San Donato Arch in Siena

A contribution to the history of the Roman settlement through building archaeology

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Abstract: The main aim of this paper is to contribute to the reconstruction of the urban plan of the city of Siena (Tuscany, Italy) during Roman times through one of the rare material evidence that witness the presence of an ancient structure. The focus of the research were two medieval towers in which Roman building materials were used and that appear to incorporate the remains of a Roman arch. The presence of this structure in the city is attested by several local historical sources which refer to it as “San Donato Arch”. The identification of the structure was possible through building archaeology and the application of close-range photogrammetric instruments and software (Zscan, Menci Software), that allowed us to create a 3D point cloud model of the two towers. We then performed a second post-processing phase using ZMap (Menci Software) which let us draw 3D wireframes of the buildings and produce orthophotos, DEM and wall profiles. Through the application of stratigraphical method it was then possible to identify the main building phases of the two towers and to analyze the bricks clearly related to Roman times. Those bricks were measured and compared with the ones of other buildings present in the city which could be linked to the same period, forming thus a first basis for future and deeper studies on Roman building phases throughout the city and on town planning.
Finally, a hypothetical reconstruction of the profile of the Roman arch was produced; this made possible to interpret it as a structure indicating the boundary between the *urbanitas* and the beginning of the suburban area with a necropolis.

Keywords: Siena, *Sena Vetus*, Roman arch, photogrammetry, building archaeology.

Sena Vetus: the search for the origins

Even though it is mostly famous for its medieval landscape and traditions, Siena can boast much more ancient origins than can be deduced simply by walking along its streets. The history of the city during the Roman times has aroused great interest both among local historians and in academic circles, generating the development of numerous and different interpretations. The general vision of the city as a Medieval settlement, however, has not helped the research, and indeed may have resulted in a lack of deeper investigation. The exuberance of Medieval remains, then, has made the older ones, already reduced in themselves, less recognizable. The history of Siena before the Middle Ages is still largely unknown, as supported by little evidence: the literary sources that attest its ancient origins are few and not very useful for a detailed discussion on the planning, organization and administration of the town. Even if archaeological evidence is present, it is still in small quantity, but enough to demonstrate that a Roman settlement actually existed.

Siena most likely acquired the status of a Roman city in 90 BC through *Lex Iulia de civitate*. In 87 BC, with *Lex Cornelia*, it was then elevated to *municipium* together with the other main Etruscan cities north of Rome and inscribed in a *tribus*, the *Oufentina*. During the civil wars between Marius and Sulla it would have sided with Mario together with Volterra. Plausibly it suffered the same fate as the other cities in the area and saw the progressive impoverishment of its territory, which determined a shift of production activities to the eastern areas that were more protected from the destruction of war (CIACCI 1997). From the end of the First century BC this area was hit by a decline in population and a progressive depletion and this led to a further shift towards another zone abandoned by the colonization of *possessores sullani*. Although it is not possible to propose a precise date for the event, the foundation of the military colony of *Saena Iulia* was fixed at the end of the First century BC (CRISTOFANI 1979). The city is cited in Plinius' *Naturalis Historia* (3, 51) together with other *coloniae*, *municipia* and settlements that formed Augustean regions, while Tacitus' *Historiae* (4, 4) describe an episode of indiscipline that led the Emperor Vespasianus to make an official call to order to the population. Another proof of the existence of the city comes from the *Tabula Peutingeriana*, that shows that *Saena Iulia* was linked to *Clusium* (Chiusi) by a via passing through 3 *mansiones.*

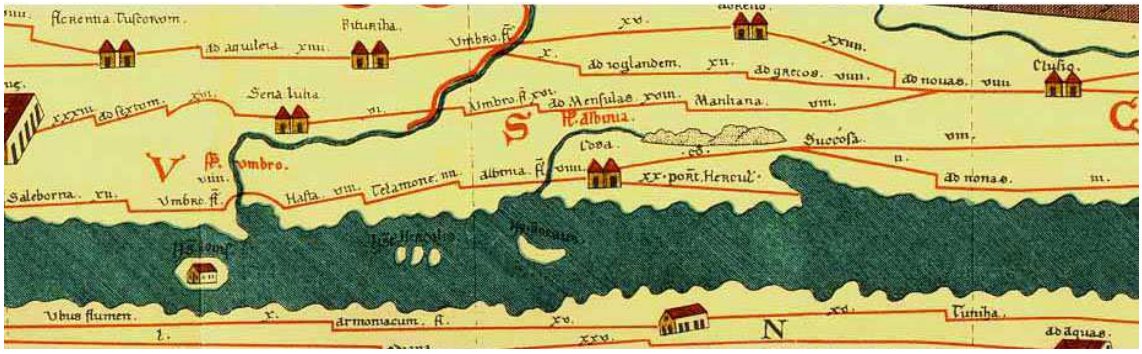


Fig. 1 – The via connecting *Saena Iulia* and *Clusium* according to the *Tabula Peutingeriana*

A total of 57 Latin inscriptions were found in the city, in addition to others related to citizens but found in other places of the Empire. Most of them are not dated, and mainly related to military or civilian sepulchral contexts.

The main archaeological findings related to the colony settlement are collocated in the south-western part of the city, more precisely on the hills of the actual Cathedral and the ancient Hospital of Santa Maria Della Scala.

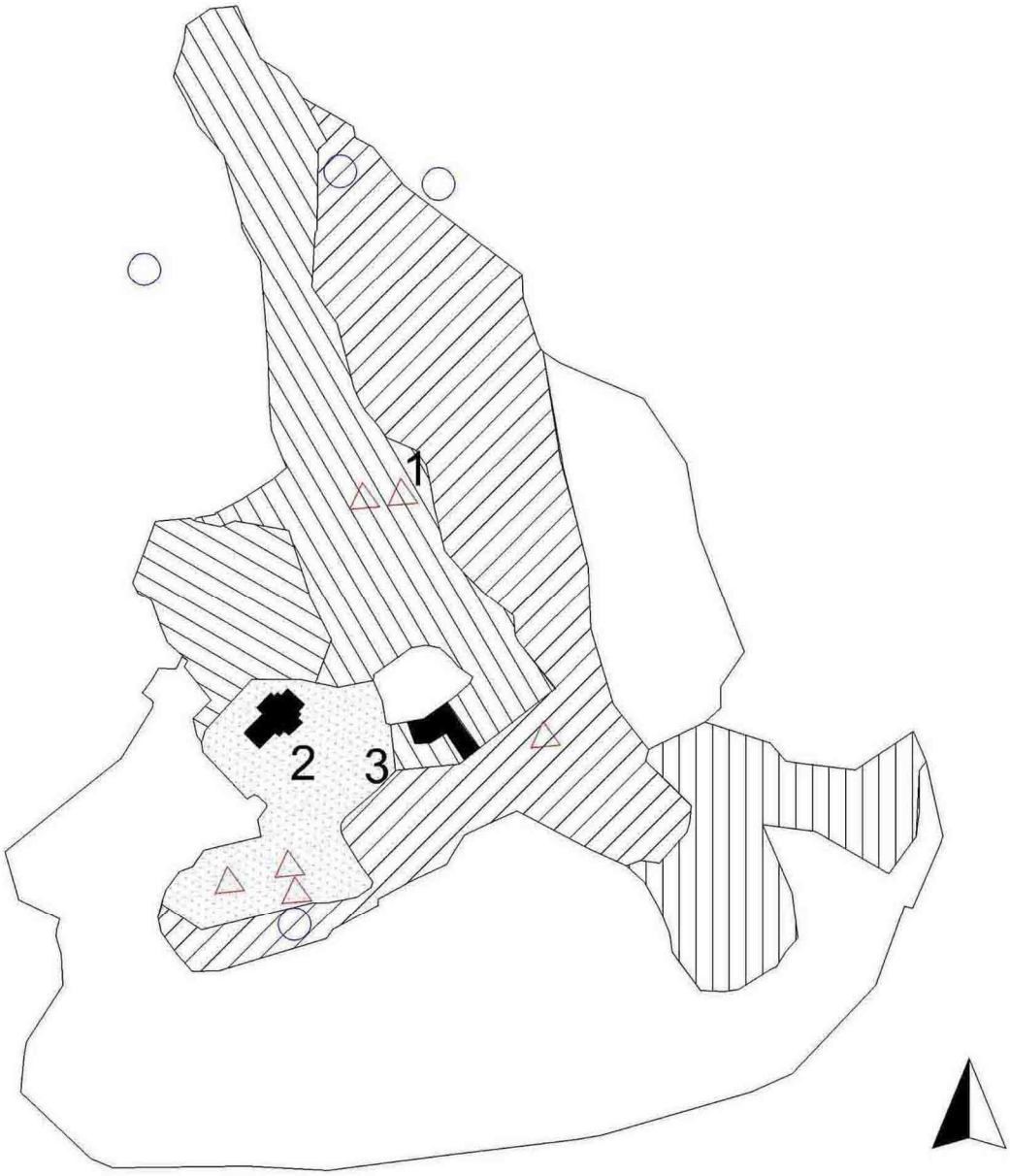


Fig.2 – Distribution of the findings related to Etruscan and Roman times in the city. Triangles indicate structures related to the colony settlement, circles roman necropolis. 1: San Donato Arch; 2:Hills of the Cathedral and of Santa Maria; 3: Via di Stalloreggi (from CRISTOFANI 1979).

San Donato Arch

The presence of this structure is not evident in itself, but can be noted observing the vestments of two medieval towers located at the beginning of Via dei Montanini (nn. 1 and 16) in the northern part of the city. The existence of the arch is witnessed by two notarial acts dating to December 1012 and March 1087 (ASF Passign. 1012 dicembre and 1087 marzo, in PRUNAI 1990). The second one is particularly interesting, as it says

"*Actum Sena juxta ecclesia de S. Donato q. est prope arco antico* "

(PRUNAI 1990)

and testifies to the antiquity of the building compared to those located nearby. Historians and local scholars provide also information about the vicissitudes that led to the demolition of the structure and propose hypotheses on both its conformation and role within the urban fabric of the colony. Their interest arose from the presence of another witness: the inscription walled on the tower at number 1 (CIL XI, 1814), consisting of two pieces of travertine, presumably belonging to the underside of a lintel (Fig.3).

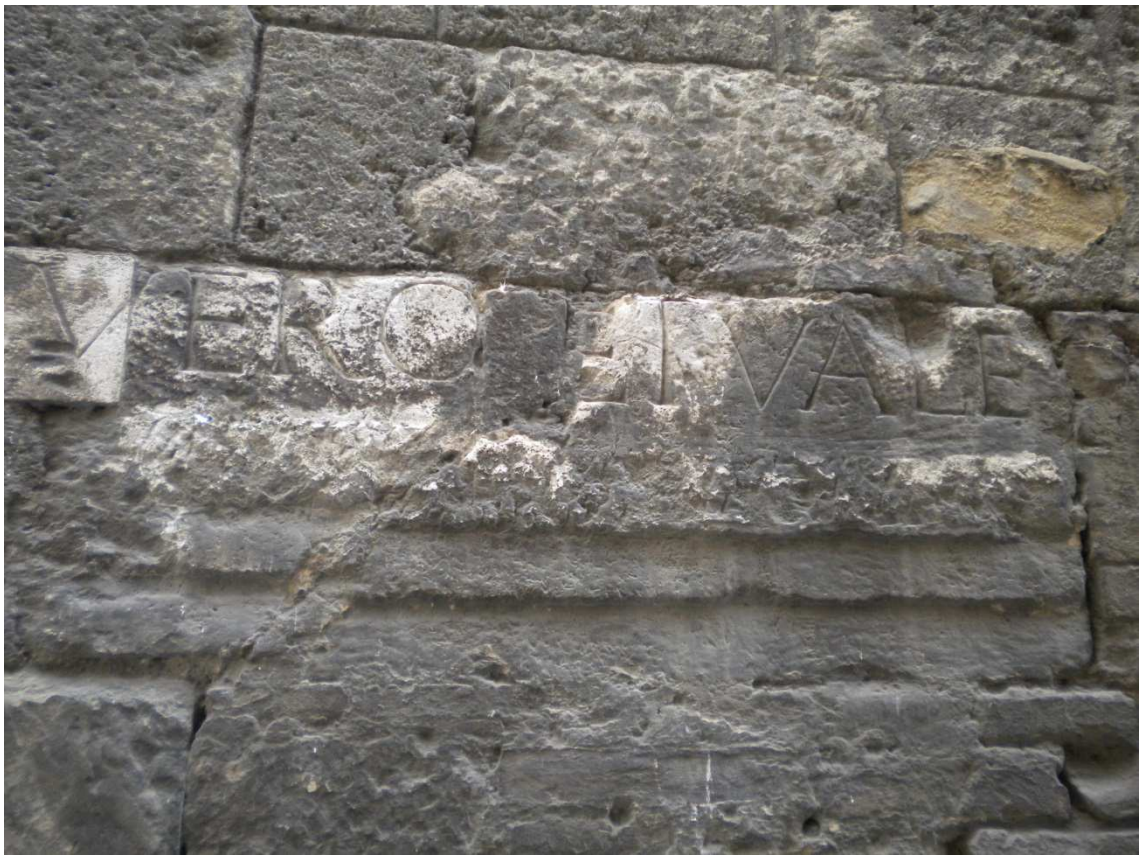


Fig. 3 – The inscription walled in the western tower.

Moreover, a conspicuous reuse of ancient building materials is clearly visible on the vestments of the eastern tower, with ashlars of travertine, limestone, bricks and earthenware. The presence of antique materials in this structure and in other ones all along the city was already noted and studied (PARENTI 1988, 1992a, 1992b, 1996). Starting from the data obtained from these former researches, we tried to reinterpret an already known structure through the application of new methods and to propose a new synthesis.

The methodology

The analysis of wall surfaces was mainly focused on those areas where Roman materials were evidently reused in the construction of the two towers. Another important part of the study was the measurement of the ashlars constituting the walls and their components.

The buildings were analysed through a topographic survey and close-range photogrammetric instruments and software. The topographic survey with total station identified 92 GCPs, that were then combined with the pictures taken with a high-resolution SLR camera with fixed specially calibrated optics of 60 and 28mm.

ZScan (Menci Softwares) is a 3d scanning instrument for point cloud acquisition through digital cameras, slide bar and software packages. Every portion of the surface must be photographed 3 times from 3 different positions depending on the distance between the camera and the surface. The reflex was positioned on a precision slide 900 mm long fixed on a professional tripod. This equipment allowed pictures of the wall surfaces to be taken from distances ranging from 0 -0.2m to more than 9 m: the slide, in fact, has numbered holes on which we could place the machine according to the distance from the surface that had to be photographed.
Data recording was carried out through special recording sheets made by the University of Siena LAArch(Archaeology of Architecture Lab); the images were then processed with two specific software packages for the creation and post-processing of point clouds from frames.
ZScan software allowed to obtain georeferenced models of portions of the structures in the form of RGB textured point clouds. The association of the topographic coordinates, however, was only carried out where it was possible and usefu. Making a photographic survey of high structures from the ground generated a distortion of the images that made it slow or even impossible to locate them in geo-referenced space. This led to a placement of the survey points on those triplets -above all the lower parts of the structures- that would ensure the least possible error in their positioning (with a maximum gap of 2-3 mm). For the other parts geo-referencing was not carried out and models were linked to each other through the identification of common points during the post-processing with another software, ZMap. The partial models obtained (Fig.4) have then a degree of metric accuracy that is dependent on the distance between the camera and the object, on the baseline chosen and on the type of lens that was used. Consequently lower parts that were photographed at lower distance and with a frontal shot have high accuracy and definition, while higher ones offered good results even if with less texture and metric accuracy. As a result of these difficulties, the model of the western tower was affected by a lack in the highest part (Fig.5).

The results

From the 3d models it was possible to obtain different products: orthophotos, DEMs and wall profiles. Orthophotos were created through a specific function of ZMap and then imported into CAD environment where they have been vectorized (Fig.6). With the DEMs it was then possible to verify the accuracy of the collimation process and observe the wall profiles.

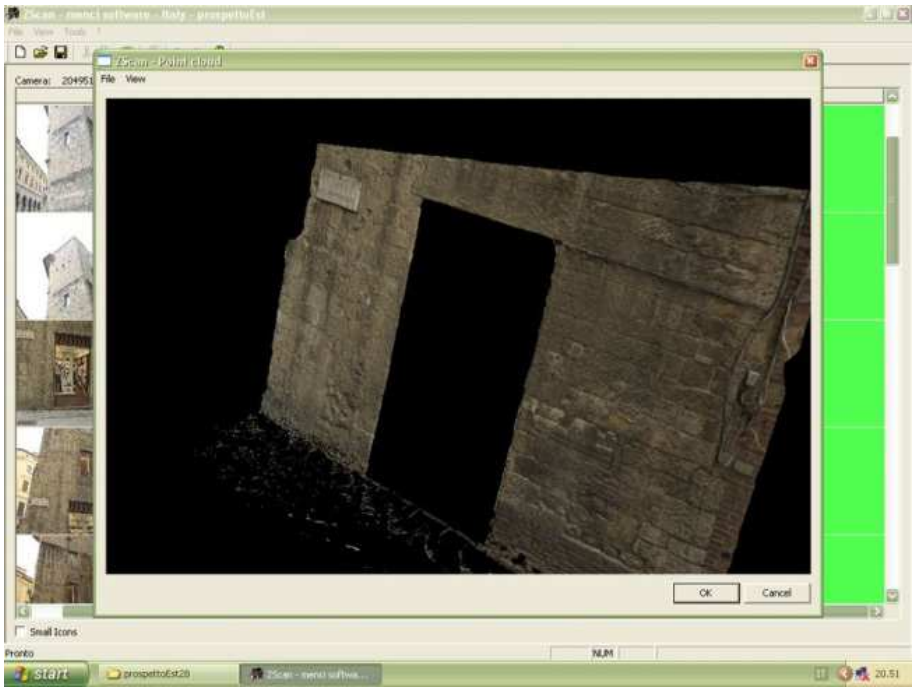


Fig. 4 – Partial model of one of the two buildings obtained at the end of the processing in ZScan.

Fig. 5 – 3d models obtained

Fig. 6 – Orthophoto, vectorization of the components of the wall and application of stratigraphical method on one side of the eastern tower.

Stratigraphical analysis of walls was performed in both the three-dimensional environment and orthophotos. The 3D wireframe was obtained by a vectorization in ZMap that allowed volume and depth variations on the surfaces to be observed and represented. The wireframe has also been linked to the digitisation of the cadastral map of the area using CAD in order to have a more complete view of the structures in their relationship with the urban environment (Fig.7).

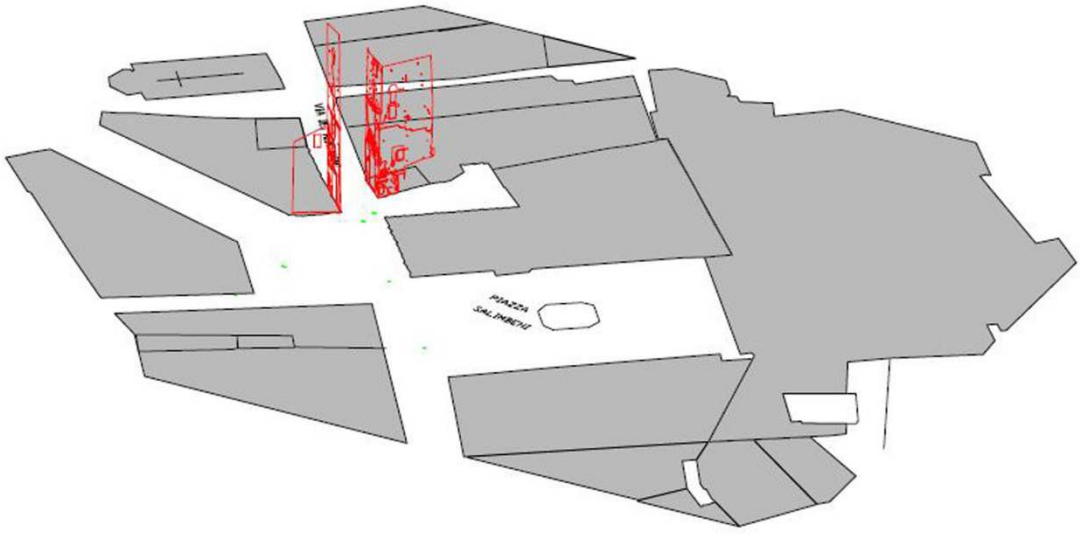


Fig. 7 – 3d wireframe in the cadastral map of the area.

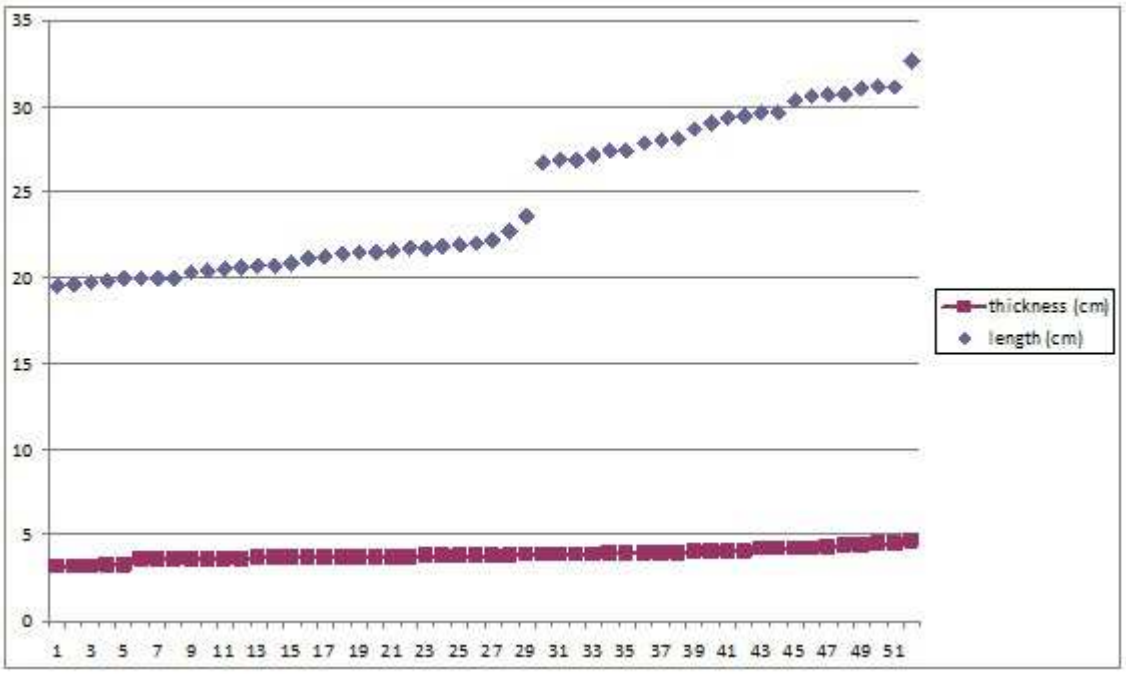
As already said, reused materials are a distinctive feature of the walls of the two towers that allowed the presence of an ancient structure to be recognized.

Fig. 8 – South wall of the east tower, built with reused materials.

Bricks are particularly important, as they constitute the majority of the materials that were reused in the construction. On one of the vestment of the eastern tower (Fig. 8), they seem to have been cut, squared and smoothed as stone ashlars, while on the façades of both the buildings they are clearly visible as remains after the destruction of the arch (Fig.9).

The bricks of the eastern tower were analyzed in order to create a preliminary measuring study. The importance of this kind of investigation lies in the possibility of connecting production trends to a precise chronological range (MANNONI 1984; MANNONI & MILANESE 1988) through the collection of data on regional scale. For this reason, these measurements only want to give a first basis for a future and more detailed research that takes into account the entire geographical area of Siena. As they were all walled, it was only possible to measure their length and thickness. The results obtained reveal the presence of two dimensional series characterised by a similar average thickness of 3.9 cm and length of 20.8 and 29.1 cm (Tab. 1).

Fig. 9 – The remains of the arch on the façades of the two buildings.



Tab.1 – Graph of length and thickness of bricks.

We can exclude a link between these measures and those identified for brick production in Medieval Siena, which are quite different: the size Thirteenth century bricks, in fact, is on average 28.3 / 28.5 x12, 5/12.7 x5, 8 / 6.5 cm (CORSI 1991).

The bricks used in the eastern tower are probably a local production as they do not correspond to measures of standard Roman bricks (*bessales*, *sesquipedales* and *bipedales*). They are either rectangular (20.8 x 29.1 cm) or square (20.8 x 20.8 cm) even if they they were cut on the diagonal as in Roman brick construction. The rectangular module of 20.8 x 29.1 cm has similarities with *sesquipedales semilateres* produced in Vingone near Florence, of 29 x 20.6 x 7.5 cm (SHEPERD *et al.* 2006), while the square bricks broken in two can be seen as a decorative element of the overhang of a tower in Siena (Via Stalloreggi, 2) where the reuse of Roman materials has been recognized.

The reconstruction

The hypothetical reconstruction proposed only tries to give reference to the form of the complex. The faint traces left do not allow us to go beyond the determination of height and width of the arch. On the façade of the eastern tower it is possible to observe the trace of the springing of the arch (located at 7.6 m from the present level of the ground) and of the curve of the intrados, while on the western tower the visible part of the structure belongs to a higher portion of the intrados. The reconstruction started from the determination of the ancient floor level, obtainable by observing the limit of the restoration on the lower parts of the towers, attributable to the foundation level and located approximately 3 m higher than current street level. Starting from the wall profiles, obtained through the DEM, it was possible to make a drawing in CAD of the hypothetical structure.
What emerged was a structure with a springing line of 4.7 m and maximum height of 4.5 m, close to the Roman measures of 16 and 15 feet (Fig.10).

Interpretation

According to the traces of urban settlement, it is not possible to identify the arch as a city gate: archaeological data point out, in fact, a higher concentration of remains on the hills of the Cathedral and Santa Maria, that can be considered as the first nucleus of the Roman settlement (PALLECCHI 2006, LEONCINI 1998). It can be assumed therefore that our arch could be collocated in the suburban area of the city, out of the zone of main concentration of urban life. The findings related to this zone of the city are much less numerous and especially connected to a necropolis. The construction of arches in extra and suburban areas was identified as an innovation introduced at the end of Republican period or in the Augustan age (SCAGLIARINI CORLAITA 1979). The main feature of these structures was to signal the passage from an area closer and linked to the activities of the city to another with different functions. Among these Frothingham (1905) identified a specific group of civic monuments presumably built during the foundation of a colony or significant changes in its framework, which function was to indicate the end of urban jurisdiction. Furthermore, if placed in the vicinity of necropolis, they would constitute at the same time the prolepsis of the city gate and the door of the necropolis. As an example we can cite the arch of *Glanum* (Saint-Rémy-de-Provence, France) and the mausoleum of the Julii, located just 13 m outside the *pomoerium* (SCAGLIARINI CORLAITA 1979). Although we do not have similar structures in the same *regio* that could endorse our hypothesis, on the basis of these data we can suppose that the construction is referable to this particular

type of honorary monument with the function of signalling the end of *urbanitas* and at the same time the beginning of the area reserved for the necropolis. In absence of archaeometrical analysis, it is not possible to propose a precise date to the arch. Nevertheless, the reused materials of the vestments clearly indicate that a Roman structure existed and was partly incorporated during the construction of the two medieval towers.

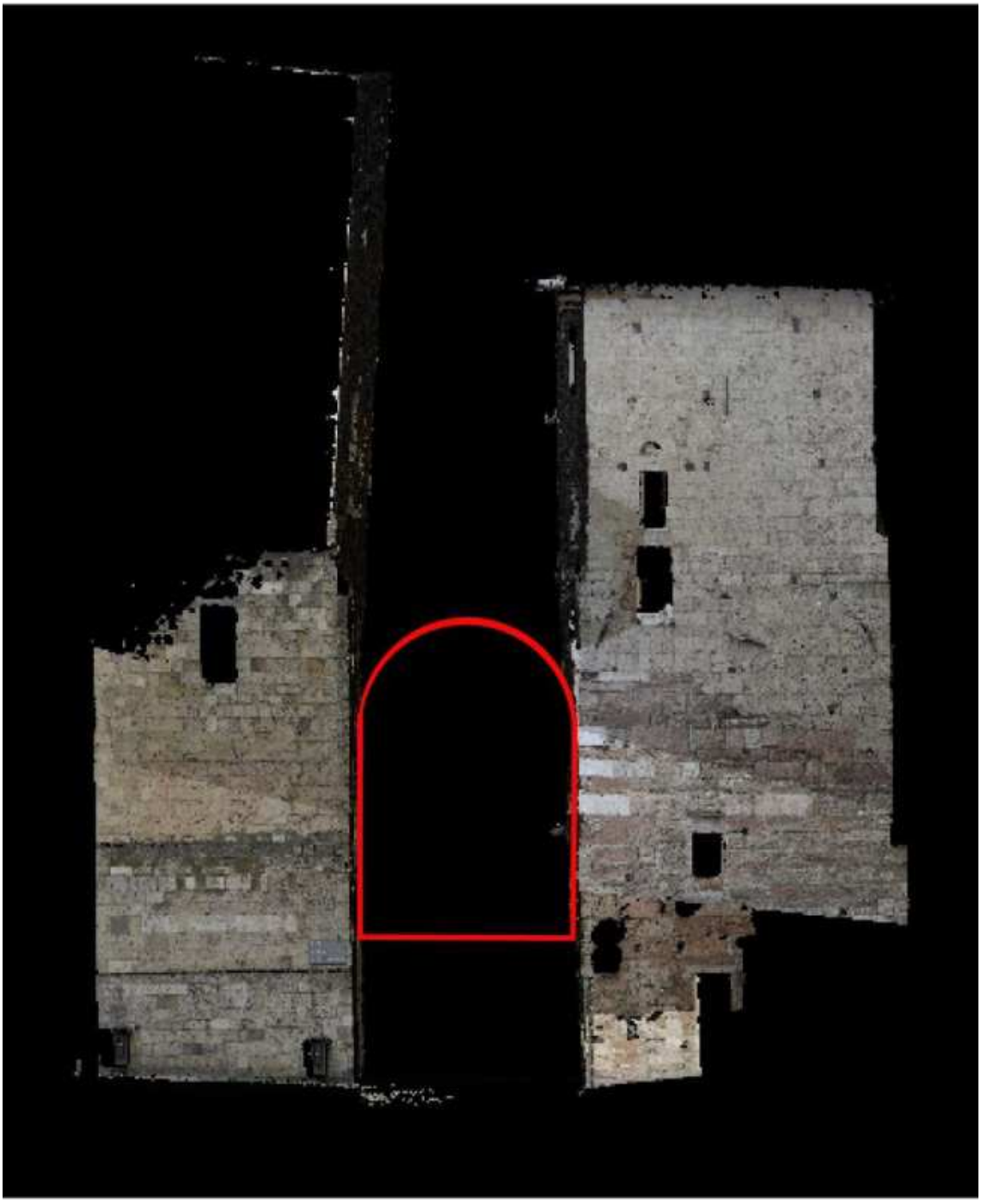


Fig. 10 – Hypothetical reconstruction.

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Imprint:
Proceedings of the 17th International Conference on Cultural Heritage and New Technologies 2012 (CHNT 17, 2012)
Vienna 2013
http://www.chnt.at/proceedings-chnt-17/
ISBN 978-3-200-03281-1
Editor/Publisher**:** Museen der Stadt Wien – Stadtarchäologie
Editorial Team: Wolfgang Börner, Susanne Uhlirz
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