



# *European Workshop*

Benatallah Sarah - Bicho Noémie - Dolfi Lisa - Dumont Margaux - Mejdoub Mayla

24/02/2025 - 04/03/2025

# TEAM COMPOSITION

## Sarah Benatallah

Séminaire DE7 : Chantier de crises  
Worked with raw earth during S4  
Focus : sustainable materials

## Noémie Bicho

DE3 : Habitat  
Seminar DE3 habitat  
Focus: home comfort

## Lisa Dolfi

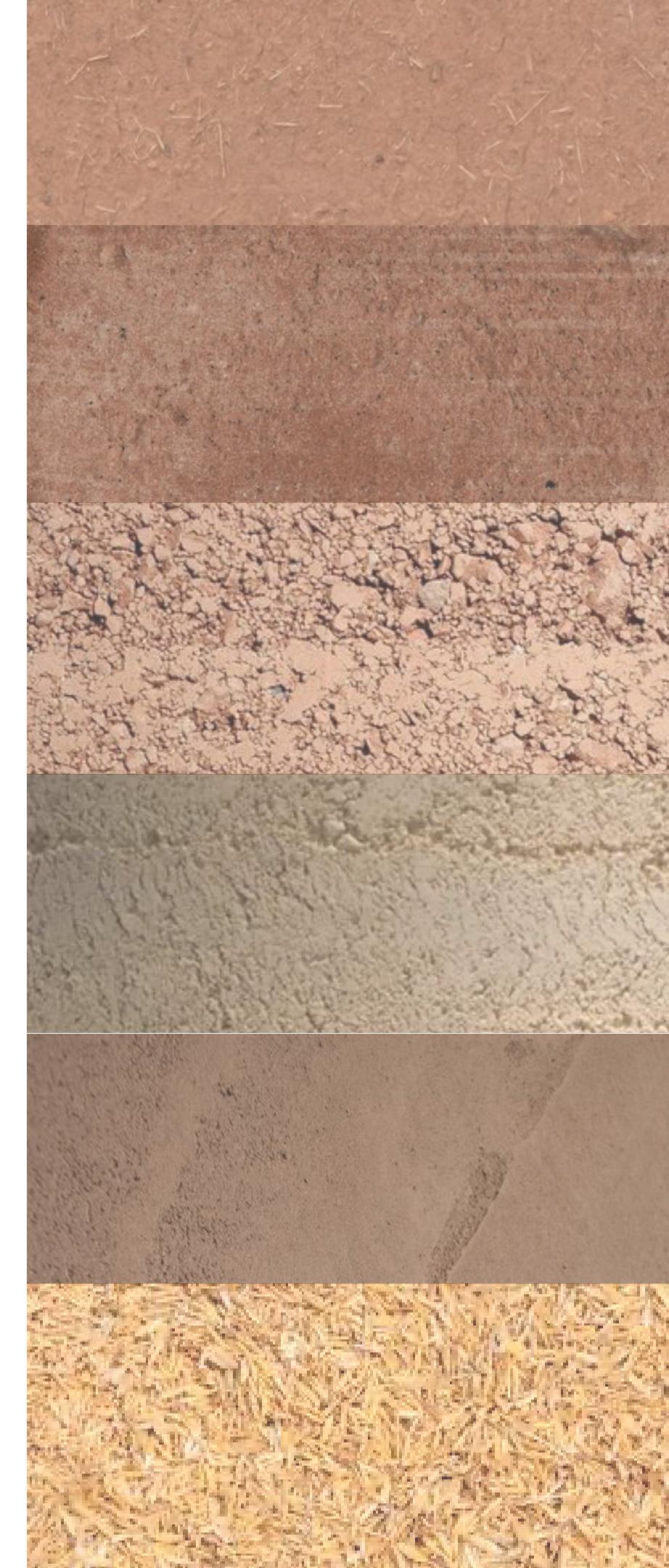
Seminar DE 8 Patrimoine, ressources  
et climat  
First-year work-study student  
Focus : ephemeral architecture

## Margaux Dumont

DE 6 Matière et Expérience  
Seminar DE 6 Matière et Expérience  
Worked with raw earth during S7  
Focus : sustainable architecture

## Mayla Mejdoub

DE 9 : Prendre soin par l'histoire  
Seminar DE 9 : Transformations  
Focus : the link between architecture and  
sociology



**Establish reference research on the properties of the bio-sourced materials available to us**

## Reference 1

### ADOBE FLOORING IN CHAMBERY

Pisé is a traditional technique in which layers of earth are compacted to create a floor that is both solid and aesthetically pleasing. This technique provides a good thermal inertia, which helps maintain good temperature regulation. The idea behind this project is to have a natural floor that combines comfort, durability and low environmental impact. What's more, it blends in well with the architecture of the house, proving that raw, ecological materials have their place in modern construction.





## Reference 2

### RAW EARTH FLOOR

Raw earth slab in a yurt. The 7 cm layer was tested with different recipes to avoid cracks and weak spots. Preparation included levelling with lime blocks to support the structures. The final composition combines gravel, sand and clay slip. The slab is rammed and floated to ensure cohesion and flatness. It remains fragile to impact (compression) but offers a natural, pleasant floor.





## Reference 3

### RICE HUSK FLOOR

Rice husk flooring is an ecological and sustainable alternative to traditional materials. Made from rice hulls, it is mixed with other materials such as earth, plaster, etc. to offer superior resistance to weather, UV and termites. Suitable for terraces and pool surrounds.



*Enduit intérieur terre / balle de petit épautre (Archibale Isolation)*



*Prototypes d'enduits intérieur plâtre / cosse de sarrasin (Plâtres Vieujot)*



*Prototype d'enduit plâtre / cosse de sarrasin (Plâtres Vieujot)*



*Enduits intérieur terre / balle de riz (Association Le Village)*



*Enduit prêt à l'emploi italien chaux / balle de riz*



*Enduit prêt à l'emploi italien chaux / balle de riz*



# KAI<sup>II</sup>TRILLA

## Origin of the name:

- KAI<sup>II</sup>= mermaid scale
- TRILLA = for the triangle shape and the “a” of terra

## Objective:

1. Create triangular raw earth briquettes that resist compression to create a floor.
2. Understand to what extent raw earth can be self-sufficient in forming a solid floor with the minimal addition of natural additives.

Hypothesis: rice husk + clay could increase the compressive strength of raw earth.

### Elements of the proposed mixture before handling:

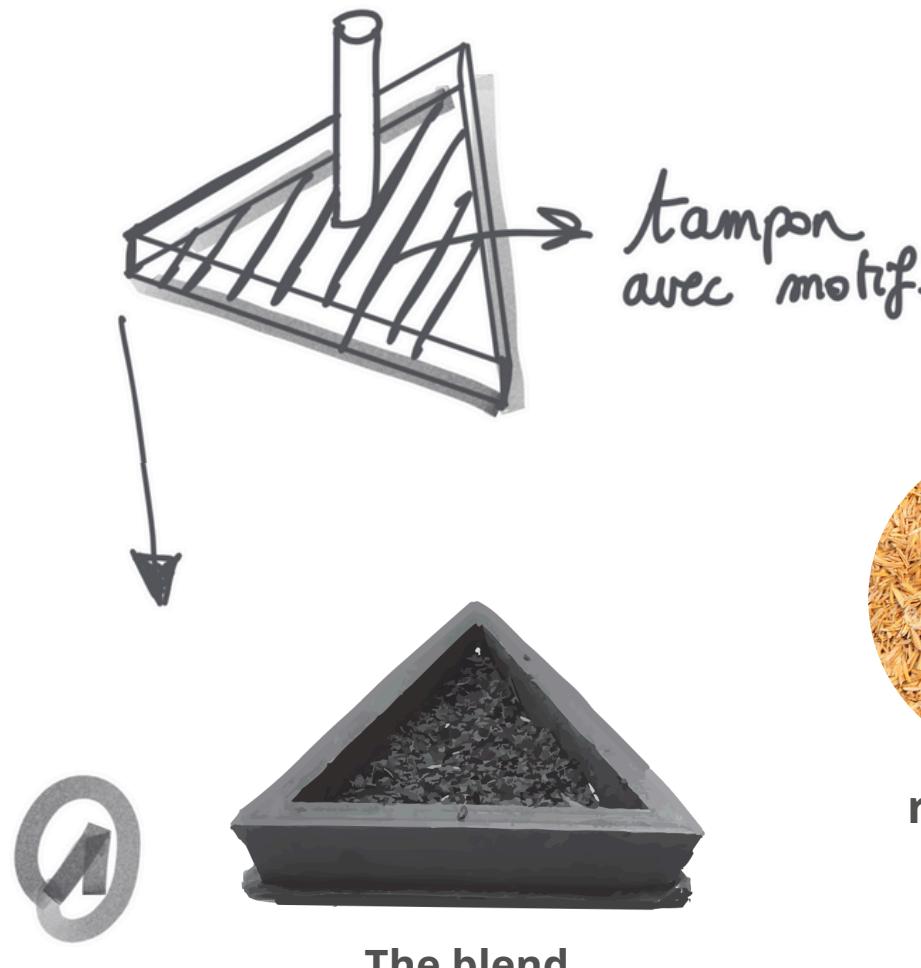
- Raw earth: Provides main structure and cohesion
- Clay: Acts as a binder and improves the plasticity of the mix
- Rice husk: Lightens the slab, improves thermal insulation and reduces drying shrinkage

### Suggested dosage before handling:

- rice husk 15%
- raw earth 60%
- clay as a binder for the whole 25%

### Questions:

- Will the rice husk be an important parameter in the compressive strength of the raw earth?
- Will the pattern weaken the briquette's rigidity?
- Will the planned dosage provide optimum strength for loading the new floor?



The blend



Mix together in a triangular mould to create the briquette.  
Vary the quantities to find the strongest mixture.



Press the whole into the mould to compact the clay and imprint the pattern created.

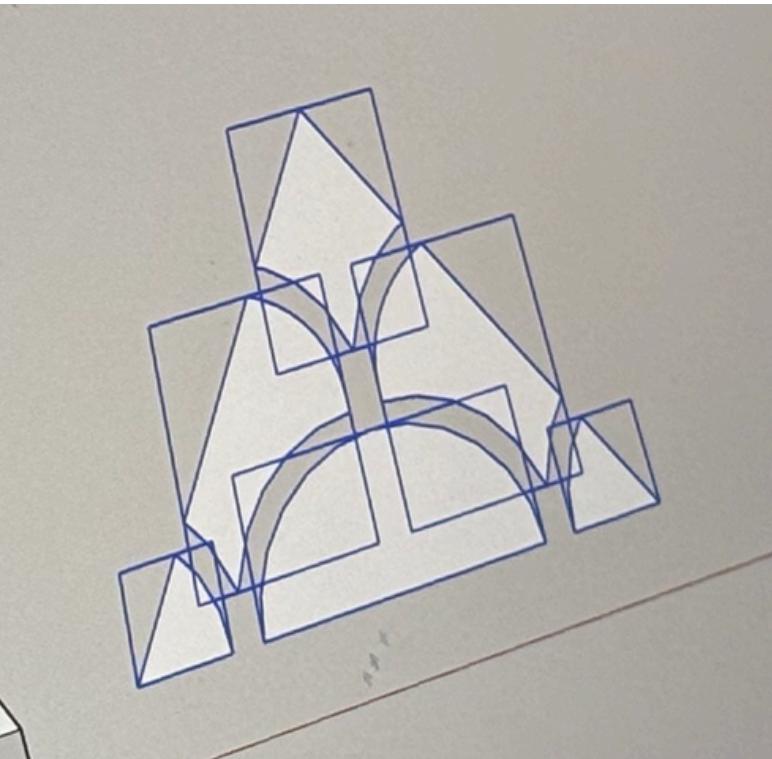
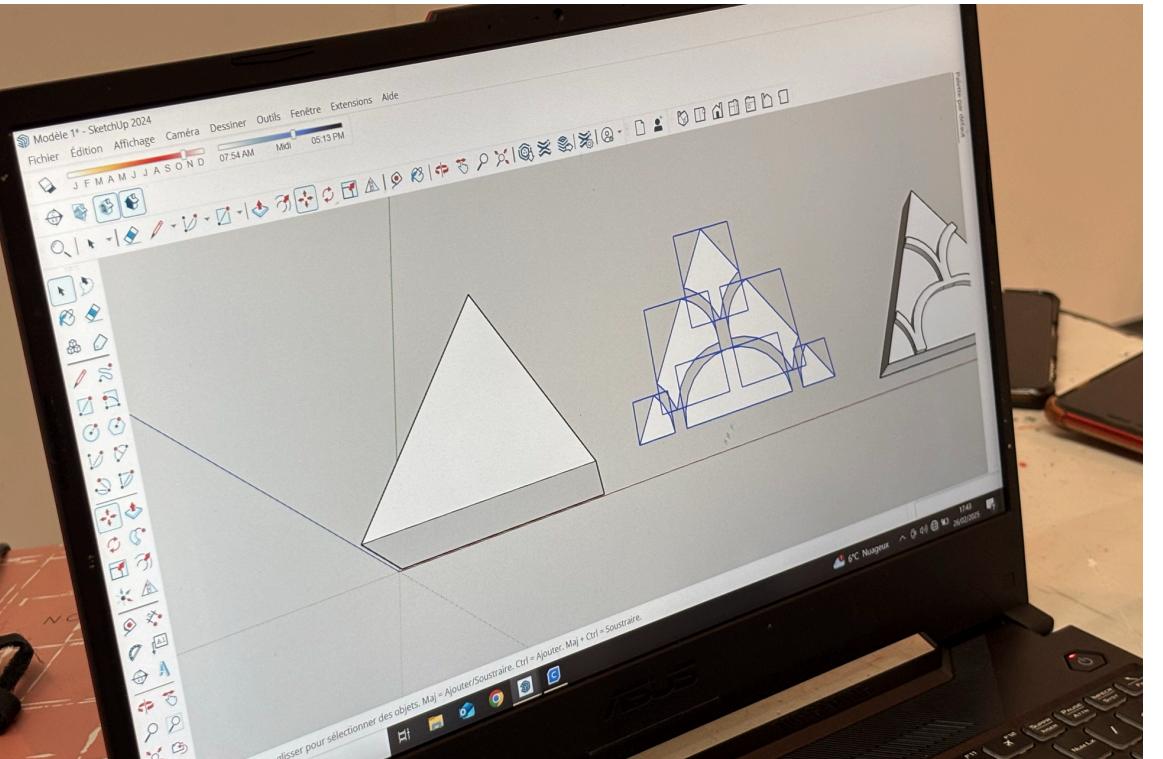
# DESIGN PATTERN

## First draft of pattern BEFORE manipulation

- Intention to create a shape with small arcs in order to practice the speed, precision, and consistency of 3D printing.

## Second draft of pattern AFTER manipulation

- Intention to create a simpler, larger shape with circular arcs
- The triangular shape allows the pattern to be adapted in many different ways.



Possible brick layouts:



## Wednesday Feb. 26

Start of practice and initial analysis of the test matrix.

Raw earth + rice husk



### First blends:

- 100% raw earth / 0% water
- 95% raw earth / 5% water
- 90% raw earth / 10% water

### Second blends:

- 70% raw earth / 15% water / 15% rice husk
- 85% raw earth / 10% water / 5% rice husk
- 80% raw earth / 10% water / 10% rice husk
- 75% raw earth / 10% water / 15% rice husk

### Third blends:

- 70% raw earth / 10% rice husk / 15% water / 5% clay
- 65% sifted earth (wire gauge 1,9mm) / 15% barley straw / 15% water / 10% clay
- 55% sifted earth (wire gauge 1,9mm) / 10% barley straw / 5% rice husk / 15% water / 15% clay + linseed oil on the surface

**Bilan :** Rice Husk is not as good as barley straw. We need as much water as barley straw and the ideal pourcentage of row earth is 65 %. Clay is essential.



## Thursday Feb.27 :

### Matrix progress and analysis

#### New features:

- sifting the soil
- we compressed the earth with a mass
- paint the motif with clay to retain the natural look of the earth
- use linseed oil to protect and strengthen the raw earth

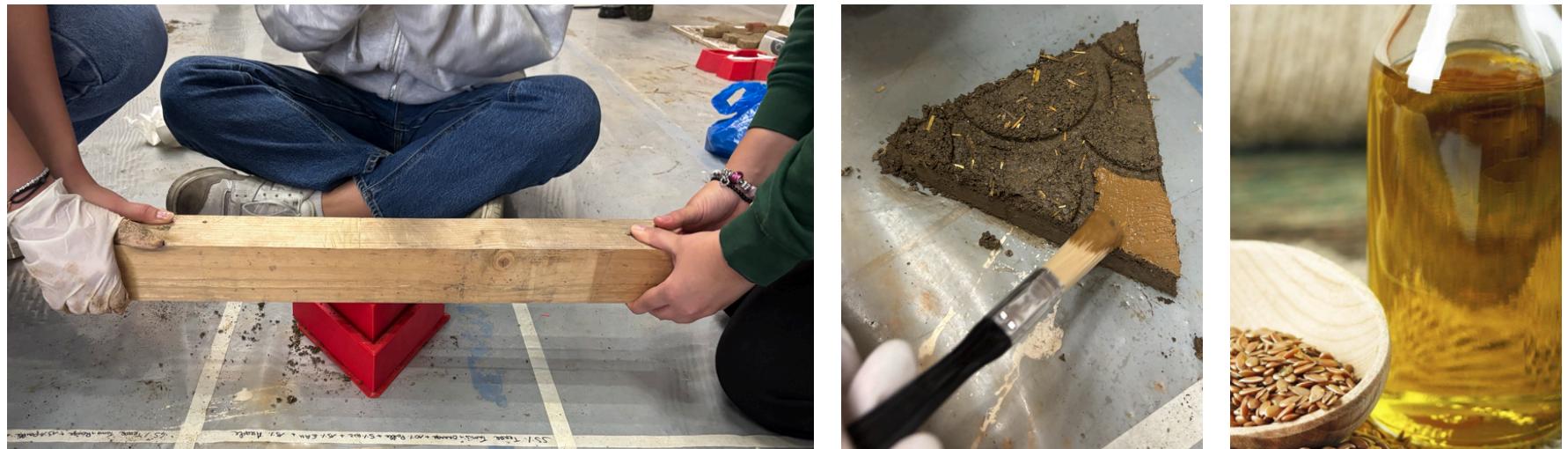
**barley straw + raw earth + clay**



#### First blends:

- 62% of sifted raw earth (wire gauge 1,9mm) / 15% barley straw / 10% clay / 15% water / 3% linseed oil
- 65% of sifted raw earth (wire gauge 1,9mm) / 15% barley straw / 10% clay / 15% water
- 55% of sifted earth (wire gauge 1,9mm) / 10% barley straw / 5% rice husk / 15% clay / 15% water
- 65% of sifted raw earth (wire gauge 1,6mm) / 15% barley straw / 10% clay / 15% water

**Bilan :** It is important to use the orange sift for a better soil texture (1,9 mm wire gauge) and to compress the mixture as much as possible.



## Thursday Feb.27 :

### Matrix progress and analysis

#### Selected composition :

- Sifting the soil
- Compressing the earth with a mallet
- Painting the pattern with clay to preserve the earth's natural look
- Using linseed oil to protect and strengthen the raw earth

barley straw + raw earth + clay



#### Second blends:

- 45% of raw earth / 30% clay / 15% barley straw / 10% water
- 65% of sifted raw earth (wire gauge 1,9mm) / 15% barley straw / 10% clay / 15% water + pattern
- 55% of sifted earth (wire gauge 1,9mm) / 10% barley straw / 5% rice husk / 15% clay / 15% water + pattern + clay paint
- 65% of sifted raw earth (wire gauge 1,6mm) / 15% barley straw / 10% clay / 15% water + pattern + clay paint + linseed oil

**Bilan :** The water pourcentage is important to have a nice pattern and linseed oil allows a more compact result. Clay works both as a pigment and a binder



## **Friday Feb.28 :**

Selection of the best composition and production of briquettes for floor assembly.

- Sifting the soil

We used two different types of sieves with different wire gauges: the orange one (1.9 mm) and the red one (1.6 mm). The difference was not very noticeable, but after testing both, we chose the orange one as it was ideal; it provided well-sifted soil with a good texture, helping to create a solid brick.



**Sifting**

- Preparing the composition and compressing the earth with a mallet

Once we finished sifting the soil, we started preparing our mixture with 62% of raw earth, 12% of water, 15.6% of barley straw and 10.4% of clay.

For this step, we had to use a mallet, as it was heavy enough to help us compress the earth as much as possible and have a very compact triangular-shaped brick of 5cm. And then, to make the final shape, we use the stamp with the pattern we created and printed in the FabLab.



**Compressing**

- Painting the pattern with clay to preserve the earth's natural look

Once we finished preparing and stamping all the bricks, we wanted to enhance even more the pattern on top so we used clay as paint and only coloring some spots so we have different shapes of patterns in the final joining.



**Clay painting**

- Assembling the bricks

As a final result, we wanted to create a section of the floor by assembling our 19 bricks using a mix of clay (80%) and water (20%). This mixture allows us to stick the bricks together and to still be joined once dried.



**Mixing**



**Stamping**



**Assembling**

# FINAL RESULT

