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3D INDOOR ARCHAEOLOGICAL SURVEY OF THE ANCIENT WALL-SYSTEM OF THE ROMAN RUINS: VILLA OF THE QUINTILI UNDERNEATH VILLA MONDRAGONE

Saverio D'Auria, Rodolfo Maria Strollo**

* LAREA, Engineering Macroarea, University of Rome 'Tor Vergata' – Rome, Italy.

Abstract

The first unit of Villa Mondragone was built in the last quarter of the sixteenth century and was partially founded on the ruins of an ancient Roman Villa, attributed to the consuls Quintili, dating back to the first century A.D. The wall-system of this factory didn't coincide with the existing structures because it was preferred to rotate it, in order to define an axiality with the rests of another wide basis villae, situated downstream. Repeated archeological excavations made at Villa Mondragone during last centuries brought to light many old walls that, however, have never been completely revealed for a global analysis. The laser scanning survey recently started on indoor archeological ruins emerged in the recent past, confirm the hypothesis by Felice Grossi Gondi at the beginning of the twentieth century, related to the choices about the ancient planning; furthermore, they allow to upgrade the existing planimetries, giving more information for a clearer knowledge of the monument.

Keywords

Archaeological survey, laser scanning, Ville Tuscolane.

1. *Historical overview*

Many of late-Renaissance Casini built on the hills of Vulcano Laziale, in the south of Rome, which contributed to the definition of the so-called Ville Tuscolane's complex, were founded on the ruins of Roman buildings with similar functions, even if dimension ally more extended (Lanciani, 1884).

Some factories of sixteenth century, although smaller than the ancient ones, traced the walls of pre-existing ruins, optimizing the use of what was still solid and structurally reliable (Strollo, 2004).

However, in other cases, didn't happen the same thing, because it was only endorsed the exploitation of the site, ignoring the tracing of original planimetric orientation (Fig. 1).

During the next phase of enlargement of the villas, which took place between the end of sixteenth century and the first decades of seventeenth century, the economic power of the owners – who replaced the first constructors – brings to the definition of high-impact compositions at landscape level, generally enlarging the axialities established during the previous phase (Belli Barsali & Branchetti, 1975).

The Complex acquired the aspect that gave to it its greatest notoriety, also sealed by lots of landscapes and engravings.

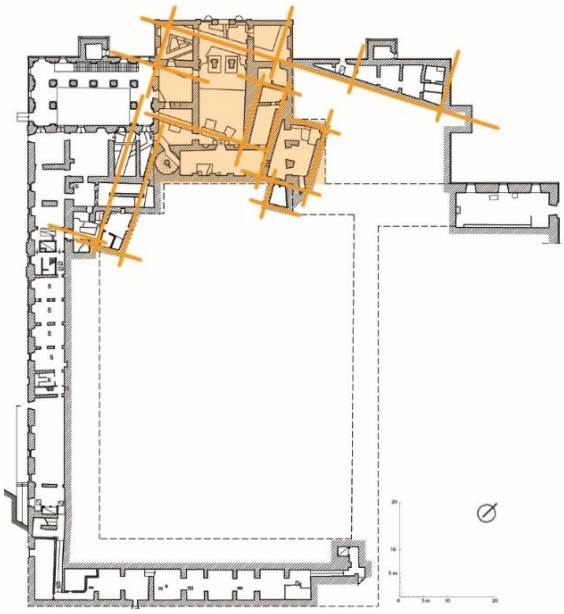

Fig. 1: Basement plan of Villa Mondragone. Walls of Quintili's Villa of the 1st century A.D. (stroked) and shape of the first 16th century structure (hatched) are highlighted in color

2. The specific situation of Villa Mondragone

The misalignment of the walls of Villa Mondragone is attributable to financial mean of the founder, the cardinal Marco Sitico Altemps, which allowed Martino Longhi il Vecchio the exploitation of panoramic characteristics of the site where also rose up the residential Roman ruins, later attributed to Villa of the Quintili[1]. As Grossi Gondi (1901), renowned Villa's researcher, said: «Perhaps, the architect [Martino Longhi il Vecchio], in order to relate the little building of Villa Tuscolana made by Vignola and the new factory, deviated from the original lines of Roman edifice». The Casino Altemps was, then, orientated along an axis that, besides correlating it with the previous residence of the cardinal (Villa Tuscolana), coincided with the extension of the diagonal of another Roman building situated nearby, having an almost square contour, probable terracing of another big Villa dating back to the first century B.C. (Fig. 2).

This wide and flat surface, according to what Grossi Gondi says, was fenced in with high walls by Altemps' will, mainly exalting, in this way, its almost regular four-sided form (220x250 meters circa). The land was, then, intended to be a pomario and later, in seventeenth century, a "barco" of livestock, acquiring the name of Barco that still identified it (Tomassetti, 1976, Valenti, 2006).

After the intervention promoted by Borgheses and entrusted to Vasanzio in sixteenth century, the general disposition of the structure acquired a more marked and recognizable aspect – also from afar – thanks to the addition of many elements situated in relation to the axis, mostly following a diagram of symmetry, both as additional buildings and as supplied elements: the extending wings of Casino, internal courtyard of Piazzale Maggiore, the Terrazzone with its balustrade characterized by: symmetric arms and central semicircle, two fountains placed opposite the axis, two pairs of high pinnacles and, also, the great exedra of containment of the land upstream (D'Auria et al, 2015).

[1] They are the two brothers consuls, Condiano and Massimo, even owners of the most famous villa on the Appia. The discovery took place in 1732, following the finding of lead *fistola* engraved with reference to Quintili.

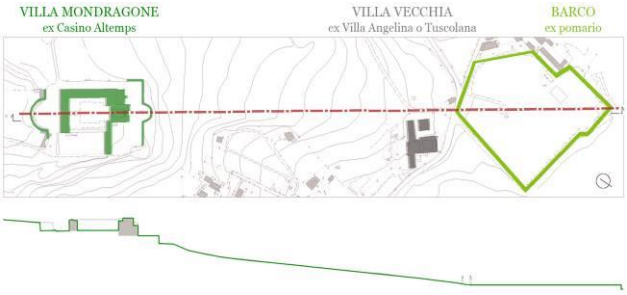

Fig. 2: From above: abstract alignment axis between Villa Mondragone and Barco; territorial section along the axis

3. The suveys

3.1 Existing surveys

The rotated disposition of the ruins of Quintilis' Villa, was already evident in the basement of modern structure of Villa Mondragone; Grossi Gondi (1898), in late nineteen century, found further confirmations thanks to the excavations made in Piazzale Maggiore – later closed – that brought out other fragments of the ancient construction, documented by himself in different phases (Fig. 3).

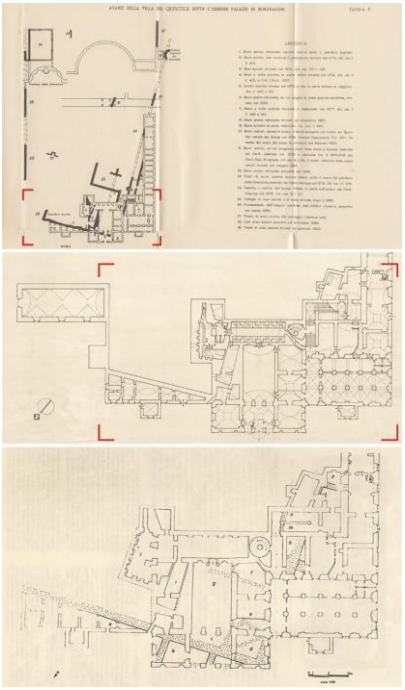

Fig. 3: Survey basement plans about ruins of Quintili's Villa. From above: Grossi Gondi 1901; University of Rome Tor Vergata 1982; archaeological Superintendence of Lazio 1987 (Ghini, 1987). Diagrams are not in scale and concerns areas gradually confined

The transfer of ownership of Villa Mondragone to the University of Rome 'Tor Vergata' in the early

80s, allowed archaeological superintendence in charge for Lazio, on the occasion of the works of restoration already started, to do ample excavations in many spaces of the factory, revealing other shreds of the ancient masonries. These researches confirmed geometric and morphological characters of Roman walls at basement level, underlying the floor of Terrazzone.

This "new" situation, recently discovered and still visible due to the stop of works, was partially documented by the superintendence itself.

Some of the remains emerged during internal excavations of Villa, made at the level of Piazzale Maggiore, have recently been valorized (2005) introducing in new pavements of the room, situated in south-east corner of Casino, a glazed frame, that has made visible a building section with a fragment of crossed-mosaic pavements.

At the same level, furthermore, there are other ruins that have remained in the same state of neglect of the downstairs ones for about thirty years: for example, building fragments placed under the planking level of seventeenth century eastern wing of Villa – the one added by Vasanzio in order to close in the northeast the great courtyard of Piazzale Maggiore – connecting it with new and majestic portico of Giardino della Girandola. This situation has been documented for the first time by laser scanning survey.

3.2 Laser scanning survey

The tool employed for the survey has been Faro Focus X 330 that, in order to ensure a correct and complete acquisition of the surfaces, has been positioned in seven change points, two of them situated opposite the pass openings between the analyzed space and Vasanzio's portico on the one hand and the stairwell on the other hand, to allow the alignment of 3D point cloud with the one of the entire complex, that is still a work in progress.

Tab. 1: Laser scanner settings

Resolution	1/5 1 pt. each 7.6 mm at 10 m
Quality	4X
Speed (pt./sec.)	122.000
Duration single scan (sec.)	222
Number of scans	7

The laser scanner, under optimal environmental conditions, guarantees a scanning range of between 60 centimeters and 330 meters, a measuring speed of up to 976.000 points per second, and a margin of error between ±2 mm.

The settings of the scanner, obviously, were chosen due to the level of resolution we expected of the final output (Tab. 1).

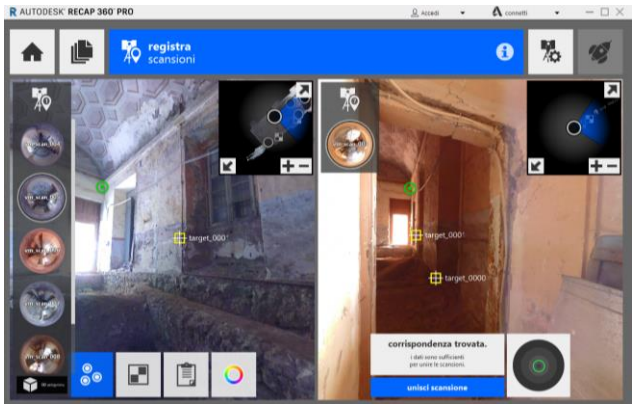

Fig. 4: Phase of manual alignment of the points clouds

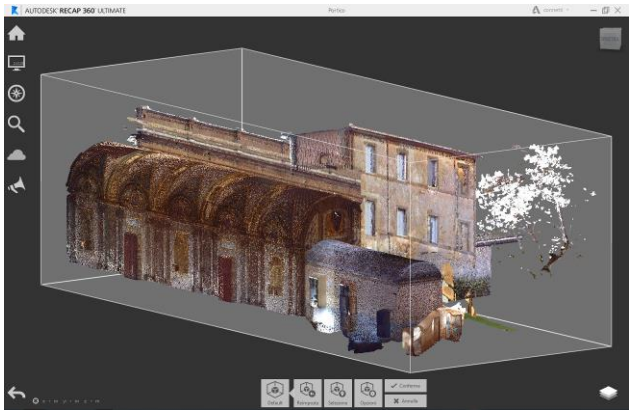

Fig. 5: Points cloud model of indoor place of Portico del Vasanzio (on left) and space that houses the ruins

Fig. 6: Clipping box corresponding to Section AA'

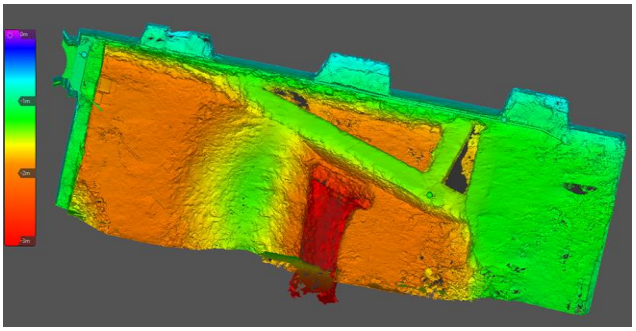

Fig. 7: DEM three-dimensional model of Roman ruins at Giardino della Girandola level

There was one setting used for the scans: 1/5 resolution (one point acquired every 7,6 mm to a distance of 10 meters); quality 4x (scanning speed of 122.000 points per second); 84 images per scan; length of scan 3 minutes and 42 seconds.

For a more accurate phase of post processing of the points clouds, spherical target ha s been employed during the survey (Fig. 4). The processing of acquired data took place in Autodesk ReCap 360 software that allows to align the scans in only one points cloud, metrically and colorimetrically reliable (Figs. 5-6). The operations of alignment has happened in easy way both for the limited number of scans that for the employment of the spatial references automatically recognized by the software.

The percentage of points characterized by an alignment error inferior to 6 millimetres results equal to the 99.7%, value considered acceptable for the purposes of the research and for the object of the survey.

To get horizontal and vertical vectorial profiles of the indoor space, has been necessary to implement the points cloud into model mesh. Such operation has been effected in Geomagic Studio software (Fig. 7). The solid model obtined, composed by approximately 3 million mesh, has been 'sliced' from planes horizontal, with step of 15 centimetres in the low part in correspondence of the archaeological ruins, and from planes vertical, with step of 30 centimeters (Fig. 8).

These profiles has been exported before in McNeel Rhinoceros in *.iges* format (Fig. 9) and then in Autodesk AutoCAD in *.dwg* format for the plans and sections elaborations updating, in this way, the existing planimetries, with a high degree of architectonical detail and metric accuracy (Fig. 10).

Fig. 8: Mesh model sliced from vertical and horizontal planes

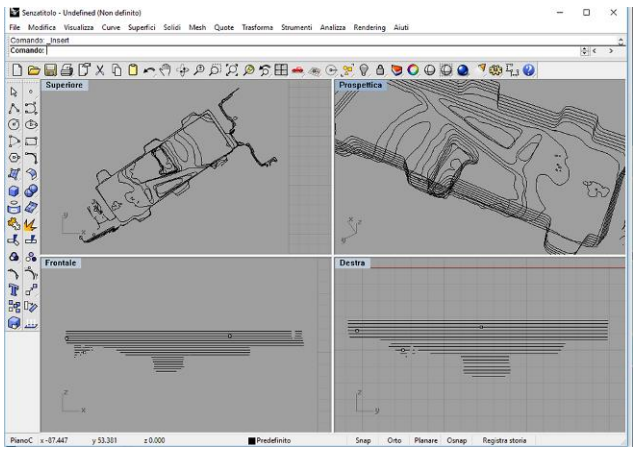

Fig. 9: Horizontal profiles of ancient walls model

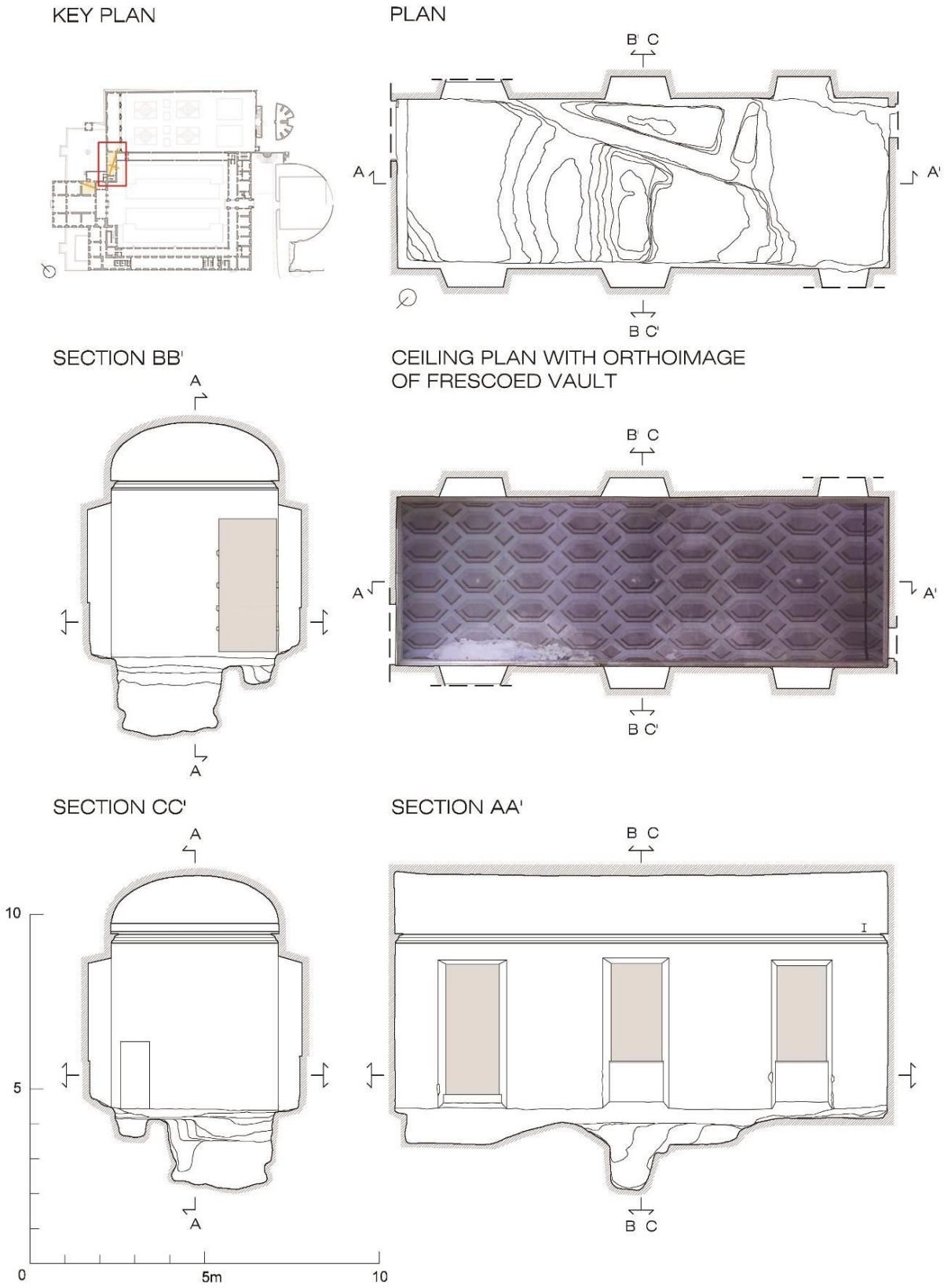

Fig. 10: Survey plans (unpublished) of Roman ruins to the Giardino della Girandola level

4. Conclusions

Thanks to the studies made on the historical building/architectural evolution of Villa Mondragone and to morphological validations based on three-dimensional surveys recently launched, it was possible to confirm that Vasanzio expanded the factory (obviously) keeping the orientation of the mesh set up by his predecessor, Martino Longhi il Vecchio.

The remains of Roman villa at the level of Giardino della Girandola[2] appears, again, rotated as compared to the masonries of modern system, maintaining a structure that corresponds to the other visible and wall fragment (under glass) in the first south-eastern room of the Casino, as well as to those on the floor below – including those that emerged in the mid-eighties of last century – and with those documented in Piazzale Maggiore in 1900 circa.

During the Baroque phase of expansion of the Villas, the plannings dictated by forerunner systems dating back to Roman Age were extended at a regional level by the addition, in these improved residential complexes, of ancillary components – such as nymphs or water theaters – which also recalled the characters, althought nominally, of ancient villas (Strollo, 2007).

This contribution is part of a broader line of research on the territory and Ville Tuscolane, carried out within the activities of Laboratory of Survey and Architecture (LAREA - Laboratorio di Rilievo E Architettura) of the University of Rome 'Tor Vergata'.

In particular, three-dimensional surveys just started on archaeological ruins found at Villa Mondragone, aim to create a three-dimensional computer graphics model of the entire artifact, in order to use it as a support tool for the research, the dissemination of scientific knowledge as well as the enhancement and the restoration of the assect (D'Auria, Sini & Strollo,2015).

Although the paper is the result of a joint research, the authors report in agreement that the paragraphs *Historical overwiev* and *The specific situation of Villa Mondragone* are attributed to Rodolfo Maria Strollo, while the paragraphs *The surveys* and *Conclusions* are attributed to Saverio D'Auria.

Fig. 11: Spherical image of the room object of survey

[2] This archaelogical site is situated inside the most oriental room of the complex of Villa Mondragone. This space, covered with the only depressed vault of the Villa, has not been object of interventions of restauration and presents doors and windows closed by provisional elements (Strollo, 2007).

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