POLYTECHNIC OF TORINO
FACULTY OF ARCHITECTURE 2
Degree in Architecture
Honors theses

The employment of low-cost energy stabilizers in earth buildings: plasters
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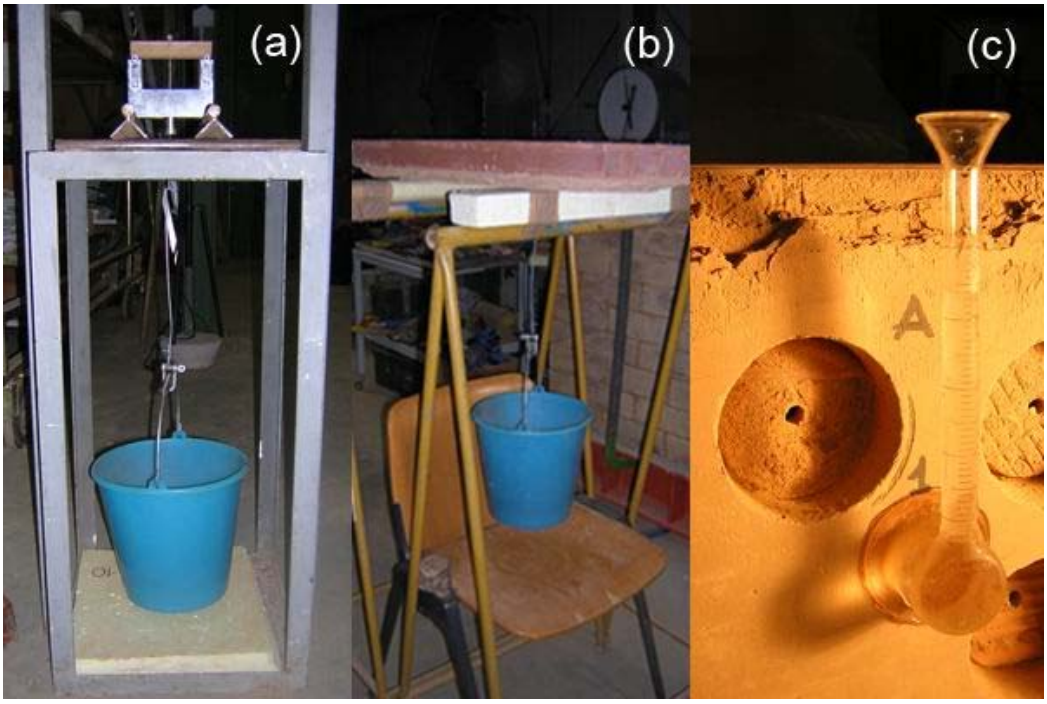
Introduction
The first part of the dissertation develops the assumptions of the experimentation through
- the study of the typologies of earth plasters and their features and methods of stabilisation;
- the analysis of previous research carried out on these plasters, and the analysis of other kinds of earth building coating.

The experimentation – conducted at the *Laboratorio Prove Materiali e Componenti* of the Faculty of Architecture II, Politecnico of Turin – was aimed at bettering the behaviour of earth plasters when they come into contact with water, through the employment of natural products. In fact, the function of plaster in earth buildings is, at the same time: give them the final finish and to protect them from atmospheric actions.

The experimental work
The basic main experimentation was carried out with earth coming from the territory of Alessandria-Italy; such earth has the following particle-size analysis: clay 14%, silt 44%, sand 38%, gravel 4%.
Afterwards, in order to make a quick comparison, the author conducted some tests with samples of earth coming from Chieri-Italy and Las Lomitas-Chaco-Argentina, which are characterised by reagent clays. Every sample of earth employed for the working of plasters were sifted through 1mm.
The analysis then highlights and compare performances of earth plasters stabilised with cement, common lime and gypsum (Plaster of Paris-emihydrate calcium sulphate), taking into account the different physical and chemical features of binders, their reaction in the presence of clay, their compatibility with additives of vegetal origin (wheat flour and ground rice, corn starch, corn gluten, vital wheat gluten) and energy costs that their production needs.

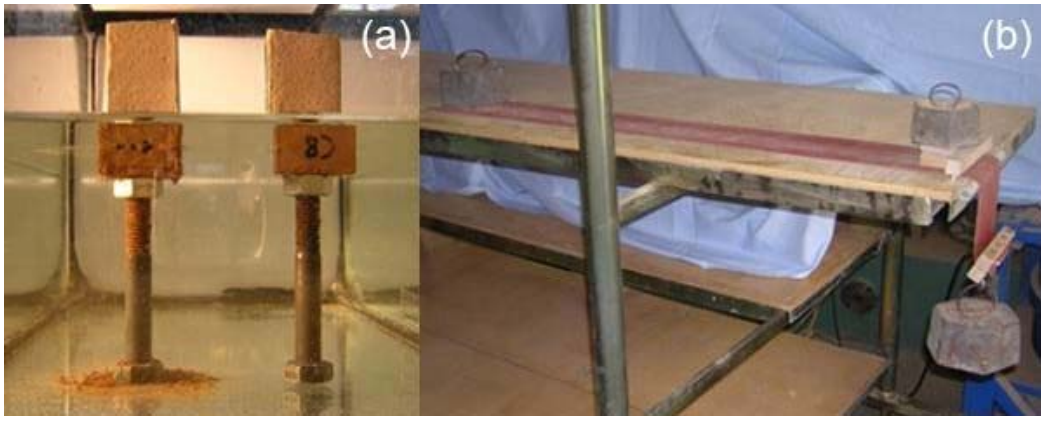
(a) Making of plaster specimens of 2x3x12cm; (b) Making of plaster in three layers on a brick hollow flat block

The experimentation focused on tests which could be easily carried out on the building yard. Such tests employed unsophisticated and handy tools – which could be suggested to and adopted by anyone considers it as a sound benching test – but reliable enough to highlight the features of the several kinds of plaster.
Particular attention was paid to plasters' shrinkage, and bending and capillary absorption tests were conducted on samples of 2x3x12cm.



(a) Bending test on plaster specimens of 2x3x12cm; (b) Adherence test of plaster on hollow flat block; (c) Absorption test with Karsten tube on brick hollow flat block

Such tests allow to point out quality and solidity of the mortar-matrix respectively, and, in a first instance, to assess the reaction of the material with water, highlighting every possible detachment and crumbling. The abrasion test, in turn, was conducted on specimens of 2x5x5cm, in order to evaluate the superficial hardness of plasters. Finally, adherence, capillary absorption with Karsten tube and erosion tests were conducted on ten kinds of plaster, spread in three layers on a brick hollow flat block, in order to have a smooth support Such test allows to determine the erosion of a plaster, simulating pouring rain.



(a) Absorption test, comparison between behaviour of plaster specimens made of earth+gypsum10% and earth+gypsum10%+vital wheat gluten; (b) Abrasion test on specimen of 2x5x5cm

Conclusions

The experimentation which has been carried out has verified the effectiveness of the employment of gypsum as binder in earth plasters, compared to the behaviour of lime and cement.

If compared to cement, the employment of gypsum as a binder: allows to obtain earth plasters with a good degree of transpirability, elasticity, and vapour permeability; allows to avoid shrinkage, a frequent problem of earth plasters;

guarantees a greater eco-biosustainability of the product; has economic and performance advantages; is low-cost energy; is compatible with additives of vegetal origin.

In particular, the author has demonstrated that, in the right proportions, when gypsum is combined with vital wheat gluten, it betters durability and performances of earth plaster, leading to better water-resistance (with a minor absorption and erosion), more hardness, better binding action and adherence to the support, longer setting time.

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