

## Entering the Emperor's Villa: an integrated methodology to enrich cognitive accessibility of an archaeological site

The monumental entrance to the Imperial Villa at Tivoli, built by Emperor Hadrian (117-138 AD), is a part of the famous Palace that is currently inaccessible, even though it can be partially explored visually. Although today this access area does not have the same grandeur and monumentality as other areas of the Villa, it should be considered as one of the strategic points for understanding the complexity of the archaeological site. In fact, the area shows the coexistence of distributive paths with different functions, both for imperial and servant use, with structures built at different levels, not all visible to the visitor, especially without entering, but which are fundamental to the design of the imperial residence. All these structures in fact are important for a comprehensive understanding of the space and if completely ignored, would produce in the visitor an evident cognitive gap on some basic concepts of the whole Hadrian's Villa.

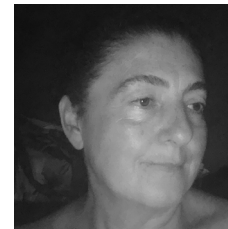
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The research aims to provide an overall view of the access to Hadrian's Villa by combining the 3D reality-based models of the site – which digital survey was carried out in August, 2022 – with a plausible reconstruction based on multidisciplinary studies, capable of providing the observer with an appropriate cognitive accessibility of the closed and non-visible areas through real-time online platforms, in order to promote a more inclusive virtual visit, also for non-ambulatory people and from unprecedented points of view. The basic idea of this contribution is therefore to structure, around the digital survey and the reliable 3D model of this area, a cognitive system for the interactive and perceptual enjoyment, in order to encourage the understanding of the area and provide guidelines for the future musealisation and educational applications, in anticipation of a possible inclusion of the site in the walkable visit tour.

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Keywords:  
Accessibility; Inclusion; Museum display;  
Data extraction/analysis; Segmentation and  
semantic representation

## 1. INTRODUCTION

The entrance to the Imperial Villa of Tivoli (Figs. 1-2), built by Hadrian (117-138 AD) and inscribed in the UNESCO World Heritage List in 1999, is part of the famous Imperial Palace, which cannot be visited at present, although it can be partially explored – only visually – from the long promenade that leads from the south side of the so-called Pecile to the area of the Serapeum-Canopus complex. Since the end of the '90ies, this area has been the subject of numerous studies, as it was almost unknown, and excavations have revealed not only the layout of the entrance, but also a series of structures related to the access to the Villa. Even if today this entrance area does not have the monumentality of the most famous pavilions of the Villa, which, although in a state of ruin, still retain an architectural grandeur (e.g. Small and Large Baths, Serapeum, Praetorium), it should be considered as one of the strategic locations for understanding the complexity of the archaeological site. In fact, the area presents a coexistence of distributive paths with different functions and different users, built on different levels – with great differences in height, so that some of them are not even visible, depending on the visitor's point of view – which reveals the attention that the emperor paid to the design of his palace as well as to its management, with particular emphasis on the entrance, which gave the first impression of his imperial residence. All these structures are important for the overall understanding of the space and, if completely ignored, would leave the visitor with an obvious cognitive gap on some fundamental concepts of the whole Hadrian's Villa.

The basic idea of this paper is therefore to structure, around the digital survey and the reliable 3D model of this area, a cognitive system for the interactive and perceptive use of the theme, in order to promote the understanding of the area and to provide guidelines and best practices for future musealisation and educational applications, in anticipation of the possible inclusion of the area in the walkable visitor route.

## 2. 3D MODELS FOR ACCESSIBLE USE

In recent years, the issue of accessibility and the expanded use of Cultural Heritage (CH) by the public, including archaeological sites, has been the subject of several sector studies [Picone 2014; Gaspari et al. 2020; Salvà Cantarellas 2023] on the activities to be undertaken in order to balance the conservation needs of the sites with their use by the general public. The sector has undergone significant developments, promoted by the European Community,<sup>1</sup> the latest governance policies, and specifically designed regulations, as well as the proactivity of the management of major cultural sites, which aim to provide an increasingly comfortable, engaging, and comprehensive experience. This has led to new expectations on the part of tourists, who are increasingly used to interacting with multimedia content based on three-dimensional digital models. The use of the latter has implications for accessibility, as a large and heterogeneous public, including people with disabilities, is increasingly accustomed to combining a museum visit with a complementary educational experience.

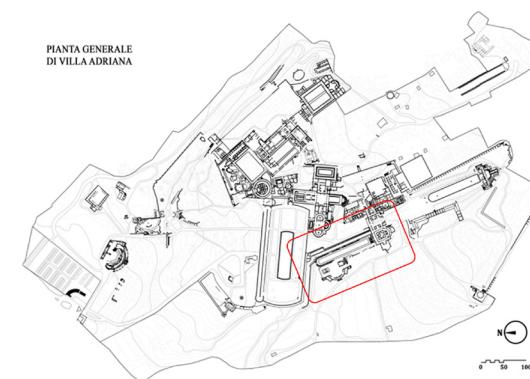
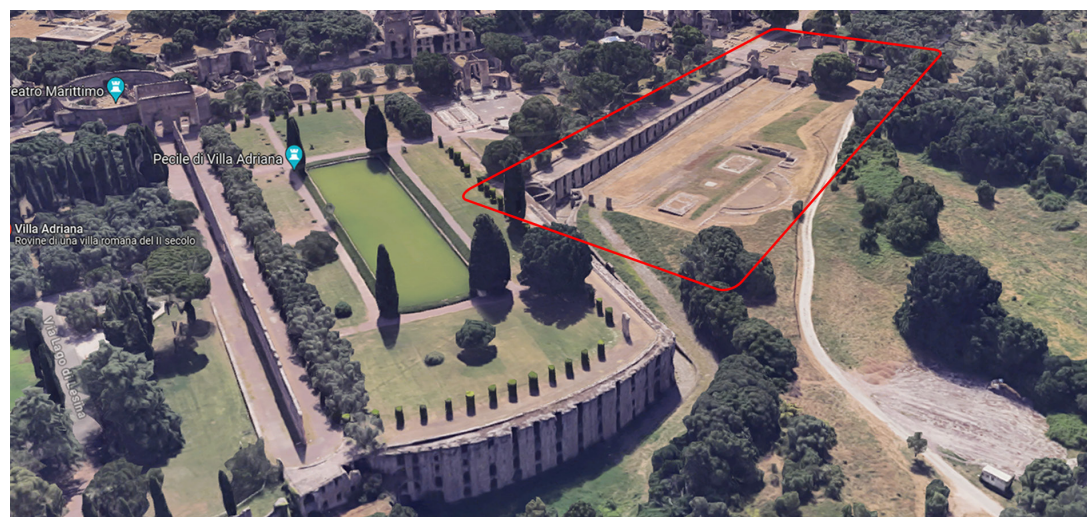


Fig. 1 - Location of the Villa's entrance highlighted in the general plan. Image credits: G.E. Cinque 2006.

Fig. 2 - General three-dimensional overview on Hadrian's Villa and the area of interest. Image Source: © 2023 Google.

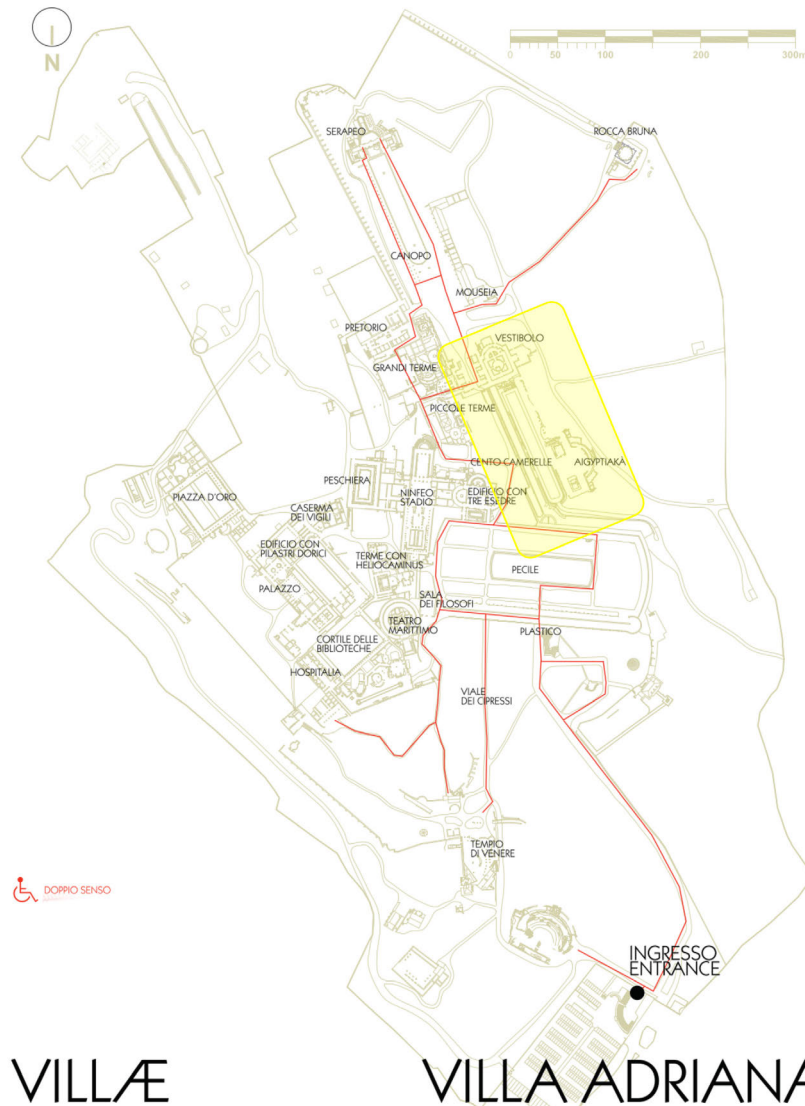


There are many experiments in various forms (augmented reality, virtual tours, reconstructive models, digital collections, gamification, etc.)<sup>2</sup> that are widely used in different cultural institutions and that focus on the use of the 3D model to broaden and integrate the cultural offer. If initially the most obvious disabilities were mainly addressed, i.e. those of a motor or visual nature, the offer has also broadened to include the many less obvious and more inclusive criticalities that arise from the possibility of ensuring cognitive accessibility in relation to the correct transmission of knowledge to non-experts, in order to facilitate the acquisition of correct notions in places not easy to interpret, such as the archaeological sites.

## 2.1 ACCESSIBILITY AT HADRIAN'S VILLA

The Istituto Autonomo Villa Adriana and Villa d'Este - *VILLAE*, Tivoli (Ministero della Cultura), has always paid particular attention to the issue of reception and accessibility in its cultural sites, with particular reference to archaeological areas, as well as to permanent and temporary exhibitions. In order to guarantee the enjoyment of all users, including those with disabilities or sensory and cognitive impairments, it has taken concrete action since 2020, with numerous initiatives to make its cultural sites more accessible to the widest possible public.

In brief, the activities have focused on going beyond different types of problems related to accessibility (Bruciati et al. 2023): 1) the overcoming of architectural barriers, for which a series of barrier-free routes have been created for people with permanent or even temporary motor disabilities, with alternative routes for easy visits to some of the Villa's buildings (Fig. 3), 2) the overcoming of sensory barriers, with the revision of the graphic information signs, in many places integrated with tactile ones (graphic totems and Braille panels of points of interest), designed for visually impaired users; 3) the overcoming of cultural and cognitive barriers, by updating the signs in different languages and making the texts clearly legible, taking into account the height at which the totems can



# VILLÆ

# VILLA ADRIANA

Fig. 3 - Official map of Hadrian's Villa with accessible routes for people with disabilities. The area of the monumental entrance to the Hadrian's Villa is highlighted in yellow. Image credits: © *Villa Adriana e Villa d'Este, Tivoli-MiC*. <https://villae.cultura.gov.it/en/services/accessibility-for-people-with-disabilities/>

be used by different users, with clarity of graphic layout and text fonts, and finally with a simplified logical structure of syntax and vocabulary. In addition to the numerous agreements to verify the accessibility of the site on a large and detailed scale (Bartolozzi & Novelli 2020), it is also necessary to mention the activities already carried out by the *VILLAE* Institute with the help of digital technologies and the tools developed on the multisensory pathways, making the archaeological site more accessible to visitors with special needs, also through reserved digital applications (Bruciati & D'Alessandro 2023).<sup>3</sup>

## 2.2 PROJECT PROPOSALS OF THE RESEARCH GROUP

About the use of digital models and their reproduction using 3D printing solutions,<sup>4</sup> the research group has participated in experiences that have taken place in the context of exhibitions. Such experiments can often have a clear positive impact on the visually impaired public, as in the case of the portrait of Matidia Minor, on loan to the British Museum for an exhibition in 2008, which was digitised and reproduced using 3D printing techniques for a temporary replacing of the original, but also to allow the tactile perception of the replica (Adembri et al. 2016, p. 291) (Fig. 4).

Another project, currently underway, involves the creation of an installation that includes both a tactile representation and a reconstructed section of the octagonal hall of the Small Baths (Fig. 5). These representations, created on reality-based data acquired by the team during previous in-depth studies on the subject (Cipriani et al. 2017), have a didactic purpose for extended and accessible use. The project involved the realisation of different parts of the monument (Fig. 6): (a) a reconstructed cutaway of the octagonal hall and adjacent spaces, kept in a display case to protect from the weather due to its outdoor location, to contextualise the subject and stimulate understanding of the highly articulated space of the thermal building; b) two tactile models for comparison – ergonomically designed to be accessible to children and wheel-



chair users and made of special materials that are resistant to weathering and wear and tear –, the first showing the actual state of preservation of the dome lacking the top, and next to it the plausible reconstruction for interpreting the dome in its original integrity, a hypothesis supported by historical studies and formulated with a multidisciplinary approach.

Fig. 4 - 3D printed replica of the head of Matidia Minor: a) survey of the marble head, b) 3D modelling and mesh processing to obtain the digital replica, c) 3D printing, d) tactile replica on display at Hadrian's Villa, year 2008. Credits: B. Adembri, F. Fantini.



Fig. 5 - Design for the display case for the octagonal hall of the Small Baths, with a focus on usability by all users. Credits: B. Ademabri, L. Cipriani, F. Fantini.

### 3. THE CASE STUDY: THE MONUMENTAL ENTRANCE TO THE VILLA

The monumental entrance to the magnificent Villa that the emperor Hadrian had built near Tivoli was a very articulated area, located in the north-western part of the residential complex. It consisted of a pavilion (the so-called Vestibule) accessed by a wide staircase, of which only the vertical wall at the bottom remains, flanked by two niches for statues and fountains at the base, and a section of paved road forming a stadium-shaped circuit (Fig. 7). The two-lane road that led from the outside to a large archway built further north, and which was considered to be the actual entrance to the Villa from outside, narrowed from here to a single-lane road, imposing a one-way system for the guests' vehicles – litters, carts, horses – passing through, and solving the problems caused by the simultaneous presence of arriving and departing vehicles on the same stretch (Fig. 8).

The one-way route ran along the western side of a peculiar structure that has come to light in the last twenty years and which, despite its poor state

of preservation, is of great interest.

Excavations have shown that, according to the current state of research, it was the last building to be constructed by Hadrian: stamps impressed on the bricks date the pavilion after 134 AD, the date of Hadrian's return from Egypt. Many elements refer to this region and to the journey made by the emperor in 130 AD, in particular the Egyptian-style sculptures, the ibis images, but also the presence of palm trees surrounding the two temples and the abundance of fountains and water channels typical of the Egyptian Serapeia of Alexandria.<sup>5</sup> The references to the Nilotic environment of the subjects and the style of the sculptural apparatus, which imitates that of the Pharaonic period, have led some scholars to hypothesise that this was a place dedicated to the memory of the young Antinous, who died during the journey to Egypt with Hadrian and the court.<sup>6</sup> It is undoubtedly the only part of the Villa in which not only have numerous sculptures of an Egyptian subjects been found, but also shows in which the decoration of the elevations shows an Egyptian style and, finally, it can be considered almost a kind of "travel souvenir"

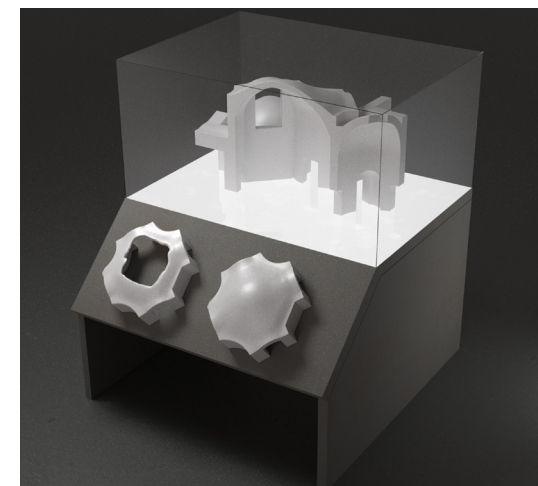


Fig. 6 - Rendering of the display case. Credits: B. Ademabri, L. Cipriani, F. Fantini.

of the emperor, the Aigyptiakà of Hadrian's Villa. Its position on the main access road, in direct connection with the Vestibule and the Canopus behind it, which constituted the largest triclinium of the Villa and was frequented by numerous guests, demonstrates the emperor's desire to give the building a prominent role in the residential complex of the Villa.

The peculiarity of this entrance area was the co-existence of circulation routes with different functions and different users: the access was reserved for the emperor Hadrian and his entourage, while a more subterranean route, hidden from the view of those entering, was used mainly by the servants who worked for the management of the Villa, and was therefore not visible to the upper class. This solution was implemented thanks to the difference in the level of the ground and the design of the structures, which prevented a view of what was going on in the servants' corridor, an aspect that is not directly perceptible today, both because the vertical structures no longer exist, or only partially, in place, and because access to the lower area is currently closed to visitors (Fig. 9).



Fig. 7 -Top: View of the remains of the entrance arch. Ph: © *Villa Adriana e Villa d'Este, Tivoli-MIC*.

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Fig. 8 - Bottom: The paved circuit in front of the Vestibule. Ph: © *Villa Adriana e Villa d'Este, Tivoli-MIC*.

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Fig. 9 - Right: The servant route of Cento Camerelle. Ph: © *Villa Adriana e Villa d'Este, Tivoli-MIC*.

#### 4. OBJECTIVES AND METHODOLOGY

The aim of the authors is to provide virtual access to an area that is not open to the public, the entrance to the Villa, which, even with the future extension of the itinerary and the opening of this area to the public, will be difficult to visit for people with reduced mobility, because, as already mentioned, it is an area with many differences in level and several slopes connected by steps that make it impossible to move independently due to the lack of alternative routes.

This project makes use of digital technologies centred on the reality-based content also acquired for this area, among several others documented for scientific research purposes in the last decade,<sup>7</sup> which combine three-dimensional digital models with multiple levels of information and content, as well as the possibility of an interactive experience for the user (Cipriani et al. 2019), with the goal of facilitating the dissemination, usability and understanding of the places to a wide audience of non-experts, through a type of communication that is as inclusive as possible.

The creation of reality-based 3D digital models through the integration of data acquired by active and passive sensors, both morphometrically and radiometrically accurate, has been a widespread practice in the field of CH for years, especially for documentation purposes (Remondino 2011; Gonizzi Barsanti et al. 2013; Croce et al. 2019) – as in this case of the state of preservation of the site's ruins –, but such reliable acquisitions can also be used as a scientific basis for the critical interpretation of the 3D digital replica (Centofanti et al. 2014; Cipriani & Fantini 2017), extrapolating useful information for finding evidence of the ancient design and hypothesising the most plausible original form of some of the Villa's emblematic buildings.

##### 4.1 STEPS IN MODELLING

The project was therefore based on the following key development steps:

##### 1. 3D data acquisition by means of a 3D survey

*of the entire area* (Figs. 10-12). The survey campaign was carried out in August 2022 as part of the educational workshop (see end-note 7) and by members of the Department of Architecture-UNIBO team; this included a terrestrial laser scanner survey using a Leica ScanStation C10 in order to fully document both the upper part and the lower parts of the access and communication route in the area of the slave quarters (excluding the interiors of the lodgings, where archaeological finds are now stored, the area under the Vestibule, the lower service road for the Cento Camerelle). This was integrated by a photogrammetric campaign of the façade, obtained from the data collected for educational purposes and subsequently processed to obtain orthophotos. After registration, the point cloud was used to study the area metrically, taking into account the units of measurement at that time, and also to obtain dimensioned technical drawings such as plans, elevations and main cross-sections, useful for the first analytical stage;

##### 2. Creation of the reality-based model (Fig. 13).



Fig. 10 - Top: Survey campaign in the underground tunnels and servants' road, year 2022. Ph: S. Bertacchi, Ph: © Villa Adriana e Villa d'Este, Tivoli-MiC.

Fig. 11 - Bottom: Perspective view of the registered point cloud from the terrestrial laser scanner campaign of the area. Point cloud registration: S. Bertacchi.



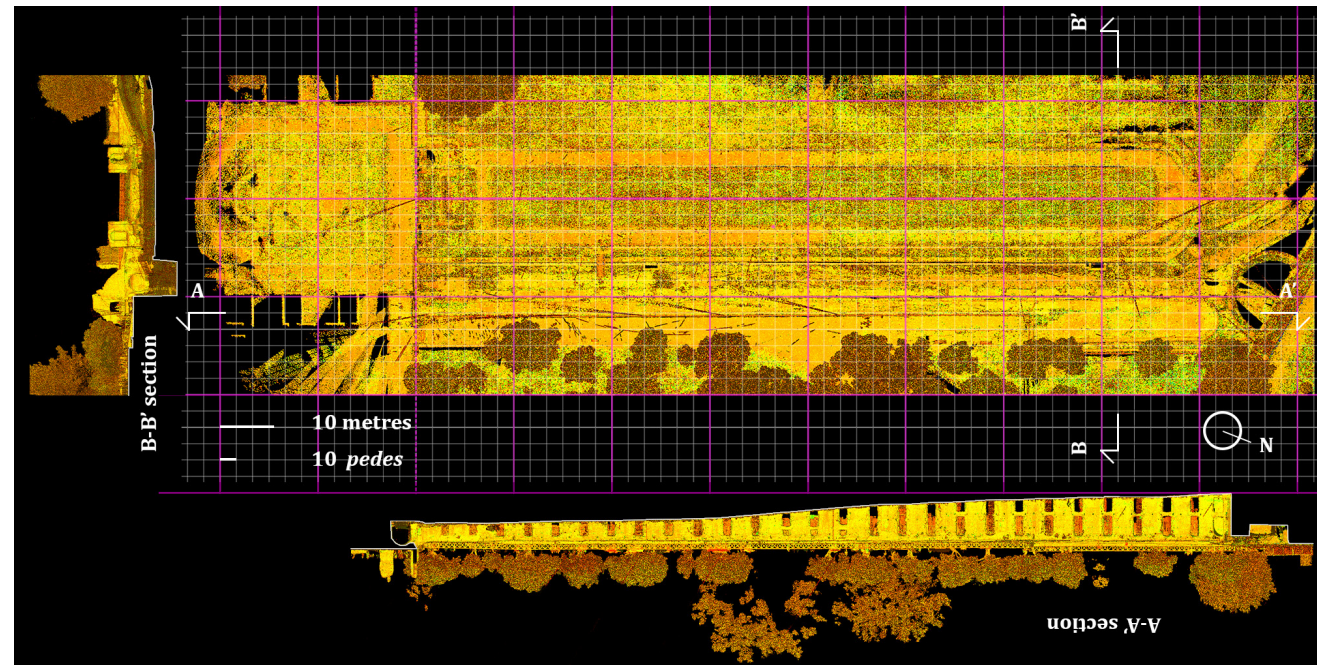


Fig. 12 - Plan view of the area and cross-sections of the point cloud, with reference grid of 10 Roman feet (white grid) and 60 Roman feet (pink grid). For the conversion in metres, 1 Roman foot = 1 *pes* = 0.2956 m (Adembri et al. 2015, p. 8); hence 10 Roman feet are equal to 2.956 m and 60 Roman feet are equal to 17.736 m). Geometric analysis: S. Bertacchi.

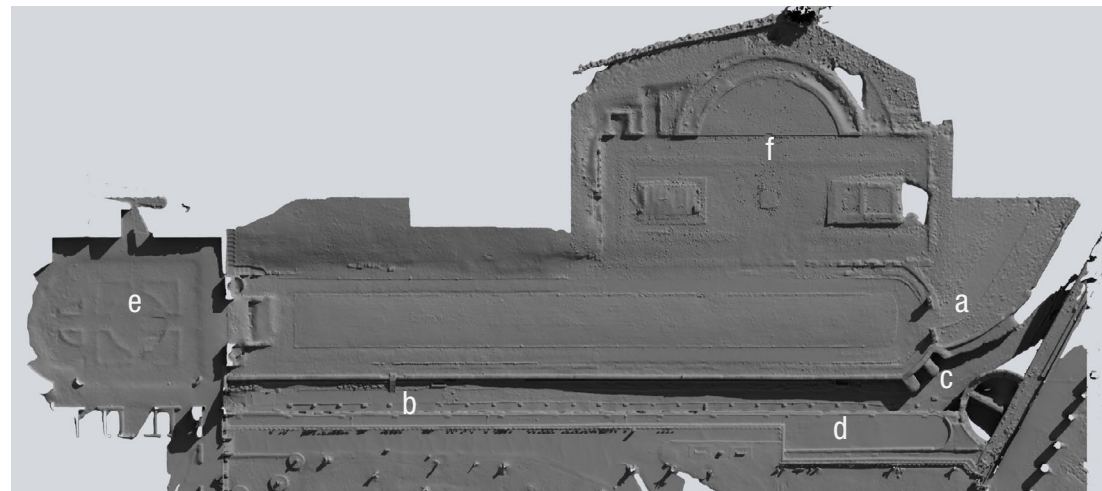


Fig. 13 - Top view of the polygonal mesh. Meshing: S. Bertacchi.



Starting from the scanner data, polygonal meshes were generated for the reconstruction of the real object, which were then segmented according to a semantic partition of the main architectural structures: a) main entrance with monumental door; b) access road for service carts entering the underground tunnels; c) servants' quarters; d) so-called Cento Camerelle with the elongated upper basin; e) entrance Vestibule with large staircase and side fountains; f) Aigyptiakà building. These meshes were subjected to

various editing procedures in order to obtain an error-free model with sufficient resolution to correctly represent the existing geometry, with the exception of the vegetation, which was initially excluded from the modelling as it was not considered necessary;

3. *Reconstruction of the possible original layout of the access area* (Fig. 14). The essential morphological information necessary for the analysis and possible virtual reconstruction of the ancient environment was then extracted from the model. It should be noted that: i)

in plan, the current layout of the walls, which are still easily recognisable, was followed as far as possible, ii) for elevations, the reconstruction and completion of the walls, now in ruins, was carried out according to the heights of the adjacent walls, where the joint of the structure is evident, iii) for the first phase of the reconstructive study, no complex forms were examined which hypotheses would be based to a large extent on interpretation alone, e.g. the Vestibule. The reconstruction has been constantly updated, thanks to the

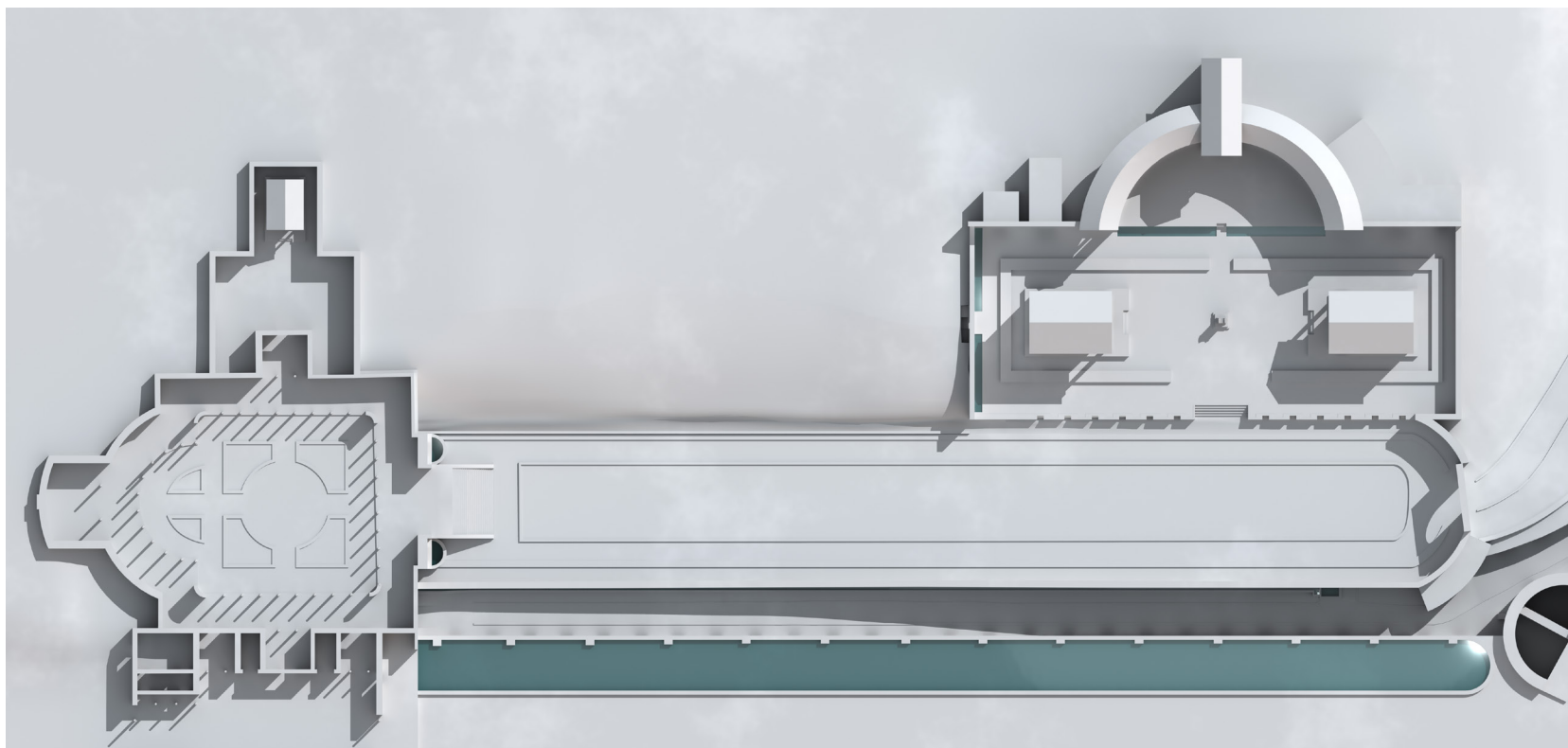


Fig. 14 - Plan of the reconstructed model. Rendering: S. Bertacchi.

multidisciplinary collaboration of archaeologists and experts in the field and is based on the archaeological traces still visible and the historical bibliography, or on comparison with surviving examples of the Villa, possibly with information derived from similar architecture and coeval Roman examples.

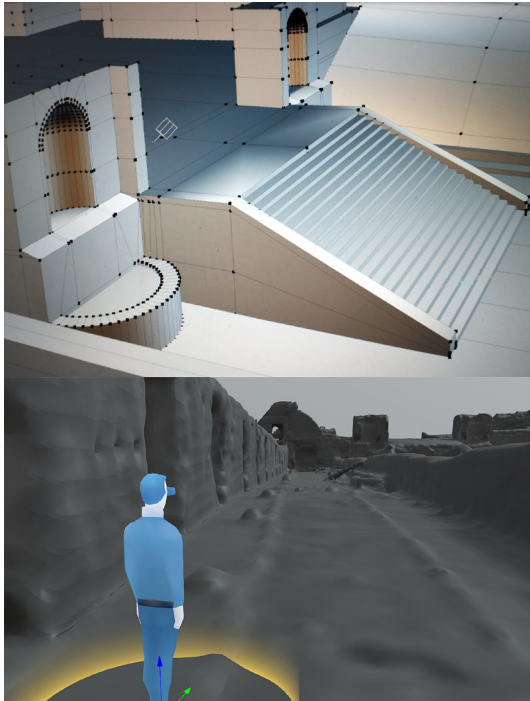


Fig. 15 - Top: Processing steps of the reconstruction model. Bottom: associated VR settings in the Sketchfab online platform for virtual walking through an area closed to visitors. Model: S. Bertacchi.

Fig. 16 - Right: Perspective and cross-section of the access area showing the height differences of the different paths and the possible viewpoints of the ancient visitor (Top: perspective view; Bottom: orthographic projection). Model: S. Bertacchi; scientific supervision for reconstruction: B. Ademabri.

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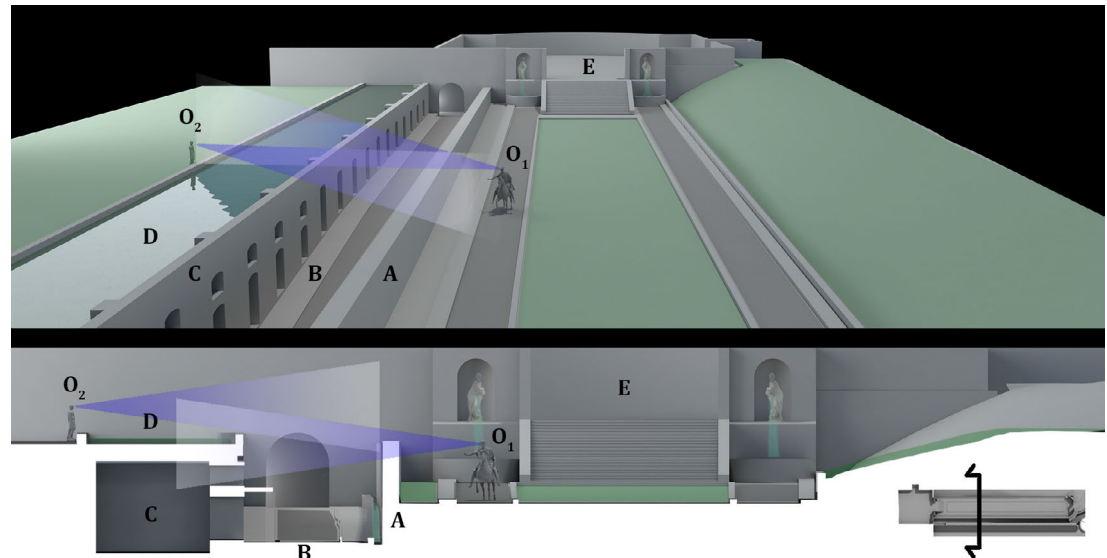
## 5. RESULTS

In order to structure a cognitive system for interactive and perceptive exploration, both the reality-based model and the proposed reconstruction, were uploaded onto a real-time visualisation platform for user-friendly virtual access to the areas closed to the public, presenting architectural elements to visitors from unprecedented points of view. In this experimental phase, we used the Sketchfab platform (<https://sketchfab.com>), which allows to test the limits and functionality of the models through real-time rendering technologies and to verify the best unseen viewpoints in which to insert informative annotations, photographic images and complementary materials (descriptive audio, etc.) to enhance the cultural content of the model before it is developed in the specific game engine (Unity: <https://unity.com>; Unreal Engine: <https://www.unrealengine.com>). In fact, the system is easily accessible from smartphones, directly through QR codes, and allows interesting AR/VR features for exploration, accessible even by

users who are not physically present on site.

Despite the possibility of free navigation and a bird's eye view of the digital model for a global understanding of the site (it is not easy to see in its entirety if not from aerial views due to its extension), some initial virtual reality points of view are set to teleport the user into a full-scale model, with a view level at human height and in predefined areas (Fig. 15). The user will then be able to explore the real space in its virtual version, switching between models. Historical notes at points of interest will help the selective exploration of specific places/topics.

The model also helps to understand the complex relationships between the articulated spatial levels, as shown in the cross-section of Fig. 16. A high wall (A), of which little remains today, delimited the imperial area along the eastern slope and blocked the view of the slave spaces (B). The imposing structure of the Cento Camerelle (Mari 2001; Manieri 2001, 2002; Sgalambro 2002; Segarra Lagunes 2007) is part of the re-functioning of the system of substructures used to overcome



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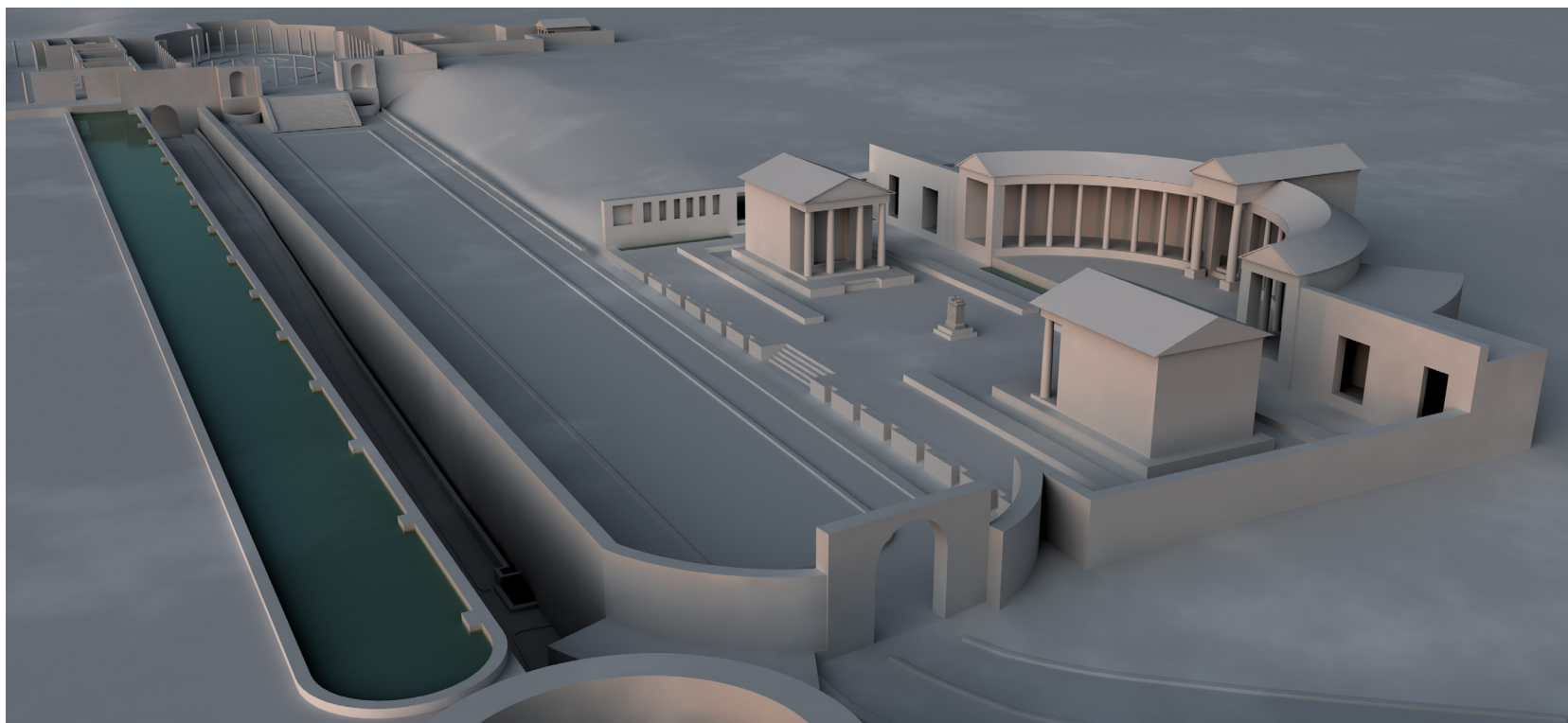


Fig. 17 - Study model for the validation of reconstruction hypotheses. Rendering: S. Bertacchi.

the steep slope of the land on which the Villa was built and to obtain the esplanade occupied by the Pecile garden. It was made up of numerous rooms (C) arranged on superimposed floors up to a maximum of four, of which more than fifty were in the lower part. The upper rooms, with wooden floors on travertine corbels and a single opening at the front, where there were also small windows, were accessible from external wooden walkways and a masonry staircase. The building was accessed by a paved road, at a lower level than the imperial road, which continued into the *basis villae* beyond the archway of the Vestibule, to allow the passage of slaves for the management of the residential

complex, i.e. the heating systems of the Small and the Great Baths. The covering of the Cento Camerelle was surmounted by a low basin filled with water (D), which, according to a successful interpretation by Cinque (2021, pp. 40-50), ensured that the guest passing through the upper gardens, which occupied the area in front of the building with the Three Exedras and the Small Baths, would not have been able to see the servants' area (service road) from the viewpoint of the artificial plateau. This is an escamotage that shows that nothing was left to chance in the design of the Villa. It is clear that in the planning of the project, particular attention was paid to the

perspective, the visual field and the itineraries of imperial attendance, so that the guest could enjoy the places to the full and at the same time realise that everything around him was an expression of the princeps and his refined aesthetic taste, but also of his power.

The specific points of view were chosen to illustrate the peculiarities of the place, which are difficult imaginable by a modern observer. To make this concept visually perceptible, it was therefore decided to include in the virtual reconstructions an observer (O,) placed on the access road to the Vestibule (E), highlighting the field of view to show what he could see at the time, when the wall -

now almost levelled – reached up to the impost of the vestibule slab. Similarly, an observer (O<sub>2</sub>) has been placed on the opposite side, in front of the basin overlooking the Cento Camerelle, in order to emphasise his viewpoint. In both cases, it is clear that the area of the lower road and the servants' quarters are not visible at all.

## 6. CONCLUSIONS AND FUTURE DEVELOPMENTS

In addition to the various activities already planned by the Institute to meet the specific needs of visitors, aimed at providing a complete and accessible experience of the cultural site, the research presents a further step towards the inclusion of virtual, immersive and multisensory experiences, proposing more inclusive and engaging ways of museum fruition based on the use of 3D.

In fact, the authors propose an overall view of the entrance to Hadrian's Villa, combining the 3D survey of the site with a credible reconstruction (Fig. 17), which could provide the viewers with an adequate cognitive accessibility, in order to make them understand the complexity of a very important area of the imperial residence, which is currently closed and therefore not fully visible in all its peculiarities, especially without entering it.

The 3D digital models are not limited to providing reliable documentation for multidisciplinary studies or as verification tools for virtual reconstructions, but prove to be effective in terms of inclusion and understanding for all visitors, offering unprecedented views of the original complex.

For this reason the reality-based replicas are suitable for the inclusive use of an inaccessible area – which probably won't be fully accessible even if it is opened to the public in the near future due to the difference in height – by means of navigation in user-friendly real-time online platforms.

This virtual musealisation with an educational approach allows the cognitive accessibility of complex areas by virtually overcoming the accessibility barriers that can prevent full usability for various reasons (inaccessibility of the area for safety reasons, difficulty/impossibility for visitors to walk due to temporary or permanent motor/visual disabilities).

## ACKNOWLEDGEMENTS

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**AUTHOR'S CONTRIBUTION:** All authors contributed to the study conception, and read and approved the final manuscript. In particular, Par. 1, 2, 3 are attributed to B. Ademuri; Par. 4, 5, 6 are attributed to S. Bertacchi, who also processed the point clouds, models and renderings.

## NOTE

[1] Among multiple actions and expert group promoting Europe's digital future and accessibility for disabled people, the use of 3D technology for digitisation and online accessibility of CH artefacts and digital preservation (ECR 2010, European Commission 2019, 2021), the European Commission has recently dealt with the 3D digitisation, developing common guidelines for comprehensive, holistic documentation of European 3D CH assets and contributing to guidelines and basic principles, (European commission 2022) to help advance 3D digitisation across Europe and thereby to support the objectives of the Recommendation on a common European data space for CH, adopted on 10 November 2021 (Commission Recommendation 2021).

[2] There are many academic sources interested in this topic. For the dissemination of CH through 3D, see Juan Vidal et al. 2010; for innovative trends in digital CH, see Ioannides et al. 2018; for interesting insights into the use of edutainment for culture and tourism, see Pescarin 2020; for an up-to-date

review on the use of augmented reality in the field of CH, archaeology and applications in virtual museums, see Giordano et al. 2023 and Gabellone 2023; for a broad perspective on experiences in virtual archaeology, virtual restoration applications and digital enjoyment in museums, see Trizio et al. 2023. For aggregation of information on 3D-centred models and resources to the reconstructed reality-based model, in order to support the understanding of the site and the management of CH in integrated service platform providing experts of the field with effective and flexible tools, see Apollonio et al. (2018, 2019). Emblematic examples of the use of tactile models in the field of accessibility include the Museo Statale Tattile Omero in Ancona (Italy) (Farroni Gallo 2023).

[3] See VILLAE PASSPARTOUT, an inclusive application by Villa Adriana and Villa d'Este Institute - *Villae*, digital product of the project "Passepartout – accessibilità culturale: creazione di nuovi percorsi multisensoriali" (in collaboration with ENS, UICI, ANFASS), with content specifically designed to facilitate the use and understanding of the places through an

inclusive way of communication. The application includes the Institute's accessible itineraries, currently offering 4 different options: VILLAE Sign, a general itinerary of the Villae through video guides in Italian and international sign language; VILLAE Touch, a sensory itinerary to discover the *Villae* through the tactile panels placed along the itineraries; VILLAE Easy, to discover through a guide in simple language, easy to read and understand for everyone; VILLAE Game, a video game application to discover the *Villae* through gamification, with special attention to the youngest visitors and usability for people with DSA: <https://villae.cultura.gov.it/app-villae-passepartout/>

[4] Emblematic examples of the use of tactile models in the field of accessibility include the Museo Statale Tattile Omero in Ancona (Italy) (Farroni Gallo 2023).

[5] Even in the 17th and 18th centuries, Egyptian sculptures were also found in this area, mainly in black stone, some of which are exhibited in the Vatican Museums, similar to those found in the excavations of the late 1990s.

[6] On the hypothesis of identification with an *Antinoeion*, first put forward by Salza Prina Ricotti (2003, 2004), followed by Mari and other scholars, see Mari (2018), with an extensive bibliography of the excavations he carried out on the site. *Contra*: Renberg 2010, pp. 181-191; see also La Rocca (2018, p. 104), and Bricault and Gasparini (2018), in particular p. 320, who, like Renberg, believe that the tomb of Antinous was located in Egypt, in Antinopolis, from where the Pincio obelisk was brought to Rome in the post-antique period; Salza Prina Ricotti and Mari believe instead originally came from Hadrian's Villa.

[7] The numerous studies carried out by the research group over the ten-year period 2013-2023, within the framework of the scientific agreement concluded earlier with the Soprintendenza Beni Archeologici Lazio and then with the Istituto Autonomo Villa Adriana e Villa d'Este - *Villae* by the Department of Architecture of Alma Mater Studiorum - University of Bologna, have included numerous campaigns of terrestrial laser scanning integrated with campaigns of close-range photogrammetry, carried out for both research and educational purposes with students and university workshops, and have resulted in the documentation for study aims of various monuments included in the archaeological site. The survey campaigns were partly carried out within the framework of the workshops promoted by the Accademia Adriana di Architettura e Archeologia, as lecturers of the workshops on Archaeological Survey and Reality-based Modelling (August 2013-2022) for the master's degree in *Museografia, Architettura e Archeologia. Progettazione Strategica e Gestione Innovativa del Patrimonio Archeologico*, coordinated by Prof. P.F. Calari. For further details, see Cipriani et al. (2016, 2020), Ottati et al. (2018), Bertacchi et al. (2023). For a general reference and a broader perspective on the studies on Hadrian's Villa, see the catalogue that presents twenty years of studies on the site and the most interesting discoveries and reconstructions (Sapelli Ragni 2010), as well as the contributions in Hidalgo Prieto & León-Castro Alonso (2013), Hidalgo Prieto et al. (2020), Cinque (2022) and by various other authors (VV.AA. 2013). It should also be noted that the completion of the digital survey of Villa Adriana, presented at Hadrian's Villa in May 2024, is currently being published by Paolo Carafa (Sapienza University of Rome).

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