

THE EARTHEN ARCHITECTURE OF PHOENICIAN AND PUNIC SETTLEMENT. A FOCUS ON SARDINIA

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Abstract: With migration follow traditions, memory, experiences, and skills, variably helping the adaptation to the new world. The Phoenicians, meeting the local populations of the Mediterranean and Atlantic coasts in the first millennium BCE, brought valuable knowledge to raw earth construction techniques there. Adapting to local needs, they modified their skills and created new patterns. The present contribution focuses on the similarities and differences that this construction technique portrays in the Phoenician and Punic settlements of the Mediterranean and the Atlantic coast of the Iron Age. Through the previously unpublished documentation of Pani Loriga in Sardinia, some interesting points of analysis of the architecture in raw earth in the Phoenician and Punic world will be presented.

Keywords: Earthen Architecture; Iron Age; Levant; Punic Mediterranean; Sardinia.

1. INTRODUCTION

Recent years have witnessed a growing academic interest in earth architecture.¹ On the one hand, the focus on earth's sustainability as a building material in modern structures may lead to appropriate conservation strategies of the outstanding past. On the other hand, this interest has helped describe past societies by examining the complex social processes underlying the development of building techniques.² It has led us to approach artefact analysis with a different methodology facilitated by technological development, such as the use of innovative technologies to define the composition and recipe of the clay characteristics and the use of fairly new science, geoarchaeology, to study the processes underlying the emergence of clay architecture and soil use.³ It can be claimed that architectural studies are a growing field nowadays.

In this context, the claim that Phoenician architecture has been extensively analysed in the Eastern Mediterranean is obvious. Several works have dealt with building techniques and their evolution over time in the Levant, especially in the south. However, the study of earthen architecture has suffered from a lack of data.

Since the late 1970s, numerous authors have addressed the study of "Oriental" architecture as such, creating veritable corpora. As far as Phoenician architecture is concerned, F. Braemer's comprehensive analysis of house architecture in the Iron Age Levant⁴ is still relevant as an excellent synthesis. He analysed most Levantine settlements and focused on building materials, devoting a separate chapter to construction techniques and building materials. He also examined the structure of the walls, including a study of mudbrick systems, and described their shapes and dimensions.⁵

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1 See Achenza – Sanna 2008; Achenza – Correia – Guillaud 2011; de Chazelle – Klein 2003; de Chazelles – Klein – Pousthomis 2011; Mecca *et al.* 2011; Mileto *et al.* 2014; also Pastor Quiles 2017 for more bibliography; Luvidi *et al.* 2021.

2 See Homsher 2012; Love 2013; Lorenzon 2019; Doerthy 2020.

3 Morgenstein – Redmount 1998; Love 2012; Lorenzon *et al.* 2020.

4 Braemer 1982.

5 Braemer 1982, pp. 121-124.

Z. Herzog's work,⁶ published a few years later in a volume edited by A. Kempinsky and R. Reich in 1992,⁷ focused in detail on the Iron Age settlements of ancient Israel, anticipating the more comprehensive analysis he published in 1997.⁸ His synthesis focused not only on the domestic side of architecture but also on the public, defensive and religious side.

O. Aurenche's 1977⁹ publication is also a significant volume for anyone studying Near Eastern architecture. In 2019, a volume was published that follows in its footsteps, *On Cob Balls, Adobe and Daubed Straw Plaits. A Glossary on Traditional Earth Building Techniques for Walls in Four Languages* by Knoll, Pastor Quiles, De Chazelles and Cooke.¹⁰ Recognising the different techniques of using raw earth in construction indeed remains one of the main concerns of archaeological research.

Nevertheless, it is Aurenche that remains our main point of reference, the first author to publish the unique synthesis about the origin of mudbrick in the Near East¹¹ and the *Maison orientale*.¹² Like Braemer, he partially devoted his analysis to stone and earth building techniques and materials.¹³ Following the trend, G.R.H. Wright published his corpora on the architecture of Syria and Palestine in 1985.¹⁴ Like the other scholars, Wright focused on the buildings, their nature and the materials used in their construction. At that time, he probably laid the foundations for his three-volume encyclopaedic work, which he published between 2000 and 2009.¹⁵

These fundamental studies can be considered the basis of current knowledge of Near Eastern architecture and constitute a vast corpus for the analysis of the domestic architecture of several settlements.

Moreover, in 1995, S.M. Cecchini¹⁶ synthesised the Levant's military, domestic and civil architecture, as S. Lancel¹⁷ did for the western Phoenician world in the same volume.¹⁸ In addition, several studies have approached this subject in recent years and produced syntheses¹⁹ for both the East and the West. F. Prados Martinez, in 2003,²⁰ published what can be considered the first synthesis on Punic architecture with a view to the East. Several studies focus in detail on individual areas of the Phoenician expansion, such as the comprehensive analysis by E. Díez Cusi²¹ on the orientalising architecture of the Iberian Peninsula, or individual settlements, such as the various studies by A. Mezzolani Andreose on North African Punic architecture.²² However, despite the abundance of case studies from the East, stone architecture has often been the primary subject of investigation in contrast to earthen architecture, especially in the West, partly due to its material persistence.

6 Herzog 1992.

7 Kempinsky – Reich 1992; Reich 1992.

8 Herzog 1997.

9 Aurenche 1977.

10 Knoll *et al.* 2019.

11 Aurenche 1993.

12 Aurenche 1981.

13 Aurenche 1981, pp. 11-92, 94-180.

14 Wright 1985.

15 Wright 2005; 2009.

16 Cecchini 1995.

17 Lancel 1995.

18 Krings 1995.

19 Hodos 2020, pp. 147-181.

20 Prados Martinez 2003; see also 2007.

21 Díez Cusi 2001.

22 Mezzolani Andreose 1996; 1998; 2000.

Recently, raw earth architecture is drawing new interest and, with it, new methodological approaches and new investigations. In 2008,²³ at Toulouse, the round table “Le culture constructives de la brique crue” took place, and in 2009, the first Mediterranean conference on earth architecture at Cagliari (Sardinia), a congress exclusively dedicated to earth architecture in the ancient Mediterranean. The conference proceedings, published in 2011,²⁴ provided exciting insights. In particular, the study presented by M. Sauvage, *Les débuts de l’architecture de terre au Proche-Orient*,²⁵ can be considered an update of the aforementioned Aurenche research.

Furthermore, much research has recently been devoted to analysing the different techniques using earth’s raw materials and their identification during fieldwork.²⁶ Starting from the earliest use of *torchis*, i.e. a heap of earth and rough straw, the wattle and daub technique, and then the use of stacked and compressed earth, *bauge* and *pisé*, up to the workers specialised in producing the famous unbaked brick, identifying the various techniques in which earth is employed seems, however, to be increasingly difficult.

The metrological aspect of architecture has also been analysed and considered as one of the most important comparative aspects in architectural science. Nevertheless, there is indeed no universal agreement on the exact size of the Phoenician cubit, due to the variability of its use in Phoenicia itself.²⁷ In 2007, Barresi published the first and only metrological study of Punic architecture, *Metrologia Punica*, which has served as a reference for comparative studies of Punic architecture for many researchers. Although metrology can be a valid element to identify the origins of stone architecture or structures in general, I do not believe the same can be said for mudbricks. The production of mud bricks required, above all, the use of mould that could not differ in centimetres or, in some cases, millimetres, in order to correspond to the Punic cubic size.

Nevertheless, no corpus has yet been produced on Phoenician and Punic adobe architecture characteristics, apart from chapters devoted to clay features. While it must be stressed that the present work in no way constitutes a synthesis of the analysis of this technique in the whole Phoenician and Punic horizon, it does aim at drawing attention to several aspects that have long been taken for granted and not considered worthy of particular study: the use, development and adaptability of a technique with ancient origins, as well as its social role and local variability. After a brief overview of Levantine earth architecture, the evidence for the western Mediterranean is examined, focusing on the rare evidence from Sardinia.

2. THE EARTHEN ARCHITECTURE OF PHOENICIAN AND PUNIC SETTLEMENTS

2.1. *The Levant*

“Mudbrick”, *brique crue*, “adobe”, *torchis*, *pisé*, “rammed-earth”, *terre empilée*, “raw brick” are the terms that define one of the oldest construction techniques globally: that derived from the bare earth. From the Neolithic period onwards, natural earth architecture appeared in large parts of the Near East, including the Levant.²⁸ The first evidence of the use of unbaked bricks, dating from around 9000 BCE, comes from the cities of Jerico and Aswad in the southern Levant.²⁹ From this moment on, which can be defined as embry-

23 de Chazelles – Klein – Pousthomis 2011. In 2007, another congress dedicated to the use of earth in construction had taken place in Sicily, see Germanà – Panvini 2008.

24 Achenza – Correia – Guillaud 2011.

25 Sauvage 2011b, p. 189.

26 Perello 2015; Love 2017; Pastor Quiles 2017, pp. 72-95; Pastor Quiles – Knoll – Jover Maestre 2019; Knoll *et al.* 2019.

27 Barresi 2007, p. 40.

28 Kemp 2000.

29 Sauvage 2011a, p. 89.



FIG. 1. a) Megiddo: plan of Situation 4 of the Q 10 trench at Megiddo, from the east, with sample locations indicated (after Homsher 2012, p. 9, fig. 6); b) Tel Dor: stone-rubble “pilaster” between two sections of mud, looking north. No bricks could be delineated in the mud construction in Gilboa (after Gilboa *et al.* 2018, p. 35, fig. 26); c) Tel Hazor: northeastern corner of entrance hall (after Bechar – Ben-Tor 2018, fig. 6).

onic for the evolution of the technique, it was further defined and standardised and led to the imposing Mesopotamian and Levantine constructions of Megiddo, Tel Dor, and Tel Hazor, which are only a few examples (FIG. 1).

One of the first sources that mention the production and use of raw bricks is the Bible, Genesis 11,3, on the Tower of Babel. In the fifth book of Exodus, the Levantine Israelites are identified as experts in producing mud and straw bricks for the Pharaoh. The origin and diffusion of earthen architecture in the ancient Near East is a subject that has been widely treated and debated. Recent studies focus on the typological and socio-cultural definition of earthen construction techniques in the Near East. These are devoted to unfired brick, its production and use in construction, and the social dynamics behind its production. S. Love and M. Lorenzon³⁰ have dedicated their research to the geoarchaeology of mudbrick architecture and its social implications in prehistory. Specifically for the Levant, the research conducted by R.S. Homsher in the southern Levant³¹ is of genuine interest. He took several samples from three Middle Bronze Age cities, Megiddo, Tel Dor and Pella, and analysed their composition and dimensions. The most thought-provoking part of this research is the economic aspect behind the featured production.³² As Love also noted for Anatolia and Lorenzon for Egypt and Crete, there are complex societal processes behind making clay bricks.

30 Love 2013; Lorenzon 2019; 2021.

31 Homsher 2012.

32 Homsher 2012, pp. 15-21.

2.2. *The Western Mediterranean and the Atlantic Coast*

Although unfired earthen architecture is an eastern peculiarity and a technique particularly suited to climates that allow it to be preserved without much maintenance, its introduction into the western Mediterranean regions affected by the Phoenician spread has resulted in it often being attributed to the latter.

Not all scholars agree on this. A. Mezzolani Andreose³³ has noted that raw earth architecture predates the Phoenician frequentation of the North African coast. She also remarked that nothing is certain: unless other investigations are carried out, one cannot be confident of either thesis. The same can be assumed for the Iberian peninsula. According to a study conducted by M. Pastor Quiles,³⁴ earthen architecture itself was customary in the Iberian Levant as early as the Neolithic period. A similar situation can be found in Sicily, where the Greek element has played up the introduction and evolution of the technique as Phoenician. F. Spatafora³⁵ specifies how this material is widely attested diachronically in central-western Sicily.³⁶ However, she observes how the use of brick is a later prerogative than the use of *bauge*, *tapis* or *pisé* itself.

Despite this, the particular use of unbaked bricks, especially on the Iberian peninsula, would appear to date back to a precise historical moment that coincides with the first stable presence of Phoenician peoples. In this regard, C.A. de Chazelles noticed³⁷ that the Phoenician component did not introduce unbaked bricks in the Iberian peninsula, where their presence is attested as early as the third millennium BCE. With a gap of about a millennium, they then reappear at the end of the Bronze Age. De Chazelles believes that through contact with the Phoenician element, the processes of specialisation in production that characterised Iron Age architecture on the Iberian peninsula emerged. Many settlements from the end of the 9th century BCE onwards testify to the technique of stone plinths with adobe upper walls: Castillo de Donna Blanca, Cerro del Villar, Malaka, Morro de Mezquitilla, Las Chorreras, Toscanos, Abdera, Sa Caleta, Huelva, Tejada la Vieja, El Carambolo, Cerro Macareno, Carmona, Montemolin, Cancho Roano, La Rebanadilla, Cadiz, to name but a few.³⁸ For the other regions of the Mediterranean, however, she supports the thesis of the introduction of raw earth architecture by Phoenicians or Greeks.³⁹

3. THE EARTHEN ARCHITECTURE IN SARDINIA

The use of raw earth architecture in Sardinia dates back to prehistory.⁴⁰ An increasing number of studies are looking at the various earthen building techniques used in the Bronze Age Nuragic period. However, as for the other Mediterranean regions aforementioned, its maturation and maximum diffusion can be traced to the moment of encounter between the allogenic and the indigenous element. Without delving into the controversial question of the origin of bricks, we will concentrate on the scanty evidence of their presence and use in the Phoenician and Punic settlements of the island. The analysis will then highlight differences and similarities in light of the new excavations at Pani Loriga by the ISPC-CNR.

Several settlements have been excavated and are still undergoing investigation. Nevertheless, only some have devoted special study to – or even sufficiently depicted – the earthen architecture of their Phoenician and Punic phases. Clay architecture evidence comes from many Phoenician settlements, but preser-

33 Mezzolani Andreose 1998.

34 Pastor Quiles 2017.

35 Spatafora *et al.* 2011, pp. 201-202.

36 For example: Spanò Giammellaro 2002; Sposito – Fernandez 2008.

37 de Chazelles 1995; 2011, pp. 157-158.

38 See Díez Cusi 2001.

39 de Chazelles 2011, pp. 157-158.

40 See for instance, Ugas – Usai 1987; Sebis 2007; Melis 2010; Usai 2013; Ugas 2014, pp. 28-33; Melis – Albero Santacreu 2017.

vation is problematic. The evidence of mudbrick structures comes from Karalis,⁴¹ Nora,⁴² Tharros,⁴³ Sulky,⁴⁴ Monte Sirai,⁴⁵ Nuraghe Sirai,⁴⁶ Pani Loriga⁴⁷ and indicate small farms and rural settlements.⁴⁸

F. Barreca published the first and only available overview of the pieces of evidence in 1986.⁴⁹ Over the years and as excavations progressed, the evidence increased, but not significantly. Barreca registered the existence of structures in mudbricks with dimensions of 25 x 17 x 7 cm at Nora, Karalis (Cagliari), S'Uraki (San Vero Milis), and Monte Sirai. One interesting aspect that emerges from the concise examination is the presence of both structures made entirely of bricks and those with a mixed technique of stone plinth and earth elevation.

3.1. *Nora*

The excavations carried out by the University of Padua in the Roman forum of Nora uncovered part of the Punic settlement. As already observed by Barreca, the domestic (sector I) and religious architecture (sector II) show the use of clay in construction both in the late Phoenician and Punic phases. J. Bonetto carried out the most detailed architectural study here.⁵⁰ He carefully analysed the different construction techniques used to realise the investigated dwelling and temple area. In all the phases analysed, the structures had no foundation pit, or at most, a pit no more than 10 cm deep. They are laid on clay deposits to achieve maximum horizontality in the construction, and in several cases, on charcoal layers.⁵¹ All the structures (in sector I) have a mixed elevation, consisting of a base of stone material (preserved) and an elevation of perishable material (unpreserved). Bonetto points out that the presence of a *pisé* elevation is only a hypothesis based on the absence of preserved elevations. However, multiple clay debris layers have led him to assume the presence of an elevation in *pisé* rather than mudbricks. Moreover, Bonetto argues that the use of a stone base would have provided better stability and insulated the structure from humidity. To support this, he points to the absence of masonry made entirely of clay, even though it had been documented at Nora by Barreca.⁵² Therefore, the lack of preservation of the residential walls compared with the ones of the temple, which preserved some bricks,⁵³ suggests that the former did not have any. The excavation in sector II exposed the structure interpreted as a temple. Although the upper masonry was better preserved here, both in terms of collapse debris and in elevation, the use of bricks in pre-Roman phases is uncertain.

The excavation by the University of Tuscia in Area T,⁵⁴ the so-called “Altoluogo di Tanit”, exposed some structures dated to the 6th-4th century BCE. As already observed for the dwelling and temple area, the exposed structures were without foundation pits, built on a brown, plastic levelling medium and on

41 Tronchetti *et al.* 1992, p. 23; Colavitti – Tronchetti 2003, p. 9.

42 Bonetto – Ghiotto – Novello 2009.

43 Cerasetti 1995.

44 Bartoloni 2005.

45 Amadasi 1966; Bartoloni 1994; Campanella – Finocchi 2005.

46 Perra 2019.

47 Bianchi – Botto – Pasci 2021.

48 van Dommelen – McLellan – Sharpe 2006.

49 Barreca 1986, pp. 271-274. To support his research in Nora, Bonetto also did a comparative study with the Sardinian and, more generally, the Mediterranean evidence.

50 Bonetto 2009, pp. 83-91.

51 Bonetto 2009, pp. 16-118.

52 Barreca 1986, p. 272.

53 Barreca 1986, p. 150, figs. 118-119, pertaining, however, to the Roman phase of the building.

54 See Finocchi – Dessena – Tirabassi 2012; Tirabassi 2016.

red clay layers directly on the outcropping bank. The discovery of several abundant clay deposits suggested elevations were made of perishable material. The absence of any modular elements suggested *pisé*, although unbaked bricks cannot be excluded. The high setting of area T, exposed to erosion phenomena, furthermore does not exclude a sudden disintegration of any building element made of perishable material after the abandonment.

3.2. *Tharros*

Like Nora, the site of Tharros was in use at least until the Roman period, although it has not been subject to deep excavations that have revealed the Phoenician and Punic residential vestiges. A recent architectural and urbanistic study published in 2020 by M. Marano,⁵⁵ however, dealt with the Punic-Roman residential quarters of the city. From her analysis, it is clear that it is difficult to specify the chronology for the structures defined as Punic-Roman. The references to the elevations of the walls in question are few. In particular, referring to sector 23 of Pesce's classification, there is a mention of a collapsed clay wall.⁵⁶ This discovery has led to the hypothesis of elevations made of perishable material rather than stone. The confirmation of the use of unbaked bricks at Tharros comes from another area, investigated between 1991 and 1992. P. Bernardini has described this area as metallurgical quarters for ironworking.⁵⁷ B. Cerasetti dedicated a brief contribution to the morphological analysis of the artefacts.⁵⁸ The analysis, which was part of a larger project which unfortunately has not been published, provides the measurements of the bricks, 30 x 10 cm, and reports the execution of a series of archaeometric analyses carried out on samples. The composition of the elements was mainly sand and a low percentage of clay: a non-canonical composition.

3.3. *Sulky*

The excavations in the Cronicario of Sant'Antioco have yielded little but interesting evidence of the use of perishable materials in construction. It should be noted that there is more evidence for the Roman period than for earlier phases of the site.

P. Bernardini reported that the structures uncovered during the excavations (1983-1989) were preserved in elevation for approximately 60 cm and provided with a mudbrick upper wall. Indeed, he noted grey and black imprints of mudbricks in sections.⁵⁹

Between 2005 and 2006, during an emergency intervention in the vicinity of the Cronicario, carried out by the History Department of the University of Sassari and the then Archaeological Superintendency of Cagliari and Oristano, a column⁶⁰ made entirely of unfired bricks was found. P. Bartoloni dates the structure to the Phoenician period, giving its dimensions (about two metres high and with a thickness of 52 x 130 cm, «cioè esattamente di un cubito per due cubiti e mezzo fenici») and reports that it was covered with hydraulic plaster.⁶¹ According to the author, the architectural element would have supported a suspended structure like in an inner courtyard (FIG. 4.b). The interesting fact that can be deduced from the published photo is the use of mudbricks not only of different clays but also in different sizes.

55 Marano 2020.

56 Marano 2020, p. 115.

57 Bernardini 1996. See also Cerasetti 1995, p. 31.

58 Cerasetti 1995.

59 Bernardini 1988, pp. 75-76.

60 Bernardini 1988, figs. 2, 11; Pompianu 2017, figs. 281, 350.

61 Bartoloni 2005, p. 11.

3.4. *Monte Sirai*

The multiple excavations at Monte Sirai⁶² provide little information about the perishable material architecture of the settlement.⁶³ The first evidence of unfired structures is found in the excavation report of the settlement sector investigated during the 1965⁶⁴ campaign where M.G. Amadasi records the presence, in a small room measuring 2.50x1.5 m, of debris which consisted of very compact and plastic earth.⁶⁵

P. Bartoloni, in his report of the 1990-1992 excavations in the “casa del lucernaio di talco”, mentions the use of fragments of unfired bricks among the stones leading to a courtyard staircase⁶⁶ (and L. Campanella reports the use of clay bricks at Monte Sirai in the Roman levels of the structures⁶⁷). However, recent research by M. Guirguis in the so-called “casa di Tufo” in Insula C suggests the presence of risers made of perishable material, so far deduced from the images of the area.⁶⁸

3.5. *Nuraghe Sirai*

Although it is not an exclusively Phoenician settlement, Nuraghe Sirai is currently among the most significant examples of symbiosis between allogenic and local elements. In recent years, the fortress has proved a veritable showcase for the study of Phoenician material culture in southern Sardinia. The excavations carried out by C. Perra since 2008 have brought to light several Iron Age rooms, including a glass-making workshop and a sacred area.⁶⁹ In the complete publication of the excavations, C. Perra devotes a chapter to building techniques,⁷⁰ noting the coexistence of stone and hybrid structures, preserved at heights varying between 70 cm and 2 m. She claims that the different heights are, on the one hand, the consequence of the variable state of preservation and, on the other hand, to the presence or absence of raw earth in the elevation.⁷¹ She theorises that the masonry preserved at the height of about 70 cm, given the volume of the debris, had a riser of perishable material, although she reports that cuboidal bricks (maximum size 33 x 40 x 5 cm)⁷² were found in the debris of the rooms with a riser preserved up to 2 m. The discovery of fragments of the roof of one of the examined rooms is also fascinating. Thanks to the discovery of elements of fired clay with imprints of vegetal elements identified by Perra as sticks and branches, she has suggested that the roof of one of the rooms consisted of a layer of alluvial clay 5-10 cm thick, resting on a framework of branches and sticks supported by a wooden frame. Nuraghe Sirai is the first settlement where archaeometric analysis (XRD) has been carried out and published, which has made it possible to identify different compositions for different brick uses.⁷³

3.6. *Pani Loriga*

The excavations carried out by the local Superintendency at the end of the 20th century on the southern plateau of Pani Loriga in southwest Sardinia exposed a portion of the Punic period settlement here (Area A).

62 For a synthesis, see for example Guirguis 2013.

63 Marras 1981; Perra 2001; Campanella – Finocchi 2002.

64 Amadasi 1966, pp. 83-103.

65 Amadasi 1966, p. 93.

66 Bartoloni 1994, p. 82.

67 Campanella 2005.

68 Guirguis 2017, p. 150, figs. 139-140.

69 Perra 2019, pp. 29-168.

70 Perra 2019, pp. 431-446.

71 Perra 2019, pp. 436-437.

72 Perra 2019, p. 437.

73 Perra 2019, p. 443.

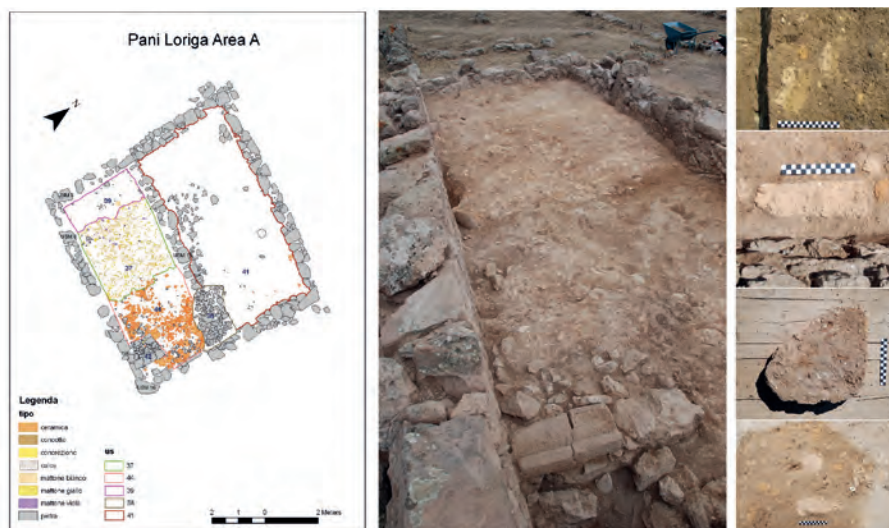


FIG. 2. Pani Loriga, Excavation in Area A: Plan of the Area (after Oggiano – Pedrazzi 2020); detail of the mudbricks collapse, and photos of mudbricks (photographs by Ida Oggiano).

The same investigations also led to the rediscovery of another sector, located slightly further north and at a higher altitude, named “Casematte” due to its apparent fortified nature (Area C).⁷⁴ As luck would have it, these excavations, very useful for the site’s rediscovery, in some cases only partially damaged the archaeological stratigraphy, preserving the collapsed elevations.

3.6.1. Area A⁷⁵

In 2007, a mission of the then ISCIMA of the CNR resumed the documentation of excavations begun in the 1970s and, under the scientific direction of I. Oggiano,⁷⁶ began investigating two adjacent rectangular rooms in the area of the southern plateau of the hill of Pani Loriga (Area A). The excavation exposed the collapsed earthen elevations of the two rooms, with unfired bricks partly preserved (FIG. 2). This is a rectangular space whose internal dimensions measure approximately 2.90 x 7.50 m for a total of approximately 22 square m. The masonry is mixed, as is most common in the Phoenician and Punic West. It has a base of local, natural stone of varying dimensions; most of the masonry is formed of larger blocks in the lower part and smaller fragments and stones in the body of the plinth. The stones are laid with mud mortar of good plastic capacity. The maximum height preserved in the structures of Area A is 1.15 m in the southern wall of Room I (USM 6), and it consists only of the stone footer. Therefore, the masonry is ideally in line with the productions of the eastern Mediterranean tradition: a stone base of an almost constant height of around 1.10/20 m and a thickness of between 0.50/60 m, with little or no foundation pit. The upper portion of the masonry was of unfired bricks, but, unfortunately, nothing was preserved *in situ*.⁷⁷ The excavation of the collapsed debris has allowed us to distinguish the use of at least two construction techniques. As previously illustrated, their complementary nature is well known but not always identifiable with certainty. The decay of the elevations

⁷⁴ See Arizza – Garbati – Pedrazzi 2021. Recent excavations in Area C have uncovered layers of debris that the excavators believe belong to a mud-brick collapse.

⁷⁵ My warmest thanks go to Ida Oggiano, who enabled the analysis and study of the materials dealt with here, and made available all the excavation documentation for a complete stratigraphic analysis.

⁷⁶ Oggiano – Pedrazzi 2020.

⁷⁷ Oggiano – Pedrazzi 2020, p. 72.



FIG. 3. Detailed picture of the earth architecture collapse (photograph by Ida Oggiano, with permission from the director of the excavation).

technique, widely attested in Sardinia during the Punic phase in the rural settlements, could have been used; or it could be a technique, already attested in the East, but also in the western Mediterranean, using roughly shaped clay blocks, but without a mould, stacked still wet on the plinth. The presence of the latter technique is suggested by the discovery of a specially shaped brick. Unlike the other selected brick fragments, the artefact in question does not present the overall mould shape. Over time, the processes of degradation that it has undergone have certainly eroded it, especially its corners. However, the irregularity of what must have been the lower surface still presents a curved course on one of the two short sides to suggest the presence of a non-flat element underneath it at the time of drying. Therefore, it could be part of a production of shaped bricks laid when wet. Comparisons for this type of architecture can be found, as mentioned, both in the East and the West, and, interestingly, this technique is still exploited today.

Unfortunately, the preserved brick fragments do not allow us to be sure about their size. Nevertheless, even in the collapsed accumulation, they have maintained the stratigraphic connection between them. This allows us to claim that the bricks must have been approximately 10 cm thick and more than 20 cm long, and they were utilised regardless of their colour – and composition – in the masonry construction (FIG. 4.a). They are currently under investigation by the author and the geology department of Gent University, Belgium. However, ongoing analyses have already confirmed the local origin of the clays of at least one of the selected bricks on which an initial laboratory test was carried out. It is not an unexpected

and the clays' physical characteristics make it challenging to identify the technique unless the elevation is preserved.

I. Oggiano and T. Pedrazzi developed the hypothesis that Room I had an upper floor, as evidenced by the collapse of the mudbrick elevation in the central part of the room.⁷⁸ The excavation revealed the collapsed elevation intact only in the western portion of the room, allowing them to assume the presence of an opening or simple covering of perishable material in the eastern portion (FIG. 3). Interesting features included bricks of different colours and an unusual, relatively regular layer of debris at the western end, close to the wall closing the room, consisting of a thin layer of red clay rubble that partially covers the collapsed coloured bricks. Due to depositional phenomena after abandonment, this layer cannot be ascribed to a structure chronologically and structurally posterior to the construction of the elevation unless it belongs to a post-abandonment phase. Instead, it would be more likely that a different technique was employed to build the room's western part, although it is unclear which. Indeed, the earth used to construct this part of the elevation was not used to manufacture the bricks. The *pisè*

78 Oggiano – Pedrazzi 2020, p. 72.

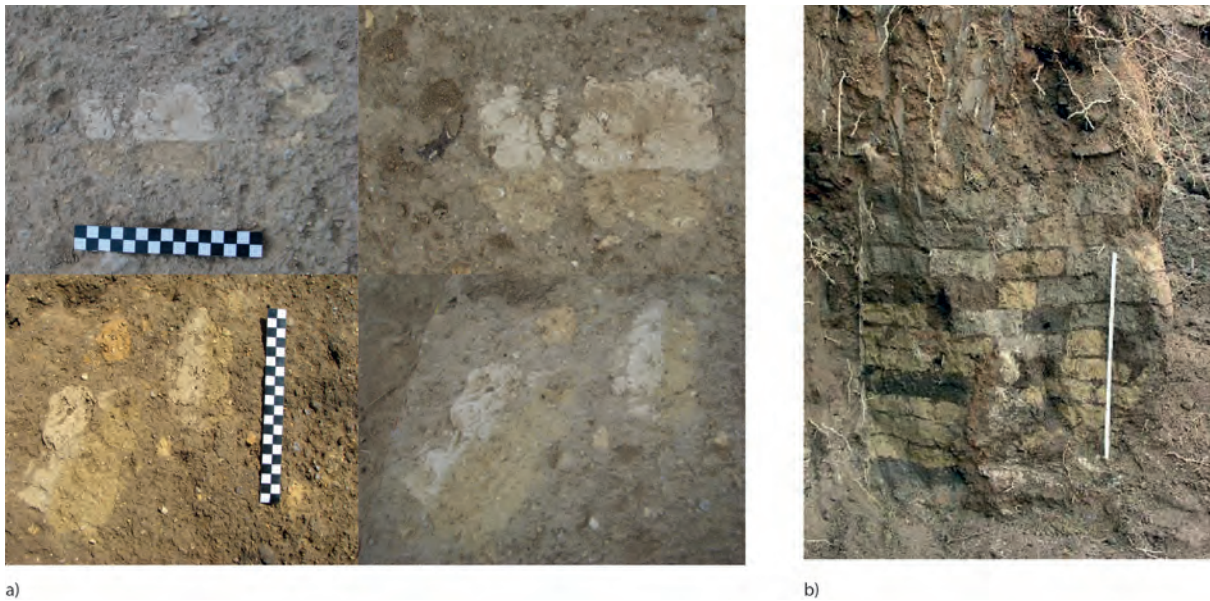


FIG. 4. a) Fragments of mudbricks from the wall collapse of Pani Loriga Area A (photograph by Ida Oggiano); b) Mudbrick pillar from Sulky (after Pompianu 2017, p. 281, fig. 350).

finding but rather a confirmation of our hypotheses, which can also be related to the different colours of the individual bricks. It is a well-known fact that the nearest available material was the best resource for construction.

3.6.2. Area B

The structures investigated in Area A are not the only ones to attest to the use of raw earth at Pani Loriga. Since 2007, the CNR, under the direction of M. Botto, has undertaken a further excavation in a different area of the hill, never identified before.⁷⁹ This area (Area B), located on the north-eastern slope, is another portion of the Punic-age settlement: a series of rectangular rooms of similar dimensions as in Area A, probably belonging to a decentralised quarter.

The urban plan of the settlement unfolds around the main roads following the course of the relief. At least four blocks can be identified, centralised on the whole eastern slope at different heights. The creation of the settlement involved exploiting outcrops, slopes and flat areas that define its particular planimetric development. The presence of an outcropping rocky substratum obviated the use of sack foundations where there were no pre-existing structures (as in the case of the huts of the prehistoric Abealzu-Filigosa *facies* in Area A), and masonry could be erected directly on the outcropping bank with massive substructures (Area B). The structures in Area B are similar in construction technique to those analysed above, but they have slightly different elements that provide some food for thought. The almost total absence of unbaked brick fragments in the debris of these structures is a fact, but it does not mean that brick was not used in the constructions mentioned above. In fact, unlike Area A, Area B is located on the slope of a hill and not on a plain; this implies that the decay phenomena that the perishable elevations underwent were undoubtedly different. Although all the rooms have yielded the collapsed parts of stone bases, which should have preserved the bricks, we cannot say with certainty how long the area was abandoned. In addition, the excavation revealed traces of

⁷⁹ See Botto 2017; Madrigali – Tirabassi 2020.



a)



b)

FIG. 5. Pani Loriga Area B excavations: a) Room 6N collapse; b) Room 5 different layer of collapse (photographs by Pani Loriga Archaeological Mission).

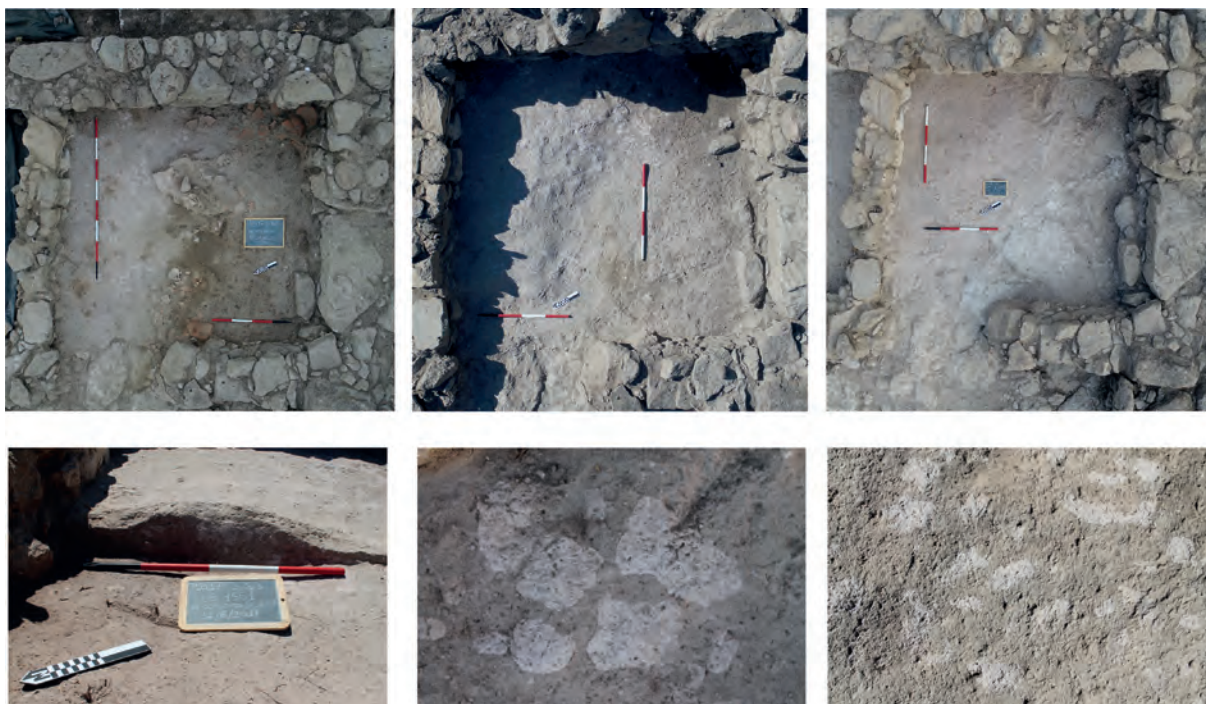


FIG. 6. Pani Loriga Area B excavations: Room 6S earth base bench and floor (photographs by the author, with the permission of Pani Loriga Archaeological Mission).

sporadic, post-collapse frequentations, mainly attributable to bivouacs and temporary solutions documented by the reuse of pottery from earlier phases in association with later forms. This underlines how the exposure of the perishable surfaces was repeated over time and thus subject to more significant degradation than in Area A.

In particular, we will analyse the south-eastern rooms of the complex: rooms 5 (FIG. 5), 8 (FIG. 7), 6N and 6S (FIGS. 5-6). These rooms are the best preserved, as they have preserved the collapsed debris of the unbaked clay elevations *in situ* and allowed a detailed study of the different uses of unbaked clay.

Rooms 5 and 8 measure approximately 2.5 x 8 m, while rooms 6N and 6S together are approximately 6 m long and maintain the standard width of approximately 2.5 m. They are two small quadrangular rooms of almost identical dimensions divided by a small partition of about 0.30 m thickness.

The stone base is preserved at less than a metre's elevation in all the rooms. Moreover, unlike the rooms in Area A, different techniques can be noted in the laying of the blocks. The masonry shared by rooms 5 and 8 presents a base made of natural stones of almost constant dimensions between 30 and 40 cm, 55 cm thick in its southern part. The northern side uses large blocks, similar to substructures, with a thickness of 77 cm. It is not only the thickness of the wall that constitutes a distinctive element. The absence of crumbled levels of earthen elevations in the rooms' northern portion also needs attention. The excavation revealed well-preserved unbaked earthen layers in the southern portion of both rooms, but this does not allow us to identify the type of technique used in the wall. In both chambers, the decomposition of the earth has different colours, suggesting different uses for different clays, in contrast to Area A. Red clay was exploited to construct the elevations and grey clay for roofing and plastering. The rooms preserved traces of two phases of use, the last of which evinces the use of yellow clay, very rich in limestone – even of considerable size – for the construction of the earthen structures. Unfortunately, the remnants of these

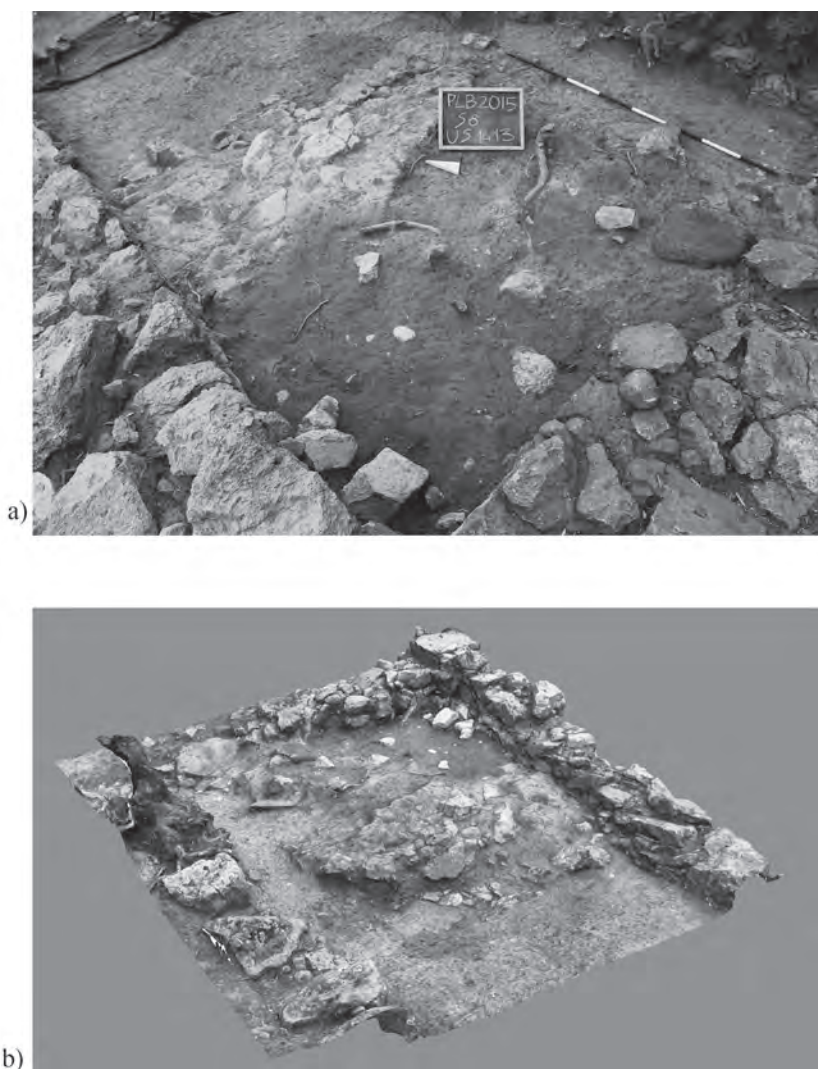


FIG. 7. Pani Loriga Area B excavations: Room 8: a) earthen architecture collapse; b) 3D model of Room 8 with the clay collapse (3D model by Pietro Caporali for Pani Loriga Archaeological Mission).

the first known case in the settlement. The chambers yielded disintegrated unbaked structures, and it was possible to distinguish elevation, plaster and roofing. The various levels of disintegration presented the same clay matrix characterised by a yellowish colour, whose autoptic analysis made it possible to distinguish the different uses. The remains of the plaster cladding were almost devoid of inclusions, which were present in large quantities in the disintegrated walls, probably made of *pisé*. As regards the floors and the adjoining structures, while the other rooms had been paved with beaten earth where clay is undoubtedly present, room 6S presented other elements both in terms of type and technique. The excavation revealed an arrangement leaning against the small partition, probably a bench, a *mastaba*. The structure, using a clay-limestone matrix and flakes of rhyolitic tuff, was in a state of decay.

Interestingly, the same preparation was employed as flooring throughout the room. This is not the only unbaked element in Area B. Room one was likely equipped with a platform, but this one was made of *pisé*, of which only a few cm of elevation remained, leaning against the room's eastern wall.

phases are barely visible as they underlie the humic layer and are scarcely datable given the absence of ceramic material due to the effects of colluvium.

Chambers 6N and S are located in a slightly flatter area of the slope, whose physical characteristics allowed for better preservation of the stone plinths and the crumbled levels of the unbaked walls protected by the masonry. As already mentioned, these are two small adjoining rooms that share the eastern perimeter wall and are divided by a small partition, not perfectly orthogonal to the supporting wall. Both rooms communicate with the adjacent room 7 through two small openings on the western side. The eastern load-bearing wall is of particular interest because, unlike all the other stone bases, it shows a *mur a piller* for the first time in Pani Loriga. Made of natural stone, roughly hewn and not squared, it is

4. CONCLUSIONS

While recent years have seen global interest in earthen architecture, its various applications and social implications, what emerges from the analysis of Sardinian documentation from the Phoenician and Punic periods is a muted interest.

There are relatively few studies that question the dynamics that we have mentioned as being at the basis of the complex socio-economic developments of the Phoenician and Punic communities of Sardinia. Only at Nuraghe Sirai have archaeometric analyses been carried out on the unbaked elements found in the excavation, and only qualitative analyses that do not inform us about the actual nature and origin of the recipe used. It is unclear whether there even were actual recipes, or a thorough knowledge of the local geology, although Perra asserts that organic and vegetable origin elements were added to the earth. The other contexts briefly mention the presence, or rather absence, of bricks, in some cases, as at Tharros, indicating the predominantly sandy composition. From Nora, we do not know much, except for the presence of bricks in one of the two investigated areas, and that they were probably indicative of a new building phase. Bonetto argues that the structures had a *pisé* elevation in the first building phase. The coexistence of techniques within the same settlement is well-known in the Levant, as in the West, and it is therefore not surprising to find it in the Sardinian sites discussed above.

Nevertheless, in light of the new research, it seems limiting to continue using the terms *pisé* and mudbrick exclusively. Some interpretations may need to be revised, given the almost total absence of preserved *pisé* structures. As already discussed, there are many uses for raw earth, just as there are many variables for unbaked bricks: moulded, cut or shaped by hand. Indeed, the earth remains a readily available material, but not all types are functional for construction. Therefore, development or adequate knowledge of geology is required to create durable elements. Brick production originated in the Near East and Egypt, where this resource is the raw material par excellence and was then introduced to the West. Sardinia bears witness to how this architectural tradition has been handed down to the present day. Walking down the streets of any town in the south of Sardinia, we can observe how the houses are still built in the same way as the Phoenician and Punic ones: a stone base and a mudbrick elevation, *ladiri*, covered with clay plaster. Indeed, clay was used here long before the arrival of the Phoenicians, but there is little or no evidence that it was employed to build walls.

The excavations currently underway at Pani Loriga allow us to approach the study of earthen architecture systematically and with a broader scope. The pedestrian survey in progress is producing tangible results regarding the exploitation of the territory. In particular, identifying one of the clay quarries exploited in ancient times has allowed for the direct comparison between raw material and bricks.⁸⁰ These analyses will make it possible to define the development at the basis of brick production at Pani Loriga, as brick production presupposes a different economic and social commitment than other techniques.

To conclude, given the scarcity of evidence, we must limit ourselves to noting the presence and absence of techniques by which raw earth was employed and, in those few cases, observe that the differences between the East and the West are almost non-existent. In both cases, the use of unfired bricks is found both in the elevations of the walls and in the floors (Dor and Nuraghe Sirai); the use of different clays to make bricks of different colours is attested (Megiddo, floor, and Pani Loriga Area A, collapsed elevation; Sulky, pilaster); to conclude with the complementarity of techniques not only in the same settlement but in the same building (stone, rammed earth and mudbricks).

⁸⁰ This material is still under study at the Dept. of Geology at Gent University, and the results will be published separately in the near future.

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