Soil housing

Exploring potential of soil as building material within contemporary context

Resurrecting traditional view on building in Romania

1. Reconsidering soil

- Why take soil into account as building material?

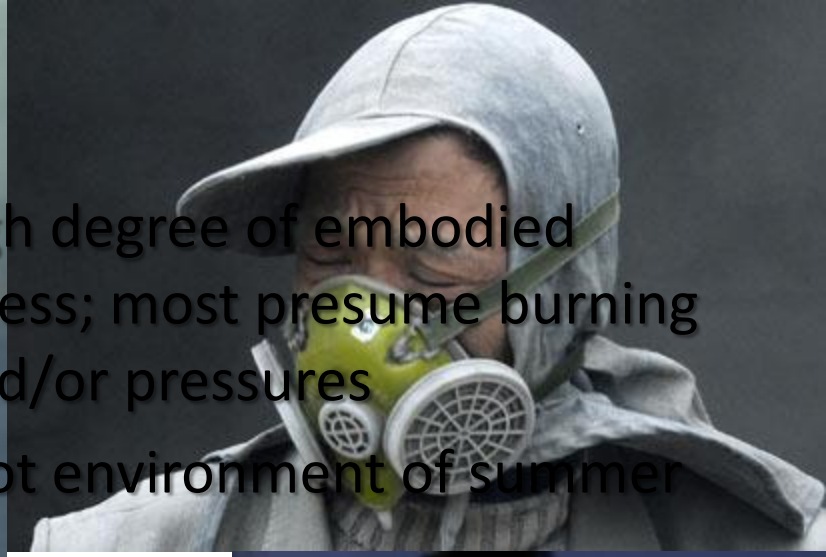
- **50%** of natural resources are used in construction;

  40% of total energy used in Europe goes into construction;

- **Availability**

  - conventional materials such as concrete, A.C.C bricks, burnt bricks are transported from of-site (sometimes for long distances)

  - soil based materials are produced on site



- **Embedded energy**

  - most regular materials have a high degree of embodied energy within the fabrication process; most presume burning or baking at high temperatures and/or pressures

  - clay bricks need only a dry and hot environment of summer days

- **External constraints(on conventional materials)**

  - regional /global economic situation

  - transportation hazards

  - production dependent on electricity and fuel availability

- Advantages - Disadvantages

- **Advantages of soil houses**

  - construction is cheap and easy (from technical point of view)

  - the walls and floors have high thermal mass, being capable of storing heat and releasing it during the night due to a property known as thermal lag.

  - the walls “breathe” allowing moisture to pass through

  - easy and affordable maintenance

  - unbaked loam can be recycled an indefinite number of times over an extremely long period. Old dry loam can be reused after soaking in water, so loam never becomes a waste material that harms the environment.

- Advantages – Disadvantages

- Owing to its low equilibrium moisture content of 0.4% to 6% by weight and its high capillarity, loam conserves the timber elements that remain in contact with it by keeping them dry. Normally, fungi or insects will not damage such wood, since insects need a minimum of 14% to 18% humidity to maintain life, and fungi more than 20%.

- **Disadvantages of soil houses**

  - loam is not water-resistant, it must be sheltered against rain and frost, especially in its wet state or else it's integrity is compromised.

  - requires frequent maintenance

- Advantages – Disadvantages

- a house of this type has lower endurance over time as opposed to bricks or concrete

- it’s not a standardized material

- it is very sensitive towards interior and exterior renders with regard to capillarity. It can lead to respiratory problems if the walls are rendered improperly.

- raising even a small house is labor intensive. when using mud bricks, a number between 2000 and 10.000 bricks would be needed to build a small dwelling with 2- 3 rooms. For such a demand, a large quantity of mixture has to be prepared and be constantly available to be put into form.

- in flood risk areas it has no chance of resistance

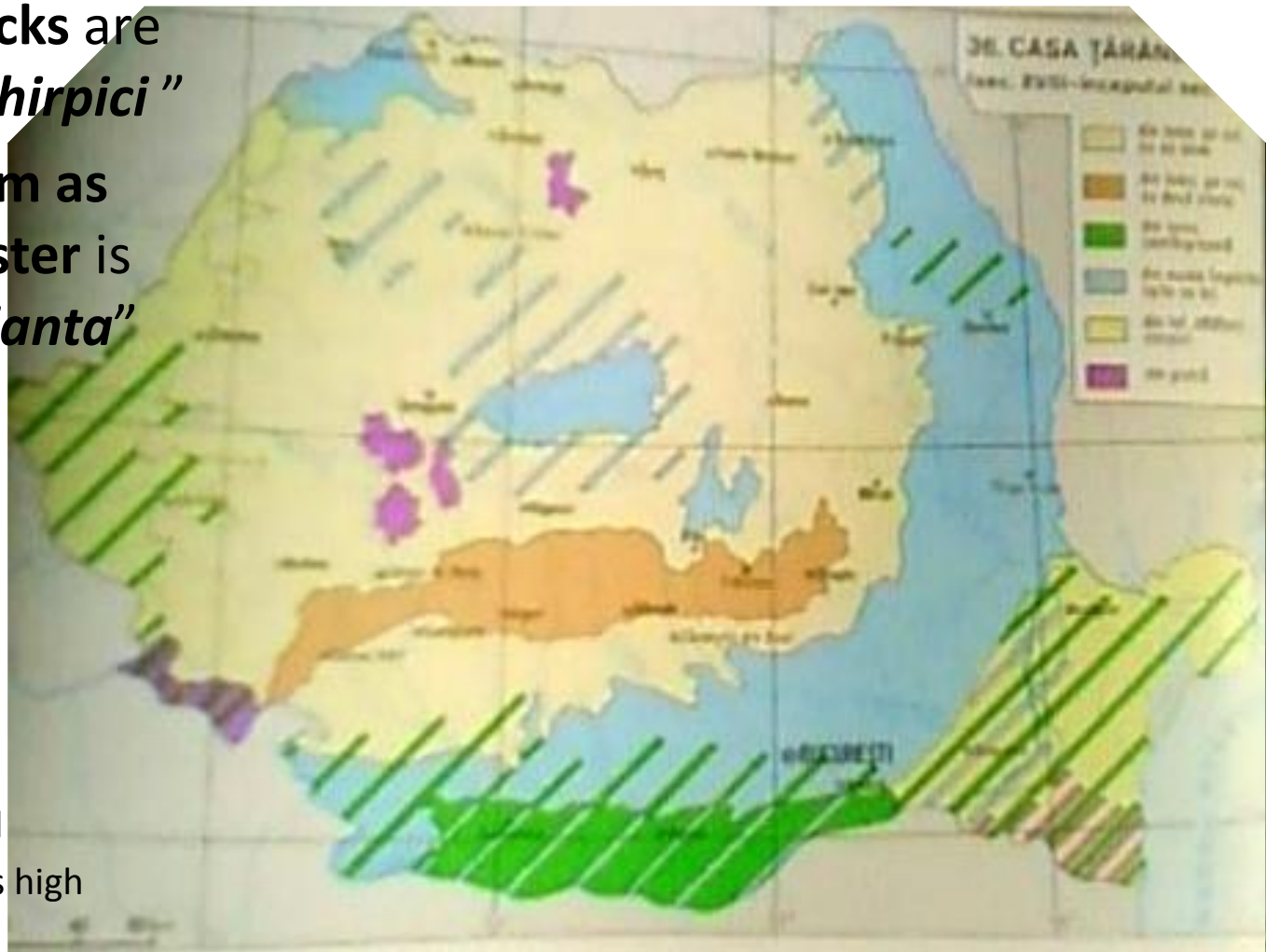
2. Soil housing in Romania

- Where is it present | What techniques are used

Adobe constructions are quite common especially in lowland areas, less industrialized, where villages were founded on working the land

- Historically there have been found two main ways of building with soil/clay : **adobe bricks** and **loam as filling and plaster**

- The **adobe bricks** are known as - “ ***Chirpici*** ”
- The use of **loam as filling and plaster** is dubbed - “ ***Paianta***”



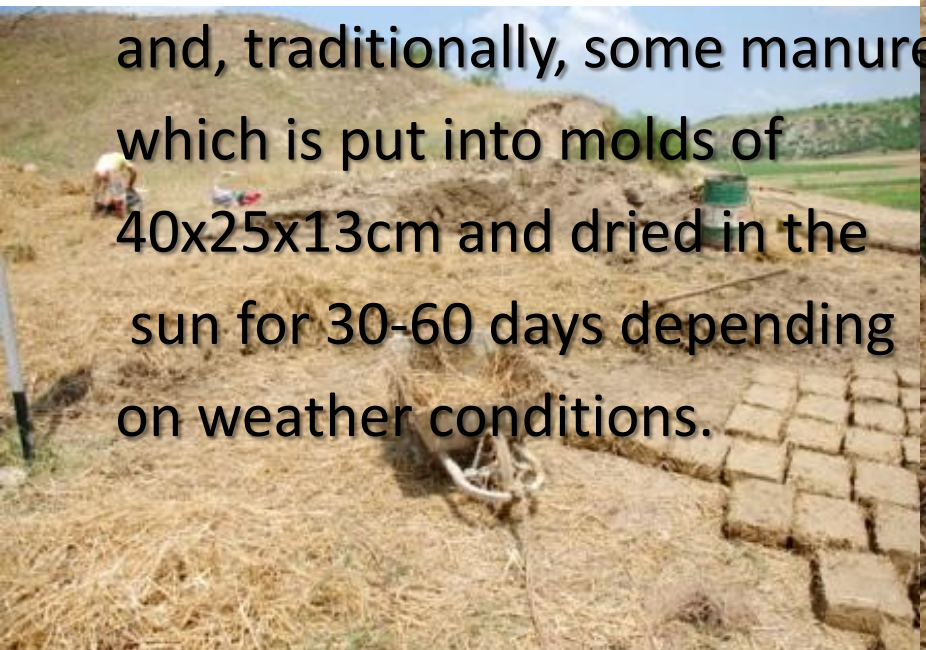
Geographical layout of different types of construction methods

Light blue: ***Paianta***
Medium yellow: ***Chirpic***
Green: Wood semi-buried
Brown: Wood, two stories high

- Basic principles | Exemplification

➢ Building with *Chirpic* bricks:

- The *chirpic* is similar to adobe, in which it consists of a mixture between clay, organic material and, traditionally, some manure, which is put into molds of 40x25x13cm and dried in the sun for 30-60 days depending on weather conditions.



Preparing of chirpic bricks in Adamclisi village in Constanta county, Dobrogea

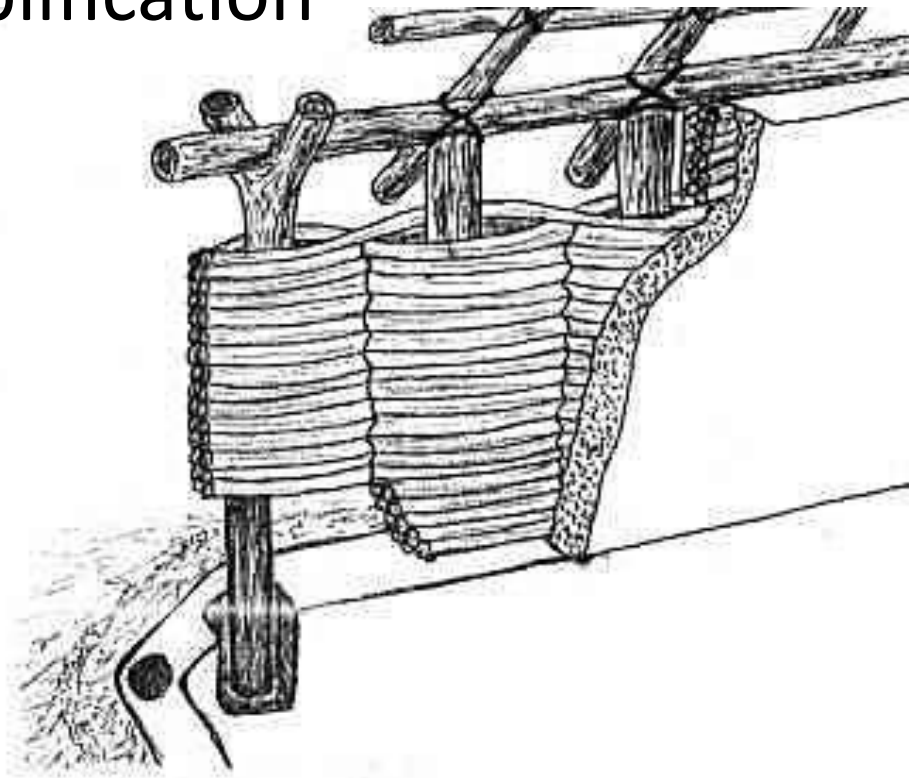
Constanta county, Dobrogea region. S-E

Ilfov county, South-Central

Constanta county, Moldova region. N-E

- Basic principles | Exemplification

➢ Building with *Paianta* :



- *Paianta* is a balanced type of construction that combines a traditional wooden bearing structure, with elastic closures of clay, mixed with straw, bonded on trellis support.
- Traditionally, this type of clay used in building is considered light, having no structural role, only closing and insulating role.
- The willow wattle trellis (1-2 cm thick) is then plastered on both sides and then rendered.

- Building with *Paianta* :

- Light straw clay is a mixture of straw and clay, of which rough density is less as 1200 kg / m^3. What kind of straw is used is debatable : some authors recommend rye straw, wheat straw or oat others; for clay plaster, **barley straws** are preferred, because they are softer.
- More important than the type of straw is the stem structure. Ideal for insulating capacity is using thin straws with resistant strains, that don't crush.
- Straw must be dry and not smell of mold.

- A more recent variation of the trellis support structure is rudimentary timber framing, or *wooden forks* as it is often called.

Fork structure visible in Danube Delta region

Timber framing . South-Central Romania.

- Clay building in Danube Delta region

➢ *Deltaic Paianta* :

- In the Danube Delta region the most common used technique is a slight variation of the usual *paianta* called " *ciamur* ".
- The only difference being the absence of the trellis support, the solution being wooden framing and with the addition of **reed** within it's spaces.
- The plaster is mostly the same in composition, maybe with a slight reed content as well.

- *Deltaic Paianta* :

- Although the use of reed is highly beneficial given it's high insulating capacity, it has to be very tightly bonded, otherwise it breaks under the weight of the clay plaster. Especially when it contains water vapors.

3. Soil housing - E.U. legislation

- Ratifying attempts| Current situation

  - 1944 – The first attempt to detail rules and thoroughly document building techniques using earth based materials was made under the title of " Lehm-bauordnung" – Regulation for earth constructions

  - 1951 – The compendium was included in the german DIN 18951, as a technical stipulation for construction works

  - Up until 1956, other norms and regulation projects were elaborated, but were not aplied.

- 1971- all the regulations were decreed as obsolete and were retreated
- After an intervention made by the Interior Minister of Hesse Land in 1982, and after the recent decree of the executive of the same land, these are still valid for approving earth constructions – in the absence of technical regulations - so that the utilizing mode explained in the old regulations won't have to be checked for every singular case.

- **Currently** the Earth Architecture Association, Germany

(Dachverdand Lehm) have an approved technical compendium at the Berlin Technical Institute for Constructions since 1998, the rules having recommendation character and being used as such in 11 lands in Germany.

- **This compendium is now at Bruxelles awaiting European level certification.**

4. Soil housing performance

- Ecological comparison with passive houses and conventional ones

  - In terms of certain ecological aspects, soil houses surpass conventional and even passive houses:

    - ✓ embedded energy
    - ✓ recyclability
    - ✓ direct environment impact due to natural contents

    and in one aspect beats passive houses from start:

    - ✓ air ventilation and purification achieved naturally with no energy requirement.

- However, some issues are difficult to solve:
  - amount of time preparing materials and readiness for further finishing works and use
  - intensive physical labor. requiring as much man power as possible
  - fragile thermal performance. generally they have good insulating capacity but it is easily reduced or even canceled in humid periods of the year
  - some modern appliances and finishing do not always work best within a clayey environment
  - limitation to ground level, compact chambers and tempered dimensioned apertures.

5. Conclusions

- Beside technical aspects, the main aspect due to which soil houses and earth based constructions in general suffer from is :

  scarce documented, certified and approved information

  Because of this:

- it is difficult to reenter the once mainstream way of building houses and be more available to the general public.

- generates confusion due to high amount of different information coming from those who had undocumented approaches

- This is why efforts have to be made to:

  - Test a variety of solutions, combining techniques from passive houses, like passive solar design, efficient renewable energy sources, with natural materials for insulation, rendering and covering.

  - Accumulating technical and performance data

  - Obtain official green certifications

  - Culminating with collaborating and supporting elaboration of regulations and technical rules to be approved by European executives.

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