

Earth Constructions in the Marche Region (Italy): Building Techniques and Materials

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INTRODUCTION

A recent survey by the International Centre for the Study of Preservation and Restoration of Cultural Property (ICCROM) showed that 10% of the UNESCO World Cultural Heritage List (720 sites) was made up of earth-built architectural/archaeological assets, and that approximately 30% of the world's population (2 billion people) lived in houses made of earth.

Throughout history different peoples and cultures have attached multiple values to earth construction in consideration of its contribution to the architectural heritage in terms of:

- *social context*, as a useful, rational and readily available resource to meet public and private functional needs (for homes as well as military, religious and public buildings);
- *cultural context*, in the evolution and mastery of the technique and the cultural development of the whole building sector, based on thousands of years of knowledge and experience useful for the future;
- *environmental context*, in the use of a material that can be recycled endlessly and is compatible with all sustainability, cost-effectiveness and energy-saving criteria. Infrastructure and production cycles are based on this material, which complies with all environmental regulations.

In developing countries many cities have been constructed with earth. Some of these earth buildings sometimes reach more than 6-8 floors (e.g. the city of Shibam in the south of Yemen), or may be ancient, such as the twelfth century walls of Marrakech in Morocco. This phenomenon affects not only the developing countries, but also the United States of America and Europe, where the countries like Italy have developed a characteristic architecture based on raw earth construction fully accommodated to its environment. In this paper we report the first results of a research project that has studied the historical development of the building techniques used for the construction of earth buildings located in the Marche region in the centre of Italy. The research shows that the earth used as a construction material in this instance directly came from the construction sites, and that the building techniques used are similar to that which are commonly called “*bauge*”.

AIMS

As was the case in other countries for several years now (ICCROM 2003; ICCROM/CRA Terre-EAG 1993), and in Italy at a national and regional level (Bollini G. 2002; Bertagnin 1999), as the various legislative measures of 2002/3 testify (Law no. 378, 24 December 2003; Abruzzo Regional Law no. 17/97; Bill introduced on 14 February 2002; Bill: Regulations to support construction in earth), in the Marche region too there has been a renewed interest in earth buildings, which, in the past, have often been abandoned by their owners. There are many reasons why they were abandoned, but the most common is the stigma of poverty and marginalisation that has always been associated with this type of housing, in this geographical area at least.

Today only a small proportion of these buildings are left (**fig.1**), because of the gradual abandonment of the remainder and the consequent “cannibalisation” of their recyclable parts. It is imperative that the remaining examples be safeguarded. Unfortunately, the prejudice with which these buildings is regarded has resulted in a completely negative attitude to their restoration for residential purposes (**fig.2**). Given that these buildings are particularly subject to natural degradation (especially by atmospheric agents, since there are no protective elements such as guttering, and in some cases whole roof sections have collapsed, due to neglect) the prospects for their survival are not good. It has been estimated that, without maintenance, these buildings have a lifespan of some 60 years (Palombarini 1987), and possible uses have to be sought for these buildings that would promote their regular maintenance, thus enabling interests in the sector to develop.



Figure 1. Panoramic view of some earth houses in Macerata (Italy)

In response to the initial stimulus of a regional law (Marche Regional Law no. 6 of 24/03/1998), the government has developed a policy of restoring earth buildings (Marche Rural Development Plan 2000/06), promoting their protection and conservation, and their reorganisation into buildings suitable for public use, such as museums throughout the area (Corridonia of Macerata). Thanks to a new sensitivity, these artful architectural properties are seen less as inconvenient relics from the

past, or as obstacles and menaces to new settlements and productive investments. On the contrary, the cultural patrimony has come to be perceived as the face of local identity and as a possible source of development.



Figure 2. An earth building abandoned by its owners

Thus, it is now urgent to define the tools and operations needed to recover and conserve this unusual type of building, above all with regard to the basic material, the raw earth found in the territory, since the publication of numerous national and international papers have not yet led to the definition of a single, consolidated strategy for professionals and government officers to carry out the works needed to protect and conserve these buildings, and to secure their future. However, it is certain that a new “sensitivity” to the problem on the part of designers and preservation corporations, is leading towards a working philosophy that regards, as an architectural asset not only the historic-artistic value of the built artefact, but also sees it as a testimony of an antique art of building that must be persevered and not distorted.

On the other hand, for such singular kinds of buildings, there is a problem linked to the protection of public safety, for example these structures must guarantee the ability to resist seismic movement (Giuffrè et al. 1996). The two objectives: on one hand conservation, on the other safety, may appear to clash if the safety problem is approached without fully comprehending the behaviour of the various elements, and if work is undertaken with new structures of modern conception, which substitute the original ones. Hiding these elements is not sufficient. The concept of conservation should also extend to building techniques.

So, what is the correct way to consciously conserve these buildings? Restoration work must certainly not represent a compromise between the two requirements of safety and conservation, but must create an ideal fusion (Giuffrè 1993). And, above all, the solution must originate from an awareness of the real objective to be achieved (Marconi 1997). Or, even better, the designer must have the desire to regain control of the constructional aspects as well and act in a “workmanlike” manner (Giuffrè 1993). The designer is often faced with difficulties in reading the entire “apparatus”, which lies precisely in the deciphering of the character and peculiarities of each earth-built system. Such difficulties have often led to design decisions, which do not respect the various elements. It is with this end in mind that we share the results of our findings regarding the current building techniques and materials used for the construction of earth buildings in the Marche region in the centre of Italy. In order to regain possession of the constructional aspects of the architecture, what used to be called “workmanlike” practice.

STATE OF THE ART

Renewed interest in earth architecture has prompted various international research groups to develop close working relationships. In the wake of the GAIA Project of 1989, which involved the International Centre for the Study, Conservation and Restoration of Cultural Heritage Buildings (ICCROM), the International Centre for Construction in Earth (CRATerre) and the Grenoble School of Architecture (EAG), the EARTH PROJECT was founded in 1998 by the three bodies mentioned above and the Getty Conservation Institute (GCI). Their aim is to develop the study and conservation of the global architectural heritage of earth buildings by means of specific activities in Research, Education, Planning and Execution, and Awareness Raising (Houben et al. 1994; ICCROM/CRATerre-EAG 1993). These international developments stimulated interest in the field of earth buildings in Italy as well, in terms of both a greater understanding of the specific conservation technologies (Bollini 2002; Bertagnin 1992, 1999; Sanna 1993; Sanna, Achenza 1998; Gilibert, Mattone 1998), given their historical-architectural and documentary value, and of the use of earth as a constructional material because of its low environmental impact and high bio sustainability.

Insofar as the Marche region is concerned, the first studies of this kind date back to the work of Santoponte Emiliani in the 1940s (Santoponte Emiliani 1941), and their aim was to trace a plausible evolution of this type of building, relating the structures created to social conditions and thus to the corresponding historical periods. The first quantifications of the distribution of earth buildings in the Marche were made in these investigations, and all subsequent authors have referred to them, such as Poeta and Brigidi (1953), who carried out a precise location study, and identified the prevalent types on the basis of suggestions by Santoponte Emiliani, and Palombarini (1987). The latter, was the first to attempt to qualify the construction techniques used, although she still referred to the bibliographic references supplied by the authors cited above.

However, these studies were primarily concerned with building type. They systematically ignore the construction aspect, or deal with it in a way that was later found to be incorrect. This is the case in

the studies of Santoponte Emiliani, where the author, referring to the wall construction only, reached conclusions that do not coincide with the oral comments of the “master earth builders” still alive until a few years ago, and which rather resemble the construction techniques indicated in an eighteenth century book published in Florence (Del Rosso 1793). Sporadic information is also available in Poeta and Brigidi (1953), about the roofs, Piangatelli (1966), about the characteristics and provenance of the earth used, and, more recently, by Palombarini and Volpe (2002) and Saracco (2002). Further studies of buildings in the Marche region have been carried out more recently (Munafò et al. 2004; Munafò, D'Orazio 1999). These studies, in particular, led to a better clarification of the technological aspects typical to these structures - showing, for example, how the earth present at the building site was used as construction material, meaning that the construction therefore varied from place to place as the techniques evolved - thus indicating possible routes for restoration and recovery work.

MACERATA'S "QUARTIERE VILLA FICANA"

The earthen buildings of Macerata's “Quartiere Villa Ficana” (**fig.3**) are the case studies of this paper. “Villa Ficana” is a district in the northern neighbourhood of Macerata. It was built during the nineteenth century not far from the city centre and a lot of its houses have earthen walls. These are of a few examples of raw earth labourers' villages to have survived till now.



Figure 3. A plan of the quarter showing the location of the earth houses recorded

The common typology of the houses comprises two floors, generally with an external masonry stair (fig.4 and fig.5). The floor system is composed of a series of straight wooden beams and joists, overlaid with floor tiles (fig.6).

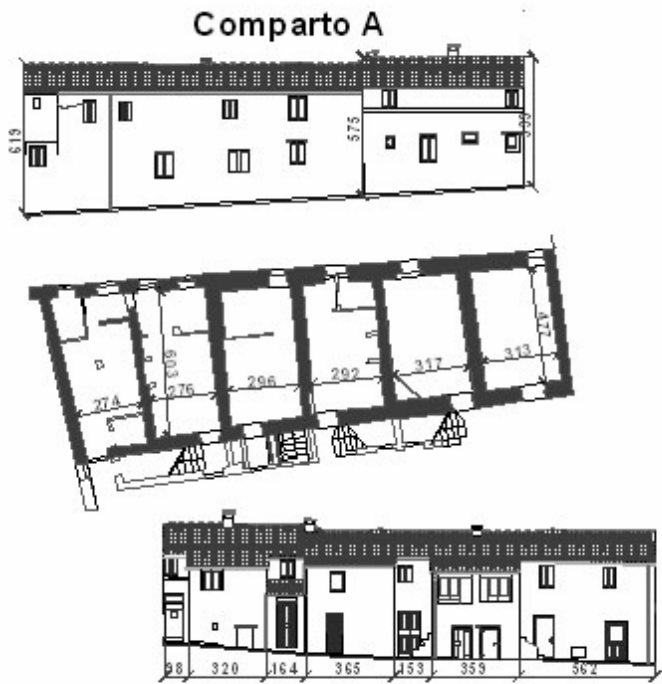


Figure 4. Plan and elevation of the earth houses in “Comparto A”

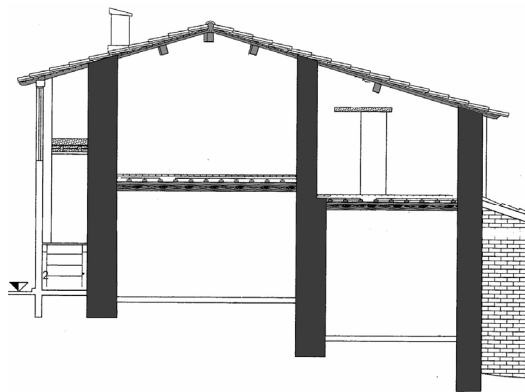


Figure 5. A typical section of a “Villa Ficana” earth house



Figure 6. Interior showing the timber floor system.

The thickness of the earthen walls is about 100-110 centimetres at the base and from 60 to 110 centimetres at first-floor level, the windows are small in order to reduce heat loss and water penetration. In some houses there are also walls made of common bricks. Several earthen walls have been erected upon a 40-50 centimetres high masonry base (**fig.7**). This reduces the earth-built wall's excessive vulnerability with respect to ground surface erosion and water absorption.



Figure 7. A masonry foundation is visible low on the left. Note also the external masonry stair to the right, the overhanging eave and the surface erosion on that part of the wall unprotected by the roof.

The roof, covered by tiles, is sloping supported by a system of primary and secondary wooden beams. The eaves have an overhang of up to 40-50 centimetres to protect the walls from the rain. The earthen wall's external surface is sometimes protected by a 5-10 centimetres earth plaster, or an external layer of bricks (**fig.8**).



Figure 8. An external “skin” of common brick is often used to protect earth-built walls

Almost all the houses studied have been abandoned by their owners and have been particularly subjected to degradation by atmospheric agents. Because of this, and considering the absolutely exceptional nature of the area, the Ministry for the Cultural Heritage recently declared this case deserving of legal protection (Legislative Decree no. 490/99), so as to guarantee the full conservation of every aspect of it, recognising the whole complex, comprising various buildings, roads, open spaces, gardens etc., to be of particular historical and documentary importance, insofar as it presents material evidence of:

- A pre-urban peasant culture typical of the nineteenth century;
- An ancient construction technique, capable of creating buildings with natural materials not derived from production processes outside the building site itself, a construction process that has by now completely disappeared;
- An urban layout that is unique in its type and as a whole.

WALL CONSTRUCTION METHODS AND MATERIALS

This section tries to clarify the technical aspects typical to earthen walls construction found in Macerata, showing how the soil present at the building site was used as the construction material.

From the data acquired during the accurate surveys and subsequent laboratory analysis carried out on the surviving earth buildings in the “Quartiere Ficana” in Macerata (Stazi et al. 2005), it has been possible to identify, straight away, the technique used to construct the relative earthen walls: it is similar to the one commonly called “*bauge*” in France or “cob” in Great Britain.

Comparing the results from soil composition and limits of consistency (Atterberg's limits) of earth samples taken from the buildings identified it emerged that the soil used as a construction material came directly from the construction site. It has the following texture: clay 30-35%; sand 15-18%; silt 50-55%, and the following limits of consistency (Atterberg's limits): LL (Liquid Limit) = 35-40%; PL (Plastic Limit) = 18-22% (figs. 9 and 10). Finally, it has a water (moisture) content of between 6% and 10%.

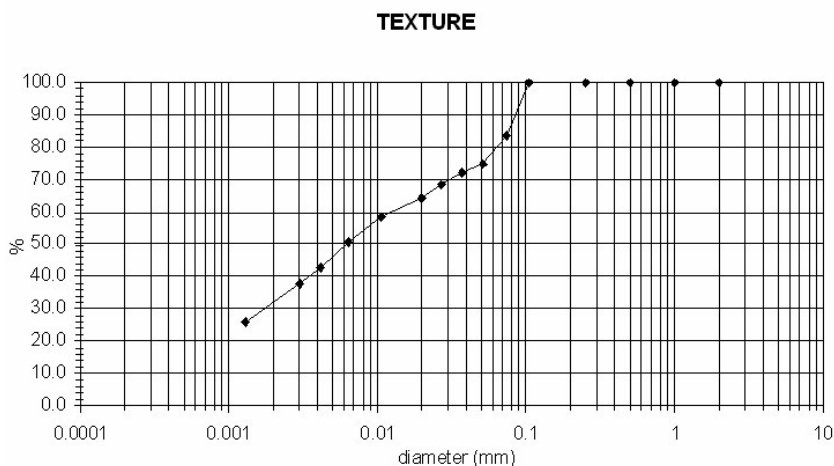


Figure 9. Analysis of the grain-size distribution of an earth sample

The mixture was probably moistened and trod by human feet in shallow pits. Subsequently, it was shaped into large cylinders 8 to 15 centimetres in diameter and 30-40 centimetres long. These were covered by straw and thrown up to the bricklayer who stands on a finished part of the wall and forms the new layer of cob by throwing the cylinders forcefully and rhythmically onto the wall up to a height of 50-70 centimetres. The wall under construction wall was then left to rest for some days for drying, after which the successive level could be constructed. No straw was found in the core of the samples taken. It was just put on the external surface, probably to limit the considerable

shrinkage of the material. In this way very thick walls (60 to 110 centimetres) consisting of several layers of monolithic appearance could be built (**fig.11**).

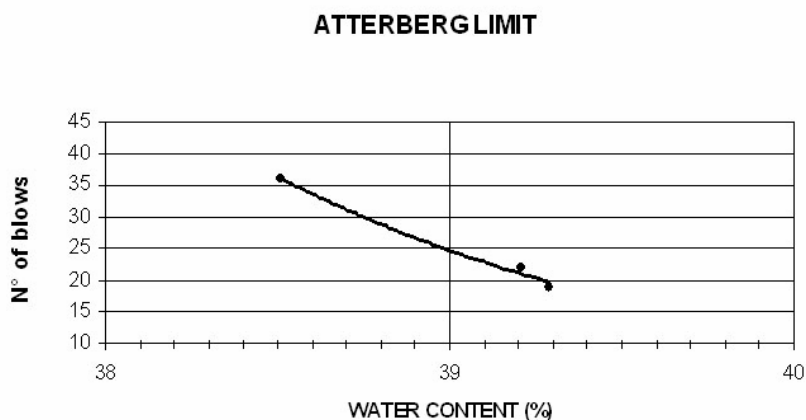


Figure 10. Measurements of Atterberg's limits of an earth sample

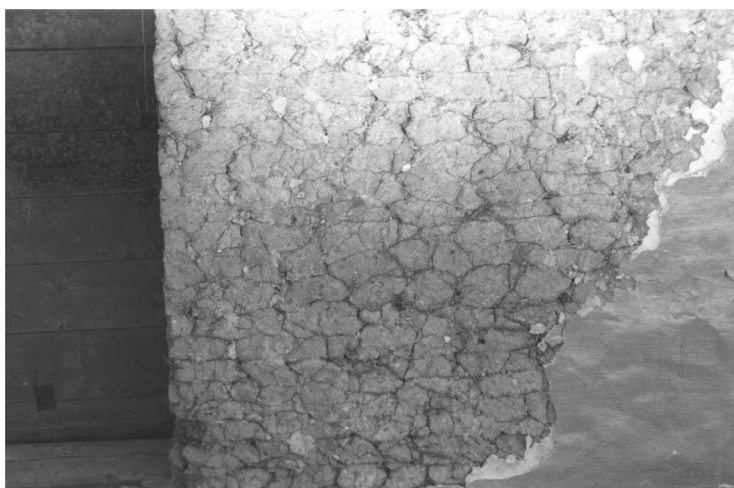


Figure 11. The material was first kneaded and then shaped into long cylinders, which were either piled or forcefully thrown onto the wall.

Cycles of experiments are currently under way. They are aimed at evaluating the prospects of reproducing the old technique, using first the in situ earth and then an earth of analogous composition, in order to regain control of the constructional aspects, namely the desired “workmanlike” practice or skill, and to identify a suitable type of soil for future use (**fig.12**). In fact, for the subsequent restoration designs to originate truly from an awareness of the real object being

worked on, the first steps have to come from knowledge of the constructional and material aspects, so that the concept of conservation could also be extended to the original building techniques.



Figure 12. As the technique is no longer used we are trying to reproduce the old method to give a tool for future interventions

CONCLUSION

In order to identify general directions for the conservation of earthen architectures it is necessary to identify homogeneous and repeatable operative working criteria in order to reuse the system as whole, given that, to this day, laws, rules or practice codes do not exist in Italy which regulate such design work. Everything is left to the expertise and professionalism of the designers and common sense of the public commissions, which handle this patrimony.

In fact, the project for the recovery and preservation of this type of building should be to preserve properly the historical building techniques of the elements considered. This would make it possible for the *new* re-use to arise out of its inherent “potential”. From a practical point of view, in fact, very invasive and destructive actions are often carried out to resolve problems linked to the public safety. Such actions could compromise the historical nature and the authenticity of the property that is to be protected in the name of its constructive culture. The suggested approach, instead, entails that the in-depth knowledge of the various *workmanlike* skills required needs to play a role in the initial phases of the project and for this to be a specific objective.

The purpose is not to obtain a statistical standardization of problems, but to account for the local specific elements and the building/formal solutions of the items under investigation. These will be the starting point for achieving a deeper knowledge of architectural issues, so that fully compatible

restoration projects can be drawn up and integrated - where possible - with the current and local technical rules. Of course we do not mean that we have the right solutions to all problems. We rather wish to put forward a reference base on which such solutions can be found, and focused on the individual cases in consideration of a more general experience.

NOTE

The following methods were used for the soil identification:

- For the texture: A.S.T.M. D 422-63 (1990) "Test Method for Particle-Size Analysis of Soils";
- For the Atterberg's limits: A.S.T.M. D 4318-95a "Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils";
- For the determination of water (moisture) content: A.S.T.M. D 2216-92 "Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock".

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