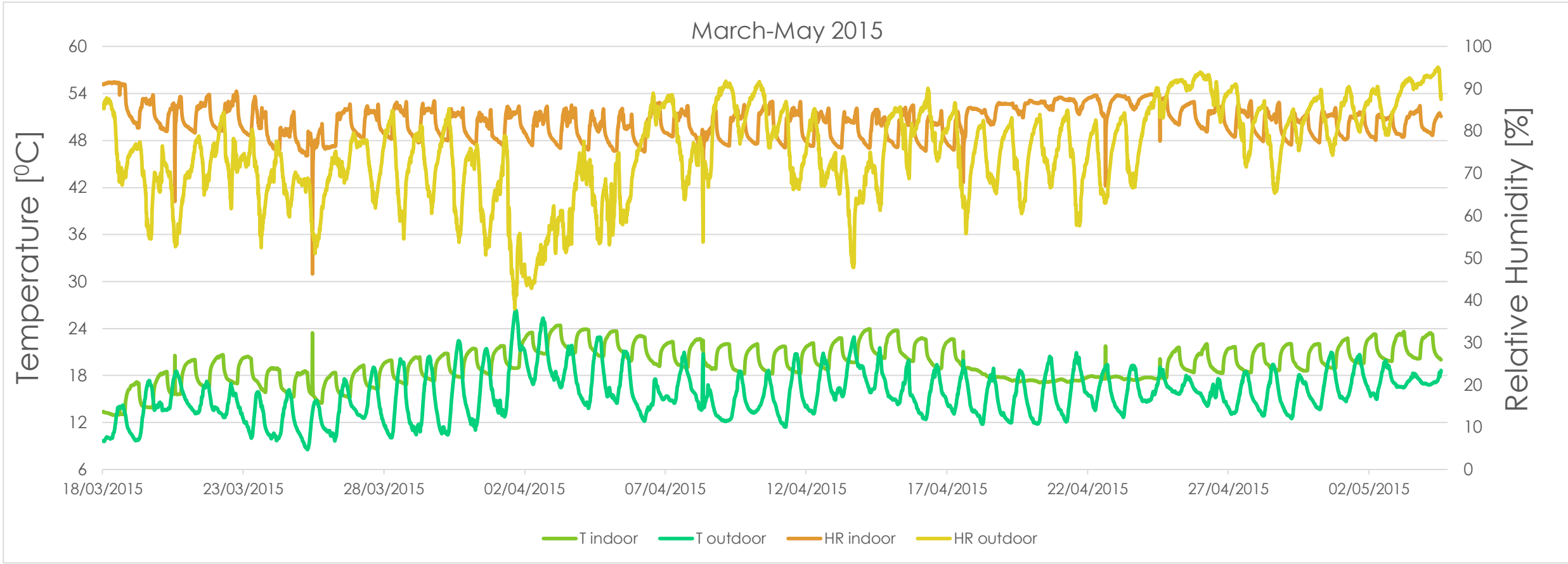
Good during the 1.5 years of natural exposure

South and West facades were limewashed

North and East facades were left without any rendering or paint system

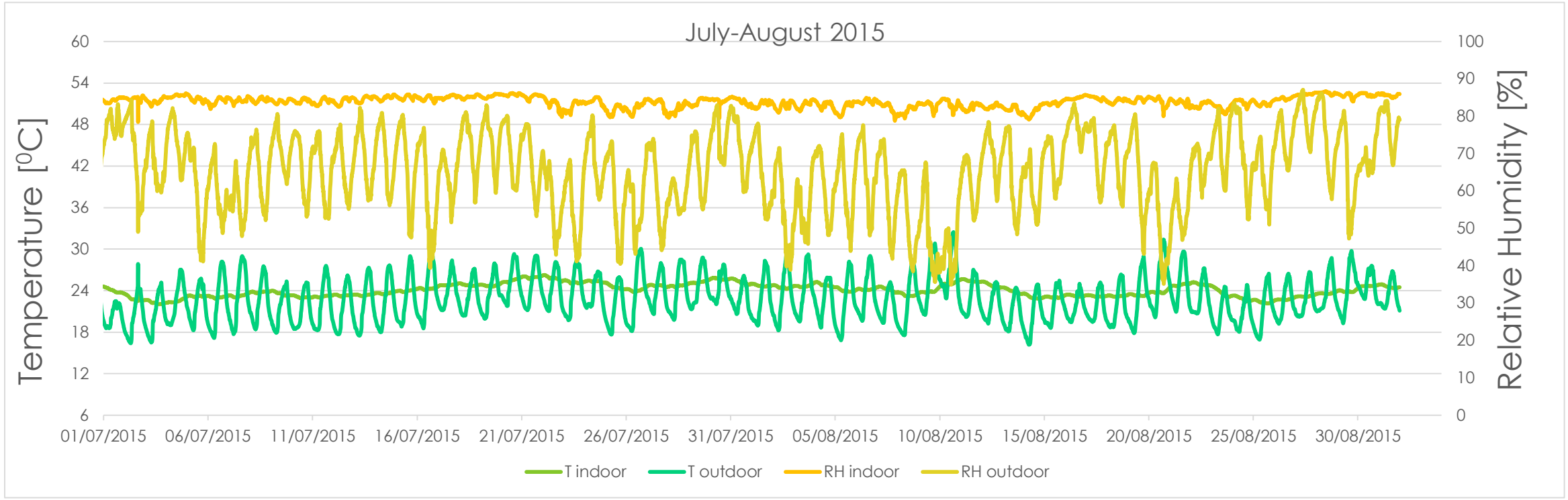
Cellule: exterior and indoor temperature and relative humidity continuosly monitored

RESULTS



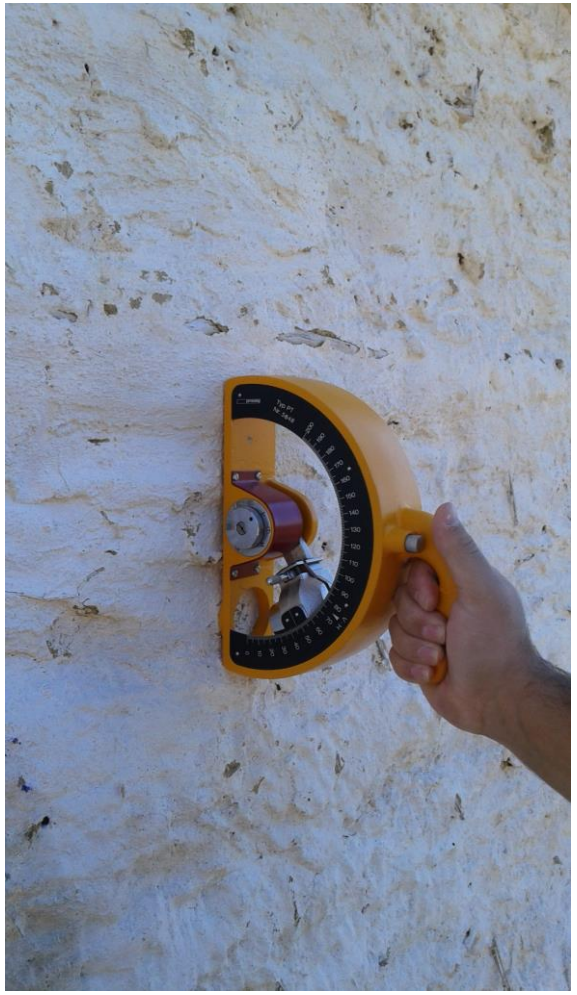
With a simple heating device working from 7pm to 7am (except between 18-23th April):
Much stable indoor temperature and with thermal inertia effect

RESULTS



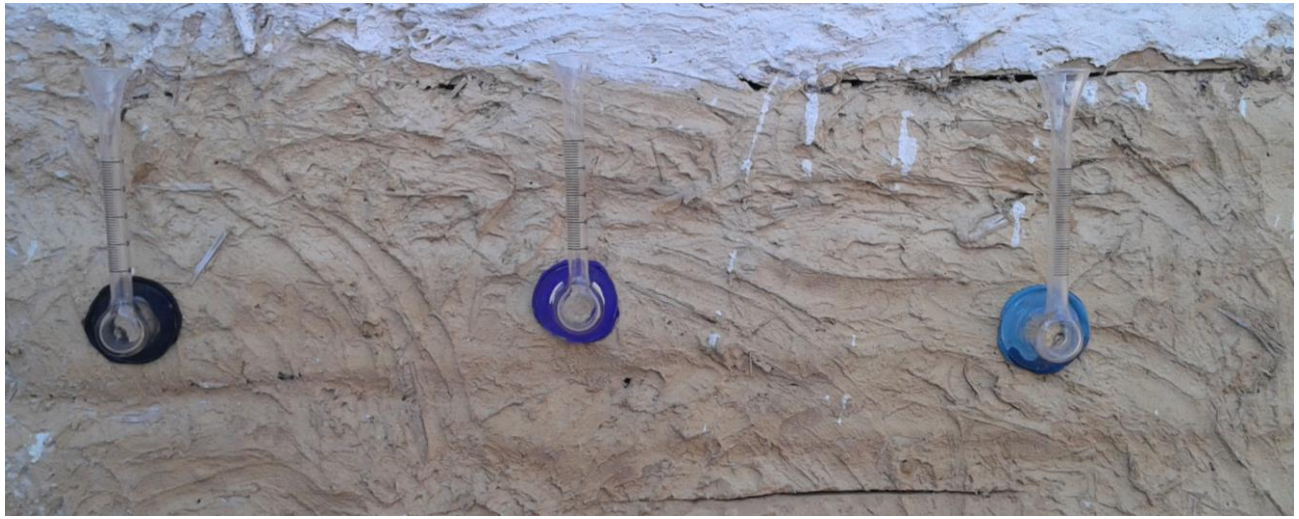
The door is close; there is no ocupation of the cellule: need to implemente indoor air renovation to decrease indoor RH

But very stable temperature indoors (22-26°C) while T outdoors has a high amplitude (16-32°C)



By sclerometer

By flat jack and Martinet-Baronnie



By Karsten tubes

IN SITU TESTING

CONCLUSIONS

- Lightweight walls with relatively low strength (as expected)
- Building technology very easy and quick to apply
  - by unskilled craftsmen
  - without needs of special equipment
- With low embodied energy: mainly local raw materials - earth and reed canes - but other canes, like bambu, can be used
- Good durability in natural exposure (for 1.5 years now)
- Thermal inertia and hygroscopic behaviour of earth-reed-based wall contributes for a stable RH and T indoor environment, in comparison with exterior conditions
- A lot to analyse and work on….

THANK YOU FOR YOUR ATTENTION !