THE ORIGINS OF CONCRETE IN ROME AND POMPEII

by

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A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
(Classical Art and Archaeology)
in the University of Michigan
2013

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To my family

Acknowledgments

The idea of writing this dissertation was thrown around, almost casually, during a lunch conversation with Nic Terrenato in the spring of 2010. The rapidity with which the work came to a successful conclusion owes much to that very first conversation, in which my advisor and friend generously shared insights that helped me shape the argument from the onset. His take on the most crucial issues of Roman Republican archaeology has been an inspiration throughout the research and writing process. Lynne Lancaster has been an invaluable source of practical advice and encouragement. Without her enthusiasm for the project, knowledge of the subject matter and attention to detail, this achievement would not have been possible. Chris Ratté's comments helped me refine the final version of the manuscript. The teachings of Mario Torelli and Elaine Gazda have also been much appreciated.

To write a synthesis on a major theme of Roman architecture, I relied on a great deal of published data. Thanks go to the staff of the University of Michigan Library, which has been instrumental in providing it. Most of the work has been conducted in Ann Arbor, in the quiet but stimulating environment of the Kelsey Museum Library. The support of the Interdepartmental Program in Classical Art and Archaeology is gratefully acknowledged, in particular the assistance of Alex Zwinak. Funding during candidacy came from the University of Michigan Horace H. Rackham Graduate School, who granted me a Simon A. Courtade Award (2010-

2011), a Rackham Humanities Research Fellowship (2011-2012) and a Rackham Predoctoral Fellowship (2012-2013).

Finally I would like to thank friends and family who have made this endeavor easier. Paolo Lupino deserves a special mention, as does my wife Gráinne, who staunchly supported me from the beginning of our overseas adventure. I truly believe this dissertation was worth it.

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ABSTRACT

The Origins of Concrete in Rome and Pompeii

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This dissertation presents an analysis of early concrete architecture in Rome and Pompeii. In the past, scholars of Roman building techniques have looked to these sites to date the introduction of concrete in the third c. BCE, on the basis of false ideas of evolutionary progress in the development of the technology. Pointing out the circularity of the arguments with which types of wall-facing, wall-painting, and decorated floors have been used to support the proposed chronology, I suggest that reliable dates can only be derived from ceramic assemblages collected from construction and occupation levels.

The analysis concentrates on buildings for which stratigraphic data are available. The sample size in both Rome and Pompeii has dramatically increased in recent years, thanks to a new wave of excavations. While the archaeological record for the Middle Republican period (late fourth/third c. BCE) remains elusive, the evidence demonstrates that concrete first appeared around the middle of the second c. BCE. The implementation of the technique

in public construction seems to have followed a phase of experimentation in the private context, for the refashioning of élite houses. Because the organization of public building in both Rome and Pompeii was in the hands of a small number of aristocratic families, who commissioned the work to private builders, this phase was probably not too long. Indeed the earliest public monuments at both Rome and Pompeii can be dated to the period from 150 to 125 BCE. The massive spread of concrete, however, can be more clearly seen only in the final decades of the second c. BCE.

The new chronology demonstrates that the technological change was not a symptom of the Roman conquest of Italy, as previously thought. Concrete architecture emerged at a time when Rome's socio-economic foundations had already developed. Furthermore, the simultaneous adoption of the new technique in Rome, Pompeii and Campania undermines the idea that Rome had a direct role in its diffusion. The impetus came from local élites, often of non-Roman origin, in the context of broader changes in self-representation, which eventually brought about what we refer to as Roman Republican Architecture.

Chapter 1

Introduction

Perhaps one of the most commonly held views on the ancient Romans is that they were a pragmatic people, who excelled in ingenuity and technological achievements rather than in high culture. Theodore Mommsen famously contrasted the Greek and Roman characters along these lines:

> "[The Greek one] sought its ideal of life in the beautiful and the good, but too often in the enjoyment of idleness […]; the Roman required nothing and honored nothing but useful act, [and] compelled every citizen to fill up every moment of his life with unceasing work."[1]

By far the most frequently cited of these technological achievements is the spread of concrete.

Concrete (*opus caementicium*) represents a major Roman contribution to the history of ancient construction. As is well known, the physical properties of this revolutionary building medium enabled significant advances, especially in vaulting techniques.[2] Although the systematic use of arches and vaults was in itself not without precedents in the ancient Mediterranean,[3] the technology implemented at Rome and other central Italian sites

[1]Mommsen 1854: 24.
[2]Lechtmann and Hobbs 1987; Lancaster 2005.
[3]As in Hellenistic Macedonia: Boyd 1978.

replaced methods which in comparison were extremely labor-intensive, because they were based on the use of individually-crafted voussoirs. Thanks to the good quality of the mortars, concrete vaulting accelerated the pace at which construction progressed, and allowed for more complex volumes (such as sloping or annular vaulted corridors) to be built more efficiently than with the old technologies (not only were voussoirs more difficult to lift, but each one had a unique place in the design). The architectural possibilities offered by the new medium resulted in dramatic changes in the organizations of public spaces and infrastructure, contributing to the development of Rome's most salient cultural features.

Iconic monuments such as the Sanctuary of Fortuna at Praeneste and the Tabularium in Rome show how the new system was successfully implemented in public construction, in order to create terracing complexes composed of tiers of hollow substructures. This solution cleverly eliminated the problem of quarrying and transporting the huge quantities of soil that would normally have to be dumped as construction fills. The same principle was applied to new types of free-standing buildings, such as the theater and the amphitheater, whose architectural forms were canonized between the late second c. and the middle of the first c. BCE.[4] Experiments with this building medium continued at a sustained pace throughout the first c. BCE, particularly in marine environments (e.g., man-made harbors; maritime villas with coastal installations for fishery).[5] This accumulated knowledge eventually allowed Roman builders of the Imperial period to meet the demands of a society that increasingly required buildings with wide covered space, such as baths and basilicas (with the demise of the Republican political system, open-air gathering spaces gradually lost importance). In Roman Imperial architecture, new building forms

[4]On these see the most recent syntheses: Sear 2006; Welch 2007.
[5]Gazda 2008; Higginbotham 1997; Oleson *et al.* 2006.

and new building medium become almost inseparable.[6] In the first and second c. BCE, many innovations were achieved in projects sponsored by emperors who had access to massive funding and expertise. Furthermore, the monuments of Rome provided models in the provinces where there were new urbanization programs.

Because of the larger sample of standing remains, scholarly attention has concentrated on Roman concrete architecture of the Imperial period, advancing significantly our knowledge of the technology in use.[7] On the other hand, very few studies tackled the problem of its initial development in a systematic fashion; these corpora are based on archaeological evidence which was mostly collected before 1950, particularly from Rome and Pompeii.[8] Owing much to the idea of the Romans as great builders, these early works contextualized the impetus for the introduction of concrete technology within the early phases of the Roman conquest of Italy, in the fourth and third c. BCE. Two important developments in the period before WWII contributed to this view. The first was a new theory proposed by G. Gatti, who tentatively identified a large concrete vaulted building, still preserved on the left bank of the Tiber, near the modern Testaccio, with a monument represented on fragments of the Forma Urbis Romae.[9] Only the last three letters of the monument's name, *-lia*, were preserved on the slab. Based on the archaeological remains of Testaccio, which seemed to correspond with the Forma Urbis as to both plan and dimensions, Gatti argued that the correct restoration of the inscription was "Porticus Aemilia", a monument said by Livy (35.10.12) to have been erected in the early second c. BC in the area of the Emporium, which was in fact situated near the modern Testaccio.

[6]See especially the characterization of Roman Imperial architecture in MacDonald 1982: 3-19.
[7]Lancaster 2005. For an overview of recent research see also Lancaster 2008.
[8]Most notably Blake 1948; Lugli 1957.
[9]Gatti 1934.

Although his stated goal was to solve a specific problem of Roman topography (previous scholars thought that the fragments represented the Septa Iulia, a civic building located in the Campus Martius), Gatti's theory had important repercussions. The monument near Testaccio featured a very complex concrete vaulting, which architectural historians assumed was the result of a long period of experimentation. The conclusion seemed to be that the introduction of Roman concrete long predated the alleged construction date of the remains. The other important contribution to this idea came from the new wave of stratigraphic investigations below the floor levels of various buildings of Roman Pompeii, which begun in 1926 under the supervision of A. Maiuri, with the explicit goal of understanding the development of the urban fabric in the period before the establishment of the Roman colony in 80 BC.[10] The excavations revealed rubble architecture, for example in the area of the forum, as well as in the early levels of some atrium houses. These structures were dated to the third c. BC or earlier, on the basis of limited soundings.

G. Lugli was the first to combine this evidence in a systematic fashion. Attempting a classification of the material from Rome and Latium, he produced a typology of concrete wall-facing styles, taking the so-called Porticus Aemilia as a fixed point for the dating. He then linked his typology with the recent finds from Pompeii.[11] Because domestic architecture was thought to replicate the design of the typical Roman house as described by Vitruvius, Lugli supposed that there could be a connection with Roman practice also in the choice of building methods.[12] Lugli conceded that local builders may have discovered the properties of lime mortars independently. Nevertheless, he firmly believed that Latium was a likely candidate for the initial development of

[10]The reports are collected in Maiuri 1973.
[11]Lugli 1957: 377-381.
[12]The idea that the urban development of Pompeii was directly or indirectly influenced by Roman models is still very popular. See Wallace-Hadrill 2008: 127-136; Sewell 2010: 120; 130.

the technique, based on the results of extensive surveys he conducted in the 1920's in the countryside of early Roman colonies such as Tarracina and Circeii, where he documented a large sample of mortar-and-rubble architecture of a similar type.[13] Furthermore, because these remains were predominantly associated with rural buildings, he saw concrete as a cheap architectural expedient, as opposed to ashlar or polygonal masonry, contributing to the view that it was invented at the lower level of society. In his perspective, the new technology would have eventually made its way from the *suburbium* of Rome into the city, where decisive improvements (e.g., the development of the facing style conventionally referred to as *opus incertum*) were allegedly achieved over a period of experimentation in the third c. BCE.[14]

On a similar note, F. Brown assigned all the standing remains of mortared masonry at Cosa to the first building phase of the colony of 273 BCE.[15] He compared the purported early structures with the coarse rubble architecture at colonial sites of the fourth c. BC studied by Lugli, such as Tarracina and Ostia, suggesting that this type of construction represented the early stage of concrete technique, because the walls did not feature a finished facing. Given Brown's desire to find Roman prototypes for Cosan archaeological realities,[16] the expectation was that the Latin colonists at Cosa learned the technique in their place of origin.

The chronology proposed by Lugli had a profound impact on the Italian scholarship: as a notable example we can cite the work of F. Coarelli, who set out to update the typology of concrete monuments from Rome.[17] Lugli's influence can be seen also in the scholarship of German architectural historians, such as F. Rakob, who stressed the importance of the atrium

[13] Lugli 1926; 1928.
[14] Lugli 1957: 374.
[15] Brown 1951: 59-63; 102-113.
[16] This view was powerfully expressed in Brown 1980. For a crtitique of Brown's ideas on the relationship between the archaeology of Rome and Cosa see Fentress 2000.
[17] Coarelli 1977.

houses of Pompeii, emphasizing the possible derivation of mortared rubble technologies from Carthage, possibly as a result of increased interaction with Rome during the third c. BCE. This intriguing but controversial idea was based on alleged similarities with walling techniques common at Punic sites of Sicily and North Africa.[18] The Lugli-Coarelli scheme crystallized in influential manuals of Roman architecture. C. F. Giuliani's *L'edilizia nell'antichità* (first published in 1990) supports the high date of mortar-and-rubble architecture at Cosa and other Middle Republican colonial sites, such as Alba Fucens.[19] Both J.-P. Adam's *Roman Building* (1994) and P. Gros's *L'Architecture Romaine* (1996) accept the connection between Rome and Pompeii, and maintain the idea that concrete in Rome was routinely used in public construction projects by 200 BCE at the latest, without questioning the dating evidence.

In sum, previous reconstructions on the origins of Roman concrete support the idea that the Romans redefined their material culture during the Middle Republican period (late fourth-third c. BCE), and seem to suggest that this trickled down to the rest of the peninsula as different areas were incorporated in the Roman sphere, especially through the agency of Roman colonists. Concrete architecture in non-colonial contexts of the Italian peninsula (e.g., Etruria and Magna Graecia) has also been interpreted as a sign of indirect Roman influence, matching its diffusion with the pattern of Roman military and political expansion.[20]

New important discoveries, however, have been made during the last few decades of stratigraphic investigations in the early levels of Rome, both in the urban core and in the

[18]Rakob (1983: 361) connects the adoption of shutterings with the clay-based technique commonly referred to as *terre pisé*.

[19]Giuliani 2006: 217.

[20]Lugli (1957: 445-446) supposed that the diffusion of *opus incertum* outside of Rome was the work of a narrow circle of architects and skilled craftsmen who dominated public construction for at least a generation, in the broader period 100-60 BCE. In Lugli's view, *opus incertum* became a "muratura ufficiale", i.e. the masonry type officially adopted by the Roman state for public projects. For recent examples in the context of domestic architecture see Jolivet 2011 (concrete atrium houses in South Italy); Tombrägel 2012 (*opus incertum* villas in the territory of Tibur).

periphery (e.g., at the Auditorium site). The results have greatly increased our knowledge of Archaic and Early Republican architecture.[21] On the other hand, they have also demonstrated that the Middle Republican phase is poorly represented, particularly in relation to domestic architecture. This corresponds to recently published evidence from Roman colonial settlements (Alba Fucens, Cosa, Paestum; Fregellae is a possible exception, as late third c. BCE architecture seems to be preserved below the second c. BCE stratum).[22] Concrete architecture is nowhere to be found in the early levels of these sites. This pattern is likely to affect the chronology of early Roman concrete in Rome and Pompeii too. In fact, there has been in recent years some discussion on the problems connected with the fifth to third c. BCE archaeology of Pompeii, though a consensus has not yet been reached.[23] The possible repercussions of this debate on the dating framework commonly employed in Rome, however, have never been thoroughly evaluated.

My work explicitly tackles this problem, testing the validity of the high chronology against the hard evidence from excavated urban sites and monuments. Because of their prominence in previous studies, I concentrate on Rome and Pompeii, but with the important difference that the archaeological evidence from both sites is first analyzed in its local context. Thus, the dissertation consists of two distinct parts: the first focuses on Rome, with only limited reference to the third and second c. BCE architecture of other sites of Latium (i.e., Fregellae and Norba, which are mainly discussed with relation to the spread of decorative systems); the second deals primarily with Pompeii, though it contextualizes the pattern within a broader picture including other major sites of Campania (i.e., Herculaneum, Puteoli, Cumae, and Capua) (**fig. 1**).

[21] Survey in Cifani 2008.

[22] Cosa: Fentress 2003. Alba Fucens: Liberatore 2004. Paestum: Bragantini *et al*. 2008. Fregellae: Coarelli and Monti 1998. For a summary and reassessment of the evidence see Sewell 2010.

[23] See the remarks by Richardson 1988; Fulford and Wallace-Hadrill 1999.

Part I opens with a preliminary discussion of the terminological issues and definitions (Chapter 2), particularly as to the types of building materials employed in *opus caementicium* and their properties. There follows a review of Late Republican texts describing construction methods based on the use of *caementa*, which highlights the main inconsistencies with relation to contemporary archaeological realities. I then offer a more detailed analysis of the way the argument for a high chronology for concrete in Rome has been constructed in the past, from the pioneering work of Van Deman (1912) to the general surveys of Lugli (1957) and Coarelli (1977), showing the false ideas of evolutionary progress underlying the theory of a slow and gradual transition from the facing style commonly referred to as *opus incertum* to the class of *opus caementicium* commonly referred to as *opus reticulatum*. Finally, I survey the dating criteria currently followed to date wall-facing styles, stressing the circularity of the arguments linking types of concrete walling, wall-painting styles, and decorated floors, and concluding that the only reliable indicator for the chronology of concrete architecture may come from stratified ceramics assemblages associated with construction and occupation levels.

After laying out these methodological principles, in Chapters 3 and 4 I delve into the details of the architectural evidence, tracing the main technical features of early concrete construction in Rome. Chapter 3 starts with a general survey of Late Republican domestic architecture in Rome, discussing the sample of *opus incertum* architecture documented under the Imperial levels, which is rather small in comparison with that of *opus reticulatum* remains. In past reconstructions this pattern was thought to simply reflect a problem of visibility of the early levels of Rome. The number of archaic domestic contexts which have emerged ubiquitously in recent excavations, however, clearly suggests that the renovation of élite houses was a later phenomenon than previously thought. The analysis focuses on two contexts that have been the object of stratigraphic investigations: the concrete houses excavated by A. Carandini and his team in a block occupying the north slopes of the Palatine south of the Via Sacra,[24] and a group of very similar structures found by C. Panella in the area adjacent to the Meta Sudans, on the northeast slopes of the Palatine.[25] This evidence is then compared and contrasted with new data from the s*uburbium* of Rome, where ashlar masonry styles dominate much of the construction well into the second c. BCE. Not only is the analysis of these contexts important for the identification of recurring architectural practices, but it also serves to establish the important principle that concrete construction may have been first introduced in the context of building activities involving aristocratic residences (whether *domus* or *villae*). The emphasis on private élite practice provides a crucial link with developments in public construction in Rome, because we know from literary accounts that this was in the hands of a few powerful families.[26] Public building was sponsored by the same aristocratic patrons, using the same professional builders.

Chapter 4 moves on to public monuments, concentrating on buildings that are commonly dated to the period between 200 and 150 BCE. The list of monuments includes sacred buildings, such as the Temple of Magna Mater (which, in fact, figures in the literature as the earliest concrete public building in Rome), and structures of utilitarian function, among which is a group of monuments located on the east side of the Forum, in the area of the Lacus Iuturnae. The analysis here aims to demonstrate that the accepted chronology rests only on stylistic grounds, or on partial readings of literary sources. Some of these monuments have been the object of new stratigraphic analysis. This allows for a contextual interpretation of the sequence of construction. For example, it has been possible to link the reconstruction of the podium of the Temple of

[24]Carandini an Papi 2005.
[25]Synthesis in Zeggio 2006.
[26]See for instance the important study on the Metelli by Morgan (1973). For the Mid-Republican period: Ziólkowsky 1992.

Magna Mater with major terracing works on the southwest flank of the Palatine. The vaulted *opus incertum* ramp behind the Lacus Iuturnae, just to mention another case, can now be understood in light of the excavation evidence from the adjacent site of the Sanctuary of Vesta (Atrium and Aedes Vestae), as well as from the deposits excavated nearby next to the Temple of Castor and Pollux. Ceramic assemblages have been published only in exceptional cases, so it has not always been possible to propose absolute dates. But the case can be made for a substantially lower chronology for most of these monuments, in the second half of the second c. BCE.

The results of this analysis suggest that developments in private construction may have preceded the adoption of new technologies in the public building industry, or at least that the two were simultaneous. This corresponds well with what we know of the organization of public construction in Rome. By the second c. BCE, this was based on the hiring of private contractors, who were responsible for the correct execution of the work.[27] Because this system probably originated in a building period characterized by the predominant use of ashlar techniques, one could in fact reasonably conclude that there was a time lag between the first introduction of structural mortar and its adoption in public monuments, and that the first phase of experimentation with concrete happened in the domestic context.

Part II shares the same basic organization as Part I, and sets out to answer the same set of questions. Chapter 5 investigates the alleged relationship between third c. BCE architecture in Pompeii and the emergence of *opus incertum*. It first presents a historiography of the so-called "Limestone period" in Pompeii, tracing the origins of the high chronology model of Pompeian concrete architecture to G. Fiorelli's and A. Mau's idea that construction phases could be singled out on the basis of the prevailing building materials. As in Rome, this view has greatly influenced the study of building techniques at the site, determining the establishment of a rigid

[27] As reconstructed in Martin 1989. See also Steinby 2012a.

evolutionary framework that has been challenged only in recent years. Especially in the last fifteen years, excavations in various parts of Pompeii have revealed a pattern which is strikingly similar to that of Rome, in that the archaic phase of occupation seems to continue rather undisturbed until the late third or even early second c. BCE.[28] The second part of the chapter reviews K. Peterse's typological study of a local variant of limestone architecture known as *opus Africanum*, assessing whether *opus incertum* was ever preceded by a phase of experimentation with clay-based mortars. In the context of this discussion, available data on mortar composition will also be presented. The results seem to contradict the idea of progressive improvements in lime content, proving that good quality lime mortars appear employed only in élite domestic contexts.

Chapter 6 consists of three sections. The order in which the evidence is presented is based on the similarities in the organization of public construction between Rome and Pompeii, as suggested by the corpus of building inscriptions in Oscan collected at the site. The first section examines the architecture of the best-known aristocratic residences of Pompeii and immediate surroundings, from the Casa del Fauno (whose stratigraphic excavations have just recently been published) to the Villa dei Misteri, highlighting how different admixtures of building materials were used throughout the Late Samnite construction period (ca. 150-80 BCE).[29] The second section discusses a group of public buildings which are usually dated to the late third or early second c. BCE (i.e., the Stabian Baths, the Temple of Apollo and the Theater), examining on the one hand the problems that the high chronology presents, and showing on the other the many points of contact with the pattern of development in house construction. This section also

[28]For a useful contextualization of these finds see Fulford and Wallace-Hadrill 1999.

[29]As a general rule, I refer to the domestic contexts of Pompeii using their conventional Italian names, because in some cases there is no commonly accepted English equivalent. The names of public buildings are always given in English.

includes a discussion of the dating of the Basilica, addressing the implications for the sequence of construction of buildings in adjacent areas, such as the Forum complex and the Temple of Venus. Overall, the evidence seems to support the lower dates suggested on various occasions by J. J. Dobbins and his collaborators. The third and final section of the chapter compares Pompeian concrete architecture with the archaeological record from the Vesuvian area and the Campi Flegrei district, both at the domestic and the public level, incorporating new evidence from recent large-scale excavations.

In conclusion, Chapter 7 joins together the evidence from Rome and Pompeii, showing how the results of the new analysis affect the broader debate on the cultural implications of the Roman conquest in Italy. The model I propose places the emergence of concrete toward the end of the process of Roman expansion, not at its beginnings, as was suggested in the past. The emphasis is on the role played by Italian élites in the process of technological innovation. Both in Rome and in Pompeii, the diffusion of Roman concrete can be characterized primarily as a phenomenon linked with new modes of aristocratic self-representation in the sphere of material culture, which resulted in the adoption and adaptation of Greek types. In this respect, my study advocates for a general reassessment of the crucial contribution by non-Roman élites to the shaping of what is conventionally, but in my view imprecisely, referred to as Roman Republican architecture.

Given the focus on the chronology of *opus caementicium* in Rome and Pompeii, a number of sites of central Italy, where important remains of Roman Republican architecture are found, were not included in my research: the Latin sites of the Anio valley (Praeneste; Tibur) and of the Monti Lepini (Cora, Signia, Norba), the Roman colonies of Latium Adiectum (Tarracina; Formiae; Minturnae), the Hernican towns of the Sacco valley (Ferentinum; Anagnia, Aletrium, Verulae). However, very few concrete monuments from these sites have been dated archaeologically. Stratigraphic evidence is also generally absent. Furthermore, scholars have rarely referred to these sites to argue for a third c. BCE dating of concrete in Rome. The views of G. Gullini, who suggested high dates both for the concrete repairs in the polygonal masonry terracing walls of the acropolis of Praeneste (i.e., late third c. BCE) and for the *opus incertum* structures in the sanctuary of Fortuna (i.e., within the first half of the second c. BCE), remained essentially isolated.[30] Even the 125-100 BCE chronology suggested by A. Degrassi on the basis of epigraphic evidence from the sanctuary of Fortuna has not met with a general consensus.[31] Most of the monuments featuring vaulted substructures in the region are now dated to the latter part of the second c. BCE (e.g., the "avancorpo" of the acropolis at Ferentinum; the complex of S. Lucia at Signia; the terracing of the Forum square at Cora; the "piccolo tempio" at Tarracina), though primarily on stylistic grounds.[32]

Beyond Latium, another important urban context that I have chosen not to discuss, in spite of its overall relevance to second c. BCE architecture, is Cosa. New stratigraphic evidence from the site has demonstrated that standing remains of houses and public buildings are the result of a building program that extended through the first half of the second c. BCE.[33] The use of structural mortar for rubble architecture in the town is very limited; early attempts seem to be detected first in the Basilica (which the excavators date to 150-140 BCE). A more selective use of concrete has been documented in the harbor, where simple lime mortar was used for elevations, while hydraulic mortar containing imported pozzolana was employed for underwater

[30] See especially Gullini 1989.
[31] Degrassi 1969; cf. Clauss 1977. A useful review of the various positions is in Rous 2010: 101-102.
[32] Ferentinum: D'Alessio 2007a. Signia: Cifarelli 2006. Cora: Palombi 2003. Tarracina: Quilici 2005 (with lower date in the first c. BCE). On the generalized diffusion of concrete vaulting at the end of the second c. BCE see D'Alessio 2011.
[33] Fentress 2003.

construction. E. Gazda has recently argued that this could be a late feature dating to the middle of the first c. BCE.[34]

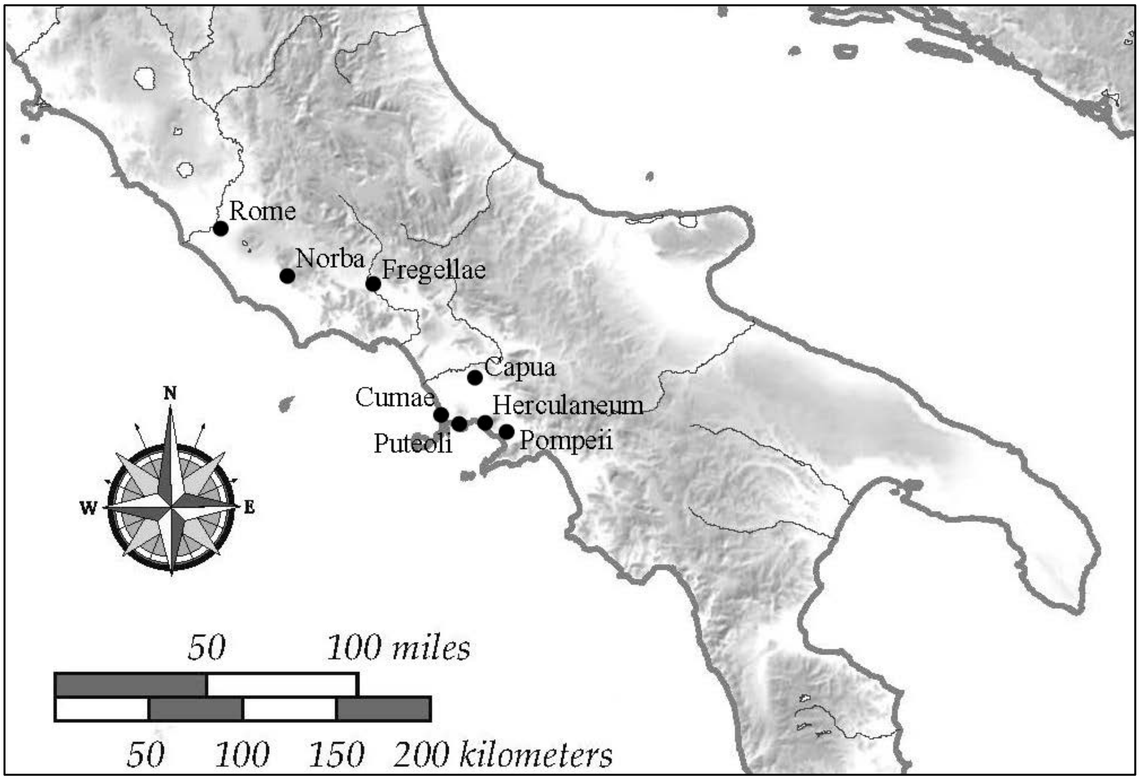

Figure 1. The most important sites for this study.

In short, early concrete architecture at these sites would fit in the pattern of development that I sketch for Rome and Pompeii, so the choice of not including a detailed treatment of this evidence in my study does not affect the validity of the model I propose.

On a final note, I hope that this work will also provide a useful contribution to other areas of research on Roman concrete. Scientific methods of analysis are being increasingly applied to samples from known Roman monuments, in order to define changes in the technological

[34] Gazda 2008.

preferences of Roman builders through time.[35] Such studies rely heavily on conventional archaeological dating.[36] While successful as to the identification of a significant discontinuity in building practices during the second half of the first c. BCE, when a trend towards the systematic selection of ingredients can be clearly detected in the composition of pozzolanic mortars, these studies tend to uncritically accept (and thus continue to reproduce) the high chronology of Roman concrete. On the other hand, the higher compositional variability of samples from monuments predating the mid-first c. BCE precludes any real possibility of estimating the absolute dating of unknown late Republican monuments with a high level of resolution.[37] Other experiments with scientific dating of early Roman concrete have been conducted at several late Republican sites in Latium (Praeneste, Tibur, Tarracina), particularly using ^{14}C AMS analysis of mortars, but have so far produced inconsistent results.[38] It should be stressed that in most cases the implementation of lab protocols and the interpretation of ambiguous results depend on the comparison of the calibrated age profiles obtained in the tests with the estimated age of monuments. The establishment of a reliable chronological framework for archaeologically dated sites and monuments is, therefore, a precondition for future developments in this field.

[35] Overview in Gazda 2001.
[36] See especially Jackson and Marra 2006: 430; Jackson *et al*. 2007: 44; Jackson *et al*. 2010: 41, Table II.
[37] E.g., Wetter 1983.
[38] See Ringbom *et al*. 2011: 204-206. The calibration curve for C^{14} in the period between the second and first c. BCE has a number of "loops", so even if this method worked well there would still be a limit on the precision possible (L. Lancaster, *pers. comm.*).

PART I

THE DIFFUSION OF OPUS CAEMENTICIUM IN ROME

Chapter 2

Dating Roman Concrete in Rome

2.1 Terminology and Definitions

2.1.1 What is Opus Caementicium?

Archaeologists use the term *opus caementicium* (or *caementitium*) to define a building medium consisting of a binder in which fragments of stone (aggregate, or *caementa*), normally ranging from fist- to head-size (0.10 to 0.30 m), are laid by hand, in separate horizontal layers. In the English-speaking world the term is often used interchangeably with "Roman concrete", though it is never attested in ancient literature on construction methods.[39] Vitruvius speaks of *structura caementorum*, simply rubble architecture (which he assumes is always lime-based).

The binder in *opus caementicium* is a mortar made of quicklime and other additives mixed with water. Different materials could be used as additives (Vitruvius, 2.4.1-2), including river sands, marine sands and volcanic ash (natural pozzolana; ground terracotta could be used as an artificial substitute). River and marine sands of non-volcanic origins produced mortars that hardened quite slowly, by absorption of carbon-dioxide from the air (aerial mortars). Natural pozzolana, which contains alumina and silica, is capable of reacting chemically

[39]Discussion in Giuliani 1998: 49. The term *opus caementitium* appears in Lamprecht 1987.

with lime, forming cementitious gels (calcium-silicate-hydrates, or C-S-H) that have exceptional binding strength. This reaction occurs only when water is added to the mix (hence the definition of hydraulic mortars; an equivalent term is pozzolanic mortars).[40] Mortars including an adequate proportion of reactive filler and lime can set more quickly than simple lime mortars, without requiring atmospheric evaporation. These properties made pozzolanic mortars well-suited for use in air-tight environments (e.g., foundations and wall-cores) and vaulting.[41]

Recent petrographic studies suggest that early concrete work in Rome was based on the use of pozzolanic mortars.[42] As it will be shown, there is no evidence in the archaeological record from Rome of a transition from clay-based to simple lime-based mortared rubble, and of a subsequent development of hydraulic lime mortars through experimentations with simple lime mortar. Thus, it seems that when structural mortar first appears in Rome, it is already of hydraulic type.

The general consensus is that concrete construction methods were already applied in Rome by the end of the third c. BCE.[43] The pattern of use of this medium in known monuments is considered to be the outcome of a phase of experimentation that began in the Mid-Republican period.[44] Based on a new reading of the textual and archaeologcial evidence, I suggest a different reconstruction, arguing that the diffusion of concrete building types in Rome was a much later and relatively sudden innovation, taking off in the second half of the second c. BCE.

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[40]See the useful explanation and presentation in Rapp 2009: 265-266.
[41]Lancaster 2005.
[42]Jackson *et al. 2*007.
[43]Adam 1994: 79-80; Boëthius 1978: 128-129; Coarelli 1977, 2007; Giuliani 2006: 216-217; Rakob 1976, 1983.
[44]Giuliani (1998: 50) gives a tentative date of the middle or late fourth c. BCE. His arguments have perhaps influenced Jackson *et al*. (2010: 41, Table II), who date the earliest known example to 380-360 BCE. The authors relate the concrete podium of the Temple of Saturn to a building phase known from a late source (Macr., *Sat.* 1.8.1). If at all historical, this perhaps was only a minor restoration of the original ashlar architecture. On this monument see Coarelli 1999: 234.

2.1.2 Sources of Building Materials in the Roman Suburbium

In the region of Rome, the materials known to have been used as *caementa* in Republican concrete architecture include almost exclusively local volcanic tuffs and lavas. Geologists distinguish between the products of the Alban Hills and of the Monti Sabatini districts.[45] Most notable in the first group are the so-called Cappellaccio (Grottarossa Pyroclastic Sequence subunit a; this outcrops in the valley between the Palatine and the Capitoline), the Tufo del Palatino (which outcrops on the top of the Palatine, but is sometimes confused with the Cappellaccio), the Tufo Lionato (quarries of this stone are known at the foot of the Capitoline, at Monteverde and on the Anio river, east of Rome, but it is very difficult to make correct identifications),[46] more durable stones from hydromagmatic deposits such as the Peperino (quarried near Marino), and leucititic lavas (basalt). The most common stones of the second group, outcropping north of Rome, include the Tufo Giallo di Prima Porta, the Tufo Giallo della Via Tiberina, and the Tufo Rosso a Scorie Nere (quarried near Fidene). Travertine *caementa* are also found, though only occasionally. This

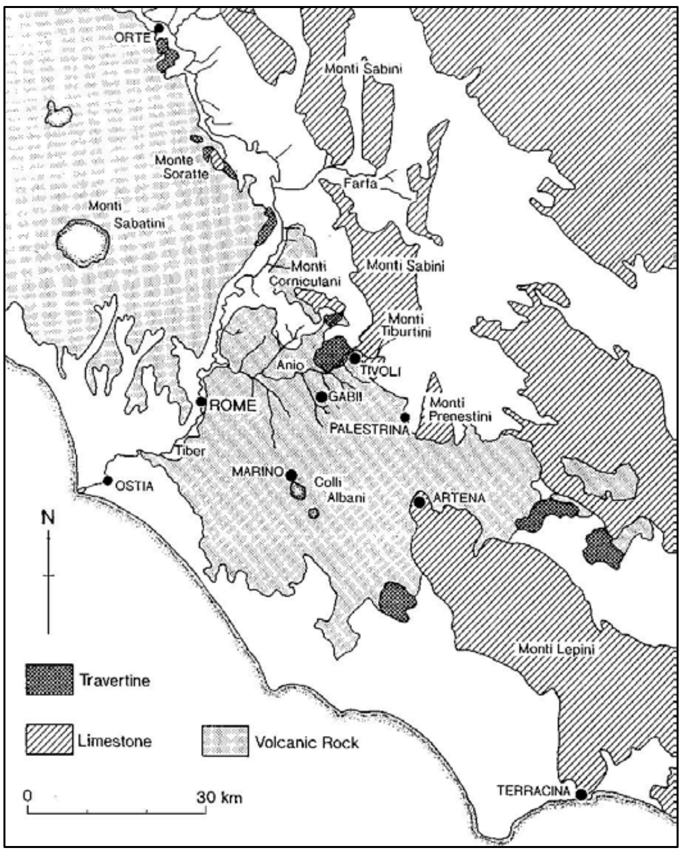

Figure 2. Volcanic and limestone areas around Rome (after DeLaine 1995).

[45] Jackson and Marra 2006: 419-421.

[46] In old archaeological reports these are based only on visual inspection, and are often unreliable. When the identification of the material is uncertain, I hereafter use the English term tuff instead of the Italian *tufo*.

material was imported from Tibur (30 km east of Rome), and was primarily used for architectural decorations or revetments.[47] Its presence in concrete structure is often secondary (from recycled elements and/or waste materials). Recent evidence demonstrates that lightweight scoria from the Vesuvian region was imported in Rome and used for concrete, but the earliest attestation is of the middle of the first c. BCE (Forum of Caesar).[48]

Suitable varieties of pozzolana were available locally, but the distribution of volcanic ash deposits of the type needed for durable concretes in the *suburbium* of Rome is not as uniform (**figs. 2-3**).[49] Pozzolana deposits are characteristic of the Colli Albani volcanic district, which outcrop on the east bank of the Tiber. The pyroclastic-flow deposits of the Monti Sabatini, which outcrop on the west bank of the Tiber, are strongly zeolitized. This material was quarried to be used mainly as dimension stone. In this area of the *suburbium*, therefore, volcanic ash had to be imported.[50] Reworked volcanic and

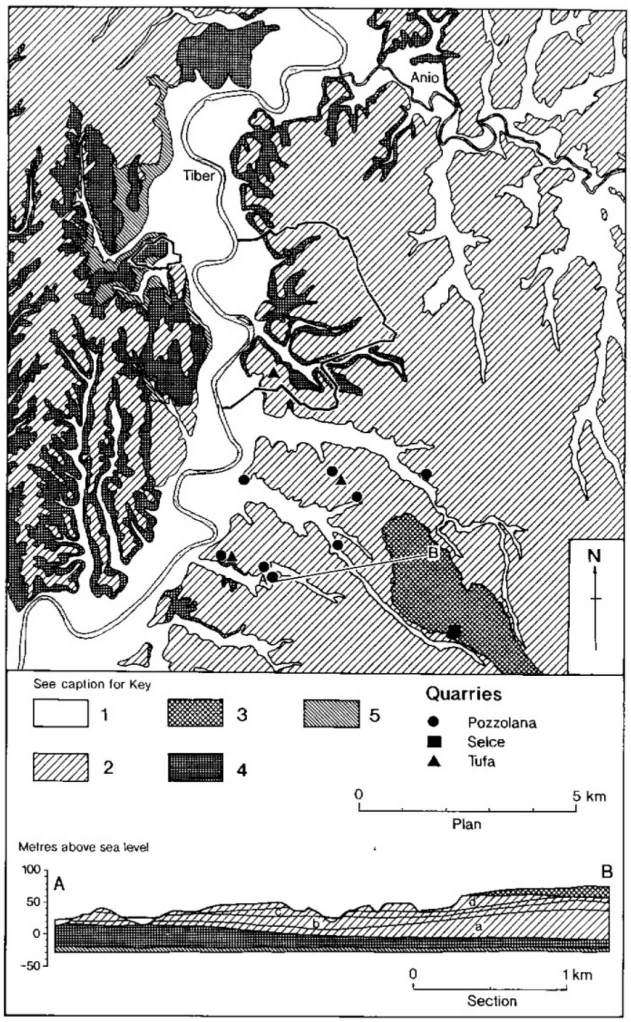

Figure 3. Geology of Rome: schematic map with location of pozzolana quarries (*1= recent alluvial deposits*; *2=pyroclastic deposits [a=tuffs ; b=Pozzolane Nere e Rosse; c=Tufo Lionato; d= Pozzolanelle]*; *3=lava*; *4=fluvio-lacustrine deposits*; *5=clay*; after DeLaine 1995).

[47]Jackson and Marra 2006: 423-424.
[48]Lancaster *et al.* 2011.
[49]Jackson *et al.* 2010.
[50]Marra *et al.* 2011. Other deposits of pozzolana are situated on the west bank of the Tiber, but at a considerable distance from the s*uburbium* of Rome (e.g., in the Vulsini district: Davidovitis 1994; Marra and D'Ambrosio 2012).

sedimentary sands deposited by the Tiber and its tributaries outcropped at the base of the Capitoline and Esquiline hills (Valle Giulia, Aurelia and S. Paolo Formations). Use of these sands has been detected in the mortars of late second c. BCE public monuments (e.g., Temple of Concord), and it has been suggested (although not yet proven scientifically) that earlier concrete architecture in the city was based on the exploitation of this material of lower quality.[51] Less altered (and thus more reactive) pozzolana deposits are present to the south and east of Rome (these are the Pozzolane Rosse and Pozzolane Nere). However, these units are covered by a less valuable horizon (Pozzolanelle), and are found in stratigraphic alternation with strongly pedogenized airfalls from the Monti Sabatini district. Exploitation of deeper beds was only feasible where the desired strata could be accessed from the side in natural cuts, such as those created by the major rivers (Tiber and Anio) and their tributaries (Marrana of the Caffarella, Almone, Fosso di Tor Carbone, Fosso delle Tre Fontane, Fosso di Pozzo Pantaleo), by means of tunneling on the sides of the trenches.

Mortar samples from late second c. BCE public monuments (Testaccio building; Temple of Concord; Temple of Castor and Pollux) show that both Pozzolanelle and the intermediate alteration facies of the Pozzolane Rosse were used at this time, while the least altered horizon of the Pozzolane Rosse began to be carefully selected only in the Augustan period.[52] Villa construction in the southeast sector of the Roman countryside during the latter part of the second c. and the early part of the first BCE (*infra*, 2.4.2) may have significantly increased knowledge of the physical properties of these deposits, influencing successive developments. Pozzolana quarries functioning during the Republican period have been reported also in the immediate environs of Rome, on the Parioli hill, near Porta S. Lorenzo (Piazza Sisto V and at S. Bibiana),

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[51]Jackson *et al.* 2007; Jackson *et al.* 2010.
[52]Jackson *et al.* 2010: Table II.

and near the Lateran (Via Amba Aradam).[53]

The closer sources of limestone suitable for lime production lie considerably far from the city and its surrounding region, outcropping on the right bank of the Tiber at the Monte Soratte, and on the left one in the Monti Corniculani, Tiburtini and Prenestini area, farther north in the Sabinum and south in the Monti Lepini.

2.2 Opus Antiquum? The *Structura Caementorum* in Late Republican Texts

2.2.1 Mortar-and-rubble Construction in Cato's De agri cultura

Archaeologists and architectural historians have often looked at Cato's *De agri cultura* for evidence that concrete construction was common during his lifetime (late third and early second c. BCE).[54] Setting out his prescriptions on how to establish and equip a rural residence ex-novo, Cato does mention walls in which lime (*calx*) was in some way employed in combination with rubble:

> (14.1-3) *Villam aedificandam si locabis novam ab solo, faber haec faciat oportet. Parietes omnes, uti iussitur, calce et caementis, pilas ex lapide angulari, tigna omnia, quae opus sunt, limina, postes, iugumenta, asseres, fulmentas, praesepis bubus hibernas aestivas faliscas, equile, cellas familiae, carnaria III, orbem, ahenea II, haras X, focum, ianuam maximam et alteram quam volet dominus, fenestras, clatros in fenestras maioris bipedalis X, luminaria VI, scamna III, sellas V, telas togalis duas, paullulam pilam ubi triticum pinsat I, fulloniam I, antepagmenta, vasa torcula II. Hae rei materiem et quae opus sunt dominus praebebit et ad opus dabit, serram I, lineam I (materiem dumtaxat succidet, dolabit, secabit facietque conductor), lapidem, calcem, harenam, aquam, paleas, terram unde lutum fiat*.
>
> "If you let the contract for a rural residence that is going to be newly built from the ground up, it will be the responsibility of the builder to make these things. All the walls of lime and rubble, as ordered, the stone

[53] Jolivet *et al.* 2009: sites D140, A 120 and A122, A133.

[54] E.g., Blake 1947: 324-327; Delbrück 1912: 89-90; Frank 1924: 35-38, n. 19; Lugli 1956; Lugli 1957: 363-374. Panella (2010: 61, footnote 1) suggests that the bulk of Cato's treatise reflects his own experience in conducting the estate of *Tusculum* that he inherited from his father, before he left for Rome in 217 BCE.

pillars that are placed at the corners, all the beams that are necessary, sills, posts, rafters, supports, winter and summer feeding-trough for the cattle, a horse stable, a slave quarter, three meat-racks, a round table, two bronze boilers, ten coops, a hearth, the main entrance and another one as the owner wishes, windows, ten two-foot lattices for the larger windows, six lamps (or window-shutters?), three benches, five chairs, two looms for togas, a small mortar to crush wheat, a vat for fulling, terracotta revetments and two presses. The owner will provide the timber and what is necessary for this and deliver it to the site, a saw, a plumb-line (as long as the contractor fells, hews, squares and finishes the timber), stone, lime, sand, water, straw, and dirt to make daub."

The common opinion is that Cato is describing "true" Roman concrete, because simple lime mortars would scarcely have enough of an edge over clay to justify the expense.[55] This idea is clearly influenced by the alleged entrepreneurship mentality that many modern interpreters have seen at the root of Cato's work.[56] Literary scholars, however, have cautioned against the many inconsistencies, repetitions and contradictions that characterize Cato's work, which seriously undermine this frequent claim.[57]

With relation to farm building, Cato's terminology can, indeed, be quite confusing. For example, Cato also speaks of a "*villa lapide calce*", contrasting some of its features with those of the "*villa calce caementis*":

(14.4-5) […] *Villa lapide calce. Fundamenta supra terram pede, ceteros parietes ex latere, iugumenta et antepagmenta quae opus erunt indito. Cetera lex uti villae ex calce caementis.*

"When a rural residence is built with limestone (ashlars?), the foundations should be one foot above ground, while the rest of the free-standing walls should be made of mud-brick; add the rafters and the revetments that will be necessary. The remaining features should be just as those of a rural residence built with lime and rubble."

[55]Blake 1947: 326.

[56]Panella (2010: 61, footnote 1) suggests that the bulk of Cato's treatise reflects his own experience in conducting the estate that he inherited from his father in Tusculum, before leaving for Rome in 217 BCE.

[57]See especially Terrenato 2012: 76-88, pointing out how partial readings of Cato's *De agri cultura* have been placed side by side with some material evidence to confirm one another. A discussion of the moralizing discourse in relation to private architecture in Cato and other second c. BCE sources is in Nichols 2010: 43-47.

Based on usage in Cato and later in Vitruvius, A. von Gerkan argued that *calx* should be taken as a direct transliteration of the Greek χάλιξ, meaning "rubble" or "gravel".[58] According to him, the actual expression for lime would be either "*calx viva*" (literally, "burnt rubble", quick-lime) or "*calx extincta*" ("slaked lime"). If this was the case, however, there would be no difference in technique between the two farm types at all. The reference, therefore, seems to be to buildings in which bedding lime was used to level the footing ("*fundamenta supra terram pede*") of walls made of mud-brick ("*ceteros parietes ex lateres*"). Structures of this type, however, are not archaeologically attested.[59] Brick architecture is attested in the early strata of Fregellae (ca. 200 BCE), but rarely do these walls have a foundation (and if present, this is normally made of dry rubble; **fig. 4**).[60]

Figure 4. Example of brickwork from the early levels of Fregellae (third-second c. BCE). Photo J. A. Becker.

An alternative meaning of "*lapide calce*" could be "limestone", but whatever type of rural residence Cato was describing would be very hard to reconcile with contemporary realities of the

[58]Von Gerkan 1958a: 188. Compare the Greek usage of χάλιξ e.g. in Strabo (5.4.6): χάλιξ mixed with ἀμμοκονία (= simple lime mortar) to make hydraulic concrete.
[59] The lack of straightforward archaeological correlates of Cato's text is noted by Terrenato 2001: 24-25; Terrenato 2012.
[60] See Battaglini and Diosono 2010.

suburbium of Rome, where limestone architecture is entirely absent.[61] In any case, known rural buildings in the region of Rome are either older, larger and richer, or much smaller but more nicely-appointed than Cato's *villae*. None of them features rubble construction, ashlar masonry being the norm (*infra,* 3.4.2). Aristocrats living in and around Rome, who most likely represented the intended audience of Cato, do not seem, on the whole, to have followed his advice. Far from being a handbook of building techniques, the *De agri cultura* was primarily a literary work, dense with political statements.

In addition, there are no clear indications in Cato's texts regarding the selection of reactive materials (one can contrast this with the detailed classification of additives in Vitruvius).[62] E. Van Deman, in fact, suggested that the walling techniques Cato was speaking about should be classified as a type of masonry in which the structure is held together by the downward pressure of the mass of *caementa,* rather than by the adhesive power of the mortar (clay or simple lime would have been used just to keep in place the stones during construction).[63]

The earliest textual evidence for the use of structural mortar in second c. BCE architecture (public building) comes from epigraphic documents. Most notable is the *lex*

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[61]The same problem seems to characterize Cato's discussion of the practice of establishing contracts for burning lime (*De agr.* 16), whereby the burner was responsible for the construction of the kiln, the preparation of wood and the transportation of lime, while the owner was required to provide stone and wood. Such arrangements make sense only if limestone was available in the catchment area of the farm (unless we imagine a separate transaction conducted by the owner directly at the quarry), or if lime-kiln and farm were at a reasonable distance between each other (which ultimately means that the farm was not far from limestone quarries, because lime industries usually developed in close proximity to these). Cf. Dix 1982, emphasizing the use of lime in agriculture.

[62]For the additives described by Vitruvius (*harenae fossiciae*) see Jackson *et al.* 2007; Jackson *et al.* 2006 discusses the ancient terminology in relation to geological observation of properties of the building materials.

[63]Van Deman defined this technique "pseudo-concrete" or "quasi-concrete" (discussion in Blake 1947: 324-327). This definition is problematic, particularly because it is based on the contrast with features of Roman concrete that are far from being unanimously accepted, such as the alleged monolithic properties of the compound, the premixing of mortar and aggregates or the application of external pressure during construction (Lancaster 2008). Among the examples mentioned by Van Deman are the retaining walls of an underground channel of the Aqua Marcia near Tibur (Van Deman 1934: 125) and repairs to the Anio Vetus (Van Deman 1934: 59-60 and 385), which she dated to 144 BCE phase. For more recent evidence on the clay-based rubble walls connected with the Aqua Marcia see Volpe *et al*. 1996.

Puteolana parieti faciundo (CIL 1^2.698: 105 BCE), a text drafted by local magistrates of the Roman colony of Puteoli, who let the contract for some structural modifications in the area of the temple of Serapis to private entrepreneurs (*redemptores*). Besides providing sureties, these contractors had to respect specified dimensions, and a standard in the quality of the construction materials they employed:

> (CIL 1^2.698.34-45) […] *eisdem maceria extrema paries / qui est eum parietem cum margine altum facito p(edes) X / eisdem ostium introitu in area quod nunc est et / fenestras quae in pariete propter eam aream sunt / pariete{m} opstruito et parieti qui nunc est propter / viam marginem perpetuom inponito eosq(ue) parietes / marginesque omnes quae lita non erunt calce / harenato lita politaque et calce uda dealbata recte / facito quod opus structile fiet in te[r]ra calcis / restinctai partem quartam indito nive maiorem / caementa(m) struito quam quae caementa arda / pendat p(ondo) XV nive angolaria(m) altiorem |(trientem) |(semunciam) facito.*
>
> "As regards the wall that forms the outermost enclosure, he [the contractor] shall make that wall ten feet high including coping. He shall wall up the doorway that now gives access to the area and the windows that open in the wall along that area, and add a continuous coping on top of the wall that is now along the road. All those walls and copings that will not be [found] coated, he will properly make them coated with a mortar of lime and sand and rendered and whitewashed with lime-wash. To make the *opus structile* he shall mix the dirt with one-fourth part of slaked lime. And he shall lay rubble not bigger than such rubble weighing fifteen lbs. when dry, and make the corner blocks not more than four and a half inches high."

Among the provisions, "*calx restincta*" ("slaked lime") was to be mixed with dirt in given proportions to make a specific kind of structural mortar (*opus structile*).[64] This material was also used for the rendering of other walls (*maceriae*), whose core may have been built with dry rubble.

2.2.2 Genus Incertum and Genus Reticulatum: Facing Styles in Vitruvius

Archaeologists conventionally name Roman concrete wall-facings with reference to the

[64]Giuliani (2006: 196) interpets the *opus structile* mentioned in this inscription as meaning *opus incertum*.

text in which Vitruvius outlines his basic classification of the *structura caementorum*:

> (2.8.1) *Structurarum genera sunt haec: reticulatum, quod nunc omnes utuntur, et antiquum quod incertum dicitur. Ex his venustius est reticulatum, sed ad rimas faciendas ideo paratum, quod in omnes partes dissoluta habet cubilia et coagmenta. Incerta vero caementa alia super alia sedentia inter seque imbricata non speciosam sed firmiorem quam reticulata praestant structuram.*
>
> "These are the types of walling: the net-like work (reticulate), which today everyone employs, and the one that is called irregular (i.e., consisting of elements of irregular shape), which came into use earlier. Of these the net-like work is the prettier, though it is likely to develop cracks, because in all parts the layers of aggregate (in the core) and the vertical joints (in the wall-facings) are disconnected. Rubble of irregular shape, lying course above course with overlapping joints, gives a structure which is not as pleasing to see but certainly stronger than the reticulate."

The *genus reticulatum*, which Vitruvius characterizes as commonly used, is interpreted as describing concrete walls featuring square blocks placed in a net-like pattern. This class of *opus caementicium* is commonly referred to as *opus reticulatum*. By contrast, *genus incertum* is interpreted as describing irregular wall-facings made of small poligonal or oval blocks, and is commonly referred to as *opus incertum*.

The *genus incertum* is said by Vitruvius to be *antiquum*. The term is usually translated as meaning "old" or "ancient", confirming not only the relative sequence of the two facing styles (i.e., *opus reticulatum* as an evolution of *opus incertum*),[65] but also the allegedly high absolute date of *opus incertum*. As Coarelli puts it, the idea that Vitruvius could define ancient a kind of structure that we know was still in use in his youth would be inconceivable.[66] Other scholars

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[65]Lugli considered *opus reticulatum* as "the product of the refined urban lifestyle" in the Rome of the time of Sulla (1957: 491). A date around 100 BCE is now commonly accepted for its introduction. Von Gerkan (1958a: 192), Coarelli (1977: 10-16) and Torelli (1980) argued that this facing style reflects a new organization of construction, which would be based on the employment of unskilled labor (slaves). Similarly, Rakob (1983: 364) suggested that the irregular forms of *opus reticulatum* found at Tibur, Tarracina, Pompeii and Herculaneum (these are conventionally referred to as *opus quasi reticulatum*) betray attempts towards industrialization in the production of limestone or lava blocks, mirroring the new forms implemented in Rome.

[66]See especially Coarelli 1977: 10-16; Coarelli 2007: 44.

pointed out, however, that the adjective *antiquus* can simply stand for "earlier" (as opposed to *vetus*, "ancient"), and that in the usage of Vitruvius may also mean "well-tried" (though usually in comparative form), because "old-fashioned". [67]

Both Van Deman and Lugli argued that the distinction Vitruvius is making relates more to the method of construction than to the physical aspect of the wall-facing:[68] in the *genus incertum*, the wall is unfaced and raised in horizontal courses of *caementa*, which are "*alia super alia sedentia inter seque imbricata*", according to the same system that he describes with relation to the *structura Graecorum* (2.8.5); in both cases, although stones with a more regular profile are selected for the exterior of the wall, there would be no separation between core and facings.[69] In the *genus reticulatum*, *cubilia* (or *coria*, i.e., the beds or layers of *caementa* in the core) and *coagmenta* (i.e., the vertical joints in the wall-facing) do not overlap.[70]

The idea we get from Vitruvius is that in walls of this kind the structure is composed of three parts, whereby the facings become free-standing structures with the function of "lost shutterings".[71] We should keep in mind, however, that Vitruvius's remarks on Roman practice have a strong ideological bias, as he criticized his contemporaries for the unresolved tension between the ideals of *venustas* and the needs of *celeritas*.[72] In reality, in both *opus incertum* and *opus reticulatum* facings and core most likely rose together, just as it in brickwork (*opus testaceum*). The contrast is with Greek tradition, though not necessarily grounded in actual practice (Vitruvius certainly derived his characterization of the *structura Graecorum* from

[67]Von Gerkan 1958a: 189.
[68]Van Deman 1912: 235, footnote 8; 244, footnote 5. Lugli 1957: 445-449.
[69]Lugli 1956: 101
[70]Cf. Rakob 1983: 305, translating *cubilia* as "joints between wall-facing elements".
[71]For this view see Wright 2005: 187-192, explaining that the pyramidal facing blocks in the so-called *opus reticulatum* were closely bedded only on the exterior and did not constitute a stable shuttering, so that facing and core had to be built up simultaneously. But he seems to think that a few courses of *opus incertum* facings could be built before adding the core.
[72]Torelli 1980; Rakob 1983.

theoretical handbooks).[73] The crucial question is rather if *opus incertum* or *reticulatum* were ever built with simple lime mortar or if concrete walling was a development that occurred together with the use of mortar containing pozzolana (i.e., with hydraulic mortar). In fact, the height of a wall above ground would be fairly limited with simple lime mortar unless the structure was really thick, because it would harden very slowly in comparison to pozzolanic mortar.

In sum, no evidence in the literary sources can be safely invoked to argue that *opus incertum*, in its conventional meaning of wall-facing made of small irregular blocks, was introduced before the second half of the second c. BCE. Many terminological uncertainties surround the exact identification of the construction techniques named by Cato. Furthermore, an often uncritical reception of Vitruvius generates more problems than solutions. Leaving aside the ideological connotations underlying the description of Roman concrete techniques as opposed to the noble ashlar masonry (*saxo quadrato*), the *genus incertum* or *antiquum* of Vitruvius could just as well refer to methods of rubble construction that did not employ lime-base mortars.[74] While Vitruvius's remarks seem to suggest that the class of *opus incertum* walls predates that of *opus reticulatum*, it is wrong to infer from them that *opus incertum* had been in use for a long time before *opus reticulatum* appeared, because the development may have been a rapid one. The more standardized form of concrete wall-facing emerged around ca. 100 BCE. It is important to note that these techniques were not mutually exclusive. *Opus reticulatum* is often found in association with *opus incertum*, depending on the function of the walls (*infra*, 4.2.1), and on the organization of construction. Furthermore, the diffusion of the two classes overlaps significantly in the first c. BCE, with *opus incertum* continuing to be used in areas where local building

[73] Tomlinson 1961

[74] According to Lugli (1957: 378, 407-408 and 447), the term *genus incertum* as used by Vitruvius should apply only to clay-based rubble architecture, such as the tuff or limestone rubble construction found in Ostia, Cosa and Alba Fucens, a technique which he defined as *opus antiquum* and dated to the third c. BCE.

materials were harder than the soft tuff available around Rome (e.g., in the limestone region of central Italy).

2.3 The Typological Study of Roman Concrete: Sequencing *Opus Incertum*

Most architectural historians believe that the implementation of Roman concrete originated from a slow process of trial-and-error, of which only the later phases of development would be archaeologically visible.[75] This common view is based on the assumption that no trace of early mortars could be possibly preserved in the archaeological record of Rome, because of the weak properties possessed by the binding materials allegedly used during the experimentation phase (whether clay, simple lime or mixes of lime and sand).[76]

But how long was this period of experimentation? A survey of the literature shows that estimates range greatly, from one or two to four or more generations, and also that in each case the rationale depends on the level of accuracy or difficulty of construction of what different scholars considered to be the first known concrete monument: the higher the qualitative standards, the longer the alleged chronological gap between the earliest dated monument and the first trials of manufacture with the new building medium.[77]

2.3.1 Early Approaches Based on Concrete Composition: Van Deman

Attempting the first systematic study of concrete monumental remains, Van Deman (1912) fixed a conventional *terminus ante quem* for the introduction of concrete to 121 BCE. This date was suggested by the presence of a series of concrete substructures incorporated in the

[75] E.g., Ward Perkins 1981: 98 "Such slow, empirical advances are in the nature of things hard to document. *It is the successes that survives, the failures that are swept away*." See also Adam 1994: 73 "In reality, the only buildings with concrete masonry […] that have survived above ground in a good condition are those that were constructed with great care, using a high quality lime [...] *It is not possible to discuss the innumerable inferior buildings since those remaining in the open air have disappeared due to their vulnerability*." (Emphasis mine).

[76] A reconstruction of this kind appears in Blake 1947: 307-308.

[77] As exemplified by the remarks of Van Deman (1912: 244): "The full mastery of technique in the handling of the new material, as shown in [the first dated monuments], makes it safe to assume [...] that a knowledge of its use antedated by a considerable period the time of their erection."

podium of the Temple of Concord of the Augustan period, which Roman topographers assigned to the second known phase of the monument (Appian, 1.26; Varro, *Ling. Lat.* 5.156).[78] Supposing that the initial phase of development of *opus caementicium* lasted one to two generations, Van Deman considered the middle of the second c. BCE, if not the early part, to represent a plausible date for the beginnings of this technology.[79] She hypoyhesized that, during this period, *opus caementicium* was used only as filler, i.e. as a mortar-and-rubble core for walls built with ashlar masonry. She did not specify, however, whether this stage would consist of simple lime as opposed to pozzolanic mortar precedents. According to Van Deman, a shift in importance would come only after repeated observation of the relative value of the two types of construction when employed in the same structure, resulting in the use of *opus quadratum* as a mere wall facing. This costly type of facing would eventually be substituted by cheaper small stones in the technique known as *opus incertum*, which would be implemented as a distinct structural masonry style at an uncertain date between the first introduction of *opus caementicium* and the age of Sulla (c. 100-80 BCE). In her view a process of this kind would explain the diffusion of *opus incertum* in the series of great works outside of Rome (Praeneste, Pompeii, Cora, Ostia etc.), which Van Deman (following Delbrück) attributed to the direct initiative of Sulla in the period 83-79 BCE.[80]

While devoting greater attention to the characterization of compositional aspects of the mortar mix and provenance of the coarse aggregate, Van Deman was initially much less

[78] See the accurate description of the remains in Middleton 1892: 332-338.

[79] Van Deman 1912: 235; 244-246.

[80] In Van Deman's model there is a direct connection between Sulla's dictatorial powers and specific advancements in construction methods (Blake 1947: 2, n. 3). See especially Van Deman 1922: 30-31. Cf. Blake (1947: 228-249), who surveyed the evidence from colonies of the Sullan period, concluding that there was a greater variability in the construction techniques. Blake ascribed it to the interplay of local conditions (the regularity of the facing depending on the workability of the local stone) and architectural traditions (either in the homeland of the veterans or in the new site).

interested in the fine-grained analysis of *opus incertum* as a facing style.[81] In fact she did recognize that distinctive features of the various construction periods could be found some times in the core of the structure and other times in the facing, but in her view *opus incertum* continued to be used well into the first c. BCE, together with the so-called *opus quasi reticulatum* and *opus quadratum*.[82] Van Deman, therefore, included only one example of *opus incertum* construction in the list of monuments for the period between 210 BCE and the age of Sulla, namely the ramp behind the Lacus Iuturnae (*infra*, 4.3.1), and did not attempt any account of the transition to the so-called *opus quasi reticulatum* and *opus reticulatum* facing techniques. She suggested a tentative Sullan date for a group of concrete buildings faced with what she identified as *opus quasi reticulatum*, which were located in the Forum area. This was on account of similarities with the *Tabularium* (the only well dated building of the period) as to the choice and processing of building materials for mortar and aggregate.

2.3.2 Early Approaches Based on Style: Lugli's "Maniere"

Proponents of the high chronology follow more or less explicitly the model devised in the 1930s by Lugli. The Italian topographer was the first to systematize the corpus of Roman materials on the basis of the then revolutionary identification of the noted *opus incertum* building of Testaccio with the Porticus Aemilia, proposed by G. Gatti in 1934.[83] The detailed sequencing of wall-facing techniques that characterizes typological studies of Roman concrete studies not by chance mirrors similar efforts in the classification and dating of other Roman decorative styles,

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[81]At a later stage, Van Deman considered that a more exhaustive investigation of building methods was needed to confirm or correct the conclusions drawn from the analysis of the structural environment (i.e., level, orientation and architectural plan). See Blake 1947: 16.

[82]Van Deman 1912: 246-247; 251.

[83]Lugli's work was already completed in 1939. On the events delaying the final publication of this work see Lugli 1957: 21. The main principles of his typological approach were first applied to the architectural study of Late Republican villas in the Roman Campagna and in Latium Adiectum. For an early review of this early work, see Billig 1944: 131-135. Similarly, the other standard work on Republican Roman construction (Blake 1947), being based on Van Deman's notes, mostly reflects the state of the question as of 1937, the date of Van Deman's death.

which also began during the 1930's. Similar problems seemed to affect the development of technological styles across different media. The technological evolution of Pompeian mosaics, for instance, appeared to follow a comparable trajectory in the transition from irregular chips to regular squared *tesserae*.[84]

In discourse, a mutual influence is clearly attested by the frequent terminological borrowings from one methodological field to the other. Precisely because of the shape of the blocks used in *opus incertum* facings, Lugli argued that the same typological framework could be applied for the systematization of both polygonal masonry and *opus incertum* architecture.[85] This system of classification was based on the concept of “maniera”, or “moda di fabbricare”, defining stylistic and formal attributes of wall-facings as a “way of doing”.[86] Just as Lugli's “maniere” were to a great extent informed by considerations of aesthetic value, which assimilated wall-facings to works of art, art historians were also influenced by scholars of Roman construction. Pernice (1938), for instance, identified a “quasi reticulate” technique to single out initial attempts in the development of “reticulate” tessellated mosaics.[87]

Figure 5. Example of “Prima Maniera” facing from Tarracina (Lugli 1957).

In Lugli's perspective, the aspect of any given *opus incertum* wall-facing would ultimately depend on the interplay between aesthetic principles and the organization of construction, as it relates in particular to the source of the building materials and the degree of

[84]E.g., Blake 1930.
[85]Cf. Rakob 1983: 362-363, defining *opus incertum* as a “miniaturized” version of polygonal masonry,
[86]Lugli 1957: 28.
[87]Pernice 1938: 129-131.

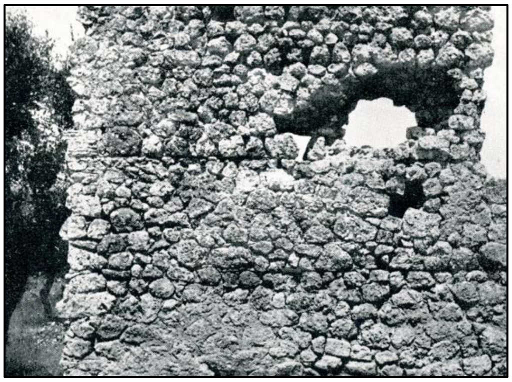

Figure 6. Example of "Seconda Maniera" facing from Cosa (after Lugli 1957).

selection and further processing of facing blocks on site.[88] In the "Prima Maniera" (**fig. 5**), facings are built with oblong polygonal blocks allegedly taken directly from quarry waste. The irregular shape and the lack of worked surfaces would make it difficult to fit the blocks closely; these are, therefore, set in thick beds of mortar. Facings of the "Seconda Maniera" are characterized by a more careful selection of blocks as to size (more uniform) and shape (blocks have a worked face, either polygonal or oval) and less mortar is needed to fit the blocks, resulting in a more regular vertical plane (**fig. 6**). In the "Terza Maniera" the wall-facing becomes a true work of art, based on a clear design. The blocks are more standardized (tuff blocks always have a polygonal face, while limestone blocks are normally rounded) and tend to assume a pyramidal shape (**fig. 7**), as it is the case with *opus reticulatum* facings (of which the "Terza Maniera" seems to be an imitation).

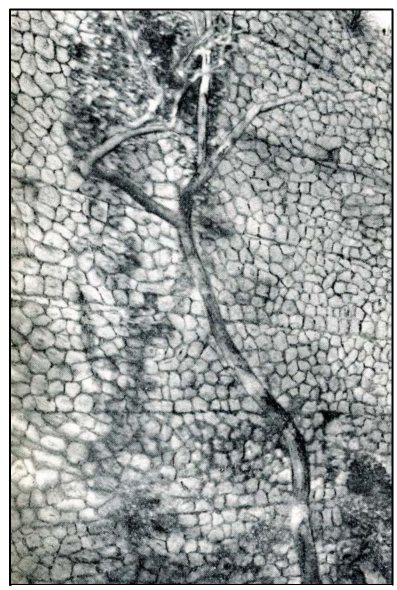

Figure 7. Example of "Terza Maniera" facing from Formiae (after Lugli 1957).

According to Lugli, however, the chronological value of this typology was only generic, because other factors could have influenced stylistic variation, such as the type of stone available locally (the generalized use of soft tuff in Rome explains why *opus incertum* as a facing style is after all so rare, as opposed to areas characterized by limestone geology), the function of a building (more uniform wall-facings should be expected in public buildings as opposed to private ones, or to utilitarian constructions for which structural soundness mattered more than

[88]Lugli 1957: 449.

aesthetics), as well as the skill of the builders.[89] For this reason, much overlap had to be allowed between the "Maniere" across the different phases that Lugli identified for the development of *opus incertum* in the region.

2.3.3 The Problem of the Porticus Aemilia and Its Implications

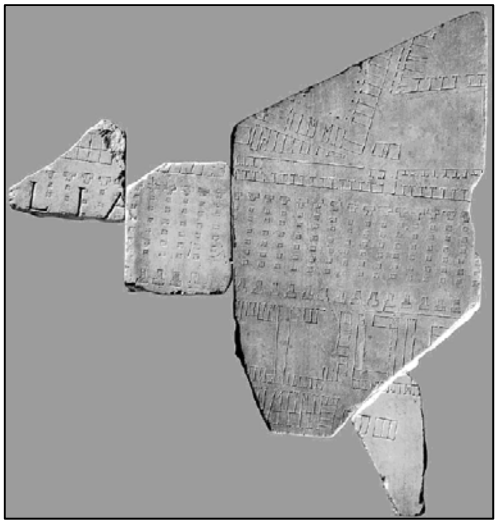

Figure 8. Forma Urbis, frg. 23 and 24 a-c (after Arata and Felici 2011).

Before 1934, the consensus was that there were no surviving examples of early second c. BCE concrete architecture, let alone of *opus incertum*. Most scholars believed that this facing technique had to at least predate 100 BCE, and that it perhaps originated as early as the period of the Gracchi (ca. 130-120 BCE).[90] Gatti's identification of the Porticus Aemilia with the standing remains in Testaccio, though primarily focused on the interpretation of specific fragments of the Forma Urbis (23 and 24 a-c; **fig. 8**), inevitably reopened the question, because of the high construction dates recorded by Livy for this monument (193 BCE: 35.10.12;174 BCE: 41.27.8).

The concrete building of Testaccio (**fig. 9**) demonstrated a limited use of the facing style with which, according to the then current theories, a monument of the early second c. BCE should have been built: *opus quadratum* was employed only in the ashlar piers framing the façade, while the rest of the building featured *opus incertum*. In fact, critics of the high chronology either rejected the identification, or assumed that the sophisticated nature of the

[89] Lugli 1957: 456-457.
[90] See discussion in Billig 1944: 124-125, footnote 3 (Sullan date of the so-called *opus quasi reticulatum*); 129, footnote 1 (dating of the Testaccio building).

facing belonged to the decades towards 100 BCE.[91] In order to confirm that the visible remains were to be assigned to the 174 BCE building and not to a later reconstruction, Gatti and Lugli planned the excavation of a test-trench across the door of one of the vaulted rooms. Reaching the bottom of the foundations, the sondage revealed no traces of earlier structures or archaeological stratigraphy.[92] Further evidence that the building in question belonged to an early stage of development of *opus incertum* was sought in the character of the facing, which Gatti considered "similar in its exterior aspect to polygonal masonry", a much older technique.[93]

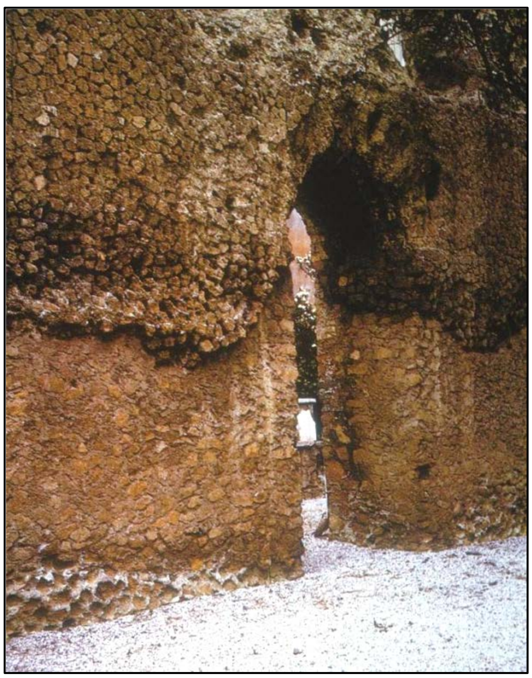

Figure 9: Rome, Testaccio: detail of concrete building with *opus incertum* facing.

Given the early date of the Porticus Aemilia (192-174 BCE), Lugli argued that the first experiments with the *structura caementorum* (primarily with clay mortar) had to be placed in the third c. BCE. Drawing from the accumulated knowledge of the so-called *opus antiquum*, the implementation, on an unprecedented scale, of new building methods based on the use of lime mortar would have been determined by the need for speedy reconstruction after the destructions caused throughout the monumental core of Rome by the sequence of fires attested for 213, 212 and 210 BCE (affecting Forum, south slopes of the Capitoline, Forum Holitorium, Forum Boarium, the Circus Maximus, and perhaps the

[91]Blake 1947: 249. See also Richardson 1976: 58-59.

[92]Lugli 1957: 451 footnote 1. Accepting Lugli's conclusions, Giuliani (1998: 60 footnote 11) suggests that the two dates recorded in Livy do not refer to the original building and subsequent reconstruction, but rather to the beginning of the construction project and to the final inspection, respectively. The *probatio* may have involved major restorations for damages occurred during the setting of the huge concrete mass, hence justifying the expression "*porticum Aemiliam reficiendam*" appearing in the sources of Livy.

[93]Gatti 1934: 145-146.

Palatine).[94] Having thus established a fixed point for the beginning of *opus incertum* construction, Lugli identified two main periods in its developmental trajectory: Period 1, from 210 to 100 BCE (in which *opus incertum* was the used alongside *opus quadratum*); and Period 2, from 100 BCE to 55 BCE (in which *opus incertum* was gradually substituted by *opus reticulatum*). In his Period 1, both "First Maniera" and "Second Maniera" were used, while the latter continued alongside the "Third Maniera" into Period 2. While the "Second Maniera" would be attested already by 174 BCE (this is how Lugli classified the Testaccio building), the earliest known example of the "First Maniera" was certainly later (the Porticus Metelli, dated to after 146 BCE), excluding in the Roman context any linear trajectory of development from the less regular to the more uniform type of masonry.[95]

Contradicting his own methodology, however, Lugli assigned a high dating to a series of *opus incertum* constructions in the monumental core of Rome solely on the basis of formal comparison with the Testaccio building. Given the fixed point of 174 BCE, morphological similarities (e.g., dimension of the blocks and thickness of the joints) and/or specific technical solutions (e.g., the use of small tuff ashlars to face the intrados of concrete vaults) allowed Lugli to match other concrete remains with building episodes attested by literary sources around the same period, or even the same year. Such is the case of the terrace formed by the low arches visible behind the Rostra, which Van Deman had identified as so-called *opus quasi reticulatum*, and connected with the building of new streets in the west end of the Forum in the Sullan period.[96] This was considered by Lugli to belong to the original paving of the Clivus Capitolinus

[94] Livy 24.47.15; 26.27.1-5; 27.11.16 (reconstructions). See Lugli 1957: 384, 449-450.

[95] Lugli 1957: 449-451. The lack of a rigid evolutionary scheme in Lugli's typology was particularly criticized by Von Gerkan (1958a: 191), who maintained that the attribution of the Testaccio building to the "Seconda Maniera" would make this later than the Porticus Metelli.

[96] Van Deman 1922: 14-16.

(Livy, 41.27.7: 174 BCE).[97] Another terracing wall faced partly with a slightly less regular *opus incertum*, which had just been discovered on the east slopes of the Capitoline (Via della Consolazione), was dated by Lugli to the same year, on the assumption that the paving of the Clivus Capitolinus involved a major reorganization of the hill.[98] Lugli found comparable structures also on the Palatine, such as the party-walls of the vaulted *tabernae* that opened onto the *via tecta* next to Scalae Caci, which he dated stylistically to 150 BCE.[99]

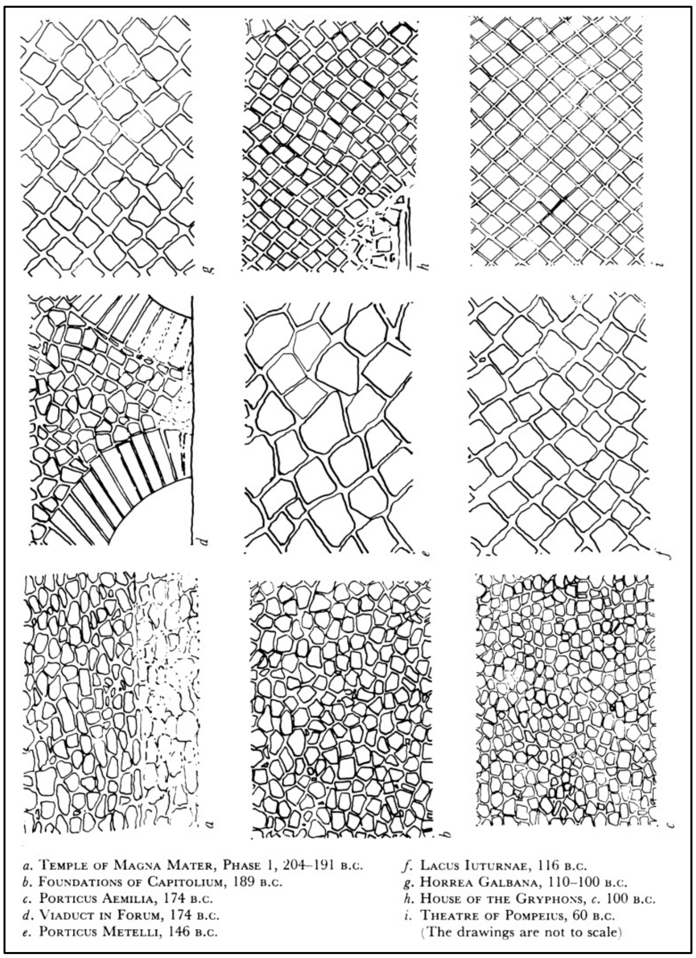

Figure 10: Seriation of *opus incertum* monuments according to Coarelli (1977).

Few additions have since been made to the canonical sequence of dated concrete monuments of Rome, but all such additions were thought to support Lugli's chronological framework. Most influential were those proposed by Coarelli (1977), who sought to identify early monuments built with *opus incertum* that would fill the gap between the time of the supposed introduction of this facing technique around 200 BCE and 174 BCE.[100] Coarelli further refined the sequence of *opus incertum* facing styles according to rigid evolutionary

[97]Lugli 1957: 452. On the stratigraphy of the *Clivus Capitolinus* and its late Republican modifications (particularly in the context of the works carried out under L. Opimius) see Filippi 1997-98: 161-166.
[98]Lugli 1957: 452, footnote 2 and 467 (174 BCE).
[99]Lugli 1957: 452, footnote 3 and 467 (150-100 BCE).
[100]E.g., Coarelli 1977: 9-15; Adam 1994: 127-128.

principles based on the increasing regularity of the joints (**fig. 10**).[101] Coarelli placed at the beginning of this sequence the concrete remains of the podium of the Temple of Magna Mater on the Palatine, which he assigned to the earliest building phase known for the monument (204-191 BCE; Livy 29.37.2, 36.36), in contrast with the common opinion that these belonged to a late second c. BCE or even later reconstruction.[102] Because in shape and size the facing blocks seem to belong to an intermediate phase between the roughly built podium of the Temple of Magna Mater and the more standardized Porticus Aemilia (as completed in 174 BCE), Coarelli assigned a high date (188 BCE) to the terracing wall of the Capitoline hill, which Lugli considered contemporary with the Testaccio building and the viaduct of the Forum, interpreting the remains as the "*substructio super Aequimelium*" mentioned by Livy (38.28.3).[103] The juxtaposition of the *opus incertum* structures to stretches in ashlars of Tufo Lionato (Monteverde; Anio seems absent) and Tufo Giallo della Via Tiberina (Grotta Oscura), instead of being interpreted as evidence of a stratified architectural sequence, was taken as a confirmation of the early character of the facing. Next in line, the Porticus Aemilia and the arches of the Clivus Capitolinus precede the Porticus Metelli, although little or no improvement can be appreciated in the selection and regularization of the facing blocks and in the uniformity of the joints: the relative order could be in fact reversed without noticeable effects on the overarching evolutionary scheme.[104] In Coarelli's reconstruction, the process of regularization would eventually result in the emergence of the so-called *opus quasi reticulatum*, of which the first example would be the Lacus Iuturnae in the post-117 BCE phase (cf. *infra*, 4.3.3).

[101]Coarelli 1977: Appendix II.
[102]Van Deman 1912: 244, footnote 4; see discussion in Blake 1947: 330 (late second c. BCE or Augustan); Lugli 1957: 409 and 468 (110-109 BCE); Romanelli 1963: 227-239 (post 111 BCE).
[103]Coarelli 1977: 13-14.
[104]See the order in the sequence of wall-facings presented in Lugli 1957: Pl. CVIII (Porticus Aemilia, Porticus Metelli, Via della Consolazione, Clivus Capitolinus).

These integrations must be considered as problematic, particularly because they derive from the expectation that formal attributes of a wall facing are determined by rigid rules of stylistic evolution through time, regardless of the structural logic and the possible economic or other concerns behind the technical choice. A new interpretation for the Testaccio building, proposed by Cozza and Tucci (2006) on both epigraphic and archaeological grounds, highlights the normative pitfalls of the model. As has been shown, most of the buildings that appear in the "Lugli-Coarelli" seriation have been identified with dated public monuments primarily, if not exclusively, on the basis of formal resemblance with the so-called Porticus Aemilia. Von Gerkan (1958a) had already suggested an alternative restoration of the inscription associated with the representation of the building on the Forma Urbis, [*Nava*]*lia* instead of [*Aemi*]*lia* (which by the way also explained the absence of the word *porticus* in the actual slab, which would have been otherwise very unusual).[105] Cozza and Tucci (2006) reopened the question, suggesting that traces of an *a* were visible before the *l* in old photographs of the preparatory incision, confirming Von Gerkan's reading also in consideration of the actual plan of the structure.[106] Utilitarian buildings of this

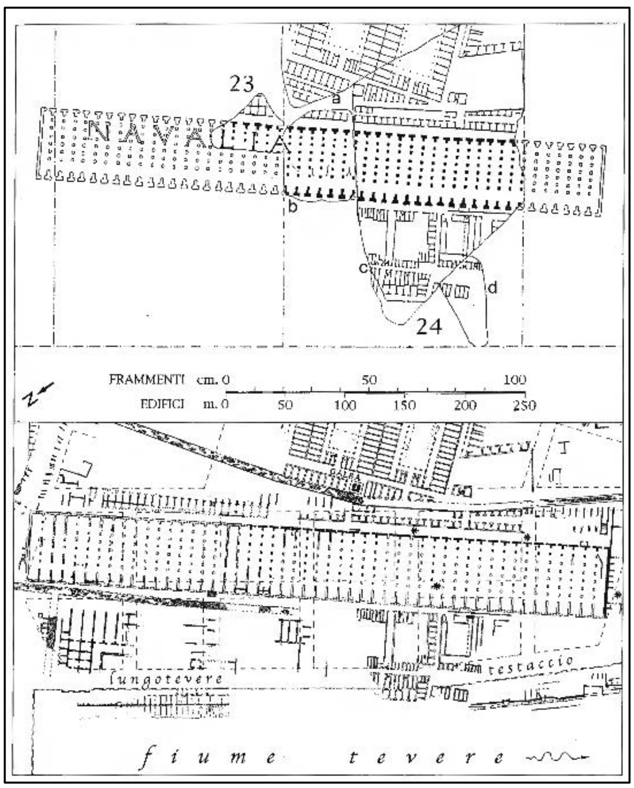

Figure 11. Restored plan of the Testaccio building based on the Forma Urbis (after Cozza and Tucci 2006).

[105]Von Gerkan 1958: 189.

[106]Cozza and Tucci 2006, following von Gerkan 1958a: 189. The letter *a* would be visible in a low oblique light photograph taken before 1960. The new interpretation is accepted by Coarelli (2007), and Steinby 2012a (50-51), but disputed by Arata and Felici 2011. A recent inspection of the fragments demonstrated that only the letters [--

function are archaeologically attested (e.g., Carthage) and do provide close comparanda for the internal organization, which in fact bears little in common with other known late Republican porticus (**fig. 11**).[107] And if the *opus incertum* building of Testaccio is to be identified with shipsheds attached to the Emporium, the Porticus Aemilia is more likely to be found in a location closer to the Porta Trigemina and the Forum Boarium area, the term referring to a covered passageway rather than to a utilitarian building.[108]

The impact of this alternative reconstruction on both the relative sequence and the absolute chronology of development of *opus incertum* should be immediately obvious. As recognized by Cozza and Tucci, the main consequence of the new identification is that the Testaccio building does not date the *opus incertum*; at best, it is the other way around.[109] Because the construction of the Navalia is of uncertain date, Cozza and Tucci assume that a chronology may be safely derived from the advanced typological features of the facing, which would not fit in the early second c. BCE, but rather in the second half if not the late part of the second c. BCE.[110] According to the logic behind Coarelli's model, this date should also be assigned to other type-monuments of the "Lugli-Coarelli" list, such as the arches of the Clivus Capitolinus and the retaining wall of Via della Consolazione, whose dating to the early second c. BCE was

-]*ia* are preserved, but this does not necessarily undermine Cozza and Tucci's argument.

[107] Cf. Nünnerich-Asmus 1994: 25-54. Recent excavations conducted by the Soprintendenza Speciale per i Beni Archeologici di Roma in collaboration with the Dutch Institute in Rome seem to confirm that the openings in the eastern long side of the building correspond to windows, which were transformed into doors in a second phase, when the floor level was raised. Thus, in its original phase the structure was oriented toward the *Emporium* and the Tiber to the west. See Tucci 2012: figs. 2-4. Hurst (2010: 32-33) believes that the vaulted corridors (spanning ca. 8.30 m) are too wide for both triremes or quinqueremes, too far from the river bank and too high up from the projected river level (but river levels rise and fall considerably during the seasons). Cf. Blackman (2008: 30), identifying a wider shipshed category with a clear of 7-8 m. The Testaccio building has been taken as a parallel for an oblong structure divided by lines of piers into bays, which has been recently investigated at Portus (Keay *et al*. 2012: 506-509, suggesting a possible function of the building as military or commercial shipshed rather than warehouse).

[108] Cozza and Tucci 2006: 176-180. On the interpretation of the Porticus Aemilia as a colonnaded connector see also: Richardson 1976; Tuck 2003.

[109] Cozza and Tucci 2006: 194.

[110] Cozza and Tucci 2006: 194.

first suggested precisely because of their morphological similarities with the Testaccio building. The lower dating correspond with that proposed for the *tabernae* of the Clivus Victoriae, which were demonstrably built in parallel with the integral reconstruction of the Temple of Magna Mater during the period 111-102 BCE.[111] What term of comparison Cozza and Tucci have in mind to define the relative complexity of the *opus incertum* in the Testaccio building remains, however, unclear.[112] Indeed, if we were to change the relative order of monuments in Coarelli's canonical sequence according to the new chronology of the Testaccio building, the development of *opus incertum* would not display a regular pattern at all.

External evidence for the dating of this monument is regrettably scanty and problematic. Cicero (*De or.* 1.14.62) is the only ancient source that connects the *Navalia* (or more precisely an "*opus navale*") with the work of a Greek architect named Hermodorus of Salamis, presumably the same Hermodorus known to have also built the first marble temple in Rome, the Temple of Iuppiter Stator in the Porticus Metelli (Vitruvius, 3.2.5). His formative years in the Greek east are usually placed in the period 170-150 BCE.[113] Based on this association, Cozza and Tucci argue that the Testaccio building may have been built either in the period 147-140 BCE (i.e., the tentative construction dates they suggest, respectively, for the Temple of Iuppiter Stator and for another building commissioned to Hermodorus, the Temple of Mars *in circo*),[114] or even before 147 BCE, thus rejecting the late second c. BCE chronology they had proposed on stylistic

[111] D'Alessio 2009.

[112] Cozza and Tucci 2006: 194 vaguely mention "early sporadic attestations of [*opus incertum*] facings" dating to the beginning of the second c. BCE and refer to the old argument of the "long period of experimentation" that made possible the successful construction of the Testaccio building.

[113] Other sources on the *Navalia* in Coarelli 1996: 339-340 (with different topographical identification). On the career of Hermodorus of Salamis see in particular: Gros 1973; 1976: 57-62; Anderson 1997: 17-19.

[114] The foundation dates of these two temples are not known with precision. Velleius (1.2.3), Livy (*Per.* 52.7), Valerius Maximus (7.5.4) and Eutropius connect the temple of Iuppiter Stator with the triumph of Q. Caecilius Metellus Macedonicus *de Macedonia et de Andrisco* (146 BCE), thus some presume that it was vowed already in 148 BCE. Its actual construction may have begun in 143 BCE at the earliest (Morgan 1973; see *infra*, 3.4). The Temple of Mars *in circo* was built *ex manubiis* by D. Iunius Brutus Callaicus (Val. Max., 8.14.2) after his triumph on the Gallaecia (for which we only have a *terminus post quem*, 133 BCE). Cornelius Nepos (fr. 26 Peter) links this temple with Hermodorus of Salamis. On the remains of this temple see Tortorici 1988.

grounds.[115] Unsurprisingly, the higher chronology is accepted by Coarelli (2007), who suggests a date in the mid-second c. BCE.[116] However, the dramatic date of the dialogue in which Cicero mentions Hermodorus's *opus navale* is 100 or 99 BCE (consulship of M. Antonius), though it seems that the passage could as well deal with events occurring in ca. 110 BCE,[117] making the career of Hermodorus implausibly long.

Taking the high date of the Porticus Aemilia out of the equation, the lack of a consistent phase of concrete architecture from third c. BCE Roman contexts finally becomes less of an issue. This has always represented a thorn in the side of proponents of the high chronology, precisely because of the complexity of what was considered to be the first known monument in *opus incertum* (particularly its longitudinal organization over an area of almost three hectares occupying unstable grounds along the Tiber bank), which in their view presupposes a much longer period of successful experiments, starting as early as the fourth c. BCE.[118] In this regard, it is worth quoting in full how the conundrum is normally conceptualized:

> "We are left with two possibilities: either we are incorrectly dating the remains of the Porticus Aemilia [i.e., the Testaccio building], which given the present state of our knowledge seems improbable, or we are unable to recognize examples of concrete masonry predating the second c. BCE, which certainly must exist."[119]

In light of what has been said so far, I argue that the first possibility is the most likely, and that the latter is a false problem. Little or no evidence can be found in support of the rigid evolutionary scheme normally applied to the seriation of wall-facing types. This developmental trajectory is an artifact of modern scholarship. The reassessment of the data demonstrates that there is a great deal of circular reasoning behind the identification of alleged early second c. BCE monuments featuring in the canonical sequence, thus excluding the possibility of assigning

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[115] Cozza and Tucci 2006: 194-197.
[116] Coarelli 2007: 42-43.
[117] Morgan 1971: 499-504.
[118] Giuliani 1998: 60, footnote 11.
[119] Giuliani 2006: 217-218.

absolute dates with reference to a gradual and progressive regularization of shape, size and bedding of the facing blocks. Quite the opposite, then, variation in technological style is to be expected even within the same structural environment, depending on a number of factors: source and availability of building materials, structural (or cultural) function of the context, skill of labor.

2.4 The Dating of Roman Concrete: Methodological Problems

2.4.1 Pompeian Styles and Roman Building Techniques

When structural remains preserve wall-paintings, the style of the paintings is often used as external evidence to assign a chronology to the wall, usually on the assumption that wall decoration is always contemporary with wall construction.

In Rome and its environs, the so-called First Pompeian (or Masonry) Style is found in few contexts, all featuring *opus quadratum* and *opus incertum* architecture in combination, as at the site of the Domus Aurea in the city, at Grottarossa in the *suburbium*, and in the broader region at Praeneste (Sanctuary of Fortuna) and Albano (so-called villa of Pompey).[120] The precise date of introduction of this style in the region is uncertain. In Pompeii, First Style ensembles have been dated mainly to the period 200-80 BCE.[121] Earlier third century BCE examples are known in some areas of Sicily (e.g., Morgantina), where the style was acquired perhaps under the influence of the Phoenicians of North Africa (fragments of First Style plaster have been retrieved from fourth c. BCE habitations at Carthage).[122]

In central Italy, the diffusion of decorative ensembles imitating the syntax of monumental

[120] Morricone Matini 1967: 8-9; 1980: 17. Caputo 1990-91 (the stylistic sequencing of First Style documents proposed in this work heavily relies on Morricone's chronological framework, as it is often based on the style of the decorated floors associated with the paintings). A gazetteer of public and private contexts with First Style decoration in Rome is also in Guldager Bilde and Slej 1992: 206-207.

[121] Laidlaw 1985: 17.

[122] Ling 1991: 12.

masonry represented a significant departure from earlier pictorial traditions, which still characterized the stucco production of the period 220-150 BCE.[123] In Latium, the First Style seems to appear in monumental public building (especially sanctuaries) around the end of the second quarter of the second c. BCE. Attestations in Rome concentrate in the second half of the century, but first c. BCE examples are also known.[124]

The spread of the style in private architecture has been connected with the semi-public function of the Roman house. Torelli and Marcattili (2011) suggest that isodomic stuccoes may have had primarily the function of recreating the ashlar masonry environment of basilicas and quadriporticus. Given this "political" connotation, one can expect to find these decorations not only in the parts of the house more accessible to the public, but also in rooms that were used for more restricted social gatherings (examples include the House of Sallust at Pompeii, which was redecorated in the late second or early first c. BCE). This interpretation may also explain why at Pompeii the First Style continues to be employed even after the earthquake of AD 62. For our purposes, the implications are particularly relevant. Firstly, the association of First Style decoration and *opus incertum* may not necessarily indicate a high chronology. Secondly, this perspective allows much overlap to exist between the First Style and the Second Style, suggesting that the correlation between changes in painting and wall-facing styles is less strong than usually thought.

The idea that the transition from the First to the Second Style in Rome was in parallel with the evolution of *opus incertum* into *opus reticulatum* was first suggested by Lugli (who dated this phenomenon in the period 100-70 BCE), and later followed by Morricone (fixing the

[123] Torelli and Marcattili 2011; for Pompeii: Brun 2008.
[124] Torelli and Marcattili 2011: 53.

change around 90 BCE).[125] In either case the dates were derived from evolutionary typologies of Mau's Second Style. These were established by Beyen (1938; 1960), who identified sub-phases based on changes in the organization of the wall-schemes.[126]

One of the basic assumptions of Beyen's approach is that developments in Roman and "provincial" painting styles are intimately linked with one another, with Rome setting the stage for tastes and lifestyles that are imitated in towns like Pompeii. The few monuments known in Beyen's day from Rome were therefore taken as benchmarks for the chronology of comparable works in Pompeii, creating an overarching evolutionary sequence that most art-historians today consider extremely problematic (this comes with the realization that the patterning of Pompeian styles may have more to do with local social processes than with Roman tastes).[127] According to this model, firmly dated examples of the Second Style in Pompeii would have to be found first of all in houses or rural residences remodeled by Roman colonists who migrated there after 80 BCE. This date would, therefore, represent a terminus *ante quem* for any Roman monument which could be placed at the top of the evolutionary sequence (e.g., the decoration of the Casa dei Grifi on the Palatine). Confirmation was sought in the building technique employed for the reconstruction of the houses, the so-called *opus quasi reticulatum*. As in the case of Second Style paintings, the arrival of Roman colonists to Pompeii would account for the spread of the technique in Campania, though there is no valid reason to dismiss the possibility that this was an independent development (soft volcanic tuff was widely available in Pompeii too).[128]

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[125]Morricone Matini 1967: 8-9. For a more general relationship between architectural advancements and stylistic change in this period see also Lugli 1957: 471. "Without a doubt there existed a circle of Italian artists (scuola di artisti) […] mostly working in central Italy and Campania, under a leader with an ingenious mind [...] who managed to exploit to the greatest degree the cohesive properties of mixed construction with stone and lime, building up level above level, founding massive buildings on hollow vaulted structures, and decorating walls and floors with pictorial motifs inspired by the same architecture, as we see in the Pompeian Second Style."
[126]For a recent contextualization of Beyen's contribution see Tybout 2001: 37-42.
[127]See remarks in Bergmann 2001: 57.
[128]Billig 1944: 126.

If Beyen's classification remains useful for comparison between different paintings, its validity for dating can be questioned because of a basic tendency toward circular reasoning in the way painting and facing styles are linked.[129]

2.4.2 Opus Signinum and Other Decorated Floors

The associations between wall-facings and wall-paintings have also been used as a fixed point for the sequencing of mosaic floors and other types of mortar-based surfaces that feature inserted stone fragments (*crustae*), whose patterns could in turn be the object of stylistic analysis.[130] These floors are variously defined in the literature as “cement floors”, “battuti cementizi”, *opus signinum* or “cocciopesto”; in the case of *opus signinum*, it is debated whether the term in Vitruvius identifies a particular mortar recipe characterized by the presence of crushed terracotta or a method of construction used for specific kinds of structures (particularly cisterns).[131] For clarity's sake, I take *signinum* and “cocciopesto” to be equivalent and *opus signinum* to mean the building medium, not its technique of use (in this sense I speak of *signinum*-floors).[132]

The consensus is that both decorated and undecorated *signinum*-floors represent a technology derived from the Punic world, possibly together with tessellated mosaics.[133] Floors of mortar mixed with crushed tile or pottery aggregate, which gives them a reddish hue, can be found in Punic North Africa as early as the fourth or third c. BCE (Kerkouane; though only a few examples from Carthage seem to predate 200 BCE),[134] and in Sicily in the third c. BCE (e.g.,

[129]See Ling 1991: 23; Zevi 1996: 128, dating the first appearance of Second Style with reference to the so-called *opus quasi reticulatum* of the Casa dei Grifi (based on Coarelli 1977). *Infra*, 3.2.1.
[130]Morricone Matini 1971; 1980. A general overview of the problems in Dunbabin 1994; 1999: 53-56. For a discussion of the terminological problems see Tang 2006; Vassal 2006.
[131]In general Tang 2006. On the interpretation of *opus signinum* as a structure see Giuliani 1992.
[132]Following Gros 2003. Cf. Lancaster 2005: 58-59 (opting for “cocciopesto”),
[133]Dunbabin 1994.
[134]Vassal 2006: 39-40; 211-212.

Monte Iato; Morgantina and Megara Hyblaea).[135] Given the reference to *Poenica pavimenta* in Cato (ORF[4] 8.185), Bruneau (1982) has suggested that pavements were considered a characteristically Carthaginian luxury, but there is no agreement on the identification of this floor type. While Festus (282L) believed that these were the Numidian marble fashionable in his time, Gaggiotti (1988) suggested that the reference in Cato was to *signinum*-floors, because these were also decorated not just with patterns made of small square *tesserae*, but also with large and irregular fragments of colored stone (though there is little evidence that marble was included).[136] Some types of decorated *signinum*-floors are also known in the literature as *scutulata* or *crustae*-pavements (but these terms are used particularly when the irregular fragments are laid on a background of smaller stone *tesserae* rather than simply on a bed of mortar; such types mostly date to the late second c. BCE or later).[137] Both Gaggiotti and Dunbabin connect the spread of the taste for these floor types in the region of Rome with the fact that Carthaginian aristocrats were being held prisoners in various cities of Latium, first at Norba and then at Ferentium and Signia (Livy 32.2.4).[138] The discovery of late fourth or third c. BCE *signinum*-floors at Buccino,[139] Naples,[140] and Fregellae,[141] however, suggests that the mechanisms of transmission may have been different. Mortar mixes including ground pottery were certainly known in the Greek East, though the medium was mostly used to line cisterns.[142] *Pavimenta Graecanica* are also mentioned in literary sources (Pesando suggests that these ought to be identified with

[135]Vassal 2006: 104-105.
[136]Gaggiotti 1988: 211-215.
[137]Morricone Matini 1971: 28-29; 1980; Donderer 1987; Dunbabin 1999: 53-54.
[138]On the *signinum*-floors archaeologically attested at Norba see Carfora *et al.* 2008; 2010; 2011; more generally Quilici Gigli 2003.
[139]Vassal 2006: 143-144, n. 195 (including lava from Mount Etna).
[140]Vassal 2006: 162, n. 298 (with Greek style designs).
[141]Coarelli 1995.
[142]Vassal 2006: 34-35 (Olinthus; Corinth). Pozzolanic examples are documented with scientific methods from Rhodes, Camiros (see Malinowsky 1992; Ktoui and Ftikos 1998) and Crete (Maravelaki-Kalaitzaki *et al.* 2003).

mosaics of large *tesserae*).[143] On the other hand, the same decorative repertoires characterizing *signinum*-floors can be found in other mortar-based pavements such as the "battuto bianco" (in which the terracotta aggregate is substituted by crushed limestone).[144] In Rome, examples are known in which the reddish color is given by a layer of red stucco applied directly to the surface of the floor before the stone *tesserae* were inserted.[145] This variability suggests that local developments may have played a significant role.

Republican architectural remains of buildings known to contain decorated *signinum*-floors, *crustae*-pavements, and tessellated mosaics excavated in Rome before 1980 appear in a series of contributions by Morricone Matini, which are primarily focused on the typological study of the decorative ensembles.[146] The earliest *signinum*-floor in the sequence would be the one found in the cella of the west temple at S. Omobono, which is thought to predate the reconstruction of 212 BCE (but this pavement has no direct relationship with surviving structures, making the dating problematic). Based on the alleged identification of the *crustae*-pavements with the *scutulata* (Pliny the Elder 36.185 explains that the first example of this floor type, which he does not describe in any detail, was dedicated on the Capitolium in 149 BCE), and on the few associations with First Style paintings, *opus quadratum* and/or *opus incertum*, Morricone suggested that most of the examples of decorated floors dated to the second half of the second c. BCE (150-90 BCE).[147]

Formal analysis shows that the documented examples of decorated *signinum*- and *crustae*-pavements of this period present many stylistic and technological differences as to type

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[143]Pesando 2008: 170.
[144]Morricone Matini 1971: 3.
[145]Gualandi and Papi 2005a: 46-47.
[146]Morricone Matini 1967; 1971; 1980. For the wall-paintings at these sites see Caputo 1990-91: 228-240.
[147]Morricone 1971: 213-215. Morricone's identification of the *scutulata* has not won general acceptance. See discussion in Tang 2006: 95-96.

of material, size and disposition of the elements, precluding a more refined sequencing.[148] A similar degree of variability characterizes tessellated mosaics made with square black *tesserae*, which in any case are far less common.[149] Two subtypes can be identified according to Morricone for the early *crusta*-pavements made of rectangular tesserae, but both traditions continue after 90 BCE into the subsequent phase of Morricone's periodization (i.e., the *opus quasi reticulatum*/Second Style phase).[150] While stylistic links can be traced between the decorated floors found under the *Tabularium* and the Palatine mosaics, the distribution of *signinum* floors seems to decrease rapidly some time after the second decade of the first c. BCE. The overall impression is that changes in building techniques and in floor technology or style do not correlate. In fact according to Morricone's system any given floor can be dated exclusively on account of its association with a wall-facing technique, whose chronology is in turn derived from the broader relation with a painting style.

On account of the alleged high chronology of *opus incertum*, Coarelli (1995) has proposed raising the date of early forms of decorated *signinum*-floors accordingly, that is at least to the first half of the second c. BCE or even the third c. BCE, in the case of floors associated with *opus quadratum* (e.g., Republican houses under the *Domus Aurea*).[151] In this way, Coarelli was also able to provide comparanda for the decorated floors found in houses he excavated at Fregellae, which belong to an occupation phase dated archaeologically to the first quarter of the second c. BCE.[152] In turn, this evidence has been invoked by the excavators of the Republican houses on the north slopes of the Palatine to confirm the late third or early second c. BCE

[148] Morricone 1980: 79-83.
[149] Morricone 1980: 74-77.
[150] Morricone 1980: 69-73.
[151] Coarelli 1995: 19-20.
[152] Coarelli 1994; Coarelli and Monti 1998: 35-41. Ceramic assemblages obtained for the second phase of the Baths of Fregellae, which is contemporaneous with the second phase of Domus 7 (both buildings were reconstructed on top of a 1.5 m-thick leveling layer that obliterated the previous phase) would give a wider time-bracket of 185-150 BCE. See Tsiolis 2008: 136-137.

chronology for a group of decorated *signinum*-floors found in association with concrete foundations, *opus incertum* and perhaps First Style paintings, though strong similarities in the decorative pattern could be found only with other Roman contexts that in previous studies had been dated to the late second c. BCE.[153] As is the case with the transmission of Second Style paintings, the expectation is that new forms of decoration always originated in Rome, only to be exported to colonial sites at a later stage by craftsmen who learned the skills in Rome. It should be noted that at Fregellae these floor types are never used in combination with *opus incertum* (which is altogether absent).[154] The case of Fregellae, where undecorated *signinum* floors may have appeared as early as the late fourth c. BCE and experimentations with geometric decorations using limestone *tesserae* were already underway in the second half of the third c. BCE,[155] shows that colonial sites may have acquired new techniques more readily than, and independently of, Rome.[156]

Beyond demonstrating that the *crusta*-pavement technology was introduced earlier than previously thought, the new data from Fregellae further confirms the *longue durée* of certain types of decoration and the low diagnosticity of this class of finds in general. If the sequencing of masonry styles is problematic in its own right, even more so will be any attempt at linking wall-facings and other decorative styles for dating purposes. These kinds of typologies may be useful for formal comparison, but not as much for assigning precise dates to concrete remains.

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[153]Papi 1995: 342.

[154]Structural mortar at this site appears employed consistently only in the late phase of occupation of the houses (150-125 BCE) to create vats, basins and conduits: Battaglini and Diosono 2010. Scanty remains of a concrete fill are attested in the podium of the temple of Aesculapius, whose original construction is dated to 175-150 BCE, but seem to be associated with a late feature (Lippolis 1986: 30 and Pl. XI, cross-section 4-4).

[155]Coarelli 1995: 19.

[156]On the idea of a derivation of *opus signinum* and “cocciopesto” from the *pavimenta punica* see Bruneau 1982; Gaggiotti 1988; Vassal 2006. Gaggiotti (1988 connects the transmission of decorated *signinum*-floors at Norba with the presence of Punic hostages at the end of the Second Punic War (198 BCE). On these monuments see Carfora *et al*. 2008; Carfora *et al*. 2011 (with a generic second c. BCE chronology).

2.4.3 Roman Concrete and Ceramic Chronologies

The typological sequencing of Roman construction techniques proposed by Lugli did encounter some early criticism. While Von Gerkan (1958a; 1958b) was pointing out inconsistencies in the way literary sources were used to date facing styles, Lamboglia (1958) targeted another aspect of Lugli's methodology. He complained that Lugli made no attempts whatsoever at integrating the study of structural remains with the stratigraphic analysis of occupation or construction levels and of associated finds. Provocatively defining the latter as *opus certum,* he advocated the adoption of artifact-based methods for dating construction techniques and masonry styles.[157] In his response, Lugli (1959) reasserted the validity of a general systematization based on the formal comparison of facing styles only, which he believed all the more necessary given all those cases for which stratigraphic data would not be available. But even if these were available, his view was that chronological indications derived from ceramic finds or coins would have to be weighed against the type of architectural plan, because the spread of specific building types normally tended to concentrate in particular historical periods (what he called "sincronismi architettonici"). Thus, deviation from the expected absolute date would require a reconsideration of the stratigraphic position of the finds in question.[158] In other words, the value of ceramic data for the dating of standing architecture would only be relative. Lugli's attitude ultimately reflected the idea of a disciplinary and methodological divide between topographers primarily concerned with the analysis of above-ground remains and archaeologists (or rather prehistorians), interested only in what was below ground level.[159]

In light of the variability of wall-facing styles and decorative ensembles, and because a clear pattern in the compositional properties of structural mortars can be hardly detected for

[157]Lamboglia 1958: 163-169.
[158]Lugli 1959: 323-326.
[159]Lugli 1959: 330.

monuments predating the middle of the first c. BCE, the contextual analysis of stratified ceramics remains the only indicator for refining the chronology of second c. BCE architecture. Many advances have been recently made in the knowledge of the pottery circulating in the area of Rome during the Middle and Late Republican period.[160] Some difficulties are posed by the relative rarity of imports in ceramic assemblages excavated in Rome compared to other areas of central Italy, particularly with relation to the most diagnostic ceramic classes. Consumption of Black-gloss pottery of the so-called Campanian A production was on a smaller scale in Rome, according to a pattern determined in part by the presence of a long-established local tradition, in part by the fact that the circulation of these mass-produced vessels happened in the context of long-distance trade. A somewhat greater role, however, was played by other regional productions such as the Campanian B from North Etruria and from Cales, whose diffusion peaks around the middle of the second c. BCE (though the archaeometric study of possible Roman imitations of these, the so-called B-oid productions, is still in its infancy).[161] Amphorae are also less well-attested in Rome, probably because of the predominance of the consumption of wine produced in the *suburbium,* which was transported in dolia or other more perishable containers.[162]

In spite of these limitations, however, it is still possible to separate with acceptable precision stratified contexts that either predate or postdate 150-140 BCE, by assessing the presence or absence of certain forms (and/or decorations) of Campanian A in comparison with published assemblages from Carthage (whose siege and final destruction provide a fixed *terminus* of 149-146 BCE for the importation of pottery).[163] In addition, another reliable

[160]For a general overview see Morel 2007. On the black-gloss pottery productions of Rome in the Middle Republican period see especially Bernardini 1986; Olcese 1998; Ferrandes 2006; 2008. For a typology of Late Republican coarse-wares in the region see Olcese 2003. New perspectives and directions are discussed more broadly in Olcese 2009.
[161]Cibecchini and Principal 2004.
[162]Panella 2010.
[163]If a type of Campanian A is not attested in Carthage, where this kind of pottery was otherwise widespread, it most

indicator is given by the presence of Dressel 1 amphora types, which completely replaced previous Graeco-Italic productions in the third quarter of the second c. BCE (there is ample evidence that Dressel 1 amphorae were produced in the coastal region of Latium Adiectum).[164]

2.5 Conclusions

In this chapter I discussed the main issues presented by the text of Cato, which scholars take to be our earliest sources on mortared rubble architecture, pointing out the lack of clear archaeological correlates of the building types and construction techniques he describes, particularly for the period before the middle of the second c. BCE. Ideological connotations of a different kind surround Vitruvius's basic classification of *structura caementorum*, which is often interpreted at face value, as evidence of the high antiquity of the *genus incertum* (i.e., the class of *opus caementicium* that archaeologists refer to as *opus incertum*), overlooking the broader context, especially the fact that Vitruvius programmatically casts contemporary Roman practice in a negative light.

In a thorough reappraisal of the criteria currently adopted to date early Roman concrete techniques, I outlined a brief account of how the dating system has been constructed since the pioneering work of Van Deman, highlighting the circularity of the arguments regarding wall types, painting styles, and floor decorations, and the false ideas of evolutionary progress in the development of the technique, particularly in relation to wall-facing styles. Given the new identification of the concrete building of Testaccio put forward by Cozza and Tucci (*Navalia*), which leaves us without fixed points for the first half of the second c. BCE, I suggest that the conventional seriation of *opus incertum* monuments, as was established by Lugli and Coarelli,

likely dates to after 149-146 BCE. On this method and more generally on the state of the problem of second and first c. BCE ceramic chronologies: Morel 1990; 2011: 95. For the periodization of second c. BCE assemblages: Morel 1976.

[164] Panella 2010: 45-52.

should be rejected. The main point is that stylistic criteria do not take into account other factors determining the aspect of walls, such as the type of material locally available (rubble architecture made of a harder or more intractable stone does not normally feature regular facings), its provenance (whether quarried on purpose or recycled), the structural context (e.g., the walling of a niche as opposed to a terracing wall), or possible labor saving concerns (walls made of larger *tesserae* can be built up in a faster way). This also explains why *opus reticulatum*, which emerged around 100 BCE (as a result of changes in the organization of construction) and became predominant in the course of the first c. BCE, can be found in late second c. BCE monuments side-by-side *opus incertum*.

In light of this, in the following analysis of purported early concrete monuments, I will assign more weight to chronological data derived from stratified ceramic finds associated with the construction levels of these buildings, with the caveat that a higher proportion of residues is to be excpected in construction fills than in occupation levels. As a general rule, dates derived from pottery assemblages should be considered more reliable than those based solely on stylistic grounds.

Chapter 3

Opus Incertum and Élite Domestic Architecture in Rome

3.1 Introduction: Roman Houses and Roman Concrete

Archaeological evidence on the development of house construction in Rome during the Middle and Late Republican periods is notoriously limited and fragmented. The sample consists mostly of isolated walls and floors belonging to private buildings that were leveled and buried underneath later concrete architecture, and for which it would be virtually impossible to obtain entire plans. Much of this evidence has been gathered through a combination of old rescue excavations[165] and occasional soundings that allowed the investigation of construction levels of later monuments.[166] The few planned excavations were narrow in scope, and often designed to deal with specific problems of Roman topography.[167] Regardless of the unsystematic character of most of this research, it can be said that the quality and quantity of available data noticeably

[165]Examples include the badly documented discoveries following the urban development of the Viminal and Quirinal in the late 1800's (Blake 1947: 250), or the clearings for the construction of Via dell'Impero in the 1930's (Colini 1933; Gatti 1985).

[166]E.g., Colini's excavations under the foundations of the so-called Tabularium and the temple of Veiovis (Colini 1942), those by G. Boni in the area of the Domus Flavia (1912-1914: Marella Vianello 1947; 1921: Morricone Matini 1967: 33-38), and by A. Bartoli in the Domus Augustana (Morricone Matini 1967, 10-16).

[167]Cf. the research of G. Carettoni (1966-67; 1978), aimed at identifying the house of Augustus on the Palatine.

increases only from around 100 BCE onwards.[168]

In order to reconstruct the Roman aristocratic house of the third and second c. BCE, therefore, scholars have looked elsewhere for remains dating to this period, particularly the houses of the atrium type appearing around 200 BCE at Pompeii, Cosa and Fregellae, interpreting the internal organization of these buildings in light of the text of Vitruvius.[169] One of the arguments is that, in book 6 of his treatise, Vitruvius offers not just a description of the recurring features of atrium houses, but a set of instructions on how to build them. It has been suggested that these norms were derived from an abstract template that was first conceptualized as early as the end of the fourth or the beginning of the third c. BCE (drawing from house design traditions that emerged in the Archaic period). It was in this period that the Romans launched their first large-scale colonization program in Italy, and as it has been pointed out, instructions expressed in terms of fixed relative proportions make sense only in the context of regularly sized blocks, which is the case primarily in *ex novo* foundations.[170]

To what extent this standardized template was adopted in Rome remains an open problem, not only because of the lack of well-preserved buildings of this period.[171] With the progress of stratigraphic investigations in the early levels of the city it is clearly emerging how, at least in relation to élite domestic architecture, the Middle Republican period was characterized by very limited construction activities, whereby the complexes built at the turn of the sixth c. BCE were carefully maintained for centuries with little, if any, structural modifications other

[168] A general discussion of the problem in Gros 2001: 38-76. On the first c. BCE developments see also Coarelli 1989.

[169] A recent reappraisal of the evidence in Sewell 2010: 109-136.

[170] Sewell 2010: 127-132. Accordingly, the diffusion of the main elements of the atrium house in a standardized design in non-colonial sites (e.g., Pompeii) is taken as a sign of strong Roman influence. See also Coarelli and Pesando 2011: 48-54.

[171] Cf. Coarelli and Pesando (2011: 51) suggest that the remains of a house excavated under the Basilica Iulia (Carettoni and Fabbrini 1961) belong to a canonical atrium house of the third c. BCE, which they identify with the one owned by the family of Scipio Africanus.

than the periodic reconstruction of floor levels.[172] In addition, it should be considered that the core of the city was never formally planned.[173] Adaptation to the uneven topography of the site as well as frequent changes in real estate ownership - a phenomenon attested at least from the second c. BCE - produced irregularly shaped plots, which might pose obvious obstacles. In the *suburbium* of Rome, however, the Auditorium site shows the diffusion of the canonical atrium layout by the late third c. BCE.[174] An atrium with impluvium, canonical alae and axial tablinum has also been hypothesized for one of the houses excavated by Carandini on the north slopes of the Palatine (House 5; *infra*, 3.3.1), which has been dated to the late third or early second c. BCE, but the reconstruction is controversial because nothing remains of the tablinum and of one of the supposed alae. Variation in the internal organization characterizes the few other second c. BCE examples for which a relatively more complete plan has been preserved (north slopes of the Palatine, Houses 6, 7 and 8 as well as in the adjacent block occupied by Carettoni's Domus Publica).[175]

As far as building techniques are concerned, the common idea is that a correlation with house design exists only at sites where standardized house plans appear in the context of mass construction projects, as is the case of Cosa and Pompeii,[176] assuming that cost-saving concerns may have influenced the choice of masonry type directly. This would explain the implementation of mixed techniques that allowed the reuse of rubble and waste material in the masonry structure (e.g., the Pompeian *opus Africanum*; the *mur en damier* at Volsinii Novi, another colonial context

[172] Carandini and Carafa 2000. On a different note, Torelli and Marcattili (2011: 44-46) show that the style of architectural decorations and mouldings remained anchored to archaic conventions for most of the third c. BCE.
[173] See discussion in Wallace-Hadrill 2008: 269-275.
[174] De Davide and Di Giuseppe 2007.
[175] A restored plan of how the internal subdivisions of this sector of the Palatine in the period between 200 and 125 BCE is in Filippi 2010: 24, fig. 6. Carandini *et al.* 2010: 81 fig. 38. For the Late Republican remains of the so-called Domus Publica see Carettoni 1978-1980.
[176] The site-wide program of house construction at Cosa has been linked with the influx of new contingents of colonists (197 BCE): Bruno and Scott 1993: 27-30 and 59-60; Fentress 2003: 19. For Pompeii see especially the data on the urbanization of the Regio VI: Coarelli and Pesando 2006.

with ample evidence of second c. BCE architecture; *infra*, 5.2), curbing the costs of ashlar or polygonal construction. Unpretentious and cheap clay-based techniques are frequently used for party-walls, although more refined architecture is normally employed for the façades.[177] In the case of Rome, as we have seen, there is a tendency to connect the appearance of *opus incertum* with experimentations with the use of concrete as a simple filler in combination with ashlar masonry, for which the new facing style would eventually become a cheaper substitute (cf. Van Deman's reconstruction, but in the context of public building).[178]

In relation to private architecture, the rapid implementation of standardized concrete techniques, and particularly of *opus reticulatum*, is usually linked with multistory apartment construction, which according to textual sources witnessed in the early decades of the first c. BCE the increased involvement of wealthy senators (cf. Plutarch, *Crassus* 2.5-6), who are assumed to have transposed new modes of labor organization from agriculture to the building industry, employing armies of unskilled slaves to rebuild at low cost.[179] Archaeology, however, shows that *opus reticulatum* was extensively used also for the development of élite neighborhoods, particularly on the Palatine.

3.2 A Survey of Late Republican Domestic Architecture in Rome

If we exclude public monuments such the Atrium Vestae in its Republican phase (strictly speaking, this can be assimilated to a house) and the so-called Domus Publica next to it, the sum

[177]The origin of mixed techniques in Etruria can be traced back to the Archaic period: see Stopponi 2006. On the techniques used for the houses of the Regio VI see more recently: Pesando 2010a. Packed clay is extensively employed for building elevations at Fregellae see Battaglini and Diosono 2010: 226-229.

[178]For a quantification of construction costs comparing ashlar masonry, *opus incertum*, *opus reticulatum*, and brickwork: DeLaine 2001; more general implications in DeLaine 2006.

[179]Gros 2001: 86-90. On the different degrees of skill required for *opus incertum* and *opus reticulatum* see especially Torelli 1980: 156-157. DeLaine (2001: 234-245) calculates that manpower costs for *opus incertum* of small-sized *caementa* can be significantly less than those of *opus reticulatum*. As Wright (2005: 192-193) points out, the dressing of small units of stone is enormously time-consuming, especially to keep the unit stable under the impact of the tooling. The common opinion is that squared *tesserae* were mass-produced in quarries and supplied to building sites in bulk. See Coarelli 1977: 18.

total of domestic contexts in which *opus incertum* has been recorded is very small. Morricone's corpora include only eight examples of this kind of architecture, though in several cases the identification of the building technique is problematic. A few other contexts known from early excavations do not appear in her analysis, either because no mosaics or decorated floors were found or because, in spite of the association with possible *opus incertum* walls, the pavements were considered to be much later in date. What follows is the complete list (**Table 1**; **fig. 12**).

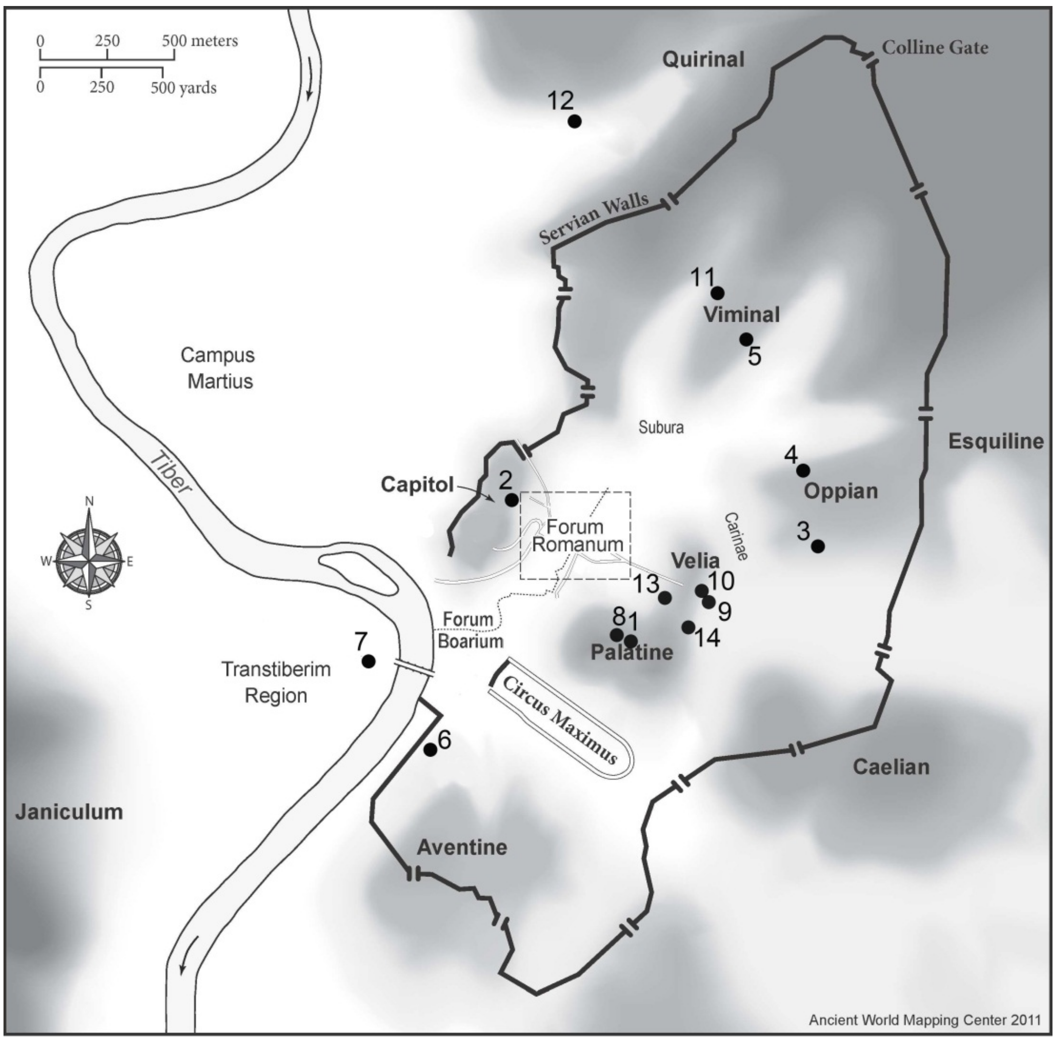

Figure 12. Schematic map of Rome with location of the houses discussed in Chapter 3 (*1=Casa dei Grifi; 2=Temple of Veiovis site; 3=Domus Aurea site; 4=S. Pietro in Vincoli; 5=S. Pudenziana; 6=S. Sabina; 7=S. Cecilia; 8=Aula Isiaca; 9=Temple of Venus and Rome site; 10=Via dell'Impero;11=Via Palermo; 12=Via Sistina; 13=North slopes of the Palatine; 14=Northeast slopes of the Palatine*).

3.2.1 The Casa dei Grifi

The Casa dei Grifi (**fig. 12, 1**) was discovered by G. Boni under the "Larario" of the Domus Flavia and excavated between 1912 and 1915. The finds were sensational, because among these were included what were soon believed to be the earliest documented Second Style paintings. These paintings seemed to provide external evidence for a secure fixed point of around 90/80 BCE, assuming that the style originated in Rome but a few years before being imported to Pompeii by Roman colonists (*supra*, 1.4.1). Fixed point for which building technique?

Establishing what type of facing style the paintings were associated with has been a contentious issue (oddly enough, in general surveys of Roman wall-painting one often finds that the dating of these monuments is suggested on the basis of the building technique; *supra*, 2.4.1).[180] While Boni described the still well preserved remains of both levels of the house as *opus reticulatum*,[181] the first editors of the paintings, Rizzo and Bartoli (1936), classified the visible wall facings in the basement floor (Rooms A-D) as a kind of *opus incertum* (**fig. 13, a**), but suggested that the paintings belonged to a later occupation phase.[182] The *opus incertum* identification was followed by Beyen (1938), who maintained that the associated paintings were in phase with the original construction of the house.[183] Other paintings that Beyen assigned to a later sub-phase of Second Style (phase Ib or Ic) were found in the house (Rooms E-G), indeed in connection with a rebuilding in *opus reticulatum*. These were therefore dated stylistically to ca. 50 BCE. A *terminus ante quem* for this construction phase was derived from the style of the mosaics (dated to around 40 BCE) that decorated the first floor; these were built atop leveling

[180] E.g., Ling 1991: 23.
[181] Marella Vianello 1947.
[182] Rizzo and Bartoli (1936: 4) compared the alleged *opus incertum* construction to Gatti's Porticus Aemilia and concluded that the first phase of the house considerably predated the paintings.
[183] See especially Beyen 1938: 46-47; 1960: 18-19. Billig (1944: 129) accepted the formal comparison between these two structures, but suggested a lower date for the Testaccio building (the Gracchan period).

layers that buried the basement of the house.[184]

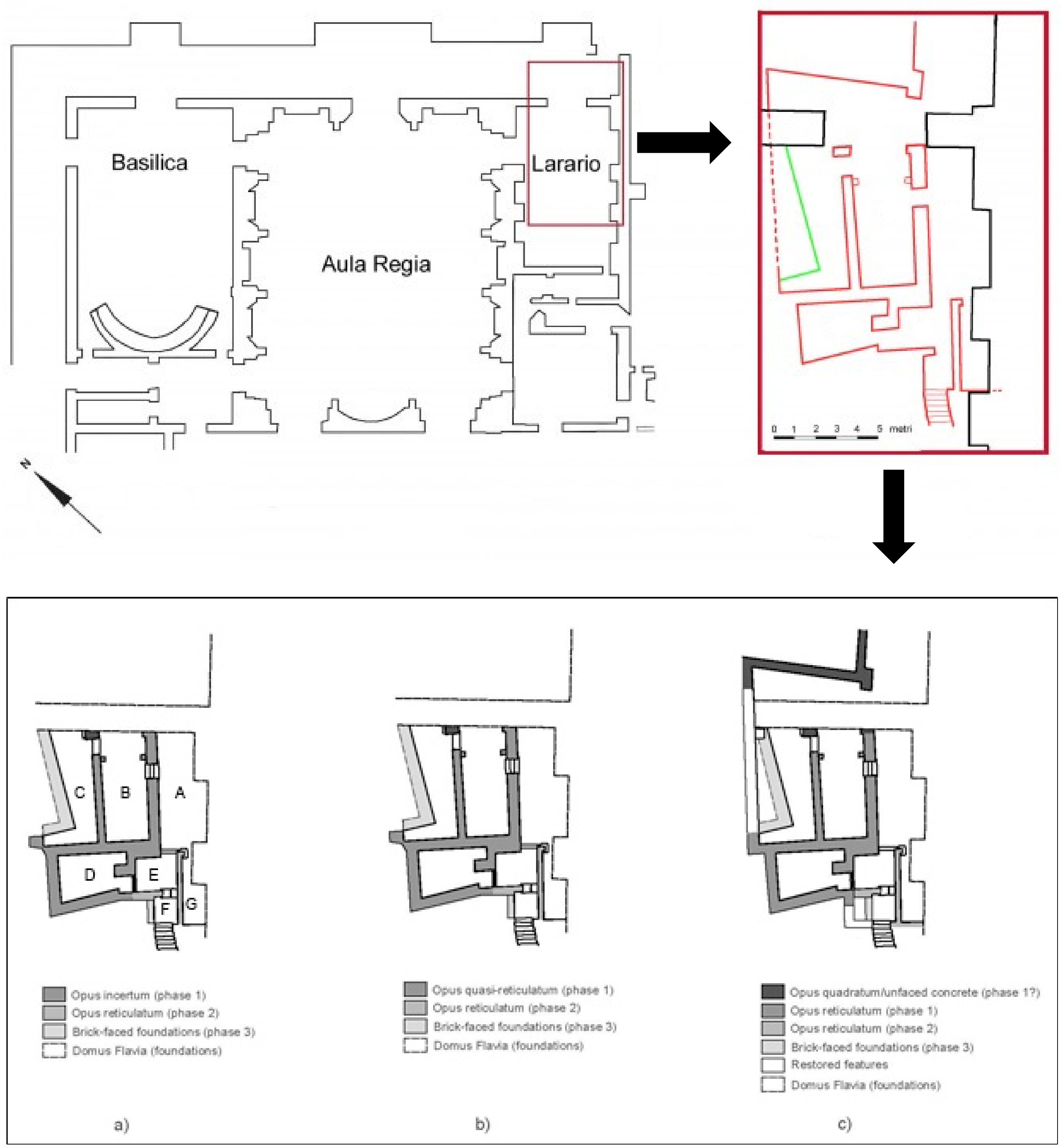

Figure 13. Rome, Palatine: Casa dei Grifi, general plan and interpretation of excavated remains in the basement (after Iacopi 1991; room numbering in a) follows Morricone Matini 1967).

Lugli on the other hand saw the particular masonry style of the first phase of the house as

[184]Beyen 1960: 361-362. This building sequence was accepted by Blake (1947: 181 and 250), who considers the paintings that cover the later partitions in *opus reticulatum* a "mechanical imitation of the earlier frescoes."

an incipient form of *opus reticulatum*, mainly because of the small dimensions and the regularized shape of most of the facing blocks. As already suggested by Beyen, Lugli classified the remains as *opus quasi reticulatum* (**fig. 13, b**), and dated the original building phase to the period 100-70 BCE, without questioning the direct relationship between construction and decoration of the house.[185]

The issue was reopened by Morricone (1967), when the removal of the paintings in Room D revealed that the decoration was applied only after a niche in the southeast corner (which showed traces of an earlier layer of plaster) had been walled in with concrete masonry. This wall appeared to be of a "more regular" kind of *opus quasi reticulatum* than that of the original walls of the room, and according to Morricone was also "more similar" to the wall-facing attested in Rooms E, F and G.[186] As a solution to the problem, Morricone proposed to classify the less regular wall-facings of Rooms A-D as *opus incertum*, following the earlier phasing of Rizzo and Bartoli. Moreover, because Boni had identified these walls as *opus reticulatum*, Morricone Matini assumed that all the first floor structures classified by Boni as *opus reticulatum*, which had by then practically disappeared, were also to be interpreted as *opus incertum*.[187] She also made both groups of Second Style paintings contemporary with each other and with a general rebuilding in *opus quasi reticulatum.* The paintings would all belong to Beyen's phase Ia, with inconsistencies in style and execution due to the work of different crews (on the assumption that smaller and less important rooms were decorated by less skilled individuals). They would thus provide a fixed point for the beginnings of *opus quasi reticulatum* construction as well as for the first appearance of tessellated mosaics, which are indeed attested in the basement. According to this interpretation, the alleged *opus incertum* walls necessarily predated 90 BCE: thus, Morricone

[185]Lugli 1957: 474; 502-503, distinguishing a form of *quasi reticulatum* used in the limestone region
[186]Morricone Matini 1967: 17-22; Tav. B, fig. 4.
[187]Morricone Matini 1967: 19; fig. 4; Tav. C, fig. 3.

Matini opted for a tentative date to the last decades of the second c. BCE and speculated that in this phase the house must have been decorated with other ensembles, most likely in the First Style.[188]

This new interpretation was accepted by Coarelli (1977), who went on to link the structural rebuilding of the house in Morricone's *opus quasi reticulatum* with probable destructions caused in the area of the house by the same fire that hit the neighboring sanctuary of the Magna Mater in 111 BCE.[189] A first implication of Coarelli's reconstruction is that the date of the alleged *opus incertum* phase of the house could be pushed back well into the second c. BCE, as early as the first half. In fact, according to Coarelli, the transition from *opus incertum* to the so-called *opus quasi reticulatum* started already in the third quarter of the second c. BCE, as inferred from the attestation elsewhere in Rome of highly standardized *opus reticulatum* already at the end of the second c. BCE.[190] On this basis, he suggested that the Second Style paintings of the Casa dei Grifi should be dated to the last decade of the second c. BCE. The circle is finally closed: now it is the building technique that dates the paintings, not the other way around. As if they were obtained independently of each other, the high chronology of the paintings and the high chronology of *opus quasi reticulatum* are usually invoked to confirm the higher chronology of *opus incertum*.[191]

Recent excavations in the house, however, have revealed a new wall delimiting the property to the north, which was also decorated with other Second Style paintings typologically close to those of Room B (**fig. 13, c**). This structure was built in a mixed technique of *opus*

[188]For the standardized association of *opus incertum* walls and First Style paintings Morricone Matini 1967: 4.
[189]Coarelli 1977: 14-15; on the relationship with the fire of 111 BCE see Coarelli 1983: 141.
[190]Coarelli 1977: 16. The high chronology proposed by Coarelli for the fisrt known monument built with *opus reticulatum*, the Horrea Galbana, is not generally accepted. Cf. Lugli 1957: 508 (50-30 BCE).
[191]More recently, Coarelli 2007: 44-45.

quadratum and unfaced concrete (only a minor stretch was faced with *opus reticulatum*).[192] This new evidence suggests that the association between the paintings and the building phases, as defined in terms of construction techniques, may not be as straightforward as Coarelli assumed.

In sum, the case of the Casa dei Grifi is particularly instructive because it shows how arbitrary the criteria for the classification of facing styles can be. Depending on the observer, the structures of Rooms A-D have been identified either as *opus incertum* or as *opus quasi reticulatum,* while the party-walls of Rooms E-G have been either considered *opus quasi reticulatum* or *opus reticulatum*, influencing to a great extent the reconstruction of the building phases of the house and the very same interpretation of the associated paintings. On a more general level, the classification of *opus quasi reticulatum* as an intermediate stage between *opus incertum* and *opus reticulatum* with fixed chronological boundaries fails to take into account other variables at play in the construction process, while attributions to *opus reticulatum* based only on the small and uniform dimensions of the blocks and on the rigid regularity of bedding and joints, if consistently followed, would exclude monuments predating the Augustan period.[193]

A more standardized method for the recording of wall-facings has been recently proposed by Medri (2001) and applied to characterize building contexts on the Palatine, such as the system of terracing walls in the sanctuary of Magna Mater and the block of houses on the north slopes of the Palatine.[194] This approach rejects the category of *opus quasi reticulatum* and adopts broader criteria for the identification of *opus reticulatum*, so as to include any walls in which are predominantly used squared blocks of a more or less regular shape (as is indeed the case for the

[192]Iacopi 1991: 83. The excavator assigns these walls and the associated paintings to a reconstruction of the house that happened not long before the final obliteration of the basement, following the low chronology of Rizzo and Bartoli 1936.

[193]*Opus quasi reticulatum* is maintained in the classification proposed by Adam 1994. Cf. Von Gerkan (1958a: 191-192), who suggested the term *pseudoreticulatum* to include *opus incertum* walls with facings made of well-jointed pyramidal blocks (even if the worked face was not quadrangular) together with early forms of so-called *quasi reticulatum.*

[194]Medri 2001; Misiani 2005: 188-193; D'Alessio 2009: 238-239.

alleged *opus incertum* walls of the Casa dei Grifi).[195] To facilitate the creation of reliable typological sequences within each site, measurements of qualitative and quantitative attributes (i.e., building materials used; shape and number of blocks; maximum, minimum and mean dimensions of blocks and joints; relative proportion of blocks and mortar) are taken from standard samples of 1 m^2. In this system, stylistic variation across sites is not used to assign dates, because the physical aspect of a wall depends first of all on its structural function and extent: comparing the facing style of the masonry that walled the small niche of Room D in the Casa dei Grifi and that of, say, the substructures of the southwest slopes of the Palatine, which are more than 40 m-long, just to establish which dates first loses much of its meaning.

In conclusion, the available evidence suggests that the remains in the basement of the Casa dei Grifi should be best described as *opus reticulatum*. The few surviving portions of the upper level are too badly preserved to demonstrate that there was an *opus incertum* phase of the house to be assigned to the period before 111 BCE.

3.2.2 Remains of Houses at the Temple of Veiovis Site

These structures were found in the saddle between the Capitol and the Arx (**fig. 12, 2**; **fig. 14**), in an area that was leveled in the early first c. BCE for the construction of the so-called Tabularium (this most likely followed a fire that devastated the Capitoline Hill in 83 BCE: Cicero, *Cat.* 3.9; Sallust, *Cat.* 47.2; Tacitus, *Hist.* 3.72; Appian, 1.83 and 86; Plutarch, *Sulla* 27; Julius Obsequens, 57).[196] Two decorated *signinum*-floors were recorded in association with *opus incertum* walls belonging to a house, or perhaps to an earlier public building later replaced by the Tabularium.[197] This construction level was interpreted by the excavator as contemporary with the

[195]Misiani 2005: 188 and 194 n. 32.
[196]Morricone Matini 1967: 4; 1971: 8, n. 3-4; Morricone 1980: 19.
[197]For a different reconstruction of the local topography see Coarelli 2010a.

first concrete podium of the Temple of Veiovis, which was dated to around 150 BCE on the basis of the style of a mosaic preserved in the cella. Ashlar structures (of Tufo Giallo della Via Tiberina) of a probable house of the same period were also uncovered to the east of the temple, on a lower terrace toward the Forum.[198]

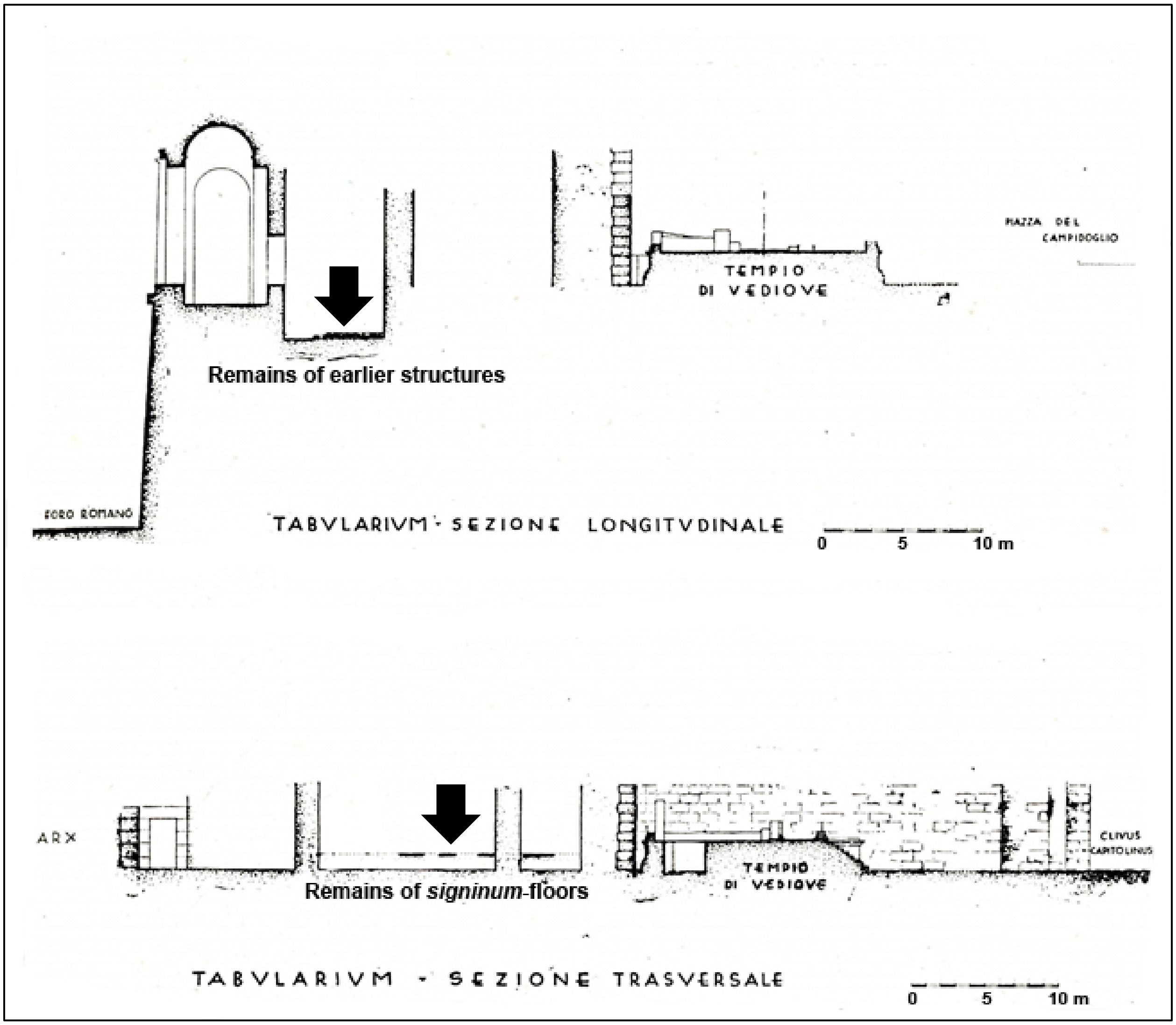

Figure 14. Rome, Capitoline: cross-section drawings of the Tabularium. The arrows show the location and floor level of the concrete houses (after Colini 1942).

[198]See the excavation report, Colini 1942: 6, 7 fig. 2; 50-51. Lugli (1957: 412) suggested a tentative chronology in the 150-120 BCE period.

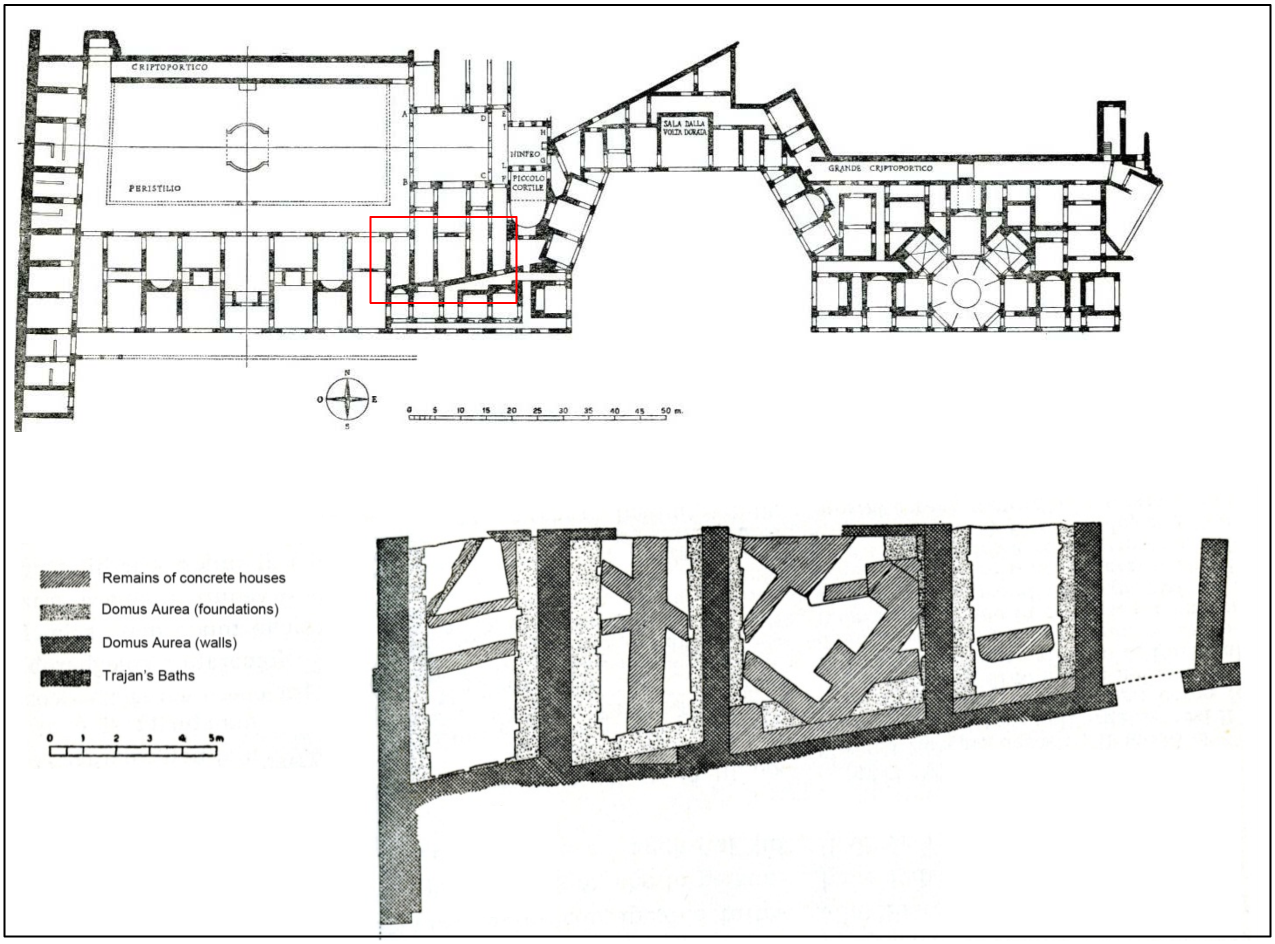

Figure 15. Rome, Domus Aurea site. General map of the complex on the Esquiline (top), and state plan (bottom) showing remains under the so-called peristilio rettangolare (after Sanguinetti 1958).

3.2.3 The Domus Aurea site

Part of a Republican *domus* was discovered in rescue excavations carried out beneath the south sector of the nymphaeum that faces onto the east side of the so-called peristilio rettangolare (**fig. 12, 3**; **fig. 15**).[199] The structures belong to a multi-phase occupation, but identification of the wall-facing technique is uncertain ("*opus incertum* transitioning to *opus reticulatum*").[200] One of the *opus incertum* walls allegedly preserved its stucco decoration (including panels outlined with incisions), while other First Style plaster fragments were reported

[199] Sanguinetti 1958: 42, fig. 5. For other remains generically dated to the late Republican or Augustan period see Fabbrini 1985-86: 132, footnote 6 and Pl. I-II.

[200] Sanguinetti 1958: 45. Morricone Matini (1971: 11-12; 1980: 27) records unspecified structures in *opus quadratum* and identifies an *opus quasi reticulatum* phase with a different orientation from that of the *opus incertum* structures.

in secondary deposition. These have been dated stylistically to the late second c. BCE.[201] Other badly documented pre-Neronian remains were found to the southwest of the latter complex, in the area of the Baths of Trajan. Among these structures is a wall that has been tentatively identified by Morricone Matini as built with *opus incertum,* though little is visible of the wall-facing.[202] This is almost completely covered by paintings that have been assigned to a transitional phase between the First and Second Style, and dated to the last decade of the second c. BCE.[203]

3.2.4 S. Pietro in Vincoli

The archaeological complex under the church of S. Pietro in Vincoli is located on the portion of the Esquiline known in antiquity as the Fagutal (**fig. 12, 4**).[204] The remains belong to two adjacent houses (**fig. 16**), which are separated by a drop in elevation of ca. 0.5 m.[205] To the east is a third c. BCE building with ashlar walls (of Tufo Giallo della Via Tiberina), with rooms furnished with undecorated *signinum*-floors and a courtyard paved with tuff slabs. In a subsequent phase these floors were obliterated by mosaics that are associated with concrete walls having the same orientation of the previous structures, some of which were also reused. Where preserved, the facing is composed of squared blocks, but is described as a kind of *opus incertum*.[206] The plan of the neighboring house to the west has been reconstructed on the basis of decorated *signinum*-floors and tessellated mosaics. One of these is associated with a concrete wall preserved only in foundation, tentatively interpreted by the excavator as *opus incertum.*

[201]Caputo 1990-91: 254-258, following Sanguinetti 1958 for the interpretation of the building phases (note that in the preliminary report by the excavator there is no mention of the paintings).
[202]Morricone 1980: 32.
[203]Caputo 1990-91: 264-265.
[204]Morricone Matini 1971: 13; Morricone 1980: 28.
[205]Colini 1966: Plate IV.
[206]Colini 1966: 13-15, fig. 13.

Further subdivisions in *opus reticulatum* are more clearly legible.[207]

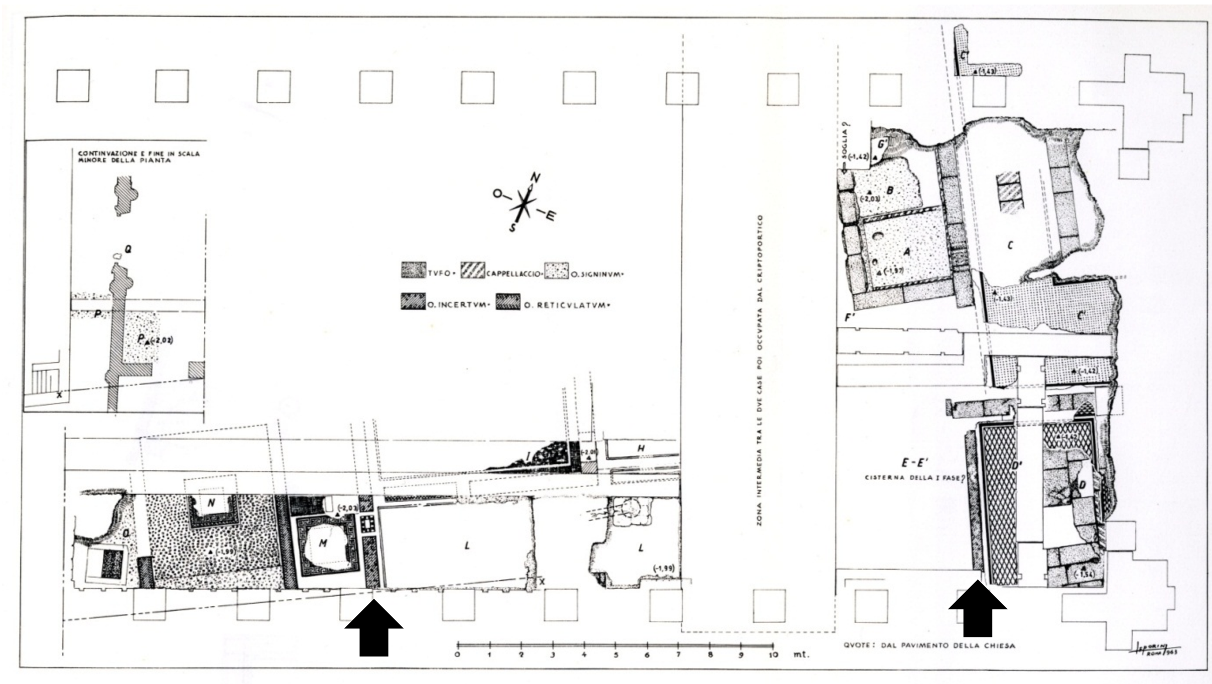

Figure 16. Rome, Oppian: remains of Republican houses at the S. Pietro in Vincoli site (the arrows indicate possible *opus incertum* walls; after Colini 1966)

3.2.5 S. Pudenziana

Extensive remains are preserved under the Basilica of S. Pudenziana (**fig. 12, 5**; **fig. 17**), on the Viminal (Vicus Patricius), but mostly date to the Imperial period.[208] A massive retaining wall in *opus incertum* (but apparently with some stretches in *opus reticulatum*)[209] is located in the west sector of the archaeological area. This wall most likely regularized the north slopes of the Viminal, supporting a terrace occupied by private buildings. In spite of the lack of direct relationships, a decorated *signinum*-floor has been assigned to this stratigraphic phase, which has been dated on stylistic grounds to the second half of the second c. BCE, following Coarelli's high

[207] Colini 1966: 15-19. See Colini's (1966: 20) cautionary remarks: "for the dating of these houses we must rely on the style of the pavements, because the walls are so badly preserved above the foundations that the structure of the facings cannot be defined with certainty."
[208] Morricone Matini 1967: 7; 1971: 13; Morricone 1980: 29-30.
[209] Angelelli 2010: 288 and 291.

chronology.[210] This floor would correspond to the earliest level of a rich house, which is almost completely obliterated by the more extensive remains of a reconstruction of the middle of the first c. BCE.[211] The diffusion of aristocratic residences on this sector of the Viminal is well documented by other contexts of the same period.[212]

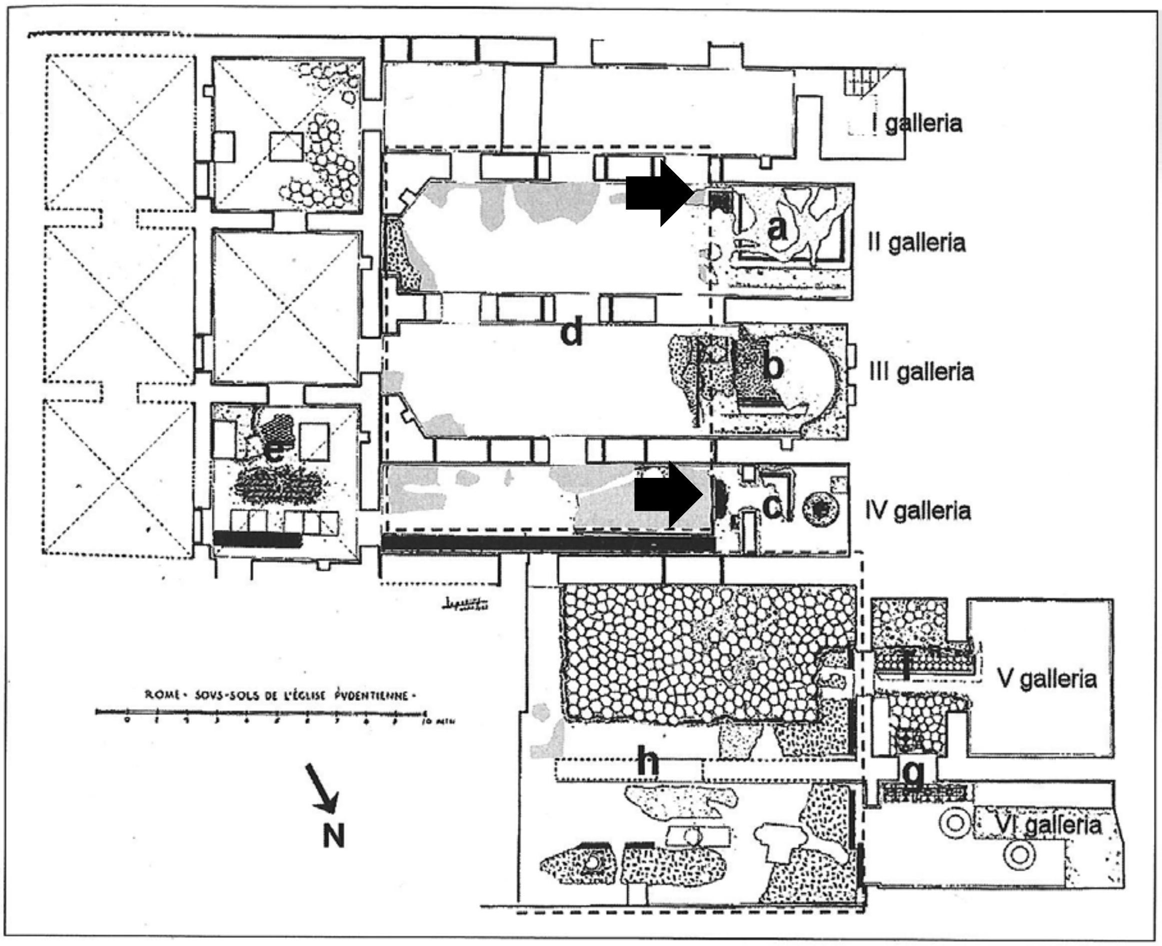

Figure 17. Rome, Viminal: remains of an *opus incertum* terracing at the S. Pudenziana site (after Angelelli 2008).

[210]Angelelli 2010: 279 footnote 5 (comparing the masonry style of the visible remains to the so-called Porticus Aemilia and to the viaduct on the west side of the Forum), and footnote 11 (dating).

[211]Angelelli 2010: 280-281.

[212]*Opus reticulatum* building on the eastern slopes of the Viminal: Ramieri 1980. Vigna de Merode: Morricone Matini 1971: 17. See also Blake 1947: 250, pl. 41, 3 and pl. 52, 3. For the general topography of the area see De Caprariis 1988: 29-39.

3.2.6 S. Sabina

Remains of concrete structures abutting on the Servian walls have been identified in the gardens of the Basilica of S. Sabina at the Aventine (**fig. 12, 6**). These poorly documented walls have been variously described as *opus incertum* or *opus quasi reticulatum*.[213]

3.2.7 S. Cecilia

Remains of a *domus* are attested under the Basilica of Santa Cecilia in Trastevere (**fig. 12, 7**).[214] The site was recently the subject of re-examination following new excavations conducted in the 1980's north of the basilica. The current understanding of the sequence identifies a first phase dated stylistically to the late second c. BCE, with structures pertaining to a house organized around an atrium of which are visible one of the walls in ashlars of Tufo Giallo della Via Tiberina and one of the four tuff columns supporting the *compluvium.* The north wall of the atrium is not in *opus incertum*, as previously thought, but in *opus reticulatum*, possibly belonging to a later restoration of the complex.[215]

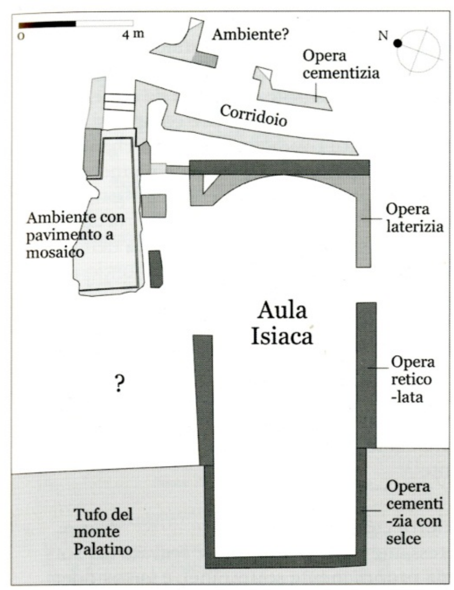

Figure 18. Rome, Palatine: state plan of the Aula Isiaca site (after Carandini *et al.* 2010).

3.2.8 The Aula Isiaca

The first phase of the so-called Aula Isiaca under the basilica of the Domus Flavia, on the Palatine (**fig. 12, 8**; **fig. 18**), features a wall built with *opus incertum* made with tuff blocks and tile fragments, uncovered behind the

[213]Morricone 1980: 31. See also Darsy 1968: 20-21, figs. 7-8.
[214]Morricone Matini 1971: 12.
[215]Parmegiani and Pronti 2004. Note however that the chronology still depends on the proposed date of the decorated floors published by Morricone Matini, which was derived from the alleged association with *opus incertum*.

later brick-faced structures that created an apse on the east (short) side of the room. This wall preserved traces of the previous decoration, which has been assigned to the early phase of the Second Style and dated stylistically to the middle of the first c. BCE.[216] The west end of the room is carved in a cut into the bedrock, which is lined with a retaining wall made of unfaced concrete containg basalt *caementa*. The long sides of the room are in *opus reticulatum*.[217]

3.2.9 Late Republican House at the Northwest Corner of the Temple of Venus and Rome

The remains are located on the south slopes of the Velia (**fig. 12, 9**; **fig. 19, a**).[218] They consist of a semi-subterranean circular room, from which four vaulted corridors depart radially. These structures are nicely appointed with glass paste mosaic floors, marble panels and wall-paintings. The first editor of the complex considered the walls as built with *opus incertum,* but in the parts that are still visible the construction technique can be best described as a kind of unfaced concrete of grey mortar and tuff *caementa*.[219] The decorations have been variously dated to the Late Republican or Augustan periods.[220]

3.2.10 Structures under Via dell'Impero (now Via dei Fori Imperiali)

These structures belong to a house occupying the south slopes of the Velia (**fig. 12, 10**; **fig. 19, b**).[221] The remains include a row of four square rooms (featuring narrow doors, undecorated-floors and ledges of *signinum*), which is connected to a circular room with niches. A symmetrical set of rooms was perhaps attested also to the south, in a sector of the house that has

[216]Vlad Borrelli 1967: 23-28, 24 fig. 11; plan in Iacopi 1997: 7, fig. 1. For the associated paintings see Iacopi 1997: 40-43; Falzone 2010: 62.
[217]Papi 1998 (51, footnote 40) wrongly connects the remains of the early decorative ensemble to the *opus reticulatum* phase.
[218]Barosso 1941; Cassatella 1985: 102-105; Morricone 1987.
[219]Morricone 1987: 69.
[220]Augustan period: Morricone 1987. Papi 1998: 49-50, footnote 31 dates the decorations to the second quarter of the first c. BCE and identifies the complex with the house of the *Domitii*. A higher date for the structures in the second c. BCE has been suggested by Fraioli (2009: 128), who accepts the association with the alleged *opus incertum.* See also Carandini *et al.* 2010: 71-74. For other *opus reticulatum* finds in the area see Panella 1985.
[221]Colini 1933, 85 fig. 8; Gatti 1985.

been completely truncated by later construction activities. These structures, built with *opus incertum*, open onto a peristyle, of which only the north half is preserved, clearly delimited by two parallel concrete foundations made with tuff *caementa*. The space between the foundations was occupied by a cistern lined with water-proof plaster, to which a conduit found

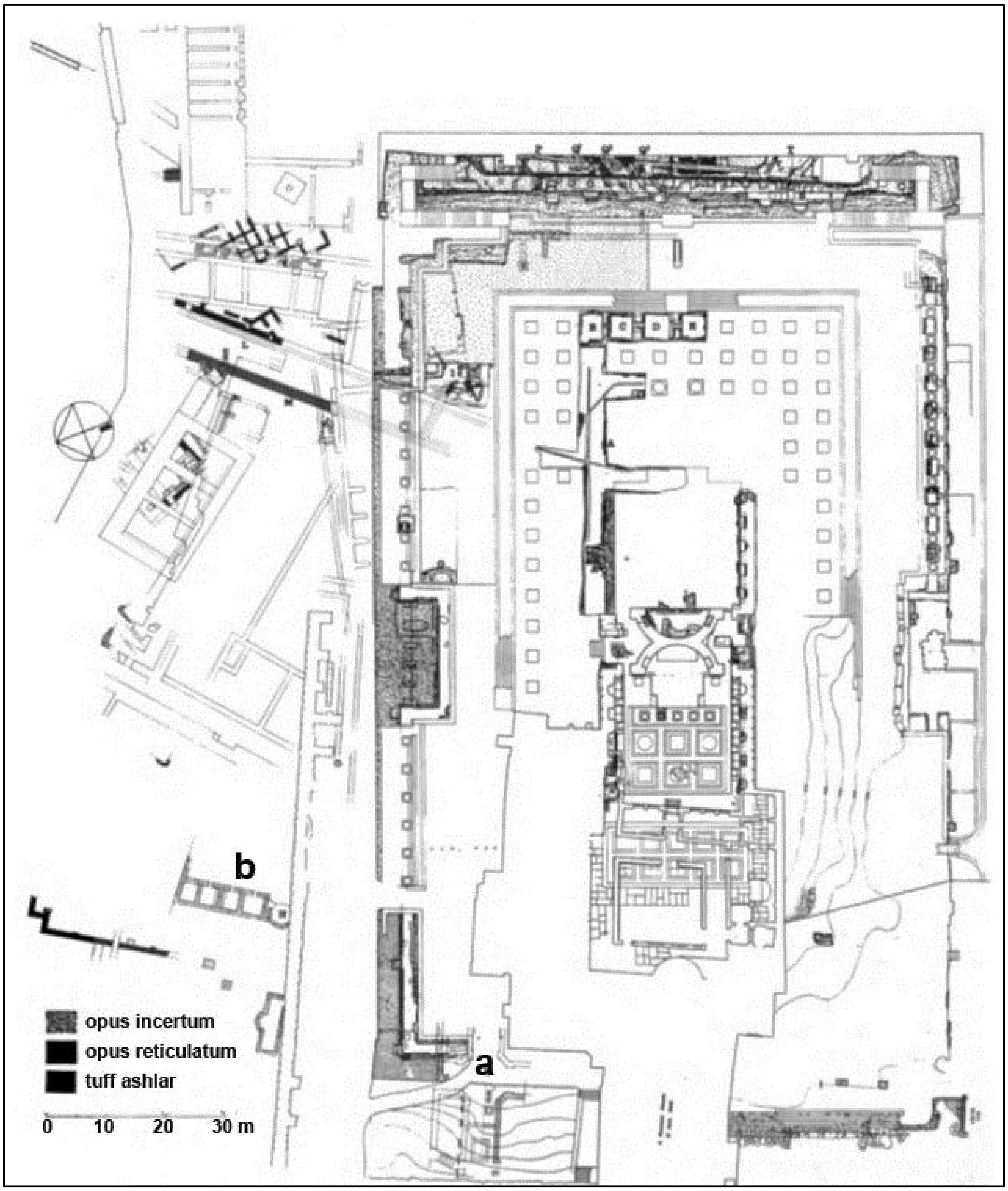

Figure 19. Rome, Velia: remains of *opus incertum* houses under the northwest corner of the Temple of Venus and Rome (a), and Via dell'Impero (b) (after Panella 1985).

in one of the square rooms led.[222] The *opus incertum* building has been interpreted as a private *balneum* belonging to an aristocratic house (perhaps that of the *gens Pompeia*, which ancient authors place on the *Carinae*),[223] and dated on the basis of the construction technique to the second or early first c. BCE.[224] It is unclear whether the concrete remains of a rectangular peristyle on a slightly different orientation farther to the north were part of the same complex.[225]

3.2.11 Via Palermo

Figure 20. Rome, Viminal: *opus incertum* terracing walls (after Lugli 1957).

The remains of a terracing wall in Via Palermo, on the north slopes of the Viminal (**fig. 12, 11**), are known from photographs only (**fig. 20**).[226] This structure presents a sequence of vaulted rooms on three superimposed levels, which create a platform perhaps occupied by a large *domus*.[227] Given the rather uniform character of the facing, Lugli assigned it to the second period of the *opus incertum* (100-50 BCE).[228]

[222]Fraioli 2009: 126-127; 128 fig. 2 n. 1-2.
[223]LTUR II: 159-160, s.v. "Domus: Pompeiorum" (V. Jolivet).
[224]Fraioli 2009: 133, footnote 3.
[225]Carandini *et al.* (2010: 52-55) argues that the *balneum* is a later addition to this peristyle, which formed the original part of the house inherited by Pompey from his father, suggesting a date to 82-81 BCE.
[226]See De Caprariis 1988: 42-44, fig. 25 (= photo Parker, n. 2078 and 2082).
[227]For the character of later houses in this sector of the hill see Rodríguez Almeida 1992 (FUR 543-570). A more detailed discussion of the finds discovered during the construction of the Ministero dell'Interno see De Caprariis 1987-88.
[228]Lugli 1957: 474.

3.2.12 Via Sistina

Remains of a private *balneum* have been preserved in the basement of a modern building in Via Sistina, in the valley between the Qurinal and Pincio (**fig. 12, 12**; **fig. 21**). These consist of at least three rooms of uncertain dimensions arranged around a circular room decorated with two semi-circular niches.[229] An *opus incertum* wall-facing is visible only for a short stretch on one of the walls of the southeast room, where it is used in combination with a technique employing tile fragments.[230] The walls are entirely covered by paintings which have been assigned to an alleged transitional phase between the First and the Second Style, and paved with mosaic floors that have been dated stylistically to the late second c. BCE.[231]

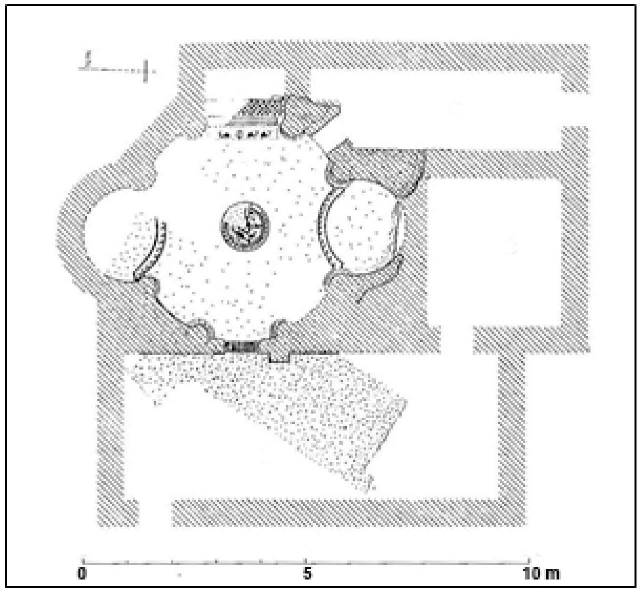

Figure 21. Rome, Via Sistina site: remains of private baths (after Papi 1999).

3.2.13 Summary of the Evidence

From this brief survey it emerges that the use of *opus incertum* in domestic architecture is securely attested only in seven or eight contexts (i.e., Tabularium site, Domus Aurea site, Via dell'Impero, S. Pudenziana, Aula Isiaca, Via Palermo, Via Sistina and perhaps S. Pietro in Vincoli), to which we may now add just two more cases (north slopes of the Palatine, House

[229]Fiorini 1988.
[230]Fiorini 1988: 53 fig. 11. Cf. Papi (1999: 710), suggesting a lower date (ca. 70 BCE).
[231]Caputo 1990-91: 265-267.

8;[232] house on the northeast slopes of the Palatine;[233] *infra*, 3.3.1-2; **fig. 12, 13-14**).

Site	***Building Techniques***	***Wall-Paintings***	***Floor Types***	***Other Dating Evidence***
Casa dei Grifi	OQ; OR	Second Style	Decorated *signinum*-floors on first level; mosaics in basement	After 111 BCE fire on Palatine
Temple of Veiovis	OQ; OI	n/a	Decorated *signinum*-floors; mosaics	Before 83 BCE fire on Capitoline
Domus Aurea	OI (?); OR	First Style	Decorated *signinum*-floors	n/a
S. Pietro in Vincoli	OQ; OI (?); OR	n/a	Undecorated *signinum*-floors; mosaics (second phase)	n/a
S. Pudenziana	OI	n/a	Decorated *signinum*-floors	n/a
S. Sabina	OI (?)	n/a	Decorated *signinum*-floors	n/a
S. Cecilia	OQ; OR	n/a	Decorated *signinum*-floors	n/a
Aula Isiaca	OI; OR; unfaced concrete	Second Style	n/a	After 111 BCE fire on Palatine
Temple of Venus and Rome	Unfaced concrete	Second Style	Mosaics (glass)	n/a
Via dell'Impero	OI	n/a	Undecorated s*ignimum*-floors	n/a
Via Palermo	OI	n/a	n/a	n/a
Via Sistina	OI	Second Style (?)	Mosaics	n/a

Table 1. Late second and early first c. BCE domestic concrete architecture in Rome (*OQ=opus quadratum; OI=opus incertum; OR=opus reticulatum*).

The common opinion is that such small numbers reflect the low visibility of the *opus incertum* building period in Rome, on the assumption that a generalized distaste for the unrefined aspect of this kind of masonry in later times in most cases encouraged radical reconstructions,[234] producing building debris that could be recycled as construction fill.[235] On a similar note, Lugli linked the transition from *opus incertum* to *opus reticulatum* with the growing demand by élites for more aesthetically pleasing structures in their urban mansions, pointing out that the earliest examples of what he described as *opus quasi reticulatum* occur in the aristocratic houses on the

[232]Gualandi and Papi 2005a: 47, fig. 30, associated with First Style paintings (Room 130).
[233]Carbonara 2006: 16-19.
[234]Blake 1947: 249-251.
[235]E.g., Villedieu 2007: 59-66 (concrete fragments with impressions of irregular *tesserae*).

Palatine, but admitted that the process of regularization of the *tesserae* may have also been influenced by economic concerns (e.g., the quantity of mortar needed to build up the facings).[236] The sporadic use of squared tuff *tesserae* can in fact be observed at the sites of the Domus Aurea, Via Palermo, S. Pietro in Vincoli, while in other cases the almost even ratio between irregularly and regularly shaped blocks in the wall-facings has led to confusions about their classification (e.g., Casa dei Grifi, S. Sabina and S. Cecilia, which could as well fit in the category of *opus reticulatum*). The problem with these views, of course, is that the unrefined character of the masonry would have been masked by the thick layer of plaster that usually covered the walls. In this regard it should also be noted that the use of regularly shaped blocks occurs also in early concrete public monuments (i.e., the ramp between the Atrium Vestae and the Lacus Iuturnae; vaulted structures on the east slopes of the Palatine; *infra*, 4.3). This seems to suggest that similar developments affected both public and private construction (most likely because private builders were involved in public contracts), and that technological change had little to do with aesthetic concerns. The fact that we have more Archaic architecture than Middle or Late Republican (at least until the latter part of the second c. BCE) suggests that it was important to maintain old buildings without significant modifications.

The absence of external dating evidence makes it difficult to reconstruct a relative sequence. *Opus incertum* retaining walls were created to regularize the slopes, and thus reclaim larger areas, for the development of élite residential neighborhoods on the Viminal (Via Palermo; S. Pudenziana, *vicus Patricius*), and on the Capitoline toward the Velabrum (Via della Consolazione). In comparison, however, *opus reticulatum* terracing structures show a much broader distribution. Major projects are documented on the Palatine at the site of the House of

[236] Lugli 1957: 487.

Augustus,[237] in the area of the sanctuary of Magna Mater and on the west flank of the hill beneath the southwest corner of the Domus Tiberiana.[238] On the Velia, massive vaulted constructions have been found on the slopes towards the valley of the Colosseum (on the alignment between Via del Tempio della Pace and S. Maria della Neve).[239] Substructures described as *opus quasi reticulatum* are attested also on the Celian, but may be related to road construction activities (Vicus Caput Africae).[240]

From the Casa dei Grifi and other élite residences on the Palatine (i.e., Boni's house southwest of the House of Livia; the houses excavated by Carettoni near the Scalae Caci), Morricone Matini isolated a homogeneous group of tessellated floors and *crustae*-pavements, which shared technological aspects and stylistic motifs (*supra*, 1.4.2).[241] When wall-decoration is preserved, and assuming that this was normally contemporaneous with floor-decoration, the recurring association is between Second Style paintings of Beyen's Ia phase and Morricone Matini's *opus quasi reticulatum.* A less regular pattern can observed in relation to Second style paintings of Beyen's phases IIa or IIb, because in some cases *opus quadratum* was still in use, although in Morricone Matini's view the association with *opus reticulatum* in the House of Livia seemed to confirm the relative sequence of wall-facing and wall-painting typologies. On the other hand, First Style paintings and *opus reticulatum* appear to be mutually exclusive. *Opus quadratum* and *opus incertum* are associated with the earliest examples of tessellated mosaics (as in the houses under the Tabularium, for which a *terminus ante quem* of 83 BCE can be reasonably assumed; *supra*, 3.2.2), and more often with decorated *signinum*-floors, which

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[237] Iacopi and Tedone 2005-06: 366 and Pl. 6. Morricone Matini 1967: 43-44.
[238] Pensabene *et al.* 2006: 538. Pensabene 2007: 337-339. For remains of houses abutting these terracing walls see Pensabene *et al.* 2006: Pl. A, q; fig. 17 Room B5; Pensabene 1995; see also Krause *et al.* 1998: 27.
[239] Colini 1933: 81-82; Gatti 1985: 317, fig. 13c and 319, fig. 14b; Panella 1985: 106-109.
[240] Pavolini 1987: 667-660 (buidling B, wall 4); Pavolini 1988.
[241] See especially Morricone Matini 1967: 3-9.

however display a great variety of type.[242] Based on the association with the building techniques, Morricone Matini dated the spread of these decorative ensembles to around 100 BCE, taking the alleged fixed point provided by the paintings of the Casa dei Grifi (90-80 BCE) as a *terminus ante quem*.[243]

The evidence on the beginnings of *opus reticulatum* in domestic architecture is also rare, although the monuments we know can be studied at a much higher level of resolution. We are particularly well informed on the development of the Palatine, thanks to a number of literary accounts that vividly portray the intense élite competition for real estate property in this area of the city.[244] Royo (1999) lists twenty-eight house plots known to have been the object of successive transactions (including inheritance, confiscation, sale or rental) between 200/150 and 36 BCE.[245] Only in two cases are the new owners explicitly recorded as *ex novo* builders: Cn. Octavius, who built a house some time before his election to the consulate in 165 BCE, and M. Livius Drusus in 91 BCE.[246] Five cases are known for the last quarter of the second c. BCE, but there are no useful indications in the sources about construction activities, with the exception of the porticus that Q. Lutatius Catulus built in 100 BCE over the house of M. Fulvius Flaccus, which had laid in ruins for two decades after the murder of its owner.[247] Alterations in the plan were likely to happen when different properties were reunited under a single owner, as is attested for the later period in the houses on the north slopes of the hill (cf. *infra*, 3.3.1).

Twenty-three late Republican contexts with structural remains are archaeologically

[242] Morricone Matini 1971: 24-33.
[243] Morricone Matini 1971: 36-37.
[244] See especially Carandini 1986; Royo 1987; Royo 1999; Carandini *et al.* 2010: 78-225. More generally Guilhembet and Royo 2008: 196-209; Coarelli 2012: 112-126, 287-346.
[245] Royo 1999: 72-75, though in at least four cases the topology is uncertain or problematic: *domus* of C. Licinius Macer Calvus (LTUR II: 129); Q. Marcius Rex (LTUR II: 83-84); M. Claudius Marcellus (LTUR II: 93); T. Annius Milo (LTUR II: 32-33).
[246] On these houses see Coarelli 1989: 183-184.
[247] LTUR II: 105, s.v. “Domus: M. Fulvius Flaccus” (E. Papi).

known on the Palatine**,** nineteen of which have an *opus reticulatum* phase dating to the middle of the first c. BCE **(Table 2)**.[248]

Building Technique	***Number of Houses***	***Chronology***
Opus quadratum only	4	Second and first c. BCE
Opus incertum with previous phase in opus quadratum	2	Middle of the second c. BCE or later
Opus incertum only	1	After 111 BCE
Opus reticulatum only	4	After 111 BCE
Opus reticulatum with previous phase in opus quadratum	19	Middle of the first c. BCE
TOTAL	30	

Table 2. Rome, Palatine: distribution of building techniques in Late Republican domestic contexts with known structural remains.

Only eleven houses for which we have structural remains can be said with certainty to predate this period. Four of these have a single phase in ashlar masonry (house under S. Anastasia;[249] remains of a building excavated by Boni under the north peristyle of the House of Augustus;[250] house under the south front of the Domus Augustana;[251] retaining wall of Tufo Giallo della Via Tiberina at the site of the Vigna Barberini),[252] three preserve traces of a phase in *opus incertum* (north slopes of the Palatine, House 8; and northeast slopes of the Palatine, Area I house, both with *opus quadratum* precedents; Aula Isiaca), while only four have an *ex novo* phase in *opus reticulatum* dating to the late second or early first c. BCE (Casa dei Grifi; so-called House of Livia;[253] house to the southwest of the so-called House of Livia;[254] house under the

[248]List in Papi 1998: 50-52, to which we should add Houses 5-8 of Carandini's excavation and the house in Area I of Panella's dig on the northeast slopes of the Palatine. The mid-first c. BCE dates are mostly based on stylistic grounds (wall-paintings and mosaics).
[249]Lugli 1946: 613.
[250]Morricone Matini 1967: 33-38. Morricone 1980: 22, n. 4
[251]Morricone Matini 1967: 10-13.
[252]Broise and Thebert 1998: 487 (dated archaeologically to the second c. BCE).
[253]According to the reconstruction in Carandini *et al.* 2010: 120-125.
[254]Carettoni 1956-57; 1967. To the southeast of the main trench, Carettoni uncovered other walls in *opus reticulatum* and *opus quadratum*, but it was not clear if these belonged to the same complex (Carettoni 1967: 297; 290 fig. 3 m1, m2). Carandini *et al.* 2010: 125-128.

lower peristyle of the Domus Augustana).[255] In the case of the Aula Isiaca, however, *opus incertum*, *opus reticulatum* and unfaced concrete seem to have been used simultaneously.

The relative scarcity of house construction activities during most of the second c. BCE may lead one to believe that the owners of the old mansions occupying the hilltop did not feel the need to update the architecture, which was still of secondary importance in comparison to a location that granted proximity to the political core and to famous monuments connected with the origins of the city. Space seems to have been completely taken up by extant buildings. Because of the high density of habitations, when new construction picked up again (after the fire of 111 BCE?) in the few plots that had remained unoccupied, the builders could only expand by digging deeper into the tuff bedrock. The solution was to obtain semi-subterranean floors (*bases*), whose concrete vaults could in turn support one or two floors above ground level (i.e., Casa dei Grifi; house to the southwest of the so-called house of Livia; first phase of the so-called House of Livia; in the Casa dei Grifi the largest vault spans ca. 4.50 m). New house models centered on a peristyle started to spread in Rome only in the first c. BCE.[256] It is interesting to note that when there was not enough room for a quadriporticus, a common solution was to dig down below the ground level (up to 6 or 7 m, as is the case for the second phase of the so-called House of Livia), exposing the foundations of previous walls (which if kept visible would now receive a facing: e.g., Carandini's House 9),[257] thus creating entirely subterranean quarters.

The change was less dramatic with relation to building techniques, because the use of *opus quadratum* in the free-standing parts remained extensive throughout the period, particularly

[255] Morricone Matini 1967: 14-15. Morricone (1971:16) suggests that the context may be part of the *opus quadratum* building found under the south front of the Domus Augustana.
[256] Papi 1998: 54-56. Sporadic late second c. BCE examples are attested at Vulci (Casa del Criptoportico) and Alba Fucens (so-called "villa urbana"). See Gros 2001: 58-60. In Rome, the earliest example seems to be that of Via dell'Impero (*supra*).
[257] Medri 2005: 70 (House 9, Activity 300).

for façades and boundary walls (e.g., Casa dei Grifi; so-called House of Livia;[258] Republican phase of the House of Augustus,[259] Atrium Vestae[260]). This pattern perhaps betrays an attempt to maintain for the exterior of the newly built houses a flavor of antiquity and monumentality.

3.3 Recent Stratigraphic Investigations of Concrete Construction on the Palatine

3.3.1 Palatium et Sacra Via

While confirming the extent and impact of first c. BCE architectural developments in élite urban housing, the recently published results of a large scale research project carried out by Carandini and his team on the north slopes of the Palatine provide a detailed picture of building practice in the preceding period.[261] Between 1985 and 1990, extensive stratigraphic excavations were conducted in the area delimited by the Via Sacra to the north, the so-called Clivus Palatinus to the east, an east-west road leading from the Clivus Palatinus to the so-called Scalae Graecae (by some identified with the Nova Via mentioned in historical texts),[262] and a north-south alley to the west, which separates this sector of the Palatine from a neighboring block occupied by public buildings (Carettoni's Domus Publica, the Atrium Vestae and the Sanctuary of Vesta). These roads define a quite regular city-block, which adapted to the morphology of the Palatine, sloping from south to north, and from east to west.[263] This block was found to be occupied by a series of concrete foundations on different terraces built on top of razed *opus quadratum* remains dating to the the Archaic, Early and Middle Republican periods (a compound that the excavators

[258] Carettoni 1953; 1957; Carandini *et al.* 2010: 120-125.
[259] Carandini *et al.* 2010: 189-198 (date 90-60 BCE).
[260] Arvanitis *et al.* 2010: 49-53 (Phases 10-12).
[261] Carandini and Papi 2005.
[262] Carandini 2005: 8, fig. 6. Cf. Carandini *et al*. 2010: 98 and 102, fig. 43 (the road in question is interpreted as a *vicus*, while the toponym *Nova Via* is connected with a minor alley between the Atrium Vestae and the Lucus Vestae). For other identifications see Hurst and Cirone 2003: 23, fig. 4.
[263] The city-block measures approximately 7000 m^2. The Via Sacra at the junction with the so-called Clivus Palatinus sits at 25.70 m a.s.l., while its elevation at the west limit of the block drops at 21.30 m.

divide in separate houses, Houses 1-4).[264] It has been estimated that a maximum of eight property plots may have occupied the block in this phase, though the reconstruction is based on fragmentary evidence (**fig. 22**).

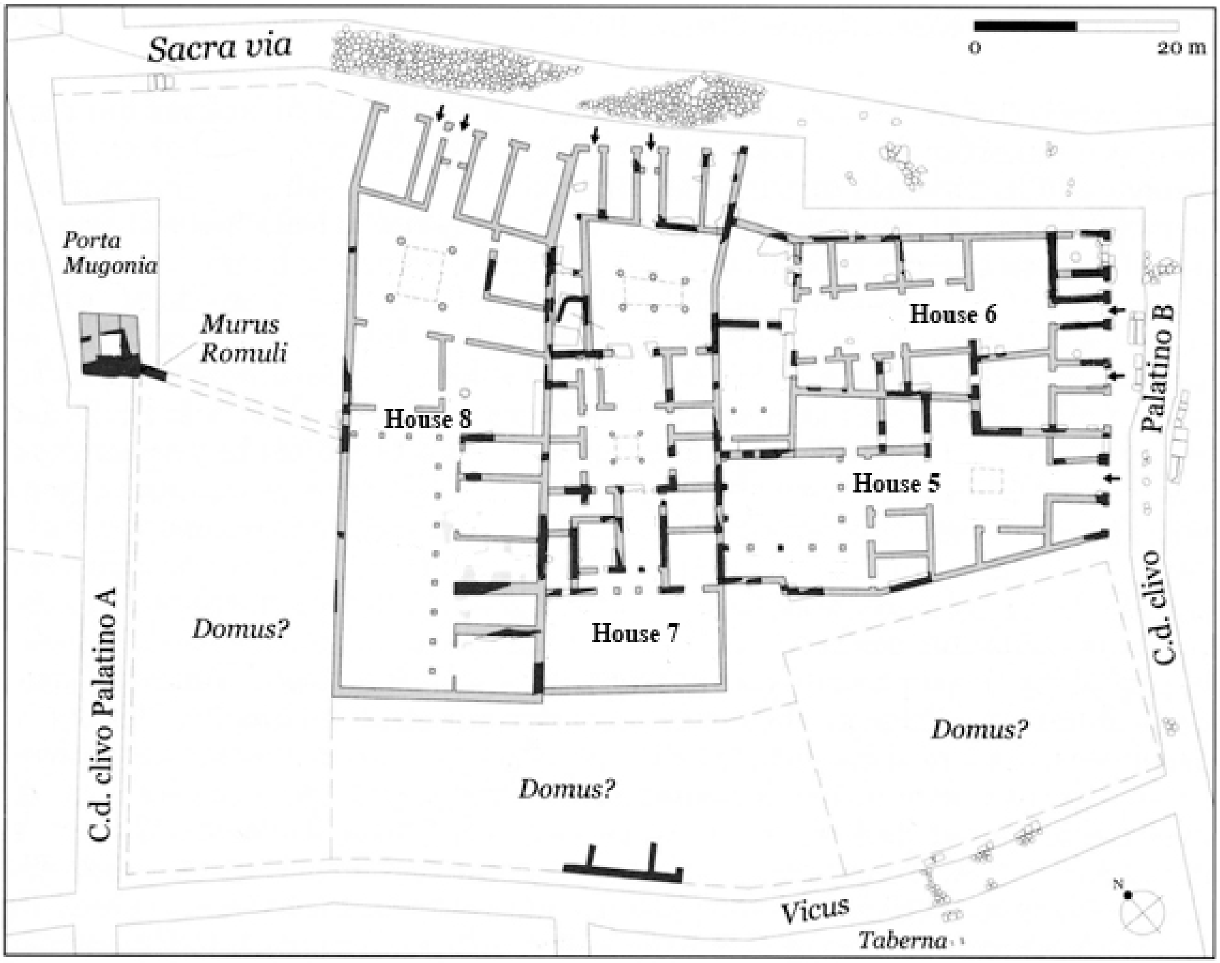

Figure 22. Rome, north slopes of the Palatine: property divisions (after Carandini *et al.* 2010). The actual remains are indicated with solid line.

According to the excavators, the remains belong to four houses with access from the Via Sacra and the Clivus Palatinus (Houses 5-8). Various finds suggest that at least two other units (one of which is known only in its first c. BCE occupation) faced on the *vicus* to the south.[265] No structures dating to this period have been preserved in the west side of the blocks, where there

[264]For the Archaic complex see Carandini and Carafa 2000: Phase 9 Att. 23.
[265]Santangeli Valenzani and Volpe 1986. See also Carandini *et al.* 2010: 110-111 and 108, fig. 46 n. 52.

seems to be enough space for two more properties.

Property boundaries have been tentatively identified on the basis of plan features and changes in elevation, but the poor preservation of structures in the east sector of the block poses serious problems in the definition of individual houses. According to the restored plan, Houses 5 and 6 would maintain size and proportions of their archaic precedents (Houses 1 and 2), and stretches of earlier party-walls were repurposed to support the new foundations (e.g., the southwest corner of House 5).[266] In the west sector lie Houses 7 and 8. These would be slightly bigger than their precedents, but much more elongated in shape.[267] The party-wall separating House 7 and 8 would respect the previous boundary between Houses 3 and 4.[268] This evidence suggests that, in spite of the generalized reconstruction of the city-block, the previous system of land division was not altered radically, but it is difficult to say whether there was continuity in ownership patterns.

The first c. BCE redevelopment of the block hampers on the overall legibility of the internal organization of the house. The construction of semi-subterranean quarters in the area previously occupied by Houses 5 and 6 (i.e. House 9),[269]as well as in House 8,[270] has determined the disappearance of most of the internal subdivisions and of almost all floor surfaces. The best preserved plan is that of House 7, which can be confidently said to have had two atria separated by an axial *tablinum*. The internal organization centered on two atria, with the bigger one without cistern, finds a comparison in late second c. BCE examples such as the Casa del Criptoportico at

[266]Gualandi and Papi 2005a: 23. Houses 5 and 6 would both measure on average 17 x 40 m (680 m^2).
[267]Gualandi and Papi 2005a: 36. Houses 7 and 8 would both measure 17 x 52 m, with a surface area of 884 m^2 as opposed to 805 m^2 in the previous phase). This change in proportions reflects an expansion of the occupation area both north and south of the limits of the previous buildings (Houses 3 and 4), due to the more northerly course given to the Via Sacra, which was rebuilt in this phase; see Gualandi and Papi 2005a: 17-18, Phase 10 Att. 202. Most of the area gained on the front of the house plots facing on the Via Sacra was occupied by *tabernae*.
[268]Carandini 2005: 7, fig. 5.
[269]Medri 2005: 70 (Phase 12, Att. 300).
[270]Gualandi and Papi 2005b: 112-117.

Vulci.[271]

The excavators reconstruct a relative sequence in the development of the block: building activities would have begun in House 6, continued in House 5 and House 8 and ended with House 7, whose internal walls abut both the west boundary of House 6 and the wall delimiting House 8 to the east. A later sub-phase would be documented by minor modifications involving Houses 5, 6 and 7.

The construction process started with the systematic demolition of the ashlar houses. These were razed to a uniform level across the new block; a sequence of construction fills was dumped to regularize the undulating topography.[272] Foundation trenches up to a few meters deep were then dug through these deposits, with no evidence of shutterings being used.[273] When new foundations for load-bearing structures had to be built on the same alignment of previous walls, these were usually demolished down to a deeper level, suggesting that the use of concrete was deemed structurally superior.[274]

Further indications about the construction phases come from the typological study of the concrete foundations.[275] Based on the macroscopic properties of the mortars (color, compaction and granulometry), the provenance of the aggregates, their relative proportion in the concrete, and the method of construction of the foundations, fifteen types have been identified. Six types (concrete types 1-4, 7 and 10) are exclusively found in occupation levels that according to the

[271]As correctly pointed out by Gualandi and Papi 2005a: 42, footnote 118.

[272]The elevation is between 23.30 and 23.50 m a.s.l. The construction fills have been observed in occasional sections in House 8 and excavated, but only partially, in House 7. See Gualandi and Papi 2005a: 39 (SU 4129=4399).

[273]Gualandi and Papi 2005a: 41.

[274]The excavators suggest that in such cases the ashlars were dismantled only after the construction fill had been dumped against them. This would be demonstrated by the re-deposition of thin lenses of the same fill on top of the ashlar foundation.

[275]Misiani 2005: 179-186. Reference is made to a series of lab tests conducted on samples of mortar, including microscopic analysis of thin sections, thermal analysis and calcimetric measurements (2005: 180), but raw data and results have not been published in any detail.

excavators predate the first c. BCE (cf. **Tables 3-4**).[276] Types 1 and 2 contain a great proportion of Cappellaccio *caementa* (50% or more) and only a small fraction of different varieties of Tufo Lionato (Anio; Monteverde; Capitoline) and Tufo Giallo della Via Tiberina aggregates. Following a technique that seems to characterize also early vaulting construction, these are placed by hand in roughly horizontal layers, interspersed with a dark gray mortar containing coarse pozzolana (up to 5 mm in diameter) and a relatively small quantity of lime (mortar type 1). These types are evenly distributed across the four houses.

On the contrary Type 3, which is characterized by the predominant use of Tufo Lionato *caementa* and includes sporadic tile, amphorae and travertine fragments, is attested only in Houses 5 and 6, in association with a different type of mortar, light gray and containing finer pozzolana (mortar type 2). The chaotic disposition of the *caementa* has led the excavators to believe that mortar and aggregates were pre-mixed and poured directly in the foundation trench. Type 4 resembles type 3 in composition. Significantly, it is found in association with an *opus reticulatum* phase possibly connected with the merging of House 5 and 6 into a single property.[277] This construction phase is also characterized by the use of Types 7 and 10, both showing a predominance of Tufo Giallo della Via Tiberina aggregates (over 50%) and small fractions of Tufo Lionato and Cappellaccio, with a grey mortar including a higher proportion of lime (mortar types 4 and 6).

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[276] Misiani 2005: 182-186. Concrete of Type 2 and 10 has been detected in two foundations that belong to much later construction periods (respectively Phase 15, second half of the first c. BCE: House 9, SU 4853; and Phase 16, first c. CE: House 9, SU 1036). Type 6 is found only in a foundation that is partly faced with *opus incertum* (SU 2533), but there is no information on its stratigraphical position.

[277] The excavators date this transformation ("House 5+6") towards the end of the second c. BCE. See Gualandi 2005: 55-60. According to the proposed reconstruction, House 5+6 would be more radically altered in a later *opus reticulatum* phase ("House 9"), but the evidence is dubious. Some of the foundations assigned to House 5+6 may contain Pozzolana Rossa (mortar types 11 and 14), but exploitation of this material seems to have picked up only in the second half of the first c. BCE (Jackson *et al.* 2007). Concrete type 5 is also used in structures dating to the final phase of the complex, in the first c. CE (Misiani 2005:188). For a different interpretation of House 9 see Lugli 1947: 139-150 (*caupona*), followed by Tomei 1995.

Type 10 concrete seems to be used exclusively in House 7, although the recycling of *opus reticulatum* and other square facing blocks as aggregates suggests that the first modifications in this house may have occurred later in the first c. BCE.[278]

Type 5 is characterized by very similar properties (Tufo Giallo della Via Tiberina *caementa*; mortar type 6), but its distribution seems much less uniform. This type occurs in Houses 5 and 6, though only in the alleged late second c. BCE occupation. Type 5 is attested also in the first concrete phase of House 8, where it is employed in foundations as well as in the cores of the few surviving elevations (these are faced with a kind of *opus incertum* made of square blocks of Tufo Giallo della Via Tiberina).[279] However, the same concrete type was used for the radical reconstruction of the house around the middle of the first c. BCE. This activity caused the complete obliteration of the previous structures.[280]

Mortar Type	***Color***	***Composition***	***Compaction***
Type 1	Dark gray	Coarse pozzolana (up to 5 mm); small proportion of lime	Friable
Type 2	Light to dark gray	Finer pozzolana; small proportion of lime	Friable
Type 4	Gray	Pozzolana; tuff fragments; high lime content	Hard
Type 6	Gray	Gray to reddish Pozzolana; high lime content	Hard

Table 3. Mortar types identified in the earliest phase of the concrete houses on the north slopes of the Palatine (after Misiani 2005).

The excavators suggest that variability in the composition of concrete types does not provide a useful chronological indicator, in the sense that the distribution of the same types across different houses and of different types even within the same house can only be explained

[278]Gualandi (2005: 60-61) cautiously remarks that this phase can only be dated in relative terms, between the construction of the house (Phase 10) and the transformations of the middle of the first c. BCE (Phase 13). Cf. also the date suggested by Misiani 2005: 186 (third quarter of the first c. BCE).

[279]Gualandi and Papi 2005a: 45-46. The elevations are preserved only for a maximum height of 20 cm. Only the eastern boundary wall (SU 1267) and one of the internal subdivisions (SU 2827) appear faced with irregular chunks of cappellaccio, but the former is composed of Type 1 concrete. Two other elevations (SU 2042 and SU 2043) have a facing made of small blocks of Cappellaccio and Tufo Lionato.

[280]Gualandi and Papi 2005b: 112-117 (Phase 13).

with relation to the organization of the building site. On the assumption that each type should correspond to the recipe known and used by a particular group of builders, the pattern has been interpreted as evidence of multiple groups moving from house to house, according to the sequence suggested by the stratigraphic relationships between the houses. The concentration of Type 3 concrete in House 5 and 6, on the other hand, has been taken as an indication that construction of these houses progressed almost in parallel.[281]

Concrete Type	***Mortar Type***	***Aggregate***	***Distribution***
Type 1	Type 1	Cappellaccio	House 5; House 7; House 8
Type 2	Type 1	Cappellaccio (>50%); Tufo Lionato; Tufo Giallo della Via Tiberina	House 5; House 6; House 7
Type 3	Type 2	Tufo Lionato (>50%); Tufo Giallo della Via Tiberina; Cappellaccio	House 5; House 6
Type 4	Type 2	Mixed tuff fragments (>50%); rare tile, travertine and basalt fragments	Houses 5 and 6 (second phase)
Type 5	Type 6	Tufo Giallo della Via Tiberina (>50%); Tufo Lionato; Cappellaccio	House 8; House 5 and 6 (second phase)
Type 7	Type 6	Tufo Giallo della Via Tiberina (>50%); other tuffs	Houses 5 and 6 (second phase)
Type 10	Types 4 and 6	*Tesserae* and oblong blocks of Tufo Giallo della Via Tiberina; basalt; rare travertine and other tuffs	House 7

Table 4. Rome, north slopes of the Palatine: composition and distribution of concrete types in Houses 5-8 (after Misiani 2005).

Provenance of the *caementa* seems to indicate that these were not quarried on purpose, but most likely obtained from the destruction of the archaic structures, which were in fact built with ashlars of Cappellaccio and, in minor quantity, of Tufo Giallo della Via Tiberina (this was employed in fourth c. BCE restorations).[282] When Cappellaccio aggregates are predominant (Types 1 and 2), it is always in combination with a mortar of poorer quality (mortar type 1). On the other hand, Tufo Giallo della Via Tiberina *caementa* occur in greater quantity with mortars of

[281]Gualandi and Papi 2005a: 20.
[282]Carandini and Carafa 2000 (Phase 9).

improved composition (mortar type 6). Aggregates of Tufo Lionato, a material which was extensively exploited for cut-stone construction of the Republican period, are far less frequent, but increase noticeably when used in combination with mortars of better quality (mortar type 2) than that found in Types 1 and 2 concrete (mortar type 1, more friable). It is worth noting that mortar type 2 occurs only in Houses 5 and 6, in foundations located along the irregular boundary between the two houses (Type 3 concrete), as well as in structures that have been assigned to a later phase (Type 4 concrete). Because Type 3 concrete is not used elsewhere in the first phase of Houses 5 and 6, I suggest that mortar type 2 structures indicate successive modifications of the original buildings.[283]

In the absence of stratigraphic data (all the occupation deposits in Houses 5 and 6 were destroyed when House 9 was built on top), improvements in mortar composition that betray a steady development of the technique (e.g., finer pozzolana; higher lime content) may be taken as significant chronological indicators, as rightly noted by Misiani. [284] In the case of House 8 (**fig. 23**), then, while the east and west boundary walls have foundations built with the type of concrete associated with the first phase of Houses 5 and 6 (Type 1), the use of mortar type 6 in the series of small rooms (*cubicula*) adjacent to the east limit should be interpreted as evidence of later modifications in the internal organization of the house.

[283]Type 1 mortar has been found in two foundations that have been assigned to the later occupation of House 5: SU 737 and SU 147 (Gualandi 2005: Phase 11, activities 220 and 207). SU 147, however, supports a wall faced with *opus reticulatum* (SU 112) and built with concrete of better quality (Type 7). This discrepancy may indicate that the foundation belongs to the first phase of the house, being perfectly on axis with other structures of the early type, thus identifying the west limit of the supposed *tablinum*. On the other hand, SU 112 would belong to a restoration of this part of the house, which is also attested by the foundation SU 299 and elevation SU 292, both made with the same type of concrete (Type 7). Three other foundations were found on the exact same alignment farther north in the area of House 6 (SU 1022, 2316 and 8139) and assigned to this phase (Gualandi 2005: Phase 11, activity 222), but they are perhaps even later, because they possibly include Pozzolane Rosse (Type 14 concrete).

[284]Cf. Misiani 2005: 181-182. Changes in major and especially minor elemental homogeneity in mortars can be used in combination with stratigraphical evidence to confirm archaeological phasing. E.g.: Donais e*t al.* 2010.

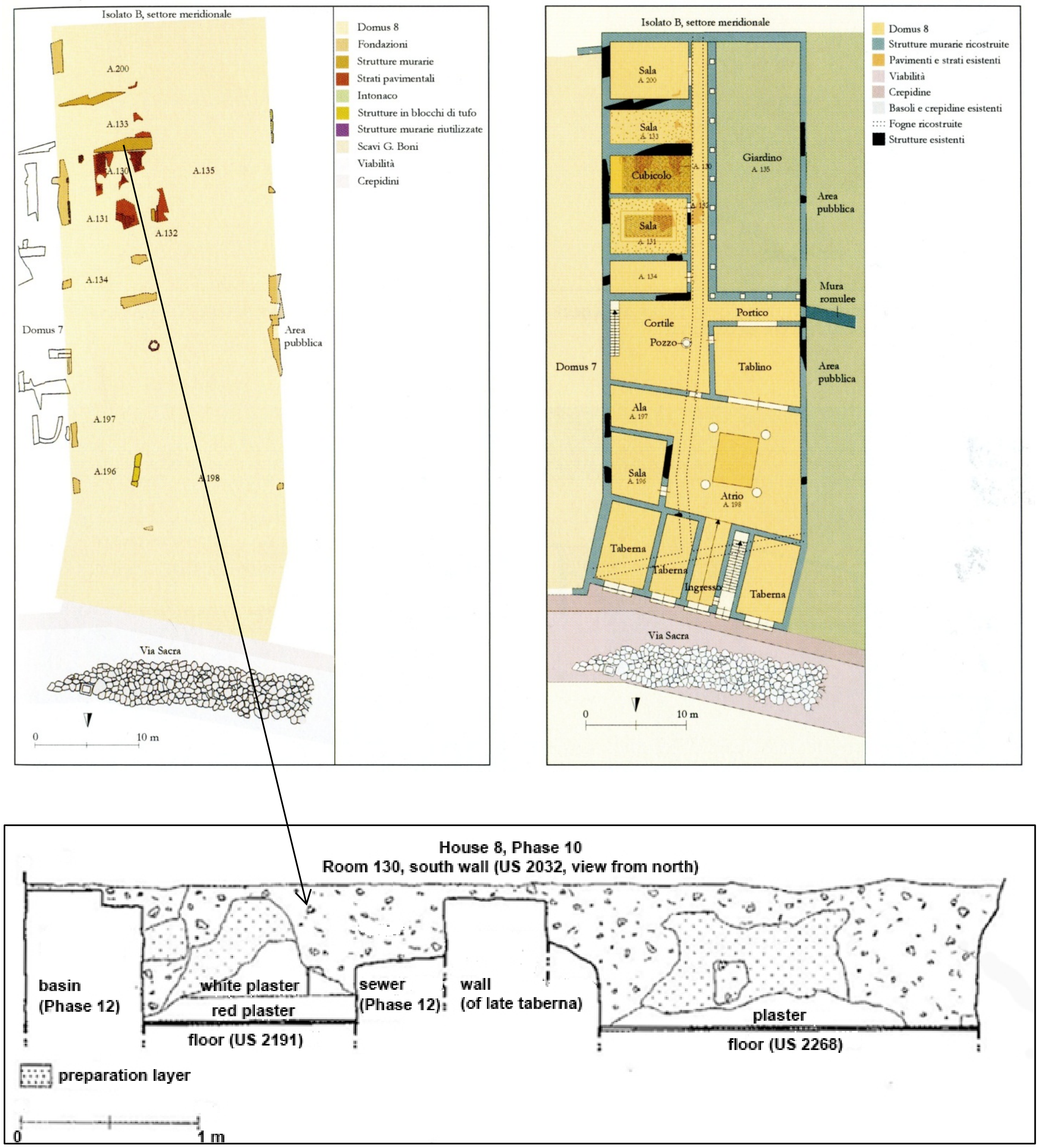

Figure 23. Rome, north slopes of the Palatine, House 8: state plan (top left), restored plan (top right), and elevation drawing of possible remains of First Style decoration in Room 130 (after Carandini and Papi 2005).

This is in contrast with the opinion of the excavators, who assign all these walls to the original phase of the concrete house.[285] Decorated *signinum*-floors have been exceptionally preserved in these rooms.[286] In one of the *cubicula,* fragments of First Style decoration were also discovered, covering an unfaced concrete wall (unfortunately no information is available on the physical characteristics of the mortar).[287]

This later construction stage in House 8 represents the only attestation of *opus incertum* in the entire city-block (and obviously the only association of *opus incertum*, decorated floors and First Style paintings). The idea of the excavators is that this technique was extensively adopted in the interior of the houses, reserving the more traditional *opus quadratum* for the exterior.[288] Surviving elevations in the rest of House 8, including the *tabernae* on the *Sacra Via*, the west boundary wall, and at least one of the internal subdivisions[289] are in Tufo Lionato ashlars. While they suggest that the Cappellaccio ashlars of the previous house were almost entirely recycled as aggregate in the foundations, the excavators do not specify whether the Tufo Lionato blocks were spolia.[290] Both Tufo Lionato and Cappellaccio blocks were used for load-bearing walls of House 6 (on the west and southwest sides), while earlier Cappellaccio walls were maintained for internal subdivision in the front and back of the house.[291] The party-wall

[285]One would expect the use of a stronger and more durable mortar in load-bearing walls if both kinds of mortar were attested in the same phase.

[286]Papi 1995: 343-346; Gualandi and Papi 2005a: 46-51.

[287]SU 3202; Gualandi and Papi 2005a: 47, fig. 30 (Room 130). The surviving decoration shows a red band, above which is a white ground possibly divided in stretchers by vertical red lines (only one is actually preserved). The absence of elements in relief would suggest a late date in the development of the First Style, but the evidence is too meager to provide a secure chronology. The continuous red band at the base is a common feature (e.g., Fregellae, Sanctuary of Aesculapius; see Caputo 1990-91: 220-221), though this is not as tall as in other known examples.

[288]Papi 2005: 200-201.

[289]Gualandi and Papi 2005a: 46, room 197 SU 1991.

[290]Gualandi and Papi 2005a: 45. Tufo Lionato was used extensively in the Republican period for cut-stone construction. It was first obtained from quarries in the city (Capitoline), as well as west and south of Rome (Monteverde; San Saba; Fosse Ardeatine). Quarries for this building material were created in the second c. BCE along the Aniene River (Tufo of the Anio). In this case, the lack of details in the published data does not allow for the determination of the provenance. For the geologic and petrographic characterization of the different varieties of Tufo Lionato see Jackson and Marra 2006: 420.

[291]Gualandi and Papi 2005a: 30

separating Houses 5 from House 6 is made of Tufo Giallo della Via Tiberina ashlars, further suggesting that this part of the house was built in a quite different fashion at a later stage.[292] Earlier Cappellaccio walls were maintained also in House 7 behind the smaller atrium, while tuff ashlars associated with concrete foundations were used for internal subdivision on the northwest side of the larger court. Finally, negative impressions of blocks have been detected on the top surface of the foundation that separates the central part of the house from the *tabernae*.[293] The architectural evidence, therefore, shows that both *opus quadratum* and *opus incertum* were used in the interior of the houses.

While the relative sequence of building phases within each house is open to alternative reconstructions, the dating is much more problematic. Although the claim is that concrete remains (and, in the case of House 8, associated floors) have been dated stratigraphically,[294] the dates proposed by the excavators for the initial construction of the four houses (late third/early second c. BCE) has been essentially derived from a partial reading of literary sources. Limited remains of beaten earth-floors which were in use from the fifth through the third c. BCE have been found in Houses 3 and 4, truncated by the foundation trenches of Houses 7 and 8.[295] This sequence of floors provides only a *terminus post quem*, because the demolition of most parts of the archaic houses up to the level of the foundations most likely caused the razing of successive surfaces. Decorated floors and First Style paintings found in one of the concrete houses (House 8) are not likely to predate the end of the second quarter of the second c. BCE and may even belong to a late renovation completed in the latter part of that century. Construction fills

[292]In the neighboring city-block, ashlars of Tufo Giallo della Via Tiberina are extensively used throughout the second c. BCE phases of occupation of the sanctuary of Vesta (Arvanitis *et al.* 2010: 48-51) and in the so-called Domus Publica excavated by Carettoni (1978-80: 346-355) in both foundations and elevations.
[293]Gualandi and Papi 2005a: 39.
[294]Papi 1995: 339.
[295]Papi 1995:338-339.

contemporary with the first phase of the concrete buildings have been excavated only in House 7.[296] This deposit contained frequent building debris coming from the destruction of the archaic structures (chunks of Cappellaccio; fragments of tiles), as well as an unknown quantity of black-gloss pottery fragments. The types are unspecified, but according to the excavators suggest a second c. BCE dating of the house; it would seem the assemblage was not sufficiently diagnostic to assign a more precise date.[297] It should also be considered that construction fills normally include a higher proportion of residual finds. In any case, the extremely limited size of the sample (just one stratigraphic unit) hinders the reliability of the dating evidence. For the same reason, it is perhaps too optimistic to conclude, from the single fragment of basalt collected in the same layer, that the construction of the houses in the city-block (and House 7 would also be the last one) "unequivocally" progressed in connection with the building of the new course of the Via Sacra (i.e., on the assumption that this was paved with basalt slabs). The northerly expansion of Houses 7 and 8 only demonstrate that the redevelopment of the city-block happened after this episode.[298]

What is known of the stratigraphy of the Via Sacra suggests that the basalt pavement associated with the occupation of the houses is consistent with the reorganization of the Forum of the Augustan period. The slopes along the line of the road was much less steep than in the early period only in the lower stretch of the road, due to the gradual infill of the Forum valley below. In the upper course the general elevation differed little from the previous period. In connection with the raising of the general level of the district, the earlier sewer below the Via Sacra (a stretch of which, in Tufo Lionato slabs, has been found between the Temple of

[296] Gualandi and Papi 2005a: 39 (SU 4129=4399).

[297] Perhaps the assemblage included Campana B or B-oid (third c. BCE productions such as the Roman "Gruppo dei Piccoli Stampigli" are usually easily recognizable). See Ferrandes 2006; Ferrandes 2008; Stanco 2009.

[298] Destructions on the north side of the archaic Via Sacra so as to create space for the new road seem limited, and in any case do not prove that the block was completely obliterated at this time. Gualandi and Papi 2005a: 17.

Antoninus and Faustina and that of Romulus) was restored in concrete faced with *opus reticulatum.* Standing architectural remains of buildings lining the north side of the road across from Houses 5-8 do not seem to predate the early first c. BCE.[299]

In sum, stratigraphic evidence alone places the construction of the houses between the third c. BCE (i.e., the latest occupation of the archaic buildings, as documented by the repairs of floor surfaces) and the first half of the first c. BCE (as indicated also by the partial destruction of House 8 and the construction of House 9). Given the scale of planning involved in the reorganization of one of the main urban thoroughfares and the impact of building activities carried out at the city-block level, the excavators connect the first phase of the concrete houses with one of the catastrophic episodes recorded by textual sources for this period, which would only have justified (or provided the opportunity for) such a radical transformation: the fire of 210 BCE (Livy 26.27).[300]

Already Van Deman considered that a new era of construction began after the destruction caused by this event, particularly because of the introduction of finer varieties of tuff for *opus quadratum.*[301] But it was Lugli who first explicitly linked the fire of 210 BCE with the official appearance of concrete in Rome (in combination with *opus incertum*).[302] Evidence that this fire spread to the north slopes of the Palatine, however, is inconclusive. From Livy's account we know that the fire started in the *tabernae* located on the north side of the Forum and then spread north and northwest, hitting the private houses behind them, in the area later occupied by the Basilica Aemilia and the Forum of Caesar, eventually reaching the *lautumiae* on the slopes of the

[299]Gualandi and Papi 2005a:17 and footnote 9 date this level to the early first c. BCE. On the late Republican phase of the Via Sacra see Van Deman 1923: 397-402. Palombi (1990) suggests that the *horrea* on the north side of the Via Sacra may have an earlier phase, which he dates to 150 BCE. The history of the excavations of the road is summarized in Cassatella 1985.
[300]Papi 2005: 199-201.
[301]Van Deman 1912: 243-246.
[302]Lugli 1957: 384.

Capitoline.[303] The reconstruction of the *tabernae* (together with that of the *macellum* and *atrium regium*) was contracted out by the censors in the following year (Livy 27.11.16), but known architectural remains of this phase never show the use of concrete.[304]

The only fire specifically said to have struck the Palatine in this period is that of 111 BCE, which in fact has been taken as a fixed point for the development of *opus reticulatum* construction in both private (e.g., Casa dei Grifi) and public contexts (e.g., Temples of Magna Mater and Victoria) on the hill. Another great fire has been recorded for 148 BCE (Julius Obsequens, 19), when we are told the Regia burned along with other unspecified buildings in the city. Given its proximity to this monument, it has been recently proposed by Carandini's team that the better preserved phase of the Republican Atrium Vestae should be dated to right after this episode, though the possible implications of this alternative reconstruction for the periodization of the adjacent domestic quarter on the north slopes of the Palatine have not been considered.[305] In any case, there seems to be no correlation between these fires and the actual introduction of the new technique.

On a different note, the late third or early second c. BCE chronology also clashes with the identification of one of the houses (House 5, which was the first to be erected in the neighborhood) with that of Cn. Octavius, which has been advanced by the excavators themselves on the basis of some topographical coordinates derived from ancient authors.[306] As already mentioned, this mansion is the only one known in written sources to have been built *ex novo* in

[303]Zevi 1991: 475-477. Livy records that on the same occasion the Temple of Vesta did not catch fire thanks to the efforts of a group of slaves, suggesting that the adjacent block of buildings south of the Via Sacra (Atrium Vestae and so-called Domus Publica) was not affected. Given the northerly direction of the fire and the presence of the road, which may have functioned as a barrier, it is unlikely that the fire propagated up to the area occupied by Houses 5-8.

[304]As documented by the excavations in the area of the Basilica Aemilia, where the *tabernae* are built entirely with Tufo Giallo della Via Tiberina ashlars. See Ertel et al. 2007: 110-115.

[305]Arvanitis *et al.* 2010: 49-50.

[306]See LTUR II: 147 s.v. “Domus: Cn. Octavius” (E. Papi); Carandini 1986: 263-268.

the area during the second c. BCE. Cicero's testimony (*De offic.* 1.39.138) seems to suggest that its construction was completed not long before the election of Cn. Octavius to the consulate in 165 BCE.[307] As fascinating as these hypotheses of identification may be, however, the risk is to complicate the problem and distract us from the main archaeological issues. One thing is to say that C. Octavius had a house in that sector of the Palatine (and we may all agree on that), another thing altogether to conclude that a specific wall was part of that house (which is much more difficult to prove).

3.3.2 Other Houses on the Northeast Slopes of the Palatine

The evidence presented so far points to a date for the redevelopment of this sector of the Palatine not before the middle of the second c. BCE. This chronology would be consistent with the results of recent excavations that Panella and her team are carrying out on the northeast corner of the Palatine, just one block away from Carandini's dig. Remains of late Republican concrete architecture have been identified in the area delimited by the modern Via Sacra to the north, the Baths of Heliogabalus to the west and the terracing wall of the Vigna Barberini complex to the south, along the ancient road that led from the valley of the Colosseum to the Forum (**figs. 24-25**).[308] Excavations revealed a multi-stratified domestic building with a substantial first c. BCE phase occupying a plot located to the south side of the east-west road leading from the valley of the Colosseum to the Via Sacra and the Forum.[309]

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[307] Carandini *et al.* 2010: 98-111, maintaining a 210 BCE date for the reorganization of the city-block, followed by a phase of modifications in the period 70-20 BCE. Cf. Carandini 2005: 10, fig. 8 (175-125 BCE phase plan showing property plots). Coarelli (2012: 290-292) accepts Carandini’s identification, but dates the house to shortly before 165 BCE.

[308] Carbonara 2006 presents a preliminary report on the finds. A general interpretation of the remains in the broader topographical context is attempted by Zeggio 2006. A first c. BCE urban development is attested also on the southeast slopes of the Velia north of the Meta Sudans (Zeggio 2006: 76-77 fig. 9, semi-subterranean vaulted corridors with *caementa* of Tufo Giallo della Via Tiberina).

[309] Panella (2007: 76; 77, fig. 1) identifies this house with that of C. Octavius, the father of Augustus, the same where the *princeps* was born. See LTUR II: 147, s.v. “Domus: C. Octavius” (W. Eck).

Figure 24. Rome, northeast slopes of the Palatine: state plan (Late Republican remains indicated in yellow; after http://digilab.uniroma1.it/palatino/sito/aggiornamenti.aspx).

The house on the northeast slopes of the Palatine is known from its east boundary wall, consisting of ashlars of Tufo Lionato laid on top of a concrete foundation, and a mosaic-paved room preserved behind a series of *tabernae* facing the main road, dating to the first c. BCE.[310] The earlier phases are less visible, but a small rectangular open court has been found beneath these structures. This was paved with a mortar-based floor, and delimited by walls faced with *opus incertum*, which were truncated by the first c. BCE boundary wall. The small court features an impluvium made of Tufo Lionato slabs (perhaps originally built in an earlier occupation of the

[310]Carbonara 2006: 19-27.

house and maintained in the concrete reconstruction).[311]

The *opus incertum* phase has been dated by the excavators to the second half of the first c. BCE, and connected with the general reorganization of the road system serving this sector of the city. The surfaces of both the east-west road and the north-south thoroughfare leading from the Esquiline to the Circus Maximus were raised, adding sidewalks made of red Tufo Lionato (Anio?) and Cappellaccio slabs.

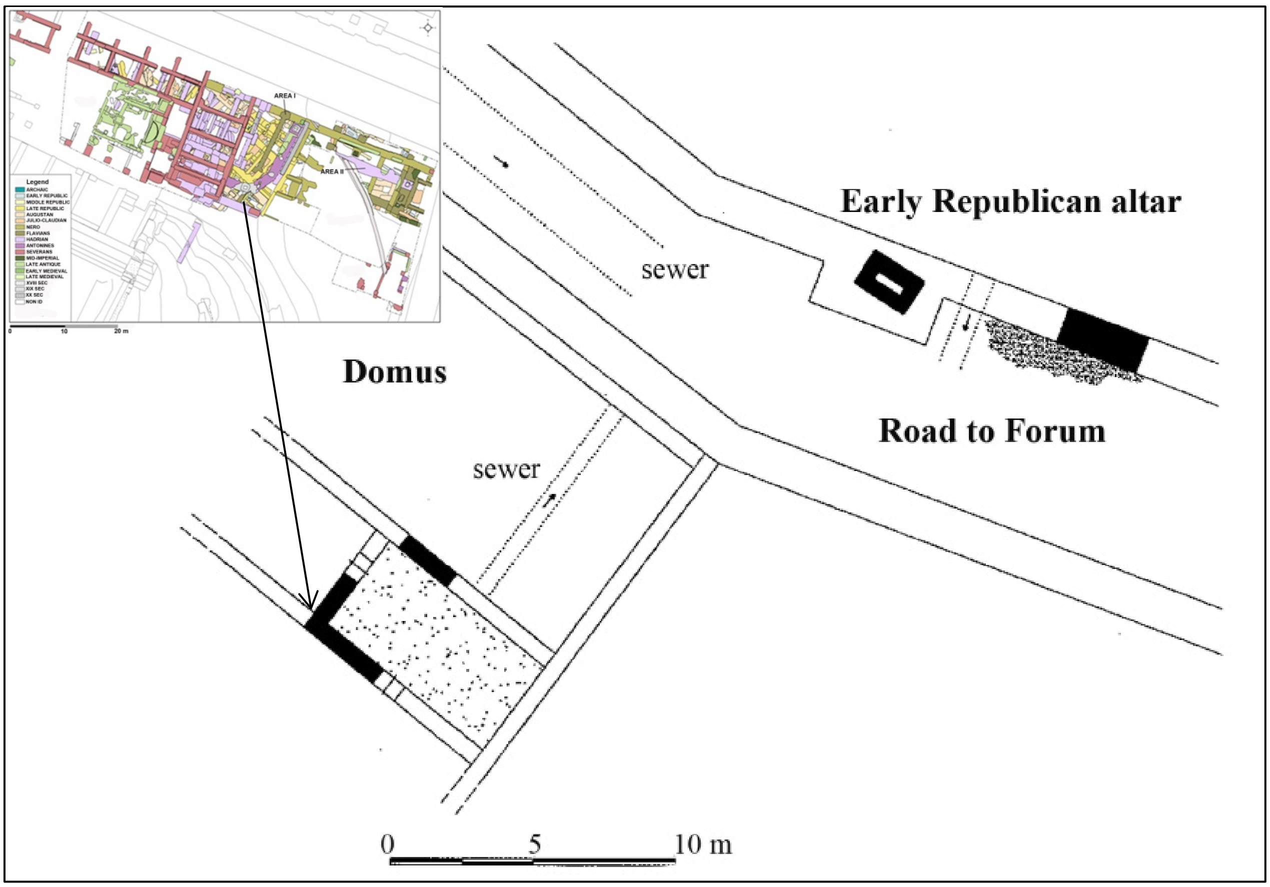

Figure 25. Rome, northeast slopes of the Palatine: *opus incertum* structures in Area I (after Carbonara 2006).

It seems that, on this occasion, the north-south road received new sewers replacing the archaic Cappellaccio channels. These conduits are built with a concrete composed of a dark gray mortar and rubble, mostly of Cappellaccio and other granular tuff varieties, laid in regular

311 Carbonara 2006: 16-19; Zeggio 2006: 74, fig. 8 nn. 11-13.

courses in a technique described as a kind of *opus incertum*.[312]

Sewers built with *opus incertum* have been found beneath the south sidewalk of the east-west road, but their construction has been assigned on stratigraphic evidence to the second quarter of the first c. BCE.[313] What is described as a similar type of concrete was also used to build two *opus incertum* walls found immediately west of the road in the west sector of the Meta Sudans excavations, belonging to another house that occupied the southeast slopes of the Velia.[314] One of these structures abuts to the west on a series of rooms delimited by walls made of horizontal courses of small rectangular tuff blocks and brown mortar. It is unclear whether the mortar is clay-based or a mix of lime and unsifted pozzolana, but it has been recently suggested that these walls may predate the concrete phase of the house.[315] The foundation of the other *opus incertum* wall, which is at a right angle to the road, seems to have been built in such a way as to accommodate the Cappellaccio blocks of the west sidewalk. This has been taken as an indication that the construction of the house progressed simultaneously with that of the road, in spite of the lack of direct stratigraphic relationships between this wall and the rest of the structures.

Zeggio (2006) has dated the renovation of the road infrastructure to 180/170 BCE, which in her view would provide a *terminus ad quem* for the *opus incertum* building phases on the southeast slopes of the Velia. This date has been derived from Livy's account of the works initiated by the censors of 174 BCE, which included the first paving of roads in the city (41.27.5-13).[316] However, the ceramic assemblage recovered from the deposits of packed clay and basalt fragments that formed the foundation for the actual road surface gives a slightly later date for this context, around the middle or during the second half of the second c. BCE, which is the date

[312]Zeggio 2006: 75, footnote 40.
[313]Carbonara 2006: 22.
[314]Panella 1990: 46-47.
[315]Zeggio 2006: 74 and footnote 37. Cf. the cautionary remarks in Panella 1990: 47.
[316]Zeggio 2006: 75 and footnote 43.

Panella originally suggested for the *opus incertum* house on the east slopes of the Palatine, based on ceramics.[317]

3.3.3 Summary of the Evidence

The concrete houses excavated by Carandini and Panella present many similarities. First, the stratigraphic sequence shows that, in both cases, the construction of the new houses followed the completion of major projects of urban development, which involved the reorganization of the road infrastructure (the Via Sacra; the east-west road leading from the valley of the Colosseum to the Via Sacra; the north-south road joining the Esquiline with area of the Circus Maximus). The date of these roads, therefore, may be taken as a *terminus post quem* for the houses. Second, the building technique of the concrete foundations demonstrates that the builders made extensive use of recycled material. This was obtained from the destruction of the archaic houses that stood in the same area (as suggested by the predominant use of Cappellaccio as aggregate). These long-lived buildings were carefully maintained for several centuries, with little architectural modifications.[318] The diffusion of concrete houses represents, therefore, a clean break with the previous architectural traditions.

Noting the discrepancy with the dating suggested by Carandini for the concrete houses on the north slopes of the Palatine, Panella argued that the refashioning of the old aristocratic houses began in the neighborhoods closer to the Forum, around 200-175 BCE, spreading to more peripheral areas only at a later stage.[319] The northeast slopes of the Palatine, however, can hardly be considered as a periphery: the house investigated by Panella lies about 200 m east of the sector excavated by Carandini. It is in fact entirely possible and more plausible that the earliest

[317]Panella 1990: 46-47.
[318]As also noted in Panella 1990: 46, footnote 17.
[319]Panella 2006: 283-284.

concrete modifications at both sites are contemporary. As I have argued above, there is no conclusive evidence to support a high date for the houses on the north slopes of the Palatine. Based on the pottery evidence from Panella's dig, the emergence of concrete architecture at these élite sites can be dated not before the middle of the second c. BCE.

3.4 Concrete Architecture in the *Suburbium* of Rome

3.4.1 The Relationship between Urban and Rural Architecture

What is the relationship between the introduction of concrete in urban domestic architecture and the diffusion of *opus incertum* in the volcanic region around Rome? Did the two phenomena happen simultaneously or did either one precede and influence the other? In previous studies there has been a tendency to assume that trial-and-error attempts resulting in the development of *opus incertum* were initially carried out by private builders in the countryside, but the actual evidence behind this hypothesis has never been discussed at length.[320] Lugli, for instance, simply characterized the spread of mortar-and-rubble techniques in terms of stylistic behavior, suggesting that the eminently practical and expeditious methods of *opus incertum* construction (as opposed to ashlar masonry) must have first been employed by commoners for unpretentious rural buildings and farms, little of which could be expected to remain in the archaeological record.[321] Because of the alleged modest beginnings, what mattered the most in Lugli's view was that *opus incertum* rapidly acquired a "rustic" connotation, which would in turn explain why this facing style was consistently adopted for élite rural residences and used in some areas of the *suburbium* even after the shift towards the more "refined" *opus reticulatum* (Lugli recognized that this pattern was influenced by local geology, noting that the tradition of *opus*

[320]With the exception of Billig (1944: 138-141, and Tables I-II), who in a general survey of the archaeological data showed that *opus incertum* spread first in the city and only later in the Roman Campagna.

[321]Lugli 1957: 363, 374. DeLaine (2001; 2006) demonstrates that ashlar masonry requires substantially more labor per unit of wall than *opus incertum*, up to four times as much.

incertum villas continued particularly where more intractable stones like limestone or basalt were only available, but maintained that cultural choice played a bigger role, creating a stark contrast between city and countryside).[322]

In a quite different perspective, Blake (1947) believed that at the root of the process of innovation of concrete technology there were concerns of economic nature, which led owners who sought to reduce construction costs to systematically exploit building materials available on their property.[323] Concrete facing styles would have still originated in a rural context, but more likely at the higher status level of *villa* architecture, which for its scale required greater resources in terms of both raw materials and labor (medium to large-scale landowners would also have had access to manpower for extraction).[324] Blake too considered that *opus incertum* provided a more practical method of construction, but precisely for this reason suggested that this technique may have remained in use for a longer period of time even in the tuff region around Rome. The implication was that not all of the *opus incertum* villas found in the *suburbium* necessarily belong to an early phase of development, further complicating the definition of a chronological framework for rural settlement types based on wall-facing style only.[325]

The idea that concrete technology emerged out of experimentation with building materials available on the land owned by Roman aristocrats is a generalization that merits deeper scrutiny.[326] First, the availability of re-deposited volcanic ashes near the monumental core of the city and the exploitation of quarries in the peri-urban areas suggest that experimentation with pozzolanic mortars in the urban context may have originated independently from architectural

[322]Lugli 1947: 461.
[323]Blake 1947: 241.
[324]See discussion in DeLaine 1995: 560-561. A particularly well documented comparanda is that of the Tomb of Caecilia Metella, which was built using pozzolana quarried from local deposits, in tunnels located right underneath the monument. See Calcaterra *et al.* 2001: 119-122.
[325]Blake 1947: 251.
[326]Jackson *et al.* 2007; Jackson *et al.* 2010; Table III. Marra *et al.* 2011: Table 1.

practice in the *suburbium*. Furthermore, in their reconstruction both Blake and Lugli simply overlook the fact that the most expensive ingredient in mortar mixes was not pozzolana, but lime.[327] Even if the available evidence is poorly published, it seems that early mortar mixes used for construction on the north slopes of the Palatine are characterized by a lower content of lime in proportion to pozzolana (*supra*, 3.3.1: type 1 mortar), perhaps betraying an attempt to curb construction costs. Though the higher quality of the mortar later employed for the first modifications of the houses can be explained in terms of a steady improvement of the recipe (*supra*, 3.3.1: type 2 mortar), we should also take into account that, given the limited scale of the works, the absolute volume of concrete (and thus of lime) needed in this phase was considerably smaller, so that a higher proportion of lime would not increase operation costs exponentially.

In sum, the local volcanic geology contradicts the idea that *opus incertum* was developed as a cheap alternative for small farms of the Roman region. The spatial distribution of pozzolana deposits (cf. s*upra*, 2.1.2) makes it unlikely that *opus incertum* buildings located in the *suburbium* north and west of the city are among the earliest examples of this technique. Both in Rome and in the *suburbium* concrete construction required an adequate supply of lime, which had to be procured in the most efficient way (cf. *supra*, 2.2.1), relying mainly on the urban market (with the possible exception of sites located further up the Anio valley, nearer to the durable travertine deposits of the Acque Albule; there is no explicit evidence, though, that the Romans burned these rocks for lime).[328] Lastly, since concrete construction requires large

[327] According to DeLaine (1997: 111-113; Tables 6 and 7), the man-power requirements per m^3 of finished product are 0.468 man-days for pozzolana and between 1.82 and 2.25 man-days for quicklime (depending on the skill of the laborers). The aggregate to binder proportion specified by Vitruvius (2.5.1) for land-based construction is 3 parts of pozzolana to 1 of lime. To this we should add transportation costs, which in the case of Rome were certainly higher for quicklime.

[328] It has been estimated that no more than 100 kilns in full operation would have been needed to satisfy the demands of Rome and Ostia at any one time (DeLaine 1995: 560). Whether by land, river or sea, it was the calcinated stone (quicklime) that was transported to Rome, not the slaked lime. In this case the slaking occurred directly at the building sites. If urban sites lacked the necessary space, lime burners could carry out this operation and

quantities of water to mix the mortar, another issue to consider is whether there could be any correlation between the distribution of concrete sites and the courses of early aqueducts and/or water streams.

3.4.2 Concrete Farms and Villas

New discoveries have greatly increased the number of sites for which enough information as to architectural plan and building techniques is available, revolutionizing our knowledge of settlement patterns in the rural landscape of Rome through the Republican period (fifth to second c. BCE). Based on a survey of recent publications, including a gazetteer of sites known from rescue excavations carried out by the Soprintendenza Speciale per i Beni Archeologici di Roma (SSBAR),[329] and three general works on the emergence of classic villa architecture in central Italy,[330] the record consists of at least ninety-four Republican sites with mapped architectural remains. Although not complete, this sample provides a critical mass to attempt a study of the distribution of building techniques (*opus quadratum*, *opus incertum* and *opus reticulatum*) with relation to both settlement type and location (**Table 5**).

Ashlar masonry construction is attested in at least forty-five contexts (**fig. 26**), of which about half (twenty-two) can be securely dated to before the second c. BCE. The few early Republican sites (fifth and fourth c. BCE) can be grouped in two sub-types:

- large complexes (up to 1500 m^2) with articulated plans and often rich decorations (of the

preserve the putty in pits covered with earth. See in general Adam 1994: 65-72. Quilici (1986: 211) suggests that Sabina (and the Tiber) played an important role in lime trade. Lime kilns are archaeologically attested in the Monte Soratte area, where in fact they are found in close proximity to the Tiber (Fontana 1995). For the physical characteristics of limes produced from limestone of the Monte Soratte and Monti Cornicolani see Jackson *et al.* 2007: 42-43. Jackson and Marra (2006: 424) believe that much of the transport was carried out on the Aniene. In the late Imperial period the main lime production center for Rome was Tarracina (DeLaine 1995: 560), but texts refer to land transport. Cargo-ships employed exclusively for lime transportation in the context of public works are attested by inscriptions of the early Imperial period (*navis ad calcem*): Panciera 2000.

[329] Jolivet *et al.* 2009.

[330] Romizzi 2001; De Franceschini 2005; Marzano 2007.

kind most notably exemplified by the Auditorium site);[331]

- much smaller farms lacking any kind of refinement (e.g., Torrino; Casale Nuovo di Grottarossa, which seems among the largest in this group, covers a surface of 240 m^2).[332]

Occupation of the sites of the first type often continued in the Imperial period, with only minor modifications attested in the intervening period (in *opus incertum* at Gregna; late first c. BCE *opus reticulatum* at the via Barbarano Romano site). On the other hand, most small farms are abandoned by the late Republican period, if not earlier (Via Aldini, Via Lucrezia Romana, Dragoncello), with no evidence of mortared-rubble construction used in combination with *opus quadratum*. At Casale Nuovo di Grottarossa, Torrino and most likely at the Via Togliatti site, late Republican concrete villas are built on top of thick post-abandonment levels. Only at Viale Tiziano the Early Republican farm is replaced by a larger complex already in the third c. BCE

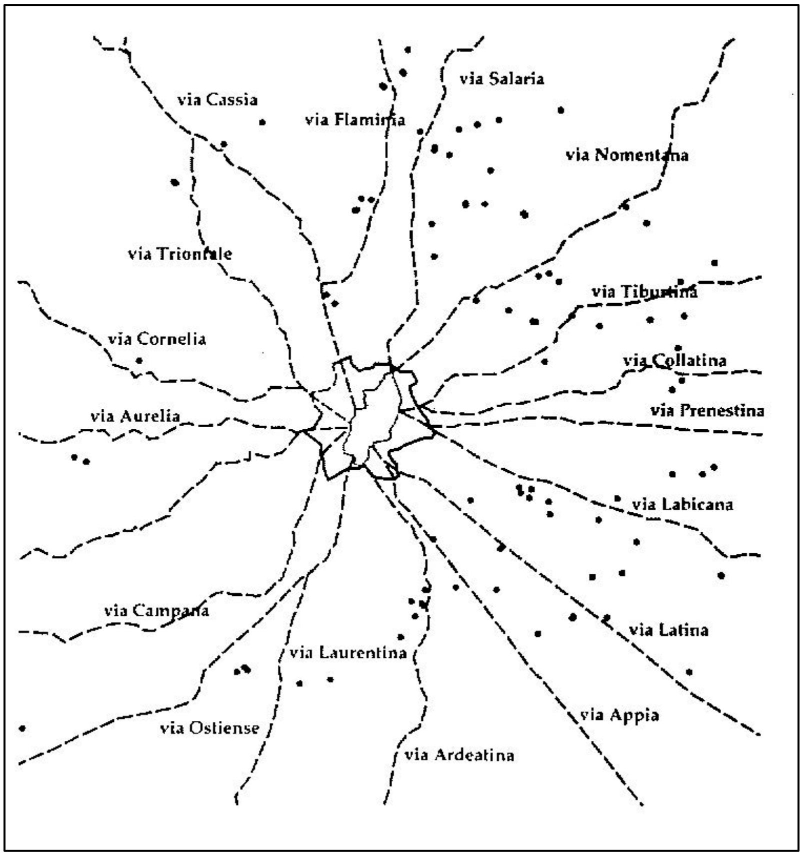

Figure 26. Rome: distribution of ashlar masonry architecture in the s*uburbium* (after Volpe 2012).

[331]Terrenato 2001; Carandini *et al.* 2007. See also Monte delle Grotte (Terrenato and Becker 2009); Quadrato di Torre Spaccata (Jolivet *et al.* 2009: Site D39); Gregna (Jolivet *et al.* 2009: Site D44); perhaps Grotte Celoni (De Franceschini 2005: Site 57) and via Barbarano Romano (Jolivet *et al.* 2009: Site B99).

[332]Pergola *et al.* 2009: Site B93. See also the limited remains found under the villa of Via Togliatti (De Franceschini 2005: Site 63); Viale Tiziano, Phase 1 (Piranomonte and Ricci 2009); Dragoncello, Site G (De Franceschini 2005: Site 89); Torrino, Site 8 (Bedini 1984); Via Aldini (Jolivet *et al.* 2009: Site D43); Via Lucrezia Romana (Jolivet *et al.* 2009: Site D41).

(Phase 3); this appears to be entirely built with tuff ashlars.

The Viale Tiziano building represents a new settlement type, which emerged in the region (as elsewhere in central and South Italy) in the middle republican period: the medium-sized farm (up to ca. 700 m^2), also referred to in the Roman context as the "Catonian" villa.[333] Nine other buildings of this type have been identified and dated within the third c. BCE.[334] *Opus quadratum* seems to be exclusively employed in the original construction of these sites, as well as for their maintenance throughout the latter part of the third and early second c. BCE (e.g., Via Gabina, Phase 1C, ca. 200 BCE). In contrast with the larger sites created in the previous period, these buildings typically show substantial renovation phases in the middle to late first c. BCE, with extensive additions in *opus reticulatum* that transform their plans quite radically.

Both at the villa of Giardini di Corcolle and the villa of Centocelle *ad duas lauros*, late reconstructions in *opus incertum* are attested. At Corcolle the *opus incertum* phase has been dated to the late second c. BCE, but the evidence is limited. The Centocelle case is exceptional because the new structures (Period 3) present a completely different orientation; these have been dated on the basis of stratified ceramic contexts to the first c. BCE.[335] A mixed technique employing tuff ashlars in combination with large tuff rubble and abundant mortar of an unspecified kind has been reported as being used sporadically in the previous phase of occupation at the villa to create internal subdivisions (in the course of the second c. BCE other restorations involving the load-bearing walls were made in *opus quadratum*).[336] The use of *opus*

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[333]For the characterization of "Catonian" villas as Hellenistic farmsteads and their relationship (or rather lack thereof) with classic villa architecture see Terrenato 2001: 17-28; Terrenato 2012.

[334]Via Gabina, Site 11 (Widrig 1987); Centocelle, villa of the Piscina, Period (Gioia and Volpe 2004: 393-402) and most likely the villa *ad duas lauros*, Period 2 (Gioia and Volpe 2004: 363-368); Giardini di Corcolle (De Franceschini 2005: Site 50); S. Palomba-Palazzo (De Franceschini 2005: Site 94); Via Ardeatina (De Franceschini 2005: Site 80); Mazzalupo-Via di Boccea (Jolivet *et al.* 2009: Site B114); Parco di Roma, Site 86 (Jolivet *et al.* 2009: Site B95); Vigne Nuove-Val Melaina (De Franceschini 2005: Site 25).

[335]Gioia and Volpe 2004: 368-371, fig. 13.

[336]Gioia and Volpe 2004: 366, fig. 7.

incertum seems to be more securely attested in the open area southwest of the Villa of the Piscina, where a large cistern (28 x 10 m) preserves in its west corner a concrete wall. This has been tentatively assigned to the Period 3 occupation (late second and first c. BCE), on the basis of the type of aggregate (yellow tuff of the same kind as that employed for the ashlar and rubble masonry of the villa in this phase).[337] Isolated concrete foundations predating the *opus reticulatum* phase have been detected at Val Melaina, but their relationship with the *opus quadratum* structures is unknown.

In sum, during the early and middle Republican period construction with mortared rubble (including clay-based mortared rubble) is virtually absent, particularly in small farms. When continuity of occupation through the late Republican period is attested, it is only with the first c. BCE that concrete structures make a significant appearance.

Building Technique	***Number of Farms and/or Villas***
Opus quadratum only (fifth to third c. BCE)	8
Opus quadratum only (second c. BCE or later)	4
Opus quadratum and opus incertum in the same building phase	3
Opus incertum with previous phase in opus quadratum	6
Opus incertum only	17
Opus reticulatum with previous phase in opus quadratum	24
Opus reticulatum only	29
Concrete foundations only	3
TOTAL	94

Table 5. Distribution of building techniques in rural sites of the suburbium of Rome (fifth to first c. BCE).

Opus quadratum remains have been detected in at least twenty-three other sites, which have been dated generically to the Late Republican period (second or first c. BCE), on the basis

[337] Gioa and Volpe 2004: 435-438, fig. 53-55.

of the building technique, the presence of cisterns of the tunnel type, and the association between ashlar masonry structures and decorated *signinum*-floors (or more rarely First Style decorations). If we limit our scope to the Republican period, four of these sites display a single phase in *opus quadratum.*[338] Only three contexts suggest that *opus incertum* and *quadratum* were used in combination in the same building period, although only at Veii-Campetti was concrete ever used in substantial amounts.[339] Remarkably, none of these sites follow the pattern attested in the urban context, where ashlar elevations were frequently built on top of concrete foundations. The other sixteen sites are characterized by a successive phase in *opus reticulatum*, but the extent of these modifications varies considerably from case to case.[340]

Larger ashlar buildings characterized by an already complex plan (e.g., canonical atrium; ten or more rooms), which often feature only minor concrete additions of the middle or late first c. BCE (usually a bathing suite and water infrastructures), may be as late as the end of the second c. BCE (e.g., Casale Bianco; Casale Monfalcone; Grotte di Cervara; Ospedaletto Annunziata, Prima Porta, S. Alessandro Site C; Casalone dell'Osa). In other cases the preexisting *opus quadratum* building was either completely obliterated or altered substantially in plan (Castel Giubileo; Fosso di Montegiardino, *ad gallinas albas*, Torre Maura, Torre Spaccata, Fosso Lombardo; La Cecchina; the site of Via Ripa Mammea is too poorly preserved to judge), as has

[338] Tor Carbone (De Franceschini 2005: Site 78); Capannelle (Pergola *et al.* 2009: Site D49); Romanina, Via Alimena (Jolivet *et al.* 2009: Site D42); Via del Quadraro (Jolivet *et al.* 2009: Site D37).

[339] De Franceschini 2005: Site 2 (the complex at Campetti has been recently the subject of a recent debate, as it has been interpreted also as a sanctuary). In the other examples of Cecchignola (De Franceschini 2005: Site 84) and the Via Tiberina km 0.550 site (Jolivet *et al.* 2009: Site B87) the use of *opus incertum* is only limited to a few rooms, suggesting that concrete structures belong to later restorations.

[340] This group includes the villa of Castel Giubileo, Site 15 (De Franceschini 2005: Site 13); Casal de' Pazzi (Jolivet *et al*. 2009: D175); Casale Monfalcone (De Franceschini 2005: Site 29); Casalone dell'Osa (Marzano 2007: Site L204); Fosso di Montegiardino (De Franceschini 2005: Site 48); Grotte di Cervara (De Franceschini 2005: Site 46); Ospedaletto Annunziata (De Franceschini 2005: Site 10); Prima Porta, villa *ad gallinas albas* (De Franceschini 2005: 7); Torre Maura (De Franceschini 2005: Site 64); Via Ripa Mammea (De Franceschini 2005: Site 45); S. Alessandro, Site C (De Franceschini 2005: Site 30); Torre Spaccata (De Franceschini 2005: 65); Fosso Lombardo (De Franceschini 2005: Site 76); La Cecchina-Podere Rosa (Jolivet *et al.* 2009: Site D180; De Franceschini 2005: Site 34); S. Basilio (De Franceschini 2005: Site 35).

also been observed for the smaller farms that emerged in the third c. BCE, indicating perhaps a higher chronology for the contexts. Mixed techniques characterized by the use of ashlar masonry in foundation and concrete walls in elevation have also been reported (Casale dei Pazzi; S. Basilio), but it is likely that the different techniques refer to successive construction phases (at La Cecchina, ashlars, *opus incertum* and *opus reticulatum* are apparently used simultaneously).

The overall impression is that throughout the second c. BCE, i.e. in the supposed period of experimentation with concrete architecture, there seems to be in the *suburbium* a strong tradition of construction with cut-stone.

The number of *opus incertum* villas built *ex novo* is surprisingly small, consisting in the most optimistic estimates of seventeen sites.[341] Including the nine attestations of an *opus incertum* phase at sites with continuous occupation from the previous period, the sum total gives no more than twenty-six contexts. By contrast, in addition to the twenty-four *opus quadratum* sites displaying a later phase in *opus reticulatum*, the latter technique is found in at least twenty-nine new sites, for a total of fifty-three contexts.[342] (At three other concrete sites the structures

[341] Only isolated walls have been identified at Via di Santa Bibiana (Jolivet *et al.* 2009: Site A121) and Via Regina Margherita (Jolivet *et al.* 2009: Site D123); an *opus incertum* cistern is connected to a 1st c. BCE possible villa site at the Tenuta Torre Serpentara-Borgata Fidene (Jolivet *et al.* 2009: Site B9). More extensive remains have been found at the Via Tiberina km 18 (Jolivet *et al.* 2009: Site B88); Castel di Guido (De Franceschini 2005: Site 54); Torricola (Jolivet *et al.* 2009: Sites D4 and D5); Vigna Casali (Jolivet *et al.* 2009: D18; Quilici 1987); Centroni (Jolivet *et al.* 2009: Site D51); Via Latina, third mile (Jolivet *et al.* 2009: Site D62); Acqua Traversa (De Franceschini 2005: Site 19); Tor de' Schiavi, Gordiani (De Franceschini 2005: Site 53); Via Carciano (De Franceschini 2005: Site 42); Quarto Cappello del Prete (De Franceschini 2005: Site 55; Caspio *et al.* 2009); Tor Vergata, Carcaricola (De Franceschini 2005: Site 73); Via della Magliana (De Franceschini 2005: Site 86); Dragoncello, Site A (De Franceschini 2005: Site 90); Viale Serenissima, Site AAI (Caspio *et al*. 2009).

[342] Borgata Ottavia (De Franceschini 2005: Site 18); Via della Marcigliana (De Franceschini 2005: Site 9); Via della Serpentara (De Franceschini 2005: Site 22); Prima Porta, Via Tiberina km 0.850 (De Franceschini 2005: Site 6); Prima Porta, Valle Lunga (De Franceschini 2005: Site 3); Via Tiberina, km 3.500 (Pergola *et al.* 2009: Site B90); Prima Porta, Cimitero Flaminio (De Franceschini 2005: Site 5); Borgata Massimina (Pergola *et al.* 2009: Site C3); Casale Tor Carbone (Pergola *et al.* 2009: Site C82); Casal Bianco, Settecamini (De Franceschini 2005: Site 36); Casal Bruciato (De Franceschini 2005: Site 51); Casale Ghella (De Franceschini 2005: Site 16); Castel Giubileo, Site 1 (De Franceschini 2005: Site 12) Cinecittà, Subaugusta (De Franceschini 2005: Site 67); Cinquina (De Franceschini 2005: Site 11); Fosso dell'Osa (497, De Franceschini 2005: Site 49); Fortezza Tiburtina (De Franceschini 2005: Site 44); Macchia Piana di S. Vittorino (Marzano 2007: Site L224); Villa of Maxentius (De Franceschini 2005: Site 69); S. Anastasio (De Franceschini 2005: Site 27); Tomba di Nerone (De Franceschini 2005: Site 20); Via Capobianco (De Franceschini 2005: Site 26); Via Pollenza (De Franceschini

are preserved only at the level of the foundations).[343] These figures seem to confirm that the diffusion of villas in the *suburbium* is a quite late phenomenon, taking off only in the middle to late first c. BCE. Excavation data suggest that the beginning of the phenomenon should be dated to the latter part of the second c. BCE. In many cases a generic second c. BCE chronology has been assigned on the basis of the wall-facing style alone, due to the absence of external evidence. At least four of these sites (Via della Magliana; Acqua Traversa, Via Tiberina and Castel di Guido) are located in areas where pozzolana was not readily available, and thus are unlikely to be among the earliest examples of use of this technique.

Where most complete, the architectural and stratigraphic evidence from *opus incertum* sites located in the southeast quadrant of the *suburbium* show that these villas are always of the classic type, extending over wide surfaces (e.g., 2500 m^2 at Dragoncello, Site A) and possessing very articulated plans, including *bases villae* with cryptoporticus on the four sides (e.g., Tor de' Schiavi), two atria (e.g., Carcaricola), and monumental water infrastructures (e.g., Quarto di Cappello del Prete, an exceptional site extending over a one-hectare area). The exploitation of local pozzolana deposits located within the villa estates has been demonstrated in a number of cases (Centroni; Quarto di Cappello del Prete, Fosso di S. Maura) and easy access to this material can be reasonably assumed for the other contexts (especially at Torricola and Vigna Casali, not far from the quarries of Tor Marancia, and the Via Carciano site, close to the Tenuta di Capannacce). Ceramic assemblages from well-documented sites suggest construction dates in the second half or end of second c. BCE (Carcaricola, Serenissima, Campetti, Centroni; at

2005: Site 33); Via Vigne Nuove (De Franceschini 2005: Site 32); Borgata Ottavia (De Franceschini 2005: Site 18); Casale di Aguzzano (De Franceschini 2005: Site 41); Via Lucrezia Romana (De Franceschini 2005: Site 82); both L'Annunziatella (Jolivet *et al*. 2009: Site C70) and Casale di Vigna Murata (Jolivet *et al*. 2009: Site C77) are near third c. BCE pottery scatters.

[343] Via Ipogeo degli Ottavi (Jolivet *et al.* 2009: Site B102); Borgata Massimina (Jolivet *et al.* 2009: Site C3); Via P. A. Micheli (Jolivet *et al.* 2009: Site D141).

Quarto di Cappello del Prete the material is not associated with the structures, but has been recovered from the pozzolana quarry fills, and may not be indicative of building activities at the site). In any case, *opus incertum* was still used in the early part of the first c. BCE (as seen for the Villa of the Piscina, as well as Serpentara, Acqua Traversa, Tor de' Schiavi).

Whether the first appearance of large *opus incertum* villas in the *suburbium* correlates with changes in land tenure patterns and agricultural productivity is a much bigger question that goes beyond the narrow limits of the present discussion. The third quarter of the second c. BCE, or more precisely the Gracchan period (130s and 120s BCE), has been in fact characterized as a phase of change also in relation to other areas of Roman material culture (especially pottery production).[344] The common view is that this phenomenon was to a great extent driven by processes of socio-economic nature (e.g., concentration of land; intensification of wine production, etc.). I shall note in this regard that about two thirds of the *opus incertum* buildings do not have architectural predecessors on site, a trend which could be indeed read as the result of major shifts in settlement forms. From the point of view of architecture, however, the most interesting implication of this pattern is that a much greater amount of newly quarried material was required for the construction of classic villas in comparison with houses in the urban context, where both aggregate and facing blocks could be easily obtained from the demolition of preexisting structures.

In neighboring areas of the Colli Albani volcanic district, regional surveys have detected a similar pattern. In the territory of Tusculum, for instance, concrete architecture emerges only in the late second c. BCE or early first c. BCE.[345] The relatively higher attestations of new *opus incertum* buildings (at least eighteen, as opposed to seventeen *opus reticulatum* villas) may be in

[344]Panella 2010: 45-56 (amphorae and black-gloss pottery).
[345]Valenti 2003; Marzano 2007: 591-627.

part explained by the intensive use of local basalt deposits, a material which is much harder to shape into small square blocks in comparison with the soft volcanic stones. Late third and early second c. BCE buildings in *opus quadratum* or polygonal masonry are also attested, in most cases receiving significant modifications or additions in *opus reticulatum* only in the middle to late first c. BCE. On the other hand, early rural buildings in *opus incertum* have a greater chance of being found in the limestone region. At Tibur, *opus incertum* construction outnumbers villas in *opus reticulatum* (at least twenty-two contexts as opposed to nineteen, if we exclude the eight cases in which both techniques are present).[346] In fact the spread of *opus reticulatum* in this region has been explicitly linked with the presence of Roman villa owners, known from literary sources.[347] In more peripheral areas of Latium Vetus and Adiectum, such as Cora and Anagnia, the proportions are entirely skewed, because of the ninety-five Republican villas recorded in a survey of architectural remains only twelve have a building phase in *opus reticulatum* (in two cases superimposed to *opus incertum* structures).[348] In the coastal areas of South Latium, the earliest type of monumental rural residence featuring *opus incertum* in association with polygonal masonry has been dated archaeologically to third quarter of the second c. BCE (Villa Prato, near Sperlonga),[349] while *opus reticulatum* seems to appear only in the middle of the first c. BCE.[350]

3.5 Conclusions

Recent stratigraphic and scientific evidence from excavated urban sites suggests that

[346]Giuliani 1970; Mari 1991 and 2003; Tombrägel 2012 dates the earliest examples to the first half of the second c. BCE.
[347]See especially Torelli 1980: 143-145.
[348]Brandizzi Vittucci 1968; Mazzolani 1969. Synthesis in Torelli 1980: 144, with footnotes 20 and 23 (the tally also includes structures built with polygonal masonry and with a mixed technique of polygonal masonry and concrete); Andreussi 1981. For a recent reassessment of the evidence: Becker 2012 (dating the *opus incertum* architecture associated with polygonal masonry platforms to the second half of the second c. BCE).
[349]Broise and Lafon 2001: 162-164 (150-110 BCE)
[350]See Lafon 2001: 66, 71-72 (75-50 BCE).

crucial steps toward the development of concrete in Rome were taken in the context of private élite house construction. While many contradictions characterize the traditional architectural chronologies, which depend on stylistic analysis and questionable associations between archaeological remains and buildings or episodes mentioned in ancient texts, ceramic assemblages associated with the new finds suggest that the change in building techniques happened around the middle of the second c. BCE. Particularly in the areas closer to the monumental and political core, aristocratic houses that had stood for centuries were torn and rebuilt, and concrete construction was developed in order to provide a way of building foundations for these new houses rapidly and economically, making extensive use of recycled building materials (as best documented at the sites on the north and northeast slopes of the Palatine). Structural mortar in these contexts is of the hydraulic type, because it contains pozzolana, while construction with simple lime mortar is entirely absent, suggesting that the development in walling techniques and innovations in mortar composition progressed in parallel.

In these houses *opus quadratum* was, however, still extensively used, especially for the visible façades. In fact, a strong tradition of construction with *opus quadratum* characterized also farm and villa building in the *suburbium* of Rome (in about 48% of the cases, rural Republican sites feature at least one phase in this technique), which shows virtually no signs of experimentation with clay-based mortar-and-rubble prior to the introduction of lime-based mortar. Walls in *opus incertum* occur only in a small number of sites, mostly in the context of minor modifications of pre-existing ashlar buildings of monumental character. The absence of a generalized phase of renovation of older rural residences may account for the slight chronological gap between the earliest examples of concrete architecture in the city and the spread of this technology in the countryside. In the few sites for which ceramic data are available, the date of the first *opus incertum* phase can indeed be placed in the latter part of the second c. BCE. The diffusion of *opus reticulatum* villas demonstrates that concrete construction in the countryside is a first c. BCE phenomenon.

Chapter 4

Early Roman Concrete and Public Buildings

4.1 Introduction: Private Builders and Public Works in Republican Rome

The organization of Roman construction from around 50 BCE to 250 CE is well-known from the writings of classical Roman jurists who dealt with legal problems arising from building contracts.[351] Combined with evidence on the supply of building materials and labor, these texts allow us to reconstruct the rules governing the activities of contracting parties in this period, and the ways the jurisprudence changed through time, indirectly informing us about the social and economic context of Rome's building industry.

The use of construction contracts in earlier periods of Roman history is less documented. Literary sources suggest that the stipulation of contracts in *locatio-conductio operis* by private individuals was common by the early part of the second c. BCE. Both Cato (*supra*, 2.2.1) and Cicero provide examples of the economic activities which were regulated by these contracts in the context of private construction.[352]

[351] See Martin 1989.
[352] Martin 1989: 21-22; 43-72.

The development of this legal system, which in contrast with earlier forms of obligations (*stipulatio*) required the agreement of parties on the terms of contractual activities and the establishment of a fixed price, was particularly suited to public construction. Inscriptions from urban sites in Campania show that Roman officials were letting contracts to private builders outside Rome as early as 135 BCE (CIL I^2 635=ILS 22=ILLRP 332: construction activities contracted by the consul Ser. Fulvius Flaccus in the sanctuary of Diana Tifatina, near Capua, with money from the sale of war-spoils). Although the earliest document of a *locatio operis* from Rome itself dates from the early second c. BCE (CIL I^2 808: construction of bridges on the via Caecilia), it is safe to assume that by the second half of the second c. BCE or earlier public construction projects of any size and complexity in the city were normally assigned to private builders.[353] These experts were considered responsible for the successful completion of the work until final approval (*probatio*) by a state official. The so-called *lex Puteolana parieti faciundo* (ILLRP 518, of 105 BCE) attests the practice of designating magistrates as final approvers of public projects.[354]

A significant evolution in the patterns of liability has been detected in classical jurisprudence, whereby in the early period the employer could expect the contractor to be totally responsible for the completion of the job. Mitigating factors, which limited the overall liability of the builder before *probatio* (e.g., the absence or presence of faults in the natural terrain; whether it was possible to foresee accidents in regard to the building site, etc.), seem to have been introduced only gradually.[355] On the other hand, given that in several Republican inscriptions the

[353]See also ILLRP 45. This inscription (dating to the first half of the second c. BCE) refers the construction of a mosaic floor in the Temple of Apollo in Circo, mentioning a *probatio* by the aediles. This seems to imply that the work was contracted out. Steinby (2012a) argues that the magistrates who let these building contracts operated under the supervision of the Senate, who seems to have been responsible for the funding even in the case of monuments built *ex manubiis*.
[354]On the *probatio* see Biscardi 1960: 433-434; Martin 1989: 103-113.
[355]Martin 1989: 89-101.

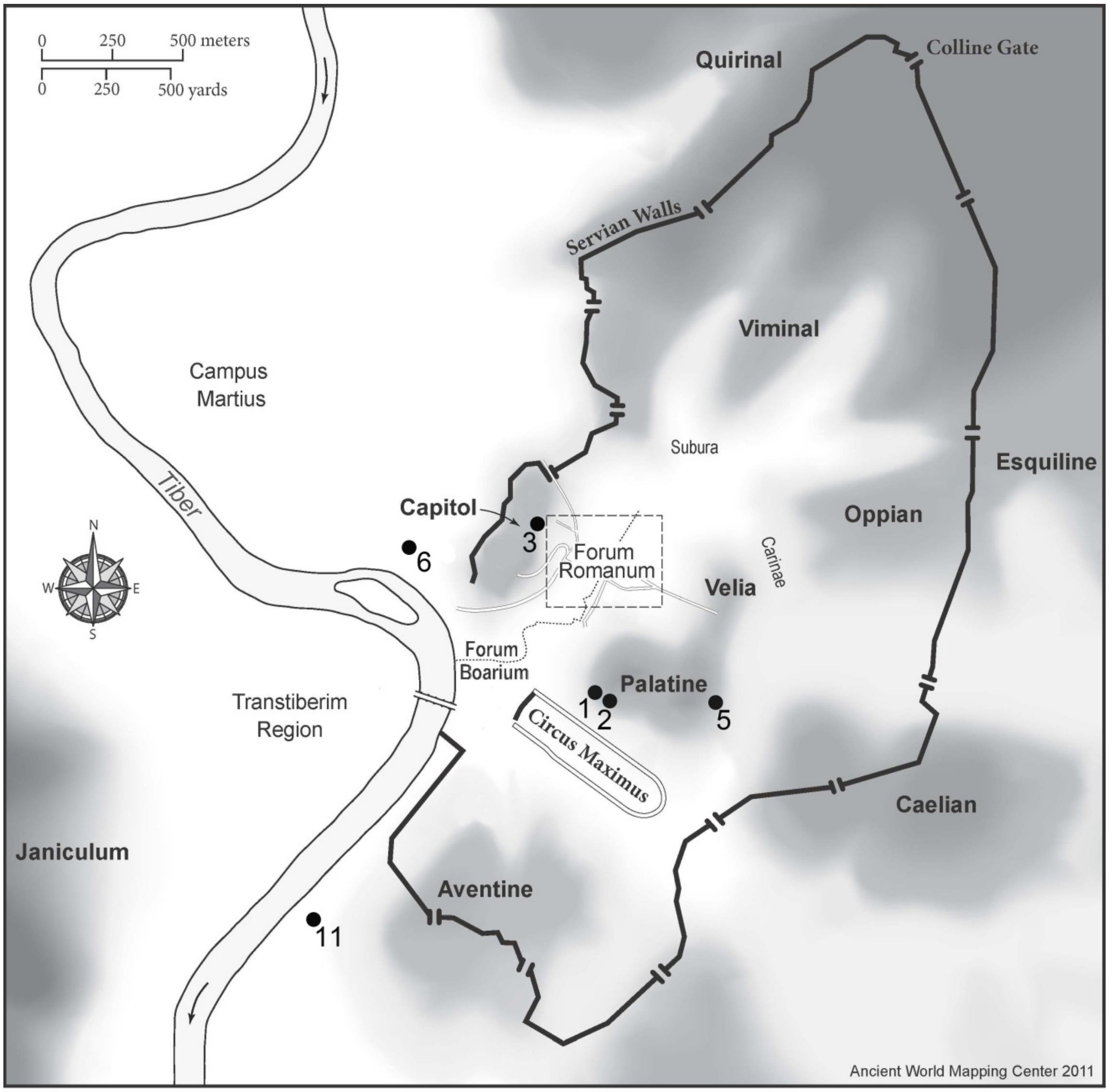
task of inspection appears assigned to the same individuals who originally contracted the work even though they were no longer in (the same) office, it has been suggested that there were early attempts to transfer at least part of the risks (*vitium operis*) from the *conductor* (i.e., the contractor) to the *locator* (i.e, the individual or group who let the contract).[356]

In conclusion, the social context of construction allows us to set a series of expectations to reconstruct the mechanism by which concrete technology could have been transferred from the private sector to public works practice. As we have seen, in the block of buildings occupying the north slopes of the Palatine, south of the Via Sacra, concrete work was used already during the second half of the second c. BCE to rebuild aristocratic residences, while adjoining public buildings such as the Carettoni's Domus Publica received concrete additions only in the middle of the first c. BCE. Precisely because the introduction of this technology in the private sector happened at the élite level, and because public construction in the late Republican period was in the hands of only a few aristocratic families, it is likely that the same groups of skilled builders were employed in both contexts.

4.2 Early Concrete in Sacred Architecture

Roman temples have remained at the forefront of archaeological research in the city. New excavation data have been gathered in a more systematic fashion, greatly increasing the sample of second c. BCE concrete architecture, thus also allowing for a general reassessment of old finds. This section discusses the evidence of *opus caementicium* from Republican temple architecture (**fig. 27, 1-6**), concentrating on the monuments that are commonly taken to predate the earliest secure example of the Temple of Concord (121 BCE; *supra*, 2.3.1; **fig. 27, 10**).

[356]Biscardi 1960: 433.



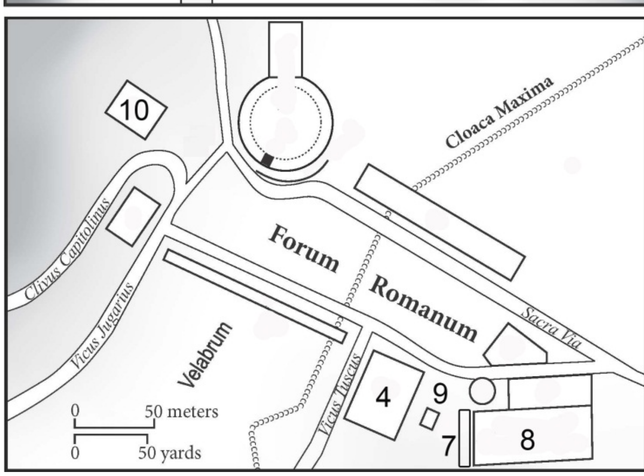


Figure 27. Schematic map of Rome with location of the public buildings discussed in Chapter 4 (*1=Temple of Magna Mater*; *2=Temple of Victoria*; *3=Temple of Veiovis*; *4=Temple of Castor and Pollux*; *5=substructiones on the east slopes of the Palatine*; *6=Porticus Metelli*; *7=concrete ramp on the east side of the Roman forum*; *8=Aedes and Atrium Vestae*; *9=Lacus Iuturnae*; *10=Temple of Concord*; *11=Testaccio building*).

4.2.1 The Temple of Magna Mater

As already mentioned, current reconstructions maintain that *opus incertum* was employed for the earliest building phase of the Temple of Magna Mater (204-191 BCE), located on the southwest corner of the Palatine (**fig. 27, 1**).[357] The temple podium was the object of limited excavations carried out by P. Romanelli in the early 1960's. These revealed a series of concrete structures founded directly on the bedrock, which were interpreted as a form of *opus incertum* featuring alternating courses of roughly shaped oblong blocks of Peperino and Tufo Giallo della Via Tiberina (**fig. 28**); remains of the cella walls, which appeared to be faced in a different style, so-called *opus quasi reticulatum* of Tufo Rosso a Scorie Nere (Fidene); and fragments architectural decoration, which was dated stylistically to the early Imperial period.[358]

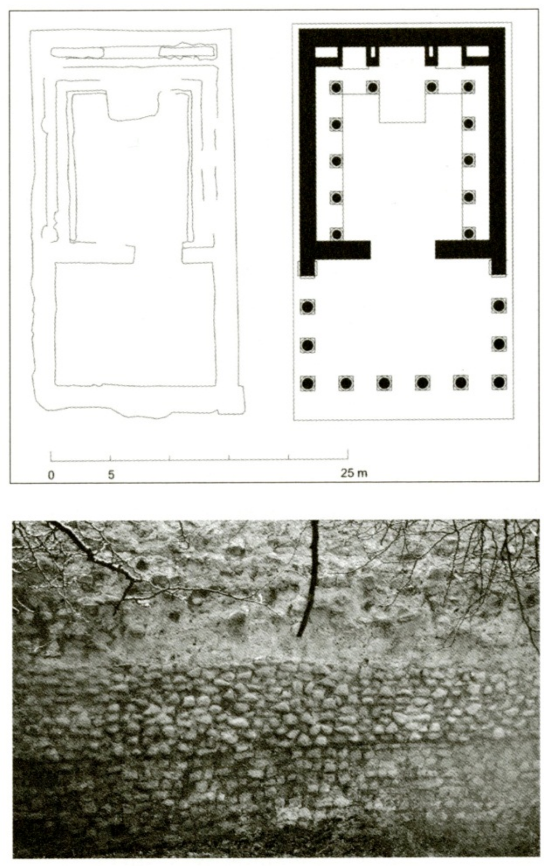


Figure 28. Rome, Palatine: plan of the Temple of Magna Mater, and detail of the concrete podium (after Coarelli 2012).

Two successive construction phases are known from textual sources in the history of the monument after its dedication: a reconstruction after the fire of 111 BCE and later restorations after 3 BCE.[359] The conclusions of the excavator were that the podium structures belonged to the post-111 BCE building phase, which completely obliterated the original building, while the cella and its architectural decoration referred to the reconstruction of the temple under Augustus,

[357]E.g., Adam 1994: 127.
[358]Romanelli 1963: 227-239.
[359]Sources in LTUR III, 1996: 206-208, s.v "Magna Mater, aedes" (P. Pensabene).

confirming the results of previous scholarship on the monument.[360] Coarelli rightly criticized the arguments offered by Romanelli to date the concrete podium: in fact Romanelli considered unlikely that a technique allegedly employed at that time only for utilitarian buildings like the so-called Porticus Aemilia (of which he obviously accepted the identification and high chronology) could be used for the construction of an early second c. BCE temple in such a prominent site. Given the irregular aspect of the facing, the unparalleled use of different materials in alternating courses and the friable compaction of the mortar, Coarelli placed the remains of the podium at the beginning of his developmental sequence of *opus incertum*, assigning the so-called *opus quasi reticulatum* walls to the late second c. BCE restorations, which also involved other areas of the sanctuary (e.g., the *tabernae* near the Scalae Caci, showing a similar technique).[361] His expectation was that different techniques would be mutually exclusive, perfectly matching the different building episodes known for the monument: the complete absence of preexisting architecture under the *opus incertum* podium was interpreted as clear evidence that there was no predecessor, while the style of the surviving architectural decoration was taken to be incompatible with the so-called *opus quasi reticulatum* remains, because it would imply too low a date for this technique.[362]

The results of intensive research activities at this site, which resumed in 1978, have substantially altered Coarelli's reconstruction (**figs. 29-30**). First, a reassessment of the excavated materials showed that the floor of the cella, which was paved with marble *tesserae*, sealed a preparation level that contained pottery sherds of Italic Red Slip of the Augustan period.[363] The

[360] Van Deman 1912: 244, footnote 4; see discussion in Blake 1947: 330 (late second c. BCE or Augustan); Lugli 1957: 409 and 468 (110-109 BCE); Romanelli 1963: 227-239 (post-111 BCE).
[361] Coarelli 1977: 10-13.
[362] Coarelli 1977: 12. But cf. the Temple B of Largo Argentina, with foundations in *opus incertum* and superstructure in early *opus reticulatum*, which Coarelli (1977: 14) assigned to the same phase (dated to 100 BCE).
[363] Romanelli 1963: 260-290; 321-330. Pensabene 1978: 69; 1980: 71; 1985, 182-183. D'Alessio 2006.

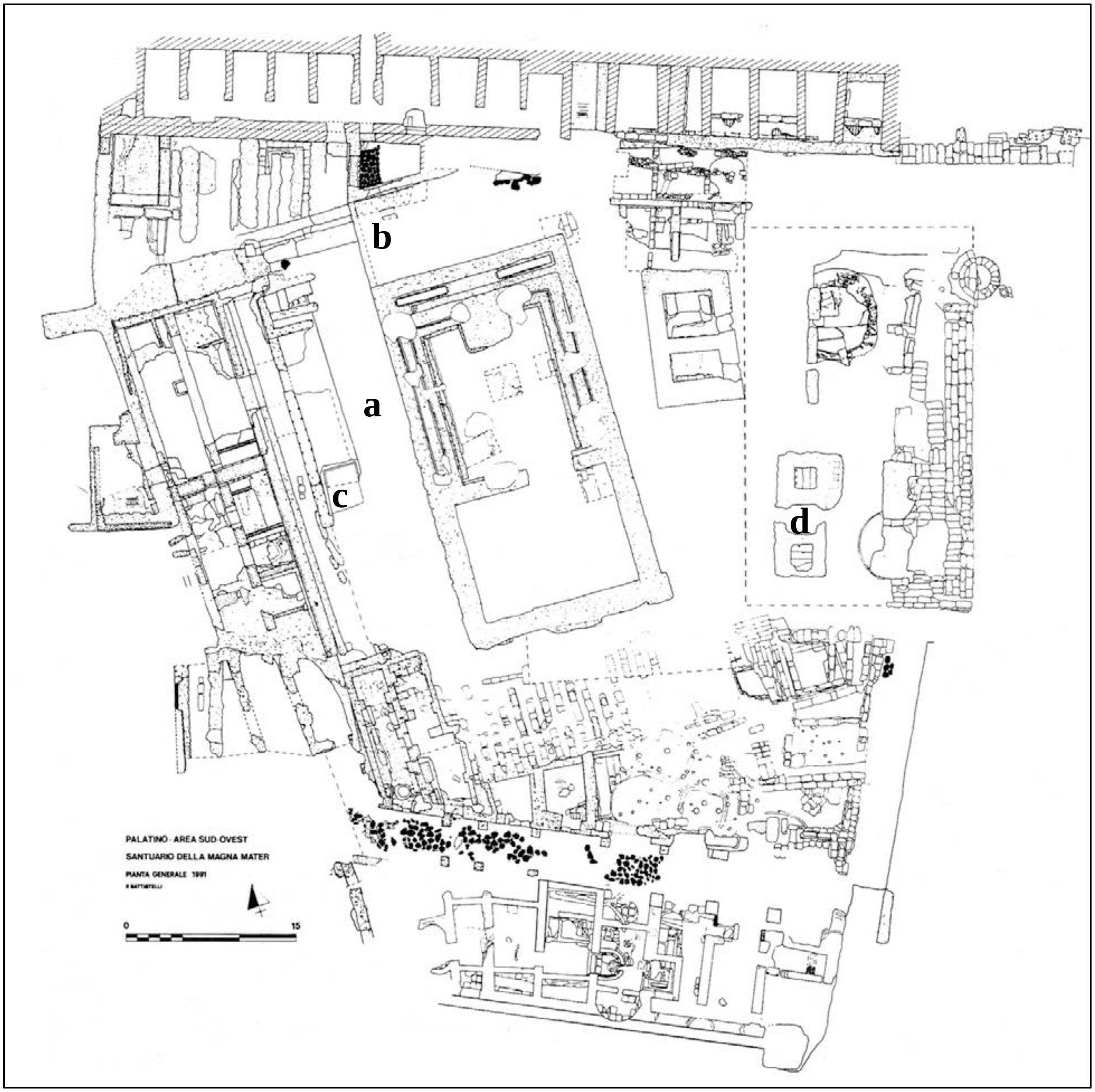


Figure 29. Rome, Palatine, Sanctuary of Magna Mater: state plan (center: Temple of Magna Mater; right: Temple of Victoria; *a=modern spoliation trench*; *b= remains of ashlar podium*; *c=concrete basin*; *d=concrete fill*; after Pensabene and D'Alessio 2006)

sequence confirms that the decorative system of the cella underwent major modifications at that time, although it is still debated whether this activity was connected with the actual reconstruction of the cella itself. This appears to be composed of three separate parts: a concrete foundation dividing cella and pronaos, joined to the podium concrete box; a wall directly abutting on both the podium and the dividing wall (this is built with *opus reticulatum* on the inner face, and functions as a foundation for the cella walls); at a distance of m 0.9 from this an inner wall was built up using timber shutterings on the exterior and an *opus reticulatum* facing on the interior, in order to support an inner colonnade (the gap between these two walls was filled at a later stage with a concrete mass). The *opus reticulatum* remains have been generally connected with the Augustan reconstruction, but it is also possible that they belong to the first phase of the concrete podium, given the widespread use of this technique in other parts of the Late Republican sanctuary.[364]

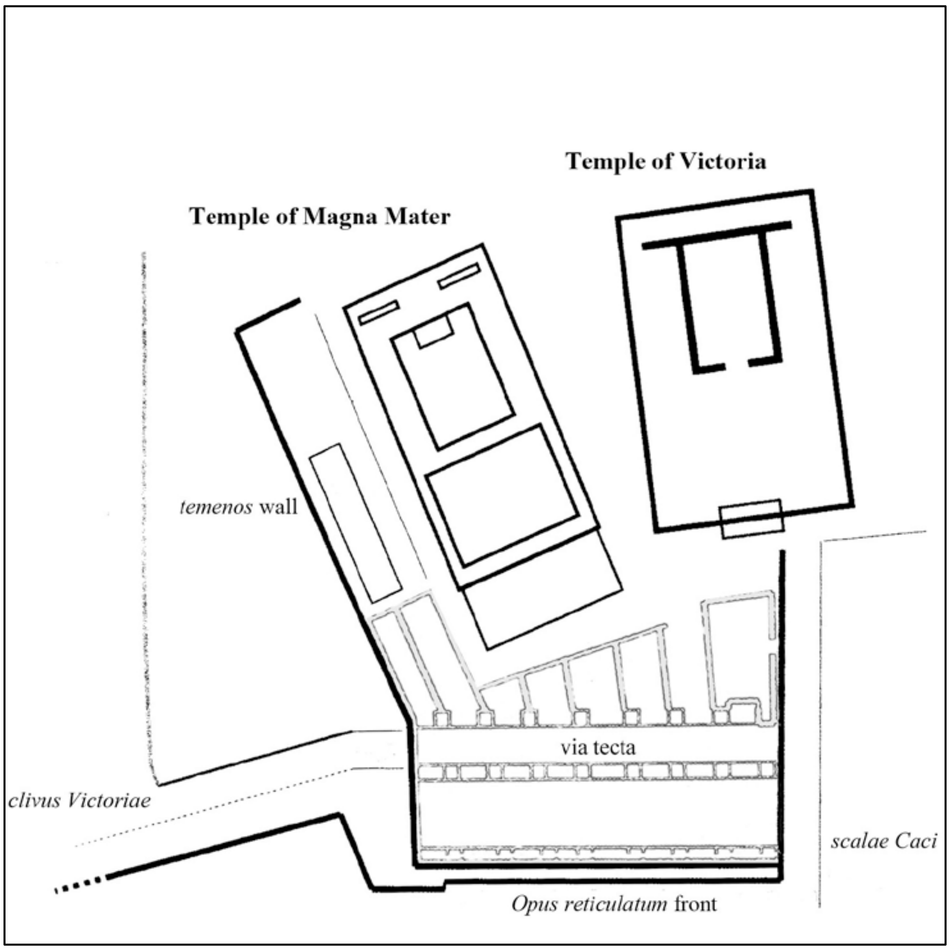


Figure 30. Rome, Palatine, Sanctuary of Magna Mater: restored plan of the late second c. BCE phase (after Pensabene and D'Alessio 2006).

[364]D'Alessio 2009: 229, footnote 7, with bibliography. Coarelli (1977: 12) dated the so-called *opus quasi reticulatum* of the cella to the late second c. BCE phase, but assigned the concrete podium to the previous period.

As already documented by Romanelli, below the mosaic floor was a uniform construction fill reaching the bottom of the podium foundations. This layer, which most likely belongs to the previous construction phase, contained numerous inclusions of building debris, such as fragments of an earlier *tessellatum* floor, Peperino architectural elements (which were also used as *caementa* in the podium concrete structures), as well as a group of Hellenistic terracotta figurines clearly in secondary deposition. This assemblage attests that temple decorations and votives associated with the second c. BCE occupation of the sanctuary were disposed of in a systematic way (probably in the context of the late second c. BCE construction activities), according to a practice also well-attested in the case of the Temple of Castor and Pollux (*infra*, 4.2.4).

The interpretation of the sequence excavated within the podium is corroborated by new data collected in other parts of the sanctuary. Investigations in the area west of the temple revealed the outline of a modern robbing trench (**fig. 29, a**), extending with a north-south orientation along the west side of the concrete podium.[365] This feature documents the spoliation of the blocks that originally faced the podium, which also truncated the adjoining stratigraphy and exposed the concrete core. The removal of the trench fill clarified the construction process of the podium walls. These were built in separate stages corresponding to horizontal layers of varying height, which are clearly distinguishable on the basis of the prevailing types of *caementa* (Tufo Giallo della Via Tiberina, Peperino and Cappellaccio; Travertine and Tufo Lionato of the varieties from Monteverde and Anio, and Tufo Rosso a Scorie Nere from Fidene). Once each concrete layer had set, a construction fill was dumped inside the perimeter of the podium, raising the surface on which the builders walked up to the level reached by the concrete box. Each time, work on the concrete walls resumed from the new level of the podium fill, building up the form-

[365]Pensabene *et al.* 1993: 28-34.

work for the next layer (indeed the sequence of "battuti" excavated within the podium matches precisely that of the concrete courses). The *caementa* were placed by hand within the form-works without a clear distinction between core and faces, thus excluding any identification with *opus incertum*.[366]

Traces of timber shuttering are visible on all sides except in the southwest corner, where the concrete mass appears to have been retained by a pre-existing stretch of ashlars, consisting of five courses having the same orientation as the concrete structures.[367] This wall was evidently reused as a permanent form-work and facing, leaving an imprint on the surface of the concrete core. Badly preserved traces of the same ashlars were also detected on the other side of the spoliation trench. At the north end of the podium, where the robbing trench turns sharply to the west, two courses of blocks of Tufo Giallo della Via Tiberina are visible, perfectly on axis with the other traces (**fig. 29, b**). These ashlar remains have been assigned to the first phase of the temple primarily because of their alignment, which differs markedly from that of other ashlar structures that are securely dated to the Mid-Republican period, conforming to that of the later concrete architecture.[368] The substructures of the podium in this phase consisted of a series of four parallel walls, perhaps joined by axial transects (**fig. 31**). This platform was raised on top of a series of terraces, first

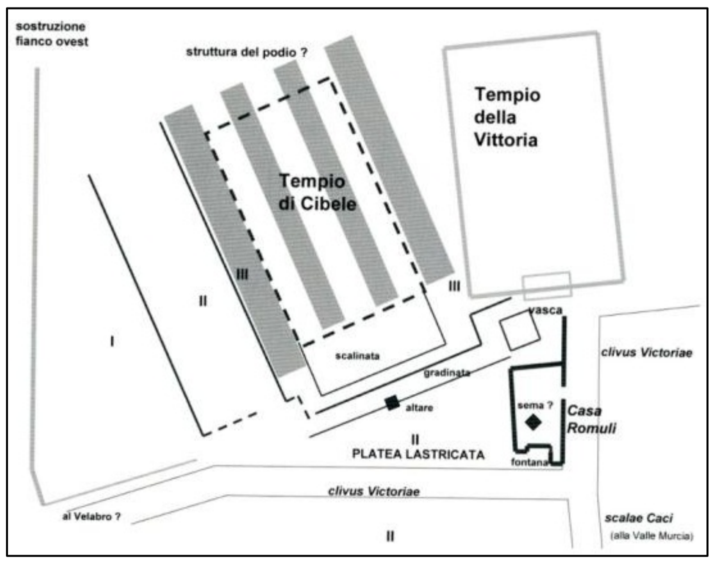


Figure 31. Rome, Palatine, Sanctuary of Magna Mater: restored plan of the early second c. BCE phase (after Pensabene and D'Alessio 2006).

[366] Pensabene 1980: 71; Battistelli 1991; D'Alessio 2009: 237-238.
[367] For a detailed description see D'Alessio 2009: 231, footnote 9.
[368] Pensabene 1980: 67; Pensabene 1981:104; D'Alessio 2006: 433-434; Pensabene and D'Alessio 2006: 32, fig. 2.

created for the construction of the Temple of Victoria but then partially remodeled. The high podium was connected to a wide staircase, which also gave access to a monumental basin located at the southeast corner of the podium.[369]

With the exception of the stretch of blocks incorporated as a facing in the southwest corner of the concrete podium, in the following building phase the ashlar structures were cut down and re-purposed in order to support a new paved terrace extending as far as the south slopes of the Palatine. In this sector, the surface of the road that delimited the sanctuary in the previous configuration (i.e., the Clivus Victoriae) was lowered through a cut in the bedrock, thus transforming the road into a *via tecta*. To the north, the road was bordered by a series of concrete vaulted rooms supported by ashlar piers connected by arches made of voussoirs of Tufo Lionato (Anio) and spandrels faced with *opus reticulatum* (i.e., the so-called *tabernae* near the Scalae Caci), while to the south a vaulted corridor ran parallel to the road (the maximum span of the vaults is approximately 4.50 m). Farther to the south, the platform rested on a pillared structure supported by the system of Tufo Lionato (Anio) *opus reticulatum* substructures, which formed the monumental front of this side of the hill.[370]

On a lower terrace west of the temple podium, a new basin lined with hydraulic mortar was built (**fig. 29, c**) in substitution of the previous one, which was obliterated under the top platform. Three other concrete structures are also related to this phase: an unfaced concrete wall delimiting the tank on the south side and closing one of the rooms facing onto the *via tecta*; on axis with this, an unfaced *temenos* wall delimiting the area of the sanctuary to the west; and another east-west wall faced with *opus incertum*, abutting on the *temenos* wall at a right angle to

[369]Pensabene and D'Alessio 2006: 37-38, fig. 4-5.
[370]D'Alessio 2009: 231-233.

the north, whose foundations directly cover the ashlar blocks belonging to the previous phase.[371] The activities connected with the reconstruction of this sector of the sanctuary disturbed heavily the upper sequence of leveling layers that had been deposited for the creation of the Mid-Republican terraces, which indeed contain frequent intrusions of materials dating to the second half of the second c. BCE (e.g., Italo-Megarian bowls, Thin-walled beakers, Late Punic amphoras). Hundreds of fragments of the same type of terracotta figurines found by Romanelli in the podium were also collected from the construction fills of the lower terrace, demonstrating a link between the construction process of the podium and that of the platform in the post-111 BCE renewal of the sanctuary.[372] The sequence of strata documented in the west sector was sealed by a thick preparation containing numerous Peperino inclusion that frequently had a worked face, suggesting that waste material resulting from the construction of the podium and the sculpting of the architectural decoration was recycled as a volume filler for the leveling deposits.

In conclusion, the stratigraphic evidence from the Temple of Magna Mater demonstrates that both *opus incertum* and *reticulatum* were used in the same phase of the sanctuary, but for different purposes within the structure. In particular, *opus reticulatum* was adopted for the most sophisticated terracing walls. The important implication is that different techniques do not always represent successive events.[373] It is also worth emphasizing with the so-called Porticus Aemilia out of the picture, the *via tecta* at the sanctuary of Magna Mater represents the earliest datable example of concrete vaulting in Rome (111-101 BCE).[374] We may infer from this that the first use of concrete walling, which represents a necessary step for the development of concrete vaulting, should predate the end of the second c. BCE.

[371]Pensabene *et al.* 1993: 29-30.
[372]For a detailed description of the assemblage see Rossi 2009: 224-225.
[373]Cf. Coarelli 2012: 249-282, who rejects the stratigraphic sequence as reconstructed by Pensabene and his team.
[374]For the dating of the dedication see D’Alessio 2009: 234-236.

4.2.2 The Temple of Victoria

The construction technique of the concrete podium of the Temple of Magna Mater finds a precise parallel in the neighboring site, which is currently identified as the Temple of Victoria (**fig. 27, 2**).[375] The reconstruction of this monument can be placed on the basis of stratigraphic evidence in the same phase. The facing ashlar blocks of Tufo Giallo della Via Tiberina, which formed the exterior of the mid-Republican temple, were also in this case maintained and reused with the function of permanent shutterings, only to be spoliated in modern times.[376] In the pronaos, the construction fill deposited inside the ashlar armature of the previous phase was completely dug out and substituted with a concrete core (**fig. 29, d**) made with mortar including red and gray varieties of pozzolana and aggregates of Tufo Lionato, Tufo Giallo della Via Tiberina, Travertine, recycling as *caementa* also architectural fragments of Peperino (including Corinthian capitals of the Italic type, and column shafts).[377] Large blocks of Tufo Lionato (Anio?) were placed at regular intervals in the concrete mass to support the columns of the pronaos, as well as in the open area in front of the façade, where they formed the pavement.

New concrete walls were added also in the cella, abutting on the older ashlar foundations, in order to support an interior Corinthian colonnade (the surviving elements have been dated stylistically to the first half of the first c. BCE).

4.2.3 The Temple of Veiovis

A slightly earlier date (between 150 and 120 BCE) has been attributed to the remains of the earliest concrete phase of the Temple of Veiovis on the Arx (**fig. 27, 3**).[378] The pre-Sullan architecture was investigated by A. M. Colini, who dug six sondages in the cella and on the sides

[375]On this identification see Pensabene 1994.
[376]Pensabene 1994: 14-15; 26-27, figs. 13-14.
[377]Pensabene 1994: 38-42.
[378]Colini 1942; Lugli 1957: 412 (150-120? BCE); cf. Billig 1944: 129, footnote 2, assigning the concrete structures to the original construction of the monument (196-192 BCE).

of the temple that replaced the preexisting one some time after the so-called Tabularium was built nearby.[379] The podium of the later monument, made of a grid of concrete walls filled with soil, was raised on top of a mass of concrete made of dark-gray ("nerastra") pozzolanic mortar and Tufo Giallo della Via Tiberina aggregates (**fig. 32**).[380] This structure follows a different orientation from that of the later temple, generating the main alignment that the southwest corner of the Tabularium respects.

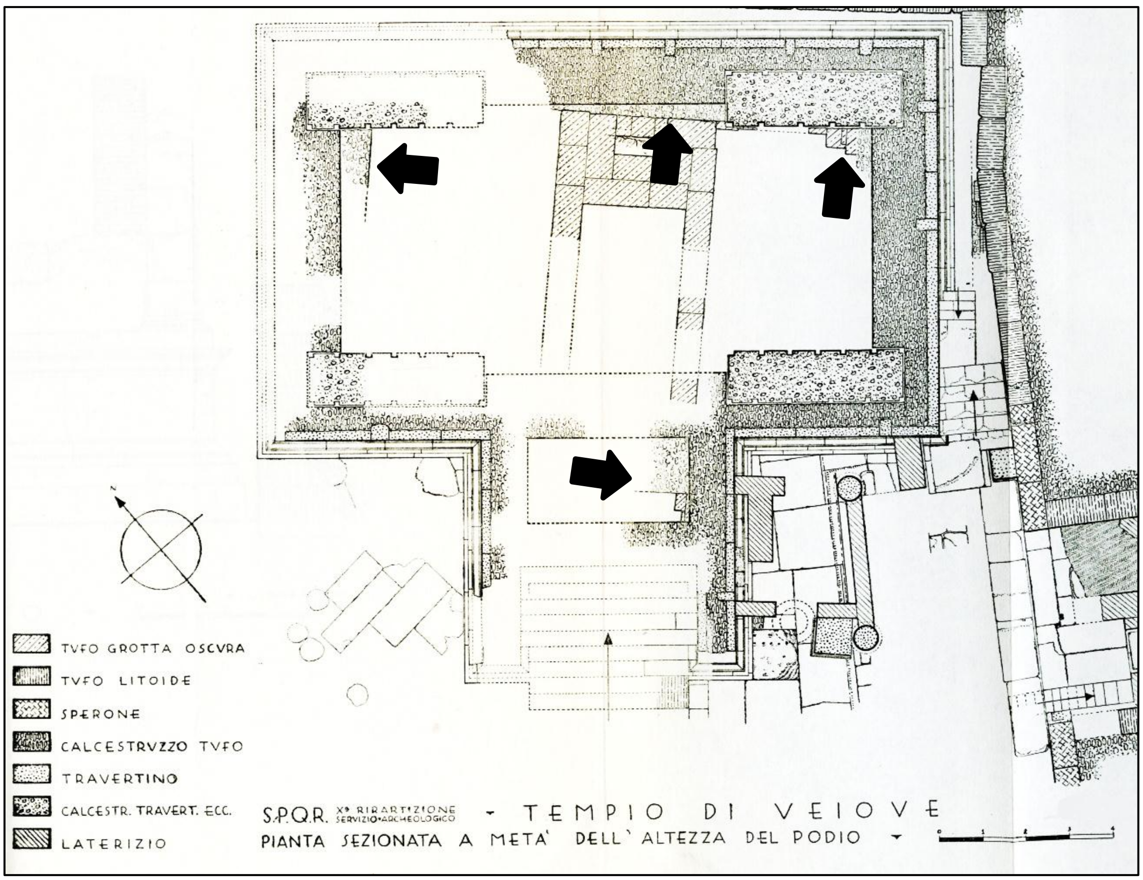


Figure 32. Rome, Capitoline: state plan of the Temple of Veiovis (the arrows indicate the second c. BCE remains; after Colini 1942).

The concrete core was faced with Tufo Giallo della Via Tiberina ashlars, of which four courses were seen below the foundation of the left flank of the pronaos of the later temple,

[379]Colini 1942: 20-25.
[380]Colini 1942: 10.

continuing on the front, where it supports the foundations of the colonnade (the situation on the other side of the pronaos is not clear; in a test-trench excavated on the exterior of the later podium no traces of the foundation were detected). Two courses of blocks joined to the concrete mass were also found on the back of the cella, where the podium structure covered a lower course of ashlars 1.20 m wide.[381] This clearly represents an earlier phase of the monument in *opus quadratum*, which was partially dismantled when the first concrete podium was built, reusing ashlars for both facing and elevation (in the north corner, the concrete foundation includes on its lower interface a block placed at an odd angle, as if it was dumped in the foundation trench). To the *opus quadratum* construction, in all likelihood corresponding to the first building phase of the monument (commonly dated to 194-192 BCE: Pliny the Elder, 16.216; Livy, 35.41.8), can be connected the remains of a lower floor made of loose crushed tuff, which contained black-gloss pottery. The floor preparation of the first concrete podium was found m 0.50 below the later cella floor; this preparation was obliterated by a construction fill containing numerous fragments of mosaic decoration, which unfortunately remained unpublished.

The style of these mosaics provided the only dating element, based on comparanda from the Temple of Hera Basilissa at Pergamum (ca. 150 BCE), and the Temple of Apollo Sosianus in Rome.[382] The latter is associated with an inscription (ILLRP 45) which Degrassi dated to the first half of the second c. BCE (transformations in the area of the temple are recorded for 179 BCE by Livy, 40.51.3; concrete, however, is not found in the architecture of this monument before the first c. BCE *opus reticulatum* phase).[383] Based on the distribution of tessellated mosaics in Rome, a chronology in the latter part of the second c. BCE is also possible. A tuff plinth with a dedicatory inscription by C. Fannius (CIL 1^2.658), dated to the year of his consulate (122 BCE),

[381]Colini 1942: 23 fig. 19.
[382]Colini 1942: 26.
[383]Ciancio Rossetto 1997-98: 191, fig. 17.

probably comes from the area in front of the temple, but its relation with the known building phases is uncertain.[384]

4.2.4 The Temple of Castor and Pollux (Phase IA)

A more selective use of concrete has been detected in the context of restoration works involving another sacred building originally built with *opus qudratum*, the Temple of Castor and Pollux in the Forum (**fig. 27, 4**). The importance of this context is immediately evident: in light of the construction sequence documented at this site, a more reliable *terminus ante quem* can be indeed be accepted for a group of concrete structures belonging to the same stratigraphic position. Recent excavations within the first concrete podium of the temple, which is conventionally identified with the one rebuilt by L. Caecilius Metellus Dalmaticus in 117 BCE (Cicero, *Scaur.* 46; *Verr.* 2.1.154), brought to light parts of the original monument, consisting of a grid of ashlar walls of Cappellaccio (Phase I). Traces of an intermediate phase (Phase IA) were also found (**figs. 33**).[385] These are represented by structures made of a concrete featuring brownish mortar, and large *caementa* predominantly of Cappellaccio (most likely recycled), but also Tufo Lionato ("hard reddish tufa" in the definition of the excavators) and Peperino, concentrated in the area of the pronaos, where they replaced stretches of the earlier Cappellaccio walls (for a maximum depth of approximately 1.50 m).[386] Based on the macroscopic properties of the mortar (reddish-brown color, with coarser additives of unspecified nature and blackish-gray pozzolana up to 1.5 cm in diameter),[387] these concrete structures can be clearly distinguished from the later constructions. Another difference is that, while the podium of the Metellan temple was built with timber shutterings, the irregular surface of the walls of Phase IA

[384]Colini 1942: 40-41.
[385]Nielsen and Poulsen 1992; Nielsen 2008.
[386]Nielsen and Poulsen 1992: 80-82 (Trench E).
[387]Nielsen and Poulsen 1992: 80; Nielsen 2008: 336.

indicates that mortar and aggregates in this case were placed directly in construction trenches which were dug through the soil fill of the podium of Phase I. To be more precise, the cuts resulted from the removal of the Cappellaccio blocks (e.g., in the "IWN" wall; **fig. 34**).[388] This construction procedure is similar to the one already discussed in the case of Houses 6 and 7 in Carandini's excavations. This evidence suggests that, as it is also documented in domestic contexts, the development of hydraulic mortar technology and the development of concrete walling in public construction progressed simultaneously.

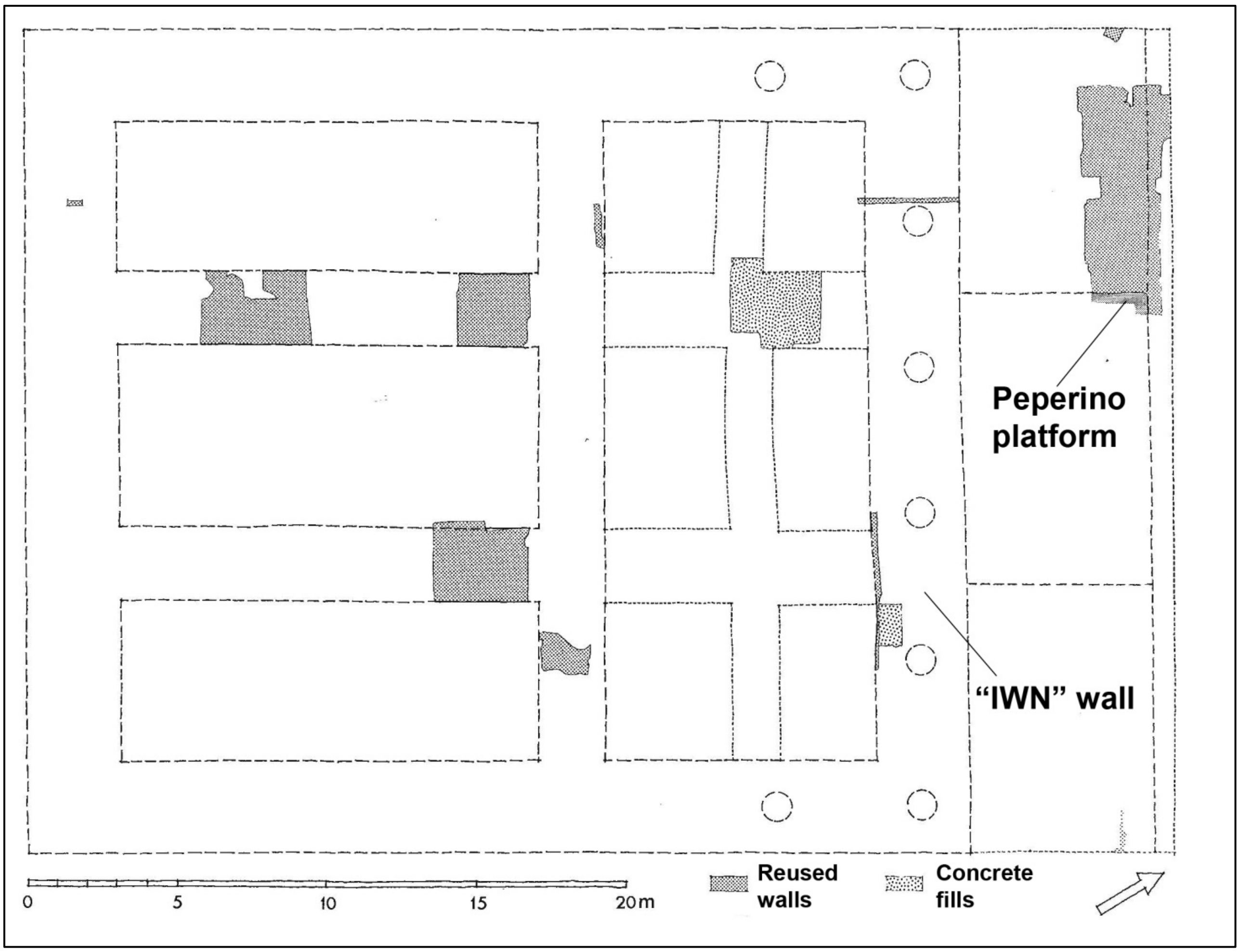


Figure 33. Rome, Forum, Temple of Castor and Pollux: restored plan of Phase IA (after Nielsen and Poulsen 1992).

388 Nielsen and Poulsen 1992: 80.

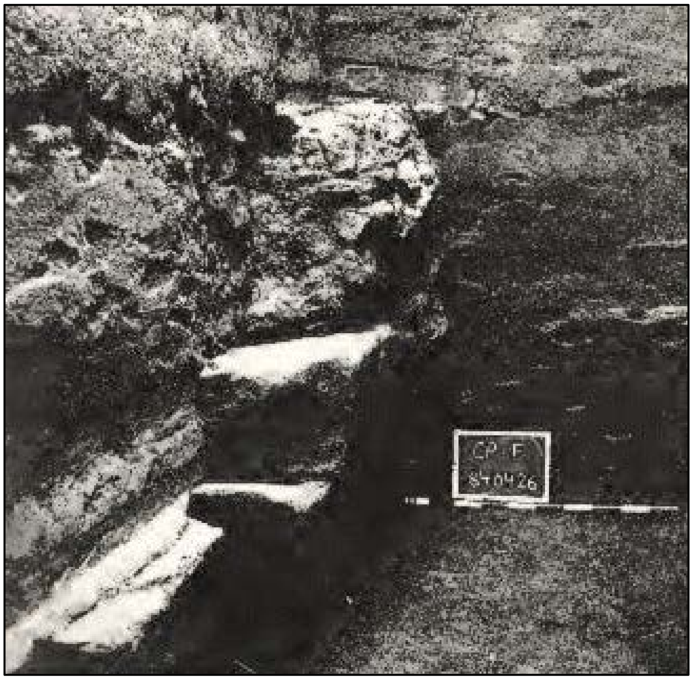


Figure 34. Rome, Forum, Temple of Castor and Pollux (Phase IA): concrete remains on top of the archaic structures ("IWN wall"; after Nielsen and Poulsen 1992).

These concrete restorations reveal that parts of the centuries-old building sustained some damage, which as the excavators suggest was perhaps discovered in the context of a series of radical modifications affecting the front of the temple (but it is also possible that the damage was caused after these alterations). The first row of columns as well as up to four courses of the ashlar exterior shell of the podium were removed in order to create a lower platform, which was then paved with slabs of Peperino (this pavement rests at the same level as the concrete restoration of the "IWN wall", suggesting that the two operations were carried out simultaneously).[389] The excavators connect this to the fact that at least from 160-159 BCE the Temple of Castor and Pollux served frequently as a meeting place for the Senate (e.g., Cicero, *Verr*. 2.1.129), and specifically to the installation of a *tribunal pro aede Castoris* (attested by Festus 362 L as functioning probably as early as 142 BCE),[390] which allegedly became the main structure for legislative and judicial assemblies (it was enlarged in the late second c. BCE reconstruction of the monument). In archaeological terms, this concrete phase has been dated

[389]Both the Peperino pavement and the concrete restoration of the "IWN wall", which according to the reconstruction of the excavators supported the new columnar façade, are at a level of m 14.95. This is considerably lower than that of the podium, which stands at m 15.60. The excavators suggest that the upper part of the foundation of the columns was built with ashlars laid on top of the concrete foundation, which would have been otherwise visible (Nielsen and Poulsen 1992: 82).

[390]Sources in LTUR I, 1993: 242-245, s.v. "Castor, Aedes, Templum" (I. Nielsen); Nielsen and Poulsen 1992: 86.

generically to the first half of the second c. BCE, arbitrarily taking 200 BCE as a *terminus post quem* for the introduction of concrete.[391]

From the fill of the Metellan temple several materials have been recovered, which have been linked to the new decorative system with which the cella was appointed in this phase: *crustae* of Palombino, fragments of First Style paintings, and stucco and terracotta revetments, including fragments of a terracotta door frame dated stylistically to the period 160-130 BCE.[392] Even though the assemblage seems to point to a date in the second half of the second c. BCE, the excavators identify three possible contexts for the renovation of the temple in the earliest part of the century: an as of yet unknown benefaction of T. Flamininus in 194 BCE, on account of his dedication of shields to the Dioscuri at Delphi, possibly after the destruction caused by the fire of 211 BCE; a connection with the construction of the Basilica Sempronia in 169 BCE, based on the hypothesis that the two archaic antefixes found by Carettoni and Fabbrini under the neighboring site of the Basilica Iulia were part of the fifth c. decoration of the Temple of Castor and Pollux, which would in turn imply that this was redecorated on the same occasion; or an initiative of L. Aemilius Paullus, based on a late text of Minucius Felix (*Oct*. 7.3) mentioning statues of the Dioscuri, in relation to the story of their appearance *in lacu* (most likely the nearby Lacus Iuturnae) to announce the victory of Pydna.[393] The latter hypothesis was first proposed by Steinby (1985), who argued for a dedication by L. Aemilius Paullus in the first year of his censorship (164 BCE), in the context of a broader building program which refashioned the east

[391]Nielsen and Poulsen (1992: 84, footnote 6) accept Coarelli's date for the first concrete phase of the Temple of Magna Mater (204-191 BCE).

[392]Nielsen and Poulsen 1992: 85. For the dating of the terracotta door frame see Richardson 1992: 171-176. Nielsen (1992: 106-108) points out that the earthfill (ca. 1,000 m^3) from which the assemblage of architectural decoration has been recovered was not obtained from excavation on the same site (the foundation of the Metellan temple are built on top of the Cappellaccio remains). It is possible that part of these materials originated from other building contexts.

[393]Poulsen 1992: 49-50; on the relationship between the Temple of Castor and Pollux and the Basilica Sempronia see Poulsen 2008: 368-369.

side of the Forum (*infra*, 4.3).[394] While the *terminus ante quem* of 117 BCE can be accepted safely, the construction dates proposed by Steinby remain entirely conjectural, given the absence of any specific reference to restorations of the Temple of Castor and Pollux. The date of Phase I, therefore, cannot be pinned down.

4.2.5 Substructiones on the East Slopes of the Palatine

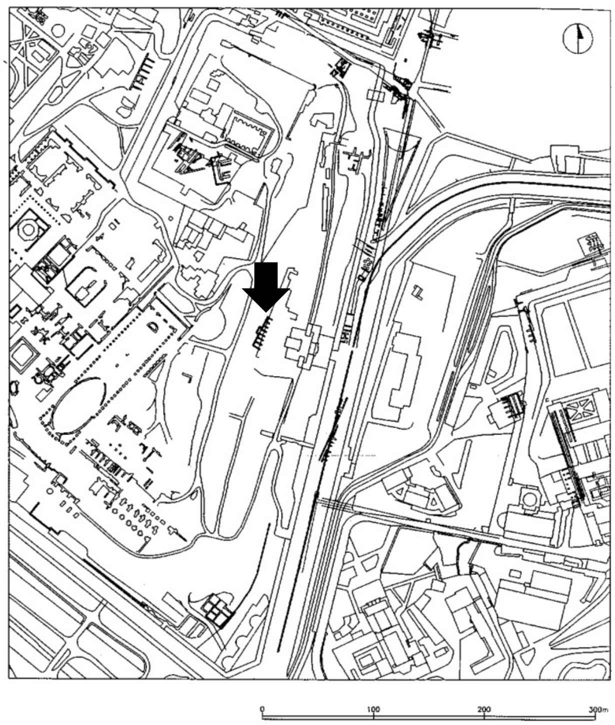


Figure 35. Rome, Palatine. Location of substructures on the east slopes of the hill (after Anselmino 2006).

A series of concrete vaulted structures supporting a terrace is located on the east slopes of the Palatine, near the Orto of S. Bonaventura (between the sites of Vigna Barberini and the Domus Flavia; **fig. 27, 5**; **fig. 35**). The building consists of a series of five rooms measuring ca. m 3 in width, at least 7 m in length (the façade is not preserved) and at least 2.50 m in height (the rooms are still partially backfilled); traces of two more rooms have been detected on either side of the standing remains, which were truncated and incorporated into multi-phased brick-faced structures of the Imperial period (**fig. 36**; the minimum width of the structure can be calculated at ca. 32 m, assuming that both these rooms were of the same dimensions as the others).[395] The walls are made with *opus incertum* of quite regularized facing blocks of Tufo Lionato (Anio) of various sizes.

[394]On this theory see most recently Steinby 2012a: 59-61 (note that the date is based on the building technique). The literary sources on the censorship of L. Aemilius Paullus are collected in Steinby 2012a: 93-94.
[395]Anselmino 2006: 229-235; fig. 8.

The rooms are spanned by barrel vaults with an intrados faced with medium-sized oblong rectangular blocks of Tufo Giallo della Via Tiberina laid radially. In her study of the monument, Anselmino (2006) points out that this technique is documented also in the Testaccio building (which she identifies with the Porticus Aemilia of 174 BCE) and, outside of Rome, at the Rione Terra in Puteoli (e.g., the "Criptoportici", for which she accepts a date in the first or second quarter of the second c. BCE; *infra*, 6.4.2). Her conclusion is that the same group of builders may have been employed at these sites, thus suggesting for the structure a date in the first half of the second c. BCE, but the connection is very tenuous.[396]

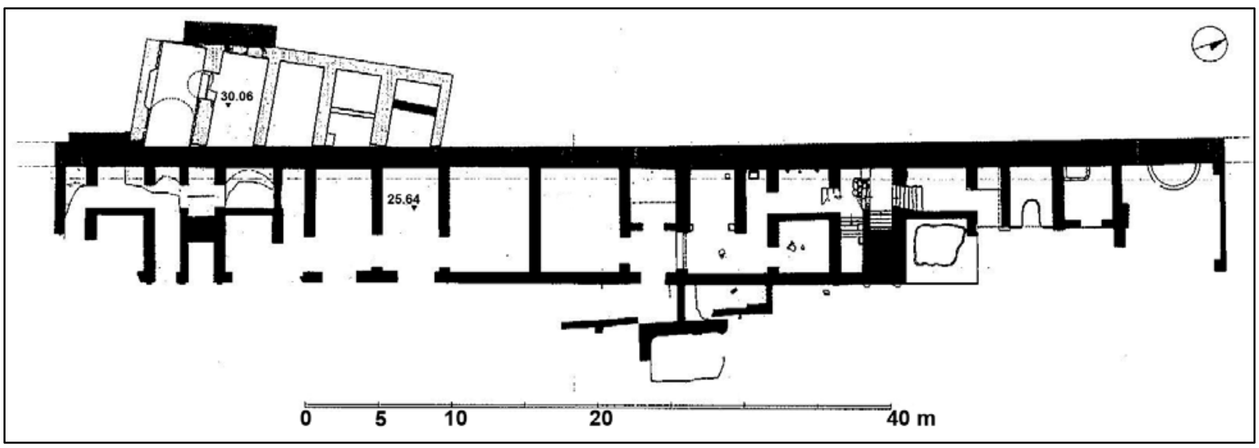


Figure 36. Rome, Palatine, east slopes: plan of *opus incertum* substructures (in gray; after Anselmino 2006).

The Palatine building shares features with other monumental contexts of Latium Vetus and Adiectus that can be generically dated to the second half of the second (Prenaeste, Via degli Arcioni; lower terrace of the Forum of Cora) or early first c. BCE (the extra-urban sanctuary at Tusculum).[397] One of such features is the narrow corridor (0.60 m) running at the back of the rooms, separating the structure from the natural bedrock (perhaps serving both as insulation and

[396]Anselmino 2006: 235 (and footnote 43), following Zevi (2003) for the connection between Puteoli, Rome and the gens *Aemilia*.
[397]Anselmino 2006: 233-234, with reference. D'Alessio 2011.

to collect surface waters). Given the less developed vaulting system, it is possible that these substructures are earlier than those of the sanctuary of Magna Mater (the *via tecta*), but it is difficult to assign a more precise chronology.

The function of this structure is also disputed, because of the lack of contextual data. Based on the widespread association of this kind of architecture with sacred buildings,[398] the *opus incertum* remains have been interpreted as the monumental *substructio* of a temple. The current identification is with the Temple of Fortuna Respiciens, which both the *Curiosum* and the *Notitia* catalogues locate on the east flank of the Palatine between the Septizonium and the Curiae Veteres. This interpretation rests primarily on the topographical relationship with the find spot of the famous terracotta pediment of via di S. Gregorio (**fig. 37**), which was recovered during late 1800s excavations along the modern road, near the piers of the aqua Claudia, about 75 m south of the *opus incertum* remains, but considerably farther down the slopes. The fragments were found in a concentration included in the lower level of a thick (up to 4 m) sequence of construction fills dumped to raise the valley bottom floor, presumably after the fire of 64 CE.[399] Alternative hypotheses have been advanced in the past to reconstruct the relative position of surviving elements as well as on the iconography of the figures, meaning of the scene and identity of the main deity. Based on these, the pediment has been interpreted by comparing it to different known temples which were located either on the Palatine or on the Celian (Mars, Venus, Victoria, Fortuna). This, in turn, influenced to a great degree the dating of the sculptural piece.

Thus, opinions on the chronology ranged from dates as early as the third c. BCE to as late

[398]On the spread of vaulted architecture in Late Republican sanctuaries see D'Alessio 2007a: 425-430; 2007b; 2011. For Rome see also Coarelli 2010.
[399]Anselmino *et al.* 1990-91.

as the first half of the first c. BCE.[400] Low chronologies were based on the reading of the scene as a *suovetaurilia* and its similarities with the *lustrum censorium* represented on the so-called altar of Domitius Ahenobarbus.[401] With few exceptions, scholars now believe that the association with the Temple of Fortuna Respiciens is the more convincing, at least because all alternative locations are farther away from the actual place where the statues were discovered.[402]

Figure 37. Fragments of the terracotta pediment from Via di S. Gregorio (after Coarelli 2012).

Based on the stylistic analysis of the only female head preserved and on the overall symmetry and paratactic composition of the scene, it has been suggested that the artists were strongly influenced by neo-Attic classicism.[403] The introduction of this style in Rome has been

[400]For a complete reference to the scholarship on this monument see Anselmino *et al.* 1990-91: 179, Table 1.
[401]There is no consensus on the chronology of this monument either. Proposed dates are as high as 128 BCE (e.g., Zevi 1976) or as low as 97-70 BCE (e.g., Hölscher 1979; La Rocca 1990).
[402]Update on the debate in Anselmino 2006: 239, with footnote 33; Coarelli 2012: 200-219.
[403]Anselmino *et al.* 1990-91: 241-252.

linked with the activities of the Greek sculptors Dionysios and Polycles, who executed the cult statues for the temples of Iuno Regina and Iuppiter Stator in the Porticus Metelli (presumably in the period 143-131 BCE: *infra*, 4.2.6; this would represent a *terminus post quem*).

Given the religious connections between the cult of Fortuna Respiciens and the liturgy of the Roman triumph,[404] M. J. Strazzulla has proposed linking the construction of the temple to which the pediment belongs with either Scipio Aemilianus, speculating on possible ritual implications in the well-known episode of Aemilianus crying after the destruction of Carthage (Polybius, 38.21); or even L. Aemilius Paullus, based on a reference in Plutarch (*De fort. Roman*. 4), which mentions the special devotion the general accorded to the goddess (in this case the dedication would be connected with his victory at Pydna). The loss of Livy as a source for Rome's construction history after 167 BCE offered a convenient (but questionable) argument *ex silentio* in support of the identification.[405]

Regardless of the chronology of the pediment, whether the *opus incertum* building should be identified with the terracing wall of the Temple of Fortuna Respiciens is an entirely different problem. The structure seems to be wide enough to support a temple whose width can be estimated at about 20 m (the pediment could measure up to 15-16 m); the space between the front of the terrace and the road running behind it (ca. 50 m) would be long enough to contain a building with very elongated proportions. On the other hand, the later history of the monument contrasts with this interpretation, because the *opus incertum* terrace was incorporated into a larger structure already by the time of Hadrian, to be transformed into what has been interpreted as an apartment block later on in the second c. CE.[406] The possibility that the terrace was also part of a domestic structure in the previous period should not be overlooked (parallels can be

[404]E.g., Coarelli 1968; 1988: 258-262; 425-426.
[405]Anselmino *et al.* 1990-91: 252-262. Anselmino 2006: 238.
[406]Anselmino 2006: 240-241.

found in the *substructiones* of Via Palermo on the Viminal; *supra*, 3.2.11).[407] If this were case, the Temple of Fortuna Respiciens would have to be located at a lower level towards the foot of the Palatine, nearer to the find spot of the pediment fragments, in the area between the Aqua Claudia and the modern gate to the Palatine.[408]

To sum up, very little evidence is available to date the concrete structures on the east flank of the Palatine, due to the uncertain identification of the monument and the broad chronological range one can assign to the terracotta sculptures that possibly decorated the building. It is impossible at present to say how early these *opus incertum s*tructures may be. A comparison with the vaulted structures on the southwest slopes of the hill in the sanctuary of Magna Mater shows that the latter are technically more sophisticated, but this does not necessarily imply a chronological separation. The 150 BCE date proposed by Anselmino (2006) remains hypothetical.

4.2.6 The Porticus Metelli

Literary sources suggest that the Romans began to construct monumental porticoes early in the second c. BCE. The Roman building type has been interpreted as an adaptation of the Greek *stoa*.[409] It differed from the Greek counterpart because it was rarely found in free-standing form, being normally attached to other buildings, often with the function of colonnaded connector ("*qua in arcem eitur*", says a late second c. BCE inscription from Aletrium, with reference to a newly built *porticus*).[410] As already noted, the Testaccio building could hardly fit in this category of monuments, forcing scholars to assume that ancient usage of the term porticus

[407]Transformation of élite *domus* into *insulae* is also a common phenomenon (see Ramieri 1980 for an example from the Viminal). The incorporation of sacred buildings into private properties is also attested by literary sources, but only in the case of small archaic shrines: Häuber 1998.
[408]A possibility considered in Anselmino *et al.* 1990-91: 211-213 but eventually rejected in Anselmino 2006.
[409]See especially Nünnerich-Asmus 1994: 25-54.
[410]CIL X 5807. On the function of the earliest porticus see Richardson 1977; Livy, 41.27.5.

could in some way apply to buildings featuring piers instead of columns.[411] With the so-called Porticus Aemilia finally out of the picture, the earliest surviving archaeological example of this new form of columnar display in Rome is the Porticus Metelli (perhaps built in the period between 143 and 131 BCE; **fig. 27, 6**).

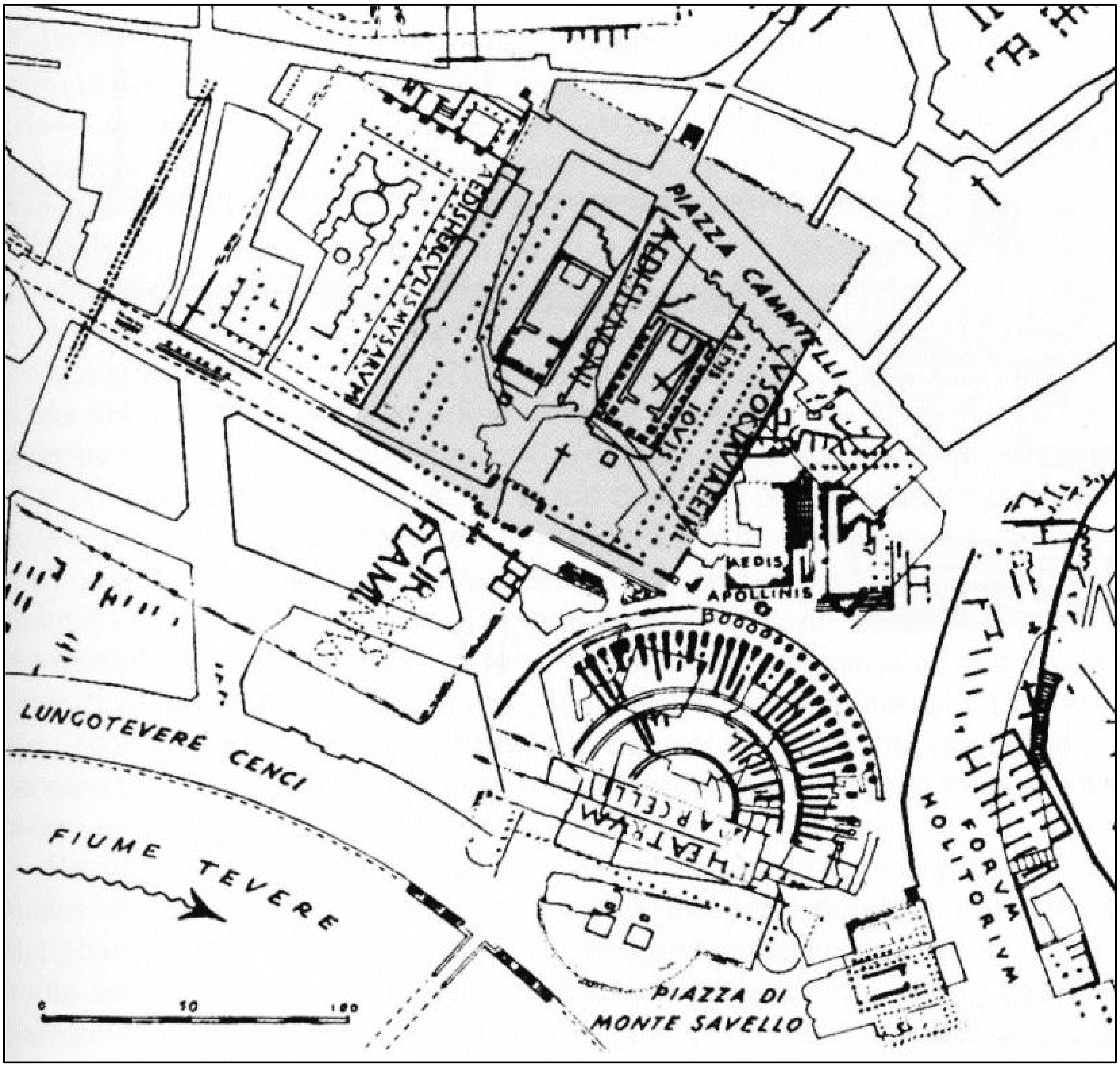


Figure 38. Representation of the Porticus Metelli/Octaviae on the Forma Urbis (shaded area; after Ciancio Rossetto 2009).

[411]Nünnerich-Asmus 1994: 26. In reality, the Testaccio building should be best described as structure made of continuous walls pierced with arched doorways, appearing as piers in sectional plans.

This monument was famous in antiquity because it displayed a number of architectural innovations (Velleius, 1.11.3-4; 2.1.2; Pliny the Elder 34.31; 34.64; Vitruvius, 3.2.5): besides being the first porticus of the peristyle type, it was also associated with the first marble temple in Rome (the temple of Iuppiter Stator, which stood at the center of the porticus alongside the temple of Iuno Regina).[412] As it happens, this represents the earliest datable attestation of *opus incertum* in public building.

The monument is represented on the fragments 31bb, 31cc, 31dd, 31 u and 31 vaa of the FUR, where it appears in the form of a *temenos* with a single colonnade on the short sides to the north and south (the latter incorporating a hexastyle propylon) and two aisles on the long sides to the east and west (**fig. 38**). In this phase the monument was known as Porticus Octaviae, being named after the step-sister of Augustus, who is said to have rebuilt the Porticus Metelli perhaps in 27 BCE.[413]

The Republican structure is preserved beneath the Augustan and later (Severan: CIL 6.1034) additions, which did not alter significantly the plan of the building. Parts of the south side were investigated first by Colini in 1950 (**fig.39**).[414] Limited soundings were then carried out in 1987 by the SSBAR in the north side and northwest corner, which are incorporated in the basement of Palazzo Patrizi Clementi.[415] More exhaustive investigations in the area were conducted in 1996-97, clarifying the sequence of construction of the podium and of the monumental entrance on the south side (**fig. 40**).[416]From these it results that the front colonnade rests on a stylobate consisting of a two parallel structures retaining a construction fill.

[412]Whether this temple was the earliest example of the type conventionally classified as *peripteros sine postico* is an open problem: Gros 1973 (suggesting that the *peripteros sine postico* in Vitruvius may indicate a peripteral temple without opisthodomos).
[413]LTUR IV, 1996: 141-145, s.v. “Porticus Octaviae” (A. Viscogliosi).
[414]Cressedi 1954; Lugli 1957: 409; 412; reappraisal of the documentation in Lauter 1980-81 and Ciancio Rossetto 1995; 1996.
[415]Giustini and Di Manzano 1990.
[416]Results in Ciancio Rossetto 2009.

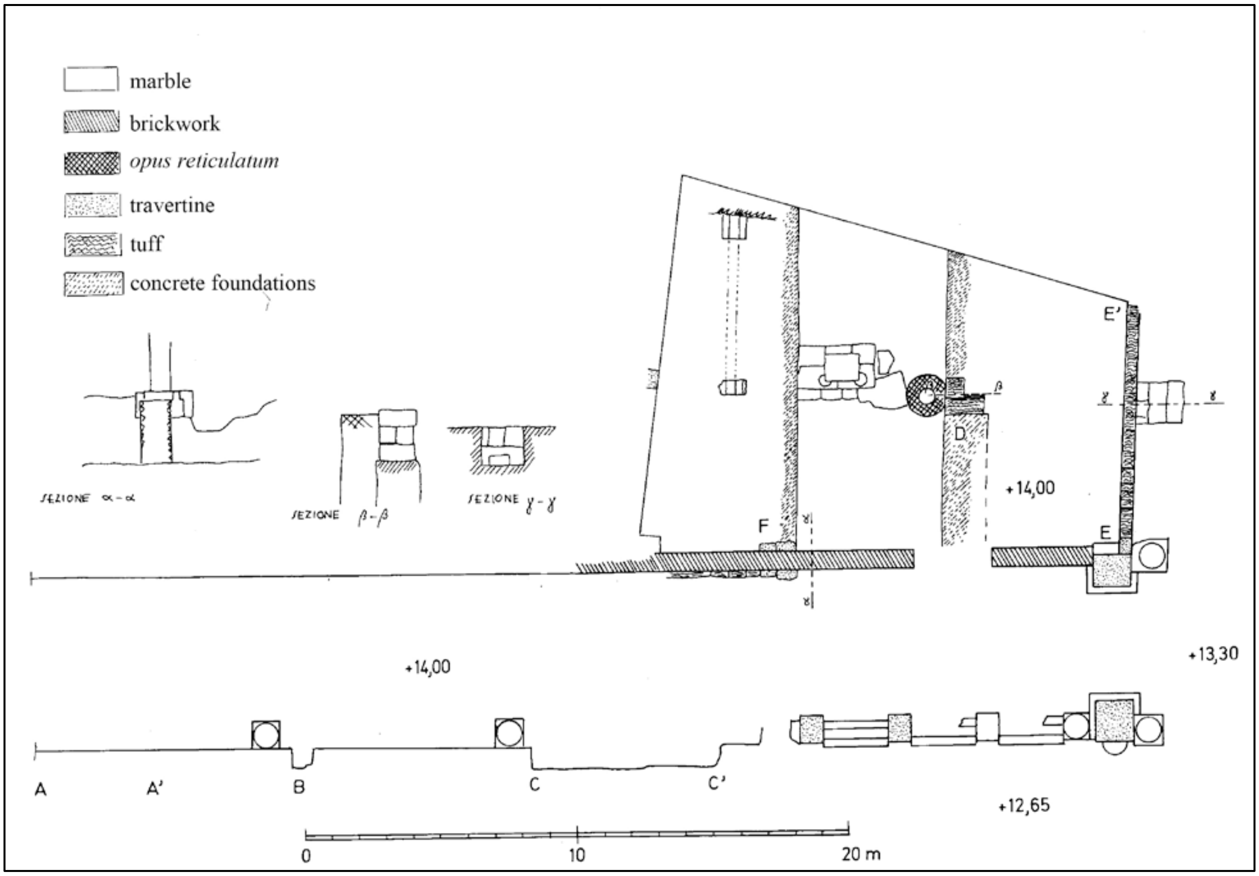


Figure 39. Rome, Campus Martius, Porticus Metelli/Octaviae: state plan of the southeast corner (after Lauter 1980-81).

The external retaining wall is made of stretchers of Tufo Lionato (Monteverde), of which the bottom course was sculpted with a *cyma reversa* moulding (perhaps this rested on another course of blocks).[417] The top layer of Peperino headers belongs to the Augustan reconstruction.[418] At the center of the south side, behind the projecting propylon added in the Imperial period, is a thick (1.10 m) *opus incertum* wall with facing blocks of Tufo Giallo della Via Tiberina, flanked to the south by a drain running parallel to it.[419] This structure is perfectly aligned with the front colonnade; its function may have been to support larger columns marking

[417]Ciancio Rossetto 1995: 96-98.
[418]Lauter 1980-81: 39-40.
[419]Ciancio Rossetto 1996: 270 fig. 4.

the entrance to the complex on this side.[420] Other interruptions in the ashlar facing are documented on the south side, indicating the presence of staircases.[421] The internal retaining wall of the stylobate is made of concrete and faced with *opus incertum*, with facing blocks of Tufo Lionato (Monteverde).[422]

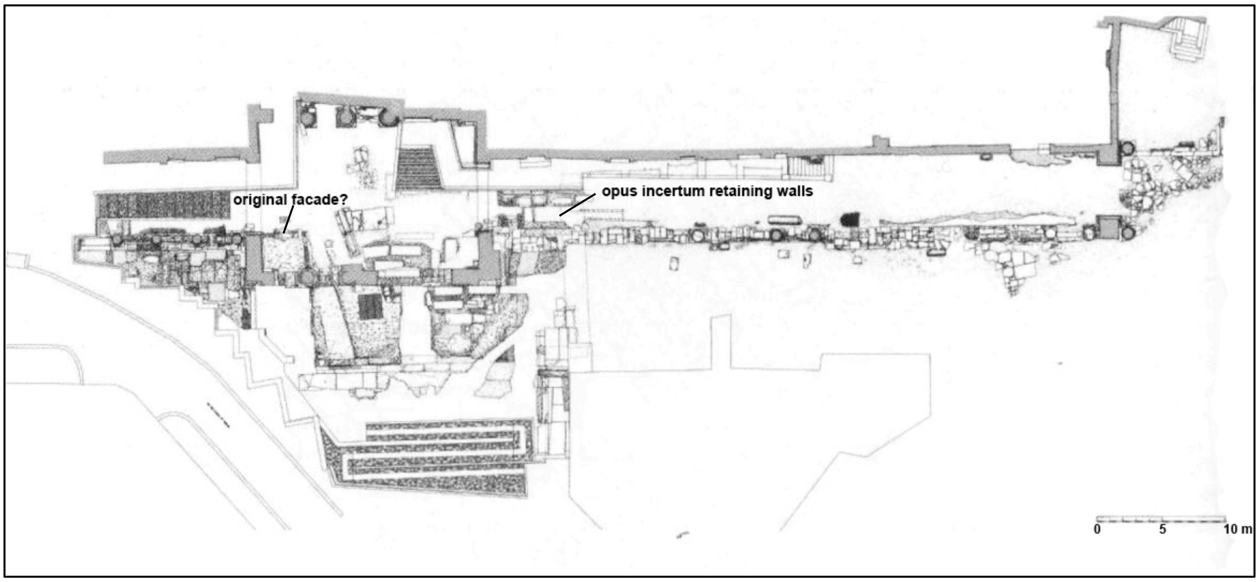


Figure 40. Rome, Campus Martius, Porticus Metelli/Octaviae: state plan of the south propylon (after Ciancio Rossetto 2009).

The southeast corner shows a similar construction technique, but features two parallel concrete foundations faced with *opus incertum* foundations instead of one, confirming the presence of a double colonnade on the long sides. The inner foundation is flanked by a drain connected with an *opus incertum* channel that runs on a slopes through the retaining walls of the south colonnade, discharging on the outside of the podium. The same arrangement has been documented in the northwest corner, where the drains were made of slabs of Peperino (the fill of this drain contained Republican coins).[423] The presence of a monumental propylon on this side of the complex already in this phase is only conjectural.

[420]Ciancio Rossetto 2009: 65.
[421]Lauter 1980-81: 42 (cross –section C-C'; the features are interpreted as exedrae).
[422]Lugli 1957: 409.
[423]Giustini and Di Manzano 1990: 71; 72, fig. 15.

Given the use of *opus incertum* for the retaining walls, it seems that the podium was built up starting from the Republican level of the area surrounding the Circus Flaminius. Once the stylobate was completed, the open space delimited by the precinct was paved with slabs of Peperino,[424] which could be accessed from a stepped ashlar structure (of at least 3 courses) abutting on the inner *opus incertum* foundation (the podium raises 1.70 m above this central courtyard). The pavement rested on top of a construction fill containing ceramic material of the Republican period, at a level considerably higher than that of the external area. At the center of the square were the temples of Iuppiter Stator and Iuno Regina, but their relationship with the pavement is unknown (according Livy, 40.52.1-2, the Temple of Iuno Regina predated the construction of the porticus by a generation: ca. 179 BCE).

The exact date of the Republican phase is not explicitly attested in historical sources. As is the case for other buildings located in the area of the Campus Martius, the common idea is that this monument has a connection with a triumph: namely, the one which M. Caecilius Metellus Macedonicus celebrated *de Macedonia et de Andrisco* (in 146 BCE: Livy, *Per*. 52; Valerius Maximus, 7.5.4).[425] Only Velleius (1.11.3) seems to place the construction of the porticoes during the period before the war in Macedonia. In another passage (2.1.3), he mentions that the Porticus Metelli was built "around the same time" as the porticoes of Scipio Nasica (perhaps of 159 BCE, year of his censorship; cf. also Tacitus, *Hist.* 3.74) and of Cn. Octavius (166 BCE: Pliny the Elder, 34.13),[426] but the details are vague. According to Morgan (1971), the earliest possible date for the *locatio* of the Temple of Iuppiter Stator and its enclosing porticoes is 143 BCE, when Metellus Macedonicus held his consulship; but he admits that a chronology in the

[424]Giustini and Di Manzano 1990: 72, fig. 16.
[425]Morgan 1971.
[426]Both of these buildings are known only from the descriptions of ancient authors. The internal organization of th the Porticus Octavia is debated. According to Gros (1976: 391), this was already in the form of a peristyle; cf. Zevi 1976: 1053.

130's remains equally valid: 136 BCE, the year of Metellus' first bid for censorship, or even 131 BCE, the actual year of his censorship.

The construction of the entire complex must have taken considerable time, considering the huge dimensions of the project, and it is likely that works started with the temple of Iuppiter Stator: moving heavy building material in and out of a raised precinct would not have been logistically feasible. We know that the architect in charge of this part of the project, Hermodorus, also received a commission to build the temple of Mars in Circo by D. Iunius Brutus Callaicus (on the basis of prosopographical data only a *terminus post quem* of 135-133 BCE can be tentatively established for the *locatio* of this temple; 128 BCE has been proposed as a date for its dedication),[427] though this does not necessarily imply that the Porticus Metelli was completed before work on the temple of Mars started. The activity of Hermodorus seemingly continued into the last decade of the second c. BCE, if in fact, as already noted, he is the architect mentioned by Cicero (*De or*. 1.62) in connection with the *opus navale* (ca. 110-100 BCE?).[428]

In sum, textual evidence allows us to place the letting of the contract for the temple of Iuppiter Stator and the Porticus Metelli in the period between 143 and 131 BCE. Construction of the temple probably started before the concrete box surrounding the sacred area was built up, suggesting for the latter a chronology in the latter part of the period, most likely in the 130s BCE. This seems consistent with the information we have on the career of Hermodorus, who was active in Rome in the final decades of the second c. BCE.

4.3 Early Concrete in Utilitarian Buildings

As we have seen, the Testaccio building and the viaduct in the Forum are among the few

[427] Zevi 1976; on the identification of this temple with the remains under S. Salvatore in Campo see also Tortorici 1988. Cf. Gros 1973.

[428] In addition to the Testaccio building, other *navalia* are known to have been in the Campus Martius. See LTUR III, 1996: 339-340, s.v. “Navalia” (F. Coarelli)

monuments attesting the use of *opus incertum* in utilitarian buildings and civil engineering projects that could well date to the late second c. BCE. Vaulted concrete architecture sharing similar principles and formal solutions had long been identified also on the east side of the Roman Forum (**fig. 27, 7**), where a row of parallel rooms covered with barrel vaults was built to span the drop in elevation from the Via Sacra to the Nova Via, supporting a ramp along the west boundary of the sanctuary of Vesta.[429] The function of this ramp, commonly referred to as the Scalae Graecae or Scalae Anulariae, was to serve as a public route to reach the site of the Porta Romanula (which was located on the northwest corner of the Palatine) without having to pass through the Forum square.[430] A stepped alley was thought to continue from the point where the ramp intersects the Nova Via up to the top of the Palatine, but recent excavations have shown that this part was probably only a passage within a different building of the Hadrianic period outside the limits of the Domus Tiberiana, built on top of a preexisting building featuring a narrow alley (**fig. 41**).[431]

The dating of the lower ramp is controversial. Van Deman and Blake first suggested a date in the Sullan period, but described the earliest remains as a form of *opus quasi reticulatum*. According to Steinby, the construction of the *opus incertum* structure could be as early as 175 BCE,[432] a date which would make this the first example of concrete architecture in Rome. This chronology requires a thorough reassessment, based on a comprehensive discussion of the formal characteristics of the ramp as well as of the relationship between this structure and the monumental complexes attached to it, the Atrium Vestae and the Lacus Iuturnae (both of which have been the object of recent stratigraphic investigations).

[429]Boni 1901: 62-64; Van Deman 1922: 17-18; Blake 1947: 251-252.
[430]Steinby 1985: 77-80; Steinby 1993.
[431]Cf. Hurst 2006.
[432]LTUR IV, 1999: 241-242 s.v. “Scalae Graecae” (E. M. Steinby), with a date before the end of the first third of the second c. BCE. Steinby 2011: 7 (“between the end of the third c. BCE and the first third of the second c. BCE”).

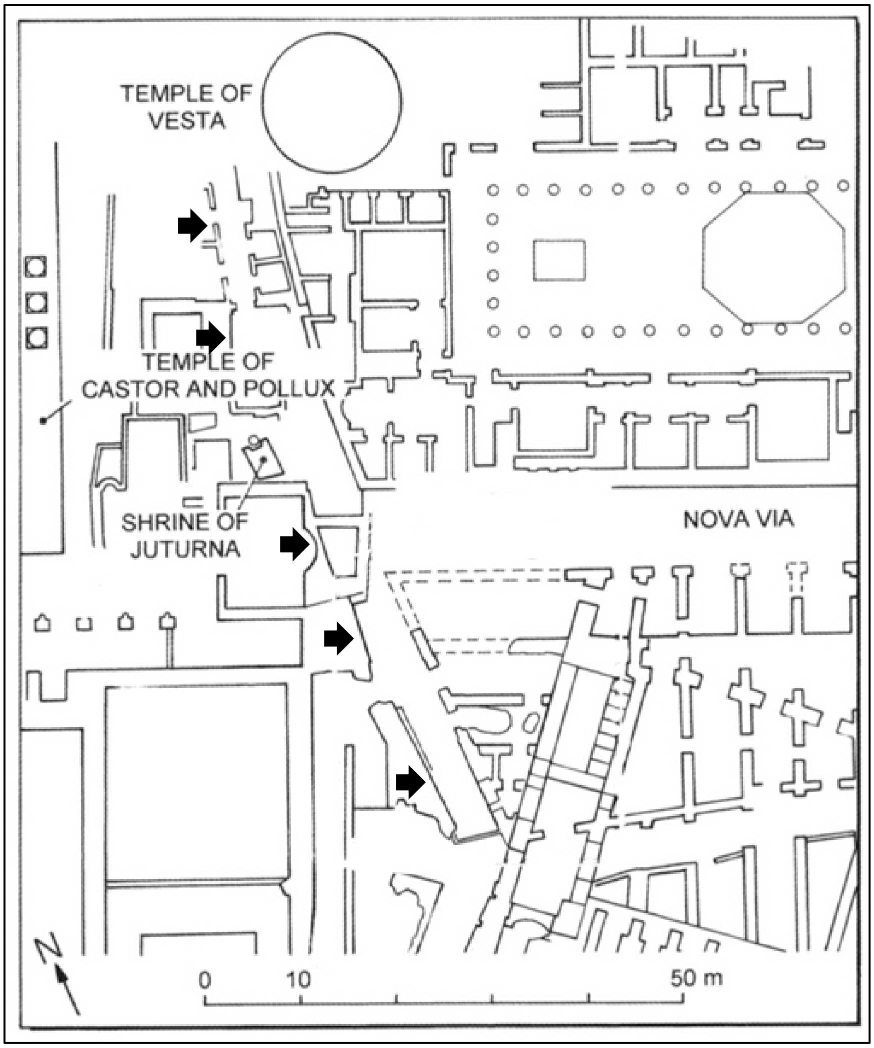


Figure 41. Rome, east side of the Forum: schematic plan showing the location of the concrete ramp (arrows; after Hurst 2006).

4.3.1 The Concrete Ramp on the East Side of the Roman Forum

Standing remains of the ramp consist of a series of parallel walls abutting on a structure that follows the curving alignment of a preexisting alley, on a contour whose level and orientation diverge from that of the Lacus Iuturnae and the Temple of Castor and Pollux, located directly to the west.[433] The walls feature a facing made with very small quadrangular facing blocks of Tufo Lionato (Monteverde?), ranging from 5 to 9 cm in size, which were laid in

[433]Steinby 1985: 80 fig. 3; 1987; 1988; 1993; 2011: 7-9; Steinby 2012b: 34-49.

horizontal courses. At least ten rooms can be identified in plan (**fig. 42**).

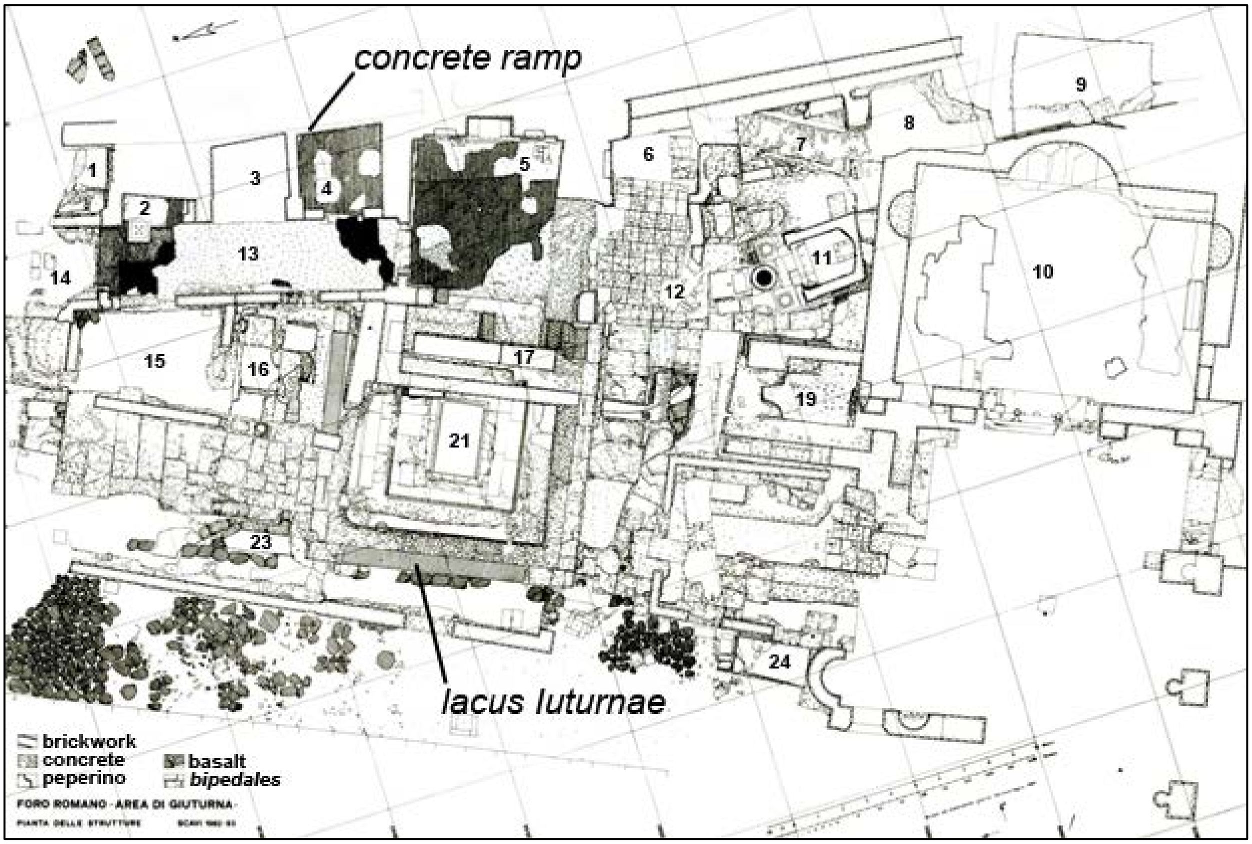


Figure 42. Rome, east side of the Forum, area of the Lacus Iuturnae: state plan with room numbering (after Steinby 1985).

Given the irregular alignment of the back wall of the ramp, the resulting rooms are slightly trapezoidal in shape, covered by barrel vaults finished with plaster (spans range between approximately 3.00 and 5.00 m). On the façade, the vaults are framed by arches built with elongated blocks of tuff, while the spandrels are faced with *opus incertum* (**fig. 43**; cf. the viaduct on the west side of the Forum). The initial part of the ramp toward the Via Sacra was truncated by later construction, though a short stretch of an *opus incertum* wall on the same alignment of the façade of the ramp cut by the Imperial foundation of the Temple of Vesta has been detected farther north.[434]

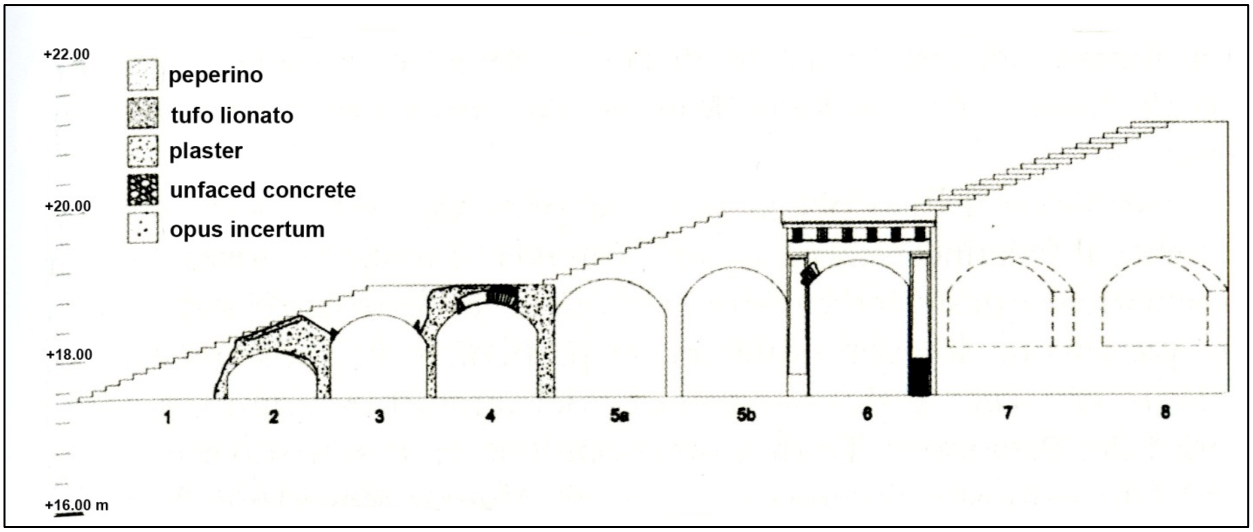


Figure 43. Rome, east side of the Forum, concrete ramp: restored elevation drawing (after Steinby 2011).

The first six rooms to the north (Rooms 1-5b; Room 5 was originally divided in two smaller sectors) open on to the area of the *lacus*, and have been interpreted as *tabernae*. The rooms on the south stretch of the ramp face the sanctuary of Vesta (the *crustae*-pavement preserved in Room 7 is at the same level as the Republican floors of the Atrium Vestae). These features suggest that the building was probably created in connection with a general renovation of the latter complex. Because concrete was extensively used to modify the west limit of the sanctuary, the normal expectation would be to find concrete architecture in other parts of the sanctuary.

4.3.2 The Sanctuary of Vesta (Aedes et Atrium Vestae)

A single program of development and date for both the concrete ramp and the sanctuary of Vesta has been suggested by Scott (2009), on the basis of the pattern of use of *opus caementicium* in the sacred precinct of the Republican period. Concrete is employed both in the

[434]Steinby 1993: 151, admitting that this structure may be simply interpreted as the boundary wall of the sanctuary of Vesta. See also Arvanitis *et al.* 2010: 53, fig. 24 m (first half of the first c. BCE).

round temple (Aedes Vestae) and in at least some of the interior walls of the Atrium Vestae, the residence of the Vestals (**figs. 44-45**).[435]

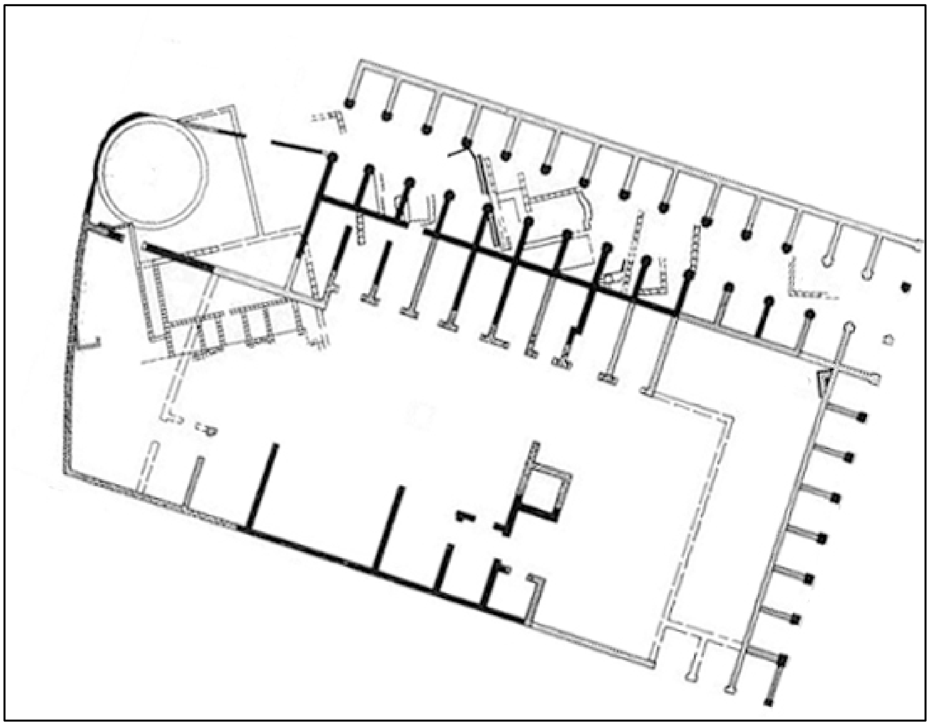


Figure 44. Rome, northwest slopes of the Palatine, Sanctuary of Vesta: schematic map showing the overlapping between early Imperial structures (solid black line) and Republican architecture (dashed line; after Carettoni 1978-80).

The concrete foundations below the round ashlar podium of the Imperial temple show at least two layers, perhaps belonging to the same phase. Below ground level, the foundations are composed of a thick mass (2.20-2.30 m) of red-brown tuff (Tufo Lionato?) chunks set in mortar. On the east flank of the temple a series of setbacks were dug in the clay bedrock to insert shutterings. These cuts were backfilled with soil deposits, from which fragments of Campanian A black-gloss pottery have been recovered (providing a *terminus post quem* of the late third or early second c. BCE).[436] On the other sides, however, the concrete was laid directly in the construction cut, as clearly indicated by the irregular surface of the foundation. On top of the

[435]Scott 2009: 18-24; 28-29. See also Carettoni 1978-80: 330-346.
[436]Scott 2009: 20-21 and 24.

foundation is another layer of concrete, which forms a podium built in elevation with red-brown tuff and Tufo Giallo della Via Tiberina rubble in hard mortar, whose upper interface was carefully leveled and marked with a layer of marble chips.[437] Scott suggests that this upper part belongs to a first c. BCE modification of the temple, and assigns the lower part of the concrete building to an earlier phase, which he then connects to the reconstructions attested in the Forum area after the fire of 210 BCE (in spite of the fact that the Aedes Vestae is the only building that is explicitly said to have been saved).[438]

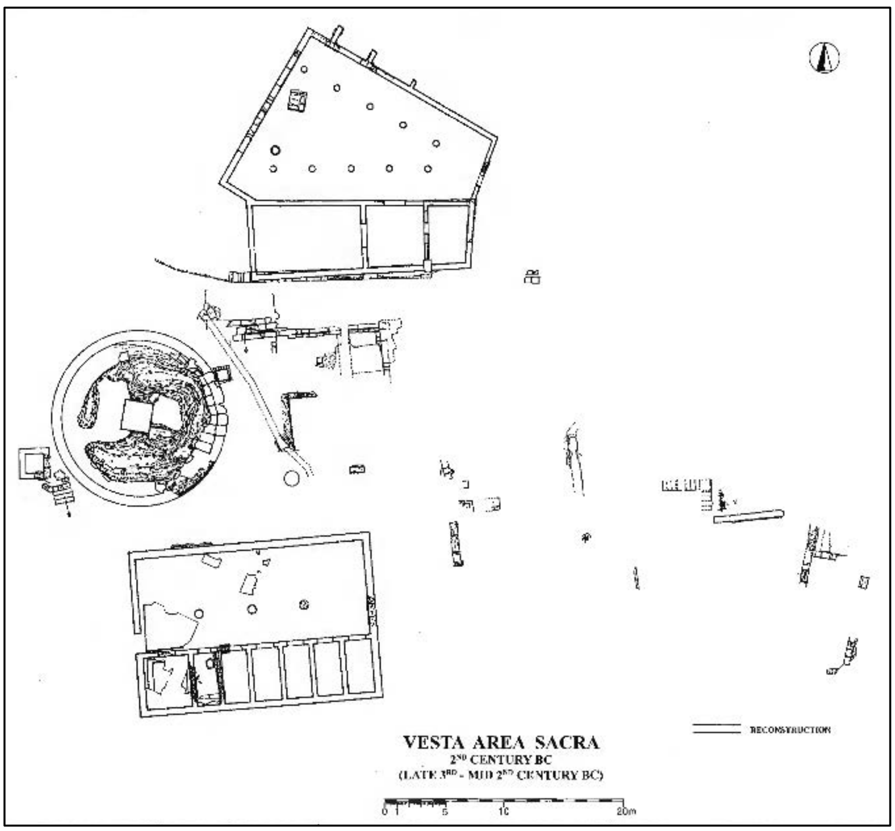


Figure 45. Rome, northwest slopes of the Palatine, Sanctuary of Vesta: second c. BCE remains according to Scott (2009).

[437]Scott 2009: 35-37, fig. E2

[438]Scott 2009: 29-30, noting however that comparanda for the architectural type date to the late second c. BCE (round temple of the Forum Boarium; Temple B at Largo Argentina). Livy (27.11.16) does not mention the Temple of Vesta in the list of damaged buildings, whose reconstruction was contracted out by the censors in the following year.

This interpretation has been challenged by Carandini and his group, as a result of new excavations being conducted in the area. It now appears that the foundation trench of the round podium truncated a preexisting concrete wall, which belongs to an occupation phase of the Atrium Vestae that has been dated to the first half of the first c. BCE.[439] This phase, which is characterized by modifications in the internal organization, seems to be the first in which there was a widespread use of concrete in this part of the sanctuary. Indeed second c. BCE construction activities are exclusively represented by structures in *opus quadratum* of Tufo Giallo della Via Tiberina (the third c. BCE phase saw only minor building episodes in which was used only Cappellaccio, presumably taken from archaic structures).[440] The concrete structures survive at the level of the foundation (which was in all cases built without shutterings); the elevation is clearly preserved only in one wall, where it consists of ashlars of Tufo Lionato (Anio?).[441] The mortar used in these structures has been described as purplish in color, with pumice inclusions, and yellow and green tuff (including Tufo Giallo della Via Tiberina and Tufo Lionato, possibly from the Monteverde quarries),[442] with rare Cappellaccio aggregate.

The sequence suggests that the ramp may have been created in this phase, perhaps replacing a previous structure in *opus quadratum* (the limit between the Atrium Vestae and the Lacus Iuturnae in the second half of the second c. BCE is represented by a stretch of blocks of Tufo Giallo della Via Tiberina found east of the podium of the round temple).[443]According to the new interpretation, the concrete podium should be connected with the radical reconstruction of

[439]Arvanitis *et al.* 2010: 54-59 (especially 58).
[440]Arvanitis *et al.* 2010: 48-51 (Phases 8-10, third and second c. BCE); 51-53 (Phase 11, first half of the first c. BCE). The use of Tufo of Grotta Oscura in the Late Republican phase is attested also in the adjacent area of the so-called Domus Publica, where excavations revealed only one concrete foundation, supporting a wall faced with tile fragments (clearly dating to the second half of the first c. BCE): Carettoni 1978-1980: 346-355.
[441]Scott (2009: 28-29) suggests that at least some of the interior walls connected with these foundations, which he assigns to the mid-Republican phase, were of rubblework.
[442]Cf. Carettoni 1978-1980: 330-332.
[443]Arvanitis *et al.* 2010: 49, fig. 21 s (148-100 BCE). Filippi 2010, fig. 6. See also Steinby 1985: 77 (blocks under the first level of Room 7).

the sanctuary around the middle of the first c. BCE (after the fire of 47 BCE? Dio Cassius 42.31.3), when a new series of box-like concrete foundations were built to support additions (whose facing was made with broken pan tiles) to the west of the Atrium Vestae, abutting on the ramp. It has been noted that these foundations appear to be quite disproportionate to the size of the superstructures, a concern which influenced the building program as a whole (the same can be said for the foundations of the round temple).[444] The northeast part of the house was also altered at this time, creating an apsidal hall.[445]

4.3.3 Lacus Iuturnae

The precise relationship between the creation of the *opus incertum* ramp and the monumentalization of the Lacus Iuturnae is less easy to define. According to Steinby (1985; 1993, 2011), the *lacus* should be interpreted as a later feature, because of the absence of any architectural façade on the stretch of ramp that sits on axis with the monumental basin.[446] The passage between the ramp and the *lacus* is indeed very narrow, and it seems as if the *lacus* encroached upon the area in front of the ramp, almost obliterating the access to the *tabernae*.[447] The actual position of both ramp and *lacus*, however, was dictated by the topography of this sector of the slopes of the Palatine toward the Forum valley. The ramp was built at a higher level, on the west limit of a ledge in the natural terrain, while the area of the *lacus* sits in the depression of the Forum.[448] Although the exact extent of the first *lacus* to the east is not known, it seems

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[444] See discussion in Scott 2009: 38-39 (with reference to the Atrium Vestae only).

[445] Carettoni 1978-1980: 338-341.

[446] Steinby 1985: 78; Steinby 1993: 151; Steinby 2011: 7. Architectural refinements have been detected on one of the piers separating Rooms 6 and 7 (a semi-column joined to a wall built with *opus reticulatum*; a similar element perhaps decorated the pier between Rooms 5 and 6), but have been interpreted as a successive modification. Steinby (2011: 8) dates this addition to the first c. BCE (i.e., her second phase of the *lacus*, post-117 BCE). According to Coarelli (2012: 57-58), this arch would mark the original location of the Nova Via. Room 5, on axis with the *lacus*, was heavily modified in the Imperial phase (Steinby 1985: 80).

[447] Steinby 1993: 155. The *tabernae* would have been incorporated in the complex only with the construction of Corridor 13 and Room 5 in the Trajanic period.

[448] Steinby 1985: 76 (bedrock in Room 9 is at 16.92, while in Room 23 is below 9.60 m).

that the monumental basin was placed right at the base of this ledge.[449] The implication is that even if built beforehand, the *tabernae* would have had only a narrow strip left in front of them. Thus, ramp and *lacus* could have been built at the same time; and the possibility that the *lacus* was earlier cannot be excluded *a priori*.[450]

Three concrete phases have been identified for the monumental basin, based on facing styles (**fig. 46**).[451] The precise dimensions of the basin in the earliest stage are not known, but it seems that the shape was of an oblong rectangle. The retaining walls, about m 1 high, are made with *opus incertum* lined with *signinum*, and support a course of tuff blocks that create a projecting rim.[452]

In a subsequent phase, the level of the rim was raised by about 1 m. A new retaining wall was built up on the south side from the bottom of the basin. The east side of the *lacus* was brought to this level laying two additional courses of tuff ashlars on top of the previous ones, while rubblework was used on the west-side. Finally, the north side of the basin was moved farther north, transforming the rectangular *lacus* into a square structure. To the south of this complex is a platform with a decorated *signinum*-floor that has been connected with this construction phase in spite of its lower elevation.[453]These structures were initially described as unfaced concrete,[454] but are now commonly referred to as *opus quasi reticulatum*.[455]

A narrow ledge abutting on the inner face of the retaining walls, built in a more uniform *opus reticulatum*, runs on all four sides, creating a lower step which was probably added in order

[449]The original floor level ascertained in Room 4 was 1 m higher than the projecting rim of the basin. See Steinby 1993: 151.
[450]The pottery recovered from the original construction fills of the ramp in Rooms 7, 8 and 12 can be generically dated to the second c. BCE. Steinby 2012b: 41 (Trenches G and H).
[451]Steinby 1985: 82-83.
[452]This stands at m 12.30 a.s.l. The bottom of the basin is at 10.90 m.
[453]Steinby 1985: 77. This platform stands at 12.58 m a.s.l., while the rim of the new basin is at 13.37 m.
[454]Boni 1901: 81; Steinby 1985: 82.
[455]LTUR III, 1996: 169 s.v. “Lacus Iuturnae” (E. M. Steinby).

to facilitate the maintenance of the basin after the edges had been raised. In the same technique and with the same building materials is built a rectangular platform at the center of the basin (3 x 2 m), slightly lower than the ledge, built on top of an ashlar base which may have supported an earlier construction.[456]

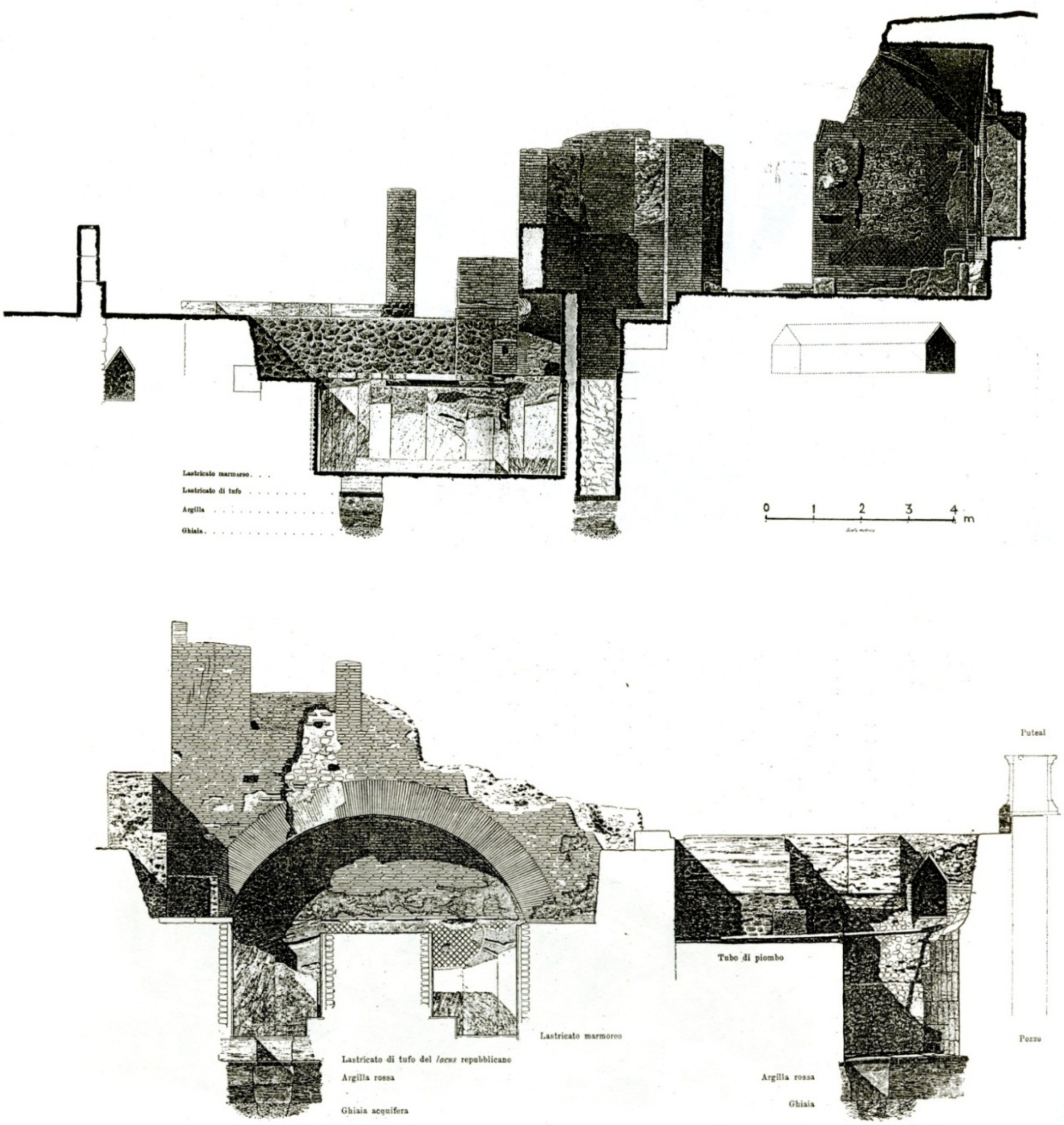

Figure 46. Rome, east side of the Forum, Lacus Iuturnae: east-west cross-section (top; view from south), and north-south cross-section (bottom; view from west) (after Boni 1901).

[456]Boni 1901: 84 (mortar containing "pozzolana rossa"; facing blocks of "tufo nerastro"); cross-section, 83, fig. 38; Steinby 1985: 83 (suggesting that the so-called *opus quasi reticulatum* facing covers an earlier core).

In the latest remodeling, ledge, platform, and bottom of the basin, were lined with marble slabs fixed with iron nails on a layer of mortar; this covered an earlier *signinum* revetment.[457] The retaining walls in this last phase were capped with travertine slabs, with traces of the setting of a metal fence, separating the *lacus* from the surrounding travertine pavement.

The dating of the concrete phases of the *lacus* is uncertain. Coarelli (1977) first suggested that both the so-called *opus quasi reticulatum* and the *opus reticulatum* remains were contemporary with the Metellan reconstruction of the temple of the Castor. In his view, the *lacus* was transformed into a more refined nymphaeum at that time, so as to match the monumental character of the new temple.[458] In keeping with this interpretation, Coarelli argued that the rectangular base at the center of the basin was specifically designed to support a statue group of the Dioscuri (which Boni had found in fragments at the bottom of the basin during his excavations at the site in 1900). The archaizing style of the statues (carved from Greek marble, with later Carrara marble restorations) was thought to correspond well with a late second c. BCE chronology.[459] This would provide a *terminus ante quem* for the earliest *opus incertum* structures.

A slightly different reconstruction has been proposed by Steinby (1985), who connects the *opus reticulatum* platform with an Augustan restoration known from an inscription dating to the period between 14 and 12 BCE.[460] Steinby maintains the relationship between the *opus quasi reticulatum* renovation and the Metellan temple, but suggests that the statues of the Disocuri were dedicated when the first *opus incertum* basin was built,[461] perhaps in connection with Phase

[457]Boni 1901: 84.
[458]Coarelli 1977: 14.
[459]Coarelli 1976: 27-30, fig. 15.
[460]Alföldy 1992.
[461]Steinby 1985: 83, footnote 36. Steinby believes that the statues were never placed on the pedestal at the center of the basin, because of the lower level of the base, but only near the basin. Limited stretches of *opus reticulatum* in Tufo Lionato (Anio) visible at the edges of both ledge and pedestal, interpreted by Coarelli (2008: 76) as

IA of the Temple of Castor and Pollux (for which she proposes a date around 164 BCE).[462]

It is more likely that the *opus quasi reticulatum*/*opus reticulatum* reconstruction was linked with the overall reorganization of the Forum pavement known for the Sullan period (at the sides of the square, the new pavement reached the level of the *opus incertum* basin, requiring the creation of a higher rim).[463] Thus, only a 78-74 BCE *terminus ante quem* can be fixed for the *opus incertum* phase of the fountain. This construction may well be connected with other activities involving the Temple of Castor and Pollux, but there is no reason to reject a late second c. or beginning of the first c. BCE date for it (i.e., post 117 BCE). Coins of A. Albinus showing statues of the Dioscuri on horses near a well-head, minted in 96 BCE, could refer to the dedication of the group (and perhaps even to the reconstruction of the *lacus*) by the Postumii, a family that was indeed connected with the original dedication of the Temple of Castor and Pollux.[464]

4.3.4 Other Concrete Structures in the Area of the Lacus Iuturnae

Two parallel concrete foundations of considerable thickness (1.30-1.50 m) run with a north-south orientation to the north of the *lacus*. These foundations seem to belong to a building

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Augustan in date, would be in turn assigned to the Trajanic phase (Corridor 13; Room 5; obliteration of Room 8). Harri 1989 admits a higher chronology for the statues, as early as the half of the second c. BCE.

[462] Based on a passage of Minucius Felix (*Oct*. 7.3), claiming that the Dioscuri appeared near the *lacus* to announce the victory at Pydna. This text, often invoked to date the construction of Lacus Iuturnae and Temple of Castor and Pollux, does not explicitly say that statues were dedicated at that time. See also Steinby 2011: 7-9; Steinby 2012b: 50-59. The 164 BCE date would in her view represent a *terminus ante quem* for the concrete ramp.

[463] Giuliani and Verduchi (1987: 55-66) date the first travertine pavement of the Forum square to 78-74 BCE (L. or M. Aurelius Cotta). A trench excavated on the eastern side of the podium of the Temple of Castor and Pollux revealed that the top surface of the construction fills in phase with the fifth c. BCE building was at 12.08 m a.s.l. In a subsequent phase, dated archaeologically to the second or first c. BCE, this level was brought up to at least 12.80 m a.s.l. The top surface of the crepidoma of the Metellan temple stands at 13.40 m a.s.l., but the original pavement is not preserved: Cullhed *et al.* 2008a: 323-326. Steinby (1988: 33) places the base of the Metellan podium at 12.25 m a.s.l. Cf. Nielsen (1992: 112), who reconstructs a floor surface on the eastern side of the podium at 13.10 m a.s.l., corresponding to the level from which the foundation trenches of the Arch of Augustus were dug; on the western side, the floor level in this phase would be represented by a pavement of terracotta *tesserae* found at 11.40 m a.s.l. Evidence for the alleged steps that spanned the drop in elevation from east to west on the front of the temple (Nielsen 1992: 112, fig. 103) is not convincing.

[464] On the genealogy of the Postumii and their relationship with the cult of the Dioscuri see especially Palmer 1990.

attached to the monumental basin (**figs. 47, a-b**). The free-standing parts are badly preserved, and seem to be built with very irregular *opus incertum*. Remains of a floor preserved at approximately the same level with the Sullan pavement of the Forum are associated with these walls.[465] Stretches belonging to the possible continuation of the east wall have been found at the site of the Temple of Divus Iulius; these structures truncate part of the wall delimiting the concrete ramp to the north.

A third foundation with square buttresses, parallel to these, was found razed in test-trenches excavated along the east side of the Temple of Castor and Pollux (Trenches A and B; **fig. 47, c**).[466]

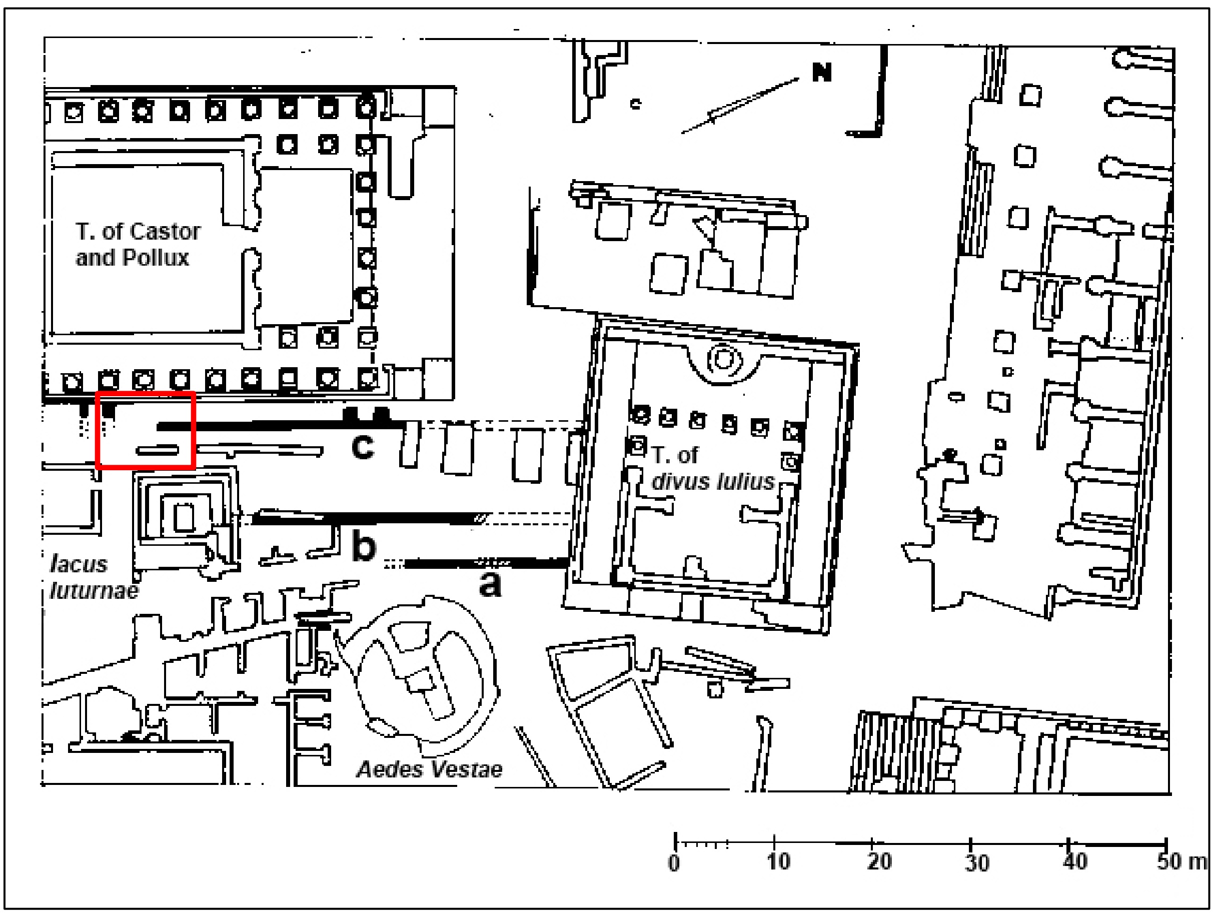

Figure 47. Rome, east side of the Forum, area of the Lacus Iuturnae: location of concrete foundations (a,b and c) north of the *lacus* (after Steinby 1988; the area outlined in red corresponds to that shown in fig. 48).

of
the area shows that these foundations are not perfectly aligned. See Steinby 2012b: 62 fig. 17.

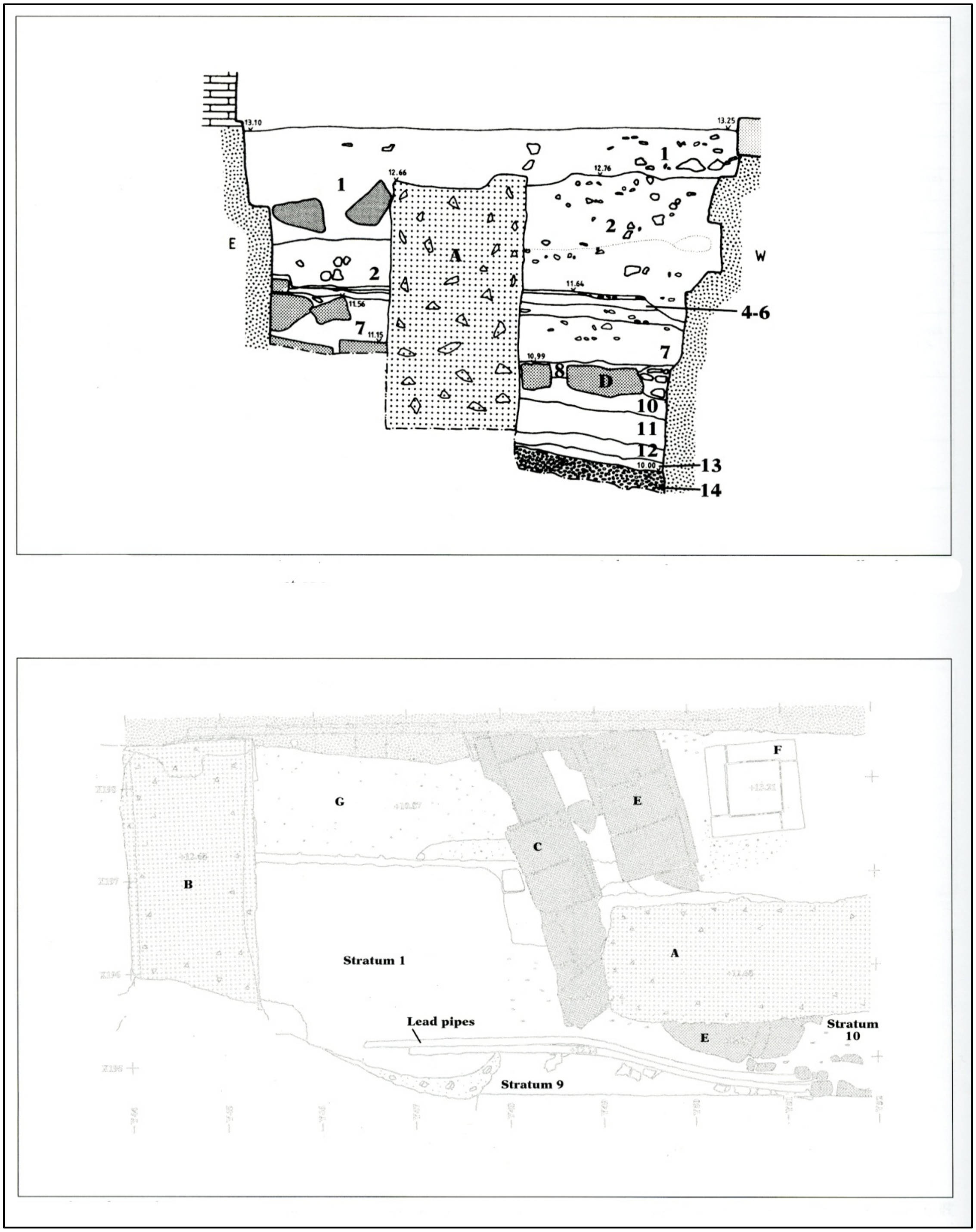

Figure 48. Rome, east side of the Forum: plan and cross-section of Trench B, showing the remains of a concrete foundation (structure A= foundation c in fig. 47) between the Lacus Iuturnae and the Temple of Castor and Pollux. Layer 2 postdates 117 BCE; layer 1 is modern (after Cullhed *et al.* 2008b).

Steinby interpreted these features as the remains of a basilica of the middle of the second c. BCE, which would have been closed to the south by two parallel concrete walls with an east-west orientation.[467] The identification of this monument of non-canonical plan with the Basilica Aemilia (to be distinguished from a Basilica Fulvia located on the north side of the Forum) has not found a consensus.[468] Later investigations revealed that the walls to the south are in phase with the concrete podium of the Metellan Temple of Castor and Pollux (**fig. 48**), and that the buttressed north-south wall may be interpreted as a retaining wall (most likely connected with the raising of the levels in the area of the *lacus*) rather than the foundation of a portico.[469]

4.3.5 Summary of the Evidence

The stratigraphic evidence available for the group of concrete monuments located on the east side of the Forum does not seem to support an early chronology for the use of this building medium in public construction.

As we have seen, the ramp connecting the Via Sacra and Nova Via was an integral part of the Atrium Vestae, and it was therefore most likely built in connection with the first concrete phase of that complex, which recent excavations put around 100 BCE. Possibly this structure replicated the model of the viaduct of the Clivus Capitolinus, whose construction may be connected with the activity of L. Opimius on the west side of the Forum in the late 120s BCE.

Around the same time, the site of the Lacus Iuturnae also received a concrete addition (most likely in relation with one of the reconstructions of the Temple of Castor and Pollux), though on a much smaller scale. Most of the concrete architecture at this site dates to the Sullan period, and can be linked with the significant modifications of the floor levels in the Forum. As

[467] Steinby 2012a: 61. Cf. Steinby 1987: 147-156 and Steinby 1988, interpreting the concrete structures as dating to the first c. BCE, and possibly replacing an earlier version built with ashlars (stretches of which would be preserved under the Temple of Divus Iulius). Steinby 2012b: 60-70 now assign the remains of the foundations a and b to two building phases. In the first phase (ca. 164 BCE), the complex would have been composed of a simple portico. This would have been transformed into a basilica only in the first c. BCE, with the addition of a second aisle (foundation c).

[468] Discussion in Elter *et al.* 2007.

[469] Cullhed *et al*. 2008b: 332.

fascinating as it may be, the idea of a building program carried out by the Aemilii on this side of the square has no archaeological basis. It seems as though *opus quadratum* remains the only building technique attested in utilitarian structures of the first half of the second c. BCE.

4.4 Conclusions

It is now possible to characterize with greater detail the patterning of concrete architecture in Rome, and to evaluate the possible relationship between the use of this building medium in private construction and its adoption for public building programs (cf. **Table 6**). As we have seen in Chapter 3, the chronology of the earliest concrete houses is quite difficult to fix, but on the basis of associated ceramic assemblages it can be argued that extant evidence points to a date not earlier than the middle of the second c. BCE. The introduction of structural concrete came some time after the diffusion of other mortar-based technologies adopted in élite domestic architecture, including *signinum* floors (the earliest examples in Rome come from the atrium-type villa at the Auditorium site, where decorated floors were found in contexts dating to the first half of the second c. BCE),[470] and fine plaster decorations (the First Style appeared in Latium at the end of the second quarter of the second c. BCE, but its diffusion to Rome seems to be a later phenomenon).[471] The change in decorative styles may have significantly influenced the organization of industrial facilities in the lime-producing region, in order to meet a rapidly increasing demand. The greater availability of lime may in turn have triggered the adoption of construction methods featuring the use of lime mortar.

The diffusion of *signinum* floors may have represented an ideal context for the

[470]De Davide and Di Giuseppe 2006: 234 fig. 143 (Period 4, Activity 76, Rooms 2 and 8; see also fig. 138). Floor preparations contain black-gloss pottery dating to the period between the end of the third c. and the middle of the second c. BCE. This was found in association with coarse-ware types whose production began around 150 BCE (250, Table 33).

[471]Torelli and Marcattili 2011: 45-53. Mortar containing artificial pozzolana (ground terracotta) was typically used as a primer for the plaster mouldings: Giuliani 1990: 141-142.

observation of the properties of pozzolanic mortar (*signinum* mixes could include natural pozzolana, though scientific evidence on this is limited to Imperial period examples).[472] Among the most important features of *signinum* revetments were the superior resistance to shrinkage and cracking during the hardening process, as well as strength (not by chance a layer of *signinum* is often found in decorated floors to fix *tesserae*). These properties were especially advantageous for use of this medium to build foundations, also in consideration of the ability of pozzolanic mortars to harden in the absence of air. In this structural environment, use of simple lime mortar (which hardens by evaporation) would have been simply not possible, or at best very slow. The same properties made concrete well-suited for free-standing walls (*opus incertum*), which could be built up in a faster way without risk of damage due to excessive compression of the core (as it would likely happen if slow-setting mortars were used).

During this first phase, in both private (e.g., north slopes of the Palatine: second half of the second c. BCE) and public construction (e.g., Temple of Castor and Pollux, Phase IA, third quarter of the second c. BCE?) concrete foundations were mainly associated with ashlar superstructures. It is possible that the diffusion of this system was also driven by structural concerns, such as the establishment of a secure base on which to build. It has been suggested that innovation in building techniques could be sparked by processes of adaptations to challenging environmental conditions, particularly in those regions of the Mediterranean which were most affected by seismic activity.[473] In the case of Rome, however, the introduction of concrete does not seem to have happened in response to such concerns. Earthquakes felt at Rome are recorded for 192 BCE (Livy 35.40.7, but with little effects), 179 BCE (Livy 40.59.7; Obseq. 7; but the epicenter was far away) and perhaps 118 BCE (Obseq. 35), while the earliest inscription

[472]Bugini *et al.* 1993: 271; see also Giuliani 1990: 171-172.
[473]See papers in Guidoboni 1989.

explicitly referring to reconstruction following an earthquake is of 52 CE (AE 1980: 5). In the Imperial period, examples from Rome show consistent attempts at reaching the bedrock (or denser soils when the bedrock was too deep) in order to avoid settling, but early concrete foundations are not that deep in comparison. Similarly, when early concrete buildings were built on top of other structures, no particular precautions were taken so as to avoid different settling patterns.

In the private context, concrete houses built *ex novo* are rare. This is in stark contrast with the pattern attested in the *suburbium* of Rome, where most early concrete construction has no precedent on site. The diffusion of concrete in Rome seems to be connected with the sudden need to entirely refashion centuries-old élite houses, which could provide most of the building material needed for both aggregate and facing blocks. Economic concerns seem to affect the pattern more than structural ones. The strong correlation with the varieties of tuff found in the *opus quadratum* phase immediately preceding the concrete houses of these buildings suggests that the material used for the *caementa* was not quarried separately, making extensive use of recycled building material. The larger dimensions of the facing blocks seen in some examples of *opus incertum*, particularly in the public context (Porticus Metelli; Testaccio building), rather than representing an early stage in the evolutionary trajectory of the technique, may reflect similar attempts at curbing the costs of construction (this would easily explain why "irregular" *opus incertum* methods were still employed in the early first c. BCE (e.g. in the ramp on the east side of the Forum and in the area of the Lacus Iuturnae).[474]

[474]On the correlation between size of facing blocks and speed of construction see DeLaine 2001. Variability in the size of *tesserae* also characterizes first c. BCE *opus reticulatum* buildings in Rome and Ostia (D'Alessio 2009: 240, fig. 15).

Monument	*Building Technique*	*Type of Rubble*	*Vaulting System*	*Stratigraphic Dating*	*Other Dating Evidence*
Castor (IA)	UC	C; TL, P	n/a	n/a	Before 117 BCE (Phase II)
Porticus Metelli	OI	TGVT	n/a	n/a	141-131 BCE (*locatio*)
Concord	UC	TGVT	n/a	n/a	121 BCE
Palatine East Slopes	OI	TL; TGVT (vaults)	Voussoirs (2.90-3.15 m)	n/a	n/a
Navalia	OI	TGVT or TGPP; C (lower parts)	Concrete (8.30 m)	n/a	110-100 BCE?
Magna Mater	UC; OI; OR	TL; TGVT; Tr; P	Concrete (4.00-4.50 m)	150-100 BCE	After 111 BCE fire
Victoria	UC	n/a	n/a	150-100 BCE	After 111 BCE fire
Veiovis	UC	TGVT	n/a	n/a	Before 78 BCE (construction of Tabularium)
Scalae Graecae	OI	TL	Concrete (3.00-5.00 m)	n/a	100 BCE? (cf. Atrium Vestae)
Atrium Vestae	UC	TGVT; TL; C	n/a	100-50 BCE	Before 47 BCE fire
Lacus Iuturnae	OI (Phase I)	?	n/a	n/a	After 117; before 78-74 BCE

Table 6. Early concrete public monuments in Rome (*UC=unfaced concrete; OI=opus incertum; OR=opus reticulatum; TL=Tufo Lionato; TGPP=Tufo Giallo di Prima Porta; TGVT=Tufo Giallo della Via Tiberina; Tr=Travertine; P=Peperino; C=Cappellaccio*).

The earliest public monument for which a construction phase in concrete architecture can be linked with building activities explicitly mentioned in written sources is the Porticus Metelli, whose construction most likely dates to the 130s BCE. This represents the earliest datable document of free-standing walls built with *opus incertum*. Perhaps this type of concrete construction was preceded by attempts on a smaller scale, mostly for repairs of foundations, in contexts such as that of the Temple of Castor and Pollux (Phase IA). The almost simultaneous adoption of this construction technique in private and public contexts may be an indicator that the same groups of builders were employed. Use of the new building medium took off by the beginning of the last quarter of the second c. BCE, particularly in connection with temple podia (which may be considered as a different form of foundation), as documented by the temples of Veiovis, Concord, Castor (Phase II), Magna Mater and Victoria, and finally the Temple B at

Largo Argentina. Vaulted construction, however, did not pick up until the end of the second century, starting with the construction of the monumental front of the southwest corner of the Palatine (*via tecta*, ca. 110-100 BCE), the viaducts of the Forum (Clivus Capitolinus; so-called Scalae Graecae), and perhaps the *substructiones* on the east slopes of the Palatine and the Testaccio building (both remain problematic to date). This fast-paced development in public building seems to run in parallel with innovations in élite domestic architecture, with the kind of vaulted architecture documented in semi-subterranean houses such as the Casa dei Grifi, and in retaining structures like that of Via Palermo.

In sum, the evidence suggests that experimentation with concrete occured first in private construction, especially at the élite level, but at a much later time than commonly thought. It then rapidly spread to public building, which was sponsored by the same aristocratic patrons, using the same professional builders, becoming common by the last quarter of the second c. BCE. This pattern would fit well with what we know of the organization of public construction in second c. BCE Rome. The effective adoption of a new technology such as *opus caementicium* within a legal system that originally developed in the context of ashlar architectural traditions must have taken some time, because innovating in this field implied for the public official who let the contract a great deal of social and political risks.[475]

[475]See Pobjoy 2000 for a reassessment of building inscriptions in first c. BCE sites of central Italy, showing the concern of magistrates for documenting that public funds had been spent correctly. Cf. Cebéillac Gervasoni 1998.

PART II

THE DIFFUSION OF OPUS CAEMENTICIUM IN POMPEII

Chapter 5

Dating Roman Concrete in Pompeii

This chapter presents a detailed account of how the arguments for a high chronology of Pompeian concrete have been constructed in the past, and critiqued in more recent years. As is the case for Rome, the dating system of Pompeian architecture is based on typologies that combine wall-facing styles and building materials according to a rigid evolutionary scheme, on the assumption of a progressive development in technique. It will be demonstrated that these frameworks assign a chronological value to forms of variation in technological style that can be easily said to depend first of all on status difference, and that the common idea of a third c. BCE chronology for the beginnings of concrete construction at the site has no archaeological basis.

5.1 Introduction: Pompeii, Rome and Early Roman Concrete

5.1.1 The Place of Pompeii in the Development of Roman Concrete

Because of the exceptional level of preservation of standing remains both in the public core and in private neighborhoods, and of the possibility this affords to study the distribution of building techniques at the level of individual city-blocks and quarters, Pompeii has naturally represented an ideal site for the sequencing of many Roman architectural developments, especially for the building periods that in Rome are not well documented archaeologically, like the Middle Republic. Thus, there has been the tendency to interpret the spread of mortar-and-rubble architectural traditions at Pompeii and other Campanian cities as linked with Roman practice (*supra*, Chapter 1). In the context of public building, for example, Zevi (2003) has connected advances in vaulted concrete architecture in the region with the establishment of the Roman port city at Puteoli (194 BCE).[476] It has also been argued that the town-planning and domestic architecture of the main Campanian cities of the late third and second c. BCE phase were influenced by Roman models.[477]

Most scholars of Roman building techniques date the beginnings of Pompeian concrete construction, in the form commonly referred to as *opus incertum*, as early as the middle of the third c. BCE.[478] Johannowsky (1976) argued that the impetus for the introduction of lime-based mortars in Campania came from the sustained demographic urbanization which top-tier sites, such as Capua, Cuma, Nuceria, and Nola, experienced from the early Hellenistic period onwards. Furthermore, just as it has been assumed for Rome, he supposed that the refinement of concrete technology, its large-scale application, and the rationalization of the building process had already begun toward the end of the third c. BCE or early second c. BCE, and that there was a direct connection with the alleged availability of cheap slave labor in the region, as a result of the Hannibalic war.[479]

The fact that building materials needed to manufacture this medium were easily available

[476]Zevi 2003: 80-87. The idea is partly based on the synchronism between the foundation date of Puteoli and the construction of port infrastructures on the Tiber (i.e., the Emporium and the Porticus Aemilia, which Zevi identifies with the *opus incertum* building of Testaccio, in 193 BCE).

[477]In terms of town-planning and domestic architecture, the Pompeii of the late third and second c. BCE has been characterized as a “Romanized” town. See Sewell 2010: 120, 130; Wallace-Hadrill 2008: 127-136.

[478]Lugli 1957: 379-383 (300-250 BCE); Adam 1994: 127; 2007: 106 (third c. BCE).

[479]Johannowsky 1976: 270-272.

in Campania has also been often as a plausible context for very early experimentation at these sites. As already noted, Lugli conceded that the discovery of pozzolanic mortar may have derived from casual observation of natural phenomena in the Vesuvian region.[480] In his view, professional builders would notice the calcination caused by lava flows on the local limestone bedrock outcrops, learning the properties that this material acquired when it came in contact with subsequent volcanic ash-fall. Puteoli became famous for the supply of natural pozzolanas, along with other sites of the Campi Flegrei (e.g., Baiae).[481] Describing the recipe to build concrete structures in marine environments, Vitruvius (2.5.1; 2.6.1–5; 5.12.2) praised the physical properties of *pulvis puteolanus* to such an extent that his remarks have without a doubt reinforced, particularly among non-specialists, the notion that the Romans further developed their technology experimenting with the highly reactive materials available in the bay of Naples.[482]

Other specialists, however, have spoken more openly of foreign influence, ascribing the appearance of mortar technologies in the region to the allegedly more intense interaction between the Campanian sites and the Greek cities of southern Italy throughout the pre-Roman period. Blake (1947), for example, argued that simple lime mortar recipes were introduced from Greece by way of the colonies of Magna Graecia, thus highlighting that technological advances in the region occurred only because of the "fortunate accident" that most of the sand available in some areas contained pozzolana.[483] More recently, expanding on an idea already put forward by Delbrück (1907), both Rakob (1983) and Adam (1994) have suggested that the spread of mortar-

[480]Lugli 1957: 383-384.

[481]Gazda 2001: 146-147, pointing out that the name *pulvis puteolanus* derives from the name of the port from which this material was shipped, not from the location of the main quarries (i.e., "ash from Puteoli", not "ash of Puteoli").

[482]E.g., Balmuth 2005. But see also Blake 1947: 312-313; Hohlfelder *et al.* 2008. For a definition and discussion of "Vitruvian pozzolanic concrete" see Oleson *et al.* 2006. Recent research at Rome has demonstrated that early attempts with concrete construction were based on the exploitation of local materials (cf. *supra*, Part I).

[483]Blake 1947: 312-313.

and-rubble techniques originated from the Punic world, based on features such as the use of wooden forms to build foundations (which has been linked with the so-called *terre pisé* construction methods),[484] and of rubble fills in superstructures (this would be derived from the so-called *opus Africanum*, a technique that is indeed largely attested in pre-Roman Pompeii).[485] According to this reconstruction, which clearly mirrors the model of diffusion of decorated mortar pavements, the technological transfer would have been mediated by the Greek cities of Sicily, which were more closely in contact with the Punic sites.

In sum, Pompeian architecture has traditionally played an important role in current models of cultural diffusion in Roman Italy. In particular, the third c. BCE date for the origins of concrete construction in Pompeii has been often linked with contemporary Roman practice. The evidence, however, demonstrates that a thorough revision of the chronology of early concrete architecture in Rome is required (*supra*, Part I). A reassessment of the old Pompeian chronology, therefore, is in order.

4.1.2 The Geology of Pompeii: Relevance to Mortars

The geological setting of Pompeii is extremely relevant to the development of hydraulic mortars, due to the association of both carbonates, which supplied the limestone needed to produce lime, and ash falls, which represented a source of natural pozzolana (**Table 7**).

To the south and east/northeast of Pompeii are two important limestone formations: the Lattari mountain ridge (also known as the Sorrento peninsula), which is composed of limestones and dolostones of the upper Triassic to upper Cretaceous, and flysch and terrigenous sediments

[484] Wright 2005: 87-90, pointing out that construction with *terre pisé* differs significantly from concrete construction, in that it does not involve a plastic medium but unconsolidated earth, which is made rigid by compression within shutterings using a ram or pounder - a procedure which is never used in concrete walling (but Vitruvius 7.1.3 says that concrete for paving is tamped down with pounder). This technique was known to Pliny the Elder (25.48), who defines it as *opus formaceum*, suggesting its use in late third c. BCE Spain and Africa. For this connection see also Varro, *De re rust*. 1.14.4.

[485] For a critique of this interpretation see *infra*, 4.2.2.

of the Miocene; and the Sarno mountains, consisting of limestones, dolomitic and conglomeratic marly limestones of the lower to upper Cretaceous. The area of *Stabiae* would have been the closest source of limestone, at a distance of 5 km from Pompeii, while the deposits east of Sarno and Nocera lie more than 15-20 km from the site, thus adding transportation costs (**fig. 49**).[486]

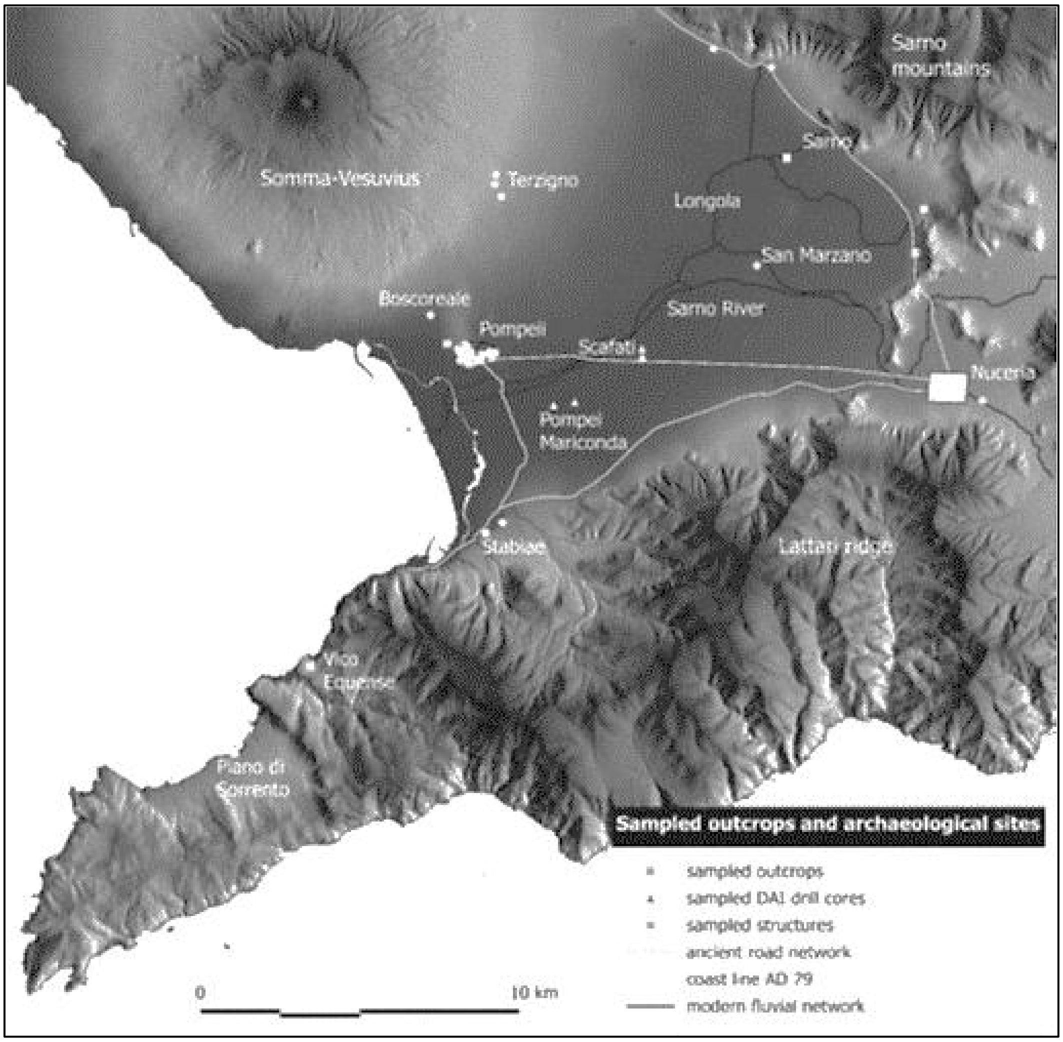

Figure 49. Sarno Valley: terrain model (after Kastenmeier *et al.* 2010).

In various parts of the Sarno river plain, which borders Pompeii to the south, other types of carbonates (i.e., fluvial and lacustrine) outcrop. These are known in the archaeological

[486]Kastenmeier *et al.* 2010: fig. 1.

literature with the generic name of Sarno limestone,[487] but appear characterized by different sedimentary structures: porous calcareous tufa (of karstic origin) and harder travertines (the latter are formed by precipitation of calcite from marine limestones decomposing in hot water). Samples taken from standing remains at Pompeii belong mainly to the former type, and their carbon and oxygen isotope ratios are comparable to those obtained from cores in the surrounding area (Pompei-Scafati; the location of ancient quarries of this material in this sector of the plain is not known due to visibility problems); harder travertine may have been available in the clacareous-dolomitic district of Sarno and Nuceria.[488] Sarno limestone was used extensively for ashlar construction; it was also employed in the form of rubble for concrete. The extent to which this material was used to produce lime is not known in any detail, but in general lime from porous stone was more suitable for stucco than for masonry (close-grained rocks were preferred to produce lime for mortars).[489]

The site itself extends on the southern slopes of the Quaternary Somma-Vesuvius volcano (**fig. 50**), on a lava spur that according to geomorphological and volcano-stratigraphic evidence may represent the relic of an independent edifice, compositionally similar to the Somma deposits.[490] Standing remains at Pompeii indicate that two main lithologies of lava were employed for building purposes: compact lavas and scoriaceous lavas (the latter are known in the archaeological literature as "cruma" or "schiuma di lava"). These lavas consist predominantly of shoshonites (basaltic trachyandesites); phonotephritic to phonolitic lavas are also attested (latite/phonolite).[491] Slabs of compact lavas are found in road pavements and fountains;

[487]See Richardson 1988: 369-371.
[488]Kastenmeier *et al.* 2010: 50-51; 53-56. cf. Richardson 1988: 372-373 (Caserta stone).
[489]Dix 1982: 334; Ling 1976: 210. Palladius 1.10.3 lists *spongia* as a suitable stone that could be burned to produce hydraulic lime, but it is not clear whether he refers to calcareous tufa or pumice.
[490]Cinque and Irollo 2004.
[491]Kastenmeier *et al.* 2010: 44, Tab. 2. Note that the term "soft lava" appearing in this work should be avoided.

otherwise this material appears in the form of rubble. In all likelihood this is the *lapis pompeianus* Cato (*De agr*. 22.3-4; 135.2) mentions as the best material available in central Italy to craft mills.[492]

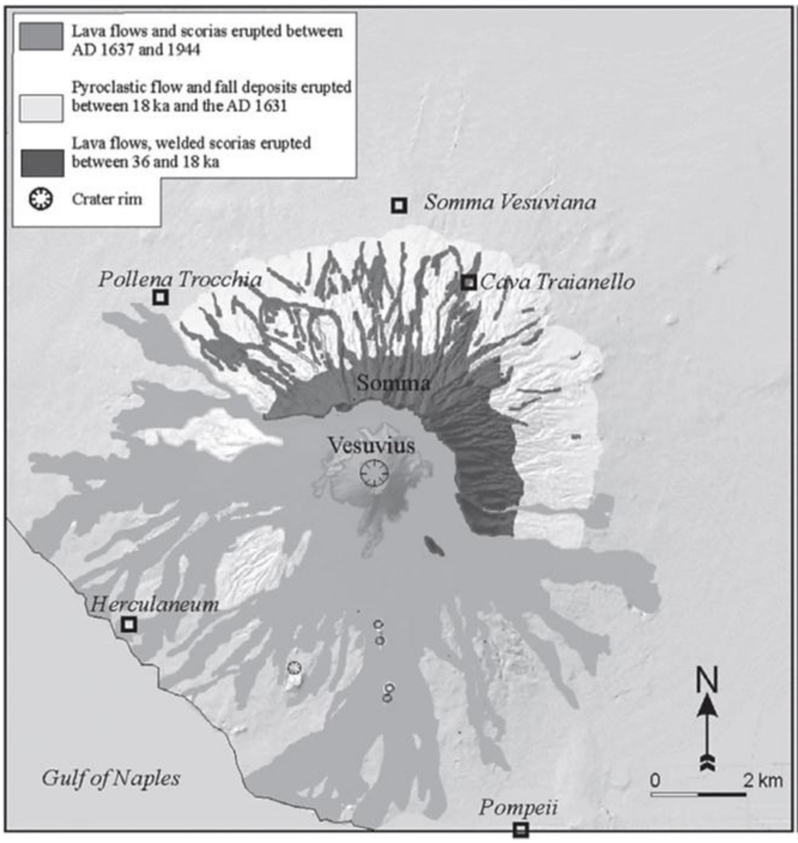

Figure 50. Geology of the Somma-Vesuvius (after Lancaster *et al.* 2011).

Mineralogical and petrographic data suggest that both compact lavas and scoriaceous lavas could be obtained from the bedrock underlying the site, but no ancient quarry is known. Recent evidence has shown that scoriaceous lavas used as *caementa* in Pompeian concrete could also be sourced from the northern slope of Vesuvius, where these deposits outcropped.[493] At Pompeii, the lavas are overlain by a pyroclastic unit, a welded tuff rich in scoria, lava and intrusive rock fragments also known as “Pappamonte”, which can be found at low depth, particularly in the southwest area of the site.[494] Pappamonte slabs were used extensively in ashlar masonry during the early phases of occupation, and could be recycled as rubble in later architecture (especially in clay-based mortar-and-rubble walls).

[492]Richardson 1988: 371-372. On the geological composition and provenance of Pompeian millstones see Buffone *et al.* 2003.
[493]Lancaster *et al.* 2011: 720-721 and fig. 8.
[494]Kastenmeir *et al.* 2010: 50.

In addition to the deposits associated with the Somma-Vesuvius activity, other consolidated tuffs attributed to the Campi Flegrei district (northeast of Naples) are also present in the area: the Campanian Ignimbrite, known locally as Nocera Tuff, and the younger Neapolitan Yellow Tuff. Nocera Tuff is a stone of a much better quality than Pappamonte, but its use at Pompeii was more limited because it had to be imported. Yellow Neapolitan Tuff can only be found at considerable depths, as it outcrops mainly in the area of Puteoli. Pozzolana was obtained from the ash-falls distributed among the Lattari and Sarno carbonate relief, at some distance from Pompeii (the thickness of these deposits is greater in the Lattari district, 4 to 7 m; 2 m in the Sarno mountains). On top of the older Campanian Ignimbrite, four deposits of ash falls predating the 79 CE eruption have been indentified: Codola, Pomici di Base-Sarno, Mercato-Ottaviano, Avellino (these are mainly from the explosive activity of the Somma-Vesuvius).[495]

Archaeological Term	***Geological Term***	***Lithology***
Pappamonte	Tuff	Welded tuff with scoriae and calcite inclusions
Sarno Limestone	Calcareous Tufa	Porous carbonate of karstic origin
Sarno Limestone	Travertine	Harder carbonate with some degree of crystallization
Cruma	Basaltic Trachyandesite	Scoriaceous lava (dark purple)
*Lava/*lapis pompeianus	Basaltic Trachyandesite	Compact lava (dark grey)
Lava	Latite/Tephriponolite	Compact lava (used for road pavements)
Nocera Tuff	Campanian Ignimbrite	Welded tuff

Table 7. Stones used as building materials in pre-Roman Pompeii.

5.1.3 Studying Opus Caementicium in Pompeii: Problems of Definition

The architecture of Pompeii is characterized by a great deal of mortared rubble construction. Numerous examples exist of structural walls in which the rubble is combined by hand with clay-based mortar. This pattern is in stark contrast with the evidence available for

[495] Kastenmeier *et al.* 2010: 42.

Rome, where the only type of rubblework archaeologically attested for the Republican period is lime-based (i.e., *opus caementicium* or concrete). There, in both private and public building, the earliest structures built with mortared rubble feature lime mortars that already contain local varieties of natural pozzolana, thus excluding that any experimentation phase with simple lime mortar ever preceded the introduction of Roman concrete. This means that all Roman examples of rubblework are based on the use of hydraulic lime (*supra*, 2.1.1). In Pompeii, however, the existence of a representative sample of both clay-based and lime-based mortar-and-rubble architecture raises a set of crucial questions. Did lime-based mortar replace clay in structural rubble, and if so when? Or did the two techniques coexist for some time as separate building traditions? Did hydraulic (pozzolanic) mortar begin to be used at the same time lime mortar was introduced, or is it a later innovation?

Among the additives employed in both types of mortar mix at Pompeii were normally included local volcanic sands and/or clays derived from the weathering of the volcanic deposits of Vesuvius. The level of reactivity in hydraulic mortars depends not only on the amount of amorphous silica and alumina (unwashed volcanic sands include large amounts of nonreactive material), but also on the size of the particles (smaller particles increase the surface area with which the lime can react), and on the proportion of hydrated lime.[496] Thus, in order to link the two techniques, a clear transition must be observed in the composition of the mortars, with increasing amounts of lime and well-sorted reactive materials progressively introduced in the recipe. Secondly, if lime-based mortars were to be interpreted as an improvement of clay-based mortars, the expectation would be that the better technique replaced the less developed one, without overlap between the two. In order to test this hypothesis, the system with which walls of the two types are commonly dated must be first scrutinized.

[496]Massazza 1998; Massazza 2002.

As we will see (*infra*, 5.2.4), mortar studies employing scientific methods of analysis represent a recent development in the field of Pompeian architecture. Early literature on the subject is based mostly on personal observations, which have inevitably led to some confusion in the terminology used to define concrete building techniques at the site. This is particularly true for *opus incertum*, a term that in the context of Pompeii, as Wallace-Hadrill (2007) rightly puts it, has become "no more than a catch-all".[497] While in Rome the conventional term refers specifically to a style of facing found in *opus caementicium* walls, in Pompeii it has been applied to a wide variety of rubblework structures, including non-load bearing clay-based rubble fills of the kind found in association with the so-called *opus Africanum* technique.[498] This technique, also known in the literature as limestone-framework or *opera a telaio*, is characterized by pillar-like limestone blocks placed alternately in a horizontal and vertical position, regularly spaced across the entire length of the wall, with gaps filled with rubble of porous lava and limestone aggregate bound with clay.[499] But to what extent was lime used in the packing of these walls? This is an important matter, because *opus Africanum* architecture is normally connected with third c. BCE developments at the site.

5.2 Third c. BCE Architecture in Pompeii and its Relation with *Opus Incertum*

5.2.1 Settlement Patterns and Literary Sources

Textual references to known monuments in Rome are numerous, though in many cases the task of assigning any archaeologically attested building phase to a precise construction

[497] Wallace-Hadrill 2007: 280.
[498] E.g., Adam 2007: 105.
[499] The term *opus Africanum* is not attested in ancient sources, but is a modern definition based on the idea that the technique originated in Punic North Africa as a "framework and fill" in which timber (which was not available locally) is replaced by stone: Lugli 1957: 379-382 (describing the technique as a construction method based on "pilastri a nervature litiche", which would be imported by the Romans after the conquest of Carthage); Adam 1994: 120-121. From there the system would have been transmitted to the Punic sites of western Sicily, where examples of this technique could date as early as the late fourth c. BCE (Selinus; Motiae). In North Africa, however, *opus Africanum* is found only in the Roman period.

episode remains problematic. In comparison, very few construction dates are available for monuments of pre-Roman Pompeii.

The historical record for the early period is virtually non-existent. Strabo (5.4.8) speaks of different waves of political domination that succeeded one another in the region originally inhabited by the Oscans: Etruscan, Samnite (from ca. 450-425 BCE) and Roman. Because of the lack of written sources concerning the early Samnite period (conventionally the fifth to third c. BCE), changes in settlement patterns have been linked with broader phenomena of urbanization unfolding in the region, suggested by the reconstruction of the fortifications and the creation of regular urban layouts at major sites, which ceramic finds seem to place between the fourth and the third c. BCE.[500] In the case of Pompeii, Coarelli (2002) has suggested that the renovation happened in connection with the events leading to the political alliance between Rome and Nuceria in the late fourth c. BCE.[501] Richardson (1988) has argued that Pompeii must have gained a higher status only in the years of the First Punic War, and that in the previous period the site was merely a dependent village in the territory of Nuceria. According to his reconstruction, the mid-third c. BCE saw the involvement of the towns of the Sarno valley in the ship-building industry, and the idea is that the profits from this eventually allowed Pompeii to embark in monumental construction and to grow as a densely populated urban center.[502]

The participation of Pompeii in the rebellion against the Romans during the Social War (Appian, 1.50; Velleius, 1.16.2), which led to the siege of the city by Sulla and eventually resulted in the planting of a Roman colony in 80 BCE, provides the only fixed point for the period under discussion. While there is evidence that élite groups of the Samnite period retained

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[500] For a recent reappraisal of the phenomenon and its impact on the urban landscapes in the region see Rescigno and Senatore 2009.

[501] Coarelli 2002: 18-19. The fourth c. BCE restructuring of Nuceria is documented archaeologically: Johannowsky 1979.

[502] Richardson 1988: xv-xviii.

some of their influence in the long term, the political life in the early years of the colony was dominated by the leaders of the new settlers, who controlled the key magistracies under the new constitution (i.e., the duovirs; quattuorvirs are also occasionally attested). Latin became the official language in public affairs, quickly replacing Oscan also as a spoken language. Thus, when Oscan inscriptions are found in association with standing buildings, a generic date in the period 150-80 BCE is assumed for their construction, although some argue that the official use of Latin may have been introduced by the Samnite élites already at the end of the Social War, in the expectation of receiving Roman citizenship.[503]

5.2.2 Limestone Architecture and the Development of Rubblework: Early Studies

The high chronology of Pompeian *opus incertum* is based largely on previous studies of a class of houses, the so-called Kalksteinatrien, which are characterized by the presence of an atrium of the Tuscan type and structures made of Sarno limestone. Fiorelli (1873), who first linked the variety of building materials and techniques documented at the site with Strabo's historical account, connected the diffusion of this type of habitation with the Etruscan phase of domination, speculating that use of limestone was entirely abandoned with the arrival of the Samnites in the late fifth c. BCE.[504] Mau (1908) agreed on the Etruscan origin of the plan of these houses, but eventually proposed that limestone continued to be used in the Samnite period, until about 200 BCE, when this building material would be replaced by Nocera Tuff, marking the start of the so-called Tufo Period.[505] Stratigraphic investigations carried out in a systematic program by A. Maiuri in various sectors of the town between 1926 and 1942 demonstrated that standing remains of “Kalksteinatrien” could not be earlier than the third c. BCE, as in the case of

[503]For a detailed account of the events of the 89-80 BCE period at Pompeii see Lauter 2009: 163-170.

[504]Fiorelli 1873: vii-xiii; on this link between waves of political domination and the variety of building materials documented at the site see also Fiorelli 1875: 2-26.

[505]Mau 1908: 36-38. Cf. Mau and Kelsey 1907: 39-40. The problematic idea of a “Limestone period” is critiqued in Fulford and Wallace-Hadrill 1999: 37-39.

the Casa del Chirurgo.[506] Furthermore, excavations under the floors of this house (1930) documented archaic structural finds in Pappamonte, suggesting that the so-called Etruscan phase was characterized by the use of mixed materials. Plastered blocks of Sarno limestone reused in the foundations of the atrium house were connected by Maiuri to the early Samnite phase of occupation, which was then taken as a period characterized by the exclusive use of Sarno limestone.[507]

The initial findings of Maiuri were systematized by Carrington (1933), who developed the first comprehensive typology of Pompeii's architecture in the supposed “Limestone period”. Carrington identified three techniques, which he dated to the fourth and early third c. BCE: ashlar masonry; *opus Africanum*; the so-called dry-stone masonry, a type of *petit appareil* made of flat pieces of limestone laid horizontally, with bigger corner blocks (**fig. 51**). He noted that where ashlar masonry is present, it is used only in the façade, while side-walls and interior subdivisions are in *opus Africanum*. He recorded houses built either with *opus Africanum* and dry-stone in all their parts (including façades). Dry-stone was found to be associated with *opus Africanum* façades, but never with ashlar façades. As described by Carrington, the pattern does not imply a chronological variation, but rather it depends on status and wealth, with houses of the first class at the top and houses where dry-stone is employed at the bottom.[508] The use of lime would not be attested in this phase.

The earliest consistent experimentations with a kind of mortar containing higher quantities of lime were placed by Carrington in the later decades of the third c. BCE. In

[506]For a summary of the results see Chiaramonte Treré 1990: 7-13.

[507]Maiuri 1930. Based on the metrology, Maiuri thought that the plastered blocks were spolia from the fortifications (the so-called “muro ad ortostati”). Cf. Richardson 1988: 376, showing that standing ashlar house façades had normally a plaster coating in the lower parts, creating the effect of a high socle. This suggests that plastered blocks found reused in foundations may have come from the dismantling of earlier houses.

[508]Carrington 1933: 129.

Carrington's view, this was a practice that emerged in parallel with a generalized, if only temporary, decline in the use of ashlar masonry, as documented at “Kalksteinatrien” sites like the Casa di Sallustio and the Villa dei Misteri, which were also investigated in those years and tentatively dated to that period. In Carrington's description, the rubblework at these sites resembles the type attested at the Casa del Chirurgo in composition (the aggregate is scoria and limestone, the latter in predominant quantities),[509] but in other ways displays advanced features of walls conventionally classified as *opus incertum* (significantly, Carrington avoided the term altogether): a clear distinction between an inner core, which is composed of loose rubble mixed with clay, and outer facings of better quality, with small blocks laid in hard lime mortar built up in layers varying in height from 0.30 to 0.75 m. The selective use of lime mortar of higher quality was interpreted as an indication that lime was still considered a luxury, and thus employed only where strictly necessary. Ashlar blocks are used for angles and door-posts, and laid horizontally and vertically in alternation, so as to grip the rubble fill, according to the technique seen in *opus Africanum* walls. In fact, Carrington took this as evidence of relative antiquity; however, houses belonging to this group do not feature interior *opus Africanum* walls with clay-based mortared rubble: pillars are never found in other sections of the walls, which are made of lime-based rubblework throughout. In Carrington's scheme the introduction of faced lime-based mortar-and-rubble structures (*opus incertum*) would still predate the “Tufo period” (200-90 BCE), but was independent of the *opus Africanum* building tradition.

The “Tufo period” was characterized by Carrington as a revival of ashlar masonry construction. This was made possible by the introduction of a new building material, Nocera Tuff, whose qualities allowed for more refined treatments in comparison with the Sarno

[509] Mau (1907: 39) argued that lava was predominant in the earliest rubblework of the “Kalksteinatrien” phase, while the use of limestone aggregate increased only at a later stage. This sequence was not unanimously accepted in subsequent studies. Adam (2007: 105) dates the introduction of lava rubble construction in the third c. BCE.

limestone. Like limestone ashlar masonry, tuff *opus quadratum* is found only in the façade, but as more complete surveys of the evidence were to show, this material was also used in limestone houses for sculpted elements such as columns, *impluvia* and other architectural decorations, proving however that the rigid separation between the two periods based solely on building materials had no secure basis.[510] Façades of limestone blocks appear in houses of the same layout and proportions attested in houses with tuff façades. Sarno limestone was evidently a cheaper substitute, because it was more readily available than the Nocera Tuff, which in any case was in the main employed only in the exposed parts. In fact, even the most elaborate tuff façades (e.g., Casa del Fauno; Casa di Pansa, Casa della Fontana Grande) are always founded on Sarno limestone blocks alternated with rubble. In addition, the interior walls in these houses were often corner quoins of Sarno stone.

In the houses with ashlar tuff façades, Carrington noticed that the construction technique of interior rubble walls is different. These are all of the *opus incertum* type, which is lime-based. According to Carrington's model, the amount of limestone in the wall-facings progressively diminished in favor of hard lava. Type-sites for this transition were deemed to be the Casa del Fauno and the Casa di Pansa, which Carrington dated to the middle of the "Tufo period" on stylistic grounds, where the two materials are attested in equal proportions. Another development in technique during this phase was the introduction of a mortar mix of good quality, containing black volcanic sand and a higher proportion of lime. The transition from limestone to lava was thought to have been a gradual one. It would be completed before the end of the century, given the association between walls made entirely of lava and First Style paintings in public monuments (e.g., the Basilica), but the pattern in the domestic sphere remained less clear.[511]

[510] See especially Richardson 1988: 370.
[511] Carrington 1933: 131-132.

Ultimately, the idea that lime-based mortar-and-rubble appeared already in the third c. BCE is in Carrington's model based only on the association between interior walls of *opus incertum* and façades of limestone ashlars, which would place *opus incertum* in the alleged “Limestone period”.

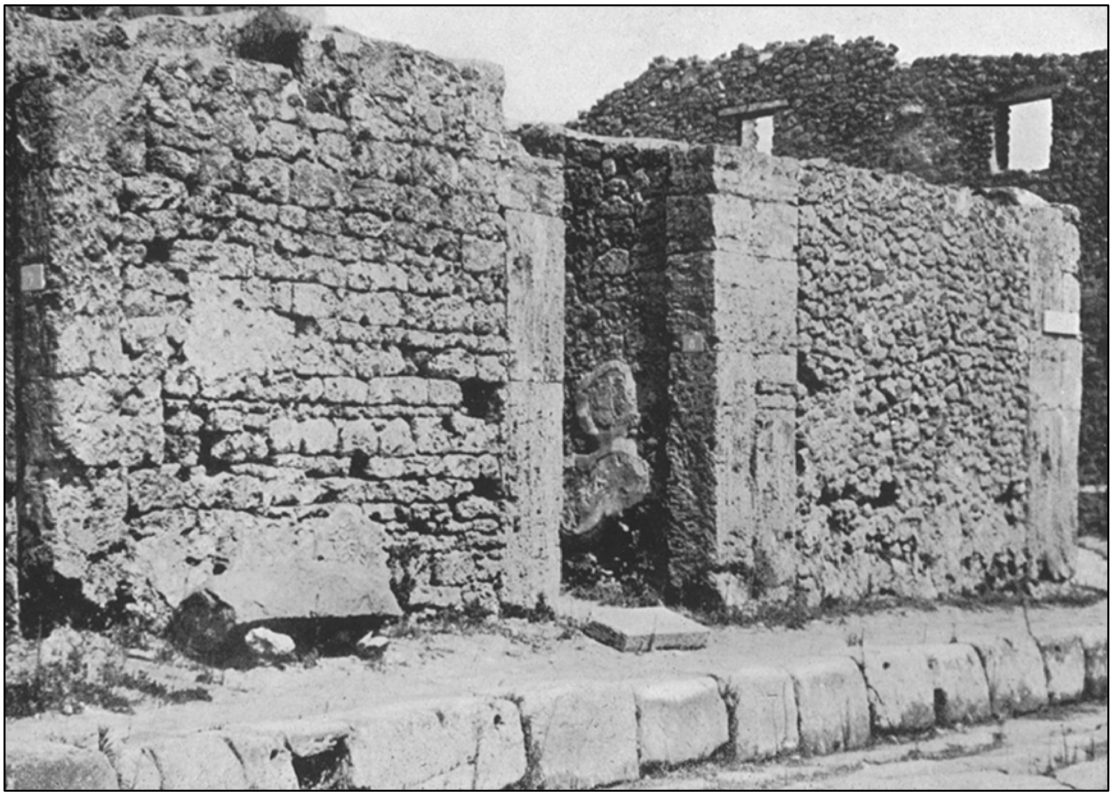

Figure 51. Pompeii, V.3.8: example of “dry-stone” masonry according to Carrington’s typology (left; after Carrington 1933).

In subsequent years, Blake (1947) and Lugli (1957) expanded on Carrington's model, confirming the canonical periodization. The former suggested that the introduction of Nocera Tuff in ashlar masonry determined the reuse of Sarno limestone to obtain *caementa* and facing blocks, and that the change from mixed Sarno limestone and lava to lava alone happened only because the supply of the recycling material was at some point exhausted; in other words, Blake's idea was that Sarno limestone was never quarried on purpose just to produce aggregate.[512] Lugli advanced the idea that Pompeian concrete originated in the context of the "Kalksteinatrien" houses, in the form of what he defined as a "coarse *opus caementicium*" (cf. *supra*, 2.3.2), though his treatment of this subject is quite chaotic, with many inconsistencies in the dating (in parts of the work which were clearly revised after Maiuri's reports were published in 1944 and 1945, Lugli dated most of the known examples to the period 150-80 BCE, while maintaining the middle of the third c. BCE as a *terminus* for the introduction of the technique).[513]

Lugli also suggested on the basis of personal inspection that the mortar in the rubble fill of some *opus Africanum* walls included lime obtained from the calcination of Sarno limestone mixed with marine sand, thus explicitly linking the development of *opus incertum* to *opus Africanum* for the first time. Pozzolana would have been introduced only later, together with *caementa* and facing blocks of what Lugli described as "dark tuff".[514] In contrast with Carrington, however, he suggested that a true differentiation between core and facings could be properly noticed only in monuments that he dated to the end of the "Tufo period" (100-90 BCE), such as the *opus incertum* portions of the fortifications and the Basilica. These are made exclusively with smaller blocks of compact lava in a technique that would characterize most of the post-80 BCE construction (especially in domestic architecture).[515]

Some of Lugli's intuitions have been more coherently expressed by Richardson (1988), who argued that there was a direct relationship between the choice of broken lava as a building material and advances in the composition of mortar and in the method of laying the lava rubble:

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[512]Blake 1947: 228-229.
[513]Lugli 1957: 379-383.
[514]Lugli 1957: 411-412; 447-448; 475-476 ("tufo vulcanico scuro").
[515]According to Lugli (1947: 498; 505), the so-called *opus quasi reticulatum* is attested at Pompeii only sporadically. A hiatus in construction activities during the middle of the first c. BCE would explain the sudden appearance of advanced froms of *opus reticulatum* (with polychromy) without transitional examples. However, the *theatrum tectum* (Odeion), the amphitheater, and the so-called temple of Zeus Meilichios (now identified with the Temple of Aesculapius), which Lugli considered as built with *opus incertum*, are now normally described as *opus quasi reticulatum* monuments: cf. Adam 2007.

this harder and heavier stone being more intractable, and producing smoother fracture surfaces that were not ideal for packing, it eventually required laying the elements in heavier beds of mortar, approaching the form of conventional *opus incertum*.[516] The better quality of the medium would have also determined its first use for foundations. According to Richardson, this process began only in the last quarter of the second c. BCE, so much so that in the previous period one can hardly speak of *opus incertum*.

5.2.3 The Low Chronology of Opus Africanum and Its Implications

Was Lugli right in linking *opus Africanum* and *opus incertum*? The most comprehensive typology of *opus Africanum* is that outlined by K. Peterse (1999; 2007), who interprets this building method as an intermediate stage between limestone ashlar masonry and *opus incertum* construction. Peterse's typology is a seriation based on the idea of progressive development, grouping standing remains of limestone-framework masonry according to variation in the spacing of the pillar-like structures (the closer the spacing between the pillars, the earlier the chronology of the wall), in the shape of the rubble elements (progressing from regular to irregular), and in the composition of the mortar (the higher the content of lime the lower the date of the wall).

On the basis of these correlating features, Peterse identifies three types of limestone-framework walls,[517] which more or less correspond to Carrington's classification:

[516]Richardson 1988: 376-378.
[517]Peterse 1999: 37-45.

- Type A, which can be best described as a structure made with rectangular blocks of varying dimensions (maximum of m 0.20 x 0.40), dressed and accurately laid in regular, horizontal courses (**fig. 52**). In fact, this technique is used almost exclusively for façades (just as ashlar masonry). When blocks of smaller dimensions are employed, the core of the wall features clay mortar. Because the blocks are well fitted, the structural role of the pillars is limited (these are usually located only at the intersection with party-walls, so that their spacing is not regular).

Figure 52. Pompeii, I.5.1-2: Peterse's Type A façade (after Peterse 1999).

- Type B, which corresponds to Carrington's "dry-stone" type (**fig. 53**). The dimensions of the blocks are similar to those attested for Type A, but occasionally large elements are also inserted. The blocks are still assembled in horizontal courses, but without dressing. Irregular joints are usually pointed with clay mortar, which is also used in the core. This technique is attested for both façades and interior load-bearing walls.

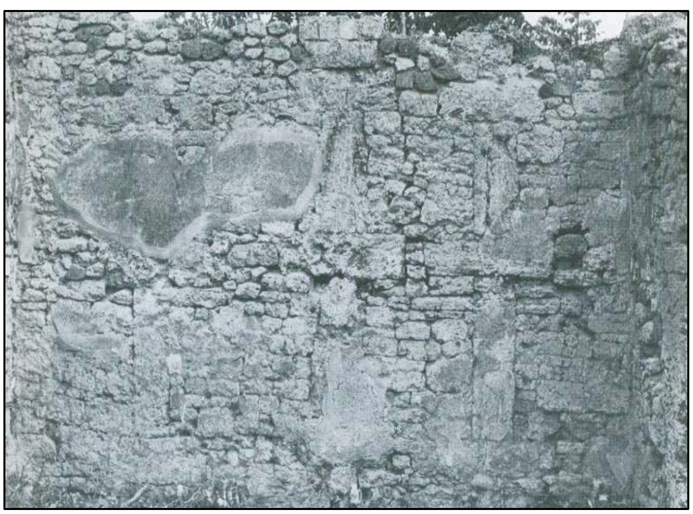

Figure 53. Pompeii, I.3.25: Peterse's Type B façade (after Peterse 1999).

- Type C, which is the only one displaying a rubble fill of irregular, fist-sized or medium *caementa*, with thicker joints (up to 2 inches) and very limited or no layering at all (**fig. 54**). This technique would represent a form of "architectural relaxation" (though in the case of joint thickness it could be argued that, because the *caementa* are more irregular, their bedding requires more mortar), which would have been compensated for by improvements in the composition and properties of mortar. This would still be mostly clay-based, but some examples of Type C rubble fills include some lime in the mix (but see *infra*, 5.2.4).[518]

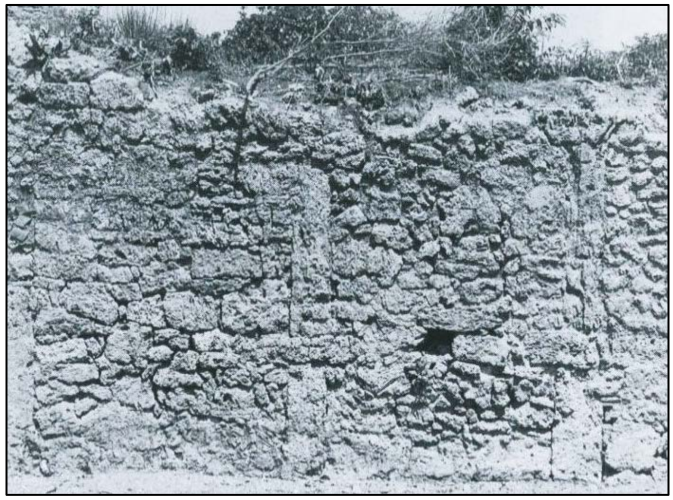

Figure 54. Pompeii, I.13.14-15, Peterse's Type C wall (after Peterse 1999).

According to Peterse, this typology provides a useful framework for the periodization of *opus Africanum*, on the assumption that each wall type corresponds to chronologically bounded building phases (defined as Periods A, B and C, respectively). In such a scheme, the architectural development at Pompeii would be characterized through time by a progressive decline in the quality of the ashlar dressing (i.e., less refined equals late), paralleled by gradual advances in that of the mortar. In Type B walls, the spacing between pillars would become more uniform, with elements placed at closer intervals than in Type A walls, given the relatively weaker nature of the fill. In Type C structures, the average distance between pillars would steadily increase, thanks to the stronger properties of the binder.[519] In reality, ample variability is attested within each type (especially for interior walls), so that in some cases the distinction between examples of irregular

[518]Peterse 2007: 375.
[519]Peterse 1999: 46-48.

Type B and of regular Type C seems arbitrary. Furthermore, there are only a few houses that demonstrate a significant increase in the average spacing of pillars in load-bearing walls (IX.1.22; VI.11.13 and 12; I.10.16-17).[520] In the best-documented of these cases (VI.11.12), this feature does not correlate with higher lime content in the clay mortar (in fact, this figures among the weakest samples).[521]

In Peterse's view, however, the relative sequence between the three types would be demonstrated by the spatial distribution on façades across the site (**figs. 55-57**).[522] Façades of Type A are found only in the central core of Pompeii, the so-called *Altstadt* (Regio VII), but overall are poorly attested (n=5). Façades of Type C are more widespread (n=50). These are found in greater proportion in the eastern sector of town (i.e., the eastern parts of Regio I, V and IX, and Regio II), in the quarter that is characterized by elongated rectangular blocks. This in fact appears to have been formally laid out at a later stage than the rest of the city-plan.[523] Façades of Type B (n=34) are attested mainly in the western sector, but have been found also in three blocks of the new quarter (I.9; IX.10 and 14), as well as in the irregular strip of blocks that connects this area with the double row of square blocks west of via Stabiana (IX.8; I.7 and 8), which was also planned in the later phase. Conversely, Type C walls are also documented in blocks of the north-western sector (and in blocks VI.2 and 5 this is the only type of limestone-framework ever attested). The overall picture is thus of substantial overlap between techniques, which does not fully support arguments based on horizontal stratigraphy.

[520]With values of 2.16 m or more: Peterse 1999: 20-31; 70-75, Tab. I.1-I.4. According to Peterse's data, in load-bearing walls in atrium houses the distance between pillars ranges between 0.71 and 1.30 m (with a cluster in the 1.00-1.30 m range); in houses without atrium this varies between m 0.82 and 1.43 (with most cases falling in the 0.94-1.38 m range). The spacing of pillars in non load-bearing walls mostly range between 0.86 and 1.35 m. This suggests that the placing of the pillars does not depend strictly on structural requirements.
[521]Peterse 1999: 106, Tab. II.6.
[522]Peterse 1999: 64-66; 67-70, figs. I.1-3.
[523]See especially Geertman 2007: 86-90.

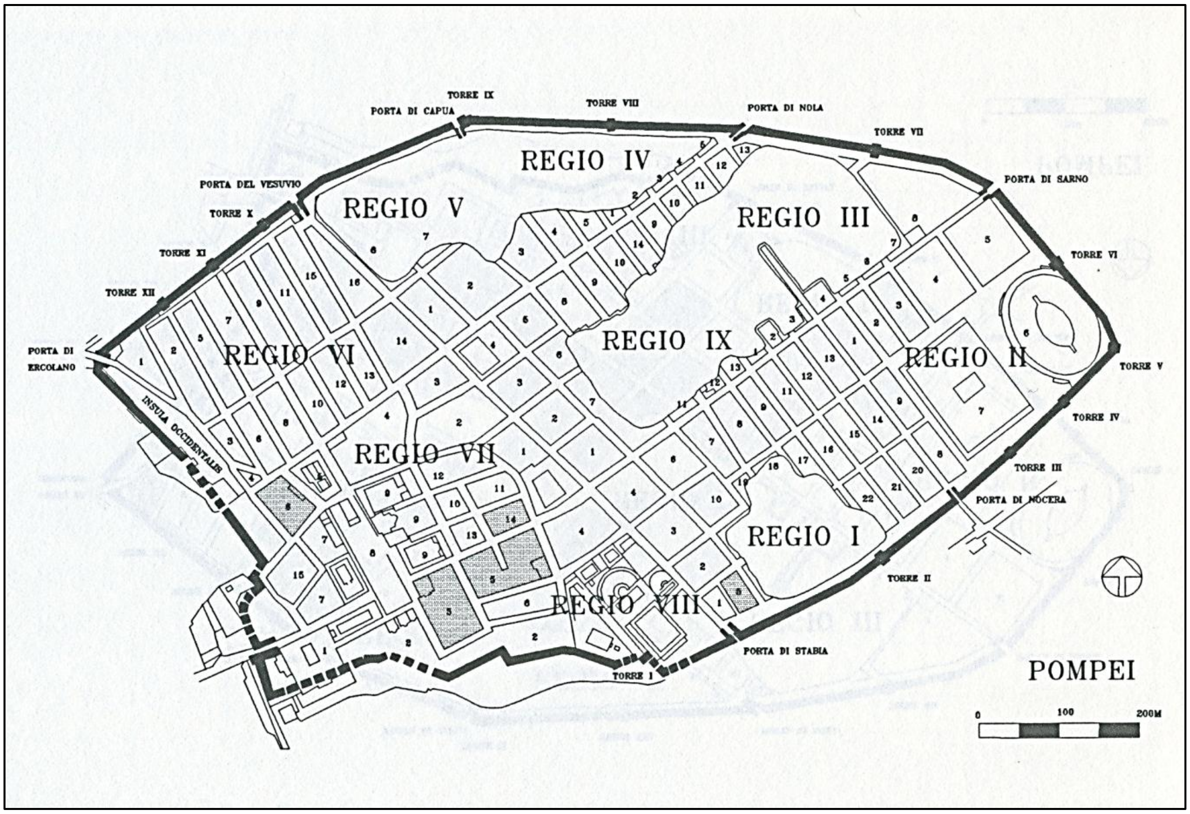

Figure 55. Pompeii: distribution of Peterse’s Type A *opus Africanum* façades (after Peterse 1999).

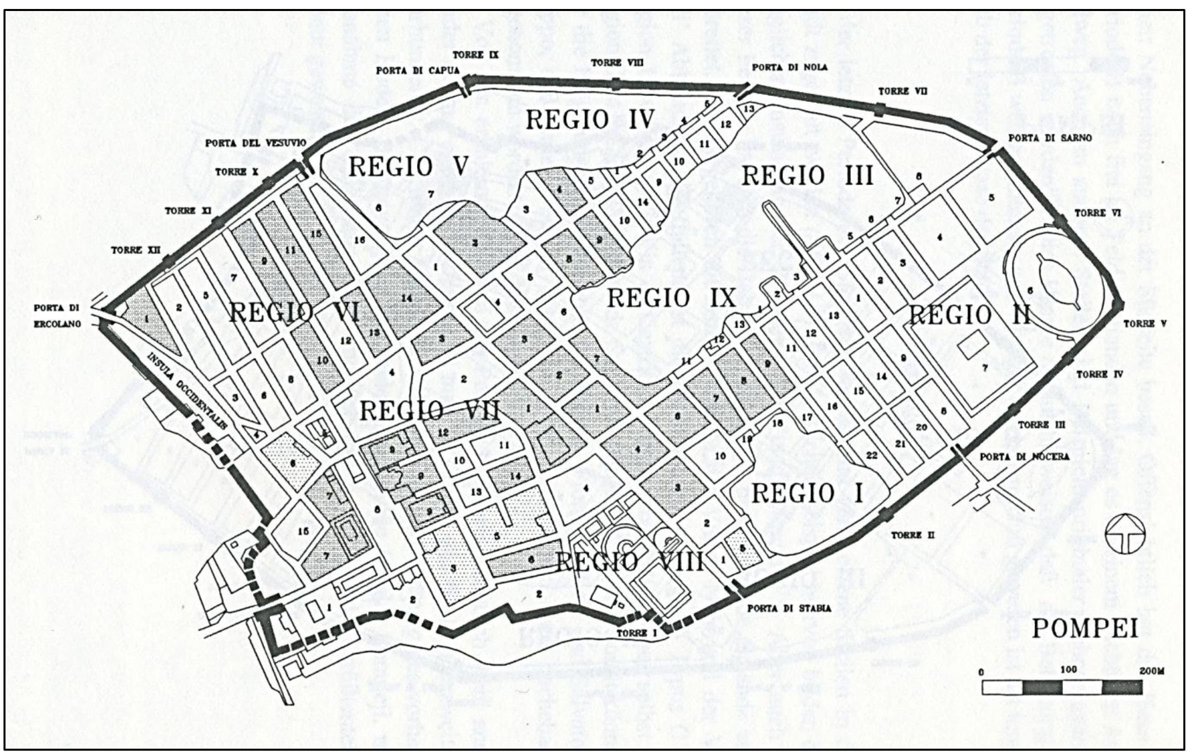

Figure 56. Pompeii: distribution of Peterse’s Type B *opus Africanum* façades (darker gray shade; lighter gray shade=Type A façades; after Peterse 1999).

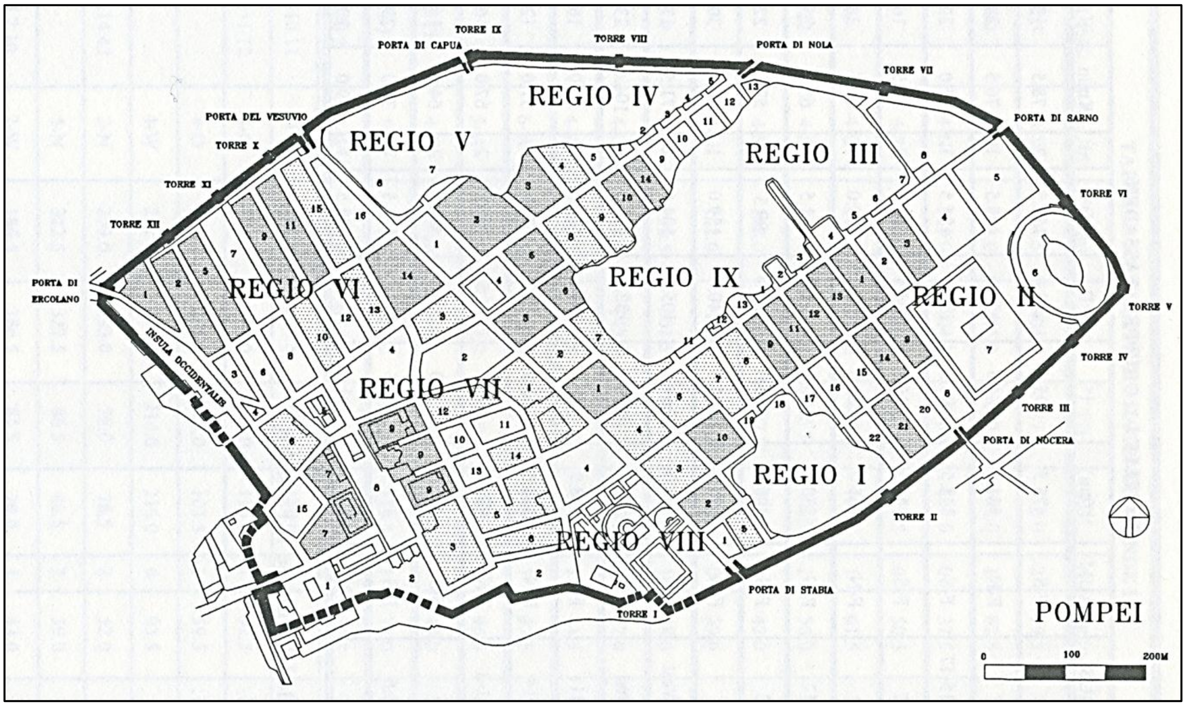

Figure 57. Pompeii: distribution of Peterse's Type C *opus Africanum* façades (darker gray shade; lighter gray shade=Type B façades; after Peterse 1999).

In terms of absolute chronology, the dating proposed by Peterse for each period is also questionable. As in previous approaches, the system appears based on the vertical stratigraphy of the fortification walls.[524] Because of the resemblance of Type A to *opus quadratum*, Peterse correlates Period A with the earliest phase of the Sarno limestone walls, for which he proposes a 450 BCE date.[525] Assuming that the small number of façades built with this technique is an indication of the short period of use of this masonry style, Peterse dates Period A to 450-420 BCE. The diffusion of Type C is thought to predate the introduction of *opus incertum*, which is in turn dated according to the conventional chronology, no later than the end of the third c. BCE. Peterse suggests that Type C technique and *opus incertum* may have coexisted only for a short

[524]Peterse 1999: 57-59. The exterior face of the circuit shows in some points a foundation in blocks of Pappamonte, on top of which is a lower level of Sarno limestone blocks that are part of a double-curtain structure (the so-called "muro ad ortostati") later substituted with a fortification of the *agger* type. The upper level is in blocks of Nocera Tuff, but a final phase in *opus incertum* is also attested: De Caro 1985; Chiaramonte Treré 2007.

[525]Following De Caro 1985. Cf. Richardson 1988: 44-50 (with a date in the third c. BCE, based on comparanda for the double-curtain type from Sicily).

period of time, in light of the alleged cheaper costs of concrete construction; with the improvement of mortar recipes, the pillars were no longer structurally relevant and would have represented an unnecessary expense. On this basis, Peterse dates Period C to 275-175 BCE, thus confirming the view that experimentation with lime began by the middle of the third c. BCE. As a result, Period B would have to be placed in the intermediate period, 420-275 BCE. Peterse finds confirmation of the high chronology of Type B in the results of stratigraphic excavations in the atrium of the Casa degli Scienziati (VI.14.43), where fourth c. BCE material has been collected, though in levels for which no direct stratigraphic relationship with the standing masonry structures can be proved.[526]

This chronology requires thorough modifications (**Table 8**). Comparing the distribution of the *opus Africanum* types with that of the most elaborate Pompeian houses of the pre-80 BCE period (including those with Sarno limestone ashlar façades), it is evident that the Peterse's Types A and B are found in greater proportion in the city-blocks which are occupied by the richest houses (**fig**. **58**).[527] In addition, these techniques are most frequently employed in the context of house-plans featuring a canonical atrium (occasionally, these are of standardized proportions but of smaller dimensions).[528] Type C, on the other hand, is typically associated either with small atrium houses or with the so-called "row-houses", which indeed are concentrated in the eastern quarter outside the *Altstadt*. The latter architectural type has been considered to be a quicker and more economical method of house construction adopted by the lower class, and its spatial distribution at Pompeii has been taken as evidence of some form of zoning.[529] In light of this, it can be argued that the choice of technique correlates with economic

[526]Peterse 2007: 377-378. On these controversial data see De Haan *et al.* 2005.
[527]Lauter 1975: 149-151.
[528]Peterse 1999: 107-125.
[529]On this architectural type see Sewell 2010: 116-121.

means rather than with chronology. While quasi-isodomic or *petite appareil* masonry may have represented a slightly cheaper solution as opposed to ashlar masonry (individual blocks could be fitted by hand; the lack of refined dressing may also be interpreted as time-saving), the close relationship between these techniques is also suggested by the fact that interior walls of houses featuring Sarno limestone ashlar façades are in most cases of Type B.[530] The extent to which Types B and C are used in houses with façades made with Nocera Tuff blocks, which rank at the top of the scale in terms of prestige, has not been studied in any detail (though party-walls in these houses are generally described in the literature as *opus incertum*).[531]

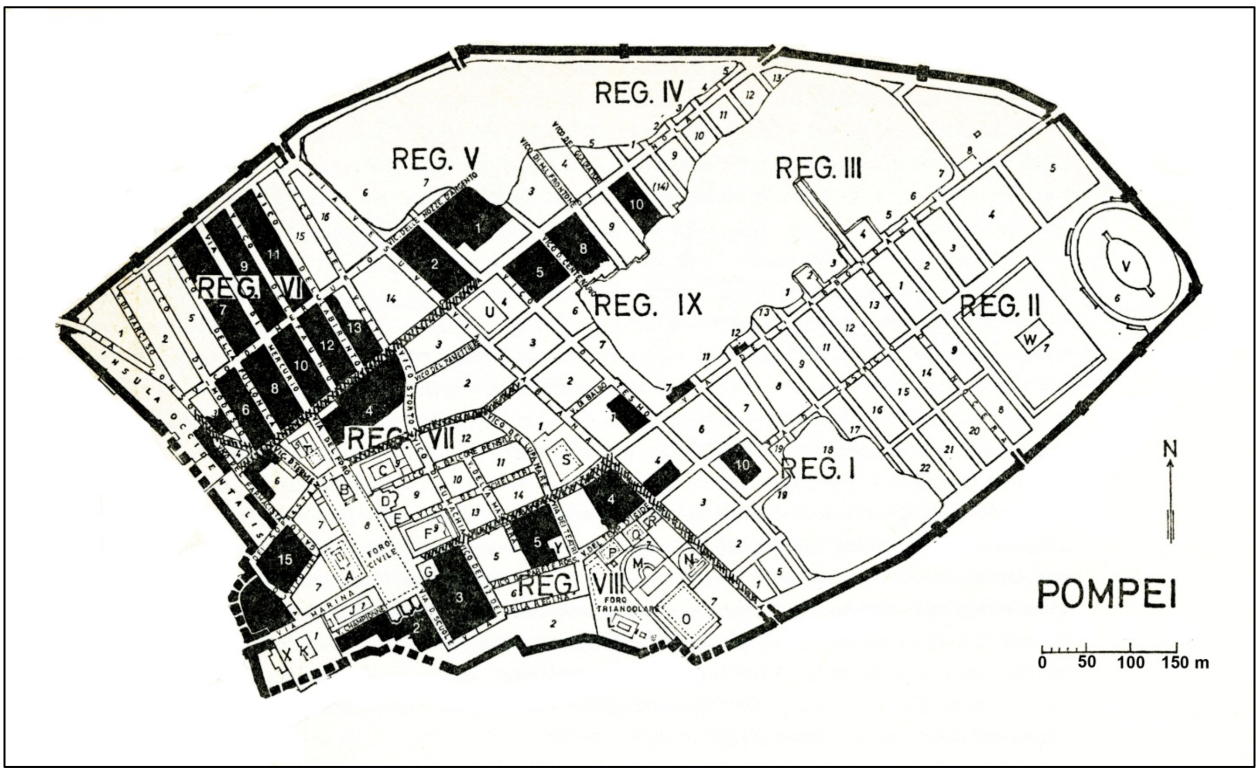

Figure 58. Pompeii: distribution of rich second c. BCE houses (after Lauter 1975).

This idea that *opus Africanum* and *opus incertum* may have been contemporary but separate traditions corresponds to the results of a new wave of stratigraphic excavations begun in

[530]Peterse 1999: 44-45.
[531]But see at VI.8.22, the Casa della Fontana Grande (Maiuri 1973: 161-165).

the early 1980s.[532] These showed little evidence of construction for the period from the fifth to most of the third c. BCE in both public and residential sectors of the town, challenging the very same idea of the "Limestone period".[533] Chiaramonte Treré (1990) first pointed out that most of the domestic structures built with limestone ashlar and/or *opus Africanum* could only be dated to after 200 BCE.[534] The progress of research has confirmed that very few contexts can be said with any certainty to predate this period. The best documented mid-third c. BCE house is the one revealed beneath the Casa del Centauro (VI.9.3-5).[535] The relative antiquity of this house is suggested by its unique layout, featuring a transverse open court and double street-front rooms (like the "row-houses"), but with shorter proportions; its façade is in limestone ashlar, the side-walls in *opus Africanum*, but interior walls are built with packed clay (the house was decorated with painted plaster and had cocciopesto floors and an early mosaic; lime mortars were not employed for structural purposes in the first phase of the house).

As already suggested by Richardson (1988), Chiaramonte Treré (1990) too recognized that in many of the well-dated examples of atrium houses (e.g., the houses of block VI.5, of the first half of the second c. BCE) Sarno limestone and Nocera Tuff were employed simultaneously, and that a great deal of variation characterized the construction technique of party-walls, including *opus incertum*.[536] The late use of Sarno limestone in the pre-Roman period was confirmed by other excavations in the 1990s, such as those in the so-called Casa di Amaranthus

[532]E.g., Arthur 1986; Bonghi Jovino 1984. For a first contextualization of these finds see Richardson 1988.
[533]For a recent reassessment of the evidence see Wallace-Hadrill 2007.
[534]Chiaramonte Treré 1990: 24.
[535]Pesando 2005: 82-88; Pesando 2006: 229-233; Pesando 2008. According to Pesando (2006), the original floor of this house is obliterated by a level containing pottery of the second half of the second c. BCE. Its construction has been dated to the middle of the third c. BCE (though a date in the latter part of the third c. is also possible).
[536]Chiaramonte Treré (1990: 21, footnote 24) accepts the high chronology of Roman concrete (late third/early second c. BCE), citing Carandini's excavations on the Northern slopes of the Palatine as a parallel. Cf. Richardson 1988: 376-378, maintaining that interior walls are always a version of *opus Africanum*, and interpreting variation as proof that this was not the work of a restricted group of builders, but that it continued for more than a century.

(I.9.11-12), where unmortared limestone rubble architecture may be as late as 200-150 BCE (earlier structures at this site incorporated Pappamonte rubble, but no ashlar blocks).[537] Controlled excavation in the "row-houses" of Regio II demonstrated that most of the plots in the eastern sector were first occupied only at the end of the third c. BCE, with a progressive infill in the course of the second c. BCE.[538] Recent coin evidence has provided a *terminus post quem* of 211 BCE for the construction of the Casa del Chirurgo.[539]

The earlier dating of limestone architecture has been forcefully defended by F. Coarelli and his collaborators in a series of contributions primarily based on their work in the blocks 9, 10 and 13 of the Regio VI.[540] The main criticism leveled against what they describe as a form of "revisionism" is that generalized lower chronologies would be based on evidence from individual houses instead of entire city-blocks, which should represent the most appropriate unit of analysis (their claim that such studies do not combine stratigraphy and architecture seems ungrounded). In their view, traditional typologies of building techniques remain the most diagnostic element for the study of Pompeian monuments, because these are based on the integration of different kinds of evidence (wall-paintings, floor-types, inscriptions).[541] What seems overlooked, however, is that these systems were originally derived from the analysis of only a small sample of sites, and that there is a great deal of circular reasoning behind many associations between building techniques, wall-painting and pavement styles (which in any case

[537] Fulford and Wallace-Hadrill 1999: 112-115. This type of architecture is attested in other fourth-third c. BCE contexts (e.g., below the atrium of the Casa delle Nozze di Ercole: D'Alessio 2008; below the Casa di Giuseppe II, and in the area of the Foro Triangolare: Carafa 2011).

[538] Nappo 1997; see also Gallo 2001: 69-77 (Casa di Epidio Rufo, IX.1.20).

[539] Jones and Robinson 2007; Jones 2008.

[540] Pesando 2005; Coarelli and Pesando 2006; Pesando 2006; Pesando 2008; Verzar-Bass and Oriolo 2009; Coarelli and Pesando 2011.

[541] Coarelli and Pesando 2006: 16-17. The criticism in this case seems directed against the lowering of the chronology of Nocera Tuff ashlar masonry (e.g., Dobbins *et al.* 1998; but see now Dobbins 2007).

would mostly apply to the late "Tufo period").[542] In the most recent synthesis of their work, Coarelli and Pesando (2011) maintain Peterse's chronological framework, suggesting that the introduction of *opus Africanum* could be even earlier (first half of the fifth c. BCE). This is on the basis of ceramic materials associated with a structure made of limestone rubble and small blocks of limestone packed with clay, which was shown to predate the establishment of the grid in block IX.7.[543] The wall in question has been exposed for less than a meter, and is preserved in elevation for less than 0.5 m, which makes its classification as limestone-framework quite problematic. In their overview of Pompeian building techniques, Pesando and Guidobaldi (2006) date the intensive use of *opus Africanum* (as well as the diffusion of First Style paintings, decorated *signinum* and mosaic floors associated with these remains) between the first half of the third c. BCE and the second quarter of the second c. BCE, but the stratigraphic evidence they invoke in support of the high chronology is not entirely convincing.[544] On the other hand, the lower chronology is consistent with examples of second c. BCE techniques related to *opus Africanum*, as attested in other regions of peninsular Italy, such as Etruria (e.g., at Bolsena).[545]

The second c. BCE date of most of the standing *opus Africanum* architecture has important implications for the study of mortar-based construction at Pompeii. Firstly, the use of this technique would overlap consistently with ashlar tuff architecture featuring *opus incertum* interior walls. This suggests that the idea of a progressive improvement of clay-based mortars

[542]See discussion in Westgate 2000: 263-272.
[543]Coarelli and Pesando 2011: 47 (citing Giglio 2008: 342, figg. 4-5).
[544]Pesando and Guidobaldi 2006: 3-4. See also Coarelli and Pesando 2011: 51 accepting the late fourth c. BCE chronology proposed for the Casa degli Scienziati. Another early example of *opus Africanum* would be at VI.10.11 (Casa del Naviglio), where construction levels contain materials of the first half of the third c. BCE. On this house: Pesando 2005; Cassetta and Costantino 2006 (322-336) for the pottery evidence. Sewell (2010: 130) rightly takes this date as a *terminus post quem*. In order to reconcile their data with the evidence obtained by Bonghi Jovino (1984), Coarelli and Pesando (2006) suggest that urbanization in this sector of Pompeii moved from north to south (i.e., starting from the periphery and slowly occupying the plots closer to the core of the *Altstadt*). Cf. Jones 2008.
[545]See especially Stopponi 2006; Di Luca and Cristilli 2011.

within the tradition of *opus Africanum*, eventually culminating in the implementation of lime mortars and *opus incertum*, is not as straightforward as previously thought. Already Richardson (1988) doubted whether we should consider the custom of packing Sarno limestone rubble in clay as a phase antedating the standardized use of mortar, suggesting that a plaster coating in combination with the pillars would have been sufficient to hold the structure together.[546] The rendering has in most cases disappeared, but traces of the lime mortar used in this type of construction may remain in the exterior joints, thus giving the impression that the walls were composed of lime-based facings and clay-based cores. Alternatively, the two techniques could be characterized to a certain extent as alternative traditions, which had more to do with issues of status. The emergence of lime-based mortar at the higher level of society would thus find a parallel with the phenomenon described above for Rome.

House	***Stratigraphic Dating***	***Building Techniques***
Casa del Naviglio (VI.10.11)	After 250 BCE	Ashlar masonry; *opus Africanum*
Casa del Centauro (VI.9.3-5)	middle/late third c. BCE	Ashlar masonry; *opus Africanum*; clay-based rubblework
Casa del Chirurgo (VI.1.10)	After 211 BCE	Ashlar masonry
Casa di Amaranthus (I.9.11-12)	Third or second c. BCE	Clay-based mortared rubble; wattle-and-daub
Insula del Centenario (IX.8)	First half of second c. BCE	*Opus Africanum*
Row-houses of Regio II	Second c. BCE	*Opus Africanum*

Table 8. Distribution of Sarno limestone structures in datable domestic contexts at Pompeii.

Secondly, the idea that the earliest *opus incertum* construction was based on the recycling of blocks taken from older buildings to produce *caementa* requires some modification. The availability of Sarno limestone rubble must be linked with the on-going quarrying of this material during most parts of the "Tufo period", so the change from limestone rubble to compact

[546]Richardson 1988: 370.

lava must have represented a specific choice in the process of implementation of mortar-based techniques at the site.

5.2.4 Further Evidence from Mortar Analysis at Pompeii

As already noticed, early typological studies of *opus incertum* did not go beyond simple observation, occasionally resulting in inaccurate identifications of building materials. A major obstacle for a more systematic definition of concrete composition was soon recognized in the masking effect that the reconstruction activities following the earthquake of 62 CE had on the urban fabric, as these involved the extensive recycling of building debris in various forms of rubble-work.[547] Hence, there is the tendency to cautiously interpret the admixture of materials other than limestone or compact lava in *opus incertum* wall-facings as an indication of later repairs.[548] Oddly, though, the possibility that visible mortar joints may be what remains of later pointing (or re-pointing), even in the case of facings in which only one kind of material is present, has not been considered with the same attention. In fact, a bias of this kind is more likely to affect the earliest rubble architecture still standing on site, which certainly required more maintenance over a longer period of time. As we have seen, one of the most common assumptions about the development of *opus Africanum* fills is that the quality of the bedding mortar used for the facings was far better than that of the core. But the pattern could just as well be interpreted as the result of multi-phased occupation or be indicative of the use of a stronger plaster, which was applied to the surface to contain the rubble.

The latter practice can be proven to have been common during the final construction phase at Pompeii, on the basis of the results of the first set of lab analyses ever to be conducted

[547]Maiuri 1942: 191-194. The presence of *pilae* of bricks is generally considered to be an indication of later date in the Roman period.
[548]E.g., Chiaramonte Treré 1990: 21.

on surviving masonry (these appeared only in 1983).[549] This work demonstrated that mortars and plasters in the post-62 CE phase at the site could be characterized as entirely different media, and perhaps even traditions, based on petrography, granulometry and binder/aggregate ratios. Samples were obtained from building debris (i.e., not from standing remains) collected from houses located in blocks VI.2; VII.2, 3 and 12; VIII.3 and 6; IX.5 and 8, as well as a public building (the Terme Centrali) and a tomb (Tomb 20 Sud in the necropolis of Porta Nocera). Overall the same materials are used in both media (including the pozzolanas of Mt. Vesuvius), but mortars from these contexts can be said to be more friable than plasters, because they were found to have a low binder-to-aggregate ratio; in addition, the aggregate for plasters was evidently washed and sifted, as it is also well-sorted.[550] However, the degree to which this trend is representative of earlier periods remains uncertain, due to the lack of comparable data.

A more extensive survey of mortars (this time from standing remains) was carried out in 1990 by Peterse, in the context of his classification of *opus Africanum*. A variety of techniques were employed to analyze the mineralogy, chemical composition, binder-to- aggregate content of samples of clay-based mortars collected from domestic contexts, distinguishing between wall cores and facings.[551] Mortar types were defined with relation to the three types of *opus Africanum* masonry (A, B, and C), but there seems to be substantial overlap between them in terms of composition (**fig. 59**). In general, the mortar associated with Type C walls seems to be characterized by an increasing quantity of volcanic material, but because of the heterogeneous composition of local clays, it could not be determined whether separately quarried material was added to the mix. More importantly, the tests did not demonstrate with certainty the use of burnt lime, admitting the possibility that ground Sarno limestone could also be included in the mix as

[549]Frizot 1983: 31-38.
[550]Adam 1983.
[551]Peterse 1999: 77-106.

aggregate.[552] The presence of C-S-H (i.e., of hydraulic mortar) was found only in two cases in which, however, the lime content appeared exceptionally high (IX.1.22, Casa di Epidio Sabino; II.3); most likely these walls were later repairs.[553]

The absence of lime in clay-based mortars used for *opus Africanum* architecture has been confirmed by the results of lab tests conducted on samples from the Insula of the Centenario (IX.8), dating to the second c. BCE.[554] Clays and silts found in these mortars were most likely sourced in the Sarno valley. On the other hand, Sarno limestone was used to produce the lime associated with the *opus incertum* structures, given the identical proportion Ca/Mg detected both in the binders and in the stone.[555] Most of the *opus incertum* architecture attested in the Insula del Centenario dates to the Augustan period, demonstrating that this technique continued to be used into the late first c. BCE.

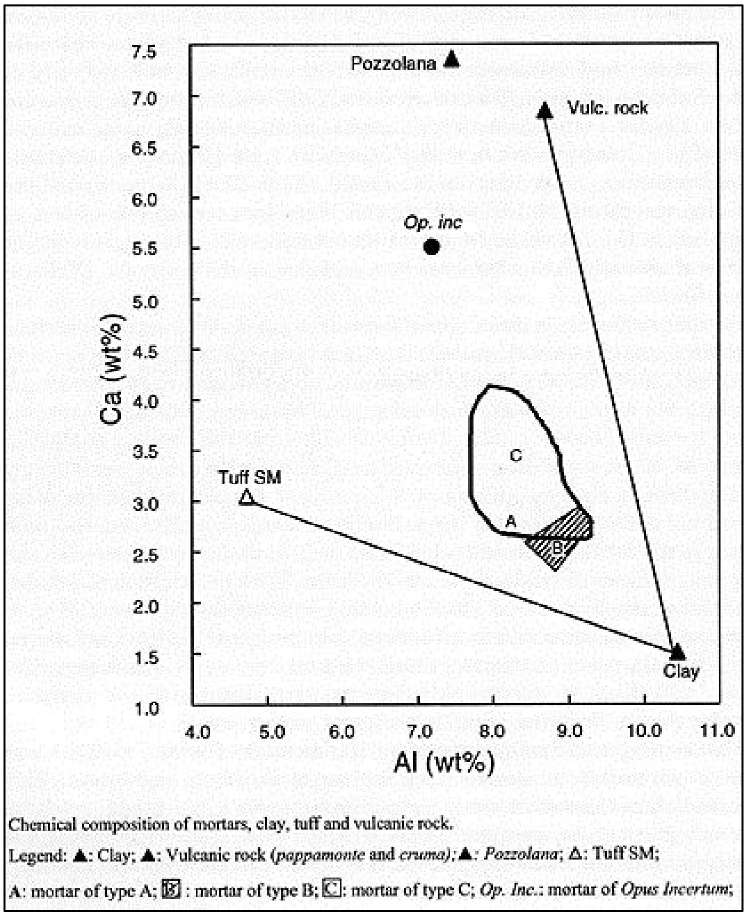

Figure 59. Composition of mortars associated with *opus Africanum* Types A, B and C (after Peterse 2007).

[552]Calcite inclusions in all resembling lime lumps are known to occur naturally in clay and volcanic ash deposits in the region. On the problems of effectively distinguishing between binder and carbonated aggregate in mortars see: Ortega *et al.* 2008.

[553]Peterse 1999: 87. These samples were not included in the cluster analysis.

[554]Bonazzi *et al.* 2007: 127, mortar type D. The chronology of the first phase of occupation of the block is based on the ceramics found in the lower floor levels (first half of the second c. BCE): Santoro *et al.* 2005.

[555]Bonazzi *et al.* 2007: 124-125.

For the period under investigation here, the only context for which reliable data on mortar composition are available is the Casa di Pansa (VI.6.1).[556] This is one of the best known examples of élite housing of the "Tufo period" (*infra* 6.1; 6.2; **fig. 62**).[557] It consists of a building of canonical atrium type with Nocera Tuff ashlar façade, and *opus incertum* interior walls with Sarno limestone corner blocks. In combination with this complex is an axial peristyle, also built during the original phase, which has been dated to the period 140-120 BCE on the basis of specific features of the plan (e.g, the restriction of the garden in the peristyle area) and of the style of the capitals (Pompeian Ionic with Attic bases).[558] All the mortar samples collected from the *opus incertum* walls in this house include natural pozzolana whose geochemical composition is compatible with the compositional fields of the Vesuvian volcanic ash. In addition, the formation of morphological types of C-S-H gels featuring reaction rims around the fragments of pozzolana has been positively identified in four samples taken in the area of the atrium, which is thought to preserve masonry dating to the first phase of the house.[559] A mortar characterized by different mineralogical phases has been associated with modifications in *opus reticulatum*, probably dating to the Augustan period.[560] This however has also been found in other *opus incertum* walls, indicating either that this technique was still used at this time (as documented in the Insula del Centenario) or that earlier walls were repaired in the context of the new building activities, simply re-pointing the wall-facings.

[556] Miriello *et al.* 2010.
[557] Maiuri 1973: 169-171; Richardson 1988: 120-124.
[558] The main entrance door is framed by pilasters with Corinthian capitals of the Italic type on a par with those found in the Casa del Fauno, which are dated by Lauter-Bufe (1987: 40-42) to the latter part of the second c. BCE. Cf. Richardson 1988: 124 (middle of the second c. BCE).
[559] Miriello *et al.* 2010: 2216-2218 (Group I mortars).
[560] Miriello *et al.* 2010: 2218 (Group II mortars).

5.3 Conclusions

The high dating of concrete architecture at Pompeii has been influenced by the early view that fifth to third c. BC construction at the site was characterized by the exclusive use of local limestone (what has been referred to as the "Limestone period"). With relation to rubble architecture, predominance of Sarno stone has been taken as evidence of relative antiquity, in turn feeding the idea that there was a progressive transition from Sarno limestone to compact lava rubble, and that decisive advances were achieved in the building tradition conventionally referred to as *opus Africanum*.

This building method has been interpreted as an intermediate stage between limestone ashlar masonry and limestone *opus incertum* construction. The most comprehensive study of *opus Africanum* groups standing remains according to variation in the spacing of the pillar-like structures (the wider the spacing between the pillars, the later the chronology of the wall), in the shape of the rubble elements (progressing from regular to irregular), and in the composition of the mortar (assuming a gradual increase in lime content; thus, the higher the content of lime the lower the chronology of the wall).

In terms of spatial distribution, the most accurate wall facings tend to concentrate in the neighborhoods where richer houses are attested. Conversely, the less regular types of *opus Africanum* are found in the "row-houses" of Regions I and II. The available scientific evidence suggests that lime-based mortar was used only for the rendering of rubble fills (i.e., in the form of plaster), after the wall had been built. These fills are composed of clay-based mortar and predominantly limestone rubble. It is uncertain whether burnt lime was ever added to the mix, but even if this was the case, the proportion was too low to develop a significantly stronger binder.

The lack of a clear transition from clay-based mortars to lime-based mortars demonstrates that the development of *opus Africanum* had little to do with the emergence of *opus incertum*, thus excluding the possibility of a third c. BCE date for early experimentations with lime mortar-and-rubble. In fact, houses built with *opus Africanum* can be found to be contemporary with houses built with ashlar façades and *opus incertum* interiors. This in turn suggests that the emergence of lime-based construction techniques must be linked with status and wealth. The next chapter will clarify when this innovation occurred.

Chapter 6

Early Concrete Construction in Pompeii

In this chapter, I review the evidence from the main building sites of Pompeii in which lime-based *opus incertum* is attested, reassessing the chronology of concrete monuments that are commonly dated within the first half of the second c. BCE. On this basis, I outline changes in construction processes in the 150-80 BCE period. I first examine the pattern of use of concrete at the domestic level, comparing and contrasting the finds with the evidence from public monuments. Finally, I contextualize the development of concrete architecture in Pompeii with broader architectural trends affecting the wider region.

6.1 Introduction: Economy and Society in the Late Samnite Period

In terms of architectural development, the second c. BCE has been described as a "golden age" for Pompeii.[561] Based on the pattern of construction at the site, it has been assumed that this was a period of extraordinary vitality for the town. The idea is that Pompeii, along with other cities of Campania (including Capua, Cumae, and Neapolis), soon became part of a single economic unit centered on the port city of Puteoli, where a Roman colony was established in 194 BCE. Proximity to, and economic ties with Puteoli would explain why Pompeii's pattern of trade

[561]See especially Lauter 1975; 1979. More recently: Pesando 2006.

with other regions of the emerging Roman Empire mirrors that of the port city.[562] Though pottery evidence on the export of local productions only picks up from the early Augustan period, amphora stamps naming the Pompeian *Lassii* (in Oscan) appear on stoppers of Dressel 1 containers found on shipwrecks off the coast of Gaul (e.g., the Chrétienne A, possibly dating to before 80 BCE, though not earlier than 150-125 BCE).[563] On the other hand, amphora assemblages recovered at Pompeii suggest that close links with the Aegean were also established during the second c. BCE.[564] Indeed other families of Pompeian origin became increasingly involved in trade with the newly incorporated areas of the Greek East at a rather early stage, as indicated by the numerous inscriptions naming local *negotiatores*, particularly at Delos in the latter part of the second c. BCE.[565] The common opinion is that local élites embarked on an unprecedented program of private construction, investing the considerable fortunes amassed in this way.

At Pompeii as elsewhere in the region, this phase is thought to reflect a powerful process of acculturation, which resulted in the adoption of current fashions and lifestyles through direct contact with the Hellenistic world. The richness and variety of material manifestations at Pompeii is also taken as a sign that local aristocrats were free from the alleged egalitarian ethos that constrained élite manifestations in Rome and other colonial contexts.[566] With regard to public architecture, the phenomenon has been seen in the appearance of buildings such as baths and theaters. As to the domestic sphere, stark variation in house size has been generally connected with increasing social stratification. The diffusion of Hellenized stylistic features at the upper-class level (particularly in the ornamentation of the houses) would also demonstrate

[562] Frederiksen 1984: 324-325.
[563] Panella 2010: 49, footnote 7, with further reference.
[564] Panella 1974-75.
[565] For a list see Castrén 1975: 39, footnote 6; Nonnis 1999.
[566] See especially Zanker 1998: 32-53; Pesando 1999.

intense competition and status display within the upper strata. This pattern has been contrasted with the apparent lack of monumental civic architecture – or interruptions in the development thereof – for most of this period. My analysis supports this view, showing that the earliest attestations of concrete construction, in Pompeii as in Rome, can be found in élite domestic architecture. Though there have been recent attempts to raise the chronology of the main poliadic temples, emphasizing the central place that these buildings occupied in the political landscapes of Samnite centers,[567] concrete architecture in public building took off at a later stage.

6.2 The Development of *Opus Incertum* at Pompeii: The Houses

6.2.1 The Character of the Evidence

The dating evidence on the *opus incertum* phase of Pompeian housing is very uneven in quality and quantity (**fig. 60**). First, many of the sites that have been taken to represent canonical benchmarks for the earliest phase of development of this technique, particularly those characterized by the predominant use of limestone *caementa* (e.g., the Villa dei Misteri), have not been explored below the floor levels of 79 CE to any significant extent. The interpretation of these buildings has been greatly influenced by the supposed relationship with the architectural traditions of the "Limestone period"; this almost invariably represents the only criterion for a high chronology. Other significant contexts remain dated primarily on stylistic grounds, based on the association of walls with surviving architectural decoration (e.g., Casa di Pansa), First Style paintings (e.g., Insula of the Menander) or a combination of both (House of Sallust).[568]

[567] Pesando 2006; Curti 2009.

[568] For a discussion of this method of study see Ling 1997: 17-20. Because the same building techniques were used across different periods, and different techniques could be used in the same construction phase, Ling maintains that masonry styles are not useful to date. According to his view, also the physical relationship between walls can be problematic, because there are numerous cases in which these appear bonded only in the upper parts, so that the safest criterion to distinguish between building periods would be the presence of plaster on one of two contiguous walls.

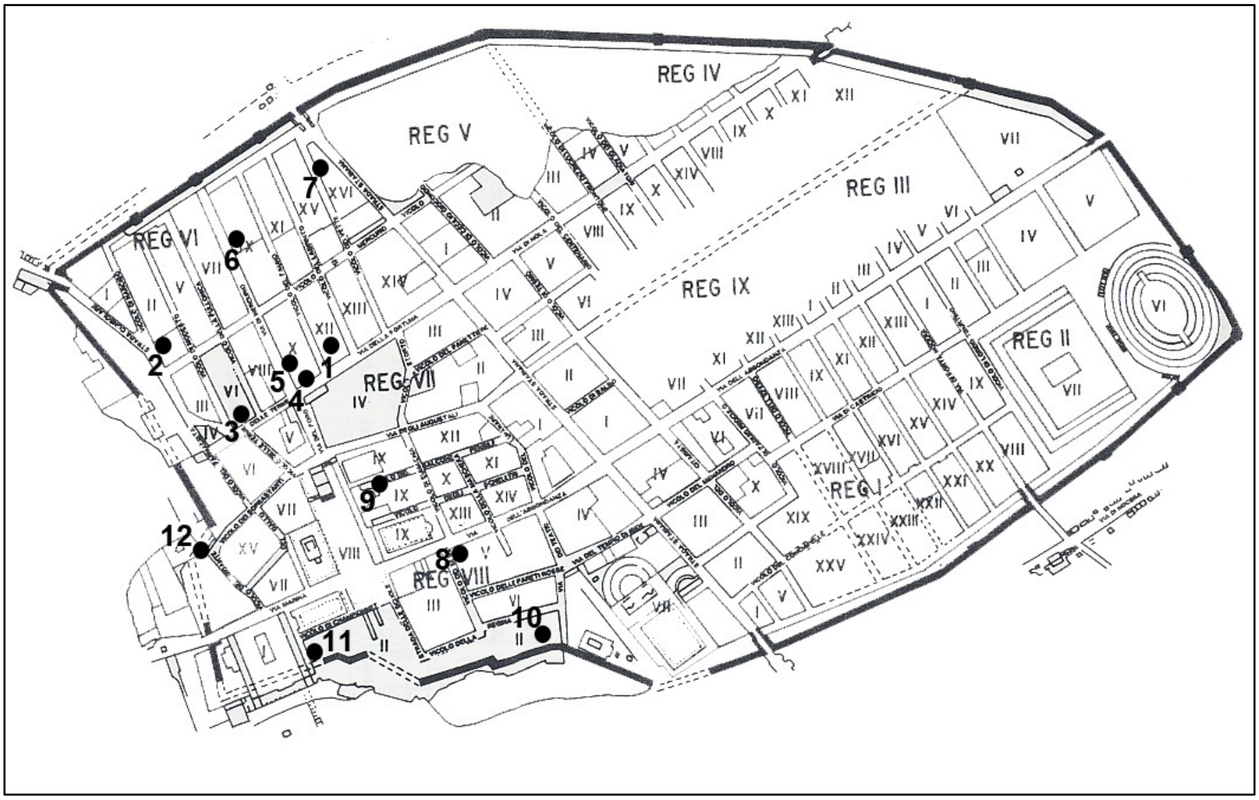

Figure 60. Schematic map of Pompeii with location of the urban concrete houses discussed in Chapter 6 (*1=Casa del Fauno*; *2=Casa di Sallustio*; *3=Casa di Pansa*; *4=Casa del Naviglio*; *5=Casa dell'Ancora*; *6=Casa del Centauro*; *7=Porta Vesuvio area*; *8=Casa del Gallo*; *9=Casa delle Nozze di Ercole*; *10=Casa di Giuseppe II*; *11=Casa di Championnet*; *12=Casa di Maio Castricio*).

Secondly, where available, stratigraphic data and ceramic finds normally come from test-trenches of limited dimensions, whose placement has often been constrained by preservation issues; these sondages tend to result in low artifact recovery rates, producing few diagnostic elements. In addition to this, most excavated deposits consist of construction fills and leveling layers, which normally contain abundant residual pottery. Ceramic assemblages collected from these levels can be at best used to provide a *terminus post quem* for the structures with which they are associated. When this excavation strategy is adopted at the level of city-blocks (as in the *Progetto Regio VI*), the sum total of data collected from small trenches, unfortunately, does not eliminate the dating problem. Open-area excavations are rare (e.g., Casa delle Nozze di Ercole), but, overall, the material does not seem to support the idea of a long-term development of *opus incertum*, confirming a late date for the refinement of some of its features.

6.2.2 The Casa del Fauno

The Casa del Fauno **(fig. 60, 1**; **fig. 61**) occupies an entire city-block in the northwest sector of Pompeii's grid-plan (VI.12). The monument has been the focus of German excavations since the first quarter of the 1900s. Stratigraphic investigations were conducted by A. Tschira and F. Rakob between 1961 and 1963 in select locations of the house (the *fauces*; two rooms off the tetrastyle atrium; the set of four rooms in the northeast corner of the latter; the south portico of the north peristyle). The results were integrated by an architectural study by A. Hoffmann between 1976 and 1981, but a detailed stratigraphic sequence and the ceramic finds have been published only recently.[569]

These excavations revealed that the house we know was built on top of earlier structures made in a mixed technique, using rubble of Sarno limestone, lava, tile and possibly *signinum*-floor fragments, bound together with some kind of mortar (clay?).[570] Elevations were partially preserved under the later tetrastyle atrium, while a foundation of Sarno rubble was identified beneath the south portico of the north peristyle; these structures conform to the same alignment of the later walls. Isolated remains of *signinum*-floors were also found, though not in association with the structures. Construction fills associated with this level contain material of the second half of the third c. BCE, while pottery of the first quarter of the second c. BCE has been collected from occupation layers obliterated by the Casa del Fauno.[571] The rubble structures evidently belonged to one or more habitations that occupied the plot in the first phase of the development of this sector of town.

[569]Faber and Hoffmann 2009.

[570]Faber and Hoffmann 2009: 33-34; 47-50. The authors found no information on the composition of the mortars in the old field documentation.

[571]Faber and Hoffmann 2009: 80-81.

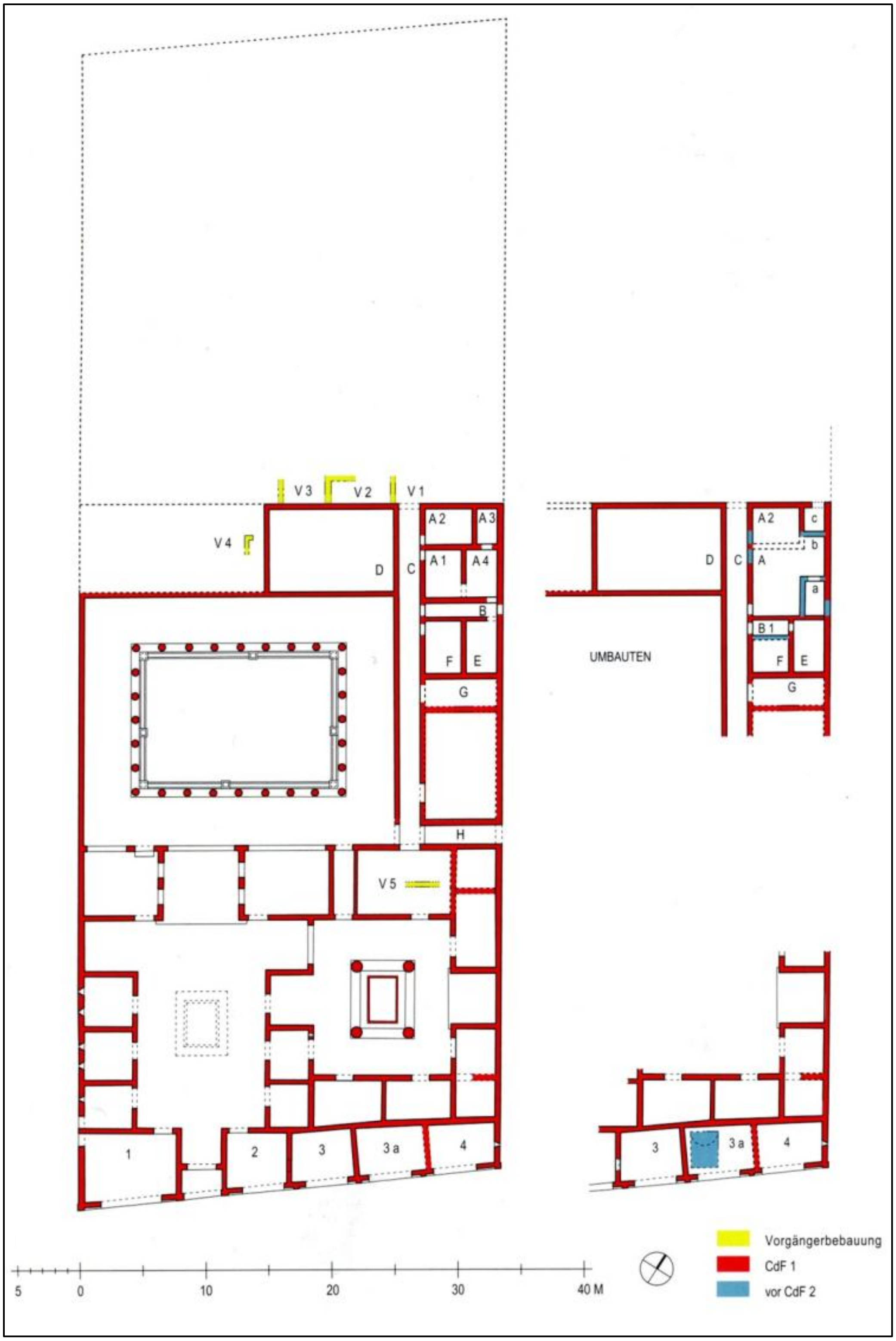

Figure 61. Pompeii, VI.12: Casa del Fauno, plan of Phase 1 (earlier structures in yellow; after Faber and Hoffmann 2009).

The original phase of the Casa del Fauno featured a dressed Nocera Tuff façade, two atria and a hortus, and it seems that the south peristyle was already present at this stage.[572] Before final publication of the results, this occupation was commonly dated to the period 185-175 BCE, on stylistic evidence.[573] Pottery recovered from the leveling layers associated with the *opus incertum* structures has been taken to place the construction of the house in the period 175-150 BCE, though in theory this should only represent a *terminus post quem*.[574] The interior walls of the house are built with individual stones mortared into place in regular courses. The quoins are of Sarno limestone blocks. Construction of the new walls started from the level of the previous occupation. The lower part of load-bearing walls was built up on top of a shallow footing ('Mortelbankett') composed of packed soil, limestone and lava rubble, and fragments of lime mortar – or more likely plaster (i.e., of a kind resembling the rubble fills packed between ashlar blocks in foundation trenches in houses with inner walls built in the limestone-framework technique).[575] The lower portion served as a retaining wall for the construction fills that were subsequently dumped to raise the new floor level. It also worked as a sort of foundation for the upper part of the wall (**fig. 62**).

The builders employed a deliberate grading of materials, using heavier compact lava in the lower portion of the walls, up to the height where the scaffolding was mounted (the lava rubble could also ensure better insulation). For the upper part the lighter Sarno limestone rubble was usually employed, with sporadic scoria and tile fragments. This construction system appears

[572]Faber and Hoffmann 2009: 21-22. Cf. Zevi 1991. Richardson (1988: 124-126) considers it a later insertion

[573]E.g., Richardson 1988: 115-117 (with a sub-phase around 125 BCE); Zevi 1991 (180 BCE).

[574]Faber and Hoffmann 2009: 82-84. Most of the black-gloss pottery belongs to types of the first half of the second c. BCE; a fragment of Dressel 1A amphora comes from the construction fills associated with modifications to the water-supply system, along with a new drainage and lavatories. Faber and Hoffmann 2009 (85) date this sub-phase to 150-125 BCE, but a date in the latter part of the second c. BCE is also possible. A *terminus ante quem* of the first quarter of the first c. BCE is given by the chronology of the second phase of the house. See Faber and Hoffmann 2009: 48-50.

[575]For other examples of this type of foundation in houses of this period see Maiuri 1973: 161-182.

consistently adopted in the atria, while in the northern half of the house the selection of materials seems less uniform. Furthermore, the northern boundary wall is made entirely with lava rubble, suggesting that whenever available a more resistant material was chosen for exposed areas.

Figure 62. Pompeii, VI.12: Casa del Fauno, lava *opus incertum* foundations found northwest of the peristyle in Room 42 (after Faber and Hoffmann 2009).

Extensive first c. BCE renovations are characterized by a harder mortar including coarser aggregate; the *opus incertum* facings are made of Nocera Tuff, scoria and *signinum* fragments; tile quoins are also attested.

In summary, ceramic finds from the leveling layers associated with the first concrete phase of the Casa del Fauno indicate a 175-150 BCE *terminus post-quem* for the *opus incertum* structures. A sub-phase consisting of minor additions and modifications is also attested, which is dated stratigraphically to a period preceding the overall restructuring of the house in the first quarter of the first c. BCE. In the second c. BCE occupation the walls feature mixed building materials (i.e., compact lava and limestone rubble), which are used selectively according to function (generally lava is used for foundations and exposed areas; limestone for elevations). The mortars are lime-based, but more detailed information on the composition is not available.

6.2.3 Other Opus Incertum Houses in Regio VI

The middle of the second c. BCE saw a burst in construction activity in this sector of Pompeii. Other sizable domestic compounds were built around this time, most notably the Casa di Sallustio (VI.2.4, recently dated to 150 BCE; **fig. 60, 2**),[576] and the Casa di Pansa (VI.6.1, commonly dated to 150 or 140-120 BCE; **fig. 60, 3**; **fig. 63**). While construction with limestone *caementa* and clay mortar continued in the context of *opus Africanum*, it is in these élite establishments that *opus incertum* makes its first appearance. The evidence from the Casa del Fauno and the Casa di Pansa suggests that conventional distinctions based on gradually varying proportions between different building materials, from Sarno limestone to compact lava, has no basis, because in lime-based mortar-and-rubble structures both stones are employed judiciously from the very beginning (while façades made entirely of lava *caementa* are generally considered to be later than those in *opus quadratum* of Nocera Tuff, the latter can be found in combination with side-walls of this kind already at this stage). *Opus incertum* walls including only limestone *caementa* are nowhere to be found in the archaeological record for the first half of the second c. BCE.[577]

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[576] For the chronology and development of this complex see Laidlaw 1994; Stella and Laidlaw 2008.

[577] *Opus incertum* walls made of limestone rubble can be occasionally found during the second half of the second c. BCE, always in association with load-bearing concrete structures featuring a grading of lava and Sarno limestone *caementa*: e.g., at VI.10.3-4 (Zampetti 2006: 109-111; the Sarno limestone *opus incertum* in this study are assigned to a previous phase only on the basis of the building material). In addition, when older ashlar walls are reused as a foundation, the footing in lava *caementa* may be absent, as in the boundary wall between VI.10.6 and VI.10.7 (Casa dell'Ancora): Benedetti 2006: 156 (based on the chronology of the Casa dell'Ancora, this wall clearly dates to the end of the second c. BCE). Cf. Verzar-Bass *et al.* 2008; Verzar-Bass and Oriolo 2009

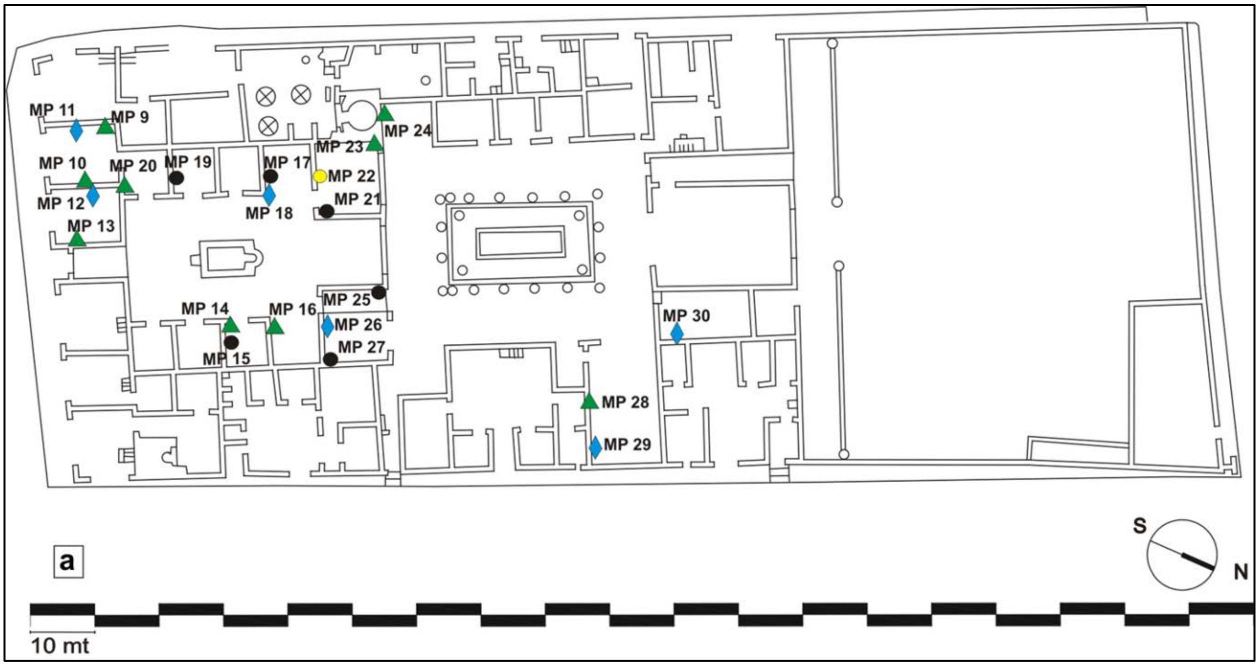

Figure 63. Pompeii, VI.6.1: Casa di Pansa, general plan with location of mortar samples (after Miriello e*t al.* 2010).

Medium-sized houses received modifications in *opus incertum* only in the latter part of the second c. BCE. In the early phase of urbanization of the block, these units had their façades built in *opus Africanum*, while party-walls were of simple rubble-work (Sarno limestone and lava rubble with clay mortar). The relative sequence between the two techniques has been documented in the Casa del Naviglio (VI.10.11; **fig. 60, 4**), where structures made with reddish-brown mortar (including pozzolana) and featuring lava *caementa* in the lower part and Sarno limestone facing blocks in the upper portion are associated with *signinum*-floors that obliterate the crest of earlier clay-based rubble walls joined with the *opus Africanum* side-walls.[578] The latest ceramic materials recovered from the floor preparations date between the second half of the second and the first quarter of the first c. BCE, but the excavators suggest a date in the late second c. BCE, which would be consistent with that of other houses investigated in the same

(especially 496, footnote 14), follow Carrington (1933) and assign *opus incertum* walls made of Sarno limestone with lava, cruma and also Nocera Tuff facing blocks in houses VI.14.2 and VI.13.6 to the first half of the second c. BCE, claiming that the diffusion of lava *opus incertum* walls in the second half of the second c. BCE represent a fixed *terminus ante quem* for the former technique.

[578]Cassetta and Costantino 2006: 316-318.

block.

One of the best documented examples of a late second c. BCE house is the Casa dell'Ancora (VI.10.7; **fig. 60, 5**). This features an *opus incertum* façade built entirely with compact lava with Sarno limestone quoins, a technique that is employed also for the foundations in the rest of the house (cf. the Casa del Fauno). The side-walls reuse earlier structures in *opus Africanum* with clay mortar, which sits on top of footings consisting of alternating Sarno limestone blocks and rubble.[579] The rooms were paved with *signinum*-floors; in one of the *oeci*, the pavement was provided with a drain consisting of a late Greco-Italic amphora (150-100 BCE), placed vertically in the preparation level.[580] A system of this kind is attested also in the Casa del Centauro (VI.9.3-5; **fig. 60, 6**), which dates to the same period (second half, or most likely last quarter, of the second c. BCE).[581]

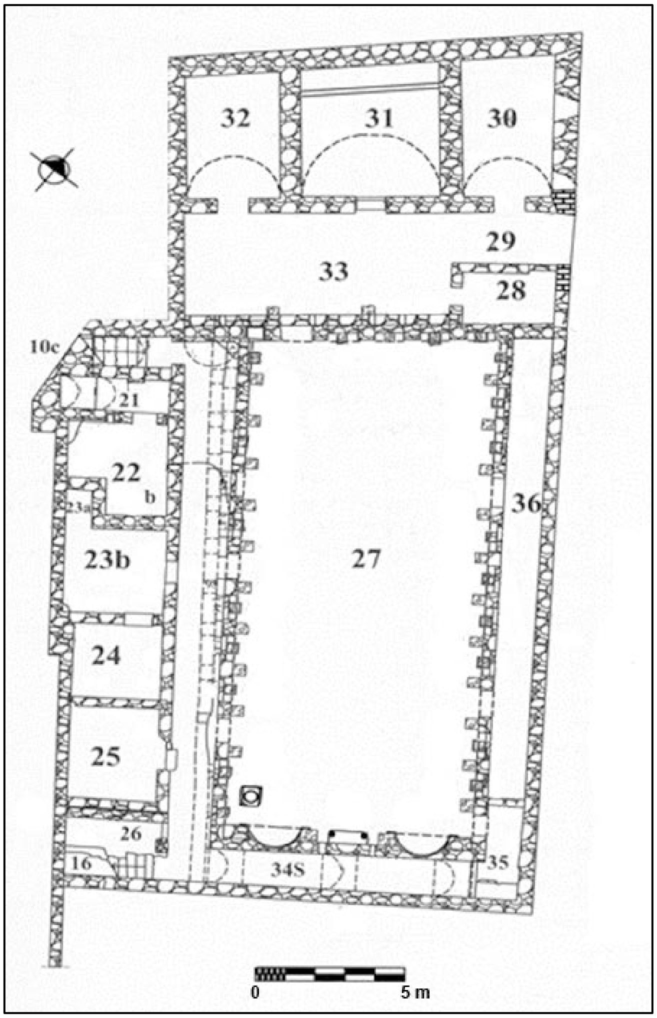

Figure 64. Pompeii, VI.10.7: Casa dell'Ancora, plan of basement (after Pesando *et al.* 2006).

[579]Pesando 2005: 82; Pesando *et al.* 2006.

[580]Pesando *et al.* (2006: 227-228) assigns a 140 BCE date to this context, though the chronology of the amphora should be taken as a *terminus post quem*. But cf. Pesando *et al.* 2006: 235 (150-100 BCE). The most diagnostic part of the amphora (neck) is not preserved; a fragment of generic second c. BCE Campana A black-gloss pottery comes from the preparation. A date in the late second c. BCE is in Pesando 2005 (last quarter of the second c. BCE).

[581]Pesando 2005: 84-87 (a *terminus post quem* is provided by the Greco-Italic amphoras of the second quarter of the second c. BCE inserted in one of the *signinum*-floors).

The Casa dell'Ancora is particularly important because it also shows one of the earliest examples of concrete vaulted construction in domestic contexts at Pompeii. In this phase, part of the adjacent plot (VI.10.8) was added to the property, which became L-shaped. While the floor level in the area of the atrium was raised about 1 m, the ground levels in the back portion of the house were maintained, creating a sunken garden delimited to the north by a set of three rooms (**fig. 64**). These have *opus incertum* walls of Sarno limestone built on foundations made of compact lava *caementa*, and are spanned by barrel vaults, supporting the area of the *tablinum* on the upper level. The largest, in Room 31, measures 5.10 m (the width of the vaults in Rooms 30 and 32 is 3.10 m and 3.67 m, respectively).[582] The undersurfaces of these vaults are not visible, because they are still covered by a thick layer of plaster, but excavators assume that these were built with *caementa* of Sarno limestone, not with voussoirs. The use of Sarno limestone (and occasionally cruma) voussoirs, however, is documented in other second c. BCE contexts at Pompeii, such as the Casa di Pansa (the elongated cisterns under the *tabernae*, spanning 1.40 m, and the peristyle, 1.30 m wide, with abundant mortar in the joints) or the structures below the Basilica (which seems to be the largest, with a span of 2.43 m, featuring dressed wedges of Sarno limestone with little mortar).[583] Lining the garden on the western side was a narrow portico (0.90 m), possibly framed by arches but covered by a flat timber roof.[584]

The late use of Sarno limestone *caementa* has been confirmed by excavations in the area of the Porta Vesuvio. In this sector of Regio VI, a generalized raising of the levels has been documented during the second c. BCE.[585] At VI.16.26-27 **(fig. 60, 7)**, the original walls are made

[582]Pesando *et al.* 2006: 204-207; Pl. XLIV.
[583]See Maiuri 1973: 169-171 (Casa di Pansa) and 205-206 (cistern under the Basilica).
[584]Pesando *et al.* 2006: 209.
[585]Similar changes in floor levels (with construction fills up to 2 m thick) have been documented in the area between Regio VI and the *Altstadt* in the second half of the second c. BCE (e.g., in the Casa di N. Popidius Priscus, at VII.2.20; the Casa della Caccia Antica, at VII.4.43/48; the Casa di Arianna, at VII.4.31/51). See Pedroni 2011: 166.

predominantly with lava *caementa*, and feature corner quoins of Sarno stone. Sarno and cruma rubble is attested in the back part of the house, which was apparently remodeled at a later stage. Ceramic materials collected in the foundation trench give a *terminus post quem* of 140/130-110 BCE; construction fills contain pottery dating to 140-120 BCE, which may come from the occupation of the house in the previous phase.[586]

To sum up, various types of evidence, especially stratigraphic, show that *opus incertum* walls and concrete vaults found in the houses of the Regio VI belong to the second half of the second c. BCE. Construction fills associated with the earliest concrete phase of the Casa del Naviglio, the Casa dell'Ancora, and in the area of the Porta Vesuvio, provide a date-range in the last quarter of the second c. BCE for many examples of *opus incertum* walls characterized by a lower portion in compact lava and an upper portion in limestone. This proves that the use of the building technique first seen in the Casa del Fauno continued also in the period that common reconstructions characterize as dominated by the use of compact lava.

6.2.4 Concrete Construction in the "Altstadt"

Previous excavations in this sector of Pompeii focused on buildings that were expected to provide useful information on the internal organization of what was believed to be the core of the settlement in the Archaic and early Samnite periods. Among the first were Maiuri's investigations in the Casa di Trittolemo (VII.7.2-5), which were explicitly designed in the context of his research on the early phases of the sanctuary of Apollo, which had been identified as a focus of religious activity since the Archaic period.[587] Those carried out later on in the Casa del Gallo (VIII.5.2-5; **fig. 60, 8**), on the other hand, represented another attempt by Maiuri at refining the chronology of the "Kalksteinatrien", of which this house preserved one of the most

[586]For the pottery see Seiler *et al.* 2005: 228-229.
[587]Maiuri 1973: 125-133.

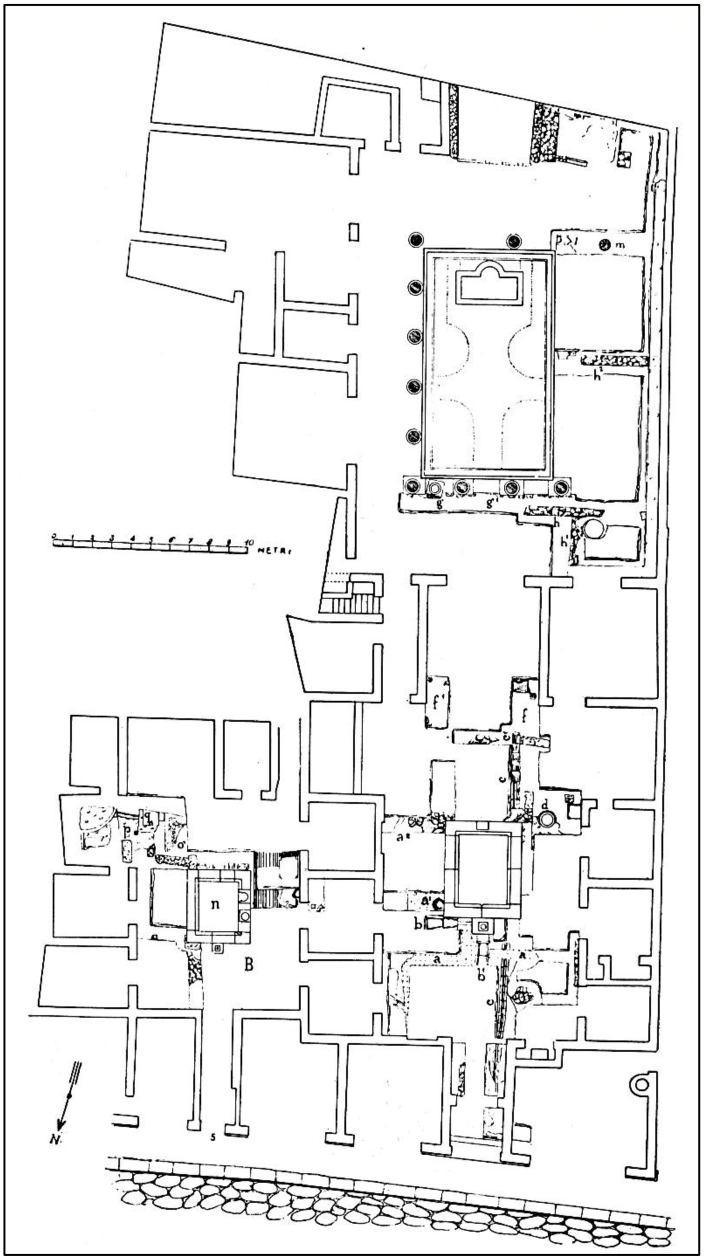

Figure 65. Pompeii, VIII.5-2-5: Casa del Gallo, plan of the first c. BCE house with indication of earlier structures (after Maiuri 1973).

complete plans. Instead of demonstrating the early diffusion of this house design in the residential quarter immediately to the east of the Forum, the results of these excavations, to some surprise, showed that the canonical type of layout was still in use for new constructions in the post-80 BCE period. A date in the early years of the Roman colony was assigned by Maiuri to the lava *opus incertum* phase of the house (**fig. 65**), as suggested by the presence of Latin mason's marks on the *impluvium* and on one of the blocks of the stylobate of the peristyle.[588] The structures found below this level, which were also made of lava *opus incertum* with rare Sarno rubble (generically assigned by Maiuri to the second c.

[588]Cf. the chronology in the third quarter of the second c. BCE proposed by Pesando (2010b: 50 and footnote 1), who rejects the interpretation of these marks as Latin letters. Zevi (1996: 132-133) suggests that the scarcity of Second Style paintings from urban contexts as opposed to the pattern observed in rural residences is an indication that there was little reconstruction of houses in the early years of the colony, and that most Roman colonists (élite and commoners alike) lived in the *suburbium.* However, the idea that First Style decorations were used only by the old Samnite aristocrats and that the Second Style was consciously rejected is problematic, because the First Style can still be found in contemporary Roman houses.

BCE), did not conform to the canonical plan.[589]

Research conducted around the same time under the Eumachia building and the so-called Temple of Vespasian demonstrated that the eastern side of what then became the Forum square received its first regularization creating a row of *tabernae* built with a mixed technique, featuring Sarno *opus Africanum* walls, and Sarno limestone and lava rubble socles with pressed earth superstructures for interior subdivision. This activity was dated by Maiuri to the fourth c. BCE, based on the style of masonry.[590]

Figure 66. Pompeii, VII.9.47: Casa delle Nozze di Ercole, state plan (excavated areas in orange; after D'Alessio 2008).

East of these monuments, other remains of walls built with the same technique have been identified under the Casa delle Nozze di Ercole (VII.9.47; **fig. 60, 9**; **fig. 66**), in the sector later

[589]Maiuri 1973: 171-179.

[590]Maiuri 1973: 53-63 and 88-91, respectively. For a similar date see Carafa 2011: 104; 105 fig. 10 (second half of the fourth c. BCE).

occupied by the atrium and *tablinum*. Ceramic materials found in the construction fills and in occupation levels date the first construction of this building to the second half of the third c. BCE, with a sub-phase in the first half of the second c. BCE (suggesting a lower dating for the *tabernae*). Partially confirming the results of Maiuri's excavations in the Casa del Gallo, the sequence at the Casa delle Nozze di Ercole indicates that the canonical atrium house in this central sector of Pompeii made its first appearance relatively late. The Casa delle Nozze di Ercole seems to have acquired its standardized configuration only some time in the last quarter of the second c. BCE, as suggested by the ceramics contained in the destruction layers and in the foundation trenches of walls. Stratigraphic excavations in this house have been carried out over an area of 540 m^2 (corresponding to almost two-thirds of the total surface occupied by the house, 860 m^2), obtaining a representative sample of the ceramic assemblage.[591] Interestingly, the structures belonging to this phase show a variety of techniques: Nocera Tuff ashlars in the pillars on the northern side, Sarno limestone ashlars in the atrium, Sarno limestone and mixed Sarno limestone and lava *opus incertum* in the rest of the house.

6.2.5 The Southwest Quarter and the Insula Occidentalis

The remodeling of houses in the old urban core followed the progressive occupation of empty lots located immediately behind the fortification walls, which started to be built over with new construction already in the first half of the second c. BCE. The best known case is that of block VIII.2, the so-called Southwest Quarter, which occupied the slopes of the lava spur between the Temple of Venus and the Theaters quarter.[592] The first building phase in this area is represented by remains in Sarno limestone ashlar and *opus Africanum* encroaching upon the

[591] D'Alessio 2008: 280, Tab. 1. Note that the pottery collected from the occupation layers is earlier than that recovered in the construction fills.
[592] Noack and Lehmann-Hartleben 1936.

pomerium. In some cases the houses were organized on terraces, featuring a basement floor that was usually covered with a flat roof and supported by ashlar retaining walls (e.g. at VIII.2.30 and 34). Recent excavations conducted in the Casa di Giuseppe II (VIII.2.39; **fig. 60, 10**) demonstrate that houses of this kind were still being built in the second half of the second c. BCE.[593]

Houses with more extensive substructures, directly abutting on the fortification walls, appeared only in a later phase; at the same time, terraces were also added to older houses (this type is known as the “Stadtrandhaus”). These substructures are normally vaulted and consist exclusively of lava *opus incertum*, which in some cases is associated with Sarno limestone *opus incertum* on the upper floor (e.g., VIII.2.29). The most elaborate example is by far the Casa di Championnet (VIII.2.1; **fig. 60, 11**), with an intermediate courtyard surrounded by a portico framed by arches (these are faced with Nocera Tuff voussoirs, but have rubble cores; the vaults of the portico are later) and a lower terrace; significantly, these structures feature only lava rubble. Expansion of house construction beyond the line of the old fortifications (which were reused as substructures) has been dated to the Roman period, because of the common association with Second Style paintings.[594] The building technique used in this phase is still lava *opus incertum*, though this includes also limestone and cruma rubble; tile fragments are occasionally used for quoins (e.g., in the façade of VIII.2.28), but Sarno limestone and Nocera Tuff blocks, evidently spolia of the fortification walls, are more common.

A similar sequence of occupation has been reconstructed for the west sector of the fortification circuit, in the so-called *Insula Occidentalis*, including the blocks between the Casa del Bracciale d'Oro to the north (VI.17.42-44) and the Casa di Maio Castricio (VII.16.17; **fig. 60,**

[593]Carafa and D'Alessio 1995-96: 139.
[594]Synthesis in Noack and Lehmann-Hartleben 1936: 175-179.

12), as well as the area located between Porta Ercolano and the Vico dei Soprastanti.[595]

Figure 67. Pompeii, VII.16.17-22: Casa di Fabio Rufo and Casa di Maio Castricio, plan of basement indicating the location of the original fortification wall (after Cassetta and Costantino 2008).

Epigraphic evidence (the *eítuns* inscription Ve. 25) seems to suggest that in 89 BCE there existed houses abutting on the fortification walls.[596] An original phase of occupation in the late decades of the second c. BCE or the early first c. BCE is suggested by early elements in the decoration of the Casa di Maio Castricio, including the few fragments of first Style paintings and decorated *signinum*-floors, the cubic Nocera Tuff jambs framing the entrance and the angular Ionic capitals in the peristyle of the capitals; this house had elevations in Sarno limestone *opus incertum.* First Style paintings are preserved also in the atrium of VII.16.12-14, a house featuring in the *tablinum* Corinthian capitals of Italic type that have been dated stylistically to the period

[595] A reconstruction of the original course of the walls in this sector is in Cassetta and Costantino 2008: 197-202. For an overview of building activities in this area see also Grimaldi 2011: 142-145.

[596] This inscription (one of six) was painted on the façade of a house located in Regio VII (now lost). It gives to a group of armed citizens who were to defend the walls in case of siege indications on the route to follow to reach the specific sector of the walls under their responsibility, which would be delimited by two houses (i.e., the houses of Maraeus Spurius and Maius Castricius). On these documents see Castrén 1975: 44-45, with a date in the year of the Sullan siege (89 BCE). Rix (2002) assigns the inscriptions to the first quarter of the first c. BCE.

110-80 BCE.[597] This house was built with the mixed type of *opus incertum*, of Sarno limestone in the upper part and lava in the lower portion of the walls (the basement abutting the fortifications functioned only as a substructure in this phase, being remodeled only in the middle of the first c. BCE).

Restorations in lava *opus incertum* appear at the base of the fortification walls along the entire stretch crossing the area, while at the northern and southern edges of the *Insula Occidentalis* the outer curtain was rebuilt up to a level corresponding to the second storey of the new houses (**fig. 67**). This activity is commonly dated to the late second c. or early first c. BCE.

6.2.6 The Villa dei Misteri

The Villa dei Misteri is commonly considered to be the earliest villa in the neighborhood of Pompeii and its architecture is thought to reflect contemporary developments in house construction in the urban core.[598] The complex is located on the Via dei Sepolcri, some 400 m outside the Porta Ercolano, but its orientation is at an odd angle with the road, following, like other rural residences in the area, the alignments of a land division scheme generated by the axis of Via di Mercurio, which is considered to be fourth or early third c. BCE in date.[599] Maiuri, who directed the first controlled excavations at the site in 1929-1930, first suggested that the Villa developed gradually from a core dating to the third c. BCE, which would have been later enlarged with the creation of a peristyle in the second c. BCE.[600] In the revised publication of the Villa, Maiuri (1947) lowered the dating to the first half of the second c. BCE, considering that the structures he assigned to the first phase presented advanced features in comparison with the

[597] Lauter-Bufe 1987: 43-44 n.122 and 123; 79. Slightly higher date in Cassetta and Costantino 2008: 204-205 and footnote 27 (130-120 BCE).
[598] E.g., Mielsch 1987: 39-41; Dickmann 1997.
[599] Zevi 1982; the Via dei Sepolcri has been dated to the Augustan period: Kockel 1983: 8-9.
[600] Maiuri 1931.

early “Kalksteinatrien” houses; he dated the second phase to 90-70 BCE.[601] Recent research has demonstrated that the idea of a progressive development of the plan is entirely conjectural, and that the complex featured a peristyle since its establishment.[602] Wall-paintings and decorated floors of the original phase are all in the Second Style.[603] Some scholars have suggested that the paintings masked a previous First Style phase of the building, which would support a date in the second half of the second c. BCE, but the evidence is tenuous.[604] Based on comparanda with other urban monuments (e.g., the Amphitheater; the Temple of Iuppiter), the original building can be more reliably assigned to the early years of the Roman colony (ca. 80 BCE).[605]

The building was laid out on a square plan (sides of ca. 50 m), on steeply sloping terrain (**fig. 68**). A U-shaped cryptoporticus, 95 m long and covered with concrete barrel vaults spanning 2.65 m (**fig. 69**), forms a *basis villae* facing the coast (this was accessible but not used or decorated).[606] The façade of the substructure on this side is decorated with blind arches built with Sarno limestone voussoirs, engaged to an *opus incertum* wall made of limestone rubble and scoria. The inner wall of the cryptoporticus is much sturdier and made with facing blocks and *caementa* of compact lava. This wall retained a thick construction fill, supporting a wide terrace, perhaps occupied by a garden. Behind this was the atrium part of the villa, which was delimited by a portico with simple Doric columns made of Sarno limestone plastered with stucco, on a

[601]Maiuri 1947: 17; 42-45.

[602]Kirsch 1993; Esposito 2007. Richardson (1988: 171-176) already observed that the plan is homogeneous and that all building techniques employed in the original parts are consistent with a post-Sullan date (following Pernice 1938: 55-58).

[603]Esposito 2007: 448-453.

[604]Cf. Mielsch 1987: 41 (still accepting Maiuri's relative sequence); Zevi 1996: 135 (interpreting the Second Style decoration as evidence that the villa was confiscated by a Roman colonist); Dickmann 1999: 170-176 and 245-246; Pesando and Guidobaldi 2004:164-169. This view is based on the presence of openings on the walls of the atrium, which would have been walled in at a later stage. On the side of the atrium the masonry was masked with wooden panels, while the other face was covered by the Second Style paintings (as seen in Rooms 19, 7 and 6). Kirsch 1993 interprets these features as false doors. According to Esposito (2007: 449), under the Second Style paintings in the atrium there is no trace of earlier layers of plaster.

[605]Kirsch 1993; Esposito 2007: 454-459.

[606]Maiuri 1947: 89-93.

stylobate of Nocera Tuff. The walls in this sector of the villa are built with *opus incertum* of Sarno limestone, cruma and an unspecified variety of tuff rubble, and corner stones of Sarno limestone.[607] Above door lintels are relieving arches made of Sarno limestone wedges.

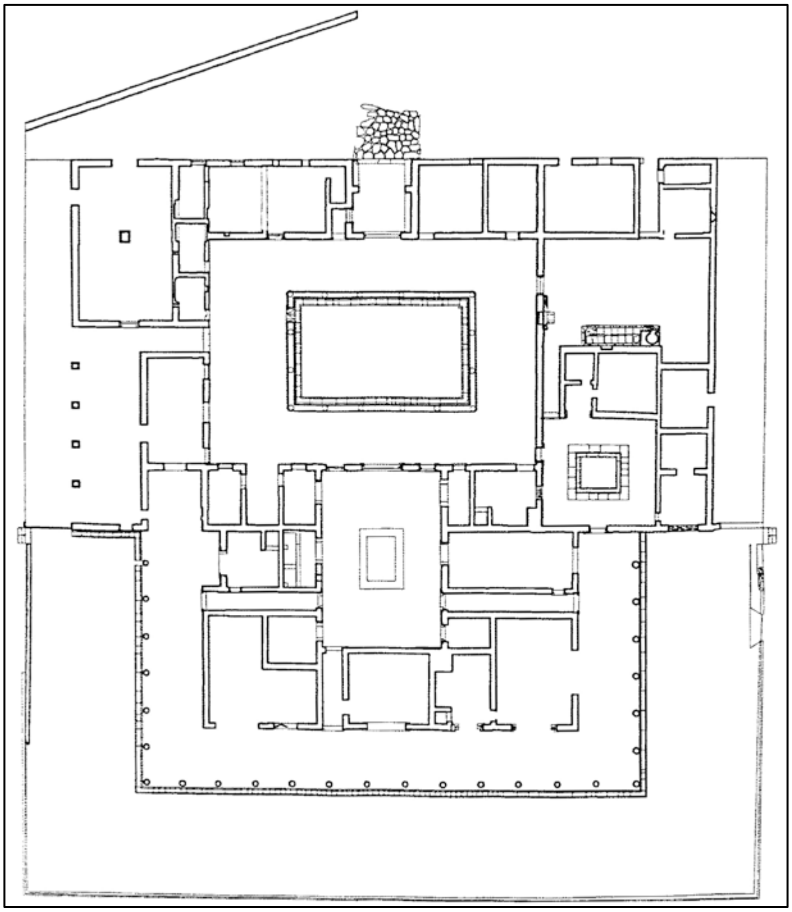

Figure 68. Pompeii, Villa dei Misteri: phase plan, ca. 80 BCE (after Esposito 2007).

Nocera Tuff is more commonly found in the east sector of the villa, where it was employed in the stylobate and columns of the peristyle, in the impluvium of the secondary atrium and in door jambs. The wall-facings found in the rooms arranged around the peristyle appeared to Maiuri more difficult to classify with precision in terms of materials ("dark, yellow and gray tuff" with rare cruma) and technique.[608] These resembled the traditional structure of *opus incertum* (especially in the quantity of mortar used for bedding), but in some features approaching the *opus reticulatum* (e.g., flat face of the blocks).[609] In the south-eastern sector was a small bath suite, whose bigger room, measuring 4.5 x 4.5 m, was originally

[607]Maiuri 1947: 42.
[608]Maiuri 1947: 43.
[609]Esposito (2007: 446) interprets the variation in building techniques as evidence that different groups of builders were working at the same time in different parts of the house.

covered with a barrel vault; a small sweat-bath was added at a later stage (ca. 50 BCE).[610]

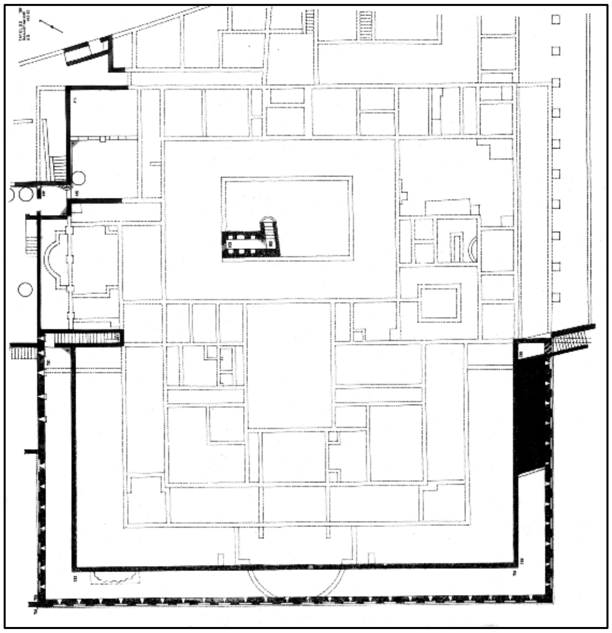

Figure 69. Pompeii, Villa dei Misteri: plan of the basement (after Kirsch 1993).

The lack of stratified ceramic materials from the early excavations makes the precise dating of the Villa dei Misteri difficult. The old date-range in the early part of the second c. BCE, based solely on the supposed antiquity of Sarno limestone construction, should be rejected. The use of compact lava in the cryptoporticus suggests that a variety of materials were used (the foundations of the interior walls of the house were never exposed, so we do not know whether lava was used in the lower portions of these structures). In general the building methods attested in the Villa dei Misteri find precise parallels with late second c. or early first c. BCE house construction at Pompeii, where the association of lava architecture in the substructures with Sarno limestone *opus incertum* in the superstructure is well documented. Other features such as the use of relieving arches, for instance, appear in houses of the Regio VI (e.g., in the second phase of the Casa del Naviglio). The spans of barrel vaults in the villa can be compared with those attested in the Casa dell'Ancora, though the presence of a vaulted cryptoporticus here may indicate a slightly later date,[611] as do the overall character and layout of the atrium, which was almost designed as a room in its own right rather than a court.[612]

[610]Maiuri 1947: 61-71. M. Trümper (*pers. comm.*).
[611]The architectural façade of the *basis villae* finds a precise parallel in the arches of the Amphitheater: Kirsch 1993.
[612]See Richardson 1988: 174.

6.2.7 Summary of the Evidence

A number of important observations can be drawn from the case-studies discussed above (**Table 9**). These show that the earliest attestations of mortar-and-rubble construction can be dated around the middle of the second c. BCE or shortly after (e.g., Casa del Fauno; Casa di Sallustio; Casa di Pansa).[613] Evidence for a diffusion of concrete already in the first half of the second c. BCE is virtually absent. In the major phase of urbanization after 200 BCE, houses with Sarno limestone or Nocera Tuff ashlar façades had interior walls made with *opus Africanum*, a technique in which clay-based binder is used (this type of wall is often referred to as *opus caementicium*,[614] but the definition is problematic). Lime mortar is first introduced at the highest level of society, as *opus incertum* appears only in the richest and most elaborate residences of the Regio VI. Concrete of the early period already included natural pozzolana in the mix; in fact, it had hydraulic properties (Casa di Pansa). The absence of any significant pattern of experimentations with simple lime mortar suggests that the technology may have been derived and adapted from observation of the properties of *signinum* floors, which are attested at Pompeii before 200 BCE (among the earliest examples is the pavement of the *andron* in block I.5);[615] a significant local variant is the so-called "lavapesta", which includes crushed lava aggregate instead of ground terracotta in the mix.[616]

An intensification in *opus incertum* construction can be detected in the last quarter of the second c. BCE, not only in the Regio VI (e.g., remodeling of the Casa del Naviglio; Casa dell'Ancora), but also in other areas of the *Altstadt* (e.g., Casa delle Nozze di Ercole; also Regio VIII.2 and *Insula Occidentalis*) where the Sarno limestone architecture was still common. The

[613]See also the sequence documented by Brun (2008) in block I.5.
[614]E.g., Pesando 2006; Pesando 2008.
[615]Brun 2008: 65.
[616]Dunbabin 1999: 33.

main features of the building technique adopted in this phase did not differ from those attested in the early examples. Construction was based on the mixed use of rubble of Sarno limestone (which is selected for the upper part of the walls) and compact lava (typically preferred for the lower part of the walls), although walls built entirely in either material are also documented.[617] Sarno limestone *opus incertum* usually appears in free-standing walls; lava was used for retaining walls directly in contact with the bedrock (e.g., at the Villa dei Misteri; cf. the Aula Isiaca in Rome), though occasionally it is found also for side-walls. Lava *opus incertum* façades with Sarno limestone quoins seem to appear in this phase (e.g., Casa dell'Ancora), but continue to be built at least until the first quarter of the first c. BCE.[618] In sum, the pattern makes it extremely difficult to date domestic architecture simply on the basis of masonry style, without other kinds of external evidence.

No major advances can be seen in concrete construction during the second half of the second c. BCE. The use of concrete in foundations, perhaps appearing already in the Casa del Fauno, is not generalized; the traditional system based on the alternation of ashlar sleepers and packed rubble is still found in many contexts featuring *opus incertum* elevations (e.g., the Casa di Pansa). In addition, a real distinction between wall-facings and core is rarely seen in private architecture; interestingly, most of the evidence in this sense comes from public buildings.[619] Vaulted construction is also unremarkable, with spans in the range of 2.5 to 5 m, just slightly above the typical width of voussoir vaults. However, significant changes must have happened in

[617]Most instructive is a study of the façades of block V.1, showing the juxtaposition of Sarno limestone *opus incertum* and lava *opus incertum*, without corner blocks, at the junction of the South and North Houses that were later incorporated into the Casa di Cecilio Giocondo (V.1.23), and at the corner between the North House of the Casa di Cecilio Giocondo and the Casa degli Epigrammi Greci (V.1.18), suggesting that different materials were used by different crews working at the same time on different sides of these buildings. See Leander Touati 2008: 121-122 and figs. 5-9.

[618]On this type of façade architecture in the early part of the first c. BCE see especially Lauter 2009.

[619]As already observed by Lugli (1957: 474-475), who in any case considered it a relatively late innovation (100 BCE).

the supply of building materials. While Sarno limestone rubble must have been a by-product of on-going ashlar quarrying, the exploitation of compact lava deposits had to be organized *ex-novo*. On the plateau, compact lava is overlain by a thick level of Pappamonte and cruma, but there is no trace of ancient quarrying of these levels on-site.[620] One of the possibilities is that lava rubble was a by-product of the quarrying of polygonal slabs for road paving, which may have started in connection with the *munitio* of the main thoroughfares of Pompeii and their suburban stretches.[621] This activity is attested epigraphically for the late Samnite period, but the exact date is uncertain (e.g., Ve. 8, mentioning the *vía stafiiana/*via Stabiana, the *vía púmpaiiana*/ via Pompeiana, the *vía iuviia/*via Iovia and the *dekkviarim* (acc.)/ Decuvia(?); *terminatio* of the *via Sarínu* in Ve .9 and 10).[622]

House	***Stratigraphic Dating***	***Types of Rubble***	***Vaulting System***
Casa del Fauno (VI.12)	175-150 BCE or later	Sarno limestone; compact lava	n/a
Casa del Centauro (VI.9.3-5)	After 175-150 BCE	Sarno limestone; compact lava	n/a
Casa dell'Ancora (VI.10.7)	After 140 BCE	Sarno limestone; compact lava	Concrete?
Porta Vesuvio (VI.16.26-27)	140/130-110 BCE	Sarno limestone	n/a
Casa delle Nozze di Ercole (VII.9.47)	125-100 BCE	Sarno limestone; compact lava	n/a

Table 9. Datable early *opus incertum* architecture from domestic contexts in Pompeii.

[620]See Nicotera 1950: 406-416.

[621]As recorded by Livy (41.27.5), the actions of Roman censors in 174 BCE suggest that the paving of streets of towns and of roads outside towns was still unusual in the second c. BCE; see Laurence 1999: 64-66. For the period before the first c. AD, inscriptions mentioning the paving of short lengths of road surfaces within towns by local magistrates are known from other sites, such as Ostia (CIL 14.375) and Casinum (CIL 10.5204). Richardson 1988: 372 dates the use of lava for road pavings to the first c. BCE. On the distribution of this material in domestic contexts at Pompeii see also Kawamoto and Tatsumi 1992.

[622] Masons' or quarrying marks of the same type as those found on the fortifications (mainly on the Nocera Tuff ashlars, but occasionally also on Sarno limestone blocks) appear on curbstones and sidewalks, though only on those made of Nocera Tuff. Three lava curbstones on via Stabiana (two at IX.4.1 and one at IX.2.25, which is perhaps in secondary deposition) carry a Latin inscription (CIL 10.807a=807b=2307) that according to the interpretation suggested by F. Coarelli (cited in Pedroni 2011: 167 footnote 31) may be read *ex k(ardine) qui(ncto)*; a similar inscription (CIL 4.1622) is on a lava curbstone on the Vico Storto and reads *k(ardo) q(uartus)* or *q(uinctus)*. Given the uniformity of the sidewalks in these stretches, this may be taken as evidence of a specific public project of the Roman period (Saliou 1999: 196-198). However, the chronological value of this pattern for the overall dating of the Nocera Tuff road infrastructure is dubious: Saliou 1999 (esp. 192 and footnote 54). Cf. Gesemann 1996: 206 (suggesting a date in the pre-Roman period).

6.3 The Development of *Opus Incertum* in Pompeii: The Public Monuments

6.3.1 The Organization of Public Construction in Pompeii before 80 BCE

In the late Samnite period public works at Pompeii were regulated by a system resembling the Roman *locatio-conductio operis* (cf. *supra*, 3.1). A series of Oscan inscriptions predating the establishment of the Roman colony shows the involvement of local magistrates in sponsoring public projects, letting contracts for the construction of monuments (the chief magistrate, *meddix tuticus*, in Ve. 14 and 15; but more commonly the *kvaísstur/quaestor*, as in Ve. 11, 12, 17 and 18) or in any case as final approvers (the two *aidiles* were responsible only for road construction, Ve. 8; the *probatio* was conducted by the *meddix tuticus* in Ve. 13, 14; by the *kvaísstur/quaestor* in Ve. 19). Significantly, the Oscan expressions correspond precisely to the equivalent Latin phrases one commonly finds in Roman building inscriptions. In all likelihood these projects were contracted out to private builders (but there is no record of building contracts in the surviving documentation).

These inscriptions have been generically dated to the latter part of the second c. BCE,[623] some time after the period of initial diffusion of concrete in domestic architecture. None of these inscriptions, however, refers directly to the first phase of known concrete monuments. In fact this has been taken by some as an indication of a higher date for the original construction of at least two of them: the Stabian Baths (Ve. 12, concerning the installation of a sundial in the courtyard of this complex) and the Temple of Apollo (Ve. 18, recording the reconstruction of the decorated *signinum*-floor in the cella), sometime in the first half of the second c. BCE.[624] But what other evidence, if any, can be used in support of this chronology? And how do the main features of these and later concrete monuments relate to the development observed in private construction?

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[623]Mau 1908: 38 (end of the “Tufo period”); Castren 1975.
[624]See especially Pesando 2006.

Figure 70. Schematic map of Pompeii with location of the concrete public monuments discussed in Chapter 6 (*1=Stabian Baths*; *2=Theater, Foro Triangolare and Quadriporticus*; *3=Temple of Apollo*; *4=Capitolium and Forum Portico*; *5=Basilica*; *6=Temple of Venus*).

6.3.2 The Stabian Baths

The Stabian Baths occupy the south part of a block located at the junction of Via Stabiana and Via dell'Abbondanza (VII.1; **fig. 70, 1**), at the east edge of the so-called *Altstadt*.[625] The complex has been the object of limited stratigraphic investigations, first by A. Maiuri (in 1928 and in 1931-1932) and then by H. Eschebach (1971-1973). These have concentrated on the north wing, which had been singled out in early surveys because of the presence of Sarno limestone architecture. According to Maiuri's reconstruction (**fig. 71**), this formed the original core of the baths, which on the basis of the building techniques he dated to the late third or early second c. BCE.[626] The Nocera Tuff portico, the *palaestra* and the larger suite of canonical men's and

[625]Eschebach 1979; Richardson 1988: 100-105.
[626]Maiuri 1973: 44-48.

women's baths, all built with lava *opus incertum*, were assigned by Maiuri to a separate phase and dated to the second half of the second c. BCE (which was the date previously assigned to the building in its entirety).[627]

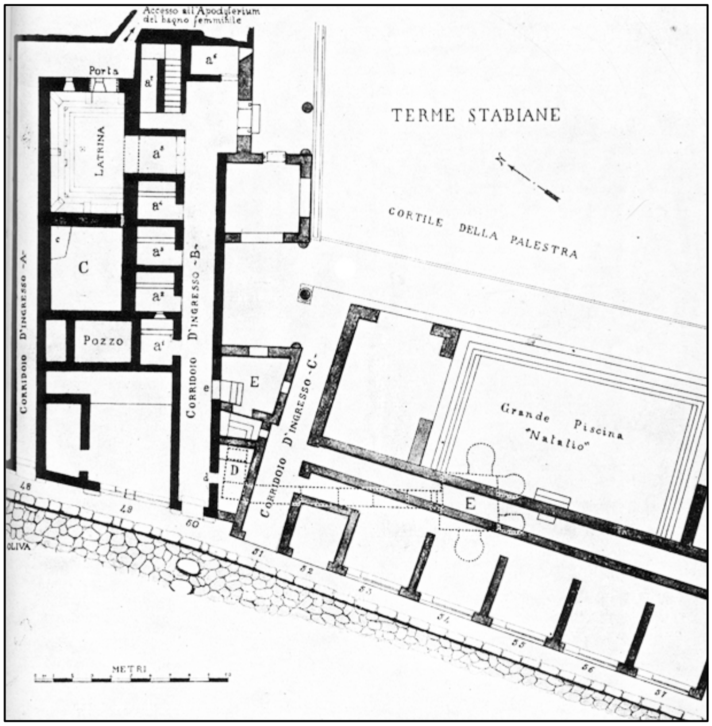

Figure 36. Pompeii, VII.1: Stabian Baths, original core according to Maiuri (1973).

The core of the north wing comprised a row of five small vaulted cubicles, occupied by individual immersion tubs on their east side. The cubicles opened to the south on a vaulted corridor that gave access to the complex from the Vico del Lupanare, where there is a door framed by dressed Nocera Tuff blocks (at VIII.1.50); at the east end of this corridor were another room (perhaps a lavatory) and a staircase that led to an upper level (a terrace). A larger room extended to the north of the cubicles, subdivided at a later stage in two sectors, one of which was eventually transformed into a *latrina*. Access to this room was by means of a door on the short east side, which could be reached from a vaulted corridor, narrower than the one to the south but framed by an identical portal on Vico del Lupanare. When the *latrina* was created (in the mid-first c. CE), the door of this room was walled in and a new access from the south corridor was opened, cutting the back wall of a cubicle.[628]

[627]Maiuri 1973: 46. For the 140-120 date see Mau and Kelsey 1907: 189-201; but cf. Mau 1908: 193 ("around the second c. BCE").

[628]Another door framed by Sarno limestone jambs opens at the end of the corridor, toward a supposed *apodyterium* and/or *frigidarium*. According to Maiuri (1973: 45-46 and footnote 6), this is a later feature; access to the

To the west of this group of rooms, the main features of water-supply system were arranged:[629] a deep well, flanked by two smaller tanks that were built up to the level of the upper story; these were fed from the well by means of a water-lifting machine. The tanks were in turn connected to a larger reservoir, which occupied most of the terrace on the upper level of the complex. The dimensions of the reservoir coincide exactly with those of the large room to the north of the cubicles, whose vault supports its load. A fistula in the southwest corner brought pressured water to the cubicles.[630] While the structures of the ground floor were built with *opus incertum* of predominantly Sarno limestone rubble (the vaults are made with wedges set radially in abundant mortar, spanning a maximum of 3.80 m in the large room), the reservoir was built using predominantly cruma; this suggests that there was an intentional grading of materials, with the heavier stone used for the lower part of the structures. Maiuri observed that the walls of the reservoir were built in two courses: a lower course, up to a height of 1.30 m (corresponding to that of the masonry buttresses engaged at regular intervals with the walls of the reservoir); this was then raised by 0.55 m (with masonry and Sarno limestone blocks), most likely to increase to capacity of the tank (from 40 to 70 m^3).

Maiuri initially thought that in the first phase the tank was part of the original design, and that the raising of the side-walls became necessary only when, according to his periodization, the east wing complex was added, since this required the use of more water. He later changed his interpretation, suggesting that the reservoir was built in a single operation, and that in the previous period the smaller tanks connected to the well were sufficient to run the complex when

apodyterium in the previous period would have been only from via Stabiana, at VII.1.17.

[629]Maiuri 1973: 32-34.

[630]Maiuri 1973: fig. 12 (f). Fagan (2001: 409) notes, however, that there is no trace of plumbing in the cubicles and doubts that these rooms were used for bathing.

the baths would have included only the small suite of cubicles.[631]

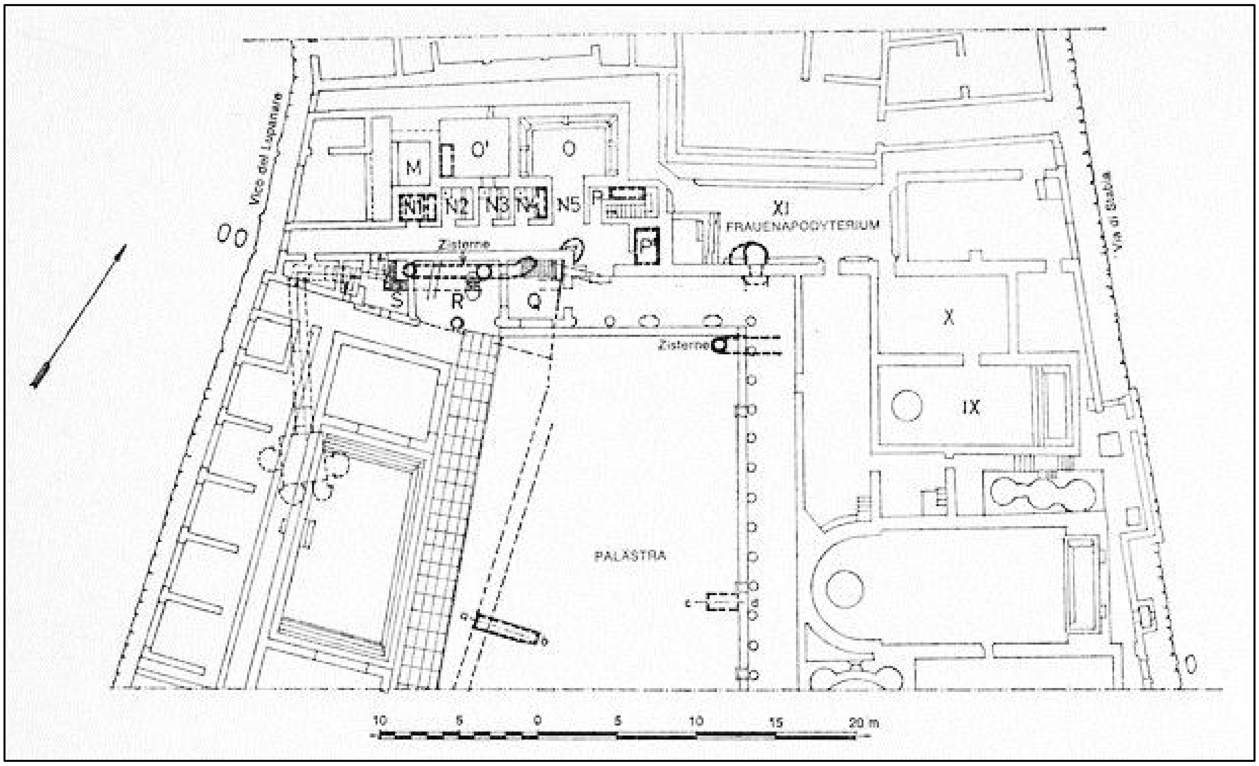

Figure 72. Pompeii, VII.1: Stabian Baths, general plan with location of early features (after Eschebach 1975).

Maiuri's phasing can be substantially modified on the basis of the results of other soundings conducted by H. Eschebach. These documented a lower stratum under the cubicle complex, in the rooms south of the south corridor and at both the west and the east edges of the courtyard of the later baths (**fig. 72**).[632] In two of the cells (i.e., the first and the fourth from the west, rooms N1 and N4) structural remains consisting of packed rubble of volcanic material (possibly Pappamonte) and clay mortar were identified, directly under the concrete masonry of the immersion tubs of the later occupation.[633] These structures followed the same orientation as the ones above, delimiting hip-baths featuring a bench and sloping base, built with clay and

[631]Maiuri 1973: 48.
[632]See esepcially Eschebach 1979.
[633]A clearer description of the finds is in Eschebach 1975. In his final publication of the monument, the sequence of building periods is confused, particularly because of the alleged relationship of the earliest features with the hypothetical course of the Archaic fortifications and moat. The results of recent geophysical work on site do not support Eschebach's reconstruction: see Dickmann and Pirson 2005.

cruma rubble. These remains were associated with a beaten earth floor, found about 1 m below the later floor surface, laid on top of a thick compact layer found ubiquitously at the base of the sequence in the north wing (this has been interpreted as a road surface of the Archaic period, but without convincing arguments).[634]

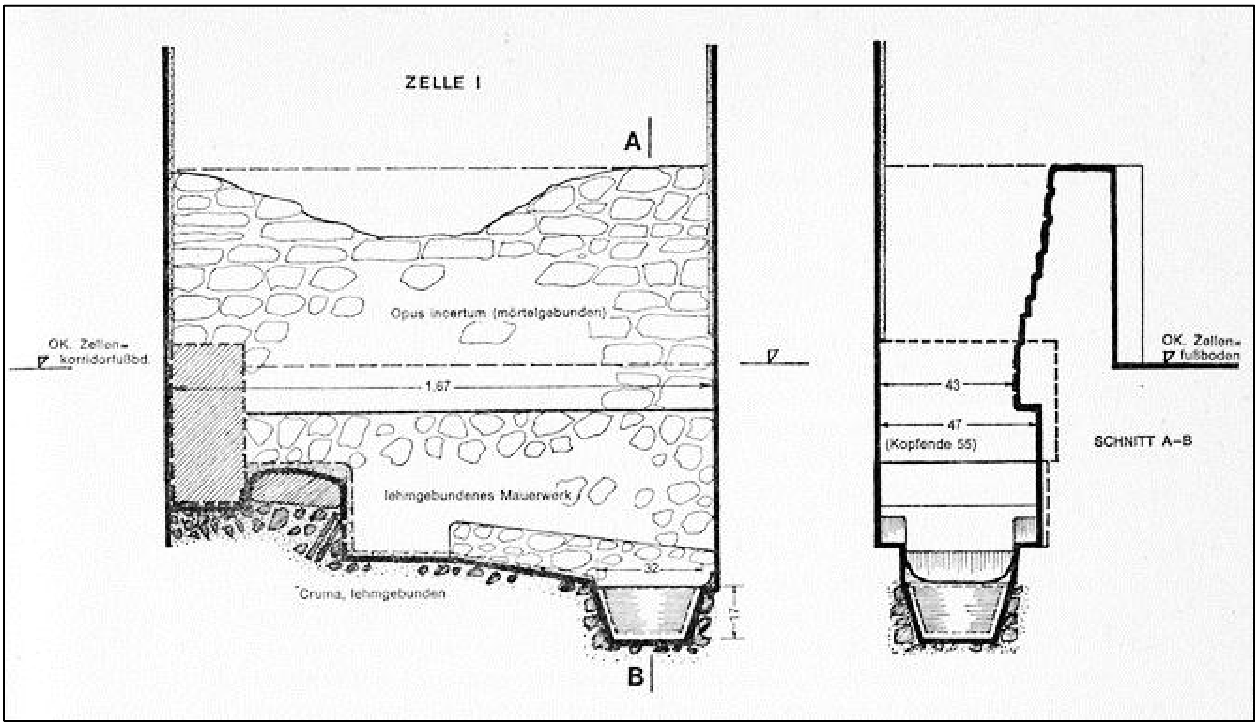

Figure 73. Pompeii, VII.1: Stabian Baths, cross-section of hip-bath in room N1 (view from east; after Eschebach 1975).

Based on the available documentation (**fig. 73**), it seems that in the first cubicle the lower portions of the east and north party-walls (if not the entire walls) were built with the rubblework of Pappamonte and clay. This kind of masonry was detected also on the exterior face of the east wall of the well shaft, in a sondage excavated on the west side of the large room north of the cubicles (rooms O' and O in Eschebach's numbering), starting from the floor level of the earlier hip-baths. However, the wall separating this sector from the cells features only solid *opus incertum* of Sarno limestone and lava rubble (this is also found also on the upper part of the well

[634]As noted by Richardson (1988: 102), a road separating the baths from the rest of the block is more likely to have been originally located north of the well, on the continuation of Vicolo di Balbo.

and of the tanks that were built up at the sides of this). Significantly, this wall was not raised starting from the same level as the other party-walls, but was provided with much deeper foundations, cutting through the alleged road layer. It is not known whether the north wall of Rooms O and O', which was found by Maiuri to be a single structure, also had the same kind of foundations (though this is probable). Evidently a sturdier structure was needed to buttress the barrel vault, which in turn supports the reservoir that sits on the terrace.

The sectional plan of the west cubicle (room N1) shows that, at the level where the original door should have been, the northern wall of the south corridor has a continuous foundation (**fig. 74**). This suggests that this side of the cubicles was partially rebuilt at a later stage, most likely at the same time as the construction of the reservoir and south corridor. Surviving elements of the original front of the cubicles (apparently also in Sarno limestone rubble) were noted by Eschebach in the east cells (rooms N3 and N4). In the earlier occupation, however, the cubicles faced on a wider elongated room, whose limits are defined by a series of packed rubble and clay mortar structures found under the floors of the rooms located immediately to the south of the south corridor (rooms S, R and Q in Eschebach's plan). The west corner of this room aligns precisely with the western limit of the well, while the south wall conforms to the overall orientation of the

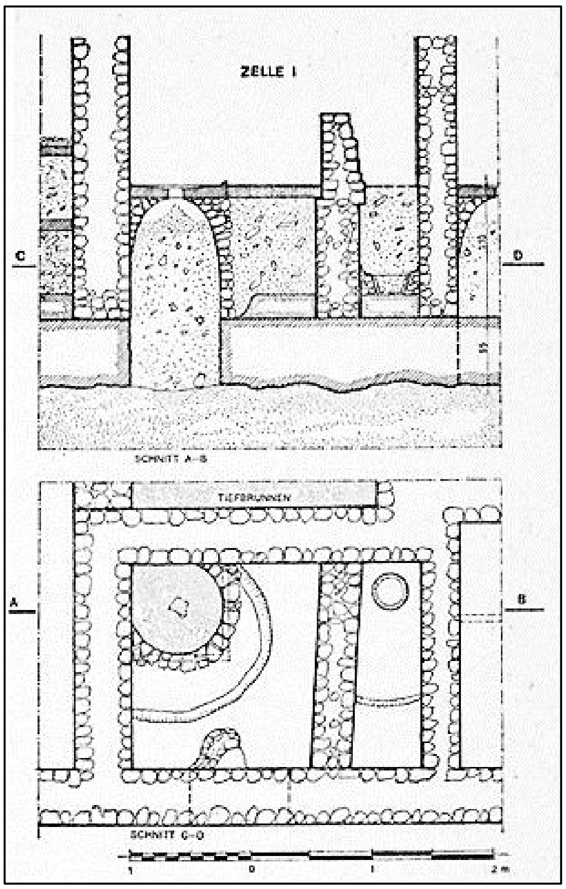

Figure 74. Pompeii,VII.1: Stabian Baths, plan and cross-section of the stratigraphy in Room N1 (after Eschebach 1975).

cubicles. An underground tunnel-cistern runs parallel to this wall, and was accessible by one or two man-holes (the eastern one may have been created only in the later phase, when the western one was obliterated by the party-wall between rooms S and R). This room was most likely covered with a flat ceiling, as suggested by the presence of possible beam-holes on the original wall delimiting the cubicles (these openings were walled when the vaulted corridor was built). The presence of the rock-cut cistern clearly explains why the later vaulted corridor deviates from the line of rooms arranged on the north side of the portico. In fact, the corridor formed the southern limit of the reservoir terrace, which obviously had to be founded on solid terrain. Thus, the builders moved the southern wall of the corridor a little to the north, creating a protruding a structure.

In sum, Eschebach's data confirm that the baths had an earlier and smaller core, but that this was not Maiuri's one.[635] The first establishment was sandwiched between the public well to the north and a plot perhaps occupied by private houses to the south. Eschebach assumed that the coarse Sarno limestone architecture and the Pappamonte rubblework belonged to separate phases. He arbitrarily dated the limestone *opus incertum* to the third c. BCE, pushing the Pappamonte building in the fourth c. BCE or even the late fifth c. BCE. This chronology must be rejected. The association of these baths with a *palaestra* already in this phase is also problematic (beaten surfaces roughly at the same level as that of the lower floor in the cubicles were found at the bottom of test-pits dug at the east and the west sides of the courtyard, but these are not associated with any structures).[636] The use of clay mortar and mixed rubble including Pappamonte has been found in other contexts dating between the late fourth and the first half of

[635]Cf. Richardson 1988: 103-104.
[636]See observations in Fagan 2001: 408-411 (especially 409).

the second c. BCE (e.g., the Foro Triangolare).[637] In the absence of information on the ceramic assemblage, it is impossible to assign a more precise chronology to the earlier remains; as already noted, rubble fills with scoriaceous lava are occasionally found in early Type C *opus Africanum*.

In the subsequent phase the basic layout of the hip-baths core was maintained, though extensively rebuilt with the structures in *opus incertum* of Sarno limestone. Decorated *signinum*-floors of First Style type are preserved in various rooms. Based on the overall decorative ensemble, DeLaine (1989) has suggested that a date in the late third or early second c. BCE is also possible.[638] This would make the Stabian Baths an isolated example of concrete architecture in the construction history of Pompeii. But conclusions based only on stylistic evidence must be avoided.

As we have seen, the vaulted rooms behind the cubicles, and the north and south corridors were added in the *opus incertum* phase, in order to support the large reservoir on the upper story; in technology and dimensions the vaults are consistent with the types attested in domestic contexts of the second half of the second c. BCE. This tank served as a *castellum aquae*, providing pressurized water to the hip-baths and to the new suit of heated rooms added to the east of the earlier core. The new sector of the baths could be accessed from the south corridor, as well as from two other doors at the south east corner of the block (between VII.1.9 and VII.1.10 on Via dell'Abbondanza and between VII.1.13 and VII.1.14 on Via di Stabia), which are framed by Nocera Tuff portals of the same type as those on Vicolo del Lupanare; these have been dated stylistically to 140-120 BCE.[639] This reconstruction followed a generalized raising of floor levels in this area of the so-called *Altstadt* during the second half of the second c.

[637]For a survey of attestations of this flimsier building technique in this period see Carafa 2011: 95 and footnote 17.
[638]DeLaine 1989: 117-120.
[639]Richardson 1988: 100-101.

BCE (thick fills, about 2 m, are documented in the Casa di N. Popidius Priscus, at VII.2.20).[640]

The east wing in this phase is thought to have been arranged according to the same design as the complex we see today (among the few modifications would be the apse at the western end of the *caldarium*). The *palaestra* and portico were rebuilt in the early years of the colony by the duovirs, who also added a *laconicum* and a *destrictarium* (CIL 10.829), which are to be located in the east wing. However, it is extremely difficult to distinguish between phases in the lava *opus incertum* remains in this part of the complex (also because much of the late wall decoration survives). The largest rooms have vaults spanning 6-7 m. This is slightly more than the maximum width attested in *opus incertum* houses of our survey (5 m in the Casa dell'Ancora), but still comparable with the largest voussoir vaulting attested in the region (Cumae, Terme Centrali; *infra*, 5.4.3). It is in fact possible that the original vaults of the east wing were built with voussoirs, and that the concrete barrel vaults belong to modifications of the Roman period. Nocera Tuff architecture also appears in the portico. The existence of a courtyard in the late Samnite period is proven by the Oscan inscription recording the installation of a sundial (Ve. 12), which could have been placed only in that area of the complex.

To sum up, little dating evidence is available for the earliest concrete phase of the Stabian Baths. Both the north-wing and the courtyard were built on top of thick construction fills, but only a small sample of these deposits has been excavated, recovering undiagnostic material. Some information is provided by the ceramic finds associated with the sequence of leveling layers that raised the floor surfaces in other parts of the neighborhood located on the north-eastern outskirts of the so-called *Altstadt*. The area of the Casa dei Postumi, which occupies a city-block south of the Stabian Baths, seems to have been first built up between the late third and the first half of the second c. BCE, but the earliest *opus incertum* stuctures there belong to a later

[640]Pedroni 2011: 166.

phase (end of the second or early first c. BCE).[641] In the city-blocks north of the Stabian Baths, the better documented contexts have been shown to date to the second half of the second c. BCE. This chronology corresponds to that of the Oscan inscription from the courtyard, and to the style of the Nocera Tuff architectural decorations. If the reconstruction proposed above is correct, the association of Sarno limestone and lava *opus incertum* attested in the Stabian Baths finds parallels in the architecture of the late second c. BCE. Lava in the eastern suite of the baths may have been used in place of Sarno limestone to achieve better insulation, especially in the heated rooms. Indeed, judicious selection of building materials is clearly demonstrated by the concentration of lighter stone (i.e., scoriaceous lava) in the reservoir.

6.3.3 The Theater and Its Neighborhood

The Theater (also known as the Teatro Grande) was laid out on a natural slope along the southern edge of town (VII.2; **fig. 70, 2**). Based on its design, which adapts elements typical of third and second c. BCE Greek examples (particularly the rectilinear *scaenae frons*, flanked by oblique *parascaenia*; and the horse-shoe shaped orchestra), the plan is believed to be relatively old, though very little structural remains can be assigned to its original phase.[642]

The standing parts of the monument belong mainly to a reconstruction of the Augustan period, which affected the central core of the building (most notably the addition of the annular corridor and the *summa cavea*). Significant elements of a building period in the early years of the Roman colony also remain. The original orchestra was most likely modified at this time, excavating it down into the bedrock to accommodate additional straight rows of seats (a technique seen in contemporary examples, such as the Amphitheater and the Odeion). Vaulted *parodoi* and approaches from the Via Stabiana were also added, employing lava *opus incertum.*

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[641] Dickmann and Pirson 2005: 164.
[642]Richardson 1988: 85-90 (first half of the second c. BCE); Sear 2006: 49-50 (second c. BCE).

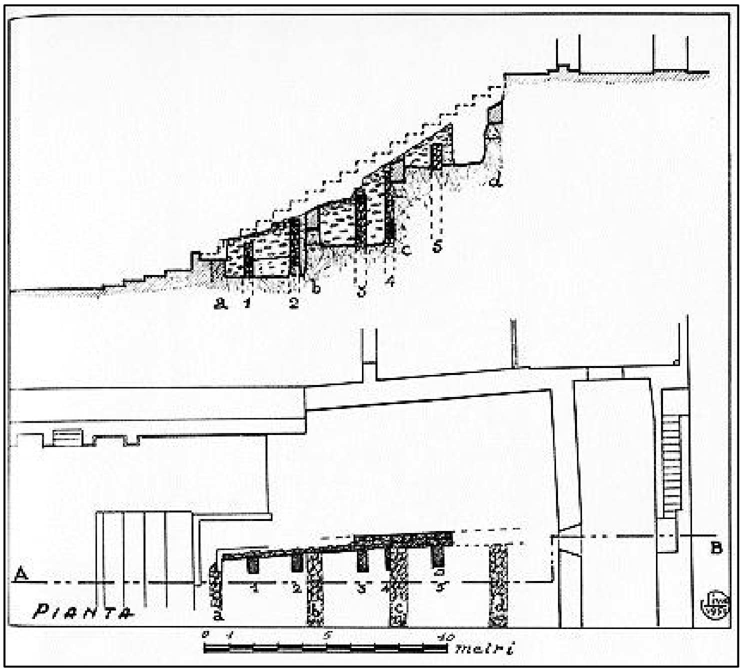

Figure 75. Pompeii, Theater, west side: cross-section of the remains attributed to the first phase of the *cavea* (after Maiuri 1973)

Dressed Nocera Tuff elements reused in the west part of the stage building, and a keystone with sculpted female head placed in the arch over the west *parodos* are generally considered to be the only surviving elements of the original structure, which is therefore taken to be contemporary with the Nocera Tuff fortifications or the houses with Nocera Tuff façades.

Parts of the early *cavea*, which was originally detached from the stage building, were uncovered by Maiuri north of the west *parodos* (**figs. 75-76**).[643] The *analemma* wall consisted of a thick *opus incertum* structure made predominantly of Sarno limestone rubble (of quite large dimensions) and a small amount of compact lava. The height of this wall is 1.40 m at the bottom of the orchestra, reaching a maximum of 3.10 m toward the exterior of the *cavea*, of which it retained the construction fill. The ends of five rows of seats are also preserved. These consist of buttresses of varying width (from 1.40 to 2.10 m), built with the same kind of *opus incertum* as the *analemma* and capped by dressed Sarno limestone blocks, abutting on the main wall.

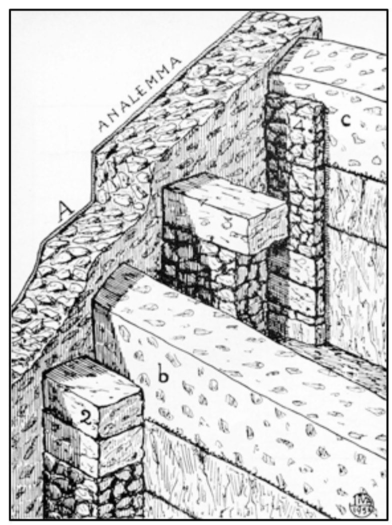

Figure 76. Pompeii, Theater, west side: elevation drawing of the remains (after Maiuri 1973)

[643]Maiuri 1973: 183-189, figs. 104, 106-107.

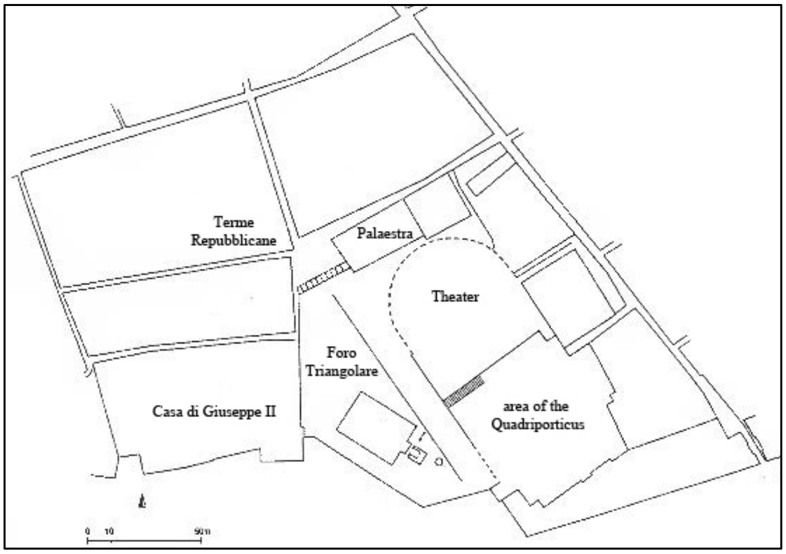

Figure 77. Pompeii, VIII.7: the Theater and its neighborhood after 130 BCE (modified after Carafa 2011).

The construction of the theater can be linked with the overall urban development of the surrounding neighborhood, which was completely reshaped with the remodeling or addition of other public monuments in the Late Samnite period: the Foro Triangolare, the so-called Samnite Palaestra, the Quadriporticus, and perhaps the Terme Repubblicane (**fig. 77**).[644] Ceramic finds from the Foro Triangolare place the beginning of the monumentalization of this sector of town around 130 BCE (obliteration of the ditch separating the area of the Doric temple and the atrium houses of blocks VIII.2, 5 and 6; construction of the north-south *opus incertum* wall between the Foro Triangolare and the Theater and Samnite Palaestra, parallel to the eastern limit of the sanctuary).[645]

Evidence of concrete architecture in this phase is most clearly preserved in some parts of the Quadriporticus, a building connected to the Theater (a *porticus post-scaenam*?).[646] On the west side, at ground level, still survives an unbroken wall of considerable thickness (0.9 m), which is built with Sarno limestone rubble and lime mortar and Nocera Tuff quoins (perhaps these blocks were recycled from earlier buildings). This wall continues to the southwest, where it

[644]A higher chronology of the Terme Repubblicane (usually dated to the first c. BCE) has been suggested by Pesando 2006: 235-236, who interprets the baths in connection with the Samnite Palaestra.
[645]Carafa 2011: 95-98. The dating of the Doric colonnade remains controversial. For the status of the debate see Carafa 2005.
[646]Poehler and Ellis 2011: 4-5; 2012: 5-6.

consists entirely of lava *opus incertum* (with Sarno ashlar quoins). Two original rooms survive in the northernmost stretch of this wing, with party-walls built with mixed Sarno limestone and compact lava rubble. Another terracing structure lies further up the slope, toward the Foro Triangolare, supporting the second storey of the complex; this structure is parallel to the wall at the lower level and features Sarno limestone rubble and lime mortar. The Foro Triangolare and Quadriporticus were connected by a monumental staircase placed on the northwest side of the complex. An arch made of Sarno limestone voussoirs embedded in the later façade of the northern side of the Quadriporticus may belong to the original version of the staircase.

To sum up, direct dating evidence for the Teatro Grande is limited. Given the similarities in design and the almost identical proportions, the Pompeian monument has been interpreted as the model for the well-dated late second c. BCE examples of Sarno and Pietrabbondante.[647] This may indicate that the theater of Pompeii was contemporary or slightly earlier.[648] A date in the first half of the second c. BCE cannot be ruled out in principle, but it would not correspond to the chronology of other concrete buildings attested in the neighborhood. The overall features of concrete architecture in this sector of town, with the admixture of Sarno limestone and compact lava and the adoption of voussoir vaults, finds a close parallel in the Stabian Baths and, as we shall see, in the first phase of the Temple of Apollo. These buildings seem to belong to the same construction phase.

6.3.4 The Temple of Apollo

The Temple of Apollo lies on the west side of the Forum of Pompeii (**fig. 70, 3; fig. 82, 2**).[649] Excavations by A. Maiuri around the temple podium and by P. Arthur along the east

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[647]Lauter 1976.
[648]As already suggested by F. Coarelli (discussion in Lauter 1976: 422-423).
[649]For an overview of the remains see Richardson 1988: 89-95.

precinct wall of the sanctuary have demonstrated that a sacred building had existed in that location at least as early as the Archaic period, and that the Archaic complex underwent at least one major reconstruction before the initial monumental development of the Forum.[650]

The relative sequence between the sanctuary and the Forum is evident in the orientation of the sanctuary. This is at an odd angle with that of the square, while it conforms to the alignment of a linear ditch running in a north-south direction.[651] This feature was eventually filled in, and covered by the Forum portico. The area of the sanctuary, therefore, originally extended farther to the east, including a sector possibly occupied by a garden.[652] It perhaps extended also to the south, if the series of parallel Nocera Tuff sleepers found at the south-east corner of the sanctuary under the pavement of via Marina, as well as the flight of three steps just north of it, are to be interpreted as providing a monumental access way to the temple enclosure.[653]

Given the absence of any traces of wear on the steps, the occupation phase to which these structures belonged seems to have been short-lived. Arthur (1986) has suggested a possible date in the first half of the second c. BCE for these features, but De Caro (1986) has linked the construction of the staircase with the rebuilding of the temple podium, and dated this activity to 150 BCE or a little after.[654] The reduction in size of the precinct must have happened in parallel with the expansion of the Forum area and the construction of the Temple of Iuppiter, which

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[650]The results of Maiuri's investigations are published in De Caro 1986; Arthur 1986. For the latest research on site see Dobbins *et al.* 1998; Carrol and Godden 2000.

[651]The ditch has been detected as far north as the horrea at VII.7.29 and south in trench 7 of Arthur's excavations. See Arthur 1986: 34-35. A similar feature delimited also the Foro Triangolare in its early phase: Carafa 2011.

[652]An amphora (possibly of Dressel 1A type) has been found in this area, sunken in a round pit. It has been suggested that this was used to plant a small tree or bush: Arthur 1986: 35. Cf. Pesando 2006, who interprets it as a drainage for a *signinum* floor. This find would suggest a *terminus post quem* of the third quarter of the second c. BCE for creation of the garden or paved surface. For similar features in the later phase of the sanctuary see Carroll and Godden 2000: 748-749.

[653]The ashlar structures under Via Marina are described in Arthur 1986: 37 and Plate IV fig. b. The steps are truncated to the east by the stylobate of the Forum portico. This reconstruction is accepted by De Caro 1986.

[654]De Caro 1986: 13; 19.

represents the focal point of the new square (*infra*, 6.3.5). The ceramic materials found in the fill of the ditch date to the second half of the second c. BCE.[655]

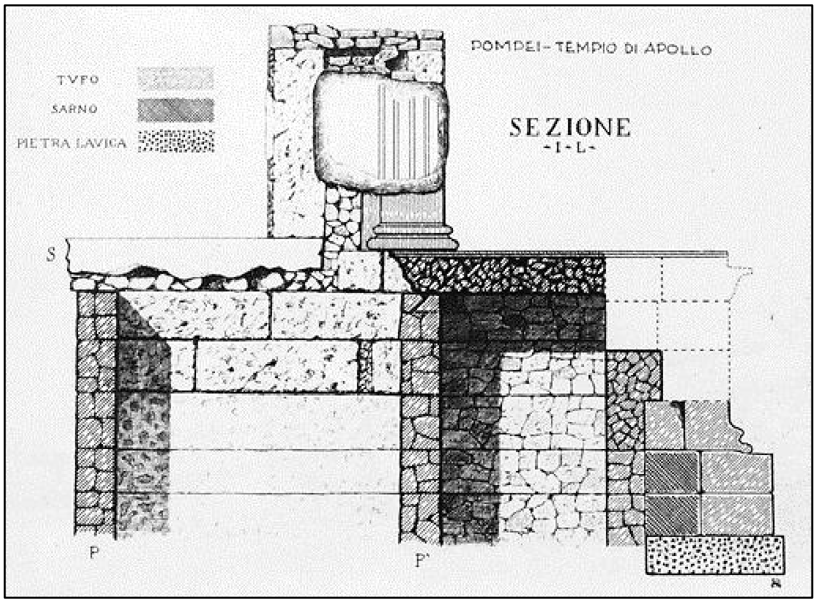

Figure 78. Pompeii, Temple of Apollo: cross-section of the podium (after De Caro 1986).

The temple of Apollo is supported by a high podium (2.30 m), consisting of an outer ashlar structure delimiting an inner concrete grid (**fig. 78**).[656] The ashlar structure is built on top of a foundation course made of individual blocks of Nocera Tuff and Sarno limestone (but Pappamonte, scoriaceous lava, and a local yellow tuff are also attested), placed in parallel rows on the bottom of a shallow foundation trench, the gaps filled with packed rubble and pottery fragments (according to a technique well documented in second c. BCE house construction).

The free-standing part of the podium features two adjoining facings. The inner one is composed of two horizontal courses of Sarno limestone blocks and an upper course of Nocera Tuff ashlars. The exterior facing originally included four courses of Nocera Tuff, with an Attic base (a double torus separated by a scotia, partly carved and partly built in masonry and stuccoed), and possibly crown molding (but nothing survives of this).[657] The grid consists of a coarse rubble-work of Sarno limestone, Nocera Tuff, and yellow tuff set in pozzolanic mortar.

[655]Arthur 1986.
[656]De Caro 1986: 10-13.
[657]Lauter (1979: 422) dates the architectural molding of the podium to the last decade of the first c. BCE, based on the earliest attestation of the type in Rome (i.e., the podium of the Temple B at Largo Argentina).

The elements of the grid were built up in parallel with the construction of the outer ashlar frame, in horizontal layers that correspond precisely with the ashlar courses. Waste material derived from the dressing of the blocks was most likely recycled as *caementa.* Smaller Sarno limestone and Nocera Tuff chips are also interspersed with the soil deposits dumped within the grid; these concentrations possibly identify the surfaces at which the work was stopped to let the concrete set. The space between the ashlar facing of the podium and the internal concrete grid is filled with a mass of concrete including exclusively lava *caementa.* This concrete structure projects on top of the upper Nocera Tuff course of the inner curtain, up to the level of the fourth course of the outer facing, and supports the colonnade. The columns of the colonnade rest on masonry bases, have shafts with twenty flutes (like the ones of the portico) and feature Corinthian capitals similar to those of the Basilica.[658]

The cella of the temple is quite small, leaving a deep porch on the front. The walls of the cella are founded on three courses of Sarno blocks inserted on the corresponding elements of the concrete grid. Two floor levels are preserved: a lower *signinum* surface laid on top of a preparation of beaten Sarno limestone rubble, and a later decorated floor featuring trompe l'oeil decoration in *opus sectile* (lozenges of black white and green set to give an optical illusion of perspective), framed by a colored band in turn surrounded by a mosaic of black and white *tesserae*. The Oscan inscription inserted in the mosaic (Ve. 18) says that the redecoration of the cella was the work of the *kvaísstur* Oppius Campanus; this must predate the establishment of the colony (late second or early first c. BCE, based on the style of the mosaic).[659] The wall-paintings

[658]Lauter-Bufe 1987: 38-39 n. 99-103 (110-100 BCE). The dating is based on the chronology proposed by Lauter for the podium base on stylistic grounds. This is considered too low by De Caro 1986: 28, footnote 72.

[659]On this type of mosaic and its distribution at Pompeii see Westgate 2000: 259-260 and 263; cf. Pesando (2006), who identifies it as a *scutulatum* and suggests a chronology closer to the earliest allegedly example attested in Rome (Capitolium, 149-146 BCE, based on Pliny the Elder, 36.185). See also Tang 2006: 95-96 (archaeologically attested examples in Rome date to the last decade of the second c. BCE at the earliest). Pernice (1938: 69-70) assigned the mosaic to his Second Style period.

are First Style.

The only modification to the original design of the podium is the frontal staircase, which was perhaps added when the new altar was dedicated by the quattuorvirs of the Roman colony (CIL 10.800). The staircase is built on top of six east-west *opus incertum* cisterns, all connected by conduits and covered with barrel vaults of Sarno limestone voussoirs (width: 0.60 m), which were backfilled and put out of use at that time. Recent stratigraphic investigation in the courtyard has shown that the compact layer covering the crest of the third, fourth, and fifth cistern contains pottery of the late first c. BCE, but because this level was razed in the course of the first excavations of the temple in the 1800's the risk of intrusions is extremely high.[660] In the previous phase these cisterns collected the rain-water from the roof of the temple. Other tunnel cisterns, slightly larger (1.20 m) are attested at both the south-eastern and north-eastern corners of the precinct. The former continues under the portico that surrounds the precinct (the stylobate of the portico actually respects the extrados of the vault) toward the ditch, but is truncated by the foundations of the wedged-shape pillared structure that connects the portico of the sanctuary with the portico of the Forum, reconciling their different orientations (*infra*, 6.3.4 for the dating of this structure).[661]

The relationship between the podium and the colonnade that surrounded the precinct is more problematic. Based on Maiuri's finds under the pavement of the Forum portico and along the east side of the colonnade, De Caro suggested that the precinct was later than the original podium (i.e., contemporary with the redecoration of the cella).[662] In fact the pillared structure

[660]For the pottery see Carroll and Godden 2000: 746-747. Activity of the Augustan period on top of this level is demonstrated by a series of planting pits containing Dressel 2/4 amphoras found on the eastern flank of the podium.

[661]De Caro 1986: 14-15. For this relative sequence see also Dobbins *et al.* 1998: 753-756 and figs. 16-18.

[662]De Caro 1986: 19. Cf. Richardson (1988: 90-91), who reconstructs the portico as a single-storey building and explaining the very high podium (about half the height as that reconstructed for the portico) as a device to make the temple rise above the colonnade.

between the sanctuary and the Forum portico physically supports both colonnades, indicating that the peristyle of the sanctuary was created in the context of the monumentalization of the Forum square, a project which De Caro dated to the late second c. BCE. Two north-south *opus incertum* foundations found behind the third and fourth opening in the pillar structure may represent what remains of a previous precinct wall.[663]

The pillared structure features shallow foundations made of rows of big ashlars and rubble fills, of the same type as those found under the podium. On the other hand, the back walls of the colonnade on the west, north and south sides of the colonnade have deep concrete foundations (with mixed Sarno limestone, Nocera Tuff and lava), continuous on all sides.[664] Although ashlar foundations have been documented also for the stylobate of the colonnade, the difference in technique between the precinct wall and the podium has been taken as an indication of a chronological separation between the two components of the sanctuary. Ceramics from a test-pit excavated on the exterior face of the west wall of the precinct confirmed that construction activities occurred on this side in the Augustan period.[665]

Epigraphic evidence from the sanctuary (CIL 10.787) shows that the duovirs of 12 BCE were involved in construction activities there. Mau suggested that a stretch of Vicolo del Gallo that once ran in the direction of Via Marina was abolished on that occasion, creating a blind alley between the sanctuary and the adjoining Casa di Trittolemo (VII.7.2), and that it was in this context that the west wall of the precinct was rebuilt.[666] Dobbins *et al.* (1998) argued that the jog in the street at the north-western corner of the sanctuary and the truncation of the south-east

[663]See also Dobbins *et al.* 1998: 754.
[664]De Caro 1986: 15-18.
[665]Dobbins *et al.* 1998.
[666]In support of this, Dobbins *et al.* 1998 (742) note that the ideal continuation of this road toward via Marina would more or less align with the wide door on the north side of the Basilica. However, the placement of this opening, which is mirrored by a symmetrical door on the Vicolo di Championnet, finds its logic in the overall proportions of the Basilica. The placement of these doors coincides exactly with the middle intercolumniation of the long sides of the interior colonnade, though according to Dobbins 2007 (171-172) the south door is a later insertion.

corner of house VII.15.7 should also be connected with this episode, and that these activities should be interpreted as alterations intended to make room for the precinct wall in its entirety. He sees the precinct wall as a single construction with the colonnade, which would therefore represent an insertion of the Augustan period.[667]

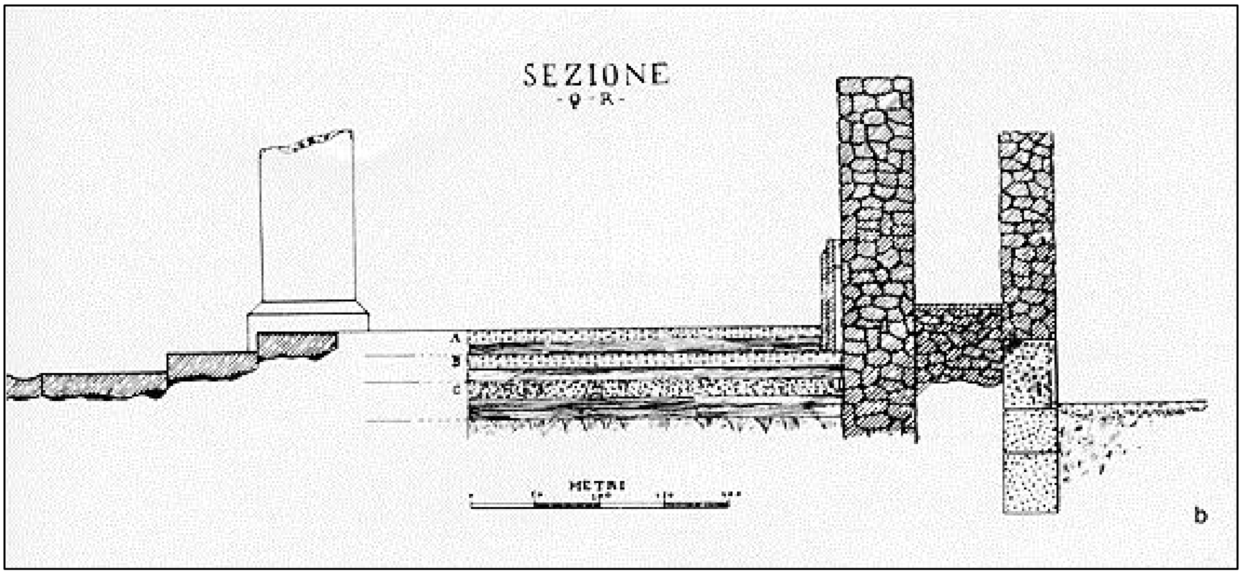

Figure 79. Pompeii, Temple of Apollo: cross-section drawing of the stratigraphy of the west colonnade (view from north), showing the ashlars below the boundary wall of the Casa di Trittolemo (right; after De Caro 1986).

The stratigraphy documented by Maiuri under the pavement of the west colonnade and across the alley shows that the east *opus incertum* wall of the Casa di Trittolemo sits on top of an ashlar wall of scoriaceous lava on a foundation of Pappamonte slabs (**fig. 79**); De Caro (1986) tentatively interpreted this structure as the precinct wall of the Archaic sanctuary, but it is also possible that this was the original façade of the house on the continuation of vicolo del Gallo.[668] A structure built with mixed rubble (including Pappamonte) and clay mortar, found at the corner between the west and south colonnade, runs parallel to this, perhaps identifying the other limit of

[667]Dobbins *et al.* 1998: 744-752.
[668]De Caro 1986: 5-6.

the road.[669] Two other surfaces were detected below the *signinum*-floor of the portico (B and C in Maiuri's section), but it seems that these correspond to preparation levels abutting on the back wall (though in some areas this pavement and its preparation were removed, possibly after the earthquake of 62 CE). The foundations of both back wall and stylobate fill a vertical cut through the bedrock. In conclusion, positive evidence for a road surface under the colonnade does not survive.[670]

On the exterior of the northwest side of the precinct, the excavation by Dobbins and his team documented a linear cut in the natural deposits that may represent the original foundation trench of the back wall; its edge is at the same level of the lower offset visible in the mortar-and-rubble structure (Trench 1, **fig. 80**).[671] This cut was backfilled by a layer (Deposit 15) containing black-gloss pottery of the second to first c. BCE (non-diagnostic fragments of Campana A). The same soil (on top of which is another leveling layer, Deposit 14) was dumped to raise the floor level on Vicolo del Gallo. This surface is covered by the packing for the road pavement, which is in turn clearly truncated by another cut (filled by Deposits 4-8 and 17, containing late first c. BCE pottery) associated with the upper level of the precinct wall foundation. It is therefore possible that the colonnade was designed with the new road layout already in the late second or early first c. BCE, and only rebuilt in the early Imperial period, though this would require a different interpretation for the 12 BCE inscription (perhaps the *ius luminum* that the duovirs purchased simply refers to the blocking of the alley at both ends).[672]

[669] De Caro 1986: 9 and Plate Ib, Trench IIe.
[670] For a more detailed description of the sequence see De Caro 1986: 129-134.
[671] As recorded by Maiuri about m 10 south of Trench 1, the cut in the bedrock was 1.60 m deep (De Caro 1986: 131, Trench V).
[672] Note that the north section of the southeast corner of VII.15.7 is perfectly aligned with the east wall of the Casa di Trittolemo (which was built on top of a preexisting structure). This suggests that the alley between the sanctuary and the Casa di Trittolemo may have originally continued up to that point. The reconstruction attested in Trench 2 was perhaps planned to connect the east-west road separating blocks VII.7 and VII.15 with the north branch of Vicolo del Gallo, allowing pedestrians to reach the houses facing on this street from Via Marina. The bottom of

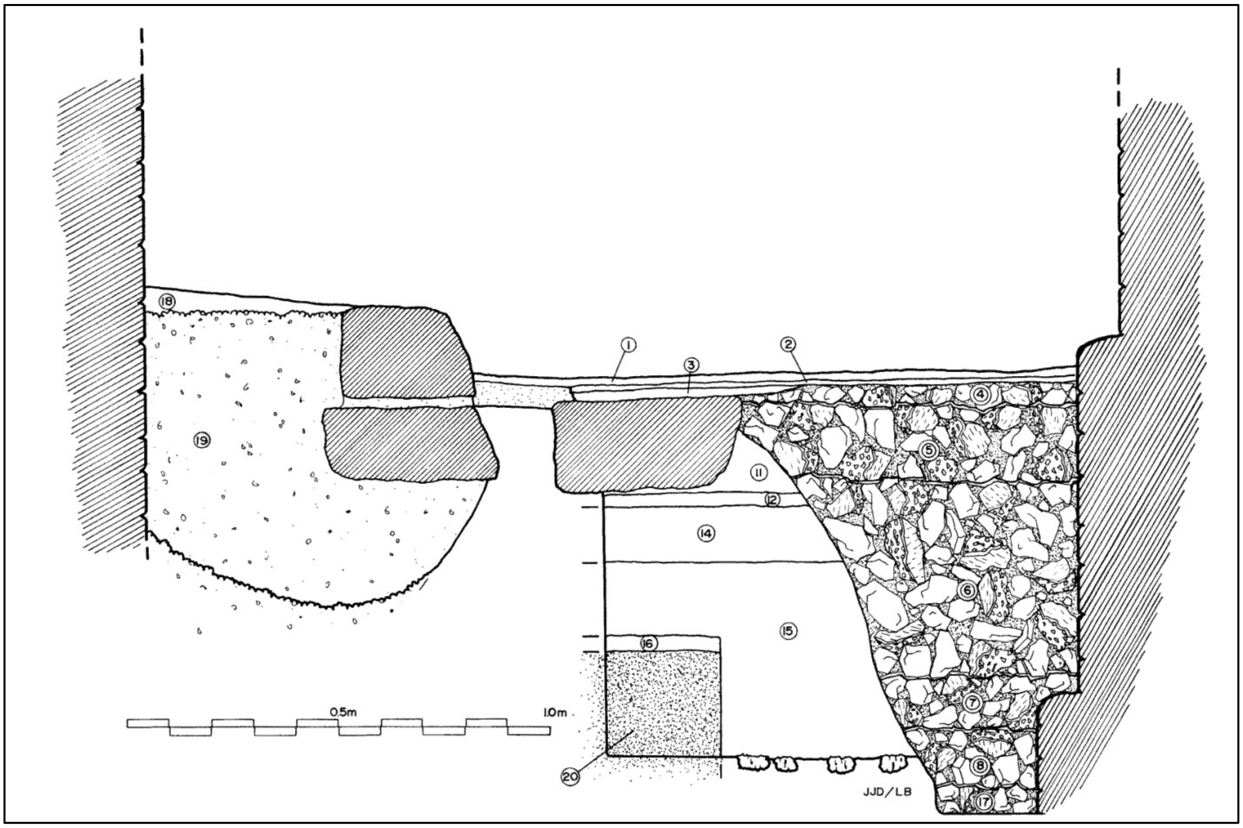

Figure 80. Pompeii, Temple of Apollo: stratigraphy of the foundation trench of the northwest side of the precinct (after Dobbins *et al.* 1998).

The chronology proposed by Dobbins and his group for the creation of the colonnade has been rejected by Pesando (2006), who argued for a date in the late 140s BCE. This is based on the text of an Oscan inscription (Ve. 61) found on one of the seven bases still preserved on top of the lower ashlar step abutting the stylobates (three are on the east, two on the west, two on the south side). The inscription reads *l.mummís.l.kúsúl*, and is believed to be a *titulus Mummianus*, one of the many dedications known from towns in Italy recording gifts of war-booty from the triumph over Corinth granted by L. Mummius to his allies.[673] Because the statue base with the inscription was found on a slightly raised base inserted in the lower ashlar step of the stylobate, inscription and colonnade have been taken to be contemporary (the *tituli Mummiani* are usually

the alley is paved with a layer of pan tiles that abuts the west wall but is joined to (or covered by) the east wall (Maiuri 1973: 127), confirming that the façade of the Casa di Trittolemo is earlier than the colonnade.

[673] Martelli 2002; Martelli 2005. On this class of monuments in general see Lippolis 2004.

dated between 144 and 142 BCE, during Mummius's censorship). Pesando (2006) concludes that the construction of the colonnade was paid for with the spoils by Mummius himself and that the model for the overall project was provided by the Porticus Metelli, which Pesando believes was built in the same years, right after 146 BCE. In turn, he dates the first monumentalization of the sanctuary (i.e., podium and propylon) to the first half of the second c. BCE.[674] As we have seen (*supra*, 4.2.6), the Porticus Metelli was most likely built only in the 130s BCE, and this would only represent the *terminus post quem* for the Pompeian replica, unless we admit that both monuments had been planned at the same time. This seems extremely unlikely; in any case, an independent origin for the Pompeian monument should not be excluded *a priori.*

The main problems for the high chronology, however, derive from the relationship between the sanctuary and the portico of the Forum. Because the construction of the colonnade requires the presence of the pillared structure on the east side, Pesando postulates that this part of the precinct was built together with the rest of the colonnade, before the creation of the Forum portico and the construction of the Temple of Iuppiter. This seems not to be the case, because the pillared structure conforms to the main axis of the square, which is in fact generated by the Temple of Iuppiter. It is clear that the main function of the pillared structure was to connect the different orientations of the Forum portico and the sanctuary.[675] And if the pillared structure and the Forum portico are contemporary, the remodeling of the sanctuary must be placed around 100 BCE at the earliest. In light of this, it is more probable that the Oscan inscription refers to a statue of Mummius erected by a Pompeian follower in the area of temple, and that this statue was later placed on the stylobate, along with the other bases, when the colonnade was built.[676] The

[674]See especially Pesando 2006: 233-234.
[675]On the architectural function of the pillared structure see Dobbins 2007: 169-172
[676]As suggested by Moormann (2011: 84-85), who however accepts the high chronology and close association between this inscription and the construction of the colonnade, speculating that there was a connection between

tituli Mummiani found in Italian towns are in fact all in Latin and include the official name of the community to which the gift was made. A close parallel for the Pompeian inscription comes from Fabrateria Nova, where another statue base inscribed only with the name of Mummius in the nominative has been found (*L. Mumi(us) L.f. Cos.*, in Latin).[677] This was evidently brought in from Fregellae after the distruction of the colony (125 BCE) and the relocation of the inhabitants on the new site.

To sum up, the stratigraphic evidence at the site of the Temple of Apollo (particularly the fact that the portico truncates one of the cisterns in phase with the original construction) provides a *terminus ante quem* of the late second or early first c. BCE for the concrete temple podium. This *terminus* would also correspond to that suggested, on the basis of stylistic evidence, by the redecoration of the cella. There are no elements, however, in support of a date earlier than the third quarter of the second c. BCE for the first construction phase of the temple. This would make the monument contemporary with domestic structures such as the Casa di Pansa, which in fact shares similar features, especially in the association of ashlar foundations and *opus incertum* elevations. The concrete grid finds a precise parallel with the first phase of the podium of the Temple of Venus, which has been recently investigated and dated to the late second c. BCE (130-120 BCE, though the chronology should be lowered by at least a couple of decades; *infra* 6.3.5).[678] The podium and the side colonnades were of the sanctuary of Venus were part of the original design, as is also evident in the similar construction technique of podium grid and foundations of the porticoes. These were built up with unfaced concrete (using shutterings) after

the original dedicant of the statue (and temple), Oppius Campanus (taken to be a member of the same family, only a generation later), and the owner of the Casa del Fauno, on the basis of similarities in the decorative ensembles (the mixed Doric and Ionic orders in the colonnade of the north peristyle; the trompe l'oeil *opus sectile* in the *fauces* and the *tablinum*), which he dates to the early first c. BCE.

677 Bizzarri 1973. For this interpretation see also Pietilä-Castrén 1978: 121.

678 Curti 2008: 53-56; Coletti and Sterpa 2008; on the temple podium see Coletti *et al.* 2010.

the structures that occupied the area were razed at the level of the pavements, and retained fills that raised the floors up to 2 m in some places. The construction of the colonnade of the Temple of Apollo (and the destuction of the old entrance staircase), the monumentalization of the Temple of Venus and the construction of the Basilica were clearly part of the same urbanization project, which resulted in the creation of Via Marina in its existing form (ca. 100-80 BCE).[679]

5.3.5 The Temple of Iuppiter and the Forum Portico

In spite of the strong coordination reflected in the construction process, general works on the topography of pre-Roman Pompeii tend to depict the project of architectural renovation of the so-called *Altstadt* as gradual and haphazard, suggesting that this was completed over two or three generations.[680] The argument rests primarily on the uncritical acceptance of the high chronology (150-120 BCE) assigned by Maiuri to the first phase of the Temple of Iuppiter (**fig. 70, 4; fig. 82, 1**), on the basis of its design.[681] His investigations on the west and north sides of the podium, in the frontal staircase and in the cella demonstrated that there was at least a major modification in the structure of the temple, seemingly connected with a redecoration of the pronaos and of the cella.[682] The second phase is unanimously interpreted as a re-dedication of the temple to the Capitoline triad (the assumption is that in the first phase the temple was dedicated to Iuppiter alone, though there is no direct evidence for this). Opinions as to the precise date of this transformation, on the other hand, vary. Lauter, who first dated the redecoration of the cella to 100 BCE, now prefers a date in the 80s BCE, based on the style of the capitals, and connects the dedication of a Capitolium with the establishment of a *municipium.*[683] The majority of

[679]The street was moved farther north from its original course. Arthur 1986: 38 (with a Sullan date for the Temple of Venus). See observations in Cottica and Curti 2008: 27-28.
[680]See Lauter 1979: 416-423 and 430-434; Zanker 1998: 53-60; Carafa 2011. Cf. especially Dobbins 2007.
[681]Maiuri 1973: 101-124.
[682]Cf. Richardson 1988: 138-145 (arguing for a single phase of development).
[683]Lauter 2009: 163-170. Dobbins 2007: 169-172.

commentators agree on a date in the early years of the Roman colony.[684] But how much older is the original building? A closer look at the remains is in order.

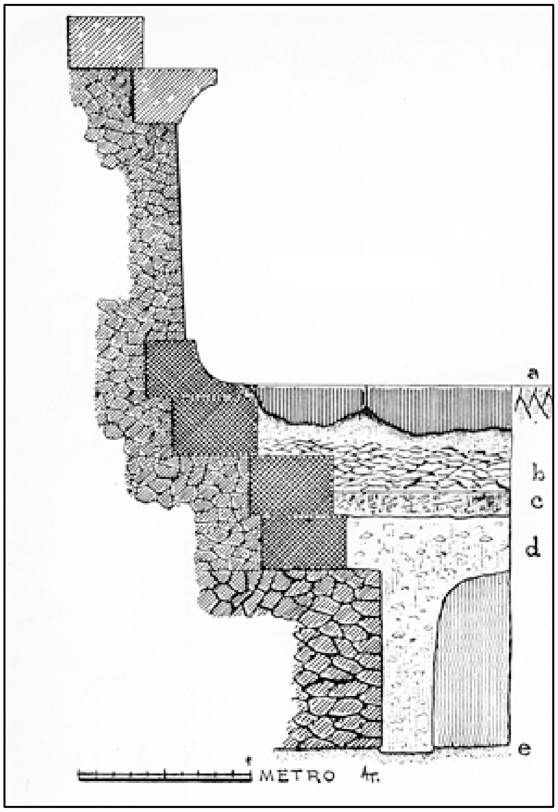

Figure 81. Pompeii, Temple of Iuppiter: cross-section of the podium (after Maiuri 1973).

The concrete podium is about 3 m high, projecting 2.40 m above the floor level of the square, and consists of two parts (**fig. 81**). On the bottom of the foundation trench is a continuous foundation platform made of pozzolanic mortar and compact lava *caementa.* On top of this rests a crypt, which is divided in three communicating corridors, each covered by a segmental concrete vault built on centering (the span is a little less than 4 m). Most notable is the absence of voussoirs, which we have seen regularly employed in early concrete vaulted construction. The crypt is also divided in two longitudinal sectors, a shorter one on the front and a longer one on the back, by an east-west wall. Access to the crypt, which is lit by narrow openings in the floor of the cella (possibly this space was used as an *aerarium*), was originally from a flight of steps descending from the continuous frontal staircase. The facing of the podium features a stepped base, formed by four courses of Nocera Tuff ashlars, the top one sculpted with a cavetto molding, and a crown molding (creating a podium of the Italic type).

The first temple had a shorter cella and pronaos than in its second phase. The original party-wall, in *opus incertum* of Sarno limestone and compact lava, was found by Maiuri razed under the upper floor, both at the south-east and southwest corners, 0.60 m north of the wall

[684]Maiuri 1973: 124; Richardson 1988: 138; Zevi 1996: 128-130; Zanker 1998: 62-65.

delimiting the standing cella and pronaos. The dimensions of the cella and pronaos in this phase corresponded precisely to those of the basement, as the party-wall was laid on top of the longitudinal wall dividing the back and front parts of the crypt, while the preparation of the original floor does not extend beyond the southern limit of the substructures. Later alterations affected also the long side-walls of the cella, which are made in *opus incertum* of compact lava.[685] A sondage excavated at the base of the west wall showed that this (and presumably also the east wall) had its original facing chiseled away, perhaps to create more space between the side-walls and the inner Ionic colonnade, which was added in the second phase on the crown of the basement vaults.[686] The exterior of the cella is decorated with First Style paintings, while the interior decoration, now in ruins, is described as Second Style.[687]

The building of the temple and the regularization of the Forum square seem to have been planned together. The foundation trench of the basement was cut through the bedrock, and presumably through the lower pavement of the square (i.e., the one associated with the *tabernae* of the east side, built with *opus Africanum*), though the precise relationship with this is not documented. On the west side of the podium, the bottom course of the ashlar facing is covered by a preparation level of packed building debris. This was framed by a Nocera Tuff structure, parts of which were found by Maiuri under the later travertine pavement along the east side of the square (next to the Temple of Vespasian and the Sacellum of the Lares Publici), in the north-west corner and in front of the pillared structure delimiting the sanctuary of Apollo.[688] The Nocera Tuff retaining structure is made of two abutting rows of slabs forming a ring around the

[685] See also Lugli 1957: 469; cf. Richardson (1988: 138) considers the masonry close in style to the Odeion.
[686] Maiuri 1973: 108-109. Richardson (1988: 141-142) finds a parallel for the placement of the columns in the Basilica of Cosa.
[687] For the problems concerning the classification and dating of the paintings of the interior of the cella see Zevi 1996: 128.
[688] Maiuri 1973: 108; 63-70.

packed debris surface (the presence of a third row, creating a shorter step on top of the floor preparation, is suggested by the fact that the side of the inner slabs is carefully dressed). The top surface of the inner slabs present a shallow depression, which most likely functioned as a drain, conveying water in the system of underground channels built with *opus incertum* of Sarno limestone and tuff.[689]

Maiuri used this evidence to argue that already in the “Tufo period” a portico ran not just on the south side, as was suggested on the basis of standing remains, but on all sides of the square.[690] Leaving the dating issue aside for the moment, the most important implication of Maiuri's discoveries is that the Forum portico and the first phase of the temple form a contemporary ensemble. Earlier *opus incertum* structures facing the open area (the north boundary wall along via dei Soprastanti;[691] the possible *tabernae* in front of the Macellum, at a right angle with Via degli Augustali;[692] and the old *tabernae* under the Eumachia building) were completely abolished with the new project.

The Forum portico is symmetrical with the temple, which stands on the central axis of the square. The original Nocera Tuff columns survive on the south side of the Forum, in front of the so-called Comitium, at the junction with both Via Marina and via dell'Abbondanza and on the southwest corner of the Eumachia building. The stylobate of the first phase consists of separate stretches of ashlar blocks, in three courses. This is preserved only on the short south side; on the long sides the original stylobate was dismantled and substituted by continuous concrete foundations for the travertine colonnade.[693]

[689]Maiuri 1973: 66-67.
[690]Cf. Lauter (1979: 430-434) and Zanker (1998: 56-57) believe that in its original phase, the Forum portico was present only on the south side.
[691]Maiuri 1973: 119-123.
[692]Maiuri 1973: 75-88.
[693]Maiuri 1973: 70-73, fig. 34.

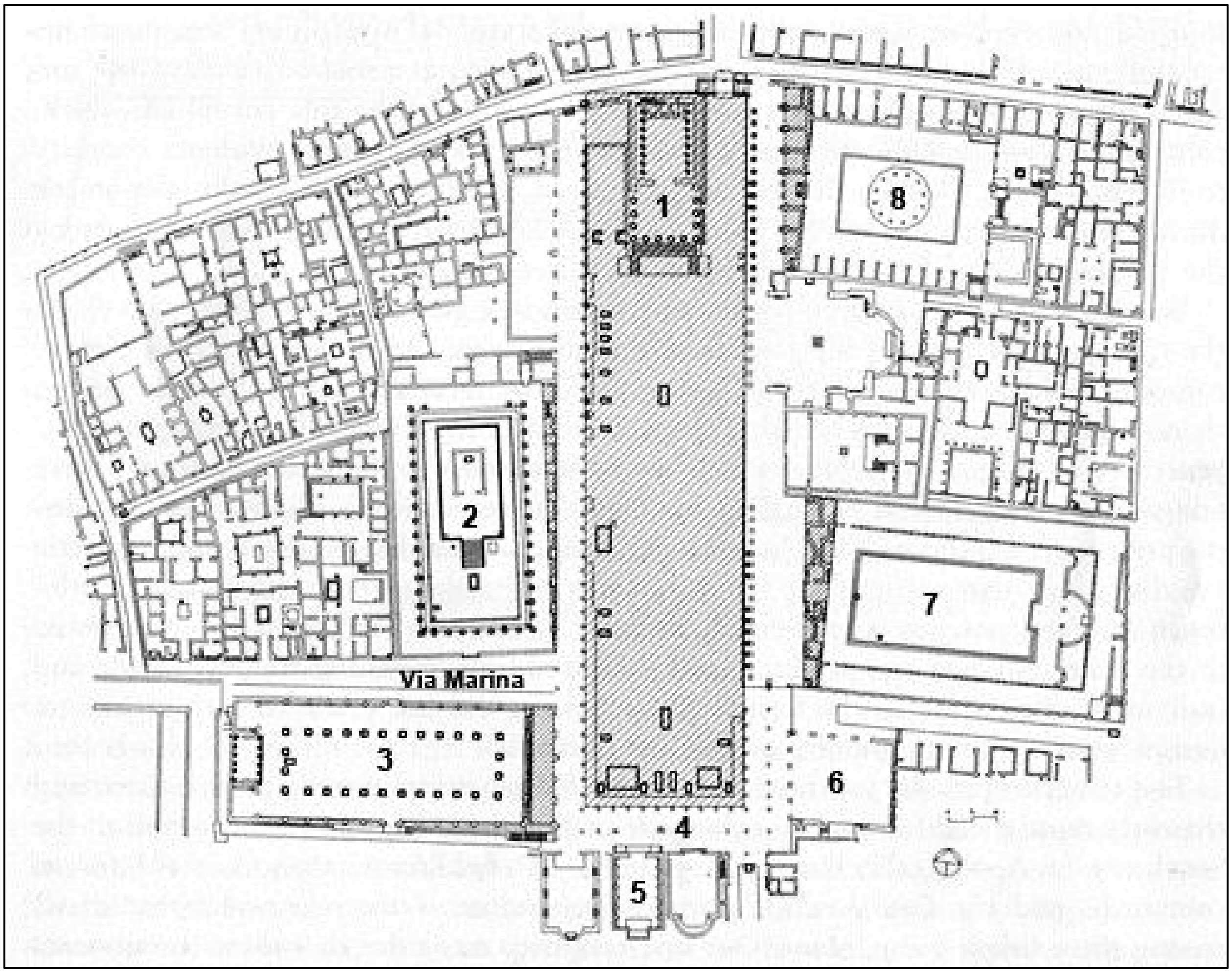

Figure 82. Pompeii, Forum: general plan showing wedge-shaped structures on the sides of the square (*1=Temple of Iuppiter*; *2=Temple of Apollo*; *3=Basilica*; *4=Forum portico*; *5=South Buildings*; *6=Comitium*; *7=Eumachia Building*; *8=Macellum*; after Dobbins 2007).

The portico is connected to the buildings on the sides of the square by means of wedge-shaped structures that regularize the different alignments (**fig. 82**): the east precinct wall of the sanctuary of Apollo and the *chalcidicum* of the Basilica (whose Doric pilasters respond to the colonnade); similar connectors are found on the east side of the Forum, in front of the Eumachia building and the Macellum, though the standing remains are clearly a late reconstruction.[694] The colonnade had a second storey; inner ends of its joists and rafters are supported by the façade

[694]See especially Dobbins 2007: 169-172; on the east side of the Forum: Wallat 1997; Dobbins 1994.

wedge of the Basilica. The south section of the portico features an inner row of columns in front of the so-called South Buildings (these were completely rebuilt in brickwork at a later stage, which also saw modifications to the colonnade),[695] and in front of the Comitium. The pillared façade of the Comitium is carved out of the north-west corner of block VIII.3 (suppressing private property), and the placement of the pillars respond to the inner row of the colonnade; the portico provides a *terminus post quem* for this building.

If the relative sequence is clear, the absolute dating of the Forum ensemble remains an open problem. The construction of a portico by the *meddix tuticus* Vibius Popidius, son of Vibius, is recorded in an Oscan inscription (Ve. 13) found in a house on the south side of Via dell'Abbondanza, near the entrance to the Forum (at VIII.3.4),[696] but its connection with the Forum colonnade must be doubted.[697] The main source seems to be a Latin inscription (CIL 10.794), also found out of context during the excavation of the Basilica, near its main entrance.[698] The inscription names the magistrate responsible for the construction of a *porticus*, the *quaestor* Vibius Popidius, son of Epidius. Though the precise association of the inscription with the Forum rather than with the Basilica was a hotly debated issue,[699] the consensus now is

[695]Maiuri 1973: 99-101, figs. 54-55; 72 (columns). The razed façades of the east and central buildings in their original phase were found by Maiuri to be on the same alignment, respectively 1.55 m and 1.15 m to the south of the later façades. An *opus incertum* wall parallel to these structures was found also in the west building, but farther south (2.70 m). Maiuri interpreted this structure as the inner party-wall of a vestibule, not as a façade. The difference in alignment is otherwise taken as evidence that the three South Buildings were not planned organically, and that the south portico formed a free-standing structure (Lauter 1979; Zanker 1998). Cf. Kockel and Frenkel (2008), interpreting the inner row on the south side as a later addition. According to their reconstruction, the ashlar foundations of the inner colonnade originally supported the back wall of the portico on this side.

[696]Della Corte 1922: 110-112. We know from a dipinti on the façade that the house in question belonged to a member of the gens *Popidia*. Della Corte (1922) suggested that the inscription was a heirloom, taken from the Forum and placed in the house after the damages of the earthquake of 62 CE. The same Vibius Popidius, son of Vibius, was responsible for the reconstruction of Porta di Nola (Ve. 14).

[697]The building named in the Oscan inscription is a *passtata*, which commentators have taken to be the equivalent of Greek *pastadas*. In Greek building inscriptions the term *pastas* (always in plural) refers to colonnades around temples (e.g., IG 2^2.1126.22 from Delphi). For the equivalence with Latin *porticus* (pl.) see Dionysius of Halicarnassus, 4.44.

[698]See Fiorelli 1854: 7 n. 16.

[699]Sogliano 1925.

that this refers to the Nocera Tuff portico, giving a date between 89 and 80 BCE. This is based on the use of Latin and the mention of the *quaestura*, which following Onorato (1951) many consider was an office not included in the constitution of the Roman colony. However, Degrassi (1967) has pointed out that this office is attested on early *programmata* for candidates with a Roman name (these documents were found only after Onorato published his work). Evidently the *quaestura* was initially maintained, though with a reduction in number of posts, so that it gradually lost importance, turning from *honos* into *munus*.[700] This suggests that the portico inscription, which in all likelihood recorded the conclusion of the works, dates to the early years of the colony (ca. 80 BCE), providing a *terminus ante quem* for the sequence of urban development of the Forum area.

6.3.6 The Chronology of the Basilica and Its Implications

The stratigraphic sondages excavated by Maiuri in the *Chalcidicum* and the architectural analysis of the standing remains by Ohr (1991) have demonstrated that the Basilica (**fig. 70, 5; fig. 82, 3**) was built in a single operation. Both the Nocera Tuff ashlar masonry of the main façade toward the Forum and the compact lava *opus incertum* of side walls and rear façades belong to the original phase of the Basilica, because these are all joined in the free-standing part as well as in foundation (**fig. 83**).[701] *Opus incertum* is used also for the foundations of the pillars of the main façade and of the interior colonnade (famous for having the column shafts built with specially shaped tiles laid with mortar), but these are not continuous, resembling the system adopted for the pillared structure in the sanctuary of Apollo. Unfaced concrete made with

[700] Degrassi 1967: 46-49. Similar cases are known for the transition from Latin colony to *municipium* and then Roman colony at Firmum Picenum, Aquileia, Beneventum and perhaps Venosa and Paestum. Cf. Castrén 1975: 88.

[701] Maiuri 1973: 191-223 (especially 207-209); Ohr 1991: 26-30. Cf. Lugli (1957: 475-476), who assigns the *chalcidicum* to a later phase because of the rounded shape of the facing blocks. See also Richardson 1988: 88-99. Ohr 1991 suggests that the different shape of the *tesserae* in this part of the building is due to weathering.

caementa of the same material is used for the barrel vault in the basement under the so-called tribunal, on the northern short side (this spans about 5 m).[702]

The type of *opus incertum* employed in this building shows advanced features, such as a clear separation between facing and core, and is also remarkable for the uniform size of the facing blocks (these are all fist-sized); volcanic sand from coastal deposits was used for the mortar.[703] Small oblong blocks of Nocera Tuff were used for the corners, but occasionally Sarno blocks are found. It is also worth noting that *opus Africanum* was still used in places, such as in the slightly projecting stretches on the south long sides.[704] Based on these features, and on the relationship between the *chalcidicum* of the Basilica and the new alignment of the square, Maiuri suggested a date in the same period of the Temple of Iuppiter or shortly after, between 130 and 120 BCE.[705] On stylistic grounds, Ohr (1991) preferred to assign a broader date-range of 150-100 BCE.[706] Richardson (1988) inclined toward a date slightly later than 120 BCE, but before the end of the century (indeed he assigned the *chalcidicum* to a later phase, contemporary with the portico of Popidius).[707]

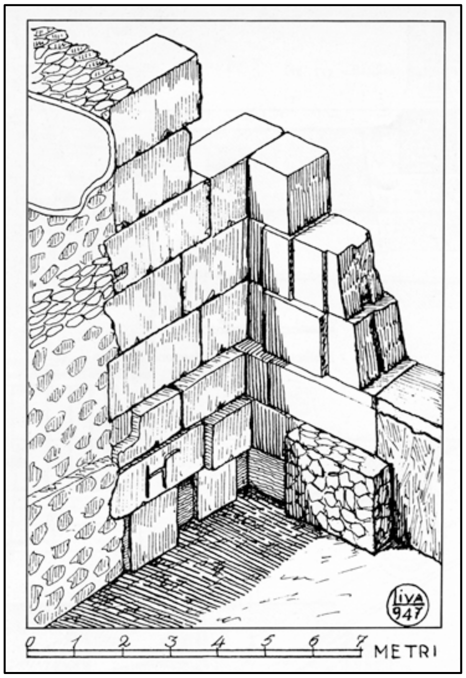

Figure 83. Pompeii, Basilica: elevation drawing of the north-east corner of the *chalcidicum* (after Maiuri 1973).

A more precise *terminus post quem* for the construction of the Basilica can be derived from a series of Rhodian amphora stamps retrieved by Maiuri from a construction fill that

[702]On the function of the basement see Richardson 1988: 97.
[703]Ohr 1991: 35-36.
[704]Cf. Ohr 1991: 27, suggesting that this technique was chosen for walls that were deemed weaker, because of lesser thickness.
[705]Maiuri 1973: 223.
[706]Ohr 1991: 78.
[707]Richardson 1988: 99.

covered razed structures and floors of the buildings occupying the area in the previous period. In turn, this fill was sealed by a thin layer of mortar found ubiquitously in the trenches excavated by Maiuri below the *signinum*-floors of the Basilica. This layer clearly represents the surface where mortar was mixed during construction.[708] This class of evidence is one of the most diagnostic for the second c. BCE, as the stamps generally include the name of the annual magistrate who was in office when the amphora was produced.[709] The fifteen amphora stamps published by Maiuri cover a broad chronological range.[710] Given the nature of the deposit, this comes as no surprise. The earliest one dates to the first period of the Rhodian production, which started in the third c. BCE.[711] The latest stamps belong to the phase Vc of the canonical periodization, and include one dated to 115 BCE and one to 112 BCE.[712] The Basilica therefore cannot be earlier than the last decade of the second c. BCE, but considering that most of the materials dumped to raise the floor levels came from the destruction of previous buildings, the stamped amphora handles must be considered residual, so that a date earlier than 100 BCE for the Basilica is extremely unlikely.[713] A *terminus ante quem* is given by a graffito left on the First Style decoration of the interior by a visitor (CIL 4.1842), who was in Pompeii on October 3, 78 BCE.

Thus, the Basilica and other main components of the Forum ensemble (including the colonnade of the Sanctuary of Apollo and the first phase of the Temple of Iuppiter) can be assigned a date between 100 and 80 BCE. There is not enough evidence to tell whether the impressive monumentalization of the urban core started before 89 BCE, though the creation of a new Forum and Basilica complex would make sense with the new status of Pompeii after the

[708] Maiuri 1973: 222-223.
[709] See especially Finkielsztejn 2001; in general also Lund 2011.
[710] Maiuri 1973: 220, nn. 1-15.
[711] E.g., Maiuri 1973: 220 n. 15.
[712] Maiuri 1973: 220 n. 4 (Arkhibios) and n.1(Aristanax II, based on the indication of the month), respectively. For the dating of these eponyms see Finkielsztejn 2001: 195, Table 21.
[713] Dobbins (2007: 172) reports pottery of the first c. BCE found in new excavations by the Pompeii Forum Project.

Social Wars (89-80 BCE).[714] In any case, the stamps in Oscan found on the roof tiles of the original Basilica and the inscription of Oppius Campanus would not be inconsistent with a chronology in the 80s BCE.[715] However, completion of the portico of Popidius does not necessarily predate 78 BCE. In fact, the continuation of works after the arrival of the colonists may account for the change in the non-canonical features of the Temple of Iuppiter (which was redecorated along Roman styles, abandoning the traditional Pompeian orders),[716]and of the Temple of Venus (where an atypical axial platform, located on a lower step of the courtyard in front of the temple, was abolished to create a uniform terrace).[717]

6.3.7 Summary of the Evidence

Very few public monuments in Pompeii can be confidently assigned to the pre-Sullan phase (Stabian Baths, Temple of Apollo, Theater and first phase of the Quadriporticus, Foro Triangolare), confirming the view that for most of the second c. BCE the ruling class invested large resources on private projects. Construction in *opus Africanum* within the public sector is virtually absent, the only exception being that of the old *tabernae* in the Forum (which however are late third c. BCE in date). The Nocera Tuff and Sarno limestone fortifications, built at the beginning of the "Tufo period", were followed by a long pause in public construction.

The available evidence suggests that lower dates should be assigned to the buildings in which concrete architecture first appears (Stabian Baths and Theater), probably not earlier than

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[714]Cf. Kockel and Flecker 2008, dating the south section of the portico to 100 BCE.

[715]On the tiles, which were found in the fill of the well located on the south side of the *Chalcidicum,* Maiuri 1973: 196-199. The stamps (Ve. 43) name a Ni(umsis) Pupie(ns), who is not a member of the *gens Popidia*, as first assumed by Maiuri, erroneously followed by Castrén (1975: 207-209) and Dobbins (2007: 172).

[716]Ohr (1991: 78, footnote 389) suggests that the dump of Pompeian Ionic and Corinthian capitals found in 1970 at the base of the fortification walls east of the Temple of Venus belonged to the first phase of the Capitolium.

[717]See Curti 2008: 55-56. For other modifications to the cella of the temple in the Sullan phase see Coletti and Sterpa 2008: 133-134 and 136. The monumentalization of the Temple of Venus has been connected by Curti (2003) with the creation of port infrastructures (*navalia*) at the foot of the *Insula Occidentalis*, just outside Porta Marina. Coarelli (2010b: 439-441) dates the first phase of these *opus incertum* structures to 100 BCE.

130 BCE (cf. **Table 10**). Thus, when public construction resumed, this involved also communal monuments of old tradition (the Temple of Apollo and the area of the Doric Temple), which most likely represented the foci of civic activity (the Theater, connected to the Foro Triangolare, could be used for public assemblies). In terms of construction techniques, these monuments show many points of contact with contemporary house construction, most notably in the system employed for the foundations (featuring predominantly ashlars), and in the selection and gradation of different building materials (Sarno limestone, compact lava and lightweight scoria, as in the Stabian baths). This indicates that builders in both public and private contexts shared common building traditions, or even that contracts for public projects were let out to groups of builders who also worked in the private sector. Although scientific data are not available, it is likely that simple lime mortar was never used for masonry, and that lime and pozzolana appeared in the mix from the earliest appearance of lime mortar (e.g., Maiuri's "calcestruzzo" in the podium of the Temple of Apollo).

The building program begun in the early first c. BCE documents a dramatic increase in the scale of construction and some signs of departure from the previous tradition, such as a tendency toward a separation between facing and core in *opus incertum* walls, the preference for compact lava as opposed to Sarno limestone (which however is still used for quoins), the introduction of concrete foundations (precinct walls of the Temple of Apollo; in the Basilica and in the Temple of Venus the foundations are built up with *opus incertum* starting from the level at which the previous structures were razed) alongside the traditional system (which is still used for stylobates, e.g., in the Forum portico). The coexistence of old and new techniques in the same building (e.g., the Basilica) may also indicate that crews with different backgrounds (and, thus, of different origins) were at work within the same construction sites, which seems likely given the impressive number of monuments under construction in this relatively short period of time. In terms of technological style, it is therefore possible that the transition to compact lava was partly influenced by builders coming from areas where limestone rubble was never used in any significant extent. However, the exhaustion of Sarno limestone quarries closer to town may also have been an important factor in this development.

A 100 BCE date has often been suggested for the restoration and overall improvement of the fortifications, in stretches of the curtain, gates and towers that feature the same type of *opus incertum* masonry as that found in some parts of the Forum ensemble.[718] Similarities in the style of wall-facings in these *opus incertum* monuments have also been contrasted with the so-called *opus quasi reticulatum* of buildings of the early years of the Roman colony, such as the Odeion and the Amphitheater. If supporters of the high chronology are right, it is as if the Pompeian community was adopting Roman cultural models while bracing itself for what must have appeared as an inevitable military clash. However, an inscription (CIL 10.937) found reused in the Casa di Marte e Venere (VII.1.8) attests a reconstruction of the fortification walls (*murus*) and of a tower in the post-80 BCE period, since this was undertaken by the duovirs Cuspius and M. Loreius.[719] But so-called *opus quasi reticulatum* facings are nowhere to be found in the circuit.[720] At Pompeii as in Rome, chronological distinctions based solely on the aspect of masonry are clearly flawed.

[718]E.g., Lugli 1957: 469. See in general Chiaramonte Treré 2007.
[719]For this interpretation see Zevi 1996: 129.
[720]See Richardson 1988: 50, assigning the *opus incertum* phase of the fortification walls to the years of the Roman colony. Extensive reconstructions of city-walls (known from inscriptions) were frequent in central and southern Italy in the middle of the first c. BCE. See Cornell 1995 (with further reference).

Monument	*Stratigraphic Dating*	*Other Dating Evidence*	*Types of Rubble*	*Vaulting System*
Stabian Baths (North Wing)	n/a	150-100 BCE (fills in city-block)	SL	Voussoirs (3.80 m)
Theater	n/a	Around 130 BCE? (cf. Foro Triangolare)	SL; CL	n/a
Foro Triangolare	Around 130 BCE	n/a	CL	n/a
Temple of Apollo	n/a	150-100 BCE (fill of ditch; creation of portico)	SL; CL	Voussoirs (1.20 m)
Basilica	After 112 BCE; before 78 BCE	After 90-89 BCE (Popidius inscription)	CL	Concrete (5.00 m)
Temple of Iuppiter	n/a	After 90-89 BCE (Popidius inscription)	SL; CL	Concrete (4.00 m)

Table 10. Datable early *opus incertum* monuments in Pompeii (SL=Sarno limestone; CL=compact lava).

6.4 The Early Concrete Architecture of Pompeii in its Regional Context

6.4.1 Concrete Construction and Domestic Architecture at Herculaneum

Herculaneum is the only major site in the region whose sample of domestic architecture is on a par with that of Pompeii, at least in quantitative terms. Isolated buildings have been revealed by rescue excavations at Capua, but these offer fragmentary evidence and cannot be dated archaeologically.[721] At Puteoli, a site that has been the object of systematic research on a much larger scale, the best documented habitation contexts date to the late second and/or early first c. BCE, while the early sequence of occupation at the site remains problematic.[722] In qualitative terms, however, the limited extent of excavation below the 79 CE levels means that at Herculaneum house construction of the Samnite period cannot be studied at a high level of resolution, even if the structures are generally better preserved than in Pompeii. Furthermore, only a few contexts have been dated to the second c. BCE (e.g., the Casa Sannitica, V.1), though solely on the basis of building technique (*opus quadratum*) and decorations (First Style

[721]De Franciscis 1956a; De Franciscis 1957; De Franciscis 1973; on the topography see Sampaolo 1999.
[722]For a general overview see Gialanella 2003.

paintings). In the core areas of other atrium houses, ashlar masonry and First Style appear associated with local variants of *opus incertum*, e.g. in tha Casa della Fullonica (IV. 5-7) and the Casa del Sacello di Legno (V.31), but their chronology is uncertain.[723]

The development of *opus incertum* in Herculaneum was certainly influenced by the local geology, which presents some differences with that of Pompeii.[724] The site is located on the southwest slopes of Vesuvius, but far away from any sources of limestone. Concrete at Herculaneum includes as aggregate only rare limestone pebbles, which could be found in coastal sands and gravels. The local sequence of volcanic deposits resembles that of Pompeii as to the varieties of lava, but in addition features a welded reddish-brown tuff (the "Tufo rossiccio"), which was better suited for ashlar construction than the Pompeian Pappamonte. *Opus Africanum* seems entirely absent, but a system of alternating tuff upright and stretchers is used for quoining in connection with concrete construction. Like in Pompeii, Nocera Tuff was imported and used primarily for architectural decoration.

A fine-grained typology of the concrete techniques attested at the site has been recently established by Ganschow (1989), who expanded on and modified the previous classification by Maiuri (1958). Based on the nature of the building materials and on the aspect of wall-facings (i.e., shape and size of facing blocks; thickness and regularity of joints; general composition of the mortar), four main variants of *opus incertum* may be said to predate the introduction of *opus reticulatum* (**Table 11)**.[725] Type A is a mortar-and-rubble masonry composed of compact and scoriaceous lavas, featuring irregular blocks of up to 0.30 m each. The larger *caementa* form the facings, but their surface is not finished, so that a thick plaster rendering was added to regularize

[723]Ganschow 1989: 103; 108-109, Table 6.
[724]Ganschow 1989: 23-27.
[725]Ganschow 1989: 37-41. This study does not provide specific information on the composition and development of lime-based mortars. Gainschow (1989: 30) maintains that, in the context of Herculaneum's construction history, extensive restorations and mortar re-pointing would make mortar analysis misleading.

the wall. Frequent pebbles are included in the lime mortar mix, indicating a low degree of selection of the sands used for the mortar. By contrast, Type B is characterized by slightly smaller *caementa* (0.10 to 0.25 m) with a flat face on the surface, but still forming irregular joints. Three sub-types can be identified based on the building materials: a) scoriaceous lava and compact lava rubble; b) scoriaceous lava and Tufo Rossiccio in equal proportions (the facing blocks are usually narrow and elongated); c) large facing blocks of Tufo Rossiccio only and scoria in the cores.

Type A, and variant a) of Type B can be found in association with ashlar masonry, and the vertical stratigraphy of standing remains indicates that these walls never abut on structures made with *opus reticulatum*, suggesting that the two techniques were never used together in the earliest phase of concrete construction at the site.[726] Type A walls are significantly less well-attested than structures built with the first variant of Type B, but it is not known whether this pattern of use is determined by function. Walls built with the other two variants of Type B *opus incertum* may be found either joining to or abutting on structures of the former types. Significantly, variants b) and c) appear often employed on the same walls: *opus incertum* with predominantly Tufo Rossiccio *caementa* is normally used for façades, but also for foundations and lower portions of interior walls whose upper part features predominantly scoria rubble (e.g., in the Casa del Mobilio Carbonizzato). This system is clearly characterized by a grading of building materials mirroring the construction method attested in the earliest concrete houses of Pompeii, where Tufo Rossiccio is substituted with compact lava, and limestone is used instead of scoria.

Fixed points for the dating of these techniques are virtually absent. As already noted, the Casa del Mobilio Carbonizzato features some First Style paintings, but in the absence of other

[726] This is inferred from a table of associations based on stratigraphic relationships between structures made with these techniques in Ganschow 1989: 110-119. However, the precise criteria for the identification of walls as "contemporary" are never specified.

external evidence its alleged second c. BCE date remains problematic (as we have seen, the use of mixed materials at Pompeii appears as early as 150 BCE). Another group of houses in which a combination of *opus quadratum* and Type A and Type B *opus incertum* is attested is in the *Insula Orientalis* I (e.g., Casa del Fregio di Telefo; Casa della Gemma; casa di M. Pilus Primigenius Graianus, respectively I.2-3, 1, and 1a). These houses are the earliest to encroach upon the fortification walls, and parallels have been invoked with the houses of the Southwest quarter of Pompeii. Ganschow (1989) suggests a date in the early first c. BCE, considering that at least some of the ashlar blocks used for the *opus quadratum* walls and for quoining of the *opus incertum* structures in these houses were recycled from the fortifications.[727] If so, all the four types of *opus incertum* were used simultaneously in this phase, although the possibility that this was the result of progressive development in the previous period cannot be ruled out.

Opus incertum continued to be used in the Roman period (Type C, featuring partly Yellow Neapolitan Tuff rubble and partly Tufo Rossiccio) alongside *opus reticulatum,* and a common idea is that this progressively included greater amounts of Yellow Neapolitan Tuff. The introduction of Yellow Neapolitan Tuff from the Campi Flegrei has been considered a sign of Roman influence, on the assumption that Roman inhabitants of the Gulf of Naples relocating to Herculaneum after the end of the Social War decided to replace the more intractable local material, which would not have been suitable for producing the surfaces required for the facings, thus also allowing for a faster processing of the facing blocks.[728] If so, the pattern would be different from that observed in Pompeii, where the so-called *opus quasi reticulatum* seen in monuments of the early decades of the Roman colony employed only local stones (e.g., Amphitheater; Odeion; Stabian and Forum Baths).

[727] Ganschow 1989: 98.
[728] Ganschow 1989: 120-122.

Concrete Type	*Aggregate*	*Other Features*	*Distribution*
Type A	CL; SL; featuring irregular blocks of up to 0.30 m each; frequent pebbles	Unfaced; coated with thick rendering	Rare; in association with *opus quadratum* and Type Ba
Type Ba	CL; SL; blocks in the range 0.10-0.25 m, with flat face	Faced; irregular joints; smaller blocks more frequent	In association with *opus quadratum* and Type A
Type Bb	SL; TR; blocks in the range 0.10-0.25 m mostly of narrow and elongated shape	Faced; irregular joints	In association with Type Bc; on upper part of wall
Type Bc	TR; S (core only); blocks in the range 0.10-0.25 m	Faced; larger blocks more frequent	In association with Type Bb; on lower part of wall

Table 11. Concrete types attested in early first c. BCE domestic contexts at Herculaneum (after Ganschow 1989).

6.4.2 The Development of Lime-Based Mortars at Puteoli

The *colonia civium Romanorum* of Puteoli was established in 194 BCE on a previously unoccupied location at the northern end of the bay of Naples, in the context of a broader program of colonization (Liternum, Volturnum, Sipontum, Tempsa, Croton, Vibo Valentia and Thurii) to defend the coasts of Campania, Lucania and Apulia (with a reinforcement in 186 BCE; Livy 32.29.3, 34.45.1-5, 39.45.5-9). The importance of the site as a Roman port city increased significantly after 168 BCE (Polybius, 3.91.3-4). In the subsequent period the whole bay of Puteoli also became the focus of maritime villas.[729] This socio-economic context has led specialists to suggest that the formula for hydraulic mortar originated in this region, whose geology featured deposits of natural pozzolana that Roman experts considered of superior quality (Vitruvius, 5.12.2; Seneca, *Nat. Quast.* 3.20.3; Pliny the Elder, 16.202).[730] While the harbor area does not preserve concrete installations predating the late first c. BCE,[731] systematic excavations on the hilltop site that was occupied by the earliest settlement (the modern Rione Terra) have recently revealed a significant sample of Republican architecture, including *opus incertum* architecture.

[729]D'Arms 1970.
[730]E.g., the discussion in Oleson *et al.* 2004: 200-202.
[731]Gianfrotta 1996: 72.

The settlement was laid out on an orthogonal plan regularizing the steeply sloped promontory with terraces dug into the bedrock (composed of deposits of Yellow Neapolitan Tuff), and creating retaining walls in ashlar masonry (*opus Africanum* occurs, though only in one case); the blocks were most likely quarried in this process.[732] The plan features a central square, which extends on the highest terrace (**fig. 84**). The square is bordered on the northern long side by an east-west *decumanus*, featuring a temple in axial position. Proportions and arrangement of the forum find a precise parallel with the plan of Liternum, also of 194 BCE, confirming that the layout dates to the earliest phase of the settlement. Two other *decumani* are attested, one farther to the north, and another south of the square. These delimit city-blocks of less than one *actus* in width. A system of north-south ramps connects the different terraces, and two major *cardines* are also known. Conforming to this layout is also a rock-cut network of water-related infrastructures, including underground channels for drainage as well as cisterns for water supply.[733]

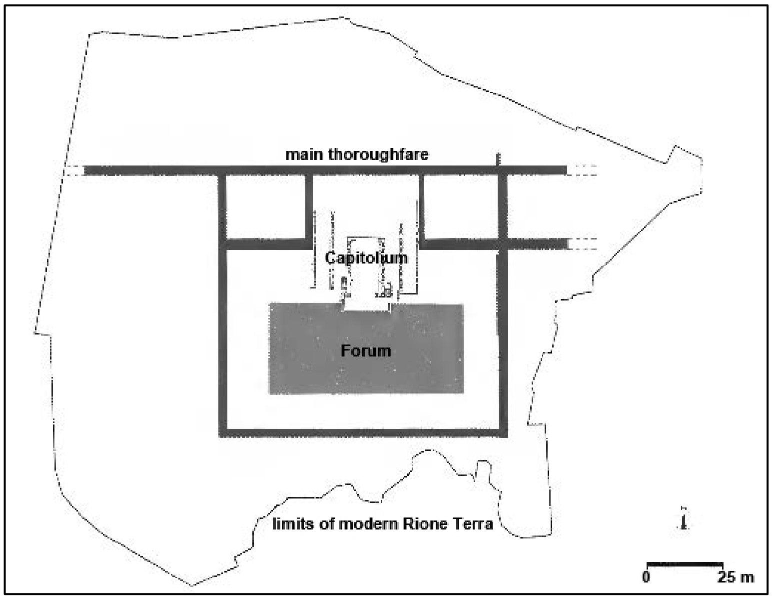

Figure 84. Puteoli: layout of the second c. BCE colony (after Gialanella 2010).

[732]On the topography of Puteoli see now Gialanella 2003; Gialanella 2010. For expansion of the settlement beyond the walls in the first c. BCE see Sommella 1988: 217-219, and figures 65-66.

[733]Gialanella 2010: 317-322.

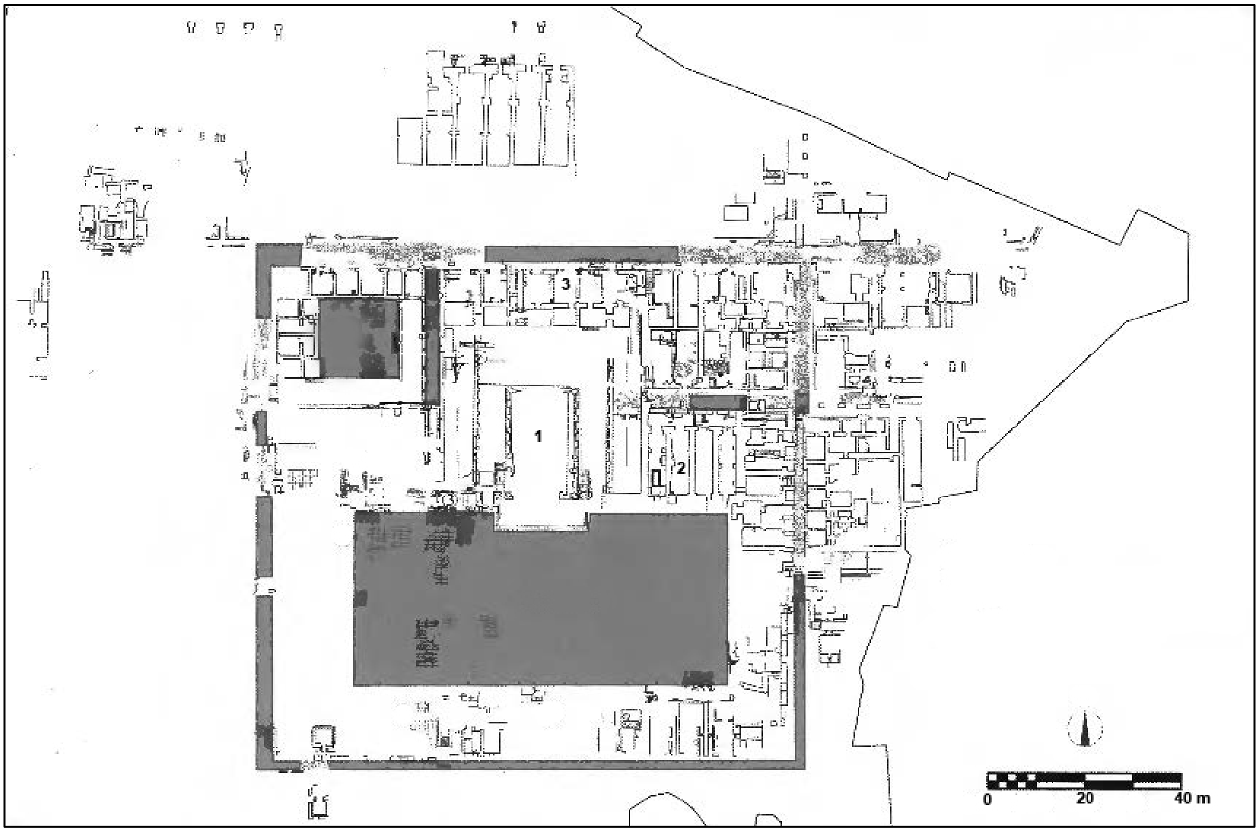

Figure 85. Puteoli, Rione Terra: the area of the Forum in the Augustan period (*1=Capitolium*; *2="Criptoportici"*; *3=Via Duomo tabernae*; after Gialanella 2010).

The temple, which was completely rebuilt in the Augustan period (**fig. 85**), sits on a high podium partly carved in the bedrock and partly built up with ashlar masonry. Dug in the podium is a vaulted corridor paved with a decorated s*igninum*-floor. This represents the only building that can be securely dated to the initial phase of the settlement,[734] with the possible exception of a semi-subterranean room facing onto the Via Duomo *decumanus*.[735] These structures do not employ any kind of mortar, as is also the case for the *opus quadratum* retaining walls that delimit the city-blocks. For the Republican period, occupation within the city-blocks is attested by concrete architecture of two types:[736] *opus incertum* with large facing blocks (up to 0.40 m;

[734]Zevi and Grandi 2004.
[735]Proietti 2006: 519-520.
[736]Paternoster *et al.* 2007b: 25-35.

based on the amount of mortar, the excavators distinguish between *opus incertum* proper and a "psudo-polygonal masonry"; in the latter case, lime mortar was used for pointing rather than bedding, suggesting that this technique should be classified as a type of dry-stone masonry);[737] and so-called *opus quasi reticulatum* with smaller facing blocks. In both types the *caementa* are exclusively made of Yellow Neapolitan Tuff. The structures in so-called *opus quasi reticulatum* generally feature corners in brick or ashlars of Piperno (a local grey welded tuff underlying the Yellow Neapolitan Tuff), and are associated with decorated floors that have been dated on stylistic grounds to the late second and first c. BCE;[738] these walls belong to multi-level buildings featuring concrete vaults. By contrast, the *opus incertum* is used primarily for party-walls (load-bearing structures are normally still in *opus quadratum*), in the context of utilitarian buildings (e.g., in the *tabernae* facing onto the Via Duomo *decumanus*; in the so-called "Criptoportici" complex east of the forum square, possibly a horreum, together with dry-stone masonry). Vaults in these buildings are normally built with Tuff voussoirs, laid radially with some lime-based bedding mortar (these vaults span a maximum of 4.50 m, as attested in the "Criptoportici").

The chronology of the *opus incertum* architecture is uncertain, because of the lack of stratigraphic data. On the basis of wall-facing styles, the excavators date it to the early years of the colony, but this interpretation seems contradicted by the fact that several cases are known in which *opus incertum* buildings destroy the rock-cut water features created with the orthogonal layout.[739] Thus, a date in the second half of the second c. BCE is more probable, given the association of *opus incertum* and voussoir vaulting with commercial buildings, as these in all

[737] Paternoster *et al.* 2007b: 29-30, suggesting that in some cases the mortar left in the joints may represent what remains of a thick plaster rendering.
[738] Proietti 2006: 518; 520-522.
[739] Paternoster *et al.* 2007b: 25.

likelihood reflect the increasing role of Puteoli in Rome's trading network. Furthermore, close similarities in the vaulting system link the technique employed in the earliest concrete architecture of Puteoli and the second construction phase of north wing of the Stabian Baths at Pompeii, which may be dated to the latter part of the second c. BCE. The "Criptoportici" complex also finds a close parallel in the terracing structures on the east slopes of the Palatine in Rome (*supra*, 3.2.5).[740]

A series of lab-tests conducted on a relatively small sample of standing architecture at the site confirm that *opus incertum* and so-called *opus quasi reticulatum* structures are closely related in terms of mortar composition, while a clear improvement in quality can only be observed with respect to structures of the Augustan and later periods.[741] Mortars of the Republican period are characterized by a high aggregate-to-binder ratio, and contain higher proportions of extremely coarse volcanic sand. Because only the finer fraction reacted with hydrated lime, these mortars are characterized by lower pozzolanicity. By contrast, the pozzolana in mortars of the Imperial period is well selected, and is mixed with a higher dose of lime.[742] The trace elements analysis shows a relatively wide distribution, which perhaps indicates variation in the sourcing of the aggregate (it is not entirely clear if this correlates with chronology, due to the low number statistics). According to Paternoster *et al.* (2007a; 2007b), samples of both periods are in any case well separated from those collected from reference Vesuvian sites; this is taken as evidence that only local materials were used.[743]

In summary, the evidence for early use of concrete at Puteoli is unremarkable. As in

[740]As noted by Anselmino 2006: 234-235.
[741]Paternoster *et al*. 2007a; Paternoster *et al.* 2007b: 63-77.
[742]Paternoster *et al.* 2007b: 76, Table IV.
[743]Paternoster e*t al.* (2007a; 2007b) used for trace elements Sr, Rb, Zr, but the first two elements are not as stable as the latter. This methodology is problematic for provenance study. Lancaster *et al.* (2011) suggest the use of Nb, Zr, and Y, which are more stable.

Pompeii, *opus incertum* seems to emerge in association with *opus quadratum*, but the former technique is mostly employed for walls of lesser structural function. The vaulting system associated with these structures (oblong voussoirs laid radially with some bedding mortar) finds comparanda with contexts of the second half of the second c. BCE (Rome, *substructiones* on the eastern slope of the Palatine; Pompeii, northern wing of the Stabian Baths). This pattern of use has been documented almost exclusively in commercial buildings. It is possible that the use of larger *caementa* represented an expedient to save on labor costs in public construction, but too little information is available on domestic contexts to make a comparison. The presence of an *opus Africanum* terracing wall in one of the city-blocks facing on the Via Duomo *decumanus* demonstrate that different techniques were used simultaneously (incidentally this confirms that, as at Pompeii, *opus Africanum* was used in Puteoli well into the second c. BCE). Intensive occupation of the city-blocks with multi-story concrete vaulted buildings seems to take off in the late second or early first c. BCE.

6.4.3 Early Vaulted Construction in the Campi Flegrei: The Terme Centrali at Cumae

One of the purported earliest examples of concrete construction in central Italy is the Terme Centrali of Cumae (**fig. 86**).[744] The high chronology commonly assigned by specialists to this building has important implications for our discussion, because it could demonstrate that the development of the vaulting systems observed at Puteoli and Pompeii was based on local, Campanian precedents.

[744]E.g., Johannowsky 1976: 270 (late third or early second c. BCE).

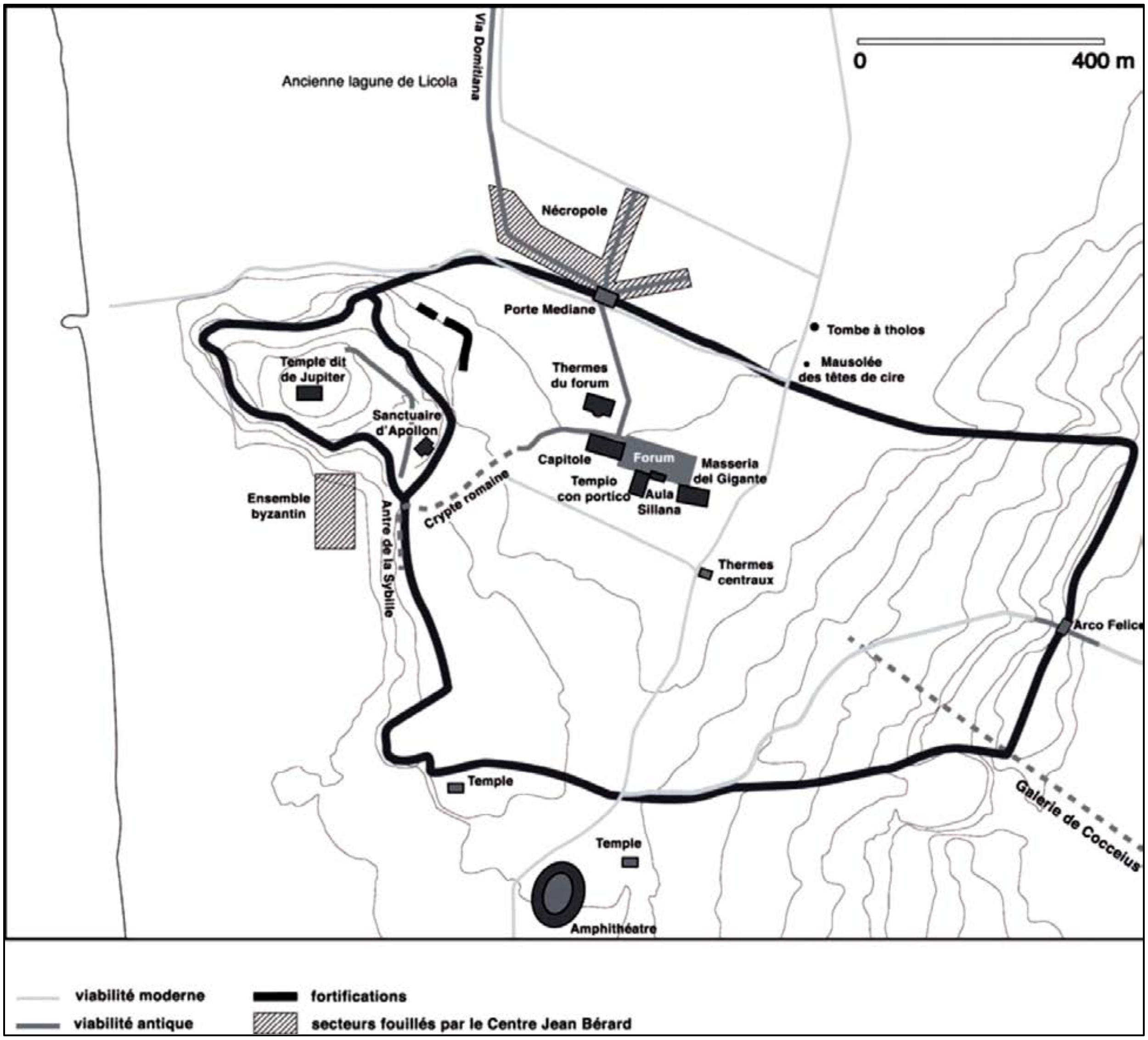

Figure 86. Schematic map of Cumae (after Munzi and Brun 2011).

The plan of the monument is not known in its entirety. To the west, the original façade has been truncated by a modern road; other structures connected to the building certainly continue to the north and to the east, but have never been exposed. The visible part is composed of seven rooms and an annex (**fig. 87**).[745] The main suite of the baths is arranged around an

[745] A recent survey of the monument is published in Volpicella 2006-07.

oblong rectangular room, which is preserved for a length of 14 m (its western limit is not original), measuring about 7 m in width (Room A). The walls of this room feature a series of small niches, suggesting that this was an *apodyterium*. On the northern long side of Room A, and communicating with it, are two smaller rooms (Rooms B and D), separated by a vestibule (Room C; this room was later transformed into a water reservoir, so that other doors had to be opened through the north wall of Room A). On the eastern short side is Rooms E, connected to Room D and originally occupied by a basin; the original layout of Room F is masked by later modifications.

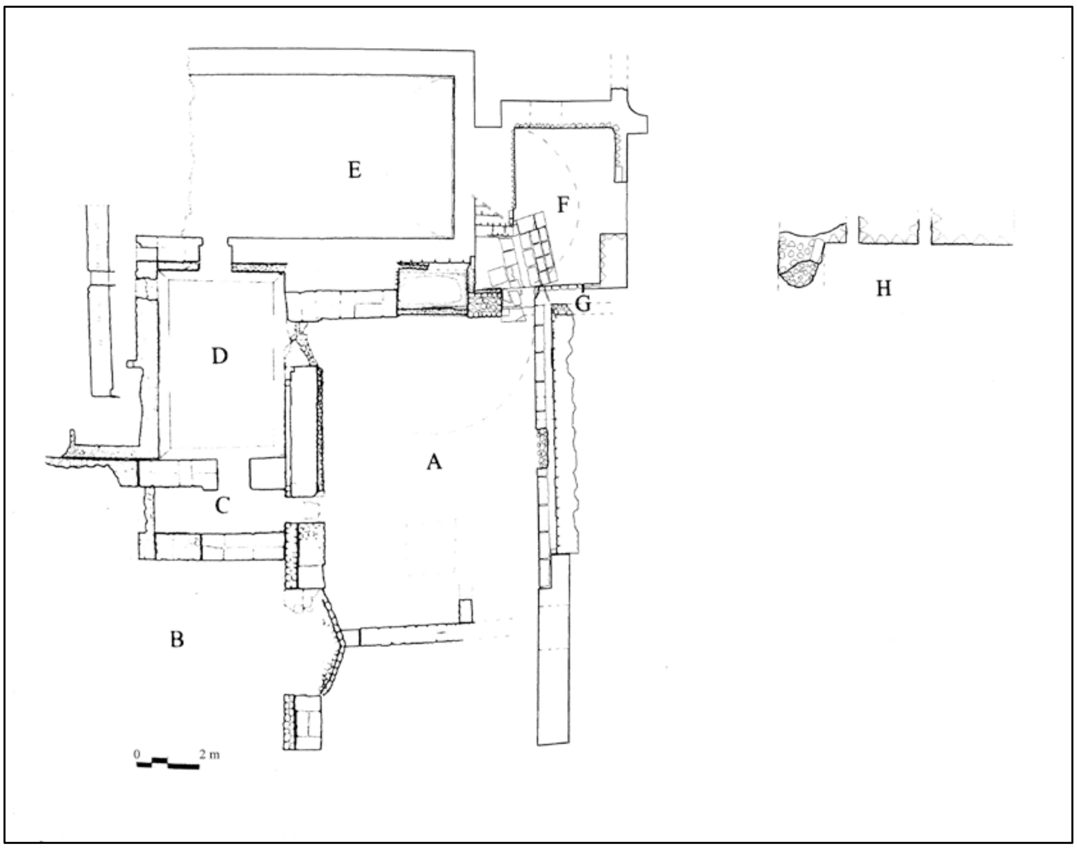

Figure 87. Cumae, Terme Centrali: state plan (after Volpicella 2006-07).

All the rooms are built with ashlars of Yellow Neapolitan Tuff on top of concrete foundations, and are covered with barrel vaults made of small blocks laid radially with small amounts of lime-based mortar. The occupation levels of the first phase of the baths are not preserved, because the floor levels inside the complex were subsequently lowered, removing the pavements and digging down into the bedrock for about 0.75 m.[746] Part of the concrete foundations was exposed as a result of this process. In addition, the niches of the *apodyterium* came to stand at a height of 2 m from the new pavement, and for this reason they were walled with mortared rubble.

Given the lack of stratigraphy, the chronology of the monument remains difficult to define. The single piece of evidence on which the high dating is based is a fragmentary Oscan inscription on a marble *labrum* found by Johannowsky in the fill of Room A (1962 excavations), recording its purchase by the *meddix* Ma. Heius.[747] This has been taken to provide a *terminus ante quem* of 180 BCE for the construction of the monument, on account of the testimony of Livy (40.42.13), who records for that year a Cumaean petition to the Senate to use Latin instead of Oscan for official business.[748] In fact at Cumae Oscan was still used epigraphically in the later second and first c. BCE, as attested by epitaphs, religious dedications and curse tablets (though none of these are state documents).[749] In any case, later excavations at the site (1975) uncovered the original stand of the marble basin. This was found lying outside the main building (more precisely, 12.5 m south of the south-east corner of room A), on top of a marble pavement, which was in turn supported by subterranean structures in *opus* reticulatum. These structures have been dated to the late first c. BCE or early first c. CE, primarily on the basis of facing styles.[750] The conclusion seems to be that, if one accepts the early chronology of the inscription, the inscribed basin was not in its original context. Thus, its relevance for the dating of the first phase of the

[746]Cf. Volpicella (2006-07: 204), suggesting that the lowering of the floor levels was obtained by removing an alleged system of *suspensurae* that heated Room A in the first phase.
[747]On the inscription see Volpicella 2006-07: 213-214.
[748]Literally, Livy's text refers to spoken language, since it specifically mentions the *praecones*; D'Arms (1970: 17) connects the request by the Cumaeans with the increased presence of Romans in the area.
[749]See Lomas 1993: 172-173.
[750]Volpicella 2006-07: 214 (location of the stand); 208-210 and 212 (modifications in *opus reticulatum*).

baths should be considered dubious.

Recent extensive excavations in the monumental core of Cumae revealed that the spread of concrete construction techniques was a relatively late phenomenon there. Most of the known concrete architecture features wall-facings in the so-called *opus quasi reticulatum.* This is documented particularly well in the area of the Forum, which was the object of a generalized reconstruction that modified pre-existing ashlar buildings. This phase can be assigned to the middle of the first c. BCE.[751] In the same period, concrete monuments began to occupy the north necropolis.[752] The amphitheater, which features so-called *opus quasi reticulatum* walls and concrete vaults, may date to this period, but a chronology in the late second or early first c. BCE has been also proposed.[753]

On the other hand, construction in *opus incertum* is very rare. Coarse lime-based mortared rubble is employed for limited repairs of the ashlar fortification circuit, but these have been dated stratigraphically to the late first c. BCE.[754] The only public monument featuring a clear *opus incertum* phase is the Stadium, a massive ashlar stepped structure built on top of an earthen embankment abutting on a sector of the northern fortifications.[755] This concrete technique was used to raise a platform on top of the cavea, as well as in other minor modifications of the original layout of the Stadium. The platform consists of two superimposed podia, each made of an *opus incertum* box faced with tuff blocks. A block with an Oscan inscription recording the dedication of a statue by a local magistrate was found in secondary deposition on the lower podium. Ceramic materials from the fills suggest a date in the second

[751] Gasparri 2009; Gasparri 2010: 585-595.
[752] For a synthesis see Brun and Munzi 2011: 155-162.
[753] Caputo 1993.
[754] This technique is still attested at Cuma in the late first c. BCE (phase IVa of the fortifications: D'Agostino et al. 2005: 14, 61-65 and 136-141).
[755] Giglio 2010: 621-626.

half of the second and early first c. BCE; a date in the final decades of the second c. BCE is consistent with the style of the podia moldings.

In sum, there is no solid evidence to date the Terme Centrali at Cumae to the early part of the second c. BCE. In terms of construction technique, the vaults of Rooms A and E have a span that compares to that of the largest rooms in the east wing of the Stabian Baths (which however are made of concrete). Thus, it would seem as though the example of the Terme Centrali represented the high point of experimentation with this vaulting technique rather than an early attestation. Furthermore, the use of concrete foundations in association with *opus quadratum* elevations is never attested at Puteoli, while at Pompeii it can only be found in monuments of the post-90 BCE phase (but cf. the houses on the northern slopes of the Palatine; *supra*, 2.3.1). In light of the pattern documented by other public concrete monuments at Cumae, none of which predates the final decades of the second c. BCE, a date in the second half of the century seems more probable.

6.4.4 Public Construction in the Late Second c. BCE: The Epigraphic Evidence from Capua

Textual evidence from Capua confirms that the major cities of Campania witnessed a burst in construction activities during the late second c. BCE, with a considerable amount of wealth from both public funds and private generosity being channeled towards public building projects. An important corpus of twenty-eight inscriptions, known as the records of the Campanian *magistri*, details the activities of annual boards of local officers who were related to various local shrines.[756] These documents provide a vivid picture of the social context of construction in a major town of Campania in the late second and early first c. BCE, giving us an idea of how the administration of public building may have functioned in Pompeii in the last

[756] Frederiksen 1959: 126-130. See now Sacchi 2012.

decades of the Samnite period.

Almost all of the Capuan inscriptions can be dated in the period between the years 112 and 71 BCE, with the exception of a few whose chronology cannot be specified. In the majority of the cases, the texts explicitly record the construction of buildings of various function; these inscriptions were clearly intended to be placed on the monuments to which they referred (as indicated by the use of expressions such as *hoc opus*), or in any case to stand in their proximity. For this reason, it is probable that those inscriptions in which the actual nature of the work undertaken is not preserved also relate to some sort of building activities. Several examples describe the construction activities in generic terms: unspecified walls (*muri*), parapets (*plutei*), foundations (*pilae*), although in some cases measurements are also provided.

Five of the texts are more specific, as they concern the erection of a theater, the *t(h)eatrum*. These inform us on the sequence of the works, and indirectly on their length.[757] This building project was started in 108 BCE, when the *magistri* of Iuppiter let the contract for the earthen embankment supporting the cavea. It continued in 105 BCE under the supervision of the *magistri* of Castor and Pollux and of Mercurius, with the construction of vaulted substructures (*fornices*), presumably for an expansion of the seating area (*gradus*). Other blocks of seats (*cunei*) were added in three separate installments before 94 BCE, when the theater is mentioned in another inscription as already functioning.[758] Other works in the urban core followed at an undiminished pace in the early decades of the first c. BCE: pavements and weights in 98 BCE; gardens and a portico of uncertain date; a second portico in 94 BCE; a monumental fountain and the purchase of a slave in 84 BCE.

[757] Frederiksen 1959: n. 6, n. 10 and n. 14-16.
[758] Frederiksen 1959: n. 17.

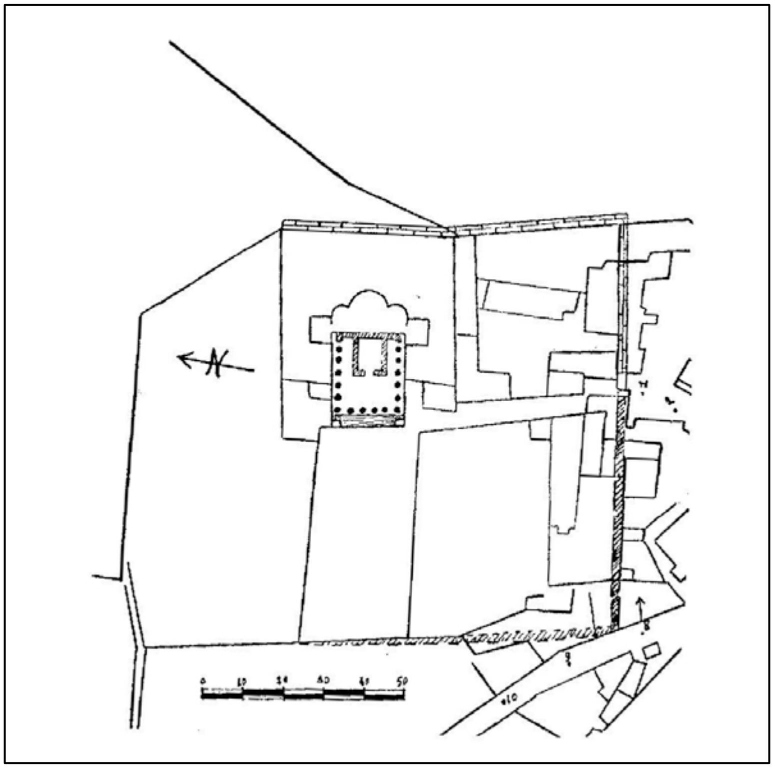

Figure 88. Capua, Sanctuary of Diana Tifatina: schematic map showing temple and *temenos* wall (after De Franciscis 1956b).

Outside the urban area, considerable extensions were made to the sanctuary of Diana Tifatina (**fig. 88**). In 108 BCE the temple was completely rebuilt, with a new decorated floor (which features a mosaic inscription recording the event) and new columns.[759] Recent excavations in the cella revealed that the ashlar podium of the original temple had at some stage been extended on its eastern (back) side, by means of retaining walls in *opus incertum*.[760] Although no direct stratigraphic relationship has been as yet documented between the floor and the concrete walls, it is likely that both features belong to the same construction phase. In 99 BCE other *magistri* were involved in the reconstruction of the western terracing wall, where the monumental access was probably located (the inscription mentions the building of a *murum ab gradu ad chalcidicum*, of the *chalcidicum* itself, and of a *porticus*).[761] In addition, building activities are recorded for 108 BCE

[759]Pobjoy 1997: 85-88. In previous studies the inscription on the pavement of the cella was dated to 74 BCE (Frederiksen 1959: n. 19).

[760]Melillo Faenza 1993; Melillo Faenza 2012.

[761]The terracing wall of the sanctuary on this side is in *opus reticulatum*. Incorporated in it was another inscription (CIL 12.635 = ILS 22 = ILLRP 332) recording the benefaction of Ser. Fulvius Flaccus (cos. 135 BCE), who let the contract to build a *murus* using funds *de manubeis*. This inscription must have been reinserted in the wall when this was rebuilt. Johannowsky (1989:67) dates the visible remains of the western terracing walls to the 135 BCE phase, but he describes them as a kind of *opus incertum*. He also assigns to this phase some unpublished concrete structures on the lower terrace of the sanctuary, which apparently belong to a bath building. On the east side, the boundary wall is in *opus reticulatum* with bands of brickwork, but it sits on top of an ashlar wall with a foundation made of sleepers: De Franciscis 1956b: 338, footnote 8.

in another important extra-urban sanctuary, that of Fondo Patturelli.[762] The earliest amphitheater has been assigned a generic date in the late second or early first c. BCE, but no epigraphic evidence for its construction survives.[763] This is also the case for the fortifications, which show substantial repairs in *opus incertum* in the western stretch.[764]

To pay for these construction projects the *magistri* heavily exploited the treasuries of the sanctuaries they oversaw, but some inscriptions make clear that they could dispose also of secular money (for instance, the fountain erected in 84 BCE was partly paid from the treasury of Iuppiter, partly from funds of the *magistri* themselves). What Frederiksen (1959) has admirably pointed out in this respect is that, despite a certain measure of direct control by Rome and the absence of a formal municipal constitution (indeed the community was organized as a *pagus*),[765] the elaborate monumentalization schemes undertaken by the *magistri* demonstrate that local affairs were characterized by a striking level of emancipation.

Monument	***Building Techniques***	***Stratigraphic Dating***	***Other Dating Evidence***	***Building Materials***	***Vaulting System***
Puteoli, "Criptoportici"	OQ; OI	n/a	Augustan restorations	YNT	Voussoirs
Cumae, Terme Centrali (concrete foundations)	OQ; UC	n/a	n/a	YNT ashlars	Voussoirs
Cumae, Stadium	OI	150-100 BCE	Late second c. BCE (podium moldings)	YNT	n/a
Capua, Diana Tifatina	OI	n/a	108 BCE (cella floor)	?	n/a

Table 12. Public concrete monuments of the Late Republican period in Campania (OQ=opus quadratum; OI=opus incertum; YNT=Yellow Neapolitan Tuff).

[762] Frederiksen 1959: n. 4.

[763] Johannowsky 1989: 67 (speculating that this could be the *teatrum* mentioned in the inscriptions of the *magistri*. For recent excavations in the area of this amphitheater see also Sampaolo 2010 (part., 79-80), proposing a date in the Gracchan period (though this is not corroborated by ceramic finds).

[764] Sampaolo 2010: 73-78, suggesting a date in the period between 91 and 83 BCE. Large fragments of architectural spolia were used as aggregate in the concrete, including tuff capitals of the same type as those of the Basilica of Pompeii.

[765] As is well known, Capua was forced into political subjection after the rebellion of 211 BCE, resulting in the loss of urban status (Livy, 26.16.7-8); the appositely created *praefecti Capuam Cumas* were sent out annually from Rome to dispense justice at least until 59 BCE.

6.5 Conclusions

In Part II, I critiqued the two basic tenets of the system commonly followed to date concrete architecture in Pompeii. The first is that there was a gradual transition from clay-based to lime-based mortar-and-rubble techniques during the third c. BCE, particularly in the context of *opus Africanum* construction. The second is that, in the context of *opus incertum*, different building materials were used as *caementa* in different periods (local limestone rubble in the early part of the second c. BCE; compact lava rubble in the second half of the second c. BCE).

As we have seen, the representative sample of domestic architecture from Pompeii suggests that the irregular forms of *opus Africanum* (in which rubble is used more extensively) can be found in lower-class housing throughout the second c. BCE (Regions I and II). In these buildings, rubble architecture is mostly clay-based. Lime-based *opus incertum* clearly emerged as an independent tradition, at the élite level of society. The earliest examples, dating to the middle of the second c. BCE, have been detected in the aristocratic houses of the Regio VI (most notably the Casa del Fauno and the Casa di Pansa). Concrete construction in these houses featured mixed materials (though these are used selectively, depending on the function of the structure), and was often associated with ashlar masonry (e.g., Nocera Tuff façades).

In the absence of stratigraphic evidence, the late third or early second c. BC date that some have suggested for the first concrete phase of public buildings such as the Stabian Baths, the Theater and the Temple of Apollo, which is mostly based on the large use of Sarno limestone rubble, remains problematic. The judicious use of lava rubble in structurally relevant parts of these monuments can be easily demonstrated (e.g., the podium substructures of the temple of Apollo). When the broader building environment is examined, the dating can be shown to be substantially lower. The construction of the Theater, for example, can be connected with the monumentalization of the Foro Triangolare, which excavation data place around 130 BCE.

As already noted, the date I propose for most of the *opus incertum* construction activities in the so-called *Altstadt* (the Forum project; the Basilica; the Temple of Venus) is largely based on the idea that the reshaping of Pompeii as a Roman town was a step that followed its formal incorporation into the Roman state after the Social War. There is no decisive evidence, though, to exclude the possibility that construction at some sites (e.g., the Basilica) had not begun already in the first decade of the first c. BCE (in fact, there are very few changes in the archaeological assemblage during the 150-80 BCE period, making the distinction).

The sequence documented at Pompeii fits well with that attested at other sites of Campania (but most of the evidence comes from public contexts). At Puteoli, the *opus incertum* structures beneath the modern Rione Terra seem to post-date the foundation of the Roman colony (194 BCE), because they obliterate the water-supply infrastructure connected with the original lay-out. There, the vaulting system associated with the earliest concrete walls still features voussoirs. This technique finds precise comparanda with the north wing of the Stabian Bath, as well as with the Terme Centrali at Cumae, where it is used in association with ashlar masonry walls and concrete foundations. The earliest datable *opus incertum* monument at Cumae (i.e. the Stadium) has been dated stratigraphically to the third quarter of the second c. BCE.

Chapter 7

The Origins of Concrete in Rome and Pompeii

7.1 Toward a Chronology for *Opus Caementicium*

Previous studies on the origins of *opus caementicium* have suggested that lime-based mortar-and-rubble construction techniques became common in central Italy during the third c. BCE, and that were eventually introduced in monumental architecture by the end of that century: the first phase of the Temple of Magna Mater (204-191 BCE) in Rome figures in current manuals of Roman architecture as the earliest datable example of *opus incertum* walling in a public context, alongside the Stabian Baths in Pompeii (Eschebach's Phases II-III, late third or early second c. BCE).[766]

The accepted model is based on an evolutionary framework that, whether in Rome or in Pompeii, orders archaeological remains according to a principle of a linear and progressive development of the technique, particularly in relation to facing styles. The common rule is that any wall built with larger and irregularly shaped facing blocks laid with thicker mortar joints must be earlier than any wall featuring smaller *tesserae* with a finished face, independently of the type of material used (rubble architecture made of a harder or more intractable stone does not

[766]E.g., Adam 1994: 127 (Temple of Magna Mater); 272 (Stabian Baths). Giuliani 2006: 216-217.

normally feature regular facings), its provenance (whether quarried on purpose or recycled) and its structural context (e.g., the walling of a niche as opposed to a terracing wall).

A pivotal element for the high chronology of concrete in Rome was the identification of the Porticus Aemilia with the famous *opus incertum* building of Testaccio. Because ancient texts date the construction of the Porticus Aemilia to the 192-174 BCE period, the facing style of the Testaccio structure was thought to provide a fixed point in the relative sequence of development of *opus incertum*, so that for any unidentified monument formal resemblance in the shape of the facing blocks and regularity of the joints could be taken as a measure of its date. In this perspective, the concrete walling of the podium of the Temple of Magna Mater, which in fact appears quite “unrefined” in comparison with that of the Testaccio building, could be legitimately placed at the beginning of the sequence. Furthermore, the advanced vaulting system of the Testaccio building (with record spans of over 8 m) seemed to support the idea of a third c. BCE chronology for the introduction of concrete, because its complexity would presuppose a long period of trial-and-error.

The identification of the Testaccio building with the Porticus Aemilia is problematic not only in relation to the ancient topography of the area, but also because in design the *opus incertum* monument differs from known types of commercial buildings. Closest comparanda for its plan can be found in archaeologically documented shipsheds (*supra*, 2.3.3). The new identification of this monument with the Navalia makes much more sense, but external evidence for a secure dating of this monument is scanty (the attribution of the Testaccio building to Hermodorus of Salamis – who is said to have built dockyards by Cicero, *De or.* 1.14.62 – remains uncertain, because *navalia* are attested by other sources also in the Campus Martius;[767]

[767]Livy 45.42.12 (167 BCE); 3.26.8. Servius, *Aen.* 11.326. See Coarelli 1996.

but if correct, a significantly lower date would have to be assigned, perhaps not earlier than 110 BCE).

With the Porticus Aemilia out of the picture, the canon established by Lugli and Coarelli appears to be a house of cards. Other alleged early second c. BCE concrete structures appear in that list whose identification with actual monuments recorded in textual sources for that period (e.g., the *substructio super Aequimelium* of Livy, 38.28.3, 188 BCE; *supra*, 2.3.3, Via della Consolazione) relied solely on the analysis of formal attributes, on the assumption that wall-facings which seemed close enough in style to those of the so-called Porticus Aemilia could in fact warrant a high date.

In Pompeii on the other hand, the early dating of concrete architecture was based on the idea that there was a progressive transition from Sarno limestone to compact lava in lime-based rubble architecture. I have pointed out that this theory originated from the old view that fifth to third c. BCE construction at the site was characterized by the exclusive use of limestone (the so-called "Limestone period"). The results of controlled excavations since the 1990s, particularly in the "row-houses" of the Regio I and II, prove that mortared limestone rubble architecture could be as late as 200-150 BCE, and that almost all of it is clay-based, strongly suggesting that lime-based mortar construction employing Sarno limestone emerged as a completely separate tradition.

Other criteria commonly followed to date concrete remains in both Rome and Pompeii are just as problematic, because based on simplistic notions of progress. The association between *opus incertum* wall-facings and First Style wall-paintings, which is often invoked in support of a late third or early second c. BCE date (particularly for the earliest concrete houses) is in most cases inconclusive, because there is ample evidence that this form of decoration continued to be used well into the first c. BCE along with the Second Style. Typologies of decorated *signinum*-floors suffer from the same evolutionary traps that characterize the study of wall-facings, particularly as to the classification of the motifs. There is a general tendency to date decorations made with irregular and sparse *tesserae* earlier than geometric ones, even though recent stratified finds (e.g., at Fregellae) suggest that the two forms could be found side by side since the introduction of these floor types in the late third c. BCE. Furthermore, the period for which most evidence is available (end of the second and early first c. BCE) shows a high degree of variation in the choice of both techniques and motifs. In sum, the arguments linking types of wall-facings, wall-painting styles and floor types are characterized by a great deal of circular reasoning.

Available data on concrete composition seem to represent a useful chronological indicator only at the intra-site level, when combined with stratigraphic analysis. Recent scientific evidence from Rome has confirmed the early findings by Van Deman, showing that a qualitative change in the selection and relative proportion of mortar ingredients can be observed only in the second half of the first c. BCE (this is the period when the highly reactive Pozzolane Rosse began to be employed in Rome, in combination with light-weight aggregate). No clear pattern has as yet been determined for mortars of the Republican period, which at Rome and elsewhere in central Italy (e.g., Puteoli) seem characterized by greater variability in composition and quality (though this may be partly due to small number statistics).

In conclusion, as Lamboglia had already pointed out fifty years ago, the contextual analysis of stratified ceramics still remains the most reliable dating tool. The end of the third c. BCE marks a clear break in the production and circulation of finewares in central Italy. Significant changes in the composition of pottery assemblages can also be deteced after the middle of the second c. BCE. In order to refine the chronology of second c. BCE architecture, stratigraphic data must be taken into account.

7.1.1 The Distribution of Early Concrete Architecture in Rome

Thanks to the results of recent stratigraphic excavations in the urban core, we can now date the earliest contexts documenting concrete construction in Rome around the middle of the second c. BCE. The most important dating evidence comes from the construction fills associated with a group of aristocratic houses built on the north-eastern slopes of the Palatine, which have been investigated in recent years by C. Panella and her team. These buildings, of which only the front parts are known with any detail, feature deep concrete foundations, which support ashlar facades and *opus incertum* party-walls. The concrete is composed of lime mortar including pozzolana (thus, the mortar is of the hydraulic type); the aggregates are mostly of Cappellaccio. The *caementa* were most likely obtained from the demolition of the archaic structures that occupied the same area in the previous period (these showed only minor modifications in the Middle Republican period).

Other fragmentary remains of up to four houses (seemingly all of the atrium type) have been found not far from the context just described, in the city-block excavated by Carandini and his group between the Via Sacra and the so-called Clivo Palatino. These concrete houses obliterated a long-lived archaic compound, which is again documented by a series of Cappellaccio ashlar structures. The remains mostly consist of concrete foundations; elevations are poorly preserved, but include ashlar structures on facades and load-bearing elements. The concrete composition shows several points of contact with the previous case (e.g., the predominant use of Cappellaccio *caementa* and of dark grey varieties of pozzolana), but other types are also attested. Unfortunately the construction of a basement in the middle of the first c.

BCE and subsequently of a *horreum* in the Augustan period caused the complete destruction of the stratigraphy that was originally associated with the early concrete buildings, making their dating extremely difficult. Floor levels are preserved only in one of the houses (House 8, which seems to come later in the sequence of occupation of the block), featuring decorated *signinum*-floors of a type that is attested in the second phase of the houses of Fregellae (185-150 BCE), as well as in other domestic contexts of Rome dated stylistically to the end of the second c. BCE. One of these floors is associated with what may have been a First Style wall-painting, the remains of which are very limited. The many similarities with the sequence excavated by Panella in the neighboring site strongly suggest that all these structures belong to the same building phase, dating around the middle of the second c. BCE or shortly after. The evidence suggests that concrete construction was developed in order to provide a way of building foundations for the new houses rapidly and economically, making extensive use of recycled building materials.

The reconstruction of the houses came after the overall reconfiguration of the urban infrastructure in the central sector, which involved the laying-out and paving of new road surfaces (Livy 41.27.5 informs us that this certainly lengthy project was started by the censors of 174 BCE). Building activities in the private context may have started as early as 165 BCE on the lower slopes of the Palatine,[768] and perhaps around 150 BCE on the slopes of the Capitoline, near the site of the Temple of Veiovis, but the infill of the hilltops with complex *bases* featuring concrete vaulting does predate the end of the second c. BCE (e.g., the Casa dei Grifi and the Aula Isiaca on the Palatine). Other élite residences of this type are attested for the early first c. BCE on the Velia and the Viminal too, where massive terracing structures in *opus reticulatum*

[768] This date is recorded for the construction of the house of Cn. Octavius by Cicero (*De off.*, 1.138), which was located near the Via Sacra (Sallust, *Hist.* frg. 2.45). Carandini and Papi (2005) identify House 5 on the north slope of the Palatine with this monument, but the evidence is not conclusive. The identification is accepted by Coarelli (2012: 290-292).

expanded the areas in which to build. This development is mirrored in the s*uburbium* of Rome, where the large majority of elaborate villas is represented by *opus reticulatum* buildings built ex-novo (by contrast, *opus incertum* is often associated with *opus quadratum*, and corresponds to only minor modifications).

Without the Porticus Aemilia, the sample of datable public concrete architecture shrinks considerably. A few *opus incertum* buildings have been tentatively dated to the second quarter of the second c. BCE, such as the substructures on the east slopes of the Palatine or the Testaccio building itself (though this dating is mostly based on comparanda from Latium that have never been investigated stratigraphically). A possible *terminus post quem* for the concrete repairs in the Temple of Castor and Pollux is 164 BCE (assigning the creation of the tribunal in Phase IA to the censorship of L. Aemilius Paullus), but only a *terminus ante quem* of 117 BCE can be securely established. At present, the earliest monument featuring *opus incertum* seems to be the Porticus Metelli, whose construction can be with a certain degree of approximation dated to the period between 143 and 131 BCE. Concrete here is used to build up the stepped podium supporting the quadriporticus that surrounds the Temple of Iuppiter Stator (which was most likely built prior to the colonnade as part of the same project) and the older temple of Iuno Regina. The same construction method is employed consistently to create new temple podia, which came to take the form of hollow concrete boxes filled with soil and faced on the exterior with ashlars. In rare cases concrete was used to repair older ashlar foundations (as documented in the case of the Temple of Castor and Pollux, Phase IA), but normally concrete structures completely replaced the old platforms. This type of structure is best exemplified by the Temple of Veiovis (perhaps of the 120s BCE), the Temple of Concord (121 BCE), the Temple of Castor and Pollux (Phase II, after 117 BCE). On the basis of this evidence, a real intensification in the use of concrete can only be demonstrated from the third quarter of the second c. BCE onwards.

Stratigraphic excavations in the sanctuary of Magna Mater demonstrated beyond doubt that the temple podium there dates to the end of the second c. BCE (111-101 BCE; this date can also be assigned to the concrete features of the Temple of Victoria, which was incorporated in the same monumental area). The site in this phase featured both *opus incertum* and *opus reticulatum*, clearly indicating that different facing styles could be used together for different structural purposes. *Opus incertum* is found in the podium structures and in boundary walls, while *opus reticulatum* is attested in the system of vaulted substructures that created a new monumental front on the south slope of the Palatine. This pattern may be connected with the organization of construction at the building site. Groups of unskilled or semi-skilled workers could be employed to build the larger structures, using blocks of standardized dimensions that could be assembled more rapidly.[769] The use of *opus incertum* for the podium may depend, on the other hand, on a more extensive use of recycled materials (including detritus obtained from the destruction of the old ashlar podium).

Because of the uncertain date of the vaulted complex on the eastern slope of the Palatine (which, however, still features small voussoirs) and of the Testaccio building, the substructures of the sanctuary of Magna Mater represent the earliest datable document of concrete vaulting in Rome (ca. 100 BCE). This corresponds to the tentative chronology of other vaulted structures in the area of the Forum, such as the concrete ramp located between the area of Vesta and the Lacus Iuturnae, in a sector of the Forum which seems to have been remodeled extensively in connection with the reconstruction of the Temple of Castor and Pollux, after 117 BCE. The ramp, also known as the Scalae Graecae, was part of the sanctuary of Vesta, whose first concrete

[769]As noted by Torelli 1980.

phase has been dated stratigraphically to 100 BCE. The structure features square facing blocks (though these are laid on their flat side), suggesting a link between the development of *opus reticulatum* and the spread of more complex forms of concrete vaulting in Rome (cf. the Casa dei Grifi). Outside Rome, however, vaulting construction remained mostly based on *opus incertum*, especially in areas characterized by limestone geology (e.g., Tibur; Praeneste).

In short, the available evidence from Rome seems to suggest that the beginnings of concrete construction are considerably later than previously thought. Adoption of this technology in the public sector may have been preceded by a phase in which use of this building medium was limited to domestic architecture, though it cannot be completely ruled out that concrete appeared simultaneously in both private and public spheres. Public works in second c. BCE Rome were normally contracted out to private builders, but the legal framework was originally developed in the context of ashlar architectural traditions. Thus, it would come as no surprise if the successful adoption of *opus caementicium* in public construction followed a period of experimentation, given the great deal of social and political risks that innovating in this field implied for the public official who let the contract.[770] However, it is worth noting that control of public construction in the late Republican period was in the hands of only a few aristocratic families. If the initial experimentation happened in the context of the refashioning of old élite residences in the urban core, the officials involved in public projects could employ groups of builders whose new skills had been already tested. The time gap would not necessarily have to be a long one.

[770]A similar development has been argued in the case of Tibur by Tombrägel (2011: 55-105), who suggests that the the spread of concrete in domestic architecture (rural residences) predates the use of *opus incertum* in public building. The proposed date for the introduction of concrete (i.e., the first half of the second c. BCE) is problematic, because still based on the identification of the Testaccio building with the Porticus Aemilia.

7.1.2 The Distribution of Early Concrete Architecture in Pompeii

The pattern documented at Pompeii is strikingly similar to the one just outlined for Rome. Because of the larger sample of domestic architecture preserved at this site, the development of concrete technology in private contexts can be reconstructed with even greater detail. The first documented examples of *opus incertum* architecture can be found in the élite houses of the Regio VI, where this facing style is used for foundations and party-walls in association with ashlar masonry facades. Among the earliest is the Casa del Fauno, which has been recently re-dated to 175-150 BCE based on the ceramic materials retrieved in the construction fill, though this should be more cautiously taken as a *terminus post quem*. Other houses (e.g., the Casa del Naviglio; the Casa del Centauro) have been shown to belong to the second half of the second c. BCE, on the basis of excavated materials. These houses feature the same construction methods as the Casa del Fauno, particularly the grading of different building materials in the *opus incertum* walls (with mixed use of compact lava for the lower part and of Sarno limestone *caementa* for the upper part).

The implementation of concrete vaulting in substructures (single rooms rather than corridors) began around the same time. Early examples are represented by the basements of the Casa dell'Ancora and of the Casa di Giuseppe II, while some terraced houses of the *Insula Occidentalis* may date to the late second or early first c. BCE. The low date of the Villa dei Misteri (ca. 80 BCE) confirms that the diffusion of more elaborate vaulted architecture peaks only in the. In any case, it has been shown with scientific methods that the mortar mixes used in the late second c. BCE contexts (e.g., in the Casa di Pansa) were already of the hydraulic type, excluding the possibility that the limited use of concrete vaulting had to do with an inferior quality of the binders.

Mixed rubble including Sarno limestone is still employed in late second c. BCE *opus incertum* construction, as attested by standing remains of houses in the area of Porta Vesuvio (for which a date in the range between 140 or 130 and 110 BCE has been proposed) and in the vicinity of the forum (Casa delle Nozze di Ercole, 125-100 BCE). This evidence demonstrates that the conventional periodization of Pompeian architecture based on the type of building materials is unreliable. We now know that most of the plots in the eastern sector of the town, where most of the lower-class "row-houses" utilizing Sarno limestone are located, were first occupied only at the end of the third c. BCE, but that the progressive infill continued in the course of the second c. BCE. This is the area in which the less solid types of *opus Africanum* concentrated. While small amounts of lime could be included in the clay-based mortars used in this architectural tradition, there are no signs of a gradual improvement eventually culminating in the implementation of lime mortars and *opus incertum*. On the contrary, the correlation of *opus incertum* with the most exclusive ashlar masonry houses strongly suggests that the introduction of lime-based construction correlates with socio-economic status.

Early concrete public monuments show many points of contact with the architecture of the houses. Both the podium of the Temple of Apollo and the walls of the Theater feature an admixture of Sarno limestone and compact lava. Neither context, however, can be dated stratigraphically. The construction of the sanctuary of Apollo is traditionally dated to the third quarter of the second c. BCE, a date which does not pose problems in light of what we know of the relative sequence of construction in neighboring areas (the Forum ensemble and the Temple of Venus are certainly later). The Theater has been considered for its design to be the model for the buildings in Pietrabbondante and Sarno, which seem to date to the late second c. BCE. Its construction may be linked with the first monumentalization of the nearby Foro Triangolare, also in *opus incertum*, for which a date around 130 BCE has been recently proposed on the basis of associated ceramic finds. A thorough stratigraphic analysis shows that the expansion of the Stabian Baths on top of the smaller hip-baths complex discovered by Eschebach under the north wing (third or early second c. BCE?) can be tentatively assigned to the same period, though it remains to be demonstrated that the thick construction fills burying the early structures built with clay-based Pappamonte mortared rubble are part of the larger project of leveling activities in the adjacent city-blocks (this stratigraphy has been dated to the second half of the second c. BCE). As in Rome, the first wave of public concrete construction seems to be concentrated in the 130s or 120s BCE.

A secure fixed point in the later history of concrete architecture at Pompeii is represented by the construction date of the Basilica. This is provided by a group of Rhodian amphora stamps collected by Maiuri under the floor level in a deposit sealed by a thick layer of mortar, which represented the original surface of the building site. The latest stamp dates to 112 BCE, which can be taken as a *terminus post quem* not only for the Basilica, but also for the impressive building program involving the reorientation of the Forum and of the main access from Porta Marina, the construction of the Temple of Iuppiter, of the Portico of Popidius, and most likely of the Temple of Venus (which in fact shares the same alignment). A chronology in the period 100-80 BCE can be suggested for at least some of these monuments (we know that the Basilica was functioning in 78 BCE). This phase is characterized by larger amounts of compact lava, which may be linked with the intensive extraction of this material for road construction.

The low chronology of Pompeian concrete finds confirmation in the record from other major cities of Campania, especially in terms of public architecture. Domestic contexts at Herculaneum show that there is very little *opus incertum* there predating the beginnings of the first c. BCE, but elsewhere the evidence is simply too fragmentary to detect a clear pattern. At Puteoli, the extensive occupation of the city-blocks seems to postdate the first phase of occupation of the colony of 194 BCE. *Opus incertum* walls obliterate some of the water-supply features created with the original layout of the roads. This technique is associated with ashlar masonry and voussoir vaults of the type and span attested in the north wing of the Stabian Baths. Large voussoir vaults have been documented in Terme Centrali at Cumae, where ashlar masonry is however found in association with concrete foundations (which is in itself a very interesting parallel for the practice attested in the early concrete houses of Rome). At this site, the only datable early concrete monument is the Stadium (ca. 125 BCE), but concrete construction takes off only in the early first c. BCE, making the late third c. or early second c. BCE date usually assigned to the Terme Centrali extremely unlikely. The corpus of late second and early first c. BCE inscriptions from Capua is a clear testimony of the concentration of building activities in this crucial period in the history of Roman Italy.

7.2 Implications of the Low Chronology

Although more focused excavations are needed, the results of the new analysis of the *opus incertum* monuments of Rome and Pompeii prompt a recasting of the development and cultural significance of concrete construction. Some important conclusions can be drawn up from our survey of early concrete architecture, which not only represent a serious challenge to the common model on the origins of *opus caementicium*, but also impact the broader intellectual debate on ancient Rome, with far-reaching implications for the understanding of cultural processes in Roman Italy. Exploring all the issues at stake with the appropriate degree of detail would go beyond the narrow scope of this work, so I will only concentrate on the most relevant aspects.

In the following discussion I will argue that, in light of the new evidence, the technological innovation of Roman concrete has no cause-and-effect relationship with Mid-Republican Roman imperialism. First, the complete lack of concrete architecture for the period before the middle of the second c. BCE means that the diffusion of this building medium came at a time when Rome's uncontested control of Italy had long been achieved. Consequently, the idea that the new technology emerged in the wave of urbanization unfolding in central Italy during the Mid-Republican period needs a thorough revision. Second, the results of my analysis prove that at Rome as elsewhere in central Italy, the social context of innovation appears to be at the élite level of society. In this sense, although it is unquestionable that, in the long run, it provided considerable economic advantages as opposed to ashlar masonry, early concrete should not be conceptualized as a cheap substitute implemented for lower-class housing, but as an item connected to new and expensive aristocratic fashions. Finally, considering the synchronous emergence of concrete architecture in the major urban sites of central Italy, a direct role played by Rome in the invention and diffusion of the new technology in the Italian peninsula should be questioned. In other words, the spread of concrete remains in Italy cannot be taken as a sign of Roman cultural influence, but must be characterized as part of a broader phenomenon of social change in central Italy.

7.2.1 Early Roman Imperialism and Technological Innovation

In the old "high chronology" model, the emergence of Roman concrete was characterized as a symptom of Rome's early expansion in Italy, because of the purported connection with the colonization program launched in the Mid-Republican period.[771] The early views of Lugli and

[771] See especially Brown 1951: 59-63; 102-113 (relationship between Cosa and other early Latin colonies in Latium Adiectum). Lugli 1957 (407-408: high dating of rubble construction at Cosa and Ostia). For a recent example see Giuliani 2006: 217 (reference to Alba Fucens and Cosa).

Brown conformed to the idea that the Romans defined a new material-cultural package in the third c. BCE, as a result of social and economic transformations brought about by the conquest of the peninsula. The most famous example is perhaps that of classic villa architecture, which was thought to appear in this phase, spreading to the rest of the peninsula as different areas were incorporated in the Roman sphere, particularly through the agency of Roman colonists.[772] The same model of cultural diffusion has been used to explain the distribution of concrete architecture (*supra*, Chapter 1).[773]

As we have seen, however, no archaeological evidence survives of a third c. BCE phase of concrete construction in Rome. Previous scholars argued that later construction activities in the urban core must have masked or destroyed the stratum, or that the early structures simply disintegrated without leaving any trace, because of the supposed inferior quality of the mortar mixes.[774] Based on this assumption, Brown interpreted the coarse aspect and the poor quality of most mortared rubble architecture at Cosa as evidence of the early date of the town-plan, concluding that these remains represented the kind of structures one would have to imagine as characterizing the formative stage of concrete construction in the metropolis.[775] The significant sample of archaic and early Republican architecture, which is being revealed by excavations below the Imperial levels of the monumental core in Rome,[776] clearly proves these sorts of

[772] An extensive critique of the classic model of villa architecture is in Terrenato 2001; Terrenao 2007; Terrenato 2012.

[773] On Roman influence in the architectural developments of third and second c. BCE Italy see Lugli 1957: 377-381. The debate on the cultural implications of the Roman conquest in Italy has seen important contributions in recent years. Terrenato (1998) explicitly addressed the relationship between the old diffusionist model and 19th c. nationalist discourse. The adoption of a uniform material culture across the peninsula is now more critically conceptualized as the result of a series of global waves of fashion spreading from the Greek east: Wallace-Hadrill 2008. This is a factor which may have facilitated the creation of a common cultural ground between Rome and central Italian elites: Terrenato 2000; Terrenato 2008.

[774] E.g., Blake 1947:307-308. A similar view is maintained by Adam (1994: 73).

[775] Brown 1951: 109-110.

[776] For a survey of this evidence see Cifani 2008.

explanation wrong. The evidence confirms that the concentration of concrete architecture, which is well-documented for the latter part of the second c. BCE, is not biased by visibility problems.

The picture of Rome emerging from the archaeological record is that of a city that in 200 BC looked very much like its Archaic and Early Republican self. Its built environment featured monuments still anchored to the old Italic tradition (particularly in temple architecture). Construction in both public and private sphere was characterized largely by mud-brick superstructures, with ashlar masonry typically limited to the foundations.

The pattern observed in Rome corresponds well with the results of stratigraphic research carried out at other sites of central Italy. These have shown that the archaeological record for the third c. BCE is ubiquitously characterized by a surprising poverty of architectural remains, especially in house construction. Monumental building at most Mid-Republican sites seems to be limited to fortification walls and poliadic temples, leaving the puzzling impression that what later became dense urban centers were originally just "empty boxes".[777] In any case, concrete is never used in the early phases of these structures, which are normally built with *opus quadratum* or polygonal masonry, depending on the types of stone available locally (polygonal masonry is found in the limestone region).[778] As the current reassessment of the archaeological record from the Mid-Republican Latin colonies makes abundantly evident, the large urbanization program initiated by the Romans could just as well spark processes of innovation and adaptation in the planning of modest housing, but these never resulted in the actual introduction of new building techniques.[779] Moreover, the fact that concrete construction appears simultaneously at other sites

[777]At Cosa, which represents the most thoroughly excavated of the Roman Mid-Republican sites, houses, temples and urban infrastructure were built within a single program of intense building activities that extend through the first half of the second c. BCE. See Fentress *et al.* 2003: 14-31. Sewell (2010: 169-171) discusses the scarcity of house construction at other colonial sites for most of the third c. BCE (Fregellae, Alba Fucens, Paestum).
[778]As noted in Becker 2007.
[779]Sewell 2010: 87-136 (with a second c. BCE date for Roman concrete).

of central Italy that were never founded as colonies (e.g., Cumae; Capua), suggests that Roman colonists had little role in the diffusion of the technique.

The development of concrete does not seem to relate with another important implication of Rome's expansion in the Mid-Republican period: namely, the growth of slavery. The current understanding is that the pattern of slave supply in Rome was well established already by the late fourth c. BCE, when Roman imperialism was in its early stage. The consensus is that a significant expansion of slavery began at the latest with the Third Samnite War (297-293 BCE).[780] While the first overseas conquests certainly accelerated the phenomenon, the growth of slavery is now viewed in more gradualist terms, with increments spreading over a longer period of time.[781] High counts give as many as 225,000 slaves in 225 BCE in greater Italy, but in contrast with previous studies, which grossly overestimated the role of slavery in agriculture (particularly for the second c. BCE), it has been now recognized that the slave population was disproportionately concentrated in urban contexts.[782] Thus, it is all the more significant to find that there is no immediate correlation between rates of innovation in the field of construction and the availability of cheap labor. In fact, the third and early second c. BCE architecture of Rome, which included big construction projects in the urban core, remained exclusively based on ashlar masonry. The same pattern can be observed elsewhere in central Italy, including the Vesuvian area and the Campi Flegrei (again, *opus quadratum* is found in the volcanic region where soft tuff was available; polygonal masonry in the limestone region).

[780] See Welwei 2000: 42-48.

[781] Based on the tallies reported in ancient sources, Scheidel (2011, Tab. 14.2) gives a total of between 672,000 and 731,000 captives in the 297-167 BCE period, reconstructing a clear progression in the annual mean of slave supply to Rome (from ca. 3,300 for 297-241 BCE, to ca. 5,300 for 241-202 BCE, to 8,701for the 202-167 BCE period). Scheidel recognizes the deficiencies of the underlying tallies, but suggests that unreasonably large adjustments would have to be made to alter the ratios.

[782] See Bradley 2011 for a general overview of the latest scholarship on the subject.

In this respect, Torelli (1980) noted that *opus incertum* construction required the work of unskilled or semi-skilled labor for the quarrying of the material or for the sourcing of building debris, but that the actual building process on site demanded the contribution of specialized masons (especially for the dressing of the facing blocks). By contrast, *opus reticulatum* walling could be assembled by unskilled personnel overseen by fewer specialists. Because *opus reticulatum* was introduced only around 100 BCE, changes in the organization of construction which may have been influenced by the development of slave economy seem to have happened only one or two generations after the emergence of concrete technology. Size and shape of facing blocks greatly influenced the overall construction costs of building projects: unless cheap labor was available, the kind of walling found in aristocratic residences like the Casa dei Grifi could be much more expensive than that of structures which featured larger irregular *tesserae*, like the Testaccio building, because it required more man-hours per wall-unit.[783] It should be kept in mind, however, that the choice of facing style may have not always been driven by labor-saving concerns, because it could also represent a form of conspicuous consumption.[784]

As we have seen, lime mixes were common in the Punic cities of Sardinia and Sicily, as well as in the Greek colonies of South Italy, already by the third c. BCE. In these areas, lime mortars were used for both floor revetments (*pavimenta poenica*; early pebble and then tessellated mosaics) and water-proofing, particularly in domestic bathing architecture.[785] *Signinum*-floors became common in the region of Rome around 200 BCE, though mainly with a decorative function. Based on the pattern of distribution of other walling features also found at Punic sites (e.g, the use of timber shuttering), Rakob (1983) even argued for the possible

[783] For a quantification of the costs in man-hours see DeLaine 2001.
[784] The conflicting attitudes toward economic rationality in Roman construction, especially in the Imperial period, are discussed in DeLaine 2006.
[785] Trümper 2010: 534-542.

derivation of mortared rubble technologies from Carthage (direct interaction with the Punic areas seemed to provide a plausible context for the technological transmission to Rome in the course of the third c. BCE).[786] The low chronology of concrete architecture concrete I suggest means that the exploitation of the possibilities offered by hydraulic mortars for structural walling (*opus caementicium*) came significantly later than the initial diffusion of mortar-based technologies (whether mediated or not by Rome).

Thus, the introduction of Roman concrete was an innovation, which can be characterized as a rapid development, standardization and expansion of preexisting technologies, not the result of a gradual process. In other words, the "discovery" of Roman concrete was just that, and not an "invention", because the technological change was brought about as a result of everyday use and experience of something that already existed rather than abstract thought.[787] Judicious observation of the pozzolanic properties of mortars including ground terracotta in the mix (particularly the quick setting and the resistance to shrinkage and/or cracking) allowed for the implementation of a medium which was suitable for building both foundations and free-standing walls. The use of simple lime would have made the hardening of foundations intolerably long, and could lead to problems of compression in load-bearing walls that were not thick enough (these would collapse under their own weight). The increase of scale in the volume of certain building materials required for concrete construction must have also played an important role in the innovation process. This is most evident in the substitution of ground terracotta, an artificial material whose processing was extremely expensive and time-consuming, with quarried

[786] Cf. the process that Carandini (1988) envisioned for the emergence of the so-called "Catonian" villas in central Italy, which he connected to methods of agricultural intensification derived from Punic practice.

[787] For the distinction between "discovery", "invention" and "innovation" see Greene 2008a: 77-84. Discovery is defined as "the revealing of something that had already existed but had not been recognized or conceptualized", while invention is a "conscious act of implementing an idea in a new device or process", which would imply originality. Roman concrete is described as a "discovery" in Green: 2008b: 812-813.

pozzolana, which made the large-scale application of concrete economically viable. All things considered, it seems that although some very conscious choices were made by builders from the onset of concrete construction,[788] Roman engineering achievements in the Late Republican period remained applications of previously existing knowledge, rather than steps in some completely new technological direction.[789]

7.2.2 The Diffusion of Early Concrete Architecture in Its Cultural Context

If the introduction of concrete happened long after the fundamental structures of Roman economy had developed, where did the impetus for its innovation come from? In previous reconstructions, there has been a tendency to contextualize the development of concrete construction at the lower level of society. Lugli's idea, for example, was that the diffusion of *opus incertum* in Rome trickled from the s*uburbium*, because of its supposed connection with rural building, including those of modest level (s*upra*, 3.4.1). Coarelli, on the other hand, linked the development of *opus incertum* with the rapid demographic urbanization that Rome experienced from 200 BCE onwards. In his view, the migration of rural poor to Rome would pose the economic need sparking the technological advance. As a solution to population growth, multi-story apartment blocks would have to be built for the growing urban *plebs*.[790] While early examples of these structures would be built making extensive use of mud-brick, the introduction of *opus incertum* would eventually allow for such a development in height, using a medium which was more durable and considerably cheaper than ashlar. According to Coarelli, this would be the context in which builders achieved a progressive regularization of *opus incertum*,

[788]Cf. Jackson and Marra 2006 (426-430), who demonstrate that by the Late Republican period the Romans acquired a good understanding of the physical characteristics of the local building materials, particularly of their relative compressive strengths.

[789]As noted by Adams 1996: 42-46. See also Hill (1984: 98-101), who regards the structural devices implemented by Gothic builders (pointed arch) far superior than Roman vaulting.

[790]Livy (21.62) mentions multi-storey compounds as early as 218 BCE. See also Boethius 1978: 134.

culminating in the so-called *opus quasi reticulatum* (which Coarelli dated to the third quarter of the second c. BCE).[791] Judging from the frequent complaints in Late Republican sources about badly planned apartment-blocks in Rome, however, the high tenement houses of the early period seem to have been the product of uncontrolled individual building activity, one still largely based on wood and mud-brick.[792]In Pompeii, too, the spread of concrete architecture has been connected with population growth after the Second Punic War.[793] As in the case of Rome, the emphasis has been placed on lower-class contexts, particularly the so-called "row-houses". The results of controlled excavation and mortar testing show that the earliest examples, which date to the second c. BCE, do not feature lime-based construction. In short, the evidence suggests that, in both Pompeii and Rome, the origins of *opus caementicium* must be contextualized at the élite level of society.

A crucial aspect to consider is that the middle of the second c. BCE in central Italy saw important developments in élite manifestations, in both the public and private spheres. New architectural types were introduced, adapting or reinterpreting previous traditions, whether local or foreign. The list includes permanent theaters (the *cavea* of the sanctuary of Iuno at Gabii has been dated to 150 BCE;[794] as we have seen, the first phase of the theater of Pompeii could be slightly later), civic buildings like the Basilica (the earliest archaeological example is the one at Cosa, which has been dated to 150-140 BCE),[795] the quadriporticus (the Porticus Metelli in Rome seems to be the first documented example, because descriptions of the Porticus Octavia are unclear as to the actual plan of the building; another example close in time to the Porticus

[791]Coarelli 1977: 17-18.
[792]For a detailed discussion of the sources see Gros 2001: 86-89. Gros regards the prescriptions laid out by Vitruvius (2.8.17) to build apartment-blocks in solid masonry as far from contemporary realities.
[793]Johannowsky 1976; Peterse 1999.
[794]For the association between temple and theater in the context of the Late Republican sanctuaries of Latium and a thorough reassessment of the evidence see now Rous 2010.
[795]Brown et al. 1993: 207-236.

Metelli can be found in the sanctuary of Apollo and perhaps also in the theater quarter at Pompeii), public baths (from the early example of Fregellae, whose best known phase is of the second quarter of the second c. BCE, to the later concrete ones of Cumae, Pompeii, to which we may also add Norba).[796] The spike in monumental writing associated with these construction projects demonstrate that old local élites had an interest in seeing their names associated with these projects (the incorporation of sets of identical inscriptions in the most visible parts of many of these buildings seems to reflect more than the actual concerns on the part of the magistrates involved in public construction to show that public funds had been properly spent).[797] Even if the lack of absolute date makes its interpretation more problematic, the sanctuary of Fortuna at Praeneste seems to fit well in the pattern of development just described.[798]

In the domestic context, elaborate residences began to replace centuries-old aristocratic mansions which in the Mid-Republican period had received only minor structural upgrading (cases are known also in Pompeii, e.g. at I.5), while by the late second c. BCE luxurious concrete villas appear in the countryside.[799] The fact that the few names of architects known for the Late Republican period are clearly connected with high ranking families, like the *Mucii* and the *Cornelii*,[800] strongly suggests that architectural developments in the public and private spheres had a common root.

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[796] It is important to point out that concrete is not used in the baths of Fregellae (Tsiolis 2008). For the bath complex at Norba see Quilici Gigli and Quilici 1998 (with a late second c. BCE date). Trümper (2009; 2010) links the development of what is commonly identified as the canonical Roman bath, i.e. the layout based on a sequence of rooms at different temperatures, the abolishment of purely cleansing bathing forms such as the hip-baths, and the introduction of more complex heating systems to broader second c. BCE developments in the Western Mediterranean (particularly in Sicily), recognizing that relaxing bathing forms appeared first in public contexts and later in private ones.

[797] A general overview based on Latin inscriptions, many of which refer to private munificence, is in Cébeillac Gervasoni 1998: 99-133.

[798] The corpus of building inscriptions that were set up by local elites at the sanctuary is collected in Degrassi 1969 (with a 125-100 BCE date).

[799] See Tombrägel 2011 and Mari 2003 for the late second and first c. BCE distribution of concrete *bases villae* in Latium and Sabina.

[800] As noted by Torelli 1980: 156.

Important changes affected also the development of decorative systems. The earliest example of First style painting in Latium seems to date around 175-50 BCE (sanctuary of Aesculapius at Fregellae), but only takes off in the latter decades of the second c. BCE.[801] As already suggested in the interpretation of the first concrete houses in Rome, the probable intensification of lime production and trade connected with the spread of a taste for elaborate stucco decorations imitating ashlar masonry may have contributed to the implementation of structural mortar there (in Pompeii, lime was more readily available). In stark contrast with the Mid-Republican period, when in terms of pottery production and consumption Italy and the Greek East represented almost completely separate worlds,[802] an increase in the scale of imports can be detected from the middle of the second c. BCE, perhaps as a result of the activities of Italian *negotiatores* in such places as Delos, but in the context of a two-way exchange pattern (e.g., the case of Eastern Sigillata A).[803] Local productions inspired by Hellenistic models were also started (e.g., the so-called Italo-megarian pottery).[804]

This pattern clearly shows that, in terms of cultural implications, the conquest of the Greece had a much greater impact on Rome than the conquest of Italy. Starting around the middle of the second c. BCE, when Rome's Mediterranean expansion was all but complete, a new wave of architectural styles and fashions flooded from the East. At the end of this process, in a matter of just one or two generations, a radically different Rome materialized, which in all aspects of material culture seems to have little or no relationship at all with its recent past. By comparison, the cultural distance between Mid-Republican Rome and its Archaic incarnation is,

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[801] Torelli and Marcattili 2011; Torelli 2011.
[802] See discussion in Morel 2002.
[803] Malfitana *et al.* 2005. For the broader picture of elite consumption see Wallace-Hadrill 2008: 356-440 (particularly 361-371, on the early first c. BCE Mahdia wreck).
[804] Marabini Moevs 1980. Among the best known productions is that of Tibur, beginning in the late second c. BCE, see Leotta 2005.

in archaeological terms, far less pronounced.[805] To paraphrase Lisa Fentress, if Martian archaeologists were to compare the city of around 100 BCE with that of around 200 BCE, they would find very little in common, and perhaps infer that a foreign culture had taken over it.

This new material-cultural assemblage reflects profound changes in élite self-representation, which impacted not only Rome, but also the main urban centers of the neighboring regions.[806] Our survey of early concrete architecture confirms that in a relatively short period of time different communities of central Italy, which were actively involved in the creation of Rome's Mediterranean Empire, engaged in impressive building programs. These resulted in the beautification of the urban cores both at the domestic and at the public level. The unprecedented scale of this effort, with numerous public projects progressing side-by-side at any one time in addition to private construction, may in fact explain why the phenomenon was accompanied by the development of a building medium capable of transforming demolition or quarry waste into a versatile, durable and fast material.[807]

Another important point is that across central Italy these developments are clearly simultaneous. The evidence from Pompeii clearly shows that, in both house construction and public building, concrete had been adopted on a significant level by late second c. BCE, just like in Rome. If it remains true that the availability of economic resources poured into these building projects came from the collusion with Rome's imperialistic agenda,[808] the pattern does not support the idea that the process of social and cultural change which brought about concrete in central Italy was initiated or directly encouraged by Rome. At Cumae, a community which

[805]In relation to wall-painting styles, just to name a context, see the analysis of Torelli (2011).
[806]Terrenato 2008: 350-360.
[807]Cf. DeLaine (2006: 249-250), who regards the pace of construction activities in the Republican period slow and gradual, and thinks that only in the Imperial period the construction industry received impetus.
[808]See the characterization of Pompeii's urban history by Wallace-Hadrill 2008: 128-137. It is important to note that Campanian élites were running trade in central Italy already by the third c. BCE, as demonstrated by recent provenance studies of Greco-Italic amphoras (Olcese *et al.* 2010). Cf. Van der Mersch 2001. This, however, did not result in widespread architectural change.

experienced forms of legal and administrative integration with Rome since the early second c. BCE, the construction of the new platform atop the *cavea* of the stadium (ca. 150-125 BCE) was accompanied by dedications in Oscan. As we have seen, the corpus of inscriptions from Capua demonstrates that as late as 100 BCE there was a great deal of local agency behind these monumental building programs. If the high dating of the Casa del Fauno is correct, the introduction of *opus incertum* in Pompeii may even predate the diffusion of this technique in Rome, suggesting that this facing style was far from being the "official" masonry of the Roman state, as Lugli claimed.[809] In short, the overall pattern of concrete distribution seems to tie in well with the results of new regional studies of other classes of evidence in central Italy (e.g., the first phase of temple building in Samnium), which allow for the possibility that local élites had unmediated access to sources of new styles.[810]

An important principle to be drawn from the new analysis is, therefore, that the introduction of the new technology, like that of any architectural styles in general, does not necessarily require a process of political and military annexation behind it. As a notable example of this we may cite the precedent of Mid-Republican Rome itself, which already participated in stylistic trends developing across the Mediterranean in the early Hellenistic period, when it was but a small regional power in a quite fragmented political landscape.[811] As a result of the low chronology of Roman concrete, the contribution of non-Roman élites in shaping what we call Late Republican Roman architecture clearly becomes a key issue. Many of what we consider distinctive building types of the Roman tradition, like the free-standing theater, the amphitheater or the baths, were codified only after the massive spread of *opus caementicium*, essentially between the last quarter of the second and the middle of the first c. BCE. Once again, these types

[809]Lugli 1957: 445-446.
[810]For a recent synthesis see Wallace-Hadrill 2008: 97-103; 137-143 (Pietrabbondante).
[811] See the evidence collected in *Roma medio-repubblicana* 1973.

appear to first emerge outside of Rome (for instance in Pompeii, in the case of the theater) before being imported in the capital.[812] It now seems that the very same building medium with which these types were engineered in the first place, Roman concrete, may lose much of its alleged "Roman-ness" too, given its synchronous and unmediated adoption across different areas of central Italy, such as the Vesuvian area. Indeed, it has been recognized as a long-held assumption of nationalistic discourse that the site of major use of a given technology is the site of its innovation. As a general rule, modern countries make greater use of technology innovated abroad than of technology innovated at home (unless they also dominate industrial production), and no positive correlation is found between rates of innovation and rates of economic growth.[813] Even if the analogy is not entirely appropriate, the same seems to be the case for Republican Rome.

The implication of this is all the more significant, because most Classicists conceptualize Roman concrete as the perfect embodiment of Roman culture and mentality, greatly contributing to the popular image of the Romans as a pragmatic people, whose achievements in the field of technology and engineering ought to be contrasted with those of the Greeks in the field of high-culture (*supra*, Chapter 1).[814] In classic reconstructions the common idea is that there was a relationship between technological achievements and the civilizing mission of the Roman Empire.[815] Though in a different light, more recent accounts still describe Roman concrete as the fundamental means of success for Rome's imperialistic agenda, particularly in the context of the centrally-sponsored urbanization programs of the Imperial period. MacMullen (2000), for

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[812] As noted by Ward-Perkins (1979), who for this reason hypothesized Campanian origins.
[813] Edgerton 1999.
[814] The same attitude at the scholarly level has often coincided with a value judgment. Cf. Greene (2004: 160): "[…] In cultural regard today, Greek "science" stands in the same relationship to Roman "technology" as the Parthenon does to the Baths of Caracalla: elegance is preferred to utility." The contrast between practicality and beauty for Rome and Greece s is indeed an ancient idea, which was introduced first by Strabo (5.3.8).
[815] Terrenato 2008: 234-240.

instance, characterizes Roman concrete as the perfect manifestation of the "tricky" character and practicality of the Romans, assuming that the technology for the large concrete structures was created in the capital. MacMullen has employed Roman concrete as a powerful metaphor to describe the nature of the process by which the Romans would eventually achieve the cultural unification of the newly-established Empire. In his view, just as Roman concrete would allow for the rapid construction of architectural forms capable of inculcating new behaviors in the provinces, by replicating simple shapes, inscriptions like *lex Ursonensis* (CIL 2.5439), which must have been set up in every colony across the Empire, would impose a repetitive message in a way that was:

> "[…] as easy as putting up work-forms for a wall; pouring the population into it was as quickly done, and the hardening of their habits of at least partial conformity could be expected to yield an equally durable set of institutions."[816]

The underlying idea is that of a quintessentially Roman ability to devise and transfer ready-made Roman designs from their home to the conquered areas.

As I hope to have demonstrated, the archaeological record suggests a more nuanced picture, revealing an important distinction between Roman imperialism in the second and first c. BCE in Italy and Roman imperialism during the Imperial period everywhere else. We can characterize the emergence of Roman concrete as a central Italian development of the Late Republican period with impetus from the local élite, often of non-Roman origin. This development was not due to Roman influence, having no relationship with the settling of colonists or the influx of slaves from the conquests abroad. Initially, the new building medium was used in the context of new forms of élite self-representation, cross-cutting perceived ethnic and political boundaries. In fact this process of cultural change was set in motion only toward the

[816] MacMullen 2000: 125.

end of Rome's expansion in the Mediterranean. Borrowing from Greene's terminology, we can conclude that Roman imperial "inventions" happened in the context of construction in Rome only under Caesar and Augustus, and later emperors, and that second c. BCE Italian élites had a greater agency in the "discovery" than previously thought.

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