



PAST AND PRESENT OF THE EARTHEN ARCHITECTURES IN CHINA AND ITALY



Edited by
Loredana Luvidi, Fabio Fratini
Silvia Rescic, Jinfeng Zhang



PAST AND PRESENT OF THE EARTHEN ARCHITECTURES IN CHINA AND ITALY

EDITED BY
LOREDANA LUVIDI, FABIO FRATINI
SILVIA RESCIC AND JINFENG ZHANG

This series of volumes comprises research outputs that have been achieved due to the financial contribution of the National Research Council of Italy (CNR) and the the Chinese Academy of Cultural Heritage (CACH) within the context of a Bilateral Agreement of Scientific and Technological Cooperation between these two Institutions.

SCIENTIFIC EDITORIAL BOARD

Chai Xiaoming, Director of the Chinese Academy of Cultural Heritage - CACH
Gilberto Corbellini, Director of the Department of Social and Human Sciences, Cultural Heritage of the National Research Council of Italy – CNR
Maddalena Achenza, ICOMOS-ISCEAH International Scientific Committee of Earthen Architectural Heritage
Loredana Luvidi, CNR Institute of Heritage Science
Fabio Fratini, CNR Institute of Heritage Science
Silvia Rescic, CNR Institute of Heritage Science
Jinfeng Zhang, CACH Chinese Academy of Cultural Heritage

© Cnr Edizioni, 2021
P.le Aldo Moro 7
00185 Roma

ISBN paper version 978 88 8080 470 3
ISBN electronic version 978 88 8080 315 7

Front-page image captions

1. TECLA (Technology and Clay) 3D printed house by WASP and Mario Cucinella Architects, Massa Lombarda, Ravenna, ITALY (2021)
2. Ruins of a vernacular building in Sant’Omero, Abruzzo, ITALY (by Dalila Fortunato and Anna Jaroszewski, 2020)
3. Ruins of Gaochang ancient city, Xinjiang Province, CHINA (by Fabio Fratini and Loredana Luvidi, 2016)
4. Keziengaha beacon tower (Han Dynasty) in Kuche city, Xinjiang province, CHINA (by Center of Conservation of Xinjiang Cultural Heritage, 2020)

TABLE OF CONTENTS

Foreword	
Gilberto Corbellini	5
Chai Xiaoming	6
Introduction	
Loredana Luvidi, Fabio Fratini, Silvia Rescic and Jinfeng Zhang	7
Part 1 - Historical use of earthen materials for architecture	
Earthen Architectures: history, typologies and construction techniques	
Manuela Mattone	11
Conservation of earthen architecture: an overview of international guidelines and resolutions	
Carla Bartolomucci	23
Part 2 - Earthen constructions in Italy and China	
Historical Earthen Architecture in Italy	
Maddalena Achenza	39
Earthen houses in Abruzzo Region (Italy)	
Silvano Agostini, Gianfranco Conti	57
The status of earthen sites in China	
Juwen Guo	69
Part 3 - Conservation of earthen architecture sites in Italy and China	
Earth Materials: characterization and traditional/innovative techniques of conservation	
Fabio Fratini, Loredana Luvidi, Silvia Rescic	85
Earthen construction and seismic action: new perspectives between tradition and innovation	
Luisa Rovero, Giulia Misseri, Ugo Tonietti	101
Conservation of earthen architecture sites in China	
Xiao Zhou, Shuai Tian	115

Part 4 - New perspectives in earthen architecture in Italy and China

Overview of contemporary earthen architecture in Italy Eliana Baglioni	135
Earthen 3D printed constructions towards a new high-efficient way of building Massimo Moretti, Alberto Chiusoli, Lapo Nardoni, Francesco De Fabritiis, Massimo Visonà	147
Research and Practice of Contemporary Earthen Architecture Mu Jun, Zhou Tiegang, Jiang Wei	157

Part 5 - Case Studies

Experimental approaches for the conservation of the Ruguan Yao kiln site in Henan province Jinfeng Zhang	177
Conservation Measures of Ancient City Ruin of Gaochang Jicai Lu	191
Archaeological Site of Lajia Ruins: preliminary study on the screening of reinforcing materials for earthen ruins Min Fan, Yingyi Fu, Yue Chen, Guangzhao Zhang	201
Preservation of the CHANGSHA Tongguan Kiln Site: evaluation of earth properties and reinforcement effect of treatments Ya Xiao, Weiqiang Zhou, Feng Gao, Haibin Gu, Yun Fang, Shaojun Liu	215
Earthen walled villages in the Shanxi Province: Laoniawan (老牛湾) case Laura Genovese, Loredana Luvidi, Roberta Varriale, Fabio Fratini	229
Mud brick architecture in Sardinia. Sulcis as case study Marco Bianchi, Massimo Botto, Paolo Pasci	239

HISTORICAL EARTHEN ARCHITECTURE IN ITALY

MADDALENA ACHENZA

Department of Civil and Environmental Engineering, and Architecture, University of Cagliari (Italy). ICOMOS-ISCEAH

Keywords: Italy, earthen architecture, historical architecture

INTRODUCTION

In Italy, the use of earth as a building material has been historically well distributed throughout the Country, with the exception of the most mountainous areas in the centre and north of the peninsula. All the 20 political regions, from south to north, from Sicily to Piedmont, attest a diverse but often rich architectural production in which earth represented, in a not very distant past, a very commonly used material. Whether for walls, bedding mortars and plasters, floors and roofs, earth was everywhere used on a more or less large scale.

The different techniques used in the construction of simple units demonstrate the skill developed for centuries in the construction of houses and cities. From the Etruscans (VI-III sec B.C.), who built adobe walls on stone foundations or even on foundations made with the same earth blocks, for both rural and urban buildings and monuments, as well as for the fortifications of their settlements (Baldacci 1958), continuing with the Romans (V-I sec B.C.) who left a considerable number of vestiges throughout the Country, up to the more recent constructions, all of these constitute the historical and traditional earthen architecture heritage of the extended Italian territories.

Few researchers have really studied the role of the earth in the Etruscan architecture, but important documentation indicates its existence through the texts of Pliny and Vitruvius: both mention this material, describe its production, and the monuments still in good condition at their times, in order to demonstrate the quality of their structure and their stability. In particular, Pliny the Elder in his book *Naturalis Historia*, dedicates a whole paragraph to earth construction "*Quid? Non in Africa Hispaniaque e terra parietes, quos appellant formaceos, quoniam in forma circumdatis II utrimque tabulis inferciuntur verius quam struuntur, aevs durant, incorrupti imbribus, ventis, ignibus omniq; caemento firmiores? Spectat etiam nunc speculas*

Hannibalis Hispania terrenasque turres iugis montium inpositas. Hinc et caespitum natura castrorum valis accomodata contraque fluminum impetus aggeribus. Inlini quidem crates parietum luto et lateribus crudis extrui quis ignorat?" (So? Aren't in Africa and Spain walls of earth, which they call clay walls, because they are done in a form surrounded with boards on both sides, they last over time, are not to be destroyed by rains, winds, fires and are more solid of any concrete? Even now in Spain, we see the Hannibal's observatories and earthen towers built on the yokes of the mountains. For this reason, it is adapted as structure to the valleys of the camps and of the riverbanks against the rush of water. Furthermore, who does not know that the surfaces of the walls are smeared with mud and are built with raw bricks?).

From these historical documents we know that different types of buildings were constructed with adobe: many temples, town walls (Arezzo, Gela), tombs (Lipari), *villae* (Roman country villas). Finally, according to a famous quote from Augustus, we can also assume that Rome itself was largely built with adobe: *Marmoream se relinquere, quam latericiam accepisse* (I left a city of marble where I found a city of earth) (Svetonio). During the Middle Ages and thereafter, the use of earth for construction was limited to public housing, as stone was reserved for wealthier families, fortifications and religious buildings. However, we have reason to believe that this material has therefore been constantly used throughout the country for centuries and also during the long period marked by the incursions of Albanians, Greeks and Slavic peoples, in the Marche, Puglia and Calabria. Slavic migrations began at the end of the 14th century, introducing new construction traditions that received a great contribution from the material earth in general, and from adobe in particular. Many places in Calabria where adobe is still in use remind of this period: Spezzano Albanese, Tarsia, Santa Caterina Albanese, Copolati, Crosia, Ghirio, Roccaforte del Greco (Galdieri 1982).

Until the middle of the last century, with a peak following the Second World War, Italy could boast of having many small villages and rural settlements, variously built with earth according to the adobe, rammed earth and cob technology. Distributed in the north, in Lombardy (Lomellina, Oltrepò Pavese, S. Angelo Lodigiano, Mirandolo, Valle Sermeide and Ostiglia in the province of Mantua), in Emilia (Cento), in Umbria (the Umbrian valley from Perugia to Spoleto) in Tuscany (Lake Trasimeno, area of Cortona, Valdarno), in Abruzzo (provinces of Chieti, Pescara, L'Aquila), in Calabria already mentioned, or in Piedmont (plain of Marengo, Frascetta), in Sardinia (Campidano, Cixerri, Sarrabus), in the Marche (provinces of Macerata and Teramo). What remains of this earthen architecture now is an articulated and widespread built heritage that testifies a dignified past and a strong identity but that is slowly being replaced by a unified and generalized way of life, that most of the time overlooks the significance of this inheritance.

The strong heritage protection actions carried out in the last two decades by public administrations, universities and private entities have finally led to many significant actions of conservation in many regions and, in some cases, have sustained new

earth construction. In the following, I will try to provide a concise overview of what earth building represents in those Regions where the remaining heritage is still well recognizable. In some cases, this legacy is more related to the memory of written documents, in other areas earth buildings are still in use proudly showing a living heritage.

THE EARTHEN BUILT HERITAGE IN THE ITALIAN REGIONS

As previously mentioned, not all Italian regions have preserved an evident heritage of earth construction. But for some of them this heritage is still present, and sometimes even still in use, and for some others it has been possible at least to refer to historical documents. In the following, is a description of the heritage of the eight Regions that have been better documented: Sicily, Sardinia, Calabria, Basilicata, Abruzzo, Marche, Tuscany and Piedmont.

Sicily

In Sicily, the unfired brick technique was used in the past for the construction of a large number of Punic, Roman and Greek sites (Fig. 1). There are now numerous archaeological findings that testify earth construction: the city walls of Capo Soprano in Gela (4th century B.C.) are the most impressive evidence of the island (Fig. 2). The walls built around 340 B.C. by the Corinthian general Timoléon, forced to restore and partially rebuild the walls already built 60 years earlier with large blocks (40 x 40 x 8 cm) (Galdieri 1982). Studies conducted by researchers from the University of Palermo led by Maria Luisa Germanà have contributed substantially to highlighting the true Sicilian roots of earthen architecture. From the research carried out on numerous archaeological sites, the findings from different periods, ranging from prehistoric to Roman times, cover different types of buildings: religious, residential, funerary, artisanal, without excluding fortifications (Germanà 2008).

The most interesting archaeological remains, after the VII century BC, when the island opened to non-indigenous influences and when earth constructions began to spread. The earth therefore remains present in the architectural heritage of Sicily until the Middle Ages, with constructions in unfired bricks and rammed earth from the Hellenistic and Roman period. Currently, apart from the archaeological remains, nothing in Sicily reminds about the construction in earth, although there is considerable interest regarding the material and its potential for new building.



Fig. 1 Sicily, Bosco Littorio. Credits: M.L. Germanà



Fig. 2 Sicily, Capo Soprano. Credits: M.L. Germanà

Sardinia

Sardinia represents a special region in Italy thanks to its numerous unfired brick constructions. In this region the earthen house is present in both rural and urban areas (Baldacci 1958).

The island has had a long and continuous tradition of earthen constructions. The remains of the Phoenician and Roman period testify that earth was already a widely used material both for the production of bricks and as a mortar for plasters and floors in stone constructions. The findings in the Punic/Roman city of Nora near Cagliari testify the current use of earth bricks also for representative buildings such as the forum (Bonetto 2012; Bonetto 2013).

Subsequently, the use of earth brick was consolidated during the Spanish domination from 1326-1718 in an area that corresponds to the great Campidano plain which occupies almost a third of the entire island.

This long domination has left a culture that has marked the consistent built heritage still recognizable in the constructive elements and the words that define them as *ladiri* from ladrillo, *tabiccu* from tabique and *boveda* unchanged. In the Campidano everything is built with earth, public and private buildings, industrial and agricultural, urban and rural, rich and poor (Fig. 3 and Fig. 4). Here the adobe technique reached shapes and characters that are rarely found in the rest of Italy, starting from the private house, the most common type, which is always organized around a courtyard. The basic type of the courtyard house can have different forms depending on its location in the specific territories, the economic condition of the family, the particular function: depending on the predominance of one or the other factor, the courtyards can be small or large, placed in front or in the rear, the residential buildings can have one or more levels, face the street or the courtyard. As always, the courtyard houses have a very introverted character, projected towards the internal space where most of the activities take place. Outside, along the access road, often represented by narrow alleys, the surrounding wall runs to protect the intimacy of the family. A sequence of solids and voids, of public and private spaces provides the rhythmic cadence of the inhabited spaces.

At the end of the nineteenth century, another typology appears in small towns, the *palazetto*, built on the street front, a two-story building, open to the public street with large windows and balconies, which escapes the logic ordered by the centrality of the courtyard. These new buildings have an urban character that replicates the model of the noble palaces in Cagliari, the main city of the island. In this case, intimacy surrenders in favour of revealing the family's wealth: stuccoes and external decorations, wrought iron balconies, proudly show the richness of the people who live there.



Fig. 3 Sardinia, Villasor. Credits: M. Achenza



Fig. 4 Sardinia, Musei. Credits: M. Achenza

Calabria

Calabria, with Sardinia and Piedmont, is one of the regions that best represent earth construction in Italy. In ancient times, earth, and the earth brick in particular, were used in Calabria to erect fortifications as evidenced by the remains of ancient Reggio Calabria (6th and 5th century B.C.), Locri and Vibo Valentia (5th century B.C.). The walls of the ancient colony of Region (Ρήγιον), today's Reggio Calabria, were built during the period of Greek domination on the Ionian coast of southern Italy. This defensive structure, discovered at the end of the 1970s, was built in the highest part of the city by ramming a mixture of earth inside two fired brick walls (Galdieri 1982).

The earth brick, used also in modern times until the middle of the last century, is known by different names, depending on the places where it is still present: *mat-tunazzu* (valley of Crati), *bresta* or *vresta* (centre-south of the region), *bisola* (near the strait of Messina). Despite the diversification in terminology, the bricks are manufactured according to identical methods used in historical times and were used both in the countryside and in the urban context until a few years ago (Cavalcanti 1999). Their dimensions vary according to the place of production: around Vibo Valentia and on the plateau of Monte Poro the bricks are larger (38 × 18 × 10 cm), in the valley of Crati and the area of Lamezia Terme, they had a size equal to 30 × 15 × 15 cm, while closer to Reggio Calabria its dimensions are smaller (27 × 14 × 12 cm). Their use is quite diversified involving both rural and urban buildings, both rich and poor.

Although there are no particularly precious decorations as sometimes happens in other countries, it is possible to find very interesting formal and technical applications such as terrace houses, noble palaces, and even industrial buildings and defensive walls. According to a re-organization of the different typologies present, made by Ottavio Cavalcanti and Rosario Chimirri (Cavalcanti 2009), the hut typology is identified which is the most primitive example of agro-pastoral construction. It is a simple and very small space (rarely larger than 7 m²), built with the wattle and daub technique. The cottage, also a rural building, but slightly larger in size, represents the most widespread type in the region. Starting from a single cell, it can have several additional rooms, and an upper floor. The animals and agricultural tools are housed in annexed service buildings.

The walls are made of bricks coated with earth plasters or with lime slurry. The farm, a building type belonging to wealthier families, has a more complex organization, with a central element on two floors around which all other service spaces are organized. This complex of several buildings can accommodate from 50 to 100 people, and can be considered as a small autonomous village, so independent that sometimes it even integrates a small church. Town houses are located within small agglomerations, along historic streets and in the vicinity of religious or military structures. These are basically of two types. The former has a single-storey terrace and has a single room where men and animals live together. The latter, more articulated,

has several rooms for different purposes. It is still possible to find, albeit infrequently, three-storey buildings with artisan shops on the ground floor (Cavalcanti, 1999).



Fig. 5 Calabria, Rural Houses. Credits: R. Chimirri



Fig. 6 Calabria, "Palazzotto". Credits: R. Chimirri

Basilicata

In Basilicata, the construction of earth houses was widely diffused throughout the nineteenth century and during the first half of the twentieth century both in rural and urban areas, for the availability of the materials on site and for the ease of realization of the artifacts (Guida et al 2015).

Now earth houses are no more commonly found, but they are still present in the valleys of Sini and Agri and can be distinguished in two types. The first one is formed by one small room, generally square or rectangular, built at the centre of the property that was cultivated. It was used as a temporary shelter during the day and permanently during the summertime. The second one was a two-storey building and represented the family house in town, built with recurrent typologies. In 1932, De Grazia reported the diffusion in the village of Senise of earthen houses in replacement of those built with stone (De Grazia 1924). These were called *casedda*, had stone foundations and adobe walls (*ciùcioli*): "The dug clay was brought close to the place chosen for building the house. It was broken, pulverized, and then put in a basin where it was wettened and mixed. To the mix wheat straw was added to make it more coherent and insulating, and as soon as the mix hardened, bricks were formed and then sun dried" (Dragonetti 2014).

Floors were made of pebbles or rammed earth, with the use of fired tiles only in rich houses and in town. Sloped roofs protruded from the walls to protect them from rain. Houses were always plastered with one or more layers of lime mix, not just for aesthetic but mainly for sanitary reasons.



Fig. 7 Basilicata, Senise. Credits: W. Secci



Fig. 8 Basilicata, Senise. Credits: W. Secci

Abruzzo

The earthen heritage of Abruzzo is mainly represented by rural buildings, documented since the mid-nineteenth century widespread in the countryside, almost never in the urban area. These are houses with a rectangular or square plan on two levels connected by an external staircase. In urban areas they are houses up to two floors high with walls that can have both raw and fired bricks together.

The ground floor, normally used as an artisan workshop or shop in the city, is used as a barn in the countryside. The use of earth has spread widely in the countryside thanks to its low cost and the availability of the material. Furthermore, the construction process was the result of an exchange of work between neighbouring farmers (Giardinelli 2004).

The most represented technique (95% of cases) is that of the freemason (Conti 2004), characterised by monolithic walls built starting from a clayey earth mixed with a large amount of straw, associated with earth brick only in very rare circumstances. According to a census of earthen houses built by the Abruzzo Region in 1997, it appears that in the areas of Chieti (Loc. Buon Consiglio and Villamagna), there are only 5 houses built entirely with earth bricks. The walls, 40 cm thick, are built with bricks measuring 10 x 12 x 35 cm, the joints and plaster are also made with earth (Gentile 2004).



Fig. 9 Abruzzo, Manoppello. Credits: M. Achenza



Fig. 10 Abruzzo, Manoppello. Credits: A. Lattanzio

Marche

Earth construction is widespread in the Marche, especially in the lower hilly areas and constitutes an important construction tradition in the province of Macerata and in the city of Treia in particular. It has been thought for many years that earth construction was present only in very limited territories (Volpe 2004). In fact, more in-depth research conducted over the last few decades by architects Gianni Volpe and Anna Paola Conti have brought to light many buildings, the most recent of which date back to the late 19th century. These buildings known as *atterrati* (literally in dialect: built in earth) were rural buildings as well as urban ones. The walls were mainly made with almost pure clay with a technique called *massone* (cob, in English), more rarely with bricks. It is worth mentioning the exceptional example of a neighbourhood built almost entirely with earth bricks now incorporated into the town of Macerata, but once a rural agglomeration, Villa Ficana (Conti 2002). It is a set of about fifty terraced houses, some of which have a mixed technique of cob and adobe. The analysis of the existing building demonstrates a masterful knowledge of mason construction and detects the presence of unfired bricks prepared without straw, especially used for internal partitions (Giustozzi 2007).



Fig. 11 Marche, Treia. Credits: A. P. Conti



Fig. 12 Marche, Villa Ficana. Credits: A. P. Conti

Tuscany

Tuscany is not a region of Italy that immediately evokes earth construction, but this material has been widely used in the region, especially in some areas, like those of Val di Chiana around Lake Trasimeno and in Valdarno. It is important to remember the well-known booklet by Giuseppe del Rosso (Del Rosso 1793) (Bertagnin 1992) which extensively describes the earth constructions in those territories. However, there are documents that refer to defensive structures built with rammed earth, and sometimes even with earth bricks. In the third century BC, during the transition period between the Etruscan and Roman domination, part of the walls of the ancient Arretium (Arezzo) was rebuilt using large rectangular unfired bricks measuring 48 ×

28 × 12 cm. These bricks had a particularity described by G. Lugli: “the bricks of the wall are made with a not very refined clay that contains stones without added straw; these were first dried in the sun, and then lightly passed over the fire, but their interior remained mostly raw due to their great thickness” (Lugli 1952). The semi-firing process has given these bricks the same shiny surface appearance of the Assyrian walls and represents in our eyes the transition phase from raw to fired brick (Galdieri 1982). Another interesting example is the Villa Settefinestre, built on a hill near Cosa, an important Roman maritime commercial port founded in 273 BC, sited along the Via Aurelia near Argentario promontory.

The villa was built in 40 BC by a family linked to the Roman Senate and had a property of 125 ha used for agriculture and livestock. Certain parts of the building made of earth prove that a good part of the Roman republican buildings used this material. What remains in Tuscany today is a limited heritage and almost unknown, essentially concentrated in the south of the region, with rare but not unimportant urban presences. This is the case of San Giovanni Valdarno where are still visible, in the historic centre of the city a group of houses perhaps designed by Baldassarre Buontalenti (1536-1608) made of unfired bricks (Galdieri 1982).

A recent uncovering is the one inside the Grange of Cuna near Monteroni d’Arbia, a big farm owned by the Santa Maria della Scala Hospital in Siena. Among the different masonries, fired brick masonries with earthen bedding mortars have been found in the original medieval nucleus, while rammed earth masonries plastered with lime mortar are present in some late medieval or post-medieval additions (Giamello 2016). Moreover, two examples of rammed earth masonries yet in the territory of Siena were reported by Parenti (2002): the Palace Bandinelli Corboli in Asciano (in the second building phase, dating to the 13th century) and Castelverdelli (San Giovanni d’Asso), where the earthen walls, made with different techniques, are largely used in the large complex, related to the 13th-14th centuries (Fratini 2020).



Fig. 13 Tuscany, Alberoro. Credits: M. Achenza (1993)



Fig. 14 Tuscany, S. Giovanni V. Credits: E. Desantis

Piedmont

Although there is no specific documentation of earth archaeological findings in the region, Piedmont is one of the richest Italian areas in earth constructions. The heritage still visible today mainly dates to the past two centuries even if it is still possible to find more ancient buildings. Many earth constructions are concentrated in an area between Alessandria, Novi Ligure and Tortona, the so called Marengo plain, where rammed earth coexists with brick construction to form an architectural presence of great diffusion and importance.

The shape of the buildings varies according to their destination. Sometimes these are residential block buildings such as in the cities of Alessandria and Novi Ligure or smaller units, as in the case of Bosco Marengo, Frugarolo and Spinetta Marengo. But also rural houses are numerous throughout this area. In the remaining part of the Alessandria province the use of earth bricks is widespread their presence characterizing many small towns such as Fresonara, Castelnuovo Bormida, Castellazzo and Basaluzzo.

Studies conducted over the last decade have shown the presence of interesting examples of earth architecture also in the provinces of Asti, Torino, Biella and Cuneo (Fratini 2020). In these buildings the use of earth brick does not exclude the employ of fired bricks and they may coexist. In some cases, in fact, earth bricks are

found only in the upper floors immediately below the roof that protects it from the elements, while in other cases the fired bricks are used for the bearing structures and earthen bricks for internal and external walls. The fired brick can be also found only as a decoration (Robboni 2007).

For the most part, these earth bricks architecture is represented by isolated houses, very simple in shape, almost always with two floors, more rarely with the addition of a mezzanine attic. In the urban context the buildings are adjacent with large façades on narrow streets or small squares, windows only starting from the first floor and open only to the back. These two or three storey buildings do not differ at all from the more recent buildings built next door, which have maintained the shapes and decorations of the earth buildings.



Fig. 15 Piemonte, Novi Ligure. Credits: I. Parodi



Fig. 16 Piemonte, Novi Ligure. Credits: G. Bollini

CONCLUSIONS

The diffusion of earth buildings in Italy has been very extended in ancient times in the whole country, as evidenced by the most recent archaeological campaigns. Nowadays, even if there are no significant concentrations of earthen buildings left, except in some regions described above, earth as a building material, where present, is well recognized and mostly still in use. In these regions, the use of earth as building material has sometimes reached such levels of exceptional skill, sobriety and richness that the heritage has survived despite almost a century of neglect and abandonment. These constructions and the culture that they bear are still far from being put at the centre of political actions of conservation and valorisation, but some activities at national level were carried out in order to frame a dedicated normative in the years 2004-2009 and several Regional laws have stated the need to recognize, preserve and valorise the local earthen built heritage.

The pandemic events of the last months seem to put this heritage again under a focus lens, as the Italian villages, the very backbone of the country, are places where people live better and differently from large cities, on a human scale; they are places of thought and slowness, that same slowness that very well represents the figure of Italian artisans, of high quality agriculture, of the protection of biodiversity, of the landscape suspended between city and countryside, between sea and hinterland. These are concepts that need to be protected and spread in order to make the living in these peripheral places more and more attractive. Famous architects as Stefano Boeri and Massimiliano Fuksas are convinced that the rehabilitation of old minor villages will be our future, able to stop the diffused uncontrolled soil consumption and to assure energy efficiency, enhance circular economies, both key instruments to respond to the climate and the pandemic crisis we are facing.

BIBLIOGRAPHY

- Baldacci O. (1958). *L'ambiente geografico delle case di terra in Italia*. Rivista geografica italiana LXV, Num. spec. Studi geogr. in onore R. Biasutti pp.13-44.
- Bertagnin M. (1992). *Il pisé e la regola. Manualistica settecentesca per l'architettura in terra*, Edilstampa, Roma.
- Bonetto J., Falezza G., Ghiotto A.R., Savio L., Tabaglio, M. Zara A. (2012). *Il Saggio PR3. Campagne di scavo 2009-2010*, in Quaderni Norensi IV, pp. 155-183.
- Bonetto J. (2013). *L'insediamento fenicio di Nora e le comunità nuragiche: contatti e distanze*, in P. Van Dommelen, A. Roppa (edd.), *Materiali e contesti nell'età del ferro sarda*, Atti della giornata di studi, Museo civico di San Vero Milis (Oristano), 25 maggio 2012, Rivista di Studi Fenici, 41/1-2, pp. 173-182.
- Cavalcanti O., Chimirri R. (1999). *Di fango, di paglia... Architettura in terra cruda in Calabria*, Rubettino Ed., ISBN 8872847877.

- Conti A. P. (2002) *Il recupero di una casa di terra*, Edicom Edizioni, Monfalcone.
- Conti G. (2004). *Viaggio nella terra cruda in Italia*, ed. Tinari, Villamagna (CH).
- De Grazia P., *Lucania e Basilicata. Contributo al problema della divisione dell'Italia in regioni e provincie*, vol XXXI (1924), pp. 213-232.
- Del Rosso G. (1793). *Dell'economica costruzione delle case di terra, opuscolo diretto agli'industriosi possidenti e abitatori dell'agro toscano*; Bouchard, Firenze.
- Dragonetti P. (2014). *Terra mediterranea. Il richiamo alla sostenibilità attraverso la promozione delle case di terra*, ed Ceged, EAN: 9788890541360, available at www.terramediterranea.com.
- Fratini F., Mattone M., Rescic S., Rovero L. (2020) "Analysis of the earthen architectural heritage in Piedmont (northern Italy): typologies, construction techniques and materials", Gremium©| Volumen 7 | Número 14 | August-December 2020, pp. 101-112.
- Gaio Plinio II il Vecchio, *Naturalis Historia*, libro XXXV, p. 169.
- Galdieri E. (1982) *Le meraviglie dell'architettura in terra*; Laterza, Roma-Bari, 8842020656.
- Gentile P. (2004). *Il censimento delle case di terra in Abruzzo*, in Conti G., *Viaggio nella terra cruda in Italia*, ed. Tinari, Villamagna (CH).
- Germanà M.L., Panvini R. (2008). *La terra cruda nelle costruzioni. Dalle testimonianze archeologiche all'architettura sostenibile*; Nuova Ipsa, Palermo, ISBN 9788876763793.
- Giamello M., Fratini F., Mugnaini S., Pecchioni E., Droghini F., Gabbriellini F., Giorgi E., Manzoni E., Casarin F., Magrini A., Randazzo F., (2016) "Earth Masonries in the Medieval Grange of Cuna – Siena (Italy)", *Journal of Materials and Environmental Sciences*. 7 (10), 3509-3521.
- Giardinelli S., *Stato dell'arte dell'architettura in terra in Abruzzo*, in P. Gentile, *Il censimento delle case di terra in Abruzzo*, in Conti G., *Viaggio nella terra cruda in Italia*, ed. Tinari, Villamagna (CH) (2004).
- Giustozzi S., *La terra cruda e gli atterrati*, in A.P. Conti (a cura di), *Il recupero di una casa di terra*, Edicom Edizioni, Monfalcone (2002).
- Guida A., Mecca I., Forlenza G. (2015) *La terra cruda in Basilicata tra memoria tradizione e conservazione*, in XI CIATTI 2014. Congresso Internacional de Arquitectura de Tierra Cuenca de Campos, Valladolid, e-print, ISBN: 9788460695431.
- Lugli G. (1952). *La tecnica edilizia romana*, G. Bardi editore, Roma.
- Parenti R., *Il "chasamento" dei Bandinelli ad Asciano e Castelverdelli nella Val d'Asso*, in *Le dimore di Siena, l'arte dell'abitare nei territori dell'antica Repubblica dal Medioevo all'Unità d'Italia*, ed. Morolli G., Firenze, Alinea (2002), pp. 107-112.
- Robboni F.C. (2007), *Terra rossa: le case della Frascetta*, ed. Spinetta Marengo.
- Svetonio, *Vite dei Cesari*, Aug., XXVIII, 3.
- Volpe G., *Le costruzioni di terra nelle Marche settentrionali*, in P. Gentile, *Il censimento delle cose di terra in Abruzzo*, in *Viaggio nella terra cruda in Italia*, a cura di G. Conti, ed. Tinari, Villamagna (Ch) 2004.
- XIV LEGISLATURA. House of Representatives - N. 2347. Bill of initiative of the

deputy Marco Lion. Amendments to the law 2 February 1974, n. 64, containing provisions for buildings with prescriptions for seismic areas, presented on February 14, 2002.

- The Unified Text. Provisions for earth constructions (C. 2347 Lion and C. 4019 Cossa). Proposal for a Unified Text prepared by the Rapporteur based on the work of the Select Committee. Provisions for earth constructions.
- XVI LEGISLATURE – Preparatory work sheet. Parliamentary act: 2358 (Fase iter Camera: 1^ lettura). Dep. Schirru Amalia. Provisions for the promotion of earth constructions. April 2, 2009: Presented to the Chamber. To be assigned to the commissions: Schirru Bill - "Provisions for the promotion of earth constructions" (2358).
- XIII LEGISLATURE – Law proposal n. 47. Presented by the Regional Councilors: Calleda, Marrocu, Barracciu, Cherchi, Corrias, Cugini, Floris Vincenzo, Lai, Mattana, Orrù, Pacifico, Pirisi, Sanna Alberto, Sanna Franco, on October 20, 2004. Provisions for the protection, recovery and the enhancement of the architectural heritage made with earthen artefacts and construction techniques and for the promotion of new bio-ecological building productions.



PAST AND PRESENT OF THE EARTHEN ARCHITECTURES IN CHINA AND ITALY

The Bilateral project "Assessment of innovative methods for the conservation of earthen surface" was financed by the National Research Council of Italy (CNR) and the Chinese Academy of Cultural Heritage (CACH) for the period 2016-2018. The research undertaken by the two teams aimed to promote a better knowledge of the earthen architecture in China and Italy, exchange and sharing of experiences about methods, tools, protocols and best practices for the conservation of earthen materials. This fragile architecture, due to the poor durability of earthen materials against atmospheric agents, is in a situation of great risk considering also the problem of climate change

This book examines the historical use of this material for architecture, the different types of earthen construction in Italy and in China, the conservation techniques used in the respective countries and the researches that are being carried out to improve these interventions. New opportunities that the earthen architecture can have in future in the two countries are illustrated.

ISBN 978 88 8080 315 7