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Building public baths outside Rome: The case study of Nora (Sardinia)

Caterina Previato

This chapter focuses on the logistics and economics of Roman construction sites, addressed through the analysis of the public baths of the town of Nora (Sardinia). Different buildings are examined and compared to define the organization and the management procedures applied in public architectural projects in a context located far from Rome. In particular, the building remains are used to reconstruct the dynamics of the supply of building materials, to define the technical knowledge applied in the projects, and to determine the cultural background of the workers involved in the construction process (on these subjects see also contributions by Vitti, Maschek, and Hufschmid in this volume). In this way it will be possible to analyse the relationship between the spread of Roman construction techniques across the Mediterranean and the persistence of local architectural traditions.[1]

Nora: A brief overview of the site

The town of Nora is located on a large peninsula along the southern coast of Sardinia, about 30 km west of Cagliari (Fig. 8.1). The first excavations at the site date back to the end of the nineteenth century, but most of the structures and buildings currently visible were unearthed in the 1950s.[2] The early settlement dates back to the Phoenician period (mid-eighth century BCE), when Nora was an important trade port (Bonetto 2009, 69–78; 2014; Bondì 2012, 82). After the conquest of Sardinia by the Carthaginians in the second half of the sixth century BCE, Nora developed into an urban centre and was provided with streets, four religious complexes, and several buildings with residential and commercial function.[3] In 227 BCE the town, as well as the whole island, became part of the Roman province of *Sardinia et Corsica*. The urban layout of Nora remained substantially unaltered until the Caesarian-Augustan age, when the town witnessed intensive building activities and was gradually equipped with typical Roman-style buildings and architectural complexes, including a forum and a theatre.[4] From the mid-second to third century CE, Nora experienced a further phase of urban development and renewal.[5] Several new buildings were constructed across the town, while some of the existing architectural complexes and private houses were restored. The streets were paved, and the sewer system renovated (Bonetto 2003, 29–31). At the same time, probably between the end of the second and the beginning of the third century CE, an aqueduct was built, the remains of which are still visible near the isthmus and the

[1] I would like to thank Niccolò Mugnai for the organization of the workshop and all the reviewers and in particular Janet DeLaine for her valuable comments and suggestions to improve the quality of my chapter.
[2] On the history of excavations and research at Nora, see Mazzariol and Zara forthcoming. Since 1990, an archaeological mission involving the Universities of Padua, Milan, Cagliari, and Genoa has conducted excavations and research on the ancient town and its territory with the aim of reconstructing its history. The most up-to-date publication on Nora is a guidebook to the site published in 2018 which contains the main results of recent excavations (Bonetto *et al.* 2018).
[3] Bartoloni *et al.* 1997, 67–97; Bonetto 2009, 182–84; 2021; Bondì 2012, 86–87.
[4] Bejor 1994a, 845–58; 1994b, 109, 112; Bonetto 2002; Ghiotto 2004, 184–85; 2009, 323–26. On the forum, see Bonetto 2009. On the theatre, see Mistretta 1961; Pesce 1972, 60–68; Bonello Lai 1987; Bejor 1993; 2000; 2003; 2007; Amucano 1994; Melis and Columbu 2000; Bejor *et al.* 2003; Tosi 2003, 645–48; Ghiotto 2004, 77–81, 90–94; Columbu and Garau 2017; Previato 2020; Previato *et al.* 2022.
[5] Bejor 1994a, 849–52; 1994b, 109–10; Ghiotto 2004, 185–86; Zara 2010–11; Fabiani 2013; Asolati *et al.* 2018, 99–146.

road leading to Nora.[6] The possibility of having running water enabled construction of several bath buildings, which are the focus of this chapter. They consist of four buildings situated in different urban sectors; three of them were built between the late second and early third century CE (Terme a Mare, Terme Centrali, Piccole Terme), and one probably slightly later (Terme di Levante).

The bath buildings of Nora

The Terme a Mare (Sea Baths)

The so-called 'Terme a Mare' are located in the western sector of the town, close to the sea. They constitute the largest baths at Nora known to date, extending for 57 m north–south and 41 m east–west. The building, already identified by Gennaro Pesce in the 1950s, was excavated in the 1970s by the Archaeological Superintendence of Cagliari.[7] This intervention made it possible to define the building plan and collect data on its chronology and construction process.

The building has a rectangular plan and faces north along street G–E, provided with a portico on this side (Fig. 8.2). A second portico is located on the eastern side. The western side, facing the sea, is less known as it is poorly preserved due to marine erosion. The main access to the building was on the north side: a staircase with three steps led from the street to the portico, and from there to the entrance hall (a). From the hall it was possible to access the *apodyterium* (b), paved with a mosaic, and the *frigidarium* (c), located in the centre of the building. The *frigidarium* has a square plan and was equipped with a niche on the eastern side and two symmetrical square pools on the northern and southern sides. Both the floor of the *frigidarium* and the pools had a marble revetment, of which only a few fragments are preserved. From the *frigidarium* it was possible to access the three heated rooms in the north–western sector of the building, all developing in east–west direction. The first room (g), rectangular in plan, was probably a *tepidarium*; the other two rooms, one with an ellipsoidal plan (f) and one with an apsidal rectangular plan (e), can be interpreted as a *sudatorium* and *caldarium*, respectively. From the *caldarium* (e), it was possible to return to the *frigidarium* through a small room (d), thus completing a ring path.

The baths had also a second entrance, which opened onto the eastern portico and led into a second hall (h), paved with a mosaic. From that room it was possible to access either the *frigidarium* (c) or a small room (i) and then a (heated) large rectangular apsidal room (l), which unfortunately has been almost entirely destroyed by the sea's erosive action.[8] The function of this room, variously interpreted as another *caldarium* for women or as a room for sunbathing, is unclear (Tronchetti 1985, 75). From the second hall (h) it was also possible to access a latrine (n), equipped with a second entrance facing the eastern portico. The latrine seats, made of shaped sandstone blocks, are still visible on the room's east, south, and west sides. The heating of the hot rooms was provided by *praefurnia* located in the western sector of the building, which are no longer visible as they have been eroded by the sea and covered with earth, but the mouths of which are preserved along the rooms' perimeter walls. A service corridor (m) ran along the northern perimeter of the *caldarium*, then bending southwards. In this space was an additional *praefurnium*, which served to provide heating to a rectangular basin on the eastern side of the *caldarium*.

The water supply of the baths was probably provided by the aqueduct. On the basis of the discovery of

[6] On the aqueduct, see Paoletti 1997; Ghiotto 2004, 146–48; Piu 2016; Cespa 2018, 16. The aqueduct was probably restored between 425 and 450 CE by Flaviolus, *praeses provinciae*, and Valerius Euhodius, *principalis ac primoris* of Nora: Ghiotto 2004, 148 with references.

[7] Pesce 1972, 83–86; Angiolillo 1981, 32; Tronchetti 1985; 2001, 55–61; Ghiotto 2004, 115–16; Bonetto *et al.* 2018, 86–92.

[8] According to C. Tronchetti (1985, 75), this room was not equipped with wall heating, but only with a heated floor.

collapsed masonry with hydraulic coating, it is believed that in the north–western sector of the building there were reservoirs connected to the aqueduct; these were located over the corridor (m), which supplied water to the pools by means of pipes placed inside the walls.[9] The reservoirs were probably accessible through a staircase, the remains of which were found near the *praefurnium* of the corridor. Wastewater flowed through a sewer underneath the floor, which was built with a concrete core and a revetment made of stone and tile and covered with 'cappuccina' tiles. The sewer passed under the hall (h) and the *frigidarium* (c), where it collected the pools' wastewater, and then headed towards the street, passing first through the latrine (n). A second sewer ran under the corridor (m).

The 1970s excavations made it possible to verify that the building was constructed in the Severan age (end of the second to early third century CE), as suggested by the chronology of the pottery recovered from the stratigraphic deposits under the floors.[10] The ground on which the baths were built was gently sloping from east to west, so after building the wall foundations, placed within small trenches excavated in the rock, it became necessary to create an artificial horizontal platform through a landfill and raise the floor level. A layer of pure lime was placed at the base, covered by a fill of soil about 1 m thick. Above that, a further layer of pure lime was laid and above it a 20 cm layer of yellowish clay was added, over which the floors were then laid. Subsequently, the walls were built above the foundations. These have a concrete core (*opus caementicium*) and a facing made of triangular-shaped bricks, with sides ranging from 20 to 26 cm and a thickness from 2.5 to 3.5 cm (Fig. 8.3).[11] The masonries were passed by courses of *sesquipedales* (45 × 45 cm) placed at regular intervals of 2.1 m, with the function of consolidating the wall section. A similar course of bricks was also placed at the base of the above-ground masonry. The core of the walls was composed of lime mortar and irregularly shaped sandstone elements arranged in horizontal courses. The same composition can be observed in the vaults of the rooms, which were found in a state of collapse and are still visible inside the building and in the area nearby (Fig. 8.4). They were shaped as cross vaults in the larger rooms and as barrel vaults in the smaller ones, and they incorporated brick ribs.

As for the floor plans, the heated rooms were characterized by the presence of hypocaust floors. The base floor, preserved in all the rooms, consisted of *bipedales* (60 × 60 cm), on which rested *pilae* about 80 cm high composed of square bricks with sides of 20–21 cm. Above that, an additional layer of bricks served as the base for the floor preparation levels. Hot air produced by the furnaces passed under the floors but also along the walls, where it flowed through gaps made with *tegulae mammatae* fixed to the wall by iron nails (Fig. 8.5).

The Terme Centrali (Central Baths)

The Terme Centrali are the second largest baths of Nora and are located in the town centre.[12] The building was brought to light by Gennaro Pesce in the last century and has been the subject of stratigraphic excavations in recent years by the University of Milan.[13] According to the chronology provided by the excavation finds, the baths were built between the late second and early third century CE in an area previously occupied by private houses dating back to the first century CE (Marchesini and Ossorio 2007, 93; Frontori 2017a-b; 2018).

The baths were accessible from street D–I (Fig. 8.6). The whole plan of the building cannot be discerned

[9] Tronchetti 1985, 73. This solution is documented also in the baths of Convento Vecchio at Tharros, Sardinia.
[10] Tronchetti 1985, 76–77. This chronology is also supported by the stylistic analysis of the mosaics of the *apodyterium* (b) and of the southern hall (h) (Rinaldi 2000–01, 115–16, nos. 64–65). The building was heavily restored in the first half of the fifth century CE and then destroyed by a fire (Tronchetti 1985, 77–79).
[11] In some points, parallelepiped sandstone blocks were inserted into the brick facing. They are probably related to ancient restorations (Tronchetti 1985, 72).
[12] Pesce 1972, 69–73; Angiolillo 1981, 10–15; Tronchetti 2001, 35–41; Canepa 2003; Ghiotto 2004, 116–17; Bonetto *et al.* 2018, 59–63; Frontori 2019.
[13] On the recent excavations, see Iacovino and Mecozzi 2012; Iacovino 2013; Panero 2013; Frontori 2014; 2018; Albertoni and Frontori 2018; Frontori and Restelli 2018.

with certainty as excavations are still in progress and the plan reading is made difficult by the overlapping of structures dating to different phases, but according to the layout the entrance hall can be identified in room (e). From here, passing through a hallway (d), it was possible to enter a large square room (a) paved with a mosaic and interpretable as an *apodyterium*. Room (a) gave access to the *frigidarium* (b) in the centre of the complex. This room, characterized by an L-shaped plan, was paved with a polychrome mosaic and was equipped with a central drain. The *frigidarium* featured a square pool on the southern side (c), accessible through some steps and decorated with a marble revetment. West of the pool there were three small service rooms (i, g, f), among which there was probably a latrine. From the *frigidarium*, proceeding westwards, it was possible to access a rectangular *tepidarium* (m) and from there a *sudatorium* (l) and finally a rectangular apsidal *caldarium* (n).[14] These rooms were heated through four *praefurnia* (o, q, t, r), two of which were used exclusively for the *caldarium*. The building was equipped with at least one elevated rectangular water tank, traces of which remain in the north–western sector of the complex (s). The cistern's water supply was probably provided by the aqueduct. In the late imperial period a second access was added on the northern side of the baths. At this stage a long north–south corridor (v) was built, paved with a mosaic. The corridor led from street D–E directly into the *frigidarium*.

As mentioned above, the bath building was built over earlier private edifices, which have been identified in several points underneath the floors of the baths' eastern compartments. Below the floor of the heated rooms, on the other hand, a platform made of squared sandstone blocks was found (Fig. 8.7). It is not clear whether it belonged to an earlier building or was instead intended as a foundation aimed at levelling the area and providing a solid surface for construction. In terms of construction techniques, the few surviving walls of the baths present a concrete core containing sandstone rubble of heterogeneous size and morphology and a facing made of sandstone blocks of around 10 cm in size, with the insertion of some courses of triangular-shaped bricks (Fig. 8.8). The foundations of the masonry were made of irregular stones bonded by lime mortar, among which pebbles and fragments of andesite predominate. A larger use of brick can be observed in the perimeter walls of the *praefurnia* (Fig. 8.9). Square bricks were also used in the lower floors of the heated rooms, which were equipped with *suspensurae*.

The Piccole Terme (Small Baths)

The Piccole Terme are located in the western sector of the town, north of the Terme a Mare.[15] It is a modest-size building, rectangular in plan, which was partially excavated by Gennaro Pesce and in more recent years by the University of Genoa.[16]

The building was constructed between the late second and early third century CE in an area previously occupied by private dwellings (Fig. 8.10) (Giannattasio 2012). In its first building phase it consisted of a rectangular *frigidarium* (a) equipped with a marble *labrum* and paved with a polychrome mosaic with a drain in the centre, two heated rooms (b, c) possibly interpretable as *tepidaria*, and an apsidal *caldarium* (d) heated by a *praefurnium* located further east. The bathing path in this phase is not clear. According to the layout, access was from the west along street G–H. A rectangular hall (m) led to room (b) and from there the *frigidarium* (a) could probably be reached. Going back to room (b) and passing through room (c) it was then

[14] This interpretation of the bathing route and the function of rooms (a), (d), (e), (f), (g), (i), (l) differs in part from that proposed by other scholars (Frontori 2018), but it seems more likely given the layout and architectural features of the complex and in the light of comparisons with other bath complexes. I thank Janet DeLaine for her suggestions.
[15] Pesce 1972, 81–82; Angiolillo 1981, 28–32; Tronchetti 2001, 52–53; Colavitti 2002; Ghiotto 2004, 117–18; Bonetto *et al.* 2018, 94–96.
[16] On the recent excavations by the University of Genoa, see Giannattasio 2012; 2014; Giannattasio and Porro 2012; Albanese and Cosentino 2013.

possible to reach the *caldarium* (d).[17] The modest size of the building at this early stage suggests it was probably a private bath, connected to the neighbouring houses.

At the beginning of the fourth century CE, the building was renovated and enlarged. The *frigidarium* was provided with a rectangular pool (h) (4.18 × 2.69 m) with walls featuring niches for statues and a marble facing. Further south, a new monumental access (i) opening onto street G–H was built. It consisted of some steps leading into a long corridor (g) that flowed into a large room (f) interpretable as an *apodyterium* given the presence, on the southern side, of a bench with triangular clothes lockers. The construction of these two rooms determined various modifications to the building's drainage system and involved construction of a new drain equipped with manholes that ran under the corridor and then flowed westwards into the sewer under street G–H (Fig. 8.11). Both the corridor (g) and the *apodyterium* (f) were paved with mosaics. Furthermore, the perimeter walls of room (e) were constructed. The larger size of the baths in this phase suggests the building had acquired a public function.

Both the first- and second-phase wall structures present a concrete core and a facing made of courses of roughly worked sandstone blocks alternating with two, three, or four courses of triangular-shaped bricks, and brick quoins at the corners (Fig. 8.12). The wall foundations were made of irregularly arranged andesite and rubble pebbles bound by earthen mortar. Between the foundation and the elevation a levelling course of 'pietra cantone' blocks was set. The only masonry structures characterized by a different technique are the perimeter walls of room (m), which are made of stones of various type and shape bound by lime mortar and arranged irregularly. As for the floor levels, the corridor (g), the *apodyterium* (h), and the *frigidarium* (a) were all paved with mosaics. Rooms (b) and (c) and the *caldarium* (d) had *suspensurae*, of which part of the *pilae* made of square bricks with a side of 21–23 cm and the base floors made of *sesquipedales* and *bipedales* remain (Fig. 8.13). Wall heating was provided by *tegulae mammatae*, some fragments of which were found during recent excavations (on the use of brick in these baths, see Giannattasio 2022).

The Terme di Levante (East Baths)

The fourth bath complex of Nora known to date is located in the town's eastern sector and was unearthed by Gennaro Pesce.[18] Regrettably, it has been heavily eroded by the sea in its eastern portion and its layout is only partially discernible (Fig. 8.14).

The building was accessed from the west along street A–B. The entrance hall consisted of a square room (a) of 9 × 9.5 m with a central pillar and paved with a mosaic. A doorway located on its eastern side provided access to a second large room, also paved with a mosaic, probably identifiable as a *frigidarium* (b). To the north, the *frigidarium* gave access to a small square room (c) and to two other rooms. The first room (e), preserved only in its western apse, can be interpreted as a *tepidarium* or *sudatorium*. Immediately to the north was the *caldarium* (d), a rectangular room also equipped with an apse on the western side. Both these rooms were heated, as evidenced by the *suspensurae* still partially visible inside them. A furnace was placed just beyond the west apse of the *caldarium*. North and south there were two long, narrow service corridors. The articulation of the southern sector of the baths is more difficult to reconstruct. The *frigidarium* (b) was connected to a rectangular pool of 10 × 6 m covered with thick hydraulic plaster and interpretable as a *natatio* (f). To the south there were two rooms of unknown function; one of them (g) shows part of its mosaic floor. Further south there was a large cistern. The eastern limit of the baths, now obliterated by the sea, is probably to be recognized in a rectilinear north–south structure running parallel to the coast for 43.5 m and identified

[17] Like for the Terme Centrali, this interpretation of the bathing route partially differs from previous proposals (Giannattasio 2012) on the basis of the building's layout and architectural features, and in the light of comparisons with other bath buildings. I thank Janet DeLaine for these suggestions.

[18] On this building, see Pesce 1972, 107–9; Angiolillo 1981, 26–28; Tronchetti 2001, 20–22; Ghiotto 2004, 124–25; Bonetto *et al.* 2018, 22.

during an underwater archaeological survey.

According to Pesce, the rooms in the baths' northern sector rest on a foundation platform made of squared sandstone blocks, which was exposed as a result of the action of the sea on the eastern side of the building. Further south, the complex appears to be built on substructures, as evidenced by the presence of a rectangular vaulted room visible underneath room (g) (Fig. 8.15). The masonry structures of the building were constructed using different techniques. In the hall (a) and room (c) the walls are made of stone of various types and morphology, bound by lime mortar and irregularly arranged (Fig. 8.16). Conversely, the construction technique of the walls of the *caldarium* is more accurate, with a concrete core containing irregular fragments of sandstone, an outer facing made of a course of sandstone blocks alternated with one, two, or three courses of bricks, (Fig. 8.17), and an inner facing of triangular-shaped bricks. The outer facing of the northern wall of the *tepidarium* also features bricks (Fig. 8.18). The *suspensurae* system was adopted in the heated rooms. Only the base of these remains, as in the apse of the *tepidarium*, consisting of *sesquipedales* (45 × 45 cm) placed over a 20 cm thick layer of *cocciopesto* (Fig. 8.19). Nothing is known about the shape of the *pilae*, or about the wall heating system.

The Terme di Levante have not been excavated stratigraphically, so their date is not clear. According to the style of the mosaics currently visible they have been dated to the fourth century CE (Angiolillo 1981, 26–28), but existence of a previous building phase cannot be excluded.

The baths of Nora: Peculiarities and dynamics of the construction process

The analysis so far conducted highlights how the four baths differ in size, plan articulation, and evolution over time. Three of them show very irregular floor plans, probably due to the fact that they were built in already occupied urban areas, and they had to adapt to pre-existing structures and the available space. The Terme a Mare are the most regular building in terms of layout. This is perhaps related to the absence of pre-existing structures on the construction site or, more likely, to the fact that construction of the baths resulted in a total obliteration of earlier structures, which was achieved through the laying of a significant fill of soil that resulted not only in a regularization of the floor level, but also in a considerable rise in elevation.

In terms of their plans, the buildings show various similarities. In all of them there are more or less large halls leading to the central sector of the building, represented by the *frigidarium*, which is always the largest room in the complex. The *frigidaria* of Nora present different plans, but inside them there is always at least one pool, which in all cases has a rectangular plan, a marble revetment, and is accessible through steps (Fig. 8.20). Moreover, niches for statues are included in the walls of the pools. In contrast, the *caldaria* seem to have more standardized morphologies: they always present a rectangular apsidal plan and are equipped with one or two *praefurnia* depending on their size. *Tepidaria* generally present a rectangular plan. The only exception is the *tepidarium* of the Terme di Levante, which appears to have an apsidal side; it should be noted, however, that this room is only partially known.

An examination of the construction process of the bath buildings reveals that particular attention was paid to the consolidation of the ground on which they were built. The best example is given by the Terme a Mare, at the base of which a 1 m thick fill of soil was placed, sandwiched between layers of pure lime. A major consolidation of the construction surface can also be recognized in the heated rooms of the Terme Centrali and of the Terme di Levante, which rest on a platform of squared sandstone blocks. It is unclear, however, whether this is a purpose-built foundation platform or a pre-existing structure reused as a foundation. This attention to the consolidation of the building surface makes us understand that, despite their current state of preservation, these buildings were meant to develop substantially in height.

With regard to building materials and techniques, strong similarities can be noted among the buildings examined. In all cases, the most common materials are sandstone and brick. The presence of sandstone is not

particularly surprising, as it is a locally sourced material, which was in use at Nora since the Phoenician period and was quarried from various sites in the region around the town.[19] Apart from the large squared blocks in the foundation platforms, the sandstone elements in the wall facings are c. 10 cm in size and (more or less irregularly) parallelepiped-shaped. It is not clear whether these were newly made or reused elements, obtained from the cutting of blocks taken from earlier structures, although the substantial amount of material used in the construction would probably point to the first hypothesis. Of great interest is the extensive use of brick, a building material attested at Nora also in earlier buildings but which was only used in rather small quantities during those building phases.[20] Three types of bricks are attested in the bath buildings of Nora, with typically Roman dimensions: *bipedales* (60 × 60 cm), *sesquipedales* (45 × 45 cm), and *bessales* (20 × 20 cm) with thicknesses varying from 2.5 to 3.5 cm.[21] Unfortunately, no data are available to understand whether these were imported or locally produced materials since no stamps have been found on the bricks, nor have archaeometric analyses been conducted.[22] Again, given the quantities of the materials in place and considering that in the proximity of Nora there are clay basins suitable for brick manufacture, it seems that a local production is the preferable option. Alongside these materials is another stone of local origin, andesite, which is used exclusively in the foundations and in the form of elements of irregular size and shape.[23] In the bath buildings of Nora there are also some imported stone materials, used for both structural and decorative purposes. These are in particular the 'pietra cantone' found in the Piccole Terme (a stone quarried from the region around Cagliari); different types of marble from various Mediterranean quarries,[24] used in the form of slabs for wall and floor veneer; and volcanic pumices used in the binding mixtures of the buildings to improve their strength, probably coming from the Phlegraean Fields.[25]

If therefore we find a mix of local and imported materials, the masonry structures themselves appear to be built using non-local, typically Roman techniques. The walls in fact are all characterized by elevations with a core and facing structure, in which the core is made of concrete. In all the buildings examined, the *caementa* embedded in the lime mortar are sandstone fragments irregularly arranged. Again, an exception is given by the Terme a Mare, where the *caementa* are placed in horizontal courses both in the walls and in the vaults. As for the facings, two different techniques are attested. In the first case, the facings consist of horizontal courses of more or less regular sandstone elements of c. 10 cm in size alternating with courses of triangular-shaped bricks, with sides ranging between 21 and 27 cm. The number of brick courses as well as the height of the stone part and the rhythm with which the two materials alternate is highly variable from structure to structure. In some cases, brick quoins are present at the corners between structures built with this technique. This is the predominant technique in the Terme Centrali, the Piccole Terme, and the Terme di Levante. In contrast, in the Terme a Mare all the walls have a brick facing. The bricks are triangular in shape, and were obtained by cutting larger elements. In this case, through courses of *sesquipedales* were inserted into the masonry for the

[19] On the stone quarries of Nora and the use of sandstone, see Previato 2016, esp. 19–67.
[20] The only building so far known in which brick is attested before the Severan age is the theatre: see Ghiotto 2004, 6–7; Previato 2020; Previato *et al.* 2022.
[21] With regard to the Piccole Terme, it has been noted that the correspondence to the Roman metric standards is somewhat approximate, with deviations of a few centimetres: Giannattasio 2022, 37.
[22] To date, a complete study of the bricks used in the buildings of Nora is still lacking. The only publications on this subject are fairly recent and concern the bricks from the Roman Temple (Piazza 2021) and the Piccole Terme (Gazzerro 2003; Giannattasio 2022).
[23] On the quarries and use of andesite at Nora, see Previato 2016, 68–83.
[24] The study of marbles from the baths of Nora is being carried out by Beatrice Marchet (University of Padua). So far, the types identified in the Terme a Mare are: greco scritto, bardiglio lunense, and cipollino; in the Terme Centrali: giallo antico; in the Piccole Terme: rosso antico, verde antico, giallo antico, greco scritto, portasanta, and fior di pesco.
[25] The study of the mortars from Nora's bath buildings is currently in progress and the provenance of the pumices from the Phlegraean Fields must be confirmed through archaeometric analyses that are being carried out by Simone Dilaria, whom I thank for these preliminary observations. Phlegraean pumices were found in the Roman Temple, dated to the Severan age (Dilaria *et al*. 2023).

consolidation of the wall body. Brick facings are also attested in the other bath buildings, where they were used only in specific points, such as in the perimeters of the heated rooms and in *praefurnia*. Another typical Roman technique was used in all the buildings as hydraulic coating, that is *cocciopesto*.

As for the water supply to the baths, it is likely that this was provided by the aqueduct, whose construction seems to be contemporary with that of the baths.[26] The aqueduct had its source at Sa Guardia Mongiasa, located 1.5 km from Nora. In the extra-urban area, it was constructed on arches, the remains of which can be seen as far as the isthmus leading into the town. The aqueduct's urban section is not preserved, but it is assumed that inside the town, after supplying the Terme di Levante and the fountain on street A–B, it headed towards the town centre, reaching the putative *castellum aquae* on the southern slopes of the Tanit hill, of which only the basement remains, and the fountain below along street D–E. From there it probably proceeded both southwards, towards the Terme Centrali, and westwards, towards the Terme a Mare and the Piccole Terme. It has been hypothesized that in the western sector of the town the conduit ran above the portico of *insula* A and on the arch at the intersection of streets E–G and G–H (Tronchetti 1984, 45; Bejor 1994a, 855). Even if the main conduit has not been found, the fact that the aqueduct reached the western sector of Nora is demonstrated by the discovery of lead *fistulae* along street G–H (Pesce 1972, 83).

Final remarks

The analysis conducted on the bath buildings of Nora allows us to make some broader observations about the architects and workers involved in the construction process and the historical, social, economic, and cultural context in which the construction took place.

Firstly, it is clear that in these buildings only typically Roman construction methods were applied, such as the use of concrete in the wall cores and the vaults, and the stone and brick or only brick facing in the masonry structures. Considering the limited use, or the almost complete absence, of these techniques in earlier buildings such as the forum and the theatre (Ghiotto 2004, 185), and their use in other contemporary buildings such as the Roman Temple (Fig. 8.21),[27] it can be hypothesized that their spread was determined by the arrival at Nora between the end of the second and the third century CE of architects or builders who came from Rome or from central Italy, or who at any rate possessed non-local building expertise.[28] Even if there is no evidence for the identity and origin of those who were involved in the construction of the baths or other contemporary buildings, it can be supposed that these foreign experts acted as vectors for the dissemination and transmission of new technical knowledge to the local workforce (on similar processes see Vitti, this volume). Given the large number of buildings that were erected at Nora in the Severan age, it seems that the local builders became familiar with the new construction techniques rather quickly. However, looking at the different quality of execution of the structures, it can be observed that they did not always apply these techniques in the same way. In fact, if one compares the various baths, it can be noticed that there are clear differences both in the shape of the stone elements used in the wall facings, which can be more or less regular, and in the rhythm with which stone and brick were laid. Considering that the materials used in all the baths are the same, and therefore the different way in which sandstone blocks were worked was not due to the different workability of the stone, it can be assumed that in the town there were different groups of workers who were active at the same time, with

[26] Paoletti 1997; Ghiotto 2004, 146–48; Piu 2016; Cespa 2018, 16.

[27] The walls of the Roman Temple have a concrete core and a facing made of stone and brick (Dilaria *et al.* 2023). Also in the aqueduct are attested building techniques quite similar to those of the baths; the piers have a concrete core and a brick facing, while the arches have a stone and brick facing (Ghiotto 2004, 147).

[28] The spread of typically Roman building techniques from the Severan age onwards is a phenomenon observable not only at Nora, but across all of Sardinia (see Ghiotto 2004, 20–22). This change in the construction methods primarily affected public architecture, while building techniques of Punic tradition remained in use in private edifices.

different and more or less refined technical skills.

With regard to raw materials, both traditional, locally sourced and easily supplied materials, such as sandstone and andesite, and new or imported materials, such as brick, Phlegraean pumice, and marble, were used. The presence and use of sandstone and andesite are not particularly surprising, given the ease of sourcing these materials, and only show that the architects were familiar with locally available resources and that the workers on the site were able to work these materials easily. In contrast, the extensive use of brick appears to be a highly innovative practice, given the limited use of this material in the town in earlier buildings.[29] Although we have no information on the possible production site of these materials, the substantial quantity of brick used in the baths of Nora points to a local production, as proposed by some scholars on the basis of the macroscopic analysis of the clay (for the Piccole Terme, see Giannattasio 2022, 37) and considering the availability of clay deposits around the town.[30] If so, it could be assumed that it was the construction of the bath buildings (and of other contemporary constructions with brick wall facings) that led to the development and/or growth of local manufacturing workshops engaged in the production of brick, thus having a significant impact on the local economy. However, this is currently only a hypothesis that needs to be confirmed in light of new data and research on brick production sites.

Equally noteworthy is the presence, in the binding mixtures, of pumices probably coming from the Phlegraean Fields. This shows, on the one hand, the knowledge of the architects who carried out the construction projects of the properties of these materials, which would provide solidity and durability to the structures, and on the other, the existence of trade relations with the Campanian area aimed at the supply of building materials. The presence of the same materials in other buildings of this period, such as the Roman Temple (Dilaria *et al.* 2023), confirms the spread at Nora in this phase of a shared technical knowledge that was applied at the same time in different construction sites. The use of marble for veneer, which was clearly determined by purely aesthetic purposes, attests both to the local contacts with various regions of the Mediterranean and to the wealth of the patrons.

All these elements confirm that in the period in which the baths were built, the town of Nora enjoyed a certain economic prosperity. At this stage, not only building materials and other goods arrived at Nora, but also technical knowledge that brought innovation to and modified the local building tradition, which in turn had an impact on Nora's society and economy. This building, economic, and cultural dynamism involved the entire town and found expression in the construction and restoration of numerous buildings and infrastructure: for instance, the paving of the streets, the renovation of the sewage system, and the construction of the aqueduct all date to this period.[31] This close link between the construction of the baths and the development of the town leads to questions about the patrons behind these projects. Unfortunately, nothing is known about the kind of financial initiative, public or private, that promoted these large-scale monumentalization works, nor is any evidence available on acts of euergetism at Nora that can be linked specifically to the construction of the bath. The fact that baths spread simultaneously at Nora as well as across Sardinia at this stage (Ghiotto 2004, 109–35) may lead to the hypothesis that this was due to a precise public (perhaps imperial?) activity, to promote construction of this kind of buildings as bearers of a distinct social practice and as a symbol of *romanitas*. Indeed, it is not by chance that these interventions began at the time of Septimius Severus, who, having personally ascertained the modest level of urbanization of the local towns during his quaestorship of Sardinia

[29] The only pre-Severan public building at Nora where brick is attested is the theatre. However, bricks were used here in limited quantities, as they are found only in the wall facings of the external niches and in some points of the stage building. It has been calculated that approximately 1,200 *bessales* were needed for the construction of the outer walls of the theatre (Previato 2020, 247).

[30] On the geological and geomorphological features of the peninsula of Nora and the surrounding territory, see Di Gregorio *et al*. 2000; 2005–06; Melis and Columbu 2000, 106–7. See also the sketch drawing published in Columbu and Garau 2017, fig. 4.

[31] The aqueduct is not dated stratigraphically, but its connection to the construction of the baths is evident, as also shown by the use of the same building materials and techniques: Ghiotto 2004, 146–48, n. 40.

twenty years before he became emperor (*Sev*. 2.4–5), might have contributed to some extent to their monumentalization (Ghiotto 2004, 203). Significant in this regard is the large number of inscriptions with dedications to third-century emperors, particularly to members of the Severan family, that have been found at Nora and in Sardinia.[32] At present, however, these remain hypotheses that may be confirmed in the future by new studies and research.

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[32] Zucca 1994; 2005; Zara 2010–11, 155–73. Of particular interest is an inscription commemorating the restoration of the basilica at Nora by a *curator rei publicae*, that is, a commissioner appointed directly by the emperor: see Zucca 1994, 876–77, no. 43; Ghiotto 2009, 343–44.

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