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FORM AND FUNCTION IN ROMAN PUBLIC ARCHITECTURE OF THE LATE REPUBLIC. THE EXEMPLARY CASE OF THE *PIAZZA POZZO DORICO* SUBSTRUCTURES IN CORI

1. Introduction

Cori, an ancient Latin city at the southern border of the *Latium Vetus*, still preserves a very rich archaeological and monumental heritage, evidence of a prestigious past that left considerable traces during the ancient, medieval and modern ages (Palombi 2013). Its foundation is variably attributed by ancient authors to the mythical figures of *Dardanus*, ancestor of the Trojans (Plin. *Hist. nat.* 6, 68; Solin. *Collect*. 2, 7), *Latinus Silvius*, descendant of Aeneas and fourth king of *Alba Longa* (Verg. *Aen.* 6, 775; Diod. 7, 5, 9; *OGR* 17, 6), or the eponymous Argive hero *Coras* (Serv. *ad. Aen.* 7, 672).

Some of the most important remains of the Roman city, called *Cora* in ancient sources – the origin of the name is unclear, but it is certainly related to the Italic linguistic substrate – are the Doric tetrastyle Temple of Hercules (Fig. 1) on the acropolis (a splendid example of Italic architecture from the late Hellenistic period, declared a national monument in 1898), the surrounding walls (originally extending for about 2 km, enclosing an area of almost 22 hectares) and the internal terracing in polygonal masonry, the hexastyle Corinthian temple dedicated to Castor and Pollux, the *Ponte della Catena*, and the *piazza Pozzo Dorico* substructures (the square is called *platea putei donici* in ancient documents, from *puteus do(mi)nicus*, "the *dominus*' well", from which the dialectal toponym *Pizzitónico* originates: Caratelli 2015).

This latter monument, so little known until a few years ago (Vittucci 1966, 18; Brandizzi Vittucci 1968, 48-52; De Rossi 1980, Pl. VI; Coarelli 1982, 256-258), has been recently at the centre of a renewed archaeological interest, which produced a detailed topographic survey and a meticulous analysis of the masonry work (unfortunately, still incomplete in some less accessible areas: Caratelli 2011). The results obtained have formed the basis for the additional studies presented in this paper, which is aimed at enhancing the existing research work, using a purely metrological approach in order to extend the possibilities for analysis provided by a precise knowledge of the geometric layout of the substructure complex. Finally, from the shape of the monument, the analysis will shift to the functional aspects of this apparently simple architectural organism, whose specific use, apart from the sector occupied by the large three-room cistern, is still unclear.

Fig. 1 – The so-called Temple of Hercules (photo by the author).

2. The substructure complex

2.1 *Structural features*

As mentioned before, the *piazza Pozzo Dorico* substructures represent one of the most significant examples of public architecture in the ancient *Cora*. The central position, at the bottom of the imposing terracing system in polygonal masonry supporting the large rectangular area (about 150×30 m) where the *forum* is usually located (the present-day *via delle Colonne*), as well as the vastness of the space occupied (more than 1000 m^2) and the design and technical effort involved in its establishment, place this building among the most important infrastructural works of the late Hellenism in southern Latium (on the topic, in general, see Cifarelli 2013).

After the recent investigation of the cistern (a preliminary report is now available in Caratelli 2019), the plan of the entire complex is now known with certainty (Figs. 2-3). It is formed by seven rooms with barrel vault,

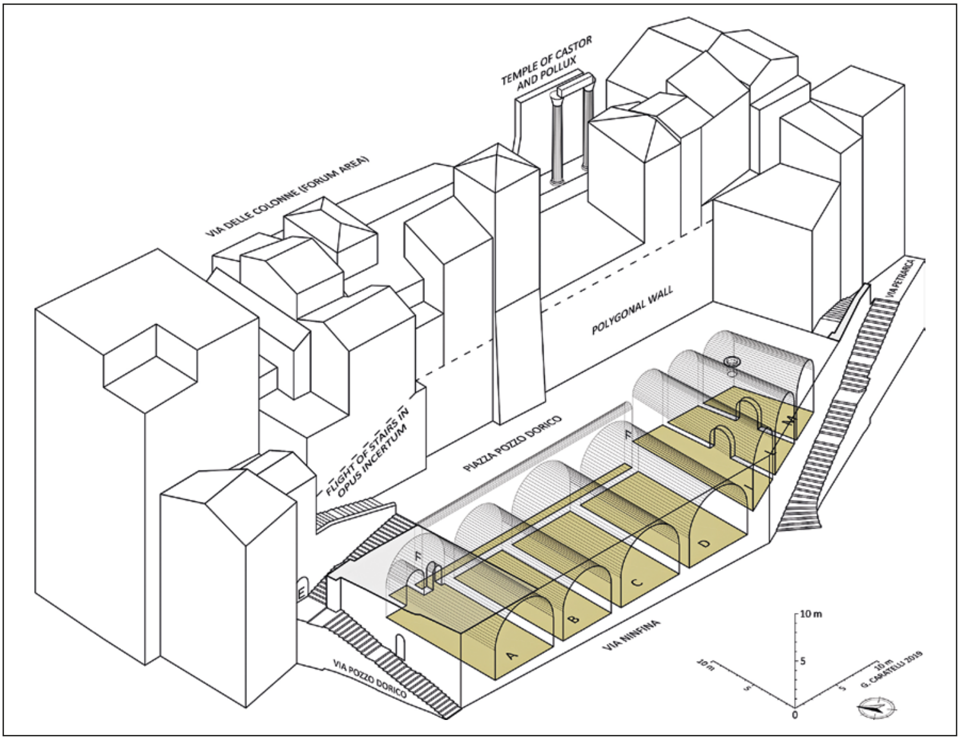

Fig. 2 – Isometric view of *piazza Pozzo Dorico* seen from the W (survey by the author).

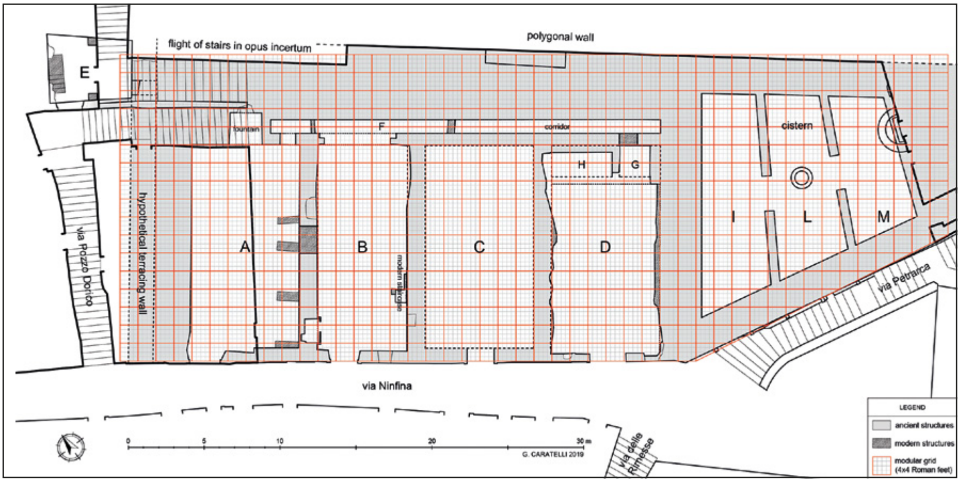

Fig. 3 – Plan of the *piazza Pozzo Dorico* substructures (survey by the author).

four of which (A-D) face present-day *via Ninfina*, while the remaining three (I-M) are flanked by the *via Petrarca* staircase and closed all around. Finally, a cavity, or corridor (F, about 25 m long and 0.90 m wide), runs behind the first four rooms, isolating the substructure complex from the cut slope of the hill. The wall facings, in *opus incertum* with small blocks of limestone or sometimes tuff, are very poorly preserved almost everywhere, except for the side towards *via Petrarca* and the walls of the corridor, since it had been probably inaccessible or unused for a long time. The laying of the stones is always very accurate, but clear formal differences can be noticed between the facing of the internal and external walls. The former, indeed, have larger stones, laid with more mortar, while the latter are characterised by the use of smaller stones with homogenous size, laid out so as to minimize the thickness of the mortar junctions. All the rooms are covered with barrel vaults made of concrete laid on a wooden centring and formed by limestone and tuff *caementa*, distributed radially along longitudinal rows. By the edges of the structure and by the piers and arched lintels tuff blocks were used, whose exposed surfaces show high corrosion.

2.2 *Description of the substructure rooms*

Excluding rooms B and C, irreparably compromised by numerous modern construction works, a synthetic description will be made of the remaining ones, starting from A. The wall to the left of the entrance and the one at the back show a 33 cm high horizontal course of tuff blocks at about 1.20-1.30 m from the modern walkway surface. On the right wall, instead, we can notice a passage (1.80 m by 2.30 m), now closed, which formerly connected rooms A and B. Finally, at the centre of the back wall, a deep square-layout recess opens (side about 2.5 m; height 2.65 m), covered with a barrel vault, which certainly contained a fountain. This is confirmed by the presence in the corridor wall (F) of two parallel grooves, which reach the recess. They were used to hold the pipes gathering the water from the nearby cistern. The presence of the corridor, faintly lightened and ventilated by the small circular holes placed at regular intervals on the covering vault, ensured a complete inspection (and therefore maintenance) of the entire water distribution system.

Room D, instead, is distinguished on the outside by a large and more recent arch built with small rectangular tuff blocks, while on the inside there is a modern plastering that makes it very difficult to inspect the masonry. Nonetheless, to the right of the entrance, next to the wall that divides the room from the nearby cistern, a square-layout recess (1.20 m wide, 1.45 m deep) can be noticed, covered with barrel vault and marked by a tuff arch supported by tuff piers. At the bottom of the room, in correspondence with the corner formed with room C, there are the remains of a passage, built with the usual technique using tuff blocks and radial ashlars, while on the opposite

Fig. 4 – *Piazza Pozzo Dorico* substructures seen from above (photo by Giuseppe Guratti).

side an entrance to the corridor can be noticed, partially blocked by a low infill. Both passages are nevertheless respected and planned by the series of structures, again in *opus incertum*, distributed orthogonally and in parallel with the back wall of room D, dividing the space in two smaller rooms (H and G in Fig. 3), covered with barrel vaults.

Leaving the main sector of the substructure complex (the four rooms facing *via Ninfina*) and going up in *via Pozzo Dorico*, one reaches a non-ancient room (E), where an *opus incertum* masonry can be seen. Most probably, this masonry is the external face of the thick retaining wall, limiting the large terrace of *piazza Pozzo Dorico*. This hypothesis is confirmed by the fact that this wall is cut twice by *via Pozzo Dorico* and its remarkable thickness (slightly more than 1.60 m) can be appreciated, which is certainly due to the retaining and closing function we mentioned earlier. Furthermore, since the direction of the wall is exactly the same as that of the longitudinal walls in rooms A-D, it is logical to conjecture that originally it would extend until reaching *via Ninfina* and orthogonally crossing the main façade of the complex (Fig. 3). Therefore, while considering the gap between this area and the left wall of room A (about 4 m), it is equally logical to suppose that also in this sector of the complex (as on the opposite side facing *via Petrarca*) there was a connecting path (probably a staircase, given the considerable slope)

Fig. 5 – Comparison between the direct survey and the orthophotomosaic generated from aerial photographs taken by drone.

between the *via Ninfina* level (which is practically the supposed ancient level) and that of the square. This hypothesis is also based on the fact that the still visible *opus incertum* staircase, connecting the ancient square with the higher terrace, starts precisely from this side (Figs. 2-5).

3. Planimetric study

3.1 *Unit of measurement*

It is well known that Roman architecture is based on modular composition (Kurent 1968). Therefore, one cannot claim a deep understanding of a Roman architectural organism, even the simplest one, if one does not identify the basic compositional unit (i.e., the module) from which the whole originated. However, in this case study, before identifying the module, we should first verify that the survey used for this purpose has a sufficient level of metric reliability (an essential condition to base any reasoning on); then we should ensure that the building was planned and sized according to the Roman metric system, whose unit of measurement is the foot, equal to 0.296 m (Lugli 1957, 188-193). In fact, since the available survey was completed a few years ago without using precision topographic instruments, it would be safer to perform a new survey campaign, although it would take too long in terms of acquisition and processing time. Therefore, as a preliminary step, it is sufficient to compare the old data with those obtained from a quick photogrammetric survey, carried out by flying over the concerned area with a drone.

The result of this comparison (which can be seen and assessed in Fig. 5, where a substantial consistency between the results of the two surveys emerges), being absolutely reassuring and, in many respects, completely satisfactory, allows us to continue in this metrological investigation and perform the second and important verification: identifying the system of measurement used in the design phase of the *piazza Pozzo Dorico* substructions. In order to do this, it is enough to measure some distances between points (only a few, given the abundance of post-ancient additions) that are located with certainty on the original facing of the ancient walls: the width of the back wall of room A (measuring 7.111 m), the width of the recess with fountain (2.078 m) and the width of the passage opening between room D and the corridor (1.186 m). By dividing these measurements by a Roman foot, the results we obtain are very close to integer numbers (24.024, 7.020 and 4.006). This leaves no doubts about the use of the Roman foot as a measurement unit to size the monument.

3.2 *Module*

By limiting the analysis, for the moment, to the regular sector of the rooms facing *via Ninfina*, we can now include a grid in the plan with one Roman foot wide spacing (Fig. 3) and we immediately notice some significant coincidences. Indeed, all the wider sides of the rooms fit almost perfectly with the grid, and this is also the case for the back sides or the passages (such as the one between rooms A and B, now closed, and the one between room D and the corridor). If we convert the measurements to Roman feet, we also obtain all integer numbers: the width of rooms A-D equals 24 feet, except for B that is 20 feet wide; the length of the rooms, measured from the external façade of the back wall, is exactly twice as large, that is 48 feet, while the dividing walls are 4 feet wide, just as the passage opening between room D and the corridor. This circumstance, therefore, leads to assume that, during the planning of the building, a 4 feet wide square module was used, which matches the thickness of the dividing walls.

On a more general level, instead, we can trace at least two compositional patterns, which may have played a crucial role during the planning of the substruction complex. Indeed, if we consider the façade and the back wall of the rooms, excluding the dividing walls, we can outline four rectangles measuring 48×24 feet (that is 12×6 modules; see Fig. 6a). If, instead, we also include the dividing walls in the pattern, we can trace four more rectangles measuring 52×26 feet (13×6.5 modules; see Fig. 6b). However, in both cases, the geometrical shape that would have originated the plan of rooms A-D would be a rectangle with the longer side twice as wide as the shorter side, thus it would be a rectangle formed by two squares.

Up to this point, however, there is not anything particularly extraordinary, given the regularity of rooms A-D. Something quite surprising, instead,

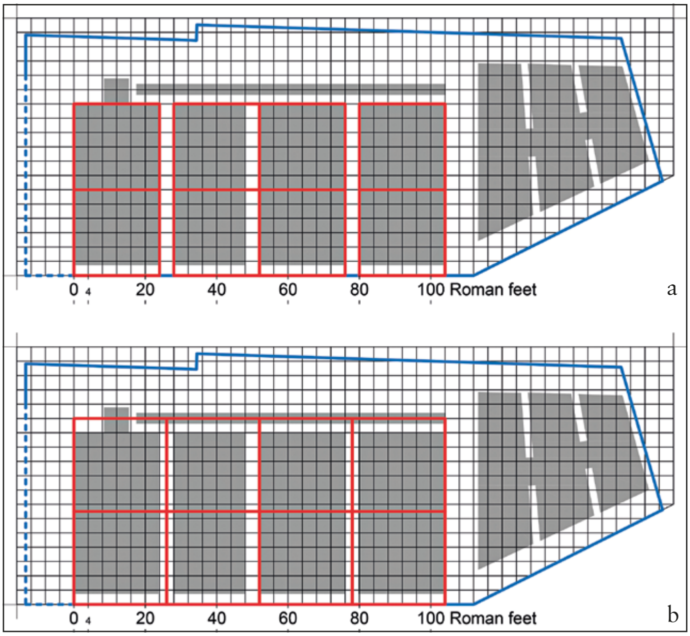

Fig. 6a-b – Two compositional patterns for the planning of rooms A-D.

occurs when we shift our focus to the other sector, the one with the reservoir rooms (I-M), which at first sight appears to be highly irregular. Indeed, the plan of the reservoir is very peculiar: the NE side is parallel to the terracing in polygonal masonry, which supports the *forum* area next to the temple of Castor and Pollux; the NW side follows the perimeter wall of room D, while the S side generates the oblique route of modern *via Petrarca*; finally, the E side also has its own direction, meaningfully matching the orientation of the façade of the private house on the higher level, where the square is (Fig. 3). The separation walls are instead arranged radially, and divide the NE and S sides into three equal parts, generating the three rooms that communicate by means of arched passages, placed along one of the median axes of the reservoir (for more details Caratelli 2019).

However, in spite of this irregularity, the reservoir appears to be planned based on a geometric pattern that closely recalls the design logic that we already mentioned in reference to rooms A-D, and that, for the sake of simplicity, we could define as "double square" logic. Indeed, the perimeter walls of the large water reservoir (except for a few imprecisions, probably due to the modern cladding), can be perfectly fitted into a square with the side equal to the length of the NW perimeter wall of the reservoir (Fig. 7). Furthermore, if this square is

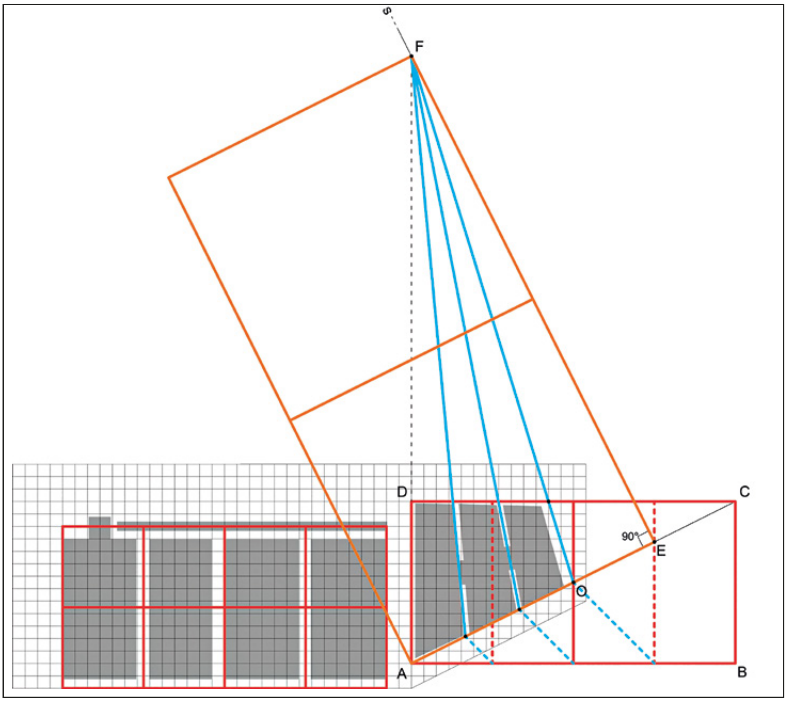

Fig. 7 – Geometric construction for the planning of the cistern rooms.

duplicated, we obtain a rectangle whose diagonal was used to design the S side of the cistern. Finally, to obtain the sizing of the other perimeter walls and of the separation walls, we need to perform the following geometric construction:

1) we identify the median point E of the half-diagonal of the rectangle ABCD;
2) from this point, we trace a half line (s) forming a 90° angle with the diagonal;
3) we stretch the segment AD, corresponding to the NW perimeter wall of the reservoir, until it intersects the half line defined in 2;
4) from intersection point F, that represents the vertex of a right triangle (AEF), we trace a segment ending in the centre (O) of the rectangle, thus obtaining the NE and E perimeter sides;
5) finally, for the dividing walls, it is sufficient to divide into three equal parts (using Thales's theorem) the half-diagonal AO of the rectangle, corresponding to the S perimeter wall of the reservoir, and then connect the extremities of the central segment with the vertex F of the triangle AEF.

Therefore, as we can see, even if it is rotated by a 90° angle, the "double square" pattern is also the basis for the architectural composition of the quadrangular cistern. It is remarkable to notice that the positioning of the dividing walls is also based on this general logic, because the right triangle whose vertex originates the segments dividing the reservoir in three rooms is similar (according to the first similarity principle, which states that if two triangles have two equal angles then they are similar) to the two right triangles with the diagonal of the "double square" as their hypotenuse.

4. Form or function?

Having reached this point, it is reasonable to ask ourselves what is the role of the functional aspect of the building in the context of the design process, considering the unquestionable importance of the geometrical basis in the planning. Actually, in order to thoroughly and safely investigate this matter the substruction complex should be entirely known. However, the lack of strong clues about its general and specific use (except, of course, for the reservoir, the fountain in room A and the corridor), dictates a limited and partial treatment of the matter, which is nonetheless interesting and meaningful. If, indeed, we consider only the plan of the sector with the reservoir, the oblique front of the S side (the one towards *via Petrarca*), although being based on the diagonal of the "double square", also has a precise functional value. This is because, as I have already explained elsewhere (Caratelli 2019), its oblique direction, with respect to a perfectly orthogonal path, enables the reduction of the slope of the street (from 40% to 27%) that in ancient times ran along the substruction complex (modern *via Petrarca*), thus allowing to overcome the difference in height of about 8 m between *via Ninfina* and the square. Naturally, this need could have been generated by the will of endowing the square with a passage for vehicles.

However, the will to section the inside of the large cistern with radially distributed walls still seems elusive. Indeed, this choice has certainly required a substantial technical and financial effort to build the three conical centring used to lay in place the vaults of rooms I-M. Furthermore, we can notice that a very similar result (especially in terms of the cistern's capacity) could have been obtained perhaps by using a series of rooms with rectangular layout (so, with simple cylindrical vaults), parallel to rooms A-D. On the contrary, the implemented design choice, considering the distinctly practical purpose of the sectors used for the cistern (where one would therefore expect function to "dominate" over form), would be explained logically only in a formal perspective. Therefore, we can legitimately ask: is this pervasive attention to the formal result in designing the cistern due to a purely creative or cultural approach completely deprived of functional meanings? In my opinion, the answer could be affirmative, at least according to the current knowledge about the building, which, we have to admit, surely extended beyond the cistern (towards SE).

In fact, if we recall some concepts cherished by Vitruvius and by the late Hellenistic treatises that informed his works, the unknown architect of the *piazza Pozzo Dorico* substructions seems to be perfectly in line with the guiding architectural principles described by the author of *De Architectura*. Let's consider, for instance, the concept of *symmetria* (Gros 1997, LIV-LX), representing the general criterion that every architect should carefully implement when designing any type of building. It recurs several times in the treatise (see mainly Vitr., 1, 2, 4; 3, 1, 1) and, despite some difficulties in its interpretation (the Greek word συμμετρία, as noted later by Plin., *Hist. Nat.*, 34, 65, does not have an exact translation in Latin, and the one used by Vitruvius, *commodulatio*, is only a calque) refers to the system of proportional ratios (see Vitr. 3, 1, 1: *ea autem paritur a proportione*) that in any building would enable to establish a relationship between any element and other elements or the whole, and vice versa.

This would be, therefore, the modular composition principle, where the module would represent a sort of minimum common denominator of the entire building. Well, the *piazza Pozzo Dorico* substructions are an excellent example of application of the *symmetriarum ratio* (or *ratiocinatio*) exposed by Vitruvius. Indeed, in the block formed by rooms A-D we can recognise a square module with a side of 4 Roman feet, which is the basis for the sizing of the rooms themselves, as well as the dividing walls and the communication passages. This sizing is not random at all, but involves a mathematical ratio of 1:2 between the width and the length of the individual rooms and the entire building. From the geometrical point of view, this is equivalent to applying a compositional pattern based on a rectangle formed by joining two squares. Surprisingly, this pattern is also found in the cistern rooms, where the placing and sizing of the perimeter and dividing walls is obtained in a purely geometrical way, based on a rectangle with the longer side twice as large as the shorter side, perfectly comparable with the one already identified for rooms A-D.

5. Conclusions

The motivations and the potential of this study should now be clearer, although the research will need to be further explored and refined. The planimetric study of the *piazza Pozzo Dorico* substructions, indeed, can provide a useful benchmark to investigate the tendencies and cultural background of Roman architects in the late Hellenistic period. For example, it is surprising that in an engineering work (a substruction complex), rather than a strictly architectural one (although anciently the two fields were practically the same), a purely formal approach prevails over a functional one. However, the planimetry of the entire building seems to find a satisfactory inspiration principle only in the modular and geometric pattern we identified, that represents at several levels (from individual rooms to the complete building) the true leitmotiv of the whole construction.

This study, therefore, even if it does not provide further indications about the ancient use of all the rooms of the complex (as it would have been desirable), offers the quite rare possibility of knowing the creative horizon and investigating the *modus operandi* of an unknown Roman architect of the late Republican period.

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REFERENCES

Brandizzi Vittucci P. 1968, *Cora. Forma Italiae, Regio I, V*, Roma, De Luca.

Caratelli G. 2015, *Pizzitónico, Pozzo Dorico, il Piglióne. Storia, erudizione e archeologia attraverso l'etimo di alcuni toponimi di Cori*, «Annali del Lazio Meridionale. Storia e Storiografia», 29, 7-28.

Caratelli G. 2011, *Cori: le sostruzioni di piazza Pozzo Dorico*, «Archeologia Classica», 62, 413-444.

Caratelli G. 2019, *Le sostruzioni romane di piazza Pozzo Dorico a Cori. Nuovi dati dall'esplorazione della cisterna*, «Annali del Lazio Meridionale. Storia e Storiografia», 38, 5-22.

Cifarelli F.M. (ed.) 2013, *Tecniche costruttive del tardo ellenismo nel Lazio e in Campania. Conference Proceedings (Segni 2011)*, Roma, Espera.

Coarelli F. 1982, *Lazio*, Roma-Bari, Laterza.

De Rossi G.M. 1980, *Lazio meridionale*, Roma, Newton Compton.

Gros P. 1997, *Vitruvio e il suo tempo*, in P. Gros (ed.), *Vitruvio, De Architectura*, Torino, Einaudi, I, IX-LXXVII.

Kurent T. 1968, *La legge fondamentale della composizione modulare*, Torino, Edizioni Quaderni di Studio.

Lugli G. 1957, *La tecnica edilizia romana con particolare riguardo a Roma e Lazio*, I, Roma, Giovanni Bardi Editore.

Palombi D. (ed.) 2013, *Cori: la città come museo*, Cori, Teameia Cultura.

Vittucci P. 1966, *Cori*, in *Studi di urbanistica antica*, Quaderni dell'Istituto di Topografia Antica della Università di Roma, 2, Roma, De Luca, 13-20.

ABSTRACT

The *piazza Pozzo Dorico* substructures in Cori (the ancient Cora, a Latin city at the north-western slopes of the Lepini Mountains) represent a remarkable example of Roman public architecture of the Late Republican period. They are situated at the bottom of a secular and imposing terracing system, distributed on at least three levels. This paper aims at identifying the modular schemes, geometric shapes and proportions governing the layout plan of this monumental infrastructure, based on recent topographic surveys and new metrological considerations. Finally, it will investigate the relationship between the layout of the archaeological complex (apparently quite simple) and its function (still largely unknown), in order to attempt to identify the several formal and functional components that played a decisive role in the development of the original project.